Financial Market Evaluation of Firms Greenhouse Gas Emissions

Submitted by Shan Hua to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Finance in February 2013

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

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ABSTRACT

Climate change has been influenced more by human activities now than previously. These influences are largely attributed to industries, whose activities can potentially produce enormous amounts of carbon dioxide and other greenhouse gases, and exacerbate the speed of climate change.

This thesis examines how the financial markets evaluate corporations' greenhouse gas emission performance. We consider various emission criteria, and distinguish between the better and worse performers in different emission policy regimes, including the US, the UK and the rest of the EU. The investigations have been conducted at three stages, presented in chapter 3, 4 and 5.

Firstly, in chapter 3 we examine the carbon effects at the portfolio-level, where total return indices are our main concern. By adopting the long-short strategy, we report that investors in the UK and EU markets, can make an arbitrage profit at the lower cut-off levels, when applying various carbon screening policies and forming equally-weighted portfolios. However, no such profit opportunities can be achieved in the US market. We further consider the reason for such arbitrage opportunities, which is the link between corporate governance/management efficiency and different levels of carbon constraint.

Secondly, in chapter 4, the carbon effects are investigated at firm-level, where firms' financial market values act as the dependent variable. Our regression models are based on the Ohlson framework, which considers firms' financial market value in relation to its accounting performance, and the 'other information', which in our case is the carbon emission performance. We find a significant relationship between the US firms' values and their carbon emission performances; however, this relationship has been weakened for UK companies, and in fact becomes even unreliable for EU companies. Further, in order to explore the reason for this relationship, we have focused on energy efficiency and firms' reputation that are associated with carbon reduction activities. The scale effects have also been discussed in this chapter, as the various deflators are adopted.

Finally, in chapter 5, again at firm-level, cash flow expectation and cost of capital have been considered to possibly be the source that drives firms' value.

Cash flow expectation is measured at the short-, medium- and long- term, by profitability, earnings growth, and residual income growth rate, respectively. Two portfolios for each target parameters are constructed according to different carbon screening criteria at different cut-off levels, the differences between each pair of portfolios are then calculated and tested for significance. A sub-sample regression, which is based on the observations available from analysts' earnings forecast, has been conducted for each of the three regimes. After matching the portfolio and regression results, we report that the implied cost of equity is only reduced for the less carbon emission firms, in regimes where more stringent carbon constraints are applied; whereas in regimes where less stringent carbon constraints exist, the less carbon emission firms have not gained any advantage through their implied cost of equity. Also, cash flow expectations indicate diverse outcomes for different time horizon and regimes.

Furthermore, various market participants, such as governments, investors, distributors and clients etc, who could possibly influence firms' carbon behaviour, have also been considered in association with their roles in reducing greenhouse gas emissions. Our work contributes to the existing literature through a wide ranging examination of major financial evaluation methods relating to emerging carbon emission issues.

Keyword: Greenhouse gases (GHGs), Carbon emissions, Climate change, Firm valuations, Portfolio analysis, Cost of capital

ACKNOWLEDGEMENTS

It would not have been possible to write this doctoral thesis without the help and support of the kind people around me, to only some of whom it is possible to give particular mention here.

First of all, I wish to express my sincere thanks to my supervisors; foremost among them is Prof. Alan Gregory. I have benefited not only from his invaluable guidance, suggestions, comments and references, but also from his encouragement and trust. I wish to thank my supervisors Julie Whittaker and Rajesh Tharyan, whose advice has always been enlightening. I have appreciated enormously their enthusiasm directed towards this research. I want to place on record my gratitude also to Paul Cox for his help in the early stages of this work.

I am grateful to the Trucost Company, provider of the emission data, for untiring commitment to this research and whose staffs' practical advice has always been invaluable throughout.

I would like to acknowledge the financial, academic and technical support of the School of Business, University of Exeter, from its staff, in providing me with all the necessary facilities over the last four years, to help ensure the completion of this work.

I owe a huge gratitude to my proofreaders Joseph Harvey and Dr Vivian Trewin, for their exceptional service in proofreading my manuscript and their constant encouragement.

I am indebted to my parents for their great understanding and kind consideration at a very challenging time in my career. Last but not least, I should not fall to express my immense thanks to all my friends for their ingenuity and unselfish contribution to this work and the continued motivation they have provided.

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Chapter 1 Theoretical Concepts

This paper proposes to investigate the relationship between the corporate financial performance (CFP) and the carbon emission performance. However, as there has been insufficient evidence focusing on the carbon emission topic in the financial market, our investigation will start with another popular topic, i.e. corporate social responsibility (CSR). By introducing the CSR and its influence on the CFP, we can draw on past experience involving the interaction between corporate social and corporate financial activities.

In the following sections, we will define the CSR, the corporate environmental performance (CEP) and the corporate carbon performance (CCP). Further, we will discuss the relationship between these.

1.1 Development of corporate social responsibility

The debate about CSR can be traced back to the 1930s'. However, Howard R. Bowen's 1953 publication, Social Responsibilities of the Businessman, is considered to be the first definitive book on the subject. In more research studies, Carroll (1979) identifies three separate issues pertaining to corporate social performance (CSP), i.e. the philosophy of social responsiveness (including reaction, proaction, accommodation and defense), the social responsibility categories, which are used to fully address the entire range of obligations business has to society (including economic, legal, ethical, and discretionary), and the social issues (such as consumerism, environment, discrimination, product safety, occupational safety, and shareholders). Following Carroll's definition, further studies consider CSR as a multi-dimensional concept (Wood, 1991a, 1991b; Aupperle et al., 1985; Aupperle, 1991). Waddock and Graves (1997) adopt KLD (Kinder, Domini and Lydenberg Database) data, which extend the social issues aspect into 8 subdivisions, including community relations, employee relations, performance with respect to the environment, product characteristics, and treatment of women and minorities, etc. Recent research by Renneboog et al. (2008) summarises CSR as the social (policy makers and the public) demand on corporations, assuming responsibility towards society, the environment and stakeholders.

The debate on the relationship between CSP and CFP has developed both in management and financial realms ever since it was first introduced. Although the concept of CSR is universally accepted now, in 1970, Friedman argues that there is no role for social responsibility in business; and any corresponding cost that is incurred because of engaging in social responsibility activities should not be paid by the company. Most of the early studies show a negative correlation between CSR and CFP; CSR activities are inevitably taken as revenue-cutting actions at an early stage. As critics of CSR point out, the firms who perform responsibly from a social perspective, suffer a competitive disadvantage (Walley and Whitehead, 1994). However, recent research (e.g. Dowell et al., 2000; Hart and Ahuja, 1996; and Russo and Fouts, 1997) argue that once the firm goes beyond basic compliance, incorporating CSR policy into the company's risk management strategy, or further innovating and promoting a sustainable business model, these CSR activities will bring the firm not only short-run efficiency, but also long-run advantages.

Though this debate is still ongoing (Griffin and Mahon, 1997; Margolis and Walsh, 2003; McWilliams and Siegel, 2000; Wood and Jones, 1995; Waddock and Graves, 1997; Guenster et al., 2006; Renneboog et al., 2008), we can draw the experience gained from the interaction between corporate social and corporate financial activities while we focus on the CEP and the CCP.

As we mention above, KLD data include the environment as one of the CSR dimensions, while climate change is one of the most important elements of the environmental issues. Therefore, we can follow the track of the CSR research when investigating the environmental and carbon issues. Initially, we define the measurements for the CEP and the CCP.

1.2 Measurement of corporate environmental performance and corporate carbon performance

In this paper, we introduce the companies' environmental and carbon outputs as the proxy for the CEP and CCP. We separate the carbon emission performance from the whole environmental category, as it is the specific focus of this research. Further, we note here that in terms of the better environmental/carbon performance, this refers to the less environmental/carbon outputs that are produced by firms, and vice-versa.

However, one problem with previous research is that most of them generate results with ranking data, where the only information provided is the relative level of social or environmental performance for certain companies. For example, the KLD rating data used by Kempf and Osthoff (2007), having six criteria, each criterion has multiple sub-criteria, which can be further divided into strengths or concerns, hence, a zero/one score. Another example is in Derwall et al. (2005), who using Innovest Eco-efficient data, evaluate the company relative to its industry peers via an analytical matrix consisting of approximately 60 dimensions, and assigning a score between 1 and 10 to each company, then multiplying by a different weight according to the importance of the eco-efficiency factor.

In spite of the effectiveness of the ranking data, there are some drawbacks to these databases. First of all, the ranking may be subject to the discretion of the analyst, for example, in the KLD case, if a company presents a strategy of no harm or benefit, awarding a score of zero or one is the decision of the analyst; secondly, as Ziegler et al. (2009) point out, in the multitude of aggregated environmental or social ratings it is hard to identify the possible positive or negative link between the driving factors; finally, researchers' decisions are totally based on the ranking, making an alternative choice impossible. In respect to the last point, even the ASSET4[1] dataset cannot avoid this, as there are only two types of answers, yes/no, to each question on climate screening policies.

Based on these views, we decide to use the Trucost Emission data (see appendix 8 for more detail). Trucost is a world-wide environmental data provider, which covers corporate environmental impacts, including gases, water, waste and pollutants. Using the latest reports and accounts, Trucost calculates companies' environmental impacts and expresses these environmental impacts in financial and quantitative terms. The advantage of the Trucost data is that they are taken from publicly available sources, and the data

[1] ASSET4 is the leading provider of objective, comparable and auditable extra-financial information. ASSET4 provides professional investors and corporate executives access to the world's largest database of ESG information and the analysis tools to integrate that information into their everyday decision making. ASSET4 is a signatory of the UN's Principles for Responsible Investment and a contributing member to organizations and initiatives like: UNEP-FI, Eurosif, UKSIF, USSIF, Nachhaltiges Investment and the Ceres Coalition. For more information, see www.asset4.com

accuracy is ensured by reviewing the company's annual reports and accounts, environmental/sustainability reports, public disclosures and other initiatives. Furthermore, as a continuous database with environmental impact quantity figures, the dataset seems more reliable and plausible, especially with respect to the greenhouse gas (GHG) emission data; also it allows more flexible analysis, by giving more information than just a ranking.

Due to the focus of our study, we consider the following measures for corporate responses to environment and GHG emission.Firstly, our measurement for the corporate environmental performance is the Trucost defined 'total environmental damage cost'[2], which is not recorded on the company's balance sheet. Therefore, it has been considered as an external environmental cost, which includes GHG emissions, water abstraction, waste generation, volatile organic compounds, heavy metals and other emissions. By introducing a 'price' for each environmental externality, the damage cost is calculated from each of the company's environmental externalities multiplied by their external costs, which is denoted in dollars.

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[2] Trucost analyses environmental impacts in financial terms. When a firm uses a natural resource or emits a pollutant, the resulting damage to the environment or human health is usually borne by society rather than by the firm itself. These damage costs are not recorded on company's balance sheet and are therefore external environmental costs.

Quantities of resources used, pollutants emitted and waste generated due to business activities are multiplied by environmental external costs. Trucost has compiled a library of prices for over 700 different natural inputs and outputs. The prices in Trucost's database are based on a review of environmental economics literature. Valuations draw on extensive international academic research into the pricing of environmental externalities and are overseen by an independent international advisory panel of leading academics. A company's environmental external costs provide a long-term indicator of the environmental sustainability of its activities.

Pricing resources and pollutants in financial terms provides the most suitable weighting factor to identify the relative significance of a range of impacts. A company's environmental external costs can be compared with financial performance measures such as revenue . Source from company website http://trucost.com/glossary-of-terms

Further, we measure the corporate carbon performance using three sub-categories. To distinguish these sub-categories, Trucost invokes 'The GHG Protocol - A Corporate Accounting and Reporting Standard'[3], where the GHGs are classified into three different scopes. Scopes 1 and 2 are carefully defined in the Standard to ensure there are no two or more companies which account for overlapping emissions.

> Scope 1 refers to the Direct GHG Emissions. "Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment."
>
> Scope 2 involves Electricity Indirect GHG Emissions. "Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated."
>
> Scope 3 includes Other Indirect GHG Emissions. "Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services."

Based on these definitions, direct GHG emissions (scope 1) constitute the largest portion of a company's total GHG emissions. Additionally, to allow a broader insight into companies' GHG emissions, Trucost proposes the measure of First-Tier Supply Chain GHG emissions, which includes indirect emissions in scope 2 and first-tier suppliers' emission in scope 3, to account for the impacts of a company's upstream supply chain. The aggregate of the supply chain and other indirect emissions can be greater than a company's direct emissions, particularly for service-based companies. Therefore, it is important to construct

[3] The Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions. This can be found at http://www.ghgprotocol.org/standards

a measurement with respect to first-tier suppliers, and estimate the impact of the company's suppliers in contributing to increased GHG emissions. Hence, we state the three carbon performance measurements as follows:

The direct plus first tier supply chain carbon emissions include the CO_2e emissions from the first-tier supply chain (both scope 2 and scope 3) and from direct emissions (scope 1); the direct carbon emissions refer to the CO_2e emission from direct emissions (scope 1); while the carbon dioxide emission only includes carbon dioxide (no equivalent) from direct emissions (scope 1).

The first two carbon measurements are expressed in the carbon dioxide equivalent [4](CO_2e) quantity (in terms of tonnes).For transferring other GHGs into carbon dioxide equivalent quantities, Trucost applies the following multipliers, with respect to the global warming potentials of certain gases: carbon dioxide (CO_2) is equal to 1 CO_2e, methane (CH_4) is equal to 21 CO_2e, nitrous oxide (N_2O) equal to 310 CO_2e, sulphur hexafluoride (SF_6) is equal to 23,900 CO_2e, per fluoro chemicals (PFCs) are equal to 7,850 CO_2e, and hydro fluoro carbons (HFCs) are equal to 2400 CO_2e. (See Appendix 13 for an example of all GHGs category)

However, as to the different requirements for each of the chapters, the basic environmental/carbon performance measurements need to be transformed into a sales and/or share number deflated version, depending on the specific topic.

[4] Greenhouse gas (GHG) emissions for each company in Trucost's database are converted into tonnes of carbon dioxide equivalent (CO2e) emissions. Nine GHGs are included in the database, including the six covered by the UN Kyoto Protocol international climate change treaty. Each GHG has a different capacity to cause global warming. Trucost converts GHGs to CO2e based on the Global Warming Potential (GWP) index published by the Intergovernmental Panel on Climate Change. This identifies the effect of the emissions of different gases over a 100-year time period relative to the emission of an equal mass of CO2. Although carbon dioxide is the least potent of all the GHGs, it is the most prevalent in terms of its contribution to climate change. http://trucost.co.uk/

1.3 Structure

By comparing CCP and CEP to CSP, our empirical study will answer two questions, first, whether carbon information has been priced in different markets; and second, how carbon performance influences the corporations' valuation in different markets.

To answer the first question, we adopt various factor models and conduct portfolio analysis, using selected strategies. To establish the connection between CFP and CEP/CCP, we consider different carbon criteria and one environmental criterion at different cut-off levels, for three major parties engaged in international climate change policy, the US, the UK, and the EU. To answer the second question, we follow the Ohlson accounting-based valuation model. Regression analysis has been conducted at firm-level, with CEP/CCP proxies as independent variables. Further investigations have also been focused on whether carbon performances also affect firms' cash flow expectation and cost of equity.

The structure of this work is as follows; in the next chapter, we will briefly discuss the carbon influence on different market participants and their relationship. The following three main chapters in this research focus; firstly, on the portfolio performances with reference to the companies' environmental/carbon performance in different markets, secondly, on the companies' financial market value implied by the companies environmental/carbon performance in different markets, and lastly, on the source of the financial market value for firms in different markets. In the final chapter, we draw conclusions and discuss the future research in related areas.

Chapter 2 Motivations

2.1 International Climate Change Policy

The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty, with the ultimate objective of achieving the 'stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. The UNFCCC parties hold an annual meeting, namely Conferences of the Parties (COP), from 1995 to assess progress in dealing with climate change. In 1997, COP 3 took place in Kyoto, Japan, where a legally binding international agreement was established to fight the global warming; thereafter, the well-known name is the Kyoto Protocol. The protocol was initially adopted on 11 December 1997, but not entered into force until 16 February 2005.

The protocol summaries the GHG emission reduction obligation for Annex I countries, along with this, several flexible mechanisms, such as emissions trading (ET), clean development mechanism (CDM) and joint implementation (JI), known as Kyoto mechanisms, are also designed to allow Annex I countries to fulfil their GHG emission obligations by purchasing GHG emission credits from other countries or institutions.

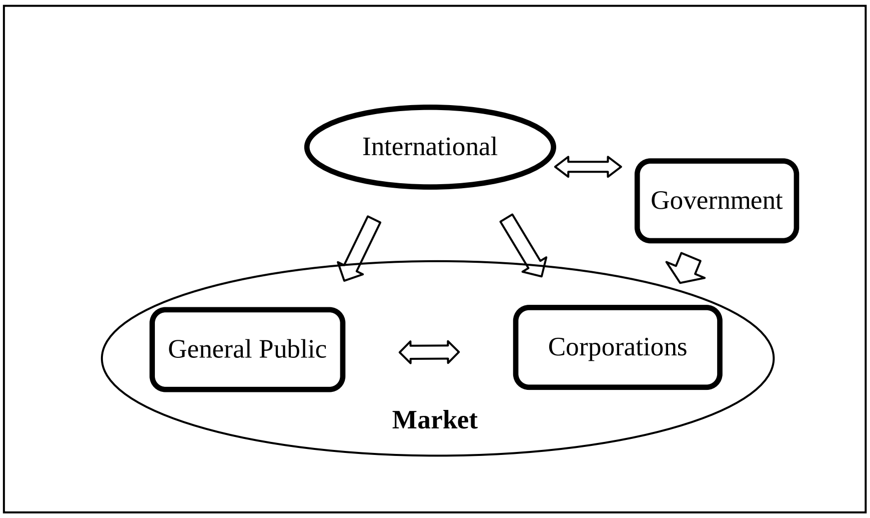
According to the treaty, in 2012, Annex I countries must have met their obligations of GHG reduction established for the first commitment period, from 2008 to 2012, which is an average of 6 to 8% below 1990 levels. Annex I countries[5] include most industrialized countries and some central European economies in transition; hence, both of our subjects, EU and US, are Annex I countries. So far, 191 states have signed the protocol, in which most of Annex I countries, including the EU, who have ratified the protocol, leaving the only

[5] List can be found in Annex B of the Protocol. See Kyoto Protocol To The United Nations Framework Convention On Climate Change, United Nations Framework Convention on Climate Change. Website download, http://unfccc.int/key_documents/kyoto_protocol/items/6445.php

exception, the United States[6]. The United States would be required to cut its total emissions by an average of 7% below 1990 levels; however, was vetoed by Congress after Clinton signed it.

Hence, our research will include two types of responder to the Kyoto Protocol, the protocol challenger, the US, and the complier, the EU[7]. Nevertheless, we will not cover the other Annex I countries and non-Annex I (developing) countries due to the space and/or data constraints.

Figure 2-1Relationship between each party reacting to climate changing policy.



As we illustrate in figure 2-1, when it comes to a climate changing policy, it is not operated by individual parties in isolation, but as an integrated system, in which each party can have its own influence but within the constraints from the controlling body(s). Within the framework of the UNFCCC, each government decides its own policy towards the carbon emissions reduction, which imposes varying degrees of constraint on corporations within the regime. The

[6] Signing the treaty is optional, implying an intention to ratify the Protocol, while ratification means that Annex I parties have agreed to control GHG emissions in accordance with the Protocol. Sources are from Status of Ratification, UNFCCC's Kyoto Protocol Background.
http://unfccc.int/kyoto_protocol/status_of_ratification/items/2613.php

[7] EU refers to the European Union. In this chapter, it includes the UK and all other member states.

corporations act under these government constraints, and also try to predict the government's next move on the carbon emissions. Therefore, whether the corporations are forced or voluntarily adopt a carbon emission reduction activity, i.e. to act as instructed or to act in expectation of regulation or other pressures; they try to maximise their firm's value by doing so. The general public, which includes the firms' stakeholders other than their shareholders, such as their creditors, clients, employees, suppliers, etc, and other social bodies, can also be influenced by the international framework convention on climate change, and hold their own views on climate change issues. As they are associated with firms in various ways, meeting their demands, can be a challenge for firms.

In the following sections, we will discuss the role of each party mentioned above, and their connection with climate change issues.

2.2 Governments' Response

In this section, we discuss the two types of responder to the Kyoto Protocol, the protocol challenger, the US, and the complier, the EU. The US government, as they dismissed the necessity of GHG reduction reinforcement, has only enforced minor constraints on US corporations; on the other hand, the EU, to fulfil its commitment, has adopted more stringent regulations to reduce GHG emissions. Specifically, we mention the UK, which provides a reward to the firms that meet the emission targets.

2.2.1 EU Emission Trading Scheme (ETS)

In 2005, the European Union Emissions Trading Scheme (EU ETS) was launched. The scheme is a crucial cornerstone representing the efforts being made by the EU member states. In the protocol, the EU has committed to reduce GHG emissions by 8 per cent by 2012, compared to 1990 emission level. However, the scheme only targets carbon dioxide (CO2) emissions (Egenhofer, 2007). The EU ETS aims at controlling energy intensive activities and mainly focuses on industrial installations (EC 2003) in four sectors, which are energy activities (e.g. combustion installations exceeding 20 MW, oil refineries), production and processing of ferrous metals, minerals industry (e.g. installation for cement and glass production) and pulp and paper production plants. The scheme covers almost half of the EU's total CO2 emissions.

Emission credits for any company/installation involved in the EU ETS are assigned for a number of consecutive years, called a Trading Period. The first EU ETS Trading Period covered all EU ETS emissions from January 2005 to December 2007. When it terminated, the 1st phase EU allowances also expired. The second Trading Period is under way now, which started in January 2008 and will last until December 2012. Currently, the installations get their trading credits from a government bureau, the NAPS (national allowance plans). Further, companies can purchase EU or international trading credits, in addition to their initial emission allocation. On the other hand, if a company performed well and emitted less amounts of carbon dioxide than its allocation, it could sell the credits and make a profit (within the same trading period). The ETS is conceived to be a self-contained system, which, eventually, can become part of a stock exchange and work under less government intervention.

There are two attitudes in EU corporations pertaining to EU ETS; some companies choose to proactively react to the emissions reduction scheme, while others deal with it in a passive way. As shown by Mathews and Daub (2008), some companies like Novartis, who realize the necessity to reduce their GHG emissions, go about to setting explicit and/or more severe emission reduction targets, and implement the target by integrating energy efficiency into the purchasing and installation process. Nevertheless, instead of making efforts towards their GHG reduction obligations, some other companies endeavour to influence the design of NAPS and lobby for optimal allocations of allowances, whose activities directly result in the over-allocation of allowances in phase I of the EU ETS; also some operators pass on the price of allowances to their customers, hence, gain a windfall profit by shifting the emission reduction pressures. These unforeseen results trigger the debate on the effectiveness of ETS, which to date, is still ongoing.

2.2.2 USEPA and Chicago Climate Exchange (CCX)

In the US, Environmental Protection Agency (USEPA) has the right of decision on CO2 regulation issues, by authorization of the Supreme Court in April 2007 (Apigian, 2008). However, given the attitude of Congress, whose fears of economic failure overwhelm the concerns for GHG regulation, none of the strict GHG regulation could be launched in a legally-enforceable format. Hence, voluntary programmes arose and supplanted any system put in place by the US government.

As early as 2002, USEPA initiated the voluntary government-industry partnership, called Climate Leaders, as part of the Climate Action Programme. In Climate Leaders (USEPA 2007), partners commit to an inventory of all 6 GHGs emissions, including CO2, CH4, N2O, HFCs, PFCs and SF6, as well as establishing long-term reduction goals, which can be met in 5-10 years. As of November 2007, 158 companies joined the Climate Leaders, covering industries ranging from manufacturing, chemical, health services, retail and entertainment.

The largest and longest running GHG emission reduction voluntary programme in North America is the Chicago Climate Exchange (CCX), which was a comprehensive cap-and-trade programme with an offsets component, operating from October 2003 to July 2010. The exchange traded in all six GHGs[8] and started prior to the trading system EU ETS, with members pledged to reduce their aggregate emissions by 6% by 2010. More than 400 members ranged from state, municipalities, educational institutions to industries, which cover many comprehensive areas, such as Automotive, Beverage Manufacturing, Chemicals, Coal Mining, Commercial Interiors, Electric Power Generation, Electronics, Environmental Services, Ethanol Production, Financial Institutions, Food and Agricultural Products & Services, Food Processing, Forest Products, Healthcare, Manufacturing, Petrochemicals, Pharmaceuticals, Real Estate Investment, Recreation, Retail, Steam Heat, Steel, Technology, Transportation, etc[9].

In spite of the highest carbon trading value of 750 US Cents per metric ton of CO2 in May 2008, the trading price fell to 10 US cents per metric ton of CO2 and the trading volume remained at zero from February 2010, and hence after 9 months the decision to close the exchange, was announced. Commentators think it was partly attributed to the limited progress of the UN climate talks in

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[8] The exchange trades in emissions of six gases: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, perfluorocarbons and hydrofluorocarbons.

[9] Source can be found at https://www.theice.com/ccx.jhtml

Copenhagen in December 2010, and a lack of U.S. action on climate change[10]. “(It) seems to indicate that this market player thinks any U.S. climate action is still a way off," said Commodities house FCStone[11].

In the US market, a combination of many factors has had an influence on the ‘climate-changing-business-enviroment’; however, the government’s inactivity contributes to an increasing instability of its characteristics, hence, augmenting the volatility of the carbon market. Although there are some companies committed to emission reductions no matter what the government’s stance; most of the others hold fire while awaiting a protocol ratification by Congress. Typically, a company may participate in one of the voluntary programmes, as a precaution against future stricter emission regulations from Congress (Apigian, 2008). Notwithstanding, there are records showing how a company could make cost saving by implementing the new energy conservation practices (see, for example, the case of IBM (USEPA, 2007)). However, many corporations are still holding back and not implementing these practices. There is therefore some distinction between the US case where there is little formal government policy, and the situation in the EU. Consequently, it is of particular interest to investigate the possible different implications of GHG emissions for firms in the two geographical regions.

2.2.3 UK Climate Change Levy (CCL)

In the UK, the Climate Change Levy (CCL) was introduced on April 1, 2001 as part of the UK's Climate Change Programme, which had the aim of cutting carbon dioxide emissions by 20% from 1990 level by 2010, which is equivalent to 2.5 million tonnes. The levy is in effect an energy tax, with some differentiation of the levy rate according to the carbon content of the energy. It

[10] Szabo M., ICE cuts staff at Chicago Climate Exchange-sources, Reuters. August 12, 2010, http://www.reuters.com/article/2010/08/12/carbon-ccx-layoffs-idUSLDE6791WI20100812

[11] In a July 27, 2010 blog, on FCStone website.

applies to most business but excludes the smallest. HM Revenue & Customs[12] is the statutory body who has the authority to implement the scheme.

Because of the particular risk the CCL brings to UK energy-intensive industries, especially those with exposure to international competition, business within such industries are given the opportunity to sign up to a Climate Change Agreement (CCA). These CCAs schemes entitle its participating members to claim up to an 80% reduction from the CCL in return for meeting challenging targets for improving energy efficiency or reducing emissions. Currently, there are 54 sectors[13] with CCA schemes. While a CCA reduces a firm's levy burden, it still requires firms to incur costs through carbon reduction strategies.

Muizon and Glachant (2003) discuss the environmental and cost efficiency effects of the UK Climate Change Levy Agreements. They argue that the combination of the negotiated agreement with a tax, leads to better environmental effectiveness, and the combination with an emission trading programme improves the cost efficiency.

Moreover, Varma (2003) describes the UK CCL as an economic role that stimulates technical change and impels energy efficiency and carbon abatement innovation. The two instruments that have been combined in the CCL are emission trading and energy taxes. The author argues that in order to maintain cost effectiveness and flexibility, both instruments should be adopted. The author further emphasises that GHG emission trading could cover emissions related to the production of goods in sectors that are exposed to keen international competition, thereby minimising possible negative effects on international competitiveness. Whereas, additional energy taxes could be concentrated on emissions related to ''non-process costs'' that are not exposed to the same pressures of international competition. Therefore, the combination

[12] All sources are from http://customs.hmrc.gov.uk/channelsPortalWebApp/channelsPortalWebApp.portal?_nfpb=true&_pageLabel=pageExcise_ShowContent&id=HMCE_PROD_009791&propertyType=document#toc

[13] As of 23 March 2011, by Climate Change Levy: Reform of Climate Change Agreements. www.hmrc.gov.uk/budget2011/tiin6125.pdf

of the UK CCL and CCA can achieve goals, such as maintaining industry competitiveness and achieving desired environmental targets.

Further evidence can been found in Barker, Ekins and Foxon (2007), who demonstrate the macroeconomic effects of UK CCL and CCA, using an integrated top–down/bottom–up model. Their results show that incentivized energy-efficiency improvements for energy-intensive industries yield positive macroeconomic effects in economic terms, with small increases in GDP and employment through improved international competitiveness, and negligible changes in general inflation.

Based on these arguments, we conclude that governments GHG reduction policies can play an influential role in impacting on a firm's carbon strategy and its financial market valuation. However, to what extent the governments' decision will influence the firm's value is in the question. In the following chapters, we will investigate this by conducting test on firms operating under different policy regimes.

Further, it is relevant to add that it is not just the government, who has the responsibility for GHG reduction, but also corporations and individuals, who have their own perspectives in relation to climate change policy. In the US, corporations may choose to cut their GHG emissions or do nothing at all, whereas, in the EU, corporations can choose to proactively respond to emission reduction or passively react to emission regulations. We will discuss these corporation carbon reduction activities and their potential financial consequences in the following section.

2.3 Influences on Corporations

In this section, we start by stating the pros and cons relating to the general CSR issue, and introduce underlying financial theorems of the CSR-CFP relationship. Further, we discuss corporation carbon reduction activities and their potential financial consequences.

2.3.1 Abatement Costs

Most of the early studies show a negative correlation between CSP and CFP when considering relative costs. Although the concept of CSR is universally accepted now, in 1970, Friedman argues that there is no role for social responsibility in business; and any corresponding cost that is incurred because of engaging in social responsibility activities should not be paid by the company. Irrespective of the question of who should be responsible, CSR activities is inevitably taken as revenue-cutting actions at an early stage, due to incurring cost. Critics of CSR suggest that the firms who perform responsibly from a social perspective, can suffer a competitive disadvantage (Walley and Whitehead, 1994), because of the extra expenses, such as doling out corporate philanthropy, providing employee day care, granting paid parental leave, and reducing environmental impact (Barnett and Salomon, 2006).

Again, arguments have been raised in support of this negative relationship when the environmental issue is isolated from the CSR family. Telle (2006) poses the question, 'if improved environmental performance pays off, why do so many firms deliver a poor environmental performance?' It is argued that the benefits from environmental innovation are small (Palmer et al., 1995), compared to the high environmental improvement costs, such as those incurred for installing, operating and maintaining environmental equipment and investigative costs for identifying and analyzing abatement options, etc (Jaffe et al. 1995).

When we focus on the GHG emission issue, abatement costs refer to the costs associated with measures seeking to prevent negative impacts[14]. One of the few investigative works has been done by Bush and Shirvastava (2011), who point out that all technology is accompanied by specific abatement costs for reducing one ton GHG. However, an investigation of costs by the consulting firm McKinsey, show that negative costs technologies are available, i.e. there are investments which can generate additional income. From these points of view, we argue that there is a cost generated associate with carbon reduction activities; however, whether the cost effect will dominate the valuation is still unclear.

Previous studies give a clue that the general cost argument applies to corporate carbon performance, but the evidence describing the carbon performance

[14] Bush Timo and Shirvastava Paul, 2011. The carbon crisis: emerging carbon constraints and strategic management options.

influence on operating cost, is still insubstantial. To examine this relationship, we will conduct investigations in the following chapters.

2.3.2 Potential Benefits

The majority of research is directed towards the other side of the cost story. Whilst quantifying the cost of CSR activities, the potential benefit from CSR performance should also be taken into account. Superficially, implementing CSR standards or complying with environmental policy is a revenue reducing activity in the short-term. However, once the firm goes beyond basic compliance, incorporating CSR policy into the company's risk management strategy, or further innovating and promoting a sustainable business model, may bring the firm not only short-run efficiency, but also long-run advantages (Dowell et al. 2000, Hart and Ahuja 1996, Russo and Fouts 1997).

a. Energy Efficiency

On the environmental issues, Dowell et al. (2000) argue that the operating cost can be lowered rather than increased, because it is more efficient and cost-saving to treat the pollution in the manufacturing or production process instead of the 'end-of-the-pipe' disposal.

As result of the emission reduction activities, Kolk and Pinkse (2004) summarize three competitive effects (based on the results of the questionnaire sent to the largest 500 multinationals on the 2002 FT500 list), which are the changes in costs, the changes in demand and the development of new technologies. Because of cost increases due to rising energy prices, it introduces a risk for companies in the energy intensive sectors. Therefore, emission reductions can result in a change in companies' costs. Further, a change in demand is strongly related to the relatively low emission potential of certain products, and therefore in high demand by customers. Finally, they indentify two ways in which companies usually achieve carbon emission reductions, which include process innovation and product development. Kolk and Pinkse (2004) argue that a company can gain a competitive edge through product development. Even greater energy-efficiency improvements can be obtained by applying process innovation.

Moreover, Worrell, Bernstein, Roy, Price, Harnisch, and Can (2009) also show that energy-efficiency and emission reduction activities have a strong association. They emphasise that energy efficiency is one of the most important technologies for reducing industrial GHG emissions in the short- to mid-term. Other opportunities include; fuel switching, material efficiency, renewables and reduction of non-CO2 GHG emissions.

Based on these arguments, we assume that the less carbon emission enterprises can also be efficient in other energy usage, hence, create for themselves an advantage in energy consumption, especially during the higher energy price periods.

b. Management Efficiency

Innovation, either as a management creation or through improvement technology, sends the signal of good business prospects. Guenster et al. (2011) suggest that CSR can serve as a proxy for management skills, as well as reflect (technological) innovativeness. The adoption of an environmental policy, especially, creates an incentive for managers to improve manufacturing or production techniques. From a resource-based view[15], Russo and Fouts (1997) suggest that firms who implement compliance environmental policies can only leave themselves in the same resource and capability situation, while firms who adopt a proactive environmental policy could be expected to make structural changes in production or service delivery processes, and further such a redesign may lead the firm to a competitive advantage.

There is still no research investigating these potential benefits of firms' GHG performance. However, we suspect that the carbon emission activities have a potential signalling effect, which can convey information about firms' efficiency in energy usage and ultimately their management skills.

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[15] A resource-based view (RBV) is a business management strategy. A resource is anything which could be thought of as a strength or weakness of a given firm. (Wernerfelt, 1984) RBV of competitive advantage examines the link between a firm's internal characteristics and performance. In order to transform a short-run competitive advantage into a sustained competitive advantage, RBV assumes that firms within an industry (or group) may be heterogeneous with respect to the strategic resources they control and these resources may not be perfectly mobile across firms, and thus heterogeneity can be long lasting. (Barney, 1991)

c. Corporate Governance

Corporate governance is defined as 'the system of internal controls and procedures by which individual companies are managed'. The purpose of this system is 'to prevent one group from expropriating the cash flows and assets of one or more other groups' (CFA institute, 2010). In a narrow sense, Shleifer and Vishny (1997) point out that corporate governance is the way in which corporation financiers assure themselves of being repaid on their investment. This definition suggests firms with a stronger corporate governance policy achieve better firm financial performances (e.g. La Porta et al., 2002).

Given the broader concept described in Tirole's (2001) work, corporate governance is 'the design of institutions that induce or force management to internalize the welfare of stakeholders'. For example, Kolk and Pinkse (2009) identify the inter-link between CSR and corporate governance, and their finding shows that firms tend to integrate corporate governance into their CSR reporting. Berghe and Louche (2005) also shows that there is a strong correlation between corporate governance and CSR and that CSR can become an additional valued property for the financial and insurance sector. Further, using Tobin's Q as the financial performance proxy, Lo and Sheu (2007) suggest a significantly positive relationship between corporate sustainability and its market value. The triangular relationship between firm value, corporate governance and CSR, has not been completely explored yet, but it can be concluded that good corporate governance is not incompatible with CSR. Furthermore, Renneboog et al. (2008) point out that, sound environmental performance may also be a proxy for good corporate governance. As such, corporate governance is not necessarily a negative factor in corporate carbon performance and CFP relationship.

Evidently, CSP positively signifies corporate governance, and CEP similarly. Consequently, we ask, will corporate carbon emission activities affect corporate governance as well? This issue will be followed up in further chapters.

d. Reputation and Intangible

Three years after Friedman's argument, Davis (1973) suggests that firms who adhere to CSR policy will benefit from improved corporate image, and further, the increased reputation also attracts new customers. Draw upon the natural

RBV (Hart, 1995)[16], Surroca, Tribo and Waddock (2010) argue that socially responsible firms are more capable of generating intangibles such as innovation, human capital, reputation, and culture, than irresponsible firms.

On the environmental issues, Heal (2005) illustrates in the example of the food producer, Heinz, who enhanced their brand and increased their profit by moving proactively to respond to the environmental issues. Similarly, the attraction of higher-quality employees, suppliers and financiers are all draw into the business due to a common interest. Further, Dowell et al. (2000) conclude that complying with stringent environmental standards leads to ‘fringe benefits’ to the companies, such as improved reputation and new market opportunities.

As to the carbon emissions issue, we assume it is most likely to track the CSR and CEP, which can improve the performing companies’ reputations and even help them to explore new market opportunities.

In summary, all these potential benefits can be associated with carbon reduction activities, but have not been proved conclusively in any of the past research. Therefore, our work will be the first to shed light on these advantages through the evaluation of performing firms.

Further, in financial markets, the general public have their own role to play in effecting GHG reductions. Therefore, should the firms consider the general public’s opinions, while meeting their shareholders’ requirements, and to what extent can the general public affect firms’ decision making? We will briefly introduce some theoretical background in the next section, and further discuss this in other chapters.

2.4 Stakeholder vs Shareholder

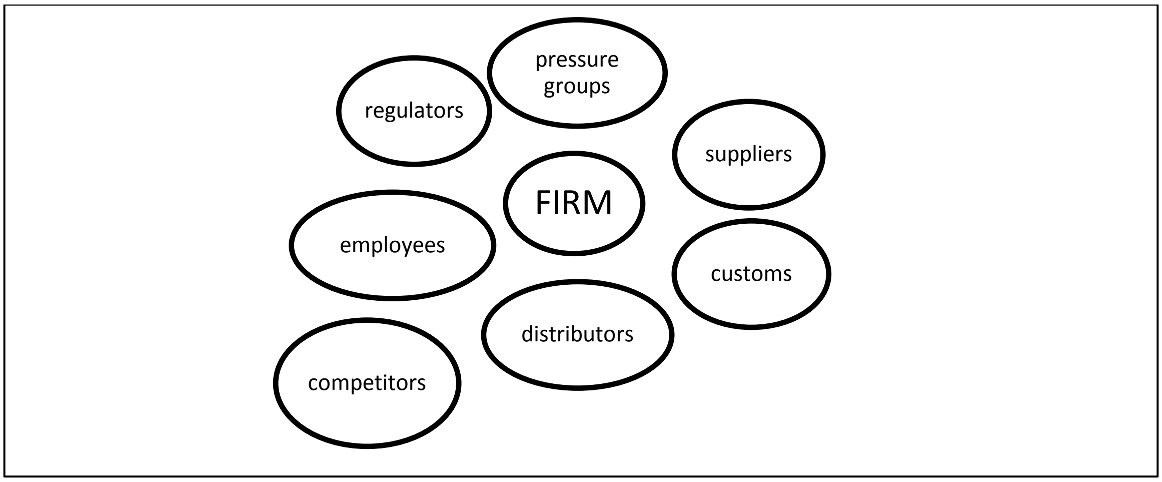
Classical economics (e.g., Adam Smith, invisible hand) describe a perfectly competitive and completely free market, where there is no conflict between the firms’ value maximisation and social welfare maximisation. But, as the ideal

[16] RBV argues that key resources and capabilities affect the ability of the firm to sustain its competitive advantage. Hart (1995) proposes a natural resource-based-view, i.e. a theory of competitive advantage based upon the firm's relationship to the natural environment. It is composed of three interconnected strategies: pollution prevention, product stewardship, and sustainable development.

assumption of the theorem is just an abstraction, the question of maximising social welfare or maximising shareholders value has been raised.

CSR has no place in neoclassicism in general (Hussain, 1999). By neoclassicism, if a 'green investment' causes the company's profit to go down, then managers should not make this investment. The schematic presentation of this neoclassical view suggests that the firm is an isolated entity from society, which includes the regulators, employees, distributors, customs, suppliers, competitors and pressure groups. The relationship is shown in Figure 2-2[17].

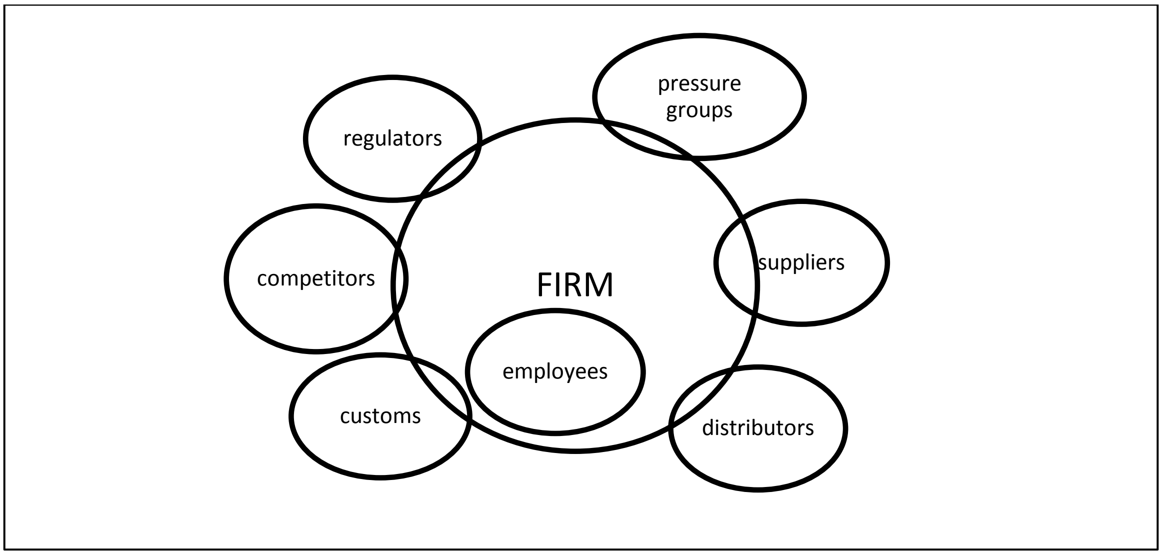
Figure 2-2 schematic presentation of this neoclassical view of the firm in society



However, from a socio-economic standpoint, profitability is only an instrument, which facilitates firms' survival in the market. Clarkson (1991) points out that to be socially responsible, a company must be 'responsive to the changing values, needs and expectations of the community and society'. Therefore, the schematic presentation of the socio-economic view suggests that the firm, the government, the general public and other societal entities are interacting with each others. The relationship is shown in Figure 2-3.

Figure 2-3 schematic presentation of this socio-economic view of the firm in society

[17] Figure 2-2 and 2-3 are from Hussain (1999).



Stakeholder theory and the socio-economic view are closely associated. Freeman's (1984) stakeholder theory states that managers must satisfy a variety of group interests, such as employees, customers, suppliers, local community organizations, financiers and others who have influence on firms' performance. Based on this theory, it is not the exclusive duty of managers to focus on maximising shareholders value. The implications are, for the firm who engages in certain CSR activities, the relevant group of stakeholders will be attracted, hence, the firm will benefit from their support. Therefore, the managers' responsibility is to balance the interests of all stakeholders, so that a maximised aggregate value can be achieved by the company. However, Jensen (2001) enlightens us by pointing out that the stakeholder theory 'contains no conceptual specification on how to make the tradeoffs among stakeholders'.

More recent research attempts to identify the watershed point in the relationship between shareholders' value and firms' CSR activities. Hillman and Keim (2001) find building better relations with primary stakeholders could lead firms to competitive advantages, whereas using corporate resources for social issues not related to primary stakeholders, may not create value for shareholders. Further, Benson and Davidson (2010) also suggest that firms' value and stakeholder management are positively related. However, their results also show that firms will not be compensated for having good relationships with firms' stakeholders. An empirical work conducted by Heal (2005) proposed a more convincing argument. He suggests that on the one hand, the firms in industries where private benefits are consistent with the greater social benefits make profits by improving their social performance and satisfying stakeholders.

On the other hand, in the industries where private interests are not aligned with social interests, CSP and CFP follow different courses of action. Hence pleasing stakeholders will not necessarily increase shareholder value, and vice versa.

Firms' carbon reduction activities benefit governments and people who are suffering or will suffer from global warming, and gain the support of certain groups (investors, customs, employees, legislative and political lobbying, etc) who are in favour of this action. However, to what extend the emission reduction will be economically beneficial to firms, is unclear. Ziegler et al. (2009) propose the hypothesis that corporate response to climate change is positively related to their financial performance in the context of stakeholder value maximising theory. However, their result rejects this hypothesis in general.

The theoretical argument as a whole does not suggest that there are any clear implications from the stakeholder theory in terms of firms' carbon emission performance at the firm level. Hence, our paper will focus on the relationship between firms' carbon performance and their financial performance, and promote debate about the differing interests of shareholders and other stakeholders.

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Chapter 3 Portfolio Based Financial Market Evaluation

3.1 Introduction

The Kyoto protocol came into effect in 2005, with the aim of fighting global warming. However, it has been nearly ten years and we can find few published papers which discuss this topic in the area of corporate finance. Some of the papers (Maier, 2008) direct their interests towards climate change and the resulting economic and policy changes, while others focus on event studies (Heal, 2005), however, few of them have examined the corporate response to climate change by means of portfolio theory. Although portfolio analysis is a common method that is broadly used in corporate social responsibility (CSR) and environmental issues (e.g., Derwall et al., 2005; Gregory and Whittaker, 2007; Ziegler et al., 2007; Kempf and Osthoff, 2007; Climent and Soriano, 2011), applying such an approach to measure corporate carbon emissions is still a fresh idea, particularly in the area of empirical studies. So far, regarding the issue of carbon emissions, the only work which has used this method, to our knowledge, is the recent research carried out by Ziegler, Busch and Hoffmann in 2009, whose paper examined the relationship between corporate climate policy compliance and stock performance by conducting a portfolio analysis.

In respect to CSR and environmental issues, debates are concentrated on whether managers, with the intention of protecting stakeholder interests or the natural environment, strategically forego profit, or whether such actions produce potential profitable opportunities for the companies, in other words, increasing shareholders' value. The main interests are further developed into two branches; the first branch is devoted to identifying specific success factors for CSR/environmental strategies that are able to decrease operating costs and/or to boost revenues; and the second branch that endeavours to detect their relevance to investors in terms of financial market effects.

In the financial market, where investors can switch their holdings and/or reduce their risks more easily than companies can, an investor's choice to whether select more or less CSR/environmental friendly stocks for their portfolios can directly affect their risk-adjusted returns. For example, a trading strategy which consists of buying stocks or stock portfolios from corporations with strong CSR/environmental performance and selling stocks or stock portfolios composed of poor CSR/environmental performance corporations could lead to either a reward or a penalty from the stock markets (e.g., Derwall et al., 2005).

By adopting portfolio analysis in relation to carbon emissions, our main contribution in this empirical area can be sub-divided into three phases. Firstly, in the selection of the external variables and type of data; while most of the previous studies focus on broad CSP (e.g., Brammer et al., 2006; Kempf and Osthoff, 2007) or common corporate environmental performance (e.g., Derwall et al., 2005; Ziegler et al., 2009) by ranking data, we introduce a quantifiable carbon emissions measure in order to analyses the response of financial market to corporate carbon performance. So far, corporate carbon performance has rarely been analysed; furthermore, the specific quantitative indicator is for the first time introduced into carbon financial practical studies. Due to the inaccessible climate change data, there is a gap in the financial literatures with respect to climate change, the study by Ziegler et al. (2009) partly fills this gap by examining the relationship between corporate responses to climate change and the respective financial performance of companies, assisted by ASSET4 ranking data. Following Ziegler et al., our study more specifically focuses on corporate GHGs emissions performance; while in addition, the adoption of quantitative indicators [18]allows us to construct more flexible and comparable portfolios by balancing and controlling almost the same number of stocks [19]on each side of the portfolios, so avoiding the potential problem of portfolio size bias.

Secondly, in the choice of financial indicators and type of models; the use of stock returns to represent the corporate financial performance (CFP) is

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[18] Comparing to the criteria that Ziegler et al. (2009) adopted, which reflect whether or not the pre-defined standard has been met, i.e. a set of qualitative indicators, our criteria are sets of real numbers, i.e. the emission quantities/cost divided by sales. See section 3.4.2 for more detail.

[19] By taking the top/bottom group from the whole sample of each year, we construct the best/worst portfolios with almost the same number of entrants; therefore, control the problem caused by different numbers of entrants (size). For example, when cut-off is 10% and the whole sample has 1,000 observations, both best and worst groups contain 100 oberservations. See section 3.4.5 for more detail.

specifically employed to compare the performance of portfolios which differ in their underlying levels of corporate carbon emissions. In contrast to the firm level analysis (e.g., Brammer et al., 2006; Guenster et al., 2006; Busch and Hoffmann, 2011), the portfolio analysis approach focuses more on how financial markets and their participants respond to the embedded information, which is, in our case, the firms' carbon emissions performance; hence, the possible influences from firm-specific factors, such as plant size, operating cost, management skill, etc is reduced. On the other hand, portfolio study investigates stock performance based on long-term returns rather than short-term returns, which are more consistent across time, when compared to those event studies (e.g., Konar and Cohen, 1997; Dasgupta et al., 2001). However, various choices of methodology only indicate the potential investor's requirements in different ways.

From the available models, our preferred option is in line with existing literature, we therefore employ the Capital Asset Pricing Model (CAPM), the Fama-French three factors model (FF3F), and the Carhart four factors model (CH4F) as an additional choice.

We construct our own portfolios, ranked by carbon emissions (Derwall et al., 2005; Ziegler et al., 2007 and 2009), instead of employing existing funds (Luther and Matatko, 1994; Goldreyer et al., 1999). Fund level studies can be subject to the fund manager's skill or misled by other variances, such as fund size and age. In contrast, self-constructed portfolios avoid all of the aforementioned problems; in fact, this approach can be a better simulation of general investor's opportunities, rather than just representative of institutional investors' attitude.

This study differentiates between three geographically regions, on grounds of their differing policy regimes. These are the US, the UK and the rest of the EU[20]. There is evidence showing a positive correlation between the CSP and

[20] In the following research, EU countries ('the rest of the EU' or 'EU excluding UK') only include Austria (AT), Belgium (BE), Czech Republic (CZ), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Hungary (HU), Ireland (IE), Italy (IT), Luxembourg (LU), Netherlands (NL), Poland (PL), Portugal (PT), Sweden (SE), and Spain (ES). Due to data collecting limitation, some of the EU countries are not included. The UK is analysed separately, unless otherwise specified.

CFP for US stocks, for instance, Derwell et al. (2005) construct the equity portfolios based on Innovest Strategic Value Advisors' corporate eco-efficiency scores, i.e., an environmental criterion, and they prove that the high-ranked portfolios produce superior financial performances compared to their low-ranked counterparts over 1995-2003 period. Kempf and Osthoff (2007) also announce significant abnormal returns based on their best-in-class screening approach, using the combination of several socially responsible screens.

We particularly separate the UK from other EU member states because in addition to the EU ETS the UK also imposes the Climate Change Levy, with Climate Change Agreements for large companies (as discussed in Chapter 2). With respect to the UK, Brammer et al. (2006) form the portfolios according to different SRI criteria and indicate a mostly negative but never statistically significant result by employing a long-short strategy. Consequently, they suggest that the relatively poor returns of the CSR firms may be attributable to their characteristic as comprising larger and more highly priced stocks. However, we also notice that their result is based on the Ethical Investment Research Service (EIRIS) data with a short duration from July 2002 to December 2005 only. An interesting result for the European corporation is disclosed by Ziegler et al. (2007), in which they examine the effect of sustainability performance of average monthly European stock returns from 1996 to 2001 and find the average environmental performance of the industry has a significantly positive influence on the stock performance, in contrast, the average social performance of the industry has a significantly negative influence. Also based on the approach of constructed mutually exclusive portfolio, Ziegler et al. (2009) confirm the negative relationship between social response investment to climate change and CFP, both for the US and Europe.

However, one pitfall with our data is, where a company’s carbon emission data are not fully public accessible, Trucost made an estimation using its own model, basically by marking the firm to the corresponding sector benchmark, (for detail, see the Trucost website). Hence, we also perform the analysis at four different cut-offs to check whether the performance is robust.

The rest of this chapter has the following structure: the second section considers performance consistency, developing hypotheses from the existing evidence. The third section discusses and compares the general portfolio analysis models; while the fourth section, introduces our data and our approach. The fifth section describes the empirical results and the final section draws conclusions and identifies areas for further discussion.

3.2 Evidence of SRI performance

Recently, there has been a rapidly growth in financial literatures relating to CSR analysis (though little specificially focused on responsibility with regard to climate change). Recent research interest has focused on the link between stock return and CSP, predominantly, constructing stock portfolios with respect to the environmental or social performance. Two groups of portfolios are adopted, social responsible investment (SRI) funds or ethical funds and self-constructed socially screened portfolios. One strand of these studies employs the ethical mutual funds and compares the CSR fund performance with the conventional fund performance (e.g., Bauer et al., 2005; Barnett and Salomon, 2006; Gregory and Whittaker, 2007). Although these studies provide empirical evidence of SRI funds performance in a practical context, the fund performances are largely subject to fund managers' skill, in addition, the result may be biased due to other non-quantifiable factors or may be very unreliable because of the overlapped holding in the SRI funds and conventional funds (Derwell et al., 2005).

A second body of empirical works compares portfolios performance based on time-series data, by constructing mutually exclusive stock portfolios according to different CSR indicators. Our paper will adopt this approach at portfolio-level.

In this section, we mainly focus on existing evidence in US, UK and EU. The results from different types of SRI portfolio (either an ethical fund or a self-constructed socially screened portfolio) and from different SRI screen policies (CSR, environment or GHG emission) form our major concern, as well as the approach that was used to derive these results.

3.2.1 US SRI Performance

a. Results from ethical funds

There are many studies which examine US SRI fund performance; however, early studies focus on the analysis of Jensen's alpha, defined by the single factor asset pricing model, CAPM, and Sharpe ratio and Treynor ratio. Hamilton et al. (1993), use the monthly returns (including dividends) of all equity mutual funds from the Lipper Analytical Service. For the time period from January 1981 to December 1990, they further divide the 32 mutual funds into two groups, a 17-fund group which were established in 1985 or earlier and a 15-fund group which were established after 1985. They find the Jensen's alpha, which is defined as the excess of the actual funds return with respect to their expected return calculated with the CAPM model, for the 17-fund group, is -0.06% per month (hence, -0.76% annually). The result is 0.08% (per month) higher than the benchmark, which is consisting of 170 conventional mutual funds; however, the difference is not significant. For the shorter history 15-fund group, the Jensen's alpha is -0.28% per month, which is worse than the corresponding 150 conventional mutual funds (-0.04% per month), though not statistically significant neither. Another truth we learn from this research is, that SRI funds only form a rather small faction compared to conventional funds before the early 90s.

Using the monthly returns funds data from the same data service, Goldreyer et al. (1999) selected funds which cover a very different sub-period, such as the two oldest SRI funds which cover the period from January 1981 to June 1997, while the newest ones cover the period from September 1994 to June 1997. Moreover, they employ all three measures, Jensen's alpha, the Sharpe ratio and the Treynor ratio, and conclude that Jensen's alpha and the Sharpe ratio favour conventional funds, whereas the Treynor ratio favours SRI funds. Meanwhile, they introduce various investment screens, resulting in a mixed conclusion on the preference of SRI or non-SRI fund. For example, the results from the equity funds sub-sector show a preference for non-SRI equity funds. The average Jensen's alpha of 20 non-SRI equity funds is 2.78%, whereas the corresponding average Jensen's alpha of 29 SRI equity funds is -0.49% per annum, an insignificant difference. The result from another sub-sector partitioned by both portfolio size and systematic risk factors demonstrate that conventional fund performance is volatile (with a Jensen's alpha range from 22.51% to -21.58%), while the SRI fund performance is more stable across different sub-samples (with a Jensen's alpha range from -0.07% to -0.89%). Their study suggests that different investment screens indeed affect the result.

Statman (2000) concludes that DSI 400 as a capital weighted index modelled on S&P 500 and an index of SRI stocks, have better performance than S&P 500 for the period from 1990 to 1998, as indicated by the higher Sharpe ratio (0.97 vs. 0.92), however the beta and standard deviation of DSI are also higher than that of S&P 500, demonstrating the riskier character of DSI. For the same period, Statman also finds that SRI funds perform better than conventional funds, with an average annual alpha -5.02% for SRI funds (-0.42% per month) and -7.45% for conventional funds (-0.62% per month); although the difference is not significant. These findings suggest that there is no significant difference between the performance of SRI and non-SRI funds in 1980s and 1990s.

Lately, most studies employ the CAPM, Fama-French three factors model or Carhart four factors model as their main analytical instruments. For the fund period from July 1963 to December 2001, Geczy et al. constructed the SRI and non-SRI portfolios of mutual funds, comprising of no-load equity mutual funds that had at least three years of return history through December 2001. The SRI portfolio has a higher monthly alpha than the non-SRI portfolio (0.21% vs. 0.08%), although the difference is not significant. Further, the result from the four factors model also reveals that SRI portfolios have higher risk exposure to the size factor (SMB) (0.20 vs. 0.16) than that of the non-SRI portfolios, which means that SRI funds are more small company oriented. However, under the Bayesian framework, Geczy et al. (2006) also construct the optimal portfolios of mutual funds for mean-variance investors with short sell constraints, for which the predicted return distribution is conditional upon a range of prior beliefs about model mispricing and manager skill. The result suggests that for an investor who disallows managerial skill but believes in multi-factors asset pricing model, the SRI constraint will cost him/her at least 30 basis points per month; while for an investor who believes strongly in the CAPM, the cost of the SRI constraint is typically just a few basis points per month, ceteris paribus.

b. Results from self-constructed full CSR screen portfolios

Kempf and Osthoff (2007) implement various CSR screen policies for stocks included in the S&P 500 and the DS 400 for the period 1992–2004, forming both value-weighted and equally-weighted portfolios and measuring their performance by the Carhart (1997) model. There are three screen policies involved, negative, positive and best-in-class, the negative policy rules out the companies from the controversial industries; the positive policy rates all companies and picks out the best ratings; and the best-in-class policy is essentially an industry-balance positive screen. The positive CSR policy rates in accordance with six qualitative criteria, community, diversity, employee relations, environment, human rights, and product etc. They form portfolios based on each of these six criteria and two combinations of these criteria, and announce a significant abnormal return of 8.7% per year based on their best-in-class screening approach under one of the combinations. As most of their results suggest, the high-rated portfolios (better CSR performance) also have lower market exposure, lower value factor exposure and higher momentum factor exposure, when compared to the of the lower-rated ones, although the results vary according to different screen policies. Moreover, they emphasise that the results are robust after taking into account transaction cost.

c. Results from environmental funds

Climent and Soriano (2011) construct three equally weighted portfolios using actively managed equity mutual funds for the period from March 1987 to December 2009, which consist of 7 environmentally responsible funds (green funds), 14 matched SRI funds, and 28 matched conventional funds, with average annualized returns of 8.45%, 7.19%, and 12.67%, whit corresponding standard deviations of 17.56%, 13.79%, and 15.05%, respectively. The result suggests a lower average annualized return as well as a substantially higher risk for the green funds. Especially, the study discloses the performance of each portfolio during 2008 to 2009, when the green funds have an average negative return of -12.99%, while the SRI and conventional funds only drop -5.65% and -7.64% each. When applying the CAPM-based methodology, green funds underperform both of the SRI and conventional funds with similar characteristics, whichever market proxy is used (S&P 500, KLD 400 and GC 100). The application of the Carhart model also indicates the high risk and small company character of the green funds for the whole period examined. However, considering the risk exposure to value factor, the green funds are more value-oriented in the early period (1987-2001), but more growth-oriented in the later period (2001-2009). Furthermore, the green funds could achieve adjusted returns insignificantly different from the rest of the SRI and conventional mutual funds for the more recent period (2001–2009).

d. Results from self-constructed full environment screen portfolios

Dewell et al. (2005) construct the mutually exclusive equity eco-efficient portfolios based on Innovest Strategic Value Advisor's corporate eco-efficiency scores, i.e., an environmental criteria, and they prove that the high-ranked portfolios produce superior financial performance when compared to their low-ranked counterparts over the period from July 1995 to December 2003. The representative portfolio consists of companies making up the 30 percent of total capitalization rated highest/lowest by Innovest. The Sharpe ratio of this high-ranked portfolio is much higher than that of the low-ranked one (0.46 vs 0.28). The result from CAPM also suggests a 3.82% difference per month between the high-ranked and low-ranked portfolios. Meanwhile, the result from the Carhart four factors model displays a higher alpha difference of 6.04%, as well as the fact that the high-ranked portfolio depends more on large-cap and growth stocks than low-ranked portfolio. Furthermore, the 30% equally-weighted result and the 20% and the 40% value-weighted results indicate the robustness of the initial scenario result; particularly, the 20% value-weighted portfolio generates the highest alpha, an 8.60% per month industry-adjusted value. In addition, the authors also suggest that we do not need to worry about autocorrelation and heteroscedasticity for both the eco-efficient and eco-inefficient portfolios by the Ljung-Box Test.

e. Results from self-constructed climate change screen portfolios

Ziegler et al. (2009) use specific disaggregated time series data for corporate carbon performance from the Swiss company ASSET4, over the time period from 2001 to 2006. In this research, they formed mutually exclusive portfolios consisting of S&P 500 companies in accordance with two carbon screen policies, the first carbon criterion is a corporate measure for climate impact attention based on the question does 'the company make a clear statement that it believes that climate change can represent commercial risks and/or opportunities?'; while the second one is an indicator for corporate carbon reduction measures answer the question does 'the company report on initiatives or new production techniques, to recycle, reduce, reuse, substitute or phase out CO_2 or CO_2 equivalents in the production process?'. Notice that, the number of firms which have such information available for analysis is different for each criterion. For example, the total number of firms with available climate impact statement information is 159 in 2001, while the number with available carbon reduction measures information is 121 in 2001. A long-short strategy is also applied by calculating the difference between the portfolio with a 'Yes' answer and the portfolio with a 'No' answer.

Applying the CAPM, the authors suggest that the 'Yes' portfolio under the climate impact statement perform worse than the corresponding 'No' group, for the period 2001-2006 and two sub-periods 2001-2003 and 2004-2006, however, no significant difference is found. On the other hand, the 'Yes' portfolio under the carbon reduction measure outperform the corresponding 'No' group, for the period 2001-2006 and the two sub-periods, particularly in the 2004-2006 sub-period, a significant difference of 0.62% per month at 5% level is recorded.

The alpha produces a similar result when the Carhart four factor model is applied, however, the Carhart model also suggest that the 'Yes' portfolio is significantly oriented towards value stocks, and partially oriented towards large capital, with insignificantly less momentum exposure, when compared to the corresponding 'No' group.

To summarise for the US stocks, the result shows an insignificant difference in performance between most of the CSR/environmental funds and their counterpart conventional funds, whichever method is used; however, in general, most of the self-constructed mutually exclusive portfolios show much better performance for the portfolios which adhere to certain CSR policies, when compared to those which do not in comply with CSR, when the CAPM, Fama-French or Carhart model is applied. However, the results are inconclusive with respect to corporate carbon performance.

3.2.2 EU excluding UK SRI Performance

a. Results from ethical funds

Schroder (2004) investigates 16 Germany and Swiss ethical funds that initial from November 1990, using both the Sharpe ratio and Jensen's alpha. The Sharpe ratio of the ethical funds is measured against the MSCI world index, however, only 4 out of the 16 funds have a Sharpe ratio above or equal to the MSCI index. In addition, the Jensen's alphas also reveal the fact that most of the ethical funds underperform their benchmarks, whichever version in used, although the result is mostly insignificant. The author also suggests that the poor results of the worst performing funds can be attributed to management fees as indicated by the SRI index results. There are two EU SRI Indices, the DJSI STOXX (DJSI2) started in January 1999 rating according to sustainability criteria and the FTSE4 Good [21]Europe 50 (FT1) which started in February 1999 and is based on socially responsible investment criteria. These indices generally perform better than the MSCI index, as suggested by the Sharpe ratios, while Jensen's alphas remain negative.

Using Eco-reporter data, Bauer et al. (2005) construct portfolios of German mutual funds from January 1990 to March 2001. On average, the German ethical funds have a smaller size and a higher expense ratio[22] compared to the German conventional funds, with an average size of 73 million dollars investment vs 323 million dollars and an expense ratio of 1.40 vs 1.04 years respectively. In the regression analysis, the Jensen's alpha, either derived from the CAPM or Carhart model, indicates pronounced negative returns from the German ethical funds, which also underperform the conventional funds; although the ethical funds appear less sensitive to the market than the conventional ones as implied by the systematic risk from both the CAPM and Carhart models. Furthermore, the German ethical funds are also heavily exposed to small-cap bias and growth-bias. These exposures are explained by the underweighting of large, value stocks in the ethical funds, such as the stocks of chemical, energy and basic industries. Additionally, they claim that the Carhart model is a better instrument than the CAPM according to the R-square.

[21] The FTSE4Good Index Series was launched in 2001 by FTSE Group, the award-winning global index provider, with the aim of objectively measuring the performance of companies that meet globally recognized corporate responsibility standards. See http://www.ftse.co.uk/About_Us/FTSE_Corporate_Responsibility/FTSE4Good.jsp

[22] Fund expense ratio is the cost of owning a fund, which is given by the total percentage of the fund's assets used for the investment advisory fee, the administrative costs, advertising (12b-1) distribution fees, and other operating expenses.

b. Results from self-constructed full CSR screen portfolios

Ziegler et al. (2007) examine the effect of sustainability performance on stock performance for European corporations in the period from January 1996 to August 2001, as measured by the average monthly stock return. Their study first calculates the market risk exposure and the size and value risk exposures under the CAPM and Fama-French model, respectively. Then, introducing the average 67 monthly return as dependent variable, the authors run cross-sectional regressions across the risk factor(s), CSR scores dummy and country dummy variables. On the industry level, both results suggest that the average social performance has a significantly negative influence on performance, which suggests that the market punishes investments in stock corporations of sectors with good social performance. However, on a corporation level, investors are suggested to apply the buy-and-hold strategy by investing in better social performing corporations, since this would not decrease their portfolio value compared with all other corporations in the same sector.

c. Results from self-constructed full environment screen portfolios

Environmental performance of European corporations has also been considered in the Ziegler et al. (2007) study. By applying the average 67 monthly return as dependent variable, the cross-sectional regressions are run across the same risk factor(s), environment scores dummies and country dummies. In contrast to the influence of social performance, the average environmental performance shows a significantly positive correlation with the stock performance at industry level, suggesting that the stock market rewards investments in clean sector stocks; although this premium is weak at corporation level.

d. Results from self-constructed climate changing screen portfolios

In Ziegler et al. (2009) research, mutually exclusive portfolios which include MSCI Europe and FTSE 350 have also been formed to investigating the relationship between European corporate carbon performance and CFP for the time period from 2001 to 2006. The carbon screen policies are the same, a measure for climate impact statement and an indicator for corporate carbon reduction.

Suggested by the CAPM model, the group which is more compliant with climate police significantly underperforms the less compliant group by 0.64% per month, based on the climate impact statement screen for the whole period 2001-2006, while based on the carbon reduction measure, an insignificant difference of -0.17% has been reported between the more compliance and the less compliant group for the same period. Regarding the two sub-periods 2001-2003 and 2004-2006, a positive but weak long-short result of 0.27%, has been found under the carbon reduction measure for the sub-period 2004-2006, while the other long-short results are all negative.

The results from Carhart model display the negative insignificant long-short results between the more compliant and the less compliant group for the whole period and former half period. However, for the later sub-period of 2004-2006, the Jensen's alpha of the long-short portfolio changes from -0.09% in CAPM to 0.07% in the Carhart model, based on the climate impact statement screen, meanwhile, the regression displays a significant negative loading on size factor, which implies that the poor financial reward offered by more climate police compliant group is attributable to their large-cap exposure. Furthermore, significant positive difference has been asserted for the same sub-period, based on the carbon reduction measure. The authors conclude that the results are becoming increasingly positive for stocks in European corporations which are more compliant with climate change policy.

According to the little evidence that was found on the EU stock market, the environmental screen process seems to provide a better standard for EU stock selection, while most of the EU ethical fund managers are still struggling with the contradiction between CFP and CSP; however, these results may vary when comparing to different benchmarks.

3.2.3 UK SRI Performance

a. Results from ethical funds

Ethical unit trusts in the UK, at the end of 1989, have an aggregate value of £201m, which is a mere 0.3% of the aggregate value of all UK-based unit trusts. In 1992, Luther et al. investigate 15 out of 16 ethical funds which are defined by the Ethical Investment Research Service (EIRIS) for the period from 1984 to 1990. Their findings show that the CAPM defined Jensen's alphas of the ethical funds have an average return of 0.03% per month, however, the results may be sensitive to the choice of index; the mean value of the Sharpe ratio is 0.046, which is more robust; also, the ethical funds are relatively overweighted with the small-cap companies. Although it is not imperative for the result and there is no further detail or investigation on GHG emission performance, it is interesting to note that in the sample selected, that 7 trusts choose British Gas as their investee company due to the company's greenhouse gases (GHG) emissions performance at the time. This implies that the GHG screen criterion had been adopted in early 90s by some companies and certain funds in the UK, even though it was not universally applied.

In a later study, Luther and Matatko (1994) employ 9 out of 20 long-lived UK ethical funds, which had been operating for more than 32 months, for the period from March 1985 to March 1992. No significant Jensen's alphas have been found for most of the ethical funds, when measured against the FT All share (FTA) index or when measured against the Hoare Govett Small Company (HGSC) index. However, the findings show a higher R-squared when the regression is performed against the FTA than when the regression is against the HGSC, this again demonstrates that the ethical funds are biased towards the small-caps factor.

Using three measures of Jensen's alpha, Sharpe ratio and Treynor ratio, Mallin et al. (1995) compare the performance of 29 ethical funds with their matching group of 29 non-ethical funds, which have been constructed with the similar size and age over the sample period from January 1986 to December 1993. While 7 out of 29 ethical funds have negative Jensen's alpha, 6 out of 29 non-ethical funds also have negative alpha, demonstrating no significant difference between the two groups. The Jensen's alphas of the ethical funds range from -0.28% to 1.21% per month, while the range is from -0.41% to 1.56% per month for the non-ethical funds, demonstrating no significant difference either. However, by all three measures, both types of funds tend to underperform the market index (FT All Share Actuaries).

Matching the fund size, formation year, type and investment balance, Gregory et al. (1997) compare ethical and non-ethical funds for the time period from January 1986 to December 1994. Jensen's alpha is the main measure in the study, which has been defined by a CAPM model and a size-adjusted CAPM model, respectively. The results from both Jensen's measures range from -0.71% to 0.24% per month, mostly insignificant, for the ethical funds; while for the non-ethical funds, it ranges from -0.41% to 0.51% per month. Furthermore, the cross-sectional regression result suggests that the ethical fund dummy makes no significant impact on the fund performance after controlling for fund age, size, and market risk. However, most of the ethical funds show a significant small-cap bias.

Gregory and Whittaker (2007) examine the return of 32 ethical funds from January 1989 to December 2002, employing a Carhart four factors model. By dividing the funds into domestic and international, they demonstrate the insignificant difference between the monthly mean return of the domestic ethical and the domestic non-ethical fund. These findings suggest that UK domestic ethical fund investors will not lose out compared to ordinary investors. In addition, the hedging strategy results show that the domestic ethical funds have significant exposure to small-cap and growth stocks, while less market risk exposure than that of the non-ethical funds. Considering persistence in performance, they find that performance appears to be time-varying, and also influenced by the chosen model, whether static or time-varying. Furthermore, a positive persistence starts to occur from 6 months onwards.

b. Results from self-constructed full CSR screen portfolios

Realizing the limitations of the funds analysis, and supported by the EIRIS CSR rating database, Brammer et al. (2006) describe a different way of portfolio construction. The portfolios are not the existing funds, neither formed by those existing funds; instead, they are constructed according to a different CSR rating, which is a three dimension ranking score, which has four triciles in total. The chosen three dimensions are: community performance, environmental performance and employee performance. The aggregate score is calculated and reclassified into four triciles, which are zero score, low score, medium score and high score. For the 42 month period from July 2002 to December 2005, using the Fama-French 3 factors model, they demonstrate that the average monthly returns, measured by the intercept terms, are all positively significant for the 4 portfolios, while the arbitrage strategy of buying the portfolio of firms with the high CSR score, and short selling portfolios of the low and of the zero firms, shows no significant difference between the two portfolios. However, the arbitrage strategy only shows the significant market risk exposure of the high score portfolio over the zero score portfolio, no difference is found in the other factors, such as size or book-to-market value.

c. Results from self-constructed full environment screen portfolios

Brammer et al. (2006) also formed portfolios under each of the sub measures. Hence, the environment screen process is used to form four portfolios as well. Similar to the CSR result, weak evidence has been found that the high environmental score portfolio outperforms the zero or low environmental score portfolio. In addition, the Fama-French model also suggests that the superior environmental portfolio tends to include bigger cap, higher book-to-market value and better performance stocks over the previous 12 month, than the inferior environmental portfolio.

d. Results from self-constructed climate changing screen portfolios

Although the Ziegler et al. (2009) research includes the FTSE 350 in the mutually exclusive portfolios; the result is regressed with respect to MSCI Europe. Therefore, we can hardly identify the performance of the UK carbon screen portfolio individually. So far, there has been no other evidence for the performance of self-constructed climate change screen portfolios in the UK.

In conclusion, most of the existing evidence shows that the influence of CSP is weak in the UK, no matter which screen policy is applied. Since there is less evidence based exclusively on UK environment or carbon screen portfolios, our hypothesis for the UK is basically in line with the EU. However, there is another consideration, since the UK is one of the countries that introduced Green policy at very early stage, the carbon information may have already been priced into the stock market, and no more excess return could be earned by undertaking a buy-and-hold strategy, which makes investment on the good carbon performance stocks unprofitable.

3.2.4 Implication of Climate Changing Policy at Portfolio-Level

When most of the countries ratified the Kyoto Protocol and agreed to control GHG emissions, the US, on the other hand, decided not to comply with the Protocol. There are some voluntary programmes in response to the climate change in the US, however, without any coercive power, we may not expect the

US market to react as strongly as the other markets, which operate under government climate regulations. In contrast, EU launched the EU ETS in 2005, which constrain the EU countries' emissions. In the UK, in addition to the EU ETS, there is the CCL, which has the potential to impact on firm strategy and performance. Consequently, the government efforts applied in the three areas are differ.

Further, as we indicated in Chapter 2, corporate carbon performance may be positively related to corporate governance, and the latter can be a good indicator of stock returns. Evidence can be found in both management and financial literature. Drobetz et al. (2004) analyse the impact of corporate governance on stock returns over the period 1998–2002 in Germany. However, due to the fact that their corporate governance data are limited to one observation, March 2002, they assume constant historical ratings. Drobetz et al. (2004) build factor portfolios using an investment strategy that buys well-governed firms and sells poorly governed firms, and their result shows a 12 percent abnormal return on an annual basis, and this result increases to 16.4 percent after accounting for different factor exposures for the portfolios. Bauer, Guenster and Ottern (2004) investigate two samples, the European Monetary Union (EMU) and the UK samples. They rank all firms on the basis of their corporate governance rating and construct portfolios for the EMU and the UK, respectively. By holding the zero-investment portfolio, i.e. long the 'Good Governance Portfolio' and short the 'Bad Governance Portfolio', they report that an annual return of 2.1 percent for the EMU portfolio and 7.1 percent for the UK portfolio from January 1997 to July 2002.

However, in the case where no emission constraint is present in the market, such as in the US market, there is no such implication relative to the companies' emission performance and their corporate governance or management skill. Fisher-Vanden and Thorburn (2011) conduct an investigation into the firms joining two voluntary corporate environmental initiatives in the US, the EPS's Climate Leader (CL)[23] programme and Ceres[24]. By controlling for shareholders'

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[23] The EPA's Climate Leaders program is an industry–government partnership that works with companies to develop long- term strategies to reduce their impact on the climate. Fisher-Vanden and Thorburn (2011)

resolution, they find that firms with weak corporate governance structures are more likely CL members, which implies that there is no necessary association between firms' corporate governance and their carbon emission performance in the US. According to the results of event-study, they report that firms' value significantly dropped after the announcement of joining the CL programme and the announcement of an emission reduction goal. The phenomenon of firms entering the CL programme irrespective of the decrease in their shareholder value, is contradictory to the shareholders value maximization theory. Therefore, the authors further suggest that this phenomenon can either be attributed to institutional pressures put on managers or to management's discretion on making voluntary environmentally responsible investment decisions. Either way, it indicates that the link between management efficiency and firms' emission performance is not dominant in a voluntary system. As the authors point out, in the US, the only viable method to reduce carbon emissions is by way of more strict federal regulation or taxation.

Hence, we look for the distinct reactions on the market in response of the carbon emissions, and propose the following hypotheses:

Ha1: A long (low carbon) short (high carbon) strategy in the UK ***outperform*** *the same strategy in the rest of the EU.*

Hb1: A long (low carbon) short (high carbon) strategy in the rest of the EU ***outperform*** *the same strategy in the US.*

3.3 General Methodology Review

3.3.1 Jensen's alphas, Sharpe ratio and Treynor ratio

Three one-parameter measures are used to describe the performance of funds, they make direct comparisons between the various funds achievable (Mallin et al., 1995). Under the Markowitz assumption of capital market theory, all investors are rational, as such they target their portfolios on the efficient frontier; and all investors have homogeneous expectations, which mean that they have identical expected return probability distributions. Hence, the two distinct

[24] Ceres is a national network of environmental organizations and other public interest groups that works with companies and investors to address sustainability challenges, including global climate change. Fisher-Vanden and Thorburn (2011)

dimensions for investors who are measuring portfolio performance are the portfolio’s risk and the portfolio’s return. Given this precondition, all three fund measures are interpreted as risk-return combinations.

The Sharpe ratio is expressed as a measure of excess return to a total risk (Sharpe, 1966).

$$S = \frac{E(R - R_f)}{\sigma} \tag{3.1}$$

Where, R is the asset return, R_f is a benchmark asset return, $E(R - R_f)$ is the expected excess return of the asset over the benchmark asset return, in our case, the excess return of the portfolio is either the return over the risk-free asset on the market where the portfolio operates, or the return over the industry-matched portfolio return (Edmans, 2011); and σ is the standard deviation of return on the portfolio, which also represent the total risk (idiosyncratic risk + systematic risk) of the portfolio. The Sharpe ratio should lay on the Capital Market Line (CML) if the market properately values the portfolio. The implication of the Sharpe ratio is that investors prefer portfolios with large Sharpe ratios to those with small Sharpe ratios, if investors making decisions depend on the risk-return performance exclusively.

However, as the ratio is a mean-variance measure, the underlying assumptions require that returns are distributed normally, while this is not the case all the time. When kurtosis or skewness is present, the result can be largely misinterpreted. Gregoriou and Gueyie (2003) point out, in the case of hedge funds, using the Sharpe ratio can lead to underestimating a fund’s tail risk, hence overestimating the fund’s performance.

The Treynor ratio is defined as the excess return to non-diversifiable risk (Treynor, 1965).

$$T = \frac{E(R - R_f)}{\beta} \tag{3.2}$$

Where, R is the asset return, R_f is a benchmark asset return, $E(R - R_f)$ is the expected excess return of the asset over the benchmark asset return, which is still the excess return of the portfolio over the return of the risk-free asset or the industry-matched portfolio return, and β is the systematic risk of the portfolio.

The Treynor ratio is based on the assumption that the market only rewards investors for bearing the systematic risk, not for bearing the diversifiable risk of the companies. Similar to the Sharpe ratio, Treynor ratio should lay on the Security Market Line (SML) if the portfolio is properately valued. Furtehr, the higher the Treynor ratio the bigger return an investor can earn in terms of each unit of systematic risk. However, as a ratio, there is no value added term, which makes the ratio become a ranking criterion only.

Lastly, the Jensen's alpha, which is the most prevailing measure of mutual funds, is used to decide the differential return between the portfolio's real return and the theoretical expected return, the latter being measured against risk factor(s) (Jensen, 1969).

$$J = R_i - E(R_i) = R_i - [R_f + \beta_i * (R_m - R_f)] \quad (3.3)$$

Where, R_i is the real portfolio return, $E(R_i)$ is the expected portfolio return, $R_i - E(R_i)$ is the excess return. The most common expression of the expected return is given by the Capital Asset Pricing Model (CAPM), which includes a single risk factor β_i, measuring the systematic risk of the portfolio-i. Since the CAPM return is a risk-adjusted measure by taking into account the non-diversifiable risk, investors would expect the same portfolio return for bearing the same systematic risk. Consequently, a higher Jensen's alpha indicates a higher abnormal return and a better fund performance.

The Jensen's alpha defined by CAPM is criticized by Grinblatt and Titman (1994), where they argue that the CAPM measured expected returns are biased towards small companies. One solution to this is the other version of Jensen's alpha, which is defined by Asset Pricing Theory (APT). The commonly used model to determine the expected return is the Fama-French three factors model, which, as we describe below, has three risk-adjusted factors, including market, size and value factors. Hence, the Jensen's alpha can be interpreted as the following formula,

$$J = R_i - E(R_i)$$

$$= R_i - [R_f + \beta_{i1} * \left(R_m - R_f\right) + \beta_{i2} * SMB + \beta_{i3} * HML] \quad (3.4)$$

However, there are still other criticisms of the Jensen's alpha. Grinblatt and Titman (1994) indicate three main concerns, which are benchmark efficiency, market timing ability and the statistical power of tests of abnormal returns. Fletcher (1995b) reviews the theoretical conditions of Jensen performance, such as the choice of unconditional mean-variance efficiency benchmark portfolio(s), the presence of a riskless asset, the condition of no binding constraints on investors and the assumption that investors only possess selective information, etc. Regarding the three concerns, firstly, he confirms that timing biases have little empirical consequence. Furthermore, he concludes that the choice of the benchmark portfolio could have an empirically significant impact; therefore, he suggests that it is possible for the Jensen measure to provide reasonably accurate inferences about fund performance, by choosing an efficient benchmark portfolio. However, the statistical power of the tests is still maintained.

3.3.2 Capital Asset Pricing Model (CAPM) Framework

The first choice for measuring portfolio performance uses the well-established Capital Asset Pricing Model (CAPM), which is estimated by an ordinary least-square (OLS) regression of the following form:

$$R_{it} - R_{ft} = \alpha_i + \beta_i * (R_{mt} - R_{ft}) + \varepsilon_{it} \qquad (3.5)$$

Where, R_{it} is the return on portfolio-i in month-t; R_{ft} is the risk-free rate; R_{mt} is the return on a selected market proxy in month-t; and ε_{it} is the error term. The model beta, β, is the measure of a portfolio's market-risk exposure, and the Jensen's alpha, α , represents the average abnormal return in excess of the return on the market proxy.

In spite of the fact that the CAPM generates the Jensen’s alpha and market-risk measure, critics argue that the explanatory power of this framework is weak, because the implicit assumption of CAPM is that the difference between the return on a portfolio and the return on the single-factor benchmark can provide an accurate estimation of risk-adjusted performance, but this does not always hold. Empirical workings also find evidence that certain portfolios bias towards company size or book-to-market value, in which case the CAPM does not provide the best estimate of the risk-adjusted return (Banz, 1981; DeBondt and Thaler, 1985; Fama and French, 1992).

3.3.3 Fama-French Three Factors Model (FF3F) Framework

Fama and French defined a three factors model (FF3F), which includes a size factor and a value factor, in addition to the market-risk factor. Therefore, the OLS regression expands into the following form:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1} * (R_{mt} - R_{ft}) + \beta_{i2} * SMB_t + \beta_{i3} * HML_t + \varepsilon_{it} \qquad (3.6)$$

Where, R_{it} is the return on portfolio-i in month-t; R_{ft} is the risk-free rate; R_{mt} is the return on a selected market proxy in month-t; and ε_{it} is the error term. The model beta, β, is the measure of a portfolio's market-risk exposure; SMB is the size factor, defined as the return difference between a small-cap and a large-cap portfolio in month-t; HML is the value factor, defined as the return difference between a value portfolio and a growth portfolio, or in another words, the return difference between a high book-to-market value portfolio and a low book-to-market value portfolio, in month-t; and the Jensen's alpha, α , defined by the average abnormal return in excess of the return on the FF3F model.

However, there are still arguments that suggest the three factors model can be further improved, for instance, it fails to account for the impact of momentum factors, which are described in Jegadeesh and Titman (1993), where they investigate US mutual fund performance persistence (Carhart, 1997).

3.3.4 Carhart Four Factors Model (CH4F) Framework

By introducing a momentum factor, Carhart (1997) redefines the standard Fama-French 3 factors model into the following form,

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1} * (R_{mt} - R_{ft}) + \beta_{i2} * SMB_t + \beta_{i3} * HML_t + \beta_{i4} * MOM_t + \varepsilon_{it} \qquad (3.7)$$

Where, R_{it} is the return on portfolio-i in month-t; R_{ft} is the risk-free rate; R_{mt} is the return on a selected market proxy in month-t; and ε_{it} is the error term. The model beta, β, is the measure of a portfolio's market-risk exposure; SMB is the size factor, defined as the return difference between a small-cap and a large-cap portfolio in month-t; HML is the value factor, defined as the return difference between a value portfolio and a growth portfolio in month-t; MOM is the momentum factor, defined as return difference between a high prior return portfolio (a 'winner' portfolio) and a low prior return portfolio (a 'loser' portfolio), based on prior 2-12 months performance; and the Jensen's alpha, α , described as the average abnormal return in excess of the return on the Carhart model.

Although the model has been acknowledged now, the appropriateness of such a model is worthy of further discussion. With respect to the momentum factor, some of the existing evidence finds that it has no significant explanatory power, for example the Liew and Vassalou (2000) study, in which the authors test the link between Gross Domestic Product (GDP) growth and the three additional Carhart factors, i.e. SMB, HML and MOM. Their findings show that the MOM strategy contains little profitable information about the future GDP growth in ten countries, including the UK and US etc. However, the evidence of the SMB and HML is a little more mixed. The results of Liew and Vassalou (2000) support the risk-based explanation for the performance of HML and SMB in most of the ten countries. In another example, Gregory et al. (2003) test the factors impact with respect to future GDP, investment and consumption growth based on UK data, and find that future GDP, consumption growth are related to HML returns individually; however the relationship becomes insignificant in the presence of SMB and market factors. By contrast, SMB is always significant in predicting future GDP, consumption and investment growth.

The construction of the factors is another problem when applying the multi-factors models. Although Kenneth R. French data library provides all of the factors based on the US data, these factors are still not publicly available for the other countries or areas. Brammer et al. (2006) form the factors based on UK data, in which the market factor is the excess return on the FTSE All-Share index over the 3-month UK T-bill yield; SMB is derived from the average return on the portfolio comprising the smallest 50% of stocks over the average return on the portfolio comprising the largest 50%; HML is calculated as the average return on the bottom 30% of stocks in excess of the top 30% of stocks sorted by price-to-book ratio; while MOM is constructed by the average return on a portfolio comprising the highest 50% of stocks ranked by prior returns minus the average return on the lowest 50% of stocks by prior returns. All portfolios are based on the FTSE All-Share index constituents.

In the case of the EU factors, Ziegler et al. (2009) form these in a similar way to the Kenneth R. French factors. The market-risk factor is defined by the excess return of the MSCI Europe Total Return Index over the monthly return of one-month Treasury Bills. The size factor (SMB) is defined as the median of the firm’s market capitalization which is based on a ranking of each year market capitalization in June; while the book-to-market factor (HML) is recalculated at 30% and 70% percentiles of the ratio between published book value and December market value of last year. As to the momentum factor (MOM), a weighted difference has been calculated between the monthly returns of the past 12 month winners and losers.

We will include the results from the Carhart 4 factors model for the UK and US for the purpose of comparison, however, as we are somewhat sceptical as to whether the four factors model is appropriate for determining a risk-adjusted return, we will not include the results from this model for the EU, which means that we will place most emphasis on the results from the three factors model.

3.4 Data and Methodology Description

3.4.1 Methodology

In order to examine the hypotheses that we have proposed, we perform the portfolio analysis by comparing the average stock performance of portfolios that comprise companies which differ in their environmental and GHG emission performance. In accordance with recent researches (e.g., Derwall et al., 2005, Bauer et al., 2005, 2007, Kempf and Osthoff, 2007, Ziegler et al., 2009), we estimate the risk-adjusted returns of different stock portfolios based on the asset pricing models.

Considering the differentials in the portfolios' market risks of the portfolios, our first model is the one-factor market model, CAPM. Under best (worst)-in-class strategy, the model is expressed in the following form:

$$R_{pt} - R_{bt} = \alpha + \beta_1 (R_{mt} - R_{ft}) + \varepsilon_t \qquad (3.8)$$

While, under the long-short strategy, the model has been further developed:

$$R_{ht} - R_{lt} = \alpha + \beta_1 (R_{mt} - R_{ft}) + \varepsilon_t \qquad (3.9)$$

Where, in both of the formulas,

R_{bt} = a benchmark portfolio return in month-t, can be either a risk-free rate, or a industry-adjusted portfolio returns;

R_{mt}= return of the market index;

R_{pt}= return on portfolio-p in month-t;

R_{ht}= return on the higher ranking portfolio in month-t;

R_{lt}= return on the lower ranking portfolio in month-t;

ε_t= error term.

The dependent variables of the best (or worst)-in-class regression, are the excess returns of the constructed portfolios over either the risk-free rate or the industry-adjusted portfolio returns, depending on whether equally-weighted or value-weighted portfolios are being examined. For the long-short regression, the dependent variables are the difference in return of the best portfolios when compared with the worst portfolios.

For the US[25], $R_{mt} - R_{ft}$, the excess return of the market portfolio, is the value-weight return on all NYSE, AMEX, and NASDAQ stocks (from CRSP) minus the one-month US Treasury bill rate (from Ibbotson Associates). For the UK[26], the market return index uses the total return on the FTSE All Share Index, and the one-month return on UK Treasury Bills is the proxy for the risk-free rate. For EU[27] countries, the market return index is the simple return developed from MSCI Europe excluding the UK Total Return Index, and the risk-free rate is given by the German three-month T-Bill yield. We mainly focus on analysing of the Jensen's alpha, in terms of the intercept, and market-risk measure, the coefficient of the market factor.

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[25] For the US factors in the CAPM, FF3F and CH4F, definitions refer to Kenneth French Data Library, data details. See website, http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html

[26] For the UK factors in the CAPM, FF3F and CH4F, definitions refer to Gregory A., Tharyan R. and Huang A. (2009), The Fama-French and Momentum Portfolios and Factors in the UK, Xfi, University of Exeter, working Paper No 09/05. See website, http://xfi.exeter.ac.uk/researchandpublications/portfoliosandfactors/index.php

[27] For the EU factors in the CAPM, FF3F and CH4F, the method refers to Gregory A. and J. Whittaker (2007), Performance and Performance Persistence of 'Ethical' Unit Trusts in the UK, Journal of Business Finance & Accounting, 34(7) & (8), 1327–1344, September/October 2007.

While the CAPM has less explanatory power according to the validity discussion (e.g., Banz, 1981, DeBondt and Thaler, 1985, Fama and French, 1992), the Fama-French Three Factors Model complements this drawback by including a size factor and a value factor. Our major model in this research, the risk-adjusted return based on the best (worst)-in-class strategy is interpreted into the following form:

$$R_{pt} - R_{bt} = \alpha + \beta_1 (R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \qquad (3.10)$$

Based on the long-short strategy,

$$R_{ht} - R_{lt} = \alpha + \beta_1 (R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \qquad (3.11)$$

As implied by most of the empirical works, the FF3F well captures most of the intrinsic risks that are inherent in the portfolios (e.g., Fama and French, 1993, 1996, for the US, Hussain et al., 2002, for the UK, and Schrimpf et al., 2007 and Ziegler et al., 2007b, for Germany). The market-risk factors have identical definitions to those in the CAPM, while the additional factors are derived as follows. Factors for the US are directly extracted from the Kenneth French data library, in which size and value factors are formed using the 6 value-weight portfolios for July of year t to June of year t+1, and includes all NYSE, AMEX, and NASDAQ stocks. Factors for the UK are from Gregory, Tharyan and Christidis (forthcoming) and provided on the Xfi website at Exeter University; however, to account for the fiscal year differential, the factors are constructed using the 6 value-weighted portfolios for October of year t to September of year t+1, and includes all UK main-market stocks.

$$SMB_t = \frac{(Small\_Value + Small\_Neutral + Small\_Growth)}{3} - \frac{(Big\_Value + Big\_Neutral + Big\_Growth)}{3} \qquad (3.12)$$

$$HML_t = \frac{(Small\_Value + Big\_Value)}{2} - \frac{(Small\_Growth + Big\_Growth)}{2} \qquad (3.13)$$

In the case of the EU, although Ziegler et al. (2009) have formed factors, the sources are still not publicly accessible. Instead, we imitate these factors in line with the approach of Gregory and Whittaker (2007), in which the factors are formed in a much more simple, but efficient way.

The paper investigates the UK SRI fund performance using the factor model; however, it has been conducted while the UK factors are still unavailable. To solve the problem, they develop factors using the difference between the small cap index and the market index to proxy the SMB factor, and the difference between the value index and the market index to proxy the HML factor. The rationale for doing this is that the adoption of only one index for the variable of interest (e.g. size or value) can cause a co-linearity problem that exists between the index and the market index. By taking the difference between e.g. the small cap index and the market index, they successfully remove the co-linearity between the market factor and other factors of interest.

Based on their theory, we develop the SMB factor for the rest of the EU using the difference between the small cap index and the market index; whereas for the HML factor, it is the difference between the value index and the growth index, which theoretically improves the quality of the HML factor as this is better follow the construction of Fama-French factors for the US.

To construct these factors, firstly, from DataStream, we obtain the MSCI EU excluding the UK small cap total return index (TRI), the MSCI EU excluding the UK value and growth TRI, and the MSCI EU excluding UK total TRI, after a simply transformation using the following formula (3.14), we derive the returns for calculating the factors.

$$R_{i,t} = \frac{TRI_{i,t}}{TRI_{i,t-1}} - 1 \tag{3.14}$$

Where, $R_{i,t}$ is the absolute return for company-i at month-t, and $TRI_{i,t}$ is the total return index for company-i at month-t.

After the above transformation, we derive the R_{small_cap} from the MSCI EU excluding the UK small cap TRI, the R_{value} from the MSCI EU excluding the UK value TRI, the R_{growth} from the MSCI EU excluding the UK growth TRI and the R_{eu} from the MSCI EU excluding UK total TRI.

The size factor is re-defined as SCR, while the value factor is shorted for VG; these factors are calculated by the following equations,

$$SCR = R_{small\_cap} - R_{eu} \quad (3.15)$$

$$VG = R_{value} - R_{growth} \quad (3.16)$$

For comparison with the existing evidence, we also introduce the Cahart Four Factors Model (e.g., Derwall et al., 2005, Ziegler et al., 2009), however, after balancing the factor validity and time expenditure on forming it, we only apply the model for the US and the UK. The basic model is adjusted into the following form, for the best (and worst)-in-class portfolios,

$$R_{pt} - R_{bt} = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \varepsilon_t \quad (3.17)$$

While under the long-short strategy,

$$R_{ht} - R_{lt} = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \varepsilon_t \quad (3.18)$$

The first three factors are in line with the previous model, the additional momentum factor is stated as below,

$$MOM_t = \frac{(Small\_High + Big\_High)}{2} - \frac{(Small\_Low + Big\_Low)}{2} \quad (3.19)$$

For the US, we still consult the Kenneth French data library, where six value-weight portfolios formed on size and prior (2-12) returns are used to construct the MOM, and include NYSE, AMEX, and NASDAQ stocks with prior return data. The monthly size breakpoint is the median NYSE market equity, while breakpoints of the monthly prior (2-12) returns are the 30th and 70th NYSE percentiles. The same methodology has been adopted in the Gregory, Tharyan and Christidis (forthcoming) paper; instead of NYSE, the largest 350 UK companies (excluding financials) by market capitalisation are used to form the UK factors.

3.4.2 Corporate Environmental Data

As we have discussed in section 3.2, the previous research either refers to ethical funds or self-constructed social screening portfolios. Since the first approach is subject to the effect of fund management skills, the self-constructed portfolio analyses seem to be more attractive.

To construct such portfolios, we introduce the Trucost defined environmental and carbon ‘footprint’, which are based on the measurements of the corporate environmental/carbon performance and deflated by companies’ sales. Firstly, the Trucost environmental impact measure, Impact Ratio (IP), is equal to the Total Environmental Damage Cost divided by company's sales, where the Total Environmental Damage Costs are not recorded on the company's balance sheet and are therefore considered as external environmental costs, the measure includes GHG emissions, water abstraction, waste generation, volatile organic compounds, heavy metals and other emissions. By introducing a 'price' for each environmental externality, damage costs are calculated from each of the company's environmental externalities multiplied by their external costs. However, this measure is subject to analyst estimation, as Trucost discloses, 'where no public disclosure has been made the figure has been estimated using Trucost's methodology, which has been developed with the assistance of our Advisory Panel of leading experts.' Hence, we only report the result from the Impact Ratio as a comparison with the existing evidence.

Pertaining to the three Carbon Dioxide Emission criteria; we invoke 'The GHG Protocol - A Corporate Accounting and Reporting Standard', where the GHGs are classified into three different scopes (see chapter 1). Scopes 1 and 2 are carefully defined in the standard to ensure there are no two or more companies which account for overlapping emissions.

Based on definitions in the standard, we measure all three criteria in terms of footprint, which is equal to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's sales (in terms of billion dollars). The Direct + First Tier Supply Chain Carbon Footprint (FF), which includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); the Direct Footprint (DF) refers to CO2e emission from direct emission (scope 1); while the Carbon Footprint (CF) only includes Carbon Dioxide (no equivalent) from direct emission (scope 1). (See Appendix 14 for an example of the calculation)

For transferring other GHGs into Carbon Dioxide Equivalent Quantities, Trucost apply multipliers, with respect to the global warming potentials of the certain gases (as we have described in chapter 1).

The three carbon criteria are highly correlated, while the Impact ratio are positive correlated with each of them (see tables 3-1-2 to 3-1-4). The number of world-wide firms for which such information is available has an increasing tendency in our dataset; due to our focus, we summarize the observation numbers for the US, UK and EU in each year from 2002 to 2008 in Table 3-1-1, and describe some basic statistics for the environmental/carbon variables in Tables 3-2.

$$[\text{Insert Tables } 3-1 \text{ and } 3-2 \text{ Here}]$$

Comparing the US, UK and the rest of the EU, we find that the UK performs the best, while the rest of the EU slightly outperforms the US, based on the environmental performance measure (IP, mean and median values). Based on the carbon performance (FF, DF and CF), the mean values indicate that the UK is still the best performer, and the US is the worst. However, the median values indicate that the rest of the EU is slightly better than the UK in terms of the DF and the CF.

3.4.3 Corporate Financial Data

We first sort all of the companies in the Trucost Carbon Emission database into a 19-industry classification for the EU and UK based on the DataStream Level 3 industry code (For the list see Appendix 1). The US companies are sorted into a 17-industry classification (defined by Kenneth R. French[28], for the list see Appendix 2) based on their SIC code.

Then, we match all companies with the DataStream Monthly Total Return Index. To identify long-term carbon emissions impact on stock performance, we track the 12-month stock performance after the Trucost carbon information has been released, hence, we allow one-year lag for the Total Return Index, which means that for the GHG emission data Year 2002 to Year 2008, we have the corresponding financial performance measured by stock return from Year 2003 to Year 2009. The stock return is calculated as follows,

$$R_{i,t} = \frac{TRI_{i,t}}{TRI_{i,t-1}} - 1 \quad (3.20)$$

[28] For detail, see Kenneth R. French webpage: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_17_ind_port.html

Where, $R_{i,t}$ is the absolute return for company-i at month-t, $TRI_{i,t}$ is the total return index for company-i at month-t. All stock returns are calculated as simple returns, to avoid a downward bias.

The other problem with the financial data is the de-listed stock problem, where DataStream has no record for the total return index or the return index becomes a constant number. Simply dropping all these missing data will cause a survivorship bias in our results; however, the method that Mitchell and Stafford (2000) applied, replacing all de-listed firms by benchmark returns, has the potential to create an upward bias. The best thing we can do in this case is to apply the approach of Gregory, Guermat and Al-Shawawreh (2009), where two treatments are used for different types of de-listed firms. If a de-listed firm has preserved its value (such as a merger or an acquisition), its return is replaced by the return of the benchmark, which is the median return of the sector that the firm belongs to. Otherwise, if de-listing has been caused by a total loss of value (such as bankruptcy), we then replace the return by -1. In indentifying this difference, we use the LSPD G10 description for the UK companies and CRSP for the US firms; however, as there is no such database recording the de-listing data for the EU countries, we do a news search to determine the type of de-listed firm.

3.4.4 Diversification and screening policy

In the risk-return characterised world, SRI may be less favourable, because to invest in SRI funds means “following their hearts and not their wallets” (Geczy et al., 2005). SRI applies a variety of screening policies to retain the portfolios social responsible feature by imposing a constraint on the investment. Hence, the portfolios’ diversification is reduced by imposing SRI constrain, and consequently, the mean-variance frontier shifts towards less favourable risk-return tradeoffs, compared to conventional portfolios.

However, according to research conducted by Renneboog et al. (2008), in which they summarise the empirical findings of SRI funds before 2008, most of the research reports no significant difference between SRI and conventional funds, and some of the others even find a superior performance for SRI funds. Proponents of SRI argue that SRI portfolios are composed of better managed stocks that tend to generate above average financial returns, where SRI funds have equivalent performance or even outperform those conventional funds, irrespective of the limited potential breadth. Other supporters also suggest that the net total cost to a socially responsible investor is overstated because of the ignored non-financial utility that is derived from being socially responsive. Our explanation is that although diversification requires more underlying stocks to be picked-up, a screening policy is crucial for deciding which ones of those stocks will be selected.

As we known, a well-diversified portfolio can be formed with as few as 20 or 30 randomly selected stocks (Fisher and Lorie, 1970; Bloomfield, Leftwich, and Long, 1977) or even as many as 50 stocks (Campbell et al., 2001). SRI funds can still successfully achieve diversification to effectively eliminate the majority of specific risk without selecting the entire universe of securities (Barnett and Salomon, 2006). Therefore, screening policies are more imperative for the specific fund, whereas diversification provides more opportunities. However, SRI screening policies are varied from one to another. While some constraints may cause the rejection of a group of non-compliant firms; others may involve the exclusion of the entire industries or even the economic sector.

Screening policy, as describes in The Forum for Sustainable and Responsible Investment (2010),

> “Include both positive and negative screens, is the practice of evaluating investment portfolios or mutual funds based on social, environmental and good corporate governance criteria. Screening may involve including strong corporate social responsibility (CSR) performers, avoiding poor performers, or otherwise incorporating CSR factors into the process of investment analysis and management. Generally, social investors seek to own profitable companies that make positive contributions to society. "Buy" lists may include enterprises with, for example, good employer-employee relations, strong environmental practices, products that are safe and useful, and operations that respect human rights around the world. Conversely, many social investors avoid investing in companies whose products and business practices are harmful to individuals, communities, or the environment”.

By this definition, there are two screening strategies, positive and negative. While the negative screening simply rules out all companies from the portfolio that engage in the perceived controversial industries, such as tobacco, military and gambling etc, positive screening is more complicated. A positive screening policy generally involves a ranking system, which is based on a set of CSR criteria, such as those mentioned above, environment, human right, employee relations, and product etc. Thus, by choosing the higher level companies from the rankings, investors can construct the portfolio according to their preference. Further, Kempf and Osthoff (2007) introduce a best-in-class screening policy, which is similar to the positive screening, except for requiring an industry-balanced portfolio, i.e. choosing the higher level companies within each industry, then pooling these to form the portfolio. For example, consider there are two industries A and B in a market, where industry A has 600 companies and industry B has 400 companies. Applying the best-in-class strategy, and adopting a 10% cut-off level, we will have 60 (600*10%) companies from industry A with the best performance for a certain screening criterion, and 40 (400*10%) companies from industry B for the same screening criterion. Thus we have 100 (60+40) companies in this best-in-class portfolio. In addition, Gregory and Whittaker (2007) perform a 'hedge' strategy by long in SRI funds and short in non-SRI controlled-funds, resulting in a zero net investment fund.

The screening policies are all applicable pertaining to carbon emission performance. However, given the characteristics of our GHG emission data, we employ the last two strategies (best/worst-in-class and long-short strategy) in this chapter.

3.4.5 Construction of Portfolios

a. Benchmark to Risk-free Rate

Subsequently, we construct both equally-weighted and value-weighted portfolios that refer to environmental criteria or different carbon criteria. To investigate the environment/carbon information impact on financial performance one-year hence, we first rank stocks according to each of the 4 criteria that we described previously, abbreviated by IP, FF, DF and CF. However, where the current criterion values are the same, we then sort the firm by the most correlated criterion, for example, in the US, the ranking order is IP, FF, DF and CF, when applying IP criterion; while sorted by DF, this order is DF, CF, FF and IP. See Tables 3-1-2 to 3-1-4.

When the best-in-class strategy is applied, we pick out the top 10% of stock returns (ranked by one of the criteria, with the smallest IP/Footprint value, which means the best carbon emission performance) in each industry, then pool these and form the best 10% portfolios. When the worst-in-class strategy is used, the bottom 10% of stocks (with the biggest IP/Footprint value, which means the worst carbon emission performance) in each industry are selected, pooled and formed into the worst 10% portfolios. In both strategies, the stocks are allocated again in each year over time, in another words, the corresponding stocks stay in the specific portfolio(s) for all 12 months of the following calendar year. In the equally-weighted portfolios, we assign each stock in the best 10% (and worst 10%) the same weight, hence, average stock return portfolios have been constructed; in contrast, we allocate each stock in the best 10% (and worst 10%) a weight according to the corporation's capitalization in the value-weighted portfolios.

Therefore, when applying the best/worst-in-class strategy and using the risk-free rate as the benchmark, both equally- and value-weighted portfolio returns are reduced by the country/area risk-free rate (one-month Treasury bill rate), i.e. in equations (3.8), (3.10), and (3.17), R_{bt} is a risk-free rate.

In addition, a long-short strategy is also introduced. The portfolios are constructed on the basis of a trading strategy, which simultaneously buys (sells) stocks of corporations with a better (worse) environment/carbon performance. The time series of the monthly returns of these hedging stock portfolios is calculated by the differences between the monthly returns of the best 10% and worst 10% portfolios under each criterion. Finally, we perform a robustness check at different cut-offs by picking out stocks at 20%, 30% and 50%, which means the portfolios are formed by the best (worst) 20%, 30% and 50% under each criterion, and all of the strategies are replicated.

b. Benchmark to Industry

In addition to the four risk factors that are presented in the Carhart model, there are also other factors that are not captured by the above models, such as the industry influence. As Edmans (2011) indicates in his paper, in certain economic environments, some industries may enjoy stronger returns than others. This can be illustrated by a period of recession, in which most industries are in downturn, for example automakers, wheras retailers may still be generating normal profits. Hence, the industry risk, which is not being captured as a systematic risk in any of the model we have described above, will potentially introduce an industry-bias into our results. To adjust for this bias, Edmans (2011) employs an industry-adjusted or industry-matched portfolio return to measure the excess return as well. By doing so, he also tries to ensure that the outperformances of the best portfolios are not the results of the selected companies that happened to be in the strong industries. His results are robust after compensating for the industry effect, in which a 49-industry classification is used to sort the companies.

In this paper, the industry-adjusted returns for the US companies are accessed from the Kenneth R. French website again, where the 17-industry monthly average equally-weighted and value-weighted returns are both available. While for the EU and UK, to remain consistent with the industry classification, the industry-adjusted returns are calculated from the DataStream Level 3 industry (19-industry) return index, which is constructed of a set of value-weighted returns. Unfortunately, there is no such equivalent for the equally-weighted portfolios in the data source that is available to us, therefore we will only test the industry effect based on the value-weighted portfolios for the EU and UK.

The equally-weighted industry-adjusted portfolios are formed by applying an average excess industry-adjusted return over all the industries, while for the US, there are 17 industries, and for the UK and EU there are 19 industries. Further, by multiplying an industry capital weight to each of the excess industry-adjusted returns, the value-weighted industry-adjusted portfolios are constructed under the same screening policies and cut-off levels. Hence, the results may not be consistent due to the different underlying benchmark returns and portfolio weightings.

To illustrate this portfolio construction procedure, we show an example at 10% cut-off level when the environmental criterion and best-in-class strategy are applied. We pick out the top 10% of stock returns (with the smallest IP) in each industry, then substract the industry return; the return difference is now multiplied by a weight, and these pooled to form the best 10% portfolios. In the equally-weighted portfolios, the weights are the same for each industry, i.e., the average of the return differences. In contrast, the weights in the value-weighted portfolios are percentages of the industries' capitalization to total capitalization.

Equations (3.8), (3.10), and (3.17) can be re-writed as follow:

CAPM,

$$\sum(R_{pt} - R_{bt})\,\omega_i = \alpha + \beta_1(R_{mt} - R_{ft}) + \varepsilon_t \qquad (3.21)$$

FF3F,

$$\sum(R_{pt} - R_{bt})\,\omega_i = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \qquad (3.22)$$

And Carhart model,

$$\sum(R_{pt} - R_{bt})\omega_i = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \varepsilon_t \qquad (3.23)$$

Where, in all three formulas,

R_{bt} = an industry benchmark portfolio return in month-t,

ω_i = an industry weight, either the averge of total numbers of industries or the proportional industry capitalisation.

The worst-in-class strategy is also applied, following the above procedure. The long-short portfolio is still the difference between the best and their counterpart worst portfolios.

3.5 Empirical Implementation

Tables 3-3 to 3-5 report the portfolio results, using corporate environmental/carbon data from year 2002 to year 2008, and matching one-year lag corporate financial data (returns) from year 2003 to year 2009, in order of US (3-3), UK (3-4), and EU excluding UK (EX) (3-5). Within each country/area results, tables are arranged in order of Impact Ratio (IP), First-Tier + Direct Emission Footprint (FF), Direct Emission Footprint (DF) and Carbon-Dioxide Emission Footprint (CF); each sub-sequence is sorted by different cut-offs, and arranged in order of 10%, 20%, 30% and 50%. Within each table set, Panels A to D display the portfolio results formed by equally-weighted, value-weighted, industry-adjusted equally-weighted (if available) and industry-adjusted value-weighted. For each panel, the first column is the name of the factor/parameter, columns 2-4 show the results of the CAPM model for the best performing portfolios, the worst performing portfolios and the long-short portfolios, respectively. In the same sequential, columns 5-7 comprise the results of the Fama-French Three Factors model, while columns 8-10 comprise the results of the Carhart Four Factors model (if available).

3.5.1 US

a. Environmental Screening & Equally-weighted results

Panels A in table 3-3-1 to table 3-3-4 exhibit the equally-weighted portfolio results benchmark to the risk-free rate, derived under the CAPM, FF3F and Carhart based framework, ranked by the environmental criterion, IP at 4 cut-off levels. Panel C shows the portfolio results benchmark to the industry peer group.

In the equally-weighted portfolios, if we compare the FF3F and CAPM result, both the best-in-class and worst-in-class results show a significant small company factor loading, which indicates that part of our portfolio returns are due to the compensation for this small-cap risk, which is, as past evidence indicates, the risk that is involved in most of the SRI portfolios stemming from their social responsible screening policies. Moreover, the Carhart model exhibits a significant negative momentum slope in both the best and worst results, which implies that both portfolios have bias towards the past 12-months 'losers'. Furthermore, the Adjusted R-square of the Carhart model is mostly higher than that of the FF3F model. Therefore, our following analysis for the equally-weighted portfolios will mainly focus on the Carhart results, if the results from FF3F and CAPM demonstrate no remarkable differences.

The best-in-class (better environmental performance) portfolios show insignificant outperformance when compared to the market proxy at all cut-off levels as indicated by the alphas; while the worst-in-class (worse environmental performance) portfolios are even better at low (10% and 20%) cut-off levels, however, they underperform at high levels (30% and 50%). Further, the market risk exposure (beta) is significantly lower than 1 in three out of four of the best portfolios, whereas all the worst portfolios have a market risk greater than 1. As to the market neutral strategy, market risk has been successfully eliminated in all of the hedging portfolios, which is reflected by the insignificant near-zero beta values. However, with insignificant and inconsistent performance difference (alpha) in these hedge portfolios, our equally-weighted results do not support the hypothesis that the best environmental performance self-constructed portfolios outperform the worst, under the environmental screening policy (impact ratio), in the US market.

In next paragraph, we are going to analyse the performance of the portfolios when compared to their industry benchmarks, applying an equal weighting. As we aforementioned, by targeting the industry benchmarks, we aim to remove the industry bias that may distort our results.

Although there is no significant momentum effect indicated by the Carhart model based on these industry-adjusted portfolios, we still focus on the four factors model, as the Adjusted R-square result demonstrates that it has the best explanatory power. The best portfolios do not exhibit any superior performance to the industry benchmark; neither do the worst portfolios, although at 10% cut-off, the worst portfolio slightly outperforms the benchmark, this performance experiences a sharp drop as the portfolios include more companies. When compared to their industry benchmarks, the large company effect dominates both the best and worst portfolios. Considering the composition of the industry benchmarks, we find that the industry portfolios consist of NYSE, AMEX, and NASDAQ stocks, in which both NYSE and AMEX are stock trading platforms for large companies with market capitalization above $50 million; however, NASDAQ has allowed listing companies with much smaller capitalization. With the above information, we can infer that our best and worst portfolios are comprised of relatively big companies within their industry, when we remove the industry bias. The best portfolios also display slightly lower market risk exposure, and growth-orientation; while their counterparts, on the contrary, display a slightly higher market risk exposure and a bias towards value companies. As to the hedge portfolios, neither economically nor statistically significant outperformance has been reported in our results.

Our results suggest that the best portfolios are more dependent on small-cap and growth companies than the worst portfolios. Particularly, when compared to the work of Dewell et al. (2005), we find that the significant alphas have disappeared in our research period, which indicates that the US market has already captured the environmental factor, hence there is no longer any existing outperformance or arbitrage opportunities.

b. Environmental Screening & Value-weighted results

To derive more detail about the environmental screening portfolios, we further analyse them by employing the value weighting approach. Though we admit that, with the value weighting, there is a bias towards large capitalization and mature companies, this approach is still a common way to construct portfolios. In the risk-free benchmarking results, as we expected, for the best-in-class strategy, the small company effect shows a decreasing trend as the portfolio includes more observations (that is, as the cut-off level rises); on the other hand, the worst-in-class portfolios show a bias towards large capitals. Even more interesting is that the best portfolios exhibit a significant growth bias, implied by the significant negative coefficients on the book-to-market factor; while the worst ones appear to be value-oriented. This is understandable, as most of the emerging industries, such as renewable energy and technology industries, have lower fuel consumption and lower emissions than those traditional heavy industries, but they are still in their business growing period with relatively small capitalizations and low book-to-market values. This effect has been shown in the equally-weighted portfolios; however, it is more significant in the results of the value-weighted portfolios. Furthermore, the negative momentum effect has been significantly promoted, especially with those worst portfolios, of which the coefficients are positive at 20% and 30% levels, though insignificant. The market risk exposure of the worst portfolios is remarkably reduced to less than 1; as a result, the hedge portfolios have a slight positive market risk. In respect of the hedge alphas, the results are mostly in accordance with the equally-weighted ones, without any significant alphas, which further confirm the no-outperformance conclusion.

The value-weighted industry benchmarking results are inconsistent in their size exposures, exhibiting a small cap effect at low cut-off levels, and a big cap effect at high levels. From the construction of our portfolios (we used the industry capitalization as the portfolio weighting), we can assume that large capitalizations are increasingly included at higher cut-off levels, while at 10% or 20%, the best and worst in terms of environmental performance are more likely to be the small companies. No other remarkable change has been shown in the value weighted results, except that we notice the worst portfolios have significantly low market exposure, and that the highest hedge alpha of 0.18% per month (or 2.18 per year) is found at the 30% cut-off, which is not an impressive result at all.

The value-weighted results further support the conclusion that no superior performance is generated by following the environmental screening policy.

c. Carbon Emissions Screening & Equally-weighted results

We have used three carbon emissions indicators, the first-tier supplier and direct carbon emissions (FF), which includes all kinds of GHG emitted by the company (scope 1) and their first tier suppliers (scope 2 and 3); the direct carbon emissions (DF) are all the GHGs emitted by the company (scope 1); and the carbon dioxide emissions (CF) are the carbon dioxide emitted by the company. The three measures are highly correlated, as indicated by our data.

For the US, however, there is no significant hedge portfolio performance under any of the screening criteria; hence, we briefly compare the performance under the three measures. While the Carhart model is still our major consideration, due to the highest Adjusted R-square level.

In line with the environmental results, there is no significant hedge profit at any cut-off levels, for the equally-weighted portfolios. Among all the 12 portfolios (3 measures, each with 4 cut-off levels), from the largest hedge alpha (positive) to the smallest (negative), none of the results is significant, i.e. neither profit nor loss.

As to the risk features of these carbon screening portfolios, the market risk exposure is significantly bigger in the best portfolios than in the worst portfolios according to the FF and DF measures; while in portfolios measured by CF, the situation tends to reverse. Larger capital orientation is exhibited in the best portfolios when compared to the worst portfolios, especially when measured using FF and DF or at high cut-off levels, which is a big difference when compared to the small-cap oriented best environmental portfolios. The value exposure appears to be growth biased in all the hedge portfolios without exception. While both the best and the worst tend to include significantly more past ‘losers’, the hedge portfolios appear to include more ‘winners’ at lower cut-off levels, especially when measured by CF. It is interesting to see that whenever the portfolio tends to include more winners, the excess return appears to be more positive.

To conclude the results of the equally-weighted portfolios performance, we can see that there is no significant outperformance resulting from any of the carbon screening policies, though the hedge portfolios under CF screening show more positive return and lower risk exposure in comparison. The slightly positive CF returns are not big enough to reverse the insignificant result when taken as a whole. Hence, we conclude that the equally-weighted best carbon performance self-constructed portfolios do not outperform their counterpart portfolios, under any of the carbon performance screening policies, based on the US stock market.

For further information on the industry-bias free performance, we run the regressions with the dependent variables benchmarked to the industry portfolios, which, in the case of the US, is formed by both equally-weighted and value-weighted approaches.

The hedge performances measured by the excess returns to the industry equally-weighted portfolios float around zero when applying the FF and DF screening policies, whereas these excess returns exhibit positive, though insignificant trend when the CF criterion is applied. Further, we find that most of these positive excess performances are due to the inferior performance of the worst portfolios when compared to their industry benchmarks, but not the result of the superior performance in the best portfolios, which also slightly underperform their industry benchmarks in most of the cases.

Moreover, both of the best and worst carbon portfolios have greater exposure to market risk factors than their industry peers. In comparison to the worst group, the best group assumes even more risk. The size factor and momentum factor effect have been both significantly reversed due to the introduction of the industry benchmark. In contrast to the small-cap effect over the risk-free benchmark, both groups indicate significant large-cap bias over the industry peer group, with the best group appearing to be larger (in absolute value) at higher cut-offs, when measured by FF and DF. While both portfolios are dominated by the ‘winners’ effect now, the best ones tend to include more winners when measured by CF. The value factor effect has been enhanced by the industry benchmarking result; the best ones have greater exposure to growth companies and the worst ones tend to be value-oriented, which, in combination, results in growth-oriented hedge portfolios in all 12 cases.

Taken as a whole, the equally-weighted industry benchmarking approach further supports the insignificant and no-outperformance conclusion, even though the best excess return was shown to reach 0.19% per month (i.e.2.3% per year) insignificantly.

To sum up, the best carbon performance self-constructed equally-weighted portfolios do not outperform their counterpart portfolios, when benchmarking to the risk-free rate or to the industry peers, under any of the carbon performance screening policies, based on the US stock market.

d. Carbon Emissions Screening & Value-weighted results

For further information on the value-weighted performance, we form the portfolios under the value-weighted approaches as well, and run the regressions with the dependent variables benchmarked to both the risk-free assets and the industry portfolios.

The risk-free benchmark value-weighted portfolios, on the other hand, demonstrate even more negative returns when utilising the hedging strategy, except at the 30% and 50% cut-off levels. The DF screened portfolios show a significant (at 90% confidence interval) negative return of -0.35% per month (i.e. -4.12% per year) at the 20% cut-off levels, however, this negative return is neither consistent at other cut-off levels, nor robust when applying other carbon criteria. In respect of the characters of the other portfolios, the value-weighted portfolios exhibit more consistence as implied by the factor exposures of the hedge portfolios: the consistent positive market risk exposure, the big-cap bias (significant in some cases), the growth-orientation (the only exception being at 10% cut-off, DF), and the ‘loser’ preference (the only exception at 10% cut-off, CF). These findings further support the no-outperformance conclusion derived from the equally-weighted approach.

Among the industry-adjusted value-weighted portfolios, though the FF and DF screened portfolios support the previous conclusion, however, an interesting result appears in the CF screened portfolios. At the two higher cut-off levels, 30% and 50%, the best portfolios tend to outperform the worst ones in excess of 0.3% and 0.25% per month, respectively. Especially, at the 50% level, the outperformance is statistically significant. These results, if we look at both sides of the hedge portfolios, are derived by the significant underperformance of the worst portfolios rather than the outperformance of the best portfolios. Hence, we assume that these hedge profits are due to some extreme underperformers (companies with greater of carbon dioxide emissions) at the third and fourth quintile when ranking by CF; while when we rank by FF or DF, these extreme underperformers happen to be assigned to the best portfolios instead. However, these two portfolios alone are not enough to change our entire view about the US carbon screened market, which, in total, shows no significant outperformance.

In conclusion, the financial market results of the US carbon screening market, using the equally-weighted and value-weighted approach, and when benchmarked to either the risk-free rate or the industry peer group, show that the best carbon performance group does not outperform the worst carbon performance group, in general. Further, the best carbon performance group exhibits more market risk exposure than its counterpart group, though other risk features (size, book-to-market and momentum) are variable due to the adoption of different cut-off levels, weighting and benchmarking approaches (e.g. the better carbon groups tend to exhibit growth bias compared to the worse carbon groups at lower cut-off levels, and the better carbon groups are exposed to more small cap risk than the worse carbon groups using value-weighting and risk-free rates as benchmarks, while in terms of momentum risk, both groups are dominated by ‘loser’ effects when the latter is again applied, i.e. tend to include past 12-month ‘losers’ more than ‘winners’).

3.5.2 UK

a. Environmental Screening & Equally-weighted results

Table 3-4-1 to table 3-4-4 exhibit the UK environmental screening results. Panel A represents the equally-weighted portfolio results benchmarked to the risk-free rate, derived using the CAPM, FF3F and Carhart frameworks, ranked by the environmental criterion, IP at four cut-off levels.

For the UK, we still focus on the Carhart four factors model, which has been shown to have the greatest explanatory power. Results at 10% and 20% cut-off levels (panel A in table 3-4-1 and table 3-4-2) show that the better environmental groups generates excess profits over the market proxy, while their counterparts outperform less or even lose out to their benchmark, hence a long-short strategy gains significant positive returns for investors, as well as bearing less market risk (e.g. at the 10% cut-off investors can earn 0.64% per month, i.e. 7.96% per year). These results are robust as indicated by the Fama-French and CAPM model. However, as we increase the number of companies in both portfolios, these significantly superior performances disappear, instead, an insignificant alpha is found at the 30% cut-off hedge portfolio, and the result is even worse in the 50% cut-off hedge portfolio. These can be understood in these terms: when we increase the stock numbers in each of the portfolios, we assign the medium environmental ranking stocks into either side of the two groups, resulting in the elimination of the advantage of the better environmental performance group, on the other hand, improving the result of the group with worse environmental performance. Hence the hedge performance tends to be neutral.

As to the other features of the equally-weighted portfolios, our result reports a small-cap effect in the better environmental group, though both groups show significant positive exposure to small-cap companies; the better environmental group is also more exposed to growth companies (low book-to-market companies). The momentum effect is not significant on either side of the groups, but the better environmental group tends to include more past ‘winners’ (positive momentum factor exposure), while their counterparty group includes more ‘losers’ (negative momentum factor exposure).

As we use DataStream industry returns, which are value-weighted, and we have no proper equally-weighted industry index index available, we cannot search for further support for the equally-weighted portfolios result using an approach free of industry-bias.

b. Environmental Screening & Value-weighted results

Table 3-4-1 to table 3-4-4 also report the UK environmental screening value-weighted results. Panel B represents the value-weighted portfolio results benchmarked to the risk-free rate, while Panel C exhibits the value-weighted portfolio results benchmarked to the industry index. Results are derived using the CAPM, FF3F and Carhart frameworks, ranked by the environmental criterion, IP at four cut-off levels.

When we weight the portfolios according to the capitalizations of each firm, the significant positive abnormal returns in the equally-weighted approach long-short portfolios are replaced by negative returns (Panel B table 3-4-1 to 3-4-4, insignificant at the 10% and 20% cut-off levels, significant at the 30% and 50% cut-off levels). This significant change is also supported by the Fama-French and CAPM results. Presumably, this change is due to the small-cap effect inherent to the better environmental portfolios. Once we allocate the portfolios in proportion to market capitalization, the small companies will be afforded much less weight when compared to the equally-weighted portfolios, consequently, the small-cap effect is weakened as well. Furthermore, the value-weighting allocation also changes the market risk exposure of the two groups, as indicated by the long-short portfolios results, which now have a positive hedge beta at 10% and 20% cut-offs, insignificantly. The growth company bias and the ‘winner’ momentum effect have been mostly reversed, when compared to the equally weighted portfolios. As a result, the hedge portfolio is increased in value by the value-company effect of the better environmental portfolios, whereas costs are generated due to the ‘winner’ effect in the worse environmental portfolios. Though, none of these factors has significant impact in the long-short strategy.

In line with the US, we are going to analyse the performance of portfolios in comparison to their industry benchmarks; however, we restrict ourselves to the value weighting approach. While the industry benchmark value-weighted returns are accessible from DataStream, no equally-weighted industry returns are available on DataStream. Hence, we focus only on the industry-adjusted value-weighted portfolios.

When compared to their industry benchmark, the best group appears to be more risky, while less profitable than the worst counterpart with a significant underperformance found at 30% and 50% cut-offs (return difference is around

0.5% per month). The return performances largely support the risk-free benchmarking results; however, the risk characters exhibit some variation.

The result indicates that the size effect has been mostly reversed in the worse environmental performance group, showing that the worst group has a large-cap bias comparing to their industries. In terms of the value factor, all of the worst portfolios and the three best portfolios exhibit growth-orientation, which further confirms our belief that SRI portfolios place more emphasis on small capitalization and growth companies. The best portfolios indicate consistent and more positive momentum factor exposures, compared to their industry benchmarks and worst counterparts, which is more convincing.

The UK industry-adjusted results cannot be used to generate arbitrage returns, however, they can be used to prove a number of ideas: firstly, that the value-weighted approach leads to inferior performance of the hedge portfolio, this is because increased weighting on value and large-cap stocks, which violates the inherent nature of the SRI portfolios. Secondly, the value-weighted approach reverses the exposure to systematic risk and value-orientation in the best portfolios. Finally, the value-weighted approach largely reduces the best portfolios' exposure to the small-cap stocks.

c. Carbon Emissions Screening & Equally-weighted results

By screening the portfolios under each of the carbon criteria (FF, DF, and CF), and applying the equal weighting approach, we construct 12 portfolios. We are going to analyse the performance of the portfolios under all three carbon criteria and explore the best strategies for UK market investors.

For the UK, we will also focus on the results using the Carhart model since it has the strongest explanatory power. At lower cut-off levels, while the equally-weighted environmental portfolios indicate significant excess profit opportunity, the performance of the equally-weighted carbon portfolios are even better. At 10% cut-off, the hedge portfolio generates a profit of 0.95% per month (i.e. 12.01% per year) under the FF screening policy, and earns excess returns of 0.50% and 0.56% per month under the DF and CF screening policies, respectively; all of these are statistically significant. These remarkable results are mostly due to the superior performance from the best carbon portfolios.

Also, we notice that these profit opportunities are mild, and are eventually diminished, as the cut-off level increases, i.e. including more stocks into each side the portfolios. We report a significant negative return (-0.25% per month at 90% confidence interval) at 50% cut-off-level, under FF criterion.

To summarize the best and worst carbon portfolios; the best ones are defined by lower market risk exposure (market beta less than 1), small-cap orientation and strong outperformance over the risk-free assets at all cut-off levels; while the worst ones are defined by higher market risk exposure (market beta greater than 1) and small-cap orientation. The worst portfolios also demonstrate strong outperformance over the risk-free assets at 20%, 30% and 50% cut-off levels, which may explain the diminishing profit opportunities of the hedge portfolios at high cut-off levels.

The UK market is operating under constraints from both the EU ETS and the UK CCL. We note that the UK CCL offers the energy-intensive sectors tax deductions. The superior financial market performance of the top 10% carbon emissions companies may be attributed to these tax advantages.

As to the risk characteristics, the best portfolios exhibit significantly less market risk than their counterpart portfolios under the FF screening policy, though this feature becomes less significant under the DF and CF screening policies. Both the best and worst portfolios are biased towards small capitalization; however, the hedge portfolios do not indicate a consistent preference on size factor exposure. Most of the hedge portfolios are defined by growth orientation. Further, the hedge portfolios tend to include more ‘losers’ at lower cut-off levels, but more ‘winners’ at higher cut-offs.

Taken as a whole, the profitable portfolios at the 10% cut-off level, formed by equal weighting and adjusted by the risk-free rate, are defined by negative market risk exposure, growth-oriented and ‘loser’ preference. This result somewhat supports the view that the best carbon performance portfolio can outperform the worst ones in the UK market.

As we do not have a proper equally-weighted industry index available, we cannot search further support for the equally-weighted portfolios without industry bias.

d. Carbon Emissions Screening & Value-weighted results

Although the equally-weighted approach provides us the evidence of arbitrage opportunities for the UK market, the value-weighted risk-free-adjusted portfolios do not show any chance of generating excess profit. In fact, the value-weighted approach removes all the advantages of the best portfolios by assigning greater weight to large capitalizations. The hedge portfolio even incuers a loss of 0.53% per month excess return at 30% cut-off, under the FF screening policy, though this negative return is not consistently significant. Hence, we conclude that the carbon screening policy do not generate arbitrage profit by employing the value-weighted portfolios. Further, for the UK market, portfolio returns are sensitive to the weighting method.

Compared to the equally-weighted hedge portfolios, the value-weighted ones show negative market risk exposure as well, and mostly maintain the momentum preference for 'losers'. Not surprisingly, most of the hedge portfolios are now marked as large-capital and value-oriented due to large-cap company effects.

Furthermore, we analyse the industry-adjusted value-weighted portfolio performance, and find that the results are consistent with the risk-free-adjusted value-weighted results: negative excess returns at all levels, except where there is slightly positive return at the 10% cut-off, under the DF screening policy. The only significant returns appear to be -0.53% and -0.32% per month at the 30% and 50% cut-off levels, under the FF screening policy, which show the significantly inferior performance of the best carbon portfolio. The results strongly approve the value-weighted risk-free benchmarked return, which is coincidently -0.53% per month.

When benchmarked to their industry index, the market risk exposures are inconsistent within the 12 hedge portfolios. However, most of the hedge portfolios can be labelled with small-cap, growth-orientation and 'winner' preference.

To conclude, for the UK, the value-weighted approach leads to nothing but an inferior performance of the hedge portfolios, while the equally-weighted portfolio does produce significant excess returns at lower cut-off levels. Therefore, the results for the UK are sensitive to weighting and that they are to a degree attributable to industry effects.

3.5.3 EU excluding UK

In this section, we use the EU conception to identify the European Union member states, excluding the UK. Our data period ranges from January 2002 to December 2008, 84 months in total. As we have already mentioned, we will mainly focus on the Fama-French model in this section, since it is beyond the scope of the research to construct the momentum factor for this data set, and similar results can be derived from the three factors model. Also, recall that the risk factors are formed in a different way, as described above.

Market risk factor: R_{eu}

Size factor:

$$SCR = R_{small\_cap} - R_{eu} \tag{3.24}$$

Book-to-market factor:

$$VG = R_{value} - R_{growth} \tag{3.25}$$

a. Environmental Screening & Equally-weighted results

Table 3-5-1 to table 3-5-4 display the EU environmental screening results (excluding the UK). Although both of the equally-weighted portfolios with better and worse environmental performance yield significantly positive returns at 20%, 30% and 50% cut-off levels (Panel A in table 3-5-2 to table 3-5-4), none of the hedge portfolios has any significant outperformance. As for the market risk exposure, all equally-weighted portfolios exhibit slightly less risk than the market index, except the better environmental performance portfolio at 10% cut-off, which has a market beta equal to 1. These findings are fairly robust as implied by consistent results using the CAPM model.

Further, both of the best and worst equally-weighted portfolios have significant bias towards the size factor that was chosen, which is describe above; in comparison, the group with better environmental performance carries more small-cap risk than their counterpart group at lower cut-off levels. Moreover, the better environmental performance group is more growth-oriented than the worse environmental performance group, indicated by the value factor exposure of the hedge portfolio.

b. Environmental Screening & Value-weighted results

To examine the sensitivity of portfolios to weighting schemes, we form value-weighted risk-free-adjusted portfolios for the EU stocks as well. The results (Panel B in table 3-5-1 to table 3-5-4) are in line with those equally-weighted portfolios in terms of excess returns, as indicated by the insignificant and unstable excess hedge alphas. Examining the risk factors, we find a negative market risk exposure is reported in the hedge portfolios at lower cut-off levels. While the small-cap bias remains in the value-weighted hedge portfolios, these portfolios demonstrate value-oriented bias, in contrast to their equally-weighted counterpart portfolios. As a matter of fact, these results reflect the weakness of the value weighting approach, which always places more emphasis on the large capitals, and in our case, the value companies too.

Value-weighted hedge results mostly perform worse than the equal-weighted results in terms of excess returns in our examination, with the only exception being at the 30% cut-off level; this differentiation to some extent implies the significant influence of the effect of small capitalization and growth companies in our portfolios, especially in the portfolios with best environmental performance.

Using a similar approach to the UK results, we are going to analyse the performance of the EU portfolios relative to their industry benchmarks and focus on the industry-adjusted value-weighted portfolios only, where the industry benchmark return is a set of value-weighted portfolios from DataStream.

Although the excess returns of the hedge portfolios are consistent with the risk-free benchmarked results, both the better and the worse environmental groups underperform their industry benchmarks, so with the hedge returns are, it is a matter of considering which group is worse. At 30% cut-off, both performances are closest to their industry benchmarks, however, returns largely deteriorate at other cut-off levels, especially at the 10% level, though none of them statistic significant.

Considering the hedge portfolios performance in the risk-free benchmarked equally-weighted and value-weighted portfolios, these results further support the view that the favouring environmental performance will not earn profit in the EU market.

As to the other features of the industry-adjusted portfolios, the best group assumes less systematic risk and has a smaller cap orientation in most of the cases, when compared to their worst counterparts. Also, in the best group, growth bias is more readily identified at lower cut-off levels, while value companies dominate at higher levels; the worst group are more exposed to growth companies than their industry benchmarks at all levels.

No doubt the conclusion for the EU market is that an environmentally friendly strategy is unprofitable. This finding is contrary to the Ziegler et al. (2007) result, where they find a positive relationship between companies environmental and stock performance at industry level, for the test period 1996 to 2001. As our data ranges from 2002 to 2008, we assume that the situation has already changed in the EU market.

c. Carbon Emissions Screening & Equally-weighted results

Table 3-5-5 to table 3-5-16 report the EU carbon screening result. Panel A represents the equally-weighted portfolio results benchmarked to the risk-free rate, derived under the CAPM and FF3F based frameworks, at different cut-off levels.

As before, we will mainly discuss the FF3F results in the following two sections. Focusing on the return performance, we find that unlike the UK, where significant return performance can be found only at the lowest cut-off levels, in the EU, the significant profit opportunities can be find at 10%, 20% and 30% cut-off levels, under the DF and CF screening policy. This difference can be attributed to many factors, including the implementation of the EU ETS.

The biggest arbitrage opportunity is derived from the hedge portfolio at the 10% cut-off under the DF criterion, which is 0.54% per month (I.e. 6.68% p.a.). The significant excess returns are mostly due to the superior performance from the best carbon group, rather than the inferior performance the worst carbon group. However, we also discover that the excess returns of the best carbon group decrease in value (but not significance) with increasing cut-off levels, while the excess returns of the worst carbon group rise at the same time. These effects, in return, result in diminishing arbitrage opportunities for the hedge portfolio. On the other hand, the excess returns under the FF criterion are positive, but show neither economical nor statistical significance.

As to the risk features, under the DF and CF criteria, the hedge portfolios tend to have negative market risk exposure, and are big-cap and growth oriented at the two lower cut-offs, however, these characteristics are inverted at the two higher cut-offs. Under the FF criterion, the hedge portfolios display the negative market risk exposure and small-cap orientation; however, they perform inconsistently in terms of the value factor.

According to the equally-weighted results, the conclusion for the EU market is that it is profitable under the DF and CF screening policy, due to the implementation of the EU ETS. However, as there is no equally-weighted industry index, we cannot perform the regression based on the industry-adjusted portfolios to further support the risk-free-adjusted results.

d. Carbon Emissions Screening & Value-weighted results

The value-weighted results again remove the significantly positive performances of the equally weighted results, instead, replacing the excess returns of the hedge portfolios with negative results under the FF, and replacing the excess returns of the hedge portfolios with positive but insignificant results under the DF and CF. Most of the hedge portfolios reserve the negative market risk exposure and are value-stock oriented. The size factor exposure tends to be biased towards small-cap at the lowest cut-off, but towards big-cap at higher cut-offs.

Returns from the value-weighted industry-adjusted portfolios are in line with the risk-free benchmarked ones. The hedge returns become negative under the FF screening policy, while remain positive and economically large under the DF and CF screening policies. However, we notice that both the best and the worst carbon portfolios underperform their industry benchmarks, which means the positive returns are more due to the inferior performance of the worst carbon portfolios. Though most of the hedge portfolios retain negative market risk exposure, the other risk features of the hedge portfolios are varying and insignificant.

In conclusion, for the EU carbon screening market, the weighting approach has a significant impact on the result; the portfolio formed by equally-weighted approach generates significant arbitrage profit under the DF and CF criteria, while no arbitrage opportunity was found using the value-weighted approach, when benchmarked to either the risk-free rate or the industry peer group.

3.6 Conclusion

Our portfolio study examines the relationship between corporate carbon emission performance over the time period of 2002 to 2008, i.e. 84 months, and their financial market performance, with respect to stock returns over the time period of 2003 to 2009.

In order to examine the possible financial market effects in relation to the relative corporate carbon emissions quantities, we consider different carbon criteria and one environmental criterion at different cut-off levels, for three major parties engaged in international climate change policy, the US, UK and EU. Methodologically, we form equally-weighted portfolios, as well as value-weighted portfolios. To estimate the corresponding risk-adjusted returns, we apply the CAPM, FF3F and Carhart four factors model; however, we mainly focus on the Carhart (FF3F) results for US and UK (EU), as this model provides the greatest explanatory power. Moreover, to avoid the industry-bias, we further introduce the industry-adjusted portfolio, and perform the regressions over these industry-adjusted portfolios. We adopt a trading strategy of buying the stocks of corporations with relatively lower carbon emissions and selling the stocks of corporations with relatively higher carbon emissions. The portfolio's financial market performance is measured by the returns difference.

Having performed the regression study over the different carbon policy regimes, we summarize our findings as follows:

1. Financial markets react differently according to whether there are government enforced carbon constraints or not.
2. Financial markets react to particular carbon criteria according to the special emphasis that is reinforced by the different carbon policy regimes.

3. The different portfolio constructions lead to various results, where the equally-weighted portfolios always have better performance than the value-weighted portfolios.
4. The results generated at different cut-off levels can be varied, while higher performance, if present, is more commonly found at lower cut-off levels.
5. Market anomalies exist in the UK market under both the environmental (IP) and carbon screening policies (FF, DF and CF); while in the rest of the EU market, these anomalies exist under the carbon screening policy only (DF and CF); by contrast, market anomalies do not exist in the US market.
6. The long-short strategy generates more returns for the UK market than the rest of the EU markets; therefore, we do not reject the hypothesis a1. Further, the long-short strategy generates no return for the US market; therefore, we do not reject the hypothesis b1.

Comparing to the only former portfolio study, Ziegler et al. (2009), which contributes the finding that firms with higher level climate change disclosure firms have slightly more positive stock performance in regions and periods with a greater institutional pressure, we find further significant evidence that indicates the positive relationship between a firm's stock performance and its carbon dioxide emission quantities in a strict climate policy regime.

For investors, holding the better carbon performance portfolios, selling the worse carbon performance portfolios, and reforming these portfolios every year, can make them a profit in UK and EU markets. In these investments, we suggest that carbon emissions might be used as proxies for the corporate governance or management efficiency, but not only emission screening criteria, which further comfirm why hypothesis a1 and b1 cannot be rejected.

Regarding the investor's perspective, our results suggest that a market premium can be earned by investing in corporations with lower levels of carbon emissions within more ambitious climate policy regimes. However, since general awareness of global warming is further increasing in Europe, the market may gradually realize the existence of such anomalies, which will diminish as a result. Further studies are required to examine this relationship with the most up to date data.

3.7 Discussion

Although our portfolio study has reviewed the market expectations of carbon emissions information from corporations, there are some drawbacks to this approach. Firstly, financial market based portfolio analysis reflects market anticipation in respect to stock returns, however, we could not determine whether the underlying companies had materialized increases in the firm's value in accordance with their reduced carbon emissions quantities, that is we cannot judge the relationship between company financial performance and company carbon performance at portfolio level. Secondly, regarding the EU ETS, criticism (e.g. Sépibus, 2007) points out several failings, including over-allocation[29], windfall profits[30], price volatility, and in general, failing to meet its goals; which also raises the question in our portfolio analysis: is the increase in firm value due to the reduction of carbon emissions or as a result of extra profit from one of these policy vulnerabilities. Equivalently, in the US market, we have a similar question, has the firm reduced its carbon emissions by taking proactive steps, or has it only made some passive reactions, such as end-of-the-pipe treatment, being afraid of more stringent government regulation or with the purpose of catching the attention of the general public. Thirdly, we cannot use the portfolios analysis to determine whether a firm's systematic risk and/or specific risk (Gregory, Whittaker and Yan, 2011) has been affected by the actions taken to reduce carbon emissions. For a further insight into these

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[29] Over-allocation refers to that too many emissions allowances have been issued by the EU governments because the system's initial caps and emissions allowance allocation based on estimates of regulated entities' emissions rather than on actual historical emissions data. http://www.edf.org/sites/default/files/EU_ETS_Lessons_Learned_Report_EDF.pdf

[30] Windfall profit is defined as the revenue that accruing to thermal power generation if the additional revenue earned from the pass-through of CO_2 (opportunity) costs to power prices exceeds the level of compliance costs incurred under that scheme by thermal generators. http://www.wwf.org.uk/filelibrary/pdf/ets_windfall_report_0408.pdf

questions, we are going to investigate the CFP-CCP relationship at firm level in the next two chapters.

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Table 3-1-1 Summary Number of Companies for Each Market.

observations	2002	2003	2004	2005	2006	2007	2008	Total
US	429	647	741	868	889	919	701	5194
UK	315	334	364	374	411	433	377	2619
EU	297	321	387	436	458	480	298	2677

Company numbers are after adjusted for missing values.

Table 3-1-2 Summary Correlation between Environment/Carbon Information, US

	IP	FF	DF	CF
IP	1.0000			
FF	0.4003	1.0000		
DF	0.4421	0.9910	1.0000	
CF	0.4551	0.9831	0.9931	1.0000

Table 3-1-3 Summary Correlation between Environment/Carbon Information, UK

	IP	FF	DF	CF
IP	1.0000			
FF	0.5890	1.0000		
DF	0.4997	0.9760	1.0000	
CF	0.4413	0.9554	0.9825	1.0000

Table 3-1-4 Summary Correlation between Environment/Carbon Information, EX

	IP	FF	DF	CF
IP	1.0000			
FF	0.4557	1.0000		
DF	0.4376	0.9860	1.0000	
CF	0.4265	0.9778	0.9911	1.0000

IP- impact ratio, equals to the Total Environmental Damage Cost divided by company's sales. FF- first-tier + direct footprint, includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); DF- direct footprint, includes CO2e emission from direct emission (scope 1); CF-carbon footprint, includes Carbon Dioxide (no equivalent) from direct emission (scope 1). Footprint equals to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's sales (in terms of billion dollars).

Table 3-2-1 Summary Environment/Carbon Information, US

Variable	Obs	Mean	Std. Dev.	Median	Min	Max	Skewness	Kurtosis
IP	5194	0.0607	0.2092	0.0184	0.0022	4.9645	14.5654	289.4808
CF	5194	0.5210	1.5245	0.0950	0.0041	17.8004	5.8265	43.8224
DF	5194	0.3877	1.4398	0.0212	0.0000	16.8136	6.1101	47.1639
FF	5194	0.3537	1.3943	0.0182	0.0000	16.5117	6.3154	49.4835

Table 3-2-2 Summary Environment/Carbon Information, UK

Variable	Obs	Mean	Std. Dev.	Median	Min	Max	Skewness	Kurtosis
IP	2608	0.0426	0.1109	0.0135	0.0023	1.7429	7.1722	72.7241
FF	2608	0.2744	0.9482	0.0853	0.0027	23.5996	13.2673	233.3963
DF	2608	0.1549	0.8885	0.0177	0.0000	23.2222	14.9442	280.6042
CF	2608	0.1303	0.8565	0.0161	0.0000	23.1308	16.1799	317.2993

Table 3-2-3 Summary Environment/Carbon Information, EX

Variable	Obs	Mean	Std. Dev.	Median	Min	Max	Skewness	Kurtosis
IP	2677	0.0512	0.1376	0.0183	0.0022	2.7541	12.0832	203.1053
FF	2677	0.4629	1.1543	0.0921	0.0025	12.6929	4.9997	32.7195
DF	2677	0.3141	1.0125	0.0170	0.0000	11.9504	5.3707	37.2923
CF	2677	0.2895	0.9864	0.0153	0.0000	11.5777	5.5739	39.2949

IP- impact ratio, equals to the Total Environmental Damage Cost divided by company's sales. FF- first-tier + direct footprint, includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); DF- direct footprint, includes CO2e emission from direct emission (scope 1); CF-carbon footprint, includes Carbon Dioxide (no equivalent) from direct emission (scope 1). Footprint equals to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's sales (in terms of billion dollars).

Table 3-3-1 Portfolio Return Regressions on US IP, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.1289***	1.2975***	-0.1686***	1.0232***	1.1947***	-0.1714**	0.9560***	1.1026***	-0.1466*
	(0.0475)	(0.0583)	(0.0596)	(0.0479)	(0.0655)	(0.0683)	(0.0484)	(0.0661)	(0.0741)
smb				0.4632***	0.2640**	0.1992*	0.4816***	0.2892***	0.1925
				(0.0840)	(0.1149)	(0.1197)	(0.0785)	(0.1073)	(0.1201)
hml				0.0190	0.2101*	-0.1911*	-0.0515	0.1137	-0.1651
				(0.0788)	(0.1078)	(0.1123)	(0.0760)	(0.1039)	(0.1163)
mom							-0.1286***	-0.1761***	0.0475
							(0.0355)	(0.0486)	(0.0544)
_cons	0.0023	0.0030	-0.0007	0.0010	0.0020	-0.0010	0.0009	0.0019	-0.0010
	(0.0021)	(0.0026)	(0.0027)	(0.0019)	(0.0025)	(0.0027)	(0.0017)	(0.0024)	(0.0027)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8718	0.8563	0.0779	0.9048	0.8677	0.1174	0.9173	0.8851	0.1148
F	565.47	495.50	8.02	264.07	182.46	4.68	231.28	160.89	3.69

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0609***	0.9809***	0.0800	1.0054***	0.9721***	0.0333	0.9602***	0.9492***	0.0110
	(0.0585)	(0.0406)	(0.0772)	(0.0623)	(0.0475)	(0.0836)	(0.0666)	(0.0513)	(0.0909)
smb				0.4358***	-0.0587	0.4945***	0.4481***	-0.0525	0.5006***
				(0.1092)	(0.0833)	(0.1466)	(0.1080)	(0.0833)	(0.1475)
hml				-0.1872*	0.1015	-0.2887**	-0.2346**	0.0775	-0.3121**
				(0.1024)	(0.0781)	(0.1375)	(0.1045)	(0.0806)	(0.1428)
mom							-0.0865*	-0.0438	-0.0427
							(0.0489)	(0.0377)	(0.0668)
_cons	0.0026	0.0022	0.0004	0.0017	0.0022	-0.0005	0.0016	0.0022	-0.0005
	(0.0026)	(0.0018)	(0.0035)	(0.0024)	(0.0018)	(0.0032)	(0.0024)	(0.0018)	(0.0033)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7981	0.8754	0.0009	0.8333	0.8757	0.1446	0.8376	0.8762	0.1383
F	329.15	584.13	1.07	139.27	195.88	5.68	108.01	147.89	4.33

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Longshort	Best	Worst	Longshort	Best	Worst	Longshort
mktrf	-0.1305**	0.0228	-0.1533**	-0.0565	0.0987	-0.1552**	-0.0219	0.1066	-0.1284*
	(0.0518)	(0.0648)	(0.0582)	(0.0589)	(0.0712)	(0.0669)	(0.0634)	(0.0776)	(0.0725)
smb				-0.2567**	-0.4415***	0.1847	-0.2662**	-0.4436***	0.1774
				(0.1033)	(0.1249)	(0.1173)	(0.1029)	(0.1259)	(0.1176)
hml				-0.0827	0.0979	-0.1806	-0.0464	0.1062	-0.1526
				(0.0969)	(0.1171)	(0.1100)	(0.0996)	(0.1219)	(0.1139)
mom							0.0663	0.0151	0.0512
							(0.0466)	(0.0570)	(0.0533)
_cons	-0.0019	-0.0010	-0.0009	-0.0010	0.0001	-0.0011	-0.0010	0.0001	-0.0011
	(0.0023)	(0.0029)	(0.0026)	(0.0023)	(0.0028)	(0.0026)	(0.0023)	(0.0028)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0606	-0.0107	0.0668	0.1136	0.1108	0.1016	0.1247	0.1003	0.1007
F	6.35	0.12	6.94	4.54	4.45	4.13	3.96	3.31	3.32

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Longshort	Best	Worst	Longshort	Best	Worst	Longshort
mktrf	-0.0307	0.0529	-0.0836	-0.0618	0.0277	-0.0895	-0.1056*	0.0103	-0.1159
	(0.0448)	(0.0403)	(0.0572)	(0.0522)	(0.0475)	(0.0676)	(0.0555)	(0.0515)	(0.0733)
smb				0.1506	0.0811	0.0695	0.1626*	0.0859	0.0767
				(0.0916)	(0.0832)	(0.1186)	(0.0899)	(0.0835)	(0.1189)
hml				-0.0093	0.0348	-0.0440	-0.0552	0.0166	-0.0718
				(0.0859)	(0.0780)	(0.1112)	(0.0871)	(0.0808)	(0.1151)
mom							-0.0839**	-0.0332	-0.0506
							(0.0407)	(0.0378)	(0.0539)
_cons	0.0019	0.0032*	-0.0013	0.0016	0.0029	-0.0014	0.0015	0.0029	-0.0014
	(0.0020)	(0.0018)	(0.0026)	(0.0020)	(0.0018)	(0.0026)	(0.0020)	(0.0018)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0064	0.0086	0.0135	0.0023	-0.0017	-0.0048	0.0412	-0.0046	-0.0063
F	0.47	1.72	2.14	1.06	0.95	0.87	1.89	0.91	0.87

Table 3-3-2 Portfolio Return Regressions on US IP, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.1089***	1.2168***	-0.1080**	1.0374***	1.1180***	-0.0806	0.9610***	1.0412***	-0.0802
	(0.0365)	(0.0465)	(0.0477)	(0.0376)	(0.0508)	(0.0549)	(0.0343)	(0.0506)	(0.0598)
smb				0.3364***	0.2719***	0.0645	0.3573***	0.2929***	0.0644
				(0.0658)	(0.0890)	(0.0963)	(0.0556)	(0.0820)	(0.0971)
hml				-0.0108	0.1833**	-0.1942**	-0.0909*	0.1029	-0.1938**
				(0.0618)	(0.0835)	(0.0903)	(0.0538)	(0.0795)	(0.0940)
mom							-0.1462***	-0.1469***	0.0007
							(0.0252)	(0.0372)	(0.0440)
_cons	0.0012	0.0018	-0.0006	0.0003	0.0007	-0.0005	0.0002	0.0007	-0.0005
	(0.0016)	(0.0021)	(0.0022)	(0.0015)	(0.0020)	(0.0021)	(0.0012)	(0.0018)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9175	0.8920	0.0473	0.9363	0.9059	0.0817	0.9548	0.9204	0.0701
F	924.66	686.20	5.12	407.70	267.30	3.46	439.42	241.04	2.56

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9764***	0.8122***	0.1641**	0.9732***	0.8189***	0.1543**	0.9148***	0.8220***	0.0928
	(0.0482)	(0.0327)	(0.0641)	(0.0534)	(0.0376)	(0.0701)	(0.0556)	(0.0410)	(0.0742)
smb				0.2246**	-0.1126*	0.3372***	0.2405***	-0.1134*	0.3540***
				(0.0935)	(0.0660)	(0.1228)	(0.0902)	(0.0665)	(0.1204)
hml				-0.2153**	0.0841	-0.2994**	-0.2765***	0.0873	-0.3638***
				(0.0878)	(0.0619)	(0.1152)	(0.0873)	(0.0644)	(0.1166)
mom							-0.1116***	0.0059	-0.1175**
							(0.0408)	(0.0301)	(0.0545)
_cons	-0.0003	0.0017	-0.0020	-0.0005	0.0019	-0.0024	-0.0006	0.0019	-0.0025
	(0.0022)	(0.0015)	(0.0029)	(0.0021)	(0.0015)	(0.0027)	(0.0020)	(0.0015)	(0.0027)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8315	0.8815	0.0627	0.8495	0.8854	0.1849	0.8607	0.8840	0.2204
F	410.60	618.70	6.55	157.13	214.76	7.27	129.25	159.14	6.87

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.1478***	-0.0554	-0.0923**	-0.0426	0.0226	-0.0652	-0.0184	0.0455	-0.0639
	(0.0445)	(0.0580)	(0.0462)	(0.0463)	(0.0627)	(0.0533)	(0.0500)	(0.0680)	(0.0581)
smb				-0.3832***	-0.4362***	0.0530	-0.3899***	-0.4425***	0.0526
				(0.0812)	(0.1099)	(0.0935)	(0.0811)	(0.1103)	(0.0943)
hml				-0.0985	0.0824	-0.1809**	-0.0731	0.1064	-0.1795*
				(0.0762)	(0.1031)	(0.0877)	(0.0785)	(0.1068)	(0.0913)
mom							0.0465	0.0439	0.0026
							(0.0367)	(0.0500)	(0.0427)
_cons	-0.0029	-0.0023	-0.0006	-0.0017	-0.0012	-0.0005	-0.0017	-0.0012	-0.0005
	(0.0020)	(0.0026)	(0.0021)	(0.0018)	(0.0024)	(0.0021)	(0.0018)	(0.0024)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.1077	-0.0010	0.0347	0.2961	0.1483	0.0641	0.3014	0.1459	0.0523
F	11.02	0.91	3.98	12.64	5.82	2.89	9.95	4.55	2.14

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0543	-0.0647**	0.0104	-0.0324	-0.0807**	0.0482	-0.0697	-0.1098***	0.0401
	(0.0414)	(0.0267)	(0.0506)	(0.0484)	(0.0313)	(0.0587)	(0.0516)	(0.0330)	(0.0640)
smb				0.0159	0.0078	0.0081	0.0261	0.0158	0.0104
				(0.0849)	(0.0549)	(0.1030)	(0.0838)	(0.0536)	(0.1038)
hml				-0.1183	0.0669	-0.1852*	-0.1573*	0.0364	-0.1937*
				(0.0796)	(0.0515)	(0.0966)	(0.0811)	(0.0519)	(0.1005)
mom							-0.0713*	-0.0557**	-0.0156
							(0.0379)	(0.0243)	(0.0470)
_cons	-0.0006	0.0003	-0.0009	-0.0005	0.0002	-0.0007	-0.0005	0.0002	-0.0007
	(0.0019)	(0.0012)	(0.0023)	(0.0019)	(0.0012)	(0.0023)	(0.0019)	(0.0012)	(0.0023)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0086	0.0556	-0.0117	0.0115	0.0522	0.0087	0.0418	0.1003	-0.0025
F	1.72	5.88	0.04	1.32	2.52	1.24	1.90	3.31	0.95

Table 3-3-3 Portfolio Return Regressions on US IP, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.1071***	1.2427***	-0.1356***	1.0451***	1.1402***	-0.0951*	0.9802***	1.0525***	-0.0723
	(0.0331)	(0.0462)	(0.0437)	(0.0335)	(0.0501)	(0.0495)	(0.0311)	(0.0481)	(0.0535)
smb				0.3200***	0.2866***	0.0334	0.3377***	0.3106***	0.0272
				(0.0587)	(0.0878)	(0.0868)	(0.0505)	(0.0781)	(0.0868)
hml				-0.0382	0.1854**	-0.2236***	-0.1062**	0.0935	-0.1997**
				(0.0550)	(0.0823)	(0.0814)	(0.0489)	(0.0756)	(0.0841)
mom							-0.1242***	-0.1678***	0.0436
							(0.0229)	(0.0354)	(0.0393)
_cons	0.0012	0.0008	0.0005	0.0004	-0.0003	0.0007	0.0004	-0.0004	0.0008
	(0.0015)	(0.0021)	(0.0020)	(0.0013)	(0.0019)	(0.0019)	(0.0011)	(0.0017)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9308	0.8971	0.0942	0.9485	0.9118	0.1530	0.9620	0.9305	0.1554
F	1117.38	724.30	9.63	510.71	287.10	6.00	526.99	278.89	4.82

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9470***	0.8417***	0.1053*	0.9741***	0.8609***	0.1133*	0.9341***	0.8656***	0.0685
	(0.0362)	(0.0294)	(0.0532)	(0.0409)	(0.0336)	(0.0597)	(0.0430)	(0.0366)	(0.0637)
smb				0.0581	-0.1382**	0.1962*	0.0690	-0.1395**	0.2085**
				(0.0717)	(0.0588)	(0.1047)	(0.0698)	(0.0593)	(0.1034)
hml				-0.1864***	0.0519	-0.2383**	-0.2284***	0.0569	-0.2853***
				(0.0673)	(0.0552)	(0.0982)	(0.0676)	(0.0574)	(0.1001)
mom							-0.0767**	0.0091	-0.0857*
							(0.0316)	(0.0269)	(0.0468)
_cons	-0.0003	-0.0009	0.0006	-0.0002	-0.0006	0.0005	-0.0002	-0.0006	0.0004
	(0.0016)	(0.0013)	(0.0024)	(0.0016)	(0.0013)	(0.0023)	(0.0015)	(0.0013)	(0.0023)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8914	0.9079	0.0339	0.8992	0.9126	0.1140	0.9050	0.9116	0.1393
F	682.47	819.36	3.92	247.82	289.91	4.56	198.68	215.05	4.36

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.1552***	-0.0264	-0.1288***	-0.0407	0.0486	-0.0893*	-0.0052	0.0600	-0.0651
	(0.0447)	(0.0552)	(0.0426)	(0.0458)	(0.0594)	(0.0484)	(0.0489)	(0.0647)	(0.0523)
smb				-0.3961***	-0.4226***	0.0266	-0.4058***	-0.4258***	0.0200
				(0.0804)	(0.1042)	(0.0849)	(0.0793)	(0.1050)	(0.0849)
hml				-0.1291*	0.0827	-0.2118***	-0.0918	0.0946	-0.1865**
				(0.0754)	(0.0978)	(0.0797)	(0.0768)	(0.1016)	(0.0822)
mom							0.0680*	0.0218	0.0462
							(0.0359)	(0.0475)	(0.0384)
_cons	-0.0028	-0.0032	0.0005	-0.0015	-0.0022	0.0007	-0.0015	-0.0022	0.0007
	(0.0020)	(0.0025)	(0.0019)	(0.0018)	(0.0023)	(0.0019)	(0.0018)	(0.0023)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.1173	-0.0094	0.0892	0.3249	0.1481	0.1431	0.3461	0.1397	0.1478
F	12.03	0.23	9.12	14.32	5.81	5.62	11.98	4.37	4.60

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0360	-0.0543**	0.0182	0.0053	-0.0525*	0.0578	-0.0156	-0.0767**	0.0611
	(0.0323)	(0.0245)	(0.0440)	(0.0369)	(0.0288)	(0.0506)	(0.0397)	(0.0306)	(0.0552)
smb				-0.0440	-0.0428	-0.0012	-0.0383	-0.0362	-0.0021
				(0.0647)	(0.0505)	(0.0887)	(0.0645)	(0.0496)	(0.0895)
hml				-0.1481**	0.0357	-0.1838**	-0.1700***	0.0103	-0.1803**
				(0.0607)	(0.0473)	(0.0832)	(0.0624)	(0.0480)	(0.0866)
mom							-0.0399	-0.0462**	0.0063
							(0.0292)	(0.0225)	(0.0405)
_cons	-0.0006	-0.0021*	0.0015	-0.0002	-0.0020*	0.0018	-0.0002	-0.0020*	0.0018
	(0.0015)	(0.0011)	(0.0020)	(0.0014)	(0.0011)	(0.0020)	(0.0014)	(0.0011)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0029	0.0452	-0.0101	0.0540	0.0368	0.0241	0.0641	0.0743	0.0121
F	1.24	4.93	0.17	2.58	2.06	1.68	2.42	2.67	1.25

Table 3-3-4 Portfolio Return Regressions on US IP, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.1819***	1.2166***	-0.0347	1.1088***	1.1308***	-0.0220	1.0327***	1.0563***	-0.0236
	(0.0326)	(0.0369)	(0.0271)	(0.0338)	(0.0385)	(0.0321)	(0.0293)	(0.0358)	(0.0349)
smb				0.2890***	0.3150***	-0.0260	0.3098***	0.3353***	-0.0255
				(0.0593)	(0.0674)	(0.0562)	(0.0476)	(0.0581)	(0.0567)
hml				0.0453	0.0785	-0.0332	-0.0345	0.0005	-0.0349
				(0.0556)	(0.0632)	(0.0527)	(0.0461)	(0.0562)	(0.0549)
mom							-0.1457***	-0.1425***	-0.0032
							(0.0216)	(0.0263)	(0.0257)
_cons	0.0011	0.0009	0.0002	0.0002	-0.0001	0.0003	0.0001	-0.0002	0.0003
	(0.0015)	(0.0017)	(0.0012)	(0.0013)	(0.0015)	(0.0012)	(0.0011)	(0.0013)	(0.0013)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9407	0.9292	0.0076	0.9534	0.9438	-0.0095	0.9701	0.9585	-0.0221
F	1316.66	1089.79	1.64	567.08	465.68	0.74	674.25	480.45	0.55

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9968***	0.8748***	0.1220***	0.9865***	0.8904***	0.0961**	0.9289***	0.8898***	0.0391
	(0.0307)	(0.0231)	(0.0402)	(0.0363)	(0.0269)	(0.0472)	(0.0358)	(0.0294)	(0.0487)
smb				0.0223	-0.0810*	0.1033	0.0381	-0.0809*	0.1189
				(0.0636)	(0.0472)	(0.0828)	(0.0580)	(0.0476)	(0.0790)
hml				0.0253	0.0100	0.0153	-0.0351	0.0094	-0.0445
				(0.0597)	(0.0443)	(0.0777)	(0.0562)	(0.0461)	(0.0765)
mom							-0.1102***	-0.0012	-0.1091***
							(0.0263)	(0.0216)	(0.0358)
_cons	-0.0011	-0.0012	0.0000	-0.0012	-0.0010	-0.0003	-0.0013	-0.0010	-0.0003
	(0.0014)	(0.0010)	(0.0018)	(0.0014)	(0.0010)	(0.0018)	(0.0013)	(0.0011)	(0.0017)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9271	0.9451	0.0899	0.9256	0.9457	0.0854	0.9384	0.9451	0.1712
F	1056.81	1429.33	9.20	345.08	483.21	3.58	316.86	357.89	5.29

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0835*	-0.0493	-0.0342	0.0197	0.0417	-0.0220	0.0437	0.0661	-0.0224
	(0.0444)	(0.0481)	(0.0269)	(0.0451)	(0.0511)	(0.0318)	(0.0486)	(0.0553)	(0.0347)
smb				-0.4223***	-0.3979***	-0.0244	-0.4289***	-0.4046***	-0.0243
				(0.0790)	(0.0897)	(0.0558)	(0.0789)	(0.0897)	(0.0562)
hml				-0.0494	-0.0178	-0.0316	-0.0243	0.0077	-0.0320
				(0.0742)	(0.0841)	(0.0523)	(0.0764)	(0.0868)	(0.0544)
mom							0.0460	0.0466	-0.0006
							(0.0357)	(0.0406)	(0.0255)
_cons	-0.0030	-0.0032	0.0002	-0.0017	-0.0021	0.0003	-0.0017	-0.0020	0.0003
	(0.0020)	(0.0022)	(0.0012)	(0.0018)	(0.0020)	(0.0012)	(0.0017)	(0.0020)	(0.0012)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0297	0.0006	0.0073	0.2699	0.1784	-0.0105	0.2759	0.1816	-0.0232
F	3.54	1.05	1.61	11.23	7.01	0.71	8.91	5.61	0.53

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0080	-0.0399**	0.0479	0.0207	-0.0343	0.0550	-0.0150	-0.0502**	0.0352
	(0.0243)	(0.0197)	(0.0306)	(0.0287)	(0.0233)	(0.0362)	(0.0294)	(0.0250)	(0.0390)
smb				-0.0560	-0.0132	-0.0428	-0.0462	-0.0088	-0.0374
				(0.0502)	(0.0409)	(0.0635)	(0.0477)	(0.0405)	(0.0633)
hml				-0.0021	-0.0126	0.0105	-0.0395	-0.0292	-0.0103
				(0.0471)	(0.0383)	(0.0595)	(0.0462)	(0.0392)	(0.0613)
mom							-0.0683***	-0.0304	-0.0379
							(0.0216)	(0.0183)	(0.0287)
_cons	-0.0007	-0.0018**	0.0011	-0.0006	-0.0018*	0.0012	-0.0006	-0.0018*	0.0012
	(0.0011)	(0.0009)	(0.0014)	(0.0011)	(0.0009)	(0.0014)	(0.0011)	(0.0009)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0109	0.0362	0.0171	-0.0203	0.0147	-0.0013	0.0827	0.0357	0.0079
F	0.11	4.11	2.45	0.45	1.41	0.96	2.87	1.77	1.17

Table 3-3-5 Portfolio Return Regressions on US FF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.3185***	1.2977***	0.0208	1.2407***	1.1785***	0.0622	1.1509***	1.0843***	0.0665
	(0.0465)	(0.0532)	(0.0477)	(0.0500)	(0.0575)	(0.0546)	(0.0477)	(0.0562)	(0.0595)
smb				0.3651***	0.3440***	0.0211	0.3897***	0.3698***	0.0199
				(0.0877)	(0.1008)	(0.0957)	(0.0774)	(0.0912)	(0.0965)
hml				-0.0107	0.2045**	-0.2152**	-0.1049	0.1058	-0.2107**
				(0.0823)	(0.0945)	(0.0898)	(0.0750)	(0.0883)	(0.0935)
mom							-0.1719***	-0.1802***	0.0083
							(0.0351)	(0.0413)	(0.0437)
_cons	0.0014	0.0014	-0.0000	0.0004	0.0001	0.0003	0.0003	0.0000	0.0003
	(0.0021)	(0.0024)	(0.0021)	(0.0019)	(0.0022)	(0.0021)	(0.0017)	(0.0020)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9063	0.8775	-0.0099	0.9210	0.8958	0.0348	0.9387	0.9149	0.0230
F	803.43	595.69	0.19	323.75	238.72	2.00	318.75	224.15	1.49

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0692***	0.9241***	0.1451**	1.0046***	0.9379***	0.0667	0.9272***	0.9008***	0.0265
	(0.0511)	(0.0380)	(0.0609)	(0.0574)	(0.0448)	(0.0680)	(0.0583)	(0.0476)	(0.0732)
smb				0.3018***	-0.0775	0.3794***	0.3230***	-0.0673	0.3904***
				(0.1007)	(0.0786)	(0.1192)	(0.0946)	(0.0772)	(0.1187)
hml				-0.0074	0.0149	-0.0223	-0.0885	-0.0240	-0.0645
				(0.0944)	(0.0737)	(0.1119)	(0.0916)	(0.0748)	(0.1150)
mom							-0.1481***	-0.0711**	-0.0770
							(0.0428)	(0.0350)	(0.0538)
_cons	0.0006	0.0006	-0.0001	-0.0003	0.0008	-0.0011	-0.0003	0.0008	-0.0011
	(0.0023)	(0.0017)	(0.0027)	(0.0022)	(0.0017)	(0.0026)	(0.0021)	(0.0017)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8406	0.8766	0.0534	0.8531	0.8751	0.1391	0.8708	0.8798	0.1503
F	438.61	590.62	5.68	161.68	194.84	5.47	140.83	152.88	4.67

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0572	0.0245	0.0327	0.1591***	0.0847	0.0744	0.1695***	0.0907	0.0788
	(0.0523)	(0.0580)	(0.0473)	(0.0572)	(0.0645)	(0.0544)	(0.0623)	(0.0703)	(0.0593)
smb				-0.3553***	-0.3618***	0.0065	-0.3581***	-0.3634***	0.0053
				(0.1003)	(0.1131)	(0.0954)	(0.1010)	(0.1140)	(0.0962)
hml				-0.1123	0.0896	-0.2018**	-0.1014	0.0958	-0.1972**
				(0.0941)	(0.1061)	(0.0895)	(0.0978)	(0.1104)	(0.0932)
mom							0.0199	0.0114	0.0085
							(0.0457)	(0.0516)	(0.0436)
_cons	-0.0027	-0.0027	-0.0000	-0.0016	-0.0018	0.0003	-0.0015	-0.0018	0.0003
	(0.0024)	(0.0026)	(0.0021)	(0.0022)	(0.0025)	(0.0021)	(0.0022)	(0.0025)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0024	-0.0100	-0.0064	0.1295	0.0894	0.0302	0.1206	0.0785	0.0184
F	1.20	0.18	0.48	5.12	3.72	1.86	3.85	2.77	1.39

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0425	0.0395	0.0031	0.0216	0.0413	-0.0196	-0.0247	-0.0031	-0.0216
	(0.0411)	(0.0378)	(0.0486)	(0.0484)	(0.0448)	(0.0574)	(0.0509)	(0.0470)	(0.0625)
smb				0.1002	0.0216	0.0786	0.1129	0.0337	0.0792
				(0.0848)	(0.0785)	(0.1006)	(0.0826)	(0.0763)	(0.1015)
hml				-0.0049	-0.0305	0.0256	-0.0534	-0.0770	0.0236
				(0.0795)	(0.0736)	(0.0944)	(0.0800)	(0.0739)	(0.0983)
mom							-0.0887**	-0.0849**	-0.0038
							(0.0374)	(0.0345)	(0.0460)
_cons	0.0009	-0.0000	0.0009	0.0006	-0.0000	0.0006	0.0006	-0.0001	0.0006
	(0.0019)	(0.0017)	(0.0022)	(0.0019)	(0.0017)	(0.0022)	(0.0018)	(0.0017)	(0.0022)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0008	0.0011	-0.0121	-0.0065	-0.0207	-0.0287	0.0484	0.0398	-0.0416
F	1.07	1.09	0.00	0.82	0.44	0.23	2.06	1.86	0.17

Table 3-3-6 Portfolio Return Regressions on US FF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2608***	1.2575***	0.0033	1.2019***	1.1314***	0.0706*	1.1220***	1.0524***	0.0696
	(0.0351)	(0.0485)	(0.0376)	(0.0364)	(0.0499)	(0.0417)	(0.0320)	(0.0492)	(0.0454)
smb				0.3147***	0.4114***	-0.0967	0.3366***	0.4330***	-0.0964
				(0.0638)	(0.0874)	(0.0730)	(0.0519)	(0.0797)	(0.0736)
hml				-0.0474	0.1681**	-0.2155***	-0.1312**	0.0854	-0.2166***
				(0.0598)	(0.0820)	(0.0685)	(0.0503)	(0.0772)	(0.0713)
mom							-0.1530***	-0.1511***	-0.0019
							(0.0235)	(0.0361)	(0.0334)
_cons	0.0008	0.0022	-0.0014	0.0000	0.0008	-0.0008	-0.0001	0.0007	-0.0008
	(0.0016)	(0.0022)	(0.0017)	(0.0014)	(0.0019)	(0.0016)	(0.0011)	(0.0018)	(0.0016)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9394	0.8901	-0.0121	0.9526	0.9153	0.0945	0.9688	0.9298	0.0831
F	1287.28	673.37	0.01	557.56	299.93	3.89	644.90	275.71	2.88

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0058***	0.7859***	0.2200***	1.0025***	0.8319***	0.1706***	0.9475***	0.8519***	0.0956
	(0.0407)	(0.0299)	(0.0506)	(0.0466)	(0.0340)	(0.0578)	(0.0482)	(0.0366)	(0.0590)
smb				0.1399*	-0.1118*	0.2517**	0.1549*	-0.1173*	0.2722***
				(0.0818)	(0.0597)	(0.1013)	(0.0782)	(0.0594)	(0.0958)
hml				-0.1280*	-0.1006*	-0.0274	-0.1857**	-0.0796	-0.1060
				(0.0767)	(0.0560)	(0.0951)	(0.0757)	(0.0576)	(0.0928)
mom							-0.1052***	0.0383	-0.1435***
							(0.0354)	(0.0269)	(0.0434)
_cons	-0.0015	0.0004	-0.0019	-0.0017	0.0009	-0.0025	-0.0017	0.0009	-0.0026
	(0.0018)	(0.0013)	(0.0023)	(0.0018)	(0.0013)	(0.0022)	(0.0017)	(0.0013)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8802	0.8927	0.1774	0.8854	0.8985	0.2179	0.8956	0.8998	0.3044
F	610.60	691.36	18.89	214.65	246.01	8.71	178.93	187.37	10.08

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0031	-0.0142	0.0173	0.1209**	0.0366	0.0843**	0.1409***	0.0575	0.0834*
	(0.0464)	(0.0558)	(0.0364)	(0.0477)	(0.0632)	(0.0403)	(0.0517)	(0.0686)	(0.0439)
smb				-0.4054***	-0.2960***	-0.1094	-0.4108***	-0.3017***	-0.1091
				(0.0837)	(0.1109)	(0.0707)	(0.0839)	(0.1113)	(0.0713)
hml				-0.1352*	0.0662	-0.2014***	-0.1143	0.0881	-0.2024***
				(0.0785)	(0.1040)	(0.0663)	(0.0812)	(0.1078)	(0.0690)
mom							0.0382	0.0400	-0.0018
							(0.0380)	(0.0504)	(0.0323)
_cons	-0.0033	-0.0019	-0.0014	-0.0019	-0.0012	-0.0008	-0.0019	-0.0012	-0.0008
	(0.0021)	(0.0025)	(0.0016)	(0.0019)	(0.0025)	(0.0016)	(0.0019)	(0.0025)	(0.0016)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0121	-0.0114	-0.0094	0.2201	0.0525	0.0966	0.2202	0.0481	0.0852
F	0.00	0.06	0.23	8.81	2.53	3.96	6.86	2.05	2.93

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0366	-0.0771***	0.1137**	0.0550	-0.0787**	0.1337**	0.0159	-0.0806**	0.0965*
	(0.0376)	(0.0274)	(0.0453)	(0.0440)	(0.0324)	(0.0534)	(0.0466)	(0.0353)	(0.0571)
smb				0.0235	0.0292	-0.0057	0.0342	0.0297	0.0045
				(0.0771)	(0.0568)	(0.0935)	(0.0755)	(0.0573)	(0.0926)
hml				-0.1101	-0.0224	-0.0877	-0.1510**	-0.0244	-0.1267
				(0.0724)	(0.0533)	(0.0877)	(0.0731)	(0.0555)	(0.0897)
mom							-0.0748**	-0.0036	-0.0712*
							(0.0342)	(0.0259)	(0.0420)
_cons	-0.0010	-0.0003	-0.0007	-0.0009	-0.0004	-0.0005	-0.0009	-0.0004	-0.0006
	(0.0017)	(0.0012)	(0.0020)	(0.0017)	(0.0013)	(0.0021)	(0.0017)	(0.0013)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0006	0.0769	0.0602	0.0043	0.0590	0.0486	0.0493	0.0473	0.0704
F	0.95	7.91	6.31	1.12	2.73	2.41	2.07	2.03	2.57

Table 3-3-7 Portfolio Return Regressions on US FF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2271***	1.2017***	0.0253	1.1824***	1.0970***	0.0853**	1.1085***	1.0244***	0.0841**
	(0.0330)	(0.0414)	(0.0317)	(0.0358)	(0.0418)	(0.0354)	(0.0325)	(0.0403)	(0.0385)
smb				0.2452***	0.3911***	-0.1460**	0.2654***	0.4110***	-0.1456**
				(0.0628)	(0.0733)	(0.0620)	(0.0527)	(0.0654)	(0.0625)
hml				-0.0423	0.0885	-0.1309**	-0.1197**	0.0124	-0.1321**
				(0.0589)	(0.0688)	(0.0582)	(0.0510)	(0.0633)	(0.0605)
mom							-0.1413***	-0.1390***	-0.0023
							(0.0239)	(0.0296)	(0.0283)
_cons	0.0015	0.0020	-0.0004	0.0009	0.0008	0.0002	0.0009	0.0007	0.0002
	(0.0015)	(0.0019)	(0.0014)	(0.0014)	(0.0016)	(0.0014)	(0.0012)	(0.0014)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9432	0.9103	-0.0044	0.9514	0.9332	0.0910	0.9659	0.9471	0.0796
F	1379.25	843.47	0.64	542.14	387.50	3.77	588.43	372.50	2.79

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0131***	0.7787***	0.2344***	1.0269***	0.8009***	0.2261***	0.9844***	0.8079***	0.1765***
	(0.0323)	(0.0260)	(0.0425)	(0.0370)	(0.0305)	(0.0491)	(0.0383)	(0.0332)	(0.0514)
smb				0.0693	-0.0721	0.1414	0.0810	-0.0740	0.1550*
				(0.0648)	(0.0534)	(0.0860)	(0.0621)	(0.0538)	(0.0835)
hml				-0.1358**	-0.0299	-0.1060	-0.1804***	-0.0225	-0.1579*
				(0.0608)	(0.0501)	(0.0807)	(0.0602)	(0.0521)	(0.0808)
mom							-0.0814***	0.0135	-0.0949**
							(0.0281)	(0.0244)	(0.0378)
_cons	-0.0008	-0.0004	-0.0005	-0.0008	-0.0001	-0.0007	-0.0008	-0.0001	-0.0007
	(0.0015)	(0.0012)	(0.0019)	(0.0014)	(0.0012)	(0.0019)	(0.0014)	(0.0012)	(0.0018)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9220	0.9149	0.2619	0.9257	0.9151	0.2831	0.9320	0.9144	0.3277
F	981.70	893.86	30.45	345.79	299.30	11.93	285.34	222.61	11.11

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0360	-0.0669	0.0309	0.0960**	0.0059	0.0901**	0.1220**	0.0324	0.0896**
	(0.0476)	(0.0509)	(0.0314)	(0.0469)	(0.0569)	(0.0351)	(0.0505)	(0.0615)	(0.0382)
smb				-0.4718***	-0.3174***	-0.1544**	-0.4789***	-0.3247***	-0.1542**
				(0.0822)	(0.0997)	(0.0615)	(0.0819)	(0.0998)	(0.0620)
hml				-0.1334*	-0.0147	-0.1187**	-0.1062	0.0131	-0.1193*
				(0.0771)	(0.0936)	(0.0577)	(0.0793)	(0.0966)	(0.0600)
mom							0.0498	0.0509	-0.0011
							(0.0371)	(0.0452)	(0.0281)
_cons	-0.0025	-0.0020	-0.0005	-0.0010	-0.0011	0.0002	-0.0009	-0.0011	0.0002
	(0.0021)	(0.0023)	(0.0014)	(0.0018)	(0.0022)	(0.0014)	(0.0018)	(0.0022)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0052	0.0087	-0.0004	0.2893	0.0983	0.0940	0.2963	0.1013	0.0825
F	0.57	1.73	0.96	12.26	4.02	3.87	9.74	3.34	2.87

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0411	-0.1019***	0.1431***	0.0774**	-0.1074***	0.1848***	0.0441	-0.1090***	0.1531***
	(0.0318)	(0.0248)	(0.0431)	(0.0366)	(0.0293)	(0.0503)	(0.0387)	(0.0320)	(0.0540)
smb				-0.0380	0.0332	-0.0711	-0.0289	0.0336	-0.0624
				(0.0641)	(0.0514)	(0.0882)	(0.0627)	(0.0518)	(0.0876)
hml				-0.1307**	-0.0087	-0.1221	-0.1656***	-0.0104	-0.1553*
				(0.0602)	(0.0482)	(0.0827)	(0.0607)	(0.0502)	(0.0849)
mom							-0.0638**	-0.0031	-0.0607
							(0.0284)	(0.0235)	(0.0397)
_cons	-0.0006	-0.0011	0.0005	-0.0003	-0.0012	0.0009	-0.0003	-0.0012	0.0009
	(0.0014)	(0.0011)	(0.0019)	(0.0014)	(0.0011)	(0.0020)	(0.0014)	(0.0011)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0080	0.1608	0.1075	0.0438	0.1446	0.1164	0.0898	0.1340	0.1309
F	1.67	16.91	11.00	2.27	5.68	4.65	3.05	4.21	4.13

Table 3-3-8 Portfolio Return Regressions on US FF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2322***	1.1676***	0.0647***	1.1702***	1.0708***	0.0994***	1.0920***	0.9983***	0.0938***
	(0.0324)	(0.0361)	(0.0245)	(0.0350)	(0.0357)	(0.0280)	(0.0305)	(0.0326)	(0.0304)
smb				0.2442***	0.3589***	-0.1147**	0.2656***	0.3787***	-0.1131**
				(0.0614)	(0.0626)	(0.0490)	(0.0495)	(0.0529)	(0.0494)
hml				0.0396	0.0844	-0.0448	-0.0423	0.0084	-0.0507
				(0.0576)	(0.0588)	(0.0460)	(0.0480)	(0.0513)	(0.0478)
mom							-0.1496***	-0.1388***	-0.0107
							(0.0224)	(0.0240)	(0.0224)
_cons	0.0007	0.0012	-0.0005	-0.0000	0.0001	-0.0001	-0.0001	0.0000	-0.0001
	(0.0015)	(0.0016)	(0.0011)	(0.0014)	(0.0014)	(0.0011)	(0.0011)	(0.0012)	(0.0011)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9457	0.9264	0.0670	0.9538	0.9475	0.1146	0.9700	0.9627	0.1060
F	1447.18	1046.16	6.96	571.93	500.22	4.58	673.03	536.09	3.46

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9928***	0.8790***	0.1138***	0.9923***	0.8842***	0.1081***	0.9535***	0.8616***	0.0919**
	(0.0250)	(0.0248)	(0.0331)	(0.0296)	(0.0290)	(0.0390)	(0.0302)	(0.0309)	(0.0422)
smb				0.0037	-0.0627	0.0664	0.0143	-0.0565	0.0708
				(0.0520)	(0.0509)	(0.0683)	(0.0491)	(0.0502)	(0.0684)
hml				-0.0014	0.0398	-0.0412	-0.0421	0.0161	-0.0582
				(0.0488)	(0.0477)	(0.0641)	(0.0475)	(0.0486)	(0.0663)
mom							-0.0742***	-0.0433*	-0.0310
							(0.0222)	(0.0227)	(0.0310)
_cons	-0.0012	-0.0010	-0.0001	-0.0012	-0.0009	-0.0003	-0.0012	-0.0009	-0.0003
	(0.0011)	(0.0011)	(0.0015)	(0.0012)	(0.0011)	(0.0015)	(0.0011)	(0.0011)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9500	0.9380	0.1152	0.9488	0.9382	0.1082	0.9545	0.9401	0.1082
F	1577.94	1256.73	11.81	513.19	420.75	4.36	436.59	326.85	3.52

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0333	-0.0982**	0.0649***	0.0811*	-0.0183	0.0994***	0.1028**	0.0084	0.0944***
	(0.0460)	(0.0459)	(0.0245)	(0.0455)	(0.0496)	(0.0280)	(0.0492)	(0.0535)	(0.0304)
smb				-0.4681***	-0.3530***	-0.1150**	-0.4740***	-0.3603***	-0.1137**
				(0.0798)	(0.0870)	(0.0490)	(0.0798)	(0.0868)	(0.0494)
hml				-0.0553	-0.0118	-0.0436	-0.0327	0.0162	-0.0488
				(0.0749)	(0.0816)	(0.0460)	(0.0773)	(0.0840)	(0.0478)
mom							0.0414	0.0510	-0.0096
							(0.0362)	(0.0393)	(0.0224)
_cons	-0.0033	-0.0028	-0.0005	-0.0020	-0.0018	-0.0001	-0.0020	-0.0018	-0.0002
	(0.0021)	(0.0021)	(0.0011)	(0.0018)	(0.0019)	(0.0011)	(0.0018)	(0.0019)	(0.0011)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0058	0.0412	0.0676	0.2825	0.1853	0.1151	0.2853	0.1922	0.1060
F	0.52	4.57	7.01	11.89	7.29	4.60	9.28	5.94	3.46

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0286	-0.0623***	0.0909***	0.0486*	-0.0636**	0.1122***	0.0170	-0.0856***	0.1026**
	(0.0240)	(0.0218)	(0.0326)	(0.0281)	(0.0257)	(0.0384)	(0.0292)	(0.0273)	(0.0417)
smb				-0.0517	-0.0193	-0.0324	-0.0431	-0.0133	-0.0298
				(0.0493)	(0.0451)	(0.0673)	(0.0474)	(0.0443)	(0.0677)
hml				-0.0404	0.0261	-0.0664	-0.0734	0.0031	-0.0766
				(0.0463)	(0.0423)	(0.0631)	(0.0459)	(0.0429)	(0.0655)
mom							-0.0604***	-0.0419**	-0.0184
							(0.0215)	(0.0201)	(0.0307)
_cons	-0.0011	-0.0014	0.0003	-0.0009	-0.0014	0.0005	-0.0009	-0.0014	0.0005
	(0.0011)	(0.0010)	(0.0015)	(0.0011)	(0.0010)	(0.0015)	(0.0010)	(0.0010)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0051	0.0797	0.0754	0.0034	0.0633	0.0679	0.0826	0.1012	0.0604
F	1.43	8.19	7.77	1.09	2.87	3.02	2.87	3.34	2.33

Table 3-3-9 Portfolio Return Regressions on US DF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2997***	1.2925***	0.0072	1.2149***	1.1744***	0.0405	1.1246***	1.0803***	0.0443
	(0.0458)	(0.0543)	(0.0475)	(0.0485)	(0.0589)	(0.0550)	(0.0458)	(0.0580)	(0.0599)
smb				0.3827***	0.3582***	0.0244	0.4074***	0.3840***	0.0234
				(0.0851)	(0.1033)	(0.0964)	(0.0743)	(0.0941)	(0.0972)
hml				0.0043	0.1852*	-0.1809**	-0.0903	0.0866	-0.1770*
				(0.0798)	(0.0969)	(0.0904)	(0.0719)	(0.0911)	(0.0941)
mom							-0.1727***	-0.1800***	0.0073
							(0.0336)	(0.0426)	(0.0440)
_cons	0.0017	0.0017	0.0000	0.0006	0.0004	0.0002	0.0006	0.0003	0.0003
	(0.0021)	(0.0024)	(0.0021)	(0.0019)	(0.0023)	(0.0021)	(0.0016)	(0.0021)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9065	0.8720	-0.0119	0.9235	0.8903	0.0130	0.9419	0.9094	0.0008
F	805.85	566.33	0.02	335.14	225.52	1.36	337.64	209.22	1.02

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0880***	0.9255***	0.1625**	1.0232***	0.9495***	0.0737	0.9537***	0.9043***	0.0493
	(0.0516)	(0.0424)	(0.0623)	(0.0579)	(0.0501)	(0.0699)	(0.0598)	(0.0529)	(0.0759)
smb				0.3059***	-0.0681	0.3740***	0.3250***	-0.0557	0.3807***
				(0.1016)	(0.0878)	(0.1226)	(0.0970)	(0.0859)	(0.1231)
hml				-0.0107	-0.0425	0.0318	-0.0836	-0.0899	0.0063
				(0.0953)	(0.0824)	(0.1150)	(0.0939)	(0.0832)	(0.1192)
mom							-0.1331***	-0.0865**	-0.0466
							(0.0439)	(0.0389)	(0.0557)
_cons	0.0009	-0.0001	0.0011	0.0001	0.0001	-0.0000	0.0000	0.0001	-0.0000
	(0.0023)	(0.0019)	(0.0028)	(0.0023)	(0.0019)	(0.0027)	(0.0021)	(0.0019)	(0.0027)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8426	0.8511	0.0653	0.8552	0.8490	0.1426	0.8686	0.8561	0.1393
F	445.46	475.50	6.80	164.34	156.60	5.60	138.16	124.49	4.36

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0379	0.0194	0.0185	0.1326**	0.0806	0.0521	0.1439**	0.0866	0.0573
	(0.0495)	(0.0590)	(0.0471)	(0.0542)	(0.0662)	(0.0547)	(0.0590)	(0.0721)	(0.0596)
smb				-0.3393***	-0.3475***	0.0082	-0.3424***	-0.3492***	0.0068
				(0.0951)	(0.1160)	(0.0959)	(0.0957)	(0.1170)	(0.0967)
hml				-0.0952	0.0703	-0.1655*	-0.0834	0.0767	-0.1600*
				(0.0892)	(0.1089)	(0.0900)	(0.0927)	(0.1133)	(0.0936)
mom							0.0216	0.0117	0.0099
							(0.0434)	(0.0530)	(0.0438)
_cons	-0.0024	-0.0024	-0.0001	-0.0014	-0.0015	0.0002	-0.0014	-0.0015	0.0002
	(0.0022)	(0.0027)	(0.0021)	(0.0021)	(0.0026)	(0.0021)	(0.0021)	(0.0026)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0050	-0.0109	-0.0103	0.1222	0.0727	0.0066	0.1138	0.0615	-0.0054
F	0.58	0.11	0.15	4.85	3.17	1.18	3.66	2.36	0.89

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0379	0.0405	-0.0026	0.0073	0.0492	-0.0419	-0.0370	0.0070	-0.0440
	(0.0429)	(0.0401)	(0.0522)	(0.0504)	(0.0473)	(0.0613)	(0.0533)	(0.0501)	(0.0668)
smb				0.1142	0.0276	0.0866	0.1263	0.0392	0.0872
				(0.0883)	(0.0829)	(0.1075)	(0.0865)	(0.0812)	(0.1084)
hml				0.0260	-0.0686	0.0946	-0.0205	-0.1128	0.0923
				(0.0828)	(0.0778)	(0.1009)	(0.0838)	(0.0786)	(0.1050)
mom							-0.0848**	-0.0806**	-0.0042
							(0.0392)	(0.0368)	(0.0491)
_cons	0.0015	-0.0001	0.0016	0.0012	-0.0000	0.0012	0.0011	-0.0001	0.0012
	(0.0019)	(0.0018)	(0.0024)	(0.0020)	(0.0018)	(0.0024)	(0.0019)	(0.0018)	(0.0024)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0027	0.0003	-0.0122	-0.0055	-0.0135	-0.0180	0.0388	0.0326	-0.0308
F	0.78	1.02	0.00	0.85	0.63	0.51	1.84	1.70	0.38

Table 3-3-10 Portfolio Return Regressions on US DF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2573***	1.2701***	-0.0128	1.2019***	1.1462***	0.0557	1.1216***	1.0644***	0.0572
	(0.0344)	(0.0489)	(0.0386)	(0.0362)	(0.0507)	(0.0430)	(0.0317)	(0.0497)	(0.0469)
smb				0.2933***	0.4114***	-0.1181	0.3153***	0.4338***	-0.1185
				(0.0635)	(0.0888)	(0.0754)	(0.0514)	(0.0807)	(0.0761)
hml				-0.0417	0.1576*	-0.1993***	-0.1259**	0.0719	-0.1978***
				(0.0595)	(0.0833)	(0.0708)	(0.0497)	(0.0781)	(0.0737)
mom							-0.1537***	-0.1565***	0.0028
							(0.0233)	(0.0365)	(0.0345)
_cons	0.0009	0.0023	-0.0015	0.0001	0.0010	-0.0008	0.0001	0.0009	-0.0008
	(0.0016)	(0.0022)	(0.0017)	(0.0014)	(0.0020)	(0.0017)	(0.0011)	(0.0018)	(0.0017)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9413	0.8902	-0.0108	0.9528	0.9143	0.0829	0.9692	0.9295	0.0713
F	1333.02	673.73	0.11	559.23	296.03	3.50	653.98	274.76	2.59

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0274***	0.8320***	0.1954***	1.0271***	0.8618***	0.1653***	0.9749***	0.8583***	0.1166**
	(0.0397)	(0.0300)	(0.0473)	(0.0461)	(0.0350)	(0.0551)	(0.0479)	(0.0381)	(0.0583)
smb				0.1047	-0.0606	0.1653*	0.1190	-0.0596	0.1786*
				(0.0808)	(0.0614)	(0.0965)	(0.0777)	(0.0618)	(0.0946)
hml				-0.1060	-0.0772	-0.0288	-0.1606**	-0.0808	-0.0798
				(0.0758)	(0.0576)	(0.0905)	(0.0752)	(0.0599)	(0.0916)
mom							-0.0998***	-0.0067	-0.0930**
							(0.0352)	(0.0280)	(0.0428)
_cons	-0.0022	0.0009	-0.0031	-0.0023	0.0012	-0.0035	-0.0024	0.0012	-0.0035*
	(0.0018)	(0.0014)	(0.0021)	(0.0018)	(0.0014)	(0.0021)	(0.0017)	(0.0014)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8894	0.9024	0.1622	0.8915	0.9033	0.1726	0.9003	0.9022	0.2094
F	668.15	768.53	17.07	228.36	259.52	6.77	188.36	192.36	6.50

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0004	-0.0017	0.0013	0.1209**	0.0514	0.0695*	0.1405***	0.0694	0.0711
	(0.0461)	(0.0551)	(0.0373)	(0.0466)	(0.0624)	(0.0416)	(0.0505)	(0.0678)	(0.0453)
smb				-0.4267***	-0.2961***	-0.1306*	-0.4321***	-0.3011***	-0.1310*
				(0.0817)	(0.1094)	(0.0729)	(0.0819)	(0.1100)	(0.0735)
hml				-0.1295*	0.0555	-0.1851***	-0.1090	0.0745	-0.1835**
				(0.0766)	(0.1026)	(0.0683)	(0.0793)	(0.1065)	(0.0711)
mom							0.0375	0.0346	0.0030
							(0.0371)	(0.0498)	(0.0333)
_cons	-0.0032	-0.0017	-0.0015	-0.0018	-0.0010	-0.0008	-0.0018	-0.0010	-0.0008
	(0.0021)	(0.0025)	(0.0017)	(0.0018)	(0.0024)	(0.0016)	(0.0018)	(0.0024)	(0.0016)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0122	-0.0122	-0.0122	0.2464	0.0527	0.0833	0.2466	0.0465	0.0718
F	0.00	0.00	0.00	10.05	2.54	3.51	7.79	2.01	2.61

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0550	-0.0418	0.0969**	0.0746*	-0.0498	0.1244**	0.0369	-0.0738**	0.1107*
	(0.0372)	(0.0277)	(0.0445)	(0.0437)	(0.0328)	(0.0525)	(0.0464)	(0.0350)	(0.0570)
smb				-0.0013	0.0426	-0.0440	0.0090	0.0492	-0.0402
				(0.0767)	(0.0575)	(0.0920)	(0.0752)	(0.0568)	(0.0925)
hml				-0.0902	-0.0066	-0.0837	-0.1297*	-0.0318	-0.0980
				(0.0719)	(0.0539)	(0.0863)	(0.0728)	(0.0550)	(0.0896)
mom							-0.0722**	-0.0460*	-0.0261
							(0.0341)	(0.0257)	(0.0419)
_cons	-0.0015	0.0004	-0.0019	-0.0014	0.0002	-0.0016	-0.0014	0.0002	-0.0017
	(0.0017)	(0.0012)	(0.0020)	(0.0017)	(0.0013)	(0.0020)	(0.0017)	(0.0013)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0141	0.0151	0.0430	0.0089	-0.0024	0.0332	0.0503	0.0244	0.0258
F	2.19	2.28	4.73	1.25	0.93	1.95	2.10	1.52	1.55

Table 3-3-11 Portfolio Return Regressions on US DF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2189***	1.2008***	0.0181	1.1735***	1.0987***	0.0747**	1.0927***	1.0296***	0.0631
	(0.0333)	(0.0413)	(0.0322)	(0.0365)	(0.0419)	(0.0362)	(0.0319)	(0.0409)	(0.0393)
smb				0.2358***	0.3901***	-0.1543**	0.2579***	0.4091***	-0.1511**
				(0.0639)	(0.0734)	(0.0634)	(0.0518)	(0.0663)	(0.0637)
hml				-0.0294	0.0772	-0.1066*	-0.1140**	0.0048	-0.1188*
				(0.0599)	(0.0689)	(0.0595)	(0.0501)	(0.0642)	(0.0617)
mom							-0.1545***	-0.1322***	-0.0223
							(0.0234)	(0.0300)	(0.0289)
_cons	0.0012	0.0023	-0.0011	0.0006	0.0011	-0.0005	0.0005	0.0010	-0.0005
	(0.0015)	(0.0019)	(0.0015)	(0.0014)	(0.0016)	(0.0014)	(0.0011)	(0.0015)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9417	0.9105	-0.0083	0.9490	0.9330	0.0723	0.9667	0.9455	0.0676
F	1341.08	845.47	0.32	516.31	386.20	3.16	603.61	361.03	2.50

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0142***	0.7817***	0.2325***	1.0293***	0.7980***	0.2313***	0.9849***	0.7996***	0.1853***
	(0.0326)	(0.0279)	(0.0427)	(0.0376)	(0.0329)	(0.0498)	(0.0389)	(0.0359)	(0.0525)
smb				0.0503	-0.0515	0.1018	0.0625	-0.0519	0.1144
				(0.0660)	(0.0577)	(0.0873)	(0.0631)	(0.0582)	(0.0852)
hml				-0.1220*	-0.0231	-0.0988	-0.1685***	-0.0215	-0.1470*
				(0.0619)	(0.0542)	(0.0819)	(0.0611)	(0.0564)	(0.0825)
mom							-0.0850***	0.0030	-0.0880**
							(0.0286)	(0.0264)	(0.0386)
_cons	-0.0012	-0.0006	-0.0006	-0.0012	-0.0005	-0.0007	-0.0012	-0.0005	-0.0007
	(0.0015)	(0.0013)	(0.0019)	(0.0015)	(0.0013)	(0.0019)	(0.0014)	(0.0013)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9209	0.9041	0.2566	0.9232	0.9028	0.2640	0.9301	0.9016	0.3006
F	967.53	783.04	29.65	333.69	258.08	10.92	277.00	191.18	9.92

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0434	-0.0682	0.0248	0.0878*	0.0072	0.0806**	0.1070**	0.0372	0.0698*
	(0.0471)	(0.0509)	(0.0318)	(0.0460)	(0.0569)	(0.0357)	(0.0498)	(0.0614)	(0.0388)
smb				-0.4811***	-0.3184***	-0.1627**	-0.4864***	-0.3266***	-0.1597**
				(0.0806)	(0.0997)	(0.0626)	(0.0807)	(0.0995)	(0.0629)
hml				-0.1205	-0.0262	-0.0943	-0.1004	0.0052	-0.1056*
				(0.0756)	(0.0935)	(0.0587)	(0.0782)	(0.0964)	(0.0609)
mom							0.0366	0.0574	-0.0208
							(0.0366)	(0.0451)	(0.0285)
_cons	-0.0029	-0.0017	-0.0011	-0.0014	-0.0008	-0.0005	-0.0013	-0.0008	-0.0006
	(0.0021)	(0.0023)	(0.0014)	(0.0018)	(0.0022)	(0.0014)	(0.0018)	(0.0022)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0018	0.0095	-0.0048	0.3050	0.1003	0.0777	0.3050	0.1073	0.0723
F	0.85	1.80	0.61	13.14	4.09	3.33	10.11	3.49	2.62

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0398	-0.0965***	0.1363***	0.0795**	-0.1042***	0.1837***	0.0422	-0.1046***	0.1468***
	(0.0323)	(0.0257)	(0.0447)	(0.0372)	(0.0304)	(0.0520)	(0.0390)	(0.0331)	(0.0556)
smb				-0.0610	0.0388	-0.0998	-0.0507	0.0389	-0.0897
				(0.0652)	(0.0533)	(0.0911)	(0.0633)	(0.0538)	(0.0902)
hml				-0.1230**	-0.0039	-0.1191	-0.1621***	-0.0043	-0.1578*
				(0.0612)	(0.0500)	(0.0855)	(0.0613)	(0.0521)	(0.0873)
mom							-0.0714**	-0.0008	-0.0706*
							(0.0287)	(0.0244)	(0.0409)
_cons	-0.0010	-0.0010	0.0000	-0.0006	-0.0011	0.0005	-0.0007	-0.0011	0.0004
	(0.0015)	(0.0012)	(0.0020)	(0.0014)	(0.0012)	(0.0020)	(0.0014)	(0.0012)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0062	0.1361	0.0911	0.0404	0.1204	0.1035	0.0989	0.1093	0.1253
F	1.52	14.08	9.32	2.16	4.79	4.20	3.28	3.55	3.97

Table 3-3-12 Portfolio Return Regressions on US DF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2304***	1.1694***	0.0610**	1.1638***	1.0770***	0.0868***	1.0807***	1.0094***	0.0714**
	(0.0332)	(0.0353)	(0.0244)	(0.0357)	(0.0352)	(0.0283)	(0.0303)	(0.0328)	(0.0305)
smb				0.2556***	0.3478***	-0.0921*	0.2784***	0.3663***	-0.0879*
				(0.0626)	(0.0617)	(0.0496)	(0.0492)	(0.0533)	(0.0495)
hml				0.0491	0.0751	-0.0260	-0.0379	0.0042	-0.0421
				(0.0587)	(0.0579)	(0.0466)	(0.0477)	(0.0516)	(0.0479)
mom							-0.1590***	-0.1295***	-0.0295
							(0.0223)	(0.0241)	(0.0224)
_cons	0.0007	0.0012	-0.0005	-0.0001	0.0002	-0.0002	-0.0002	0.0001	-0.0003
	(0.0015)	(0.0016)	(0.0011)	(0.0014)	(0.0014)	(0.0011)	(0.0011)	(0.0012)	(0.0011)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9430	0.9295	0.0594	0.9520	0.9490	0.0792	0.9704	0.9622	0.0875
F	1373.29	1095.19	6.25	549.47	516.23	3.38	681.67	529.01	2.99

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9974***	0.8741***	0.1232***	1.0012***	0.8748***	0.1264***	0.9597***	0.8550***	0.1047**
	(0.0255)	(0.0251)	(0.0343)	(0.0302)	(0.0294)	(0.0403)	(0.0306)	(0.0315)	(0.0435)
smb				-0.0044	-0.0546	0.0503	0.0070	-0.0492	0.0562
				(0.0529)	(0.0515)	(0.0707)	(0.0496)	(0.0511)	(0.0705)
hml				-0.0134	0.0530	-0.0665	-0.0570	0.0323	-0.0893
				(0.0497)	(0.0483)	(0.0663)	(0.0480)	(0.0495)	(0.0683)
mom							-0.0795***	-0.0378	-0.0417
							(0.0225)	(0.0231)	(0.0319)
_cons	-0.0011	-0.0012	0.0001	-0.0010	-0.0011	0.0001	-0.0011	-0.0011	0.0000
	(0.0011)	(0.0011)	(0.0015)	(0.0012)	(0.0011)	(0.0016)	(0.0011)	(0.0011)	(0.0016)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9486	0.9357	0.1254	0.9474	0.9360	0.1201	0.9540	0.9373	0.1278
F	1533.39	1209.21	12.90	499.19	405.45	4.78	431.39	311.08	4.04

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0352	-0.0964**	0.0612**	0.0747	-0.0120	0.0866***	0.0914*	0.0196	0.0718**
	(0.0460)	(0.0459)	(0.0244)	(0.0461)	(0.0492)	(0.0283)	(0.0500)	(0.0528)	(0.0305)
smb				-0.4566***	-0.3642***	-0.0923*	-0.4611***	-0.3729***	-0.0883*
				(0.0808)	(0.0862)	(0.0495)	(0.0811)	(0.0856)	(0.0494)
hml				-0.0454	-0.0214	-0.0241	-0.0280	0.0117	-0.0396
				(0.0758)	(0.0809)	(0.0465)	(0.0785)	(0.0829)	(0.0479)
mom							0.0319	0.0603	-0.0284
							(0.0367)	(0.0388)	(0.0224)
_cons	-0.0034	-0.0028	-0.0006	-0.0020	-0.0018	-0.0003	-0.0020	-0.0017	-0.0003
	(0.0021)	(0.0021)	(0.0011)	(0.0018)	(0.0019)	(0.0011)	(0.0018)	(0.0019)	(0.0011)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0050	0.0395	0.0602	0.2662	0.1956	0.0798	0.2640	0.2096	0.0867
F	0.58	4.42	6.32	11.04	7.73	3.40	8.44	6.50	2.97

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0298	-0.0635***	0.0932***	0.0518*	-0.0667**	0.1185***	0.0163	-0.0843***	0.1005**
	(0.0244)	(0.0218)	(0.0334)	(0.0286)	(0.0258)	(0.0392)	(0.0294)	(0.0276)	(0.0423)
smb				-0.0553	-0.0163	-0.0390	-0.0455	-0.0115	-0.0341
				(0.0501)	(0.0452)	(0.0686)	(0.0477)	(0.0448)	(0.0687)
hml				-0.0462	0.0319	-0.0781	-0.0833*	0.0135	-0.0969
				(0.0470)	(0.0424)	(0.0644)	(0.0462)	(0.0434)	(0.0665)
mom							-0.0679***	-0.0335	-0.0344
							(0.0216)	(0.0203)	(0.0311)
_cons	-0.0011	-0.0014	0.0003	-0.0008	-0.0014	0.0006	-0.0009	-0.0014	0.0005
	(0.0011)	(0.0010)	(0.0015)	(0.0011)	(0.0010)	(0.0015)	(0.0011)	(0.0010)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0058	0.0823	0.0758	0.0079	0.0675	0.0734	0.1071	0.0872	0.0760
F	1.48	8.45	7.80	1.22	3.00	3.19	3.49	2.98	2.71

Table 3-3-13 Portfolio Return Regressions on US CF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.1828***	1.3529***	-0.1701***	1.1289***	1.2310***	-0.1020	1.0507***	1.1306***	-0.0798
	(0.0466)	(0.0615)	(0.0616)	(0.0486)	(0.0681)	(0.0673)	(0.0478)	(0.0682)	(0.0731)
smb				0.3823***	0.2931**	0.0892	0.4037***	0.3205***	0.0832
				(0.0853)	(0.1195)	(0.1180)	(0.0775)	(0.1106)	(0.1185)
hml				-0.1400*	0.2696**	-0.4097***	-0.2220***	0.1644	-0.3864***
				(0.0800)	(0.1121)	(0.1107)	(0.0751)	(0.1071)	(0.1148)
mom							-0.1496***	-0.1921***	0.0425
							(0.0351)	(0.0501)	(0.0537)
_cons	0.0032	0.0016	0.0016	0.0024	0.0004	0.0020	0.0023	0.0003	0.0020
	(0.0021)	(0.0028)	(0.0028)	(0.0019)	(0.0026)	(0.0026)	(0.0017)	(0.0024)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8859	0.8532	0.0740	0.9093	0.8688	0.1945	0.9253	0.8880	0.1908
F	645.33	483.23	7.63	278.38	184.27	7.68	258.10	165.55	5.89

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9802***	0.8540***	0.1262	0.9680***	0.8605***	0.1076	0.9698***	0.8357***	0.1341
	(0.0673)	(0.0510)	(0.0907)	(0.0746)	(0.0595)	(0.1002)	(0.0813)	(0.0644)	(0.1089)
smb				0.3281**	-0.1336	0.4617**	0.3276**	-0.1268	0.4544**
				(0.1308)	(0.1042)	(0.1756)	(0.1319)	(0.1045)	(0.1766)
hml				-0.2795**	0.1067	-0.3862**	-0.2776**	0.0808	-0.3584**
				(0.1227)	(0.0978)	(0.1647)	(0.1277)	(0.1012)	(0.1710)
mom							0.0035	-0.0473	0.0508
							(0.0597)	(0.0473)	(0.0800)
_cons	0.0010	0.0020	-0.0010	0.0006	0.0022	-0.0016	0.0006	0.0021	-0.0016
	(0.0030)	(0.0023)	(0.0041)	(0.0029)	(0.0023)	(0.0039)	(0.0029)	(0.0023)	(0.0039)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7181	0.7709	0.0111	0.7473	0.7732	0.1226	0.7441	0.7732	0.1160
F	212.40	280.33	1.93	82.82	95.34	4.86	61.34	71.76	3.72

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0767	0.0781	-0.1548**	0.0491	0.1348*	-0.0857	0.0728	0.1342*	-0.0615
	(0.0517)	(0.0667)	(0.0602)	(0.0549)	(0.0739)	(0.0659)	(0.0595)	(0.0805)	(0.0715)
smb				-0.3382***	-0.4123***	0.0742	-0.3446***	-0.4122***	0.0675
				(0.0963)	(0.1296)	(0.1156)	(0.0965)	(0.1307)	(0.1160)
hml				-0.2417***	0.1576	-0.3993***	-0.2169**	0.1570	-0.3739***
				(0.0904)	(0.1215)	(0.1084)	(0.0934)	(0.1265)	(0.1123)
mom							0.0453	-0.0011	0.0464
							(0.0437)	(0.0592)	(0.0525)
_cons	-0.0009	-0.0024	0.0014	0.0004	-0.0015	0.0019	0.0004	-0.0015	0.0019
	(0.0023)	(0.0030)	(0.0027)	(0.0021)	(0.0029)	(0.0026)	(0.0021)	(0.0029)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0143	0.0044	0.0633	0.1875	0.1108	0.1827	0.1883	0.0995	0.1804
F	2.21	1.37	6.61	7.39	4.45	7.18	5.81	3.29	5.57

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0476	-0.0396	-0.0080	-0.0426	-0.0743	0.0317	-0.0457	-0.1234**	0.0777
	(0.0590)	(0.0452)	(0.0746)	(0.0695)	(0.0530)	(0.0873)	(0.0758)	(0.0560)	(0.0942)
smb				0.0758	0.0489	0.0269	0.0766	0.0623	0.0143
				(0.1219)	(0.0930)	(0.1531)	(0.1229)	(0.0908)	(0.1528)
hml				-0.1008	0.1122	-0.2130	-0.1040	0.0607	-0.1647
				(0.1143)	(0.0872)	(0.1436)	(0.1190)	(0.0879)	(0.1480)
mom							-0.0059	-0.0940**	0.0881
							(0.0557)	(0.0411)	(0.0692)
_cons	0.0005	0.0024	-0.0019	0.0004	0.0021	-0.0017	0.0004	0.0021	-0.0016
	(0.0027)	(0.0020)	(0.0034)	(0.0027)	(0.0021)	(0.0034)	(0.0027)	(0.0020)	(0.0034)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0042	-0.0028	-0.0121	-0.0146	-0.0037	-0.0092	-0.0273	0.0466	-0.0015
F	0.65	0.77	0.01	0.60	0.90	0.75	0.45	2.01	0.97

Table 3-3-14 Portfolio Return Regressions on US CF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.2266***	1.3087***	-0.0821*	1.1653***	1.1819***	-0.0166	1.0761***	1.0815***	-0.0054
	(0.0428)	(0.0527)	(0.0477)	(0.0454)	(0.0562)	(0.0517)	(0.0420)	(0.0538)	(0.0563)
smb				0.3495***	0.3204***	0.0291	0.3739***	0.3478***	0.0260
				(0.0796)	(0.0986)	(0.0907)	(0.0681)	(0.0872)	(0.0913)
hml				-0.0715	0.2647***	-0.3362***	-0.1650**	0.1595*	-0.3245***
				(0.0746)	(0.0925)	(0.0851)	(0.0660)	(0.0845)	(0.0884)
mom							-0.1706***	-0.1920***	0.0214
							(0.0309)	(0.0395)	(0.0414)
_cons	0.0020	0.0017	0.0003	0.0011	0.0004	0.0008	0.0010	0.0003	0.0008
	(0.0019)	(0.0024)	(0.0021)	(0.0018)	(0.0022)	(0.0020)	(0.0015)	(0.0019)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9080	0.8813	0.0231	0.9248	0.9015	0.1631	0.9451	0.9232	0.1554
F	820.59	617.37	2.96	341.03	254.07	6.39	357.93	250.30	4.82

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.0024***	0.8909***	0.1115*	1.0135***	0.8876***	0.1259*	0.9576***	0.8876***	0.0699
	(0.0461)	(0.0364)	(0.0646)	(0.0506)	(0.0415)	(0.0693)	(0.0527)	(0.0452)	(0.0737)
smb				0.1900**	-0.1199	0.3099**	0.2053**	-0.1199	0.3252***
				(0.0888)	(0.0727)	(0.1215)	(0.0855)	(0.0733)	(0.1196)
hml				-0.2465***	0.1384**	-0.3849***	-0.3052***	0.1384*	-0.4436***
				(0.0833)	(0.0682)	(0.1140)	(0.0828)	(0.0710)	(0.1158)
mom							-0.1070***	0.0000	-0.1071*
							(0.0387)	(0.0332)	(0.0542)
_cons	0.0008	0.0018	-0.0010	0.0006	0.0019	-0.0013	0.0006	0.0019	-0.0013
	(0.0021)	(0.0016)	(0.0029)	(0.0020)	(0.0016)	(0.0027)	(0.0019)	(0.0016)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8504	0.8780	0.0232	0.8686	0.8848	0.1820	0.8787	0.8833	0.2107
F	472.72	598.14	2.98	183.84	213.43	7.16	151.25	158.07	6.54

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0299	0.0360	-0.0659	0.0856*	0.0859	-0.0003	0.0965*	0.0852	0.0113
	(0.0476)	(0.0584)	(0.0462)	(0.0502)	(0.0638)	(0.0502)	(0.0546)	(0.0695)	(0.0546)
smb				-0.3704***	-0.3873***	0.0169	-0.3734***	-0.3871***	0.0138
				(0.0879)	(0.1119)	(0.0880)	(0.0885)	(0.1128)	(0.0885)
hml				-0.1605*	0.1639	-0.3244***	-0.1491*	0.1632	-0.3123***
				(0.0825)	(0.1049)	(0.0825)	(0.0857)	(0.1092)	(0.0857)
mom							0.0208	-0.0013	0.0221
							(0.0401)	(0.0511)	(0.0401)
_cons	-0.0021	-0.0024	0.0003	-0.0008	-0.0016	0.0008	-0.0008	-0.0016	0.0008
	(0.0021)	(0.0026)	(0.0021)	(0.0019)	(0.0025)	(0.0019)	(0.0020)	(0.0025)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0074	-0.0075	0.0123	0.1864	0.1251	0.1518	0.1788	0.1140	0.1444
F	0.39	0.38	2.04	7.34	4.96	5.95	5.52	3.67	4.50

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0049	0.0084	-0.0133	0.0263	-0.0184	0.0448	-0.0075	-0.0608	0.0533
	(0.0418)	(0.0309)	(0.0531)	(0.0481)	(0.0358)	(0.0599)	(0.0514)	(0.0370)	(0.0652)
smb				0.0274	0.0119	0.0155	0.0367	0.0235	0.0131
				(0.0843)	(0.0627)	(0.1050)	(0.0835)	(0.0599)	(0.1058)
hml				-0.1741**	0.1133*	-0.2874***	-0.2095**	0.0689	-0.2784***
				(0.0791)	(0.0588)	(0.0985)	(0.0808)	(0.0580)	(0.1025)
mom							-0.0647*	-0.0811***	0.0164
							(0.0378)	(0.0271)	(0.0479)
_cons	0.0005	0.0002	0.0003	0.0007	0.0000	0.0007	0.0006	-0.0000	0.0007
	(0.0019)	(0.0014)	(0.0024)	(0.0019)	(0.0014)	(0.0023)	(0.0018)	(0.0013)	(0.0023)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0120	-0.0113	-0.0114	0.0232	0.0098	0.0632	0.0462	0.0989	0.0528
F	0.01	0.07	0.06	1.66	1.27	2.87	2.00	3.28	2.16

Table 3-3-15 Portfolio Return Regressions on US CF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
mktrf	1.2000***	1.2587***	-0.0587	1.1526***	1.1505***	0.0020	1.0700***	1.0605***	0.0095
	(0.0379)	(0.0446)	(0.0385)	(0.0399)	(0.0476)	(0.0402)	(0.0361)	(0.0446)	(0.0438)
smb				0.3104***	0.2788***	0.0317	0.3330***	0.3034***	0.0296
				(0.0699)	(0.0834)	(0.0706)	(0.0585)	(0.0724)	(0.0711)
hml				-0.0964	0.2200***	-0.3163***	-0.1829***	0.1256*	-0.3085***
				(0.0655)	(0.0782)	(0.0662)	(0.0567)	(0.0701)	(0.0688)
mom							-0.1580***	-0.1724***	0.0143
							(0.0265)	(0.0328)	(0.0322)
_cons	0.0019	0.0012	0.0006	0.0012	0.0001	0.0011	0.0011	0.0000	0.0011
	(0.0017)	(0.0020)	(0.0017)	(0.0015)	(0.0018)	(0.0016)	(0.0013)	(0.0016)	(0.0016)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9234	0.9054	0.0157	0.9384	0.9217	0.2167	0.9570	0.9413	0.2087
F	1001.39	795.66	2.32	422.12	326.83	8.65	462.27	333.71	6.47

Panel B Value-weighted Portfolio

Panel B	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
mktrf	1.0140***	0.9115***	0.1025*	1.0382***	0.8985***	0.1397**	0.9827***	0.8972***	0.0855
	(0.0408)	(0.0338)	(0.0595)	(0.0448)	(0.0358)	(0.0605)	(0.0460)	(0.0390)	(0.0640)
smb				0.1269	-0.1555**	0.2823***	0.1421*	-0.1551**	0.2972***
				(0.0785)	(0.0628)	(0.1060)	(0.0746)	(0.0633)	(0.1038)
hml				-0.2431***	0.2201***	-0.4632***	-0.3012***	0.2187***	-0.5200***
				(0.0736)	(0.0589)	(0.0995)	(0.0723)	(0.0613)	(0.1005)
mom							-0.1061***	-0.0024	-0.1037**
							(0.0338)	(0.0287)	(0.0470)
_cons	0.0006	-0.0011	0.0017	0.0006	-0.0011	0.0017	0.0006	-0.0011	0.0016
	(0.0018)	(0.0015)	(0.0027)	(0.0017)	(0.0014)	(0.0023)	(0.0016)	(0.0014)	(0.0023)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8814	0.8976	0.0232	0.8960	0.9161	0.2636	0.9063	0.9151	0.2975
F	617.58	728.55	2.97	239.29	303.15	10.90	201.81	224.54	9.79

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0617	-0.0105	-0.0512	0.0674	0.0587	0.0087	0.0852*	0.0677	0.0175
	(0.0455)	(0.0541)	(0.0375)	(0.0456)	(0.0575)	(0.0393)	(0.0494)	(0.0626)	(0.0428)
smb				-0.4059***	-0.4303***	0.0244	-0.4108***	-0.4328***	0.0220
				(0.0800)	(0.1008)	(0.0689)	(0.0802)	(0.1016)	(0.0694)
hml				-0.1874**	0.1175	-0.3049***	-0.1688**	0.1270	-0.2958***
				(0.0750)	(0.0946)	(0.0647)	(0.0777)	(0.0984)	(0.0672)
mom							0.0340	0.0172	0.0168
							(0.0363)	(0.0460)	(0.0314)
_cons	-0.0022	-0.0028	0.0006	-0.0008	-0.0018	0.0010	-0.0008	-0.0018	0.0010
	(0.0021)	(0.0024)	(0.0017)	(0.0018)	(0.0022)	(0.0015)	(0.0018)	(0.0022)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0100	-0.0117	0.0103	0.2752	0.1684	0.2071	0.2740	0.1593	0.2000
F	1.84	0.04	1.86	11.50	6.60	8.23	8.83	4.93	6.19

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.0142	-0.0124	0.0266	0.0571	-0.0345	0.0917*	0.0201	-0.0650**	0.0851
	(0.0372)	(0.0261)	(0.0478)	(0.0424)	(0.0292)	(0.0521)	(0.0449)	(0.0306)	(0.0568)
smb				-0.0199	-0.0419	0.0220	-0.0098	-0.0336	0.0238
				(0.0744)	(0.0512)	(0.0914)	(0.0729)	(0.0496)	(0.0921)
hml				-0.1800**	0.1465***	-0.3265***	-0.2188***	0.1146**	-0.3334***
				(0.0698)	(0.0480)	(0.0857)	(0.0706)	(0.0480)	(0.0892)
mom							-0.0709**	-0.0582**	-0.0126
							(0.0330)	(0.0224)	(0.0417)
_cons	0.0005	-0.0020*	0.0025	0.0008	-0.0021*	0.0030	0.0008	-0.0022*	0.0030
	(0.0017)	(0.0012)	(0.0022)	(0.0016)	(0.0011)	(0.0020)	(0.0016)	(0.0011)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0104	-0.0094	-0.0084	0.0447	0.0800	0.1256	0.0859	0.1415	0.1155
F	0.15	0.23	0.31	2.29	3.41	4.97	2.95	4.42	3.71

Table 3-3-16 Portfolio Return Regressions on US CF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	1.1789***	1.2197***	-0.0409	1.1074***	1.1323***	-0.0248	1.0321***	1.0570***	-0.0248
	(0.0317)	(0.0373)	(0.0263)	(0.0324)	(0.0391)	(0.0309)	(0.0276)	(0.0365)	(0.0337)
smb				0.2948***	0.3094***	-0.0147	0.3154***	0.3300***	-0.0146
				(0.0569)	(0.0686)	(0.0541)	(0.0448)	(0.0592)	(0.0546)
hml				0.0317	0.0916	-0.0599	-0.0472	0.0127	-0.0599
				(0.0534)	(0.0643)	(0.0508)	(0.0434)	(0.0573)	(0.0529)
mom							-0.1441***	-0.1440***	-0.0000
							(0.0203)	(0.0268)	(0.0247)
_cons	0.0009	0.0010	-0.0001	0.0001	0.0000	0.0001	0.0000	-0.0001	0.0001
	(0.0014)	(0.0017)	(0.0012)	(0.0013)	(0.0015)	(0.0012)	(0.0010)	(0.0013)	(0.0012)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9435	0.9279	0.0168	0.9568	0.9423	0.0103	0.9732	0.9572	-0.0022
F	1385.90	1069.27	2.42	613.06	452.55	1.29	755.94	464.96	0.95

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	0.9773***	0.9024***	0.0750**	0.9940***	0.8915***	0.1025**	0.9491***	0.8748***	0.0744*
	(0.0280)	(0.0244)	(0.0374)	(0.0321)	(0.0265)	(0.0397)	(0.0325)	(0.0285)	(0.0425)
smb				0.0372	-0.0930**	0.1301*	0.0495	-0.0884*	0.1379**
				(0.0563)	(0.0465)	(0.0696)	(0.0526)	(0.0462)	(0.0689)
hml				-0.1162**	0.1459***	-0.2622***	-0.1633***	0.1284***	-0.2917***
				(0.0528)	(0.0436)	(0.0653)	(0.0510)	(0.0447)	(0.0668)
mom							-0.0859***	-0.0321	-0.0539*
							(0.0238)	(0.0209)	(0.0312)
_cons	-0.0003	-0.0019*	0.0016	-0.0003	-0.0019*	0.0017	-0.0003	-0.0019*	0.0016
	(0.0013)	(0.0011)	(0.0017)	(0.0012)	(0.0010)	(0.0015)	(0.0012)	(0.0010)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9363	0.9428	0.0352	0.9387	0.9507	0.2057	0.9467	0.9516	0.2248
F	1221.03	1369.45	4.03	425.02	535.04	8.16	369.78	408.63	7.02

Panel C Industry-Adjusted Equally-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0867**	-0.0460	-0.0407	0.0180	0.0435	-0.0255	0.0428	0.0671	-0.0243
	(0.0432)	(0.0489)	(0.0260)	(0.0436)	(0.0520)	(0.0306)	(0.0470)	(0.0562)	(0.0334)
smb				-0.4164***	-0.4036***	-0.0128	-0.4231***	-0.4101***	-0.0131
				(0.0765)	(0.0911)	(0.0537)	(0.0762)	(0.0912)	(0.0542)
hml				-0.0629	-0.0049	-0.0580	-0.0369	0.0199	-0.0568
				(0.0718)	(0.0855)	(0.0504)	(0.0738)	(0.0883)	(0.0524)
mom							0.0474	0.0452	0.0022
							(0.0345)	(0.0413)	(0.0245)
_cons	-0.0031	-0.0030	-0.0001	-0.0019	-0.0019	0.0000	-0.0019	-0.0019	0.0000
	(0.0019)	(0.0022)	(0.0012)	(0.0017)	(0.0020)	(0.0012)	(0.0017)	(0.0020)	(0.0012)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0352	-0.0014	0.0170	0.2834	0.1757	0.0096	0.2912	0.1777	-0.0029
F	4.03	0.89	2.44	11.94	6.90	1.27	9.53	5.48	0.94

Panel D Industry-Adjusted Value-weighted Portfolio

Panel D	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
mktrf	-0.0035	-0.0248	0.0213	0.0238	-0.0322	0.0559*	-0.0046	-0.0563**	0.0517
	(0.0227)	(0.0199)	(0.0283)	(0.0262)	(0.0231)	(0.0321)	(0.0273)	(0.0242)	(0.0350)
smb				-0.0470	-0.0258	-0.0211	-0.0392	-0.0192	-0.0200
				(0.0459)	(0.0406)	(0.0563)	(0.0443)	(0.0393)	(0.0568)
hml				-0.0795*	0.0607	-0.1402***	-0.1092**	0.0354	-0.1446**
				(0.0431)	(0.0380)	(0.0528)	(0.0429)	(0.0380)	(0.0550)
mom							-0.0543***	-0.0463**	-0.0080
							(0.0201)	(0.0178)	(0.0257)
_cons	-0.0001	-0.0023**	0.0022*	0.0002	-0.0023**	0.0025**	0.0002	-0.0024***	0.0025**
	(0.0010)	(0.0009)	(0.0013)	(0.0010)	(0.0009)	(0.0012)	(0.0010)	(0.0009)	(0.0013)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0119	0.0068	-0.0052	0.0174	0.0182	0.0545	0.0892	0.0842	0.0437
F	0.02	1.57	0.57	1.49	1.51	2.59	3.03	2.91	1.95

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the following criteria: impact ratio (IP), first-tier footprint (FF), direct emissions footprint (DF), and carbon only footprint (CF). "Best" are formed with stocks that perform well on each criterion (small value), "worst" are formed with stocks that perform bad on each criterion (big value). Long-short portfolio returns= the best portfolio returns – the worst portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At various cut-offs (10%, 20%, 30%, and 50%), portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by equally weighting, and portfolios in Panel D is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-1 Portfolio Return Regressions on UK IP, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.2053***	1.3558***	-0.1506**	0.9839***	1.0842***	-0.1003	0.9855***	1.0815***	-0.0960
	(0.0969)	(0.0896)	(0.0727)	(0.0561)	(0.0581)	(0.0832)	(0.0566)	(0.0585)	(0.0838)
smb				0.8534***	0.6684***	0.1850**	0.8615***	0.6550***	0.2065**
				(0.0580)	(0.0600)	(0.0860)	(0.0623)	(0.0644)	(0.0923)
hml				-0.0846	0.1994**	-0.2841**	-0.0711	0.1771*	-0.2482*
				(0.0893)	(0.0925)	(0.1325)	(0.0970)	(0.1003)	(0.1437)
mom							0.0198	-0.0325	0.0523
							(0.0536)	(0.0554)	(0.0793)
_cons	0.0069*	0.0005	0.0063**	0.0069***	0.0002	0.0067**	0.0068***	0.0004	0.0064**
	(0.0041)	(0.0038)	(0.0030)	(0.0020)	(0.0021)	(0.0030)	(0.0020)	(0.0021)	(0.0030)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6492	0.7330	0.0382	0.9149	0.9188	0.0865	0.9140	0.9181	0.0800
F	154.58	228.89	4.29	298.63	313.90	3.62	221.59	233.58	2.80

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1982***	0.9235***	0.2747**	1.0271***	1.0073***	0.0198	1.0248***	1.0188***	0.0059
	(0.0864)	(0.0582)	(0.1145)	(0.0939)	(0.0669)	(0.1238)	(0.0947)	(0.0654)	(0.1234)
smb				0.2154**	0.0194	0.1960	0.2038*	0.0765	0.1272
				(0.0970)	(0.0691)	(0.1279)	(0.1043)	(0.0721)	(0.1358)
hml				0.2905*	-0.2424**	0.5328***	0.2711*	-0.1471	0.4181*
				(0.1495)	(0.1064)	(0.1970)	(0.1624)	(0.1122)	(0.2115)
mom							-0.0283	0.1390**	-0.1673
							(0.0897)	(0.0619)	(0.1168)
_cons	0.0002	0.0057**	-0.0055	-0.0002	0.0060**	-0.0063	-0.0001	0.0052**	-0.0053
	(0.0036)	(0.0024)	(0.0048)	(0.0034)	(0.0024)	(0.0044)	(0.0034)	(0.0024)	(0.0044)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6975	0.7512	0.0542	0.7413	0.7625	0.1998	0.7384	0.7739	0.2102
F	192.36	251.57	5.76	80.30	89.81	7.91	59.57	72.01	6.52

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0347	0.0487	-0.0834	0.0327	0.0480	-0.0153	0.0440	0.0488	-0.0048
	(0.0737)	(0.0397)	(0.0825)	(0.0850)	(0.0467)	(0.0967)	(0.0843)	(0.0471)	(0.0964)
smb				0.1385	0.0631	0.0754	0.1948**	0.0672	0.1276
				(0.0878)	(0.0483)	(0.0999)	(0.0928)	(0.0519)	(0.1062)
hml				-0.2932**	-0.0486	-0.2446	-0.1993	-0.0418	-0.1575
				(0.1353)	(0.0744)	(0.1539)	(0.1445)	(0.0808)	(0.1654)
mom							0.1369*	0.0099	0.1271
							(0.0798)	(0.0446)	(0.0913)
_cons	-0.0010	0.0014	-0.0024	-0.0006	0.0015	-0.0021	-0.0014	0.0014	-0.0028
	(0.0031)	(0.0017)	(0.0035)	(0.0030)	(0.0017)	(0.0035)	(0.0030)	(0.0017)	(0.0035)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0095	0.0061	0.0003	0.0277	0.0026	0.0066	0.0508	-0.0094	0.0181
F	0.22	1.51	1.02	1.79	1.07	1.18	2.11	0.81	1.38

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-2 Portfolio Return Regressions on UK IP, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1614***	1.2818***	-0.1204*	0.9833***	1.0758***	-0.0925	0.9846***	1.0747***	-0.0901
	(0.0872)	(0.0807)	(0.0657)	(0.0550)	(0.0549)	(0.0768)	(0.0555)	(0.0554)	(0.0774)
smb				0.7576***	0.6327***	0.1248	0.7640***	0.6274***	0.1366
				(0.0568)	(0.0568)	(0.0793)	(0.0611)	(0.0610)	(0.0852)
hml				-0.1250	0.0506	-0.1756	-0.1143	0.0417	-0.1560
				(0.0875)	(0.0875)	(0.1222)	(0.0951)	(0.0951)	(0.1327)
mom							0.0156	-0.0130	0.0286
							(0.0525)	(0.0525)	(0.0733)
_cons	0.0061	-0.0004	0.0065**	0.0062***	-0.0006	0.0067**	0.0061***	-0.0005	0.0066**
	(0.0037)	(0.0034)	(0.0028)	(0.0020)	(0.0020)	(0.0027)	(0.0020)	(0.0020)	(0.0028)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6802	0.7518	0.0276	0.9080	0.9167	0.0409	0.9069	0.9157	0.0306
F	177.50	252.37	3.35	273.93	305.42	2.18	203.13	226.39	1.66

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.2028***	0.9622***	0.2406**	1.0735***	1.0459***	0.0276	1.0750***	1.0538***	0.0212
	(0.0702)	(0.0457)	(0.0998)	(0.0753)	(0.0514)	(0.1067)	(0.0760)	(0.0506)	(0.1074)
smb				0.2334***	-0.0340	0.2674**	0.2408***	0.0052	0.2357**
				(0.0778)	(0.0531)	(0.1103)	(0.0837)	(0.0557)	(0.1182)
hml				0.1629	-0.1992**	0.3620**	0.1753	-0.1338	0.3091*
				(0.1199)	(0.0818)	(0.1699)	(0.1304)	(0.0867)	(0.1841)
mom							0.0181	0.0953**	-0.0772
							(0.0720)	(0.0479)	(0.1016)
_cons	-0.0012	0.0027	-0.0039	-0.0015	0.0030	-0.0045	-0.0016	0.0024	-0.0040
	(0.0029)	(0.0019)	(0.0042)	(0.0027)	(0.0018)	(0.0038)	(0.0027)	(0.0018)	(0.0039)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7791	0.8419	0.0548	0.8157	0.8556	0.2175	0.8135	0.8608	0.2133
F	293.70	442.94	5.81	123.48	164.93	8.69	91.54	129.27	6.63

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0348	-0.0098	-0.0251	0.0546	0.0148	0.0398	0.0697	0.0117	0.0580
	(0.0611)	(0.0338)	(0.0707)	(0.0698)	(0.0398)	(0.0828)	(0.0670)	(0.0400)	(0.0794)
smb				0.0546	0.0136	0.0410	0.1294*	-0.0018	0.1312
				(0.0721)	(0.0412)	(0.0856)	(0.0738)	(0.0440)	(0.0874)
hml				-0.2857**	-0.0773	-0.2083	-0.1608	-0.1031	-0.0578
				(0.1111)	(0.0634)	(0.1318)	(0.1150)	(0.0685)	(0.1361)
mom							0.1821***	-0.0375	0.2196***
							(0.0635)	(0.0378)	(0.0752)
_cons	-0.0015	-0.0013	-0.0001	-0.0011	-0.0012	0.0002	-0.0021	-0.0010	-0.0011
	(0.0026)	(0.0014)	(0.0030)	(0.0025)	(0.0014)	(0.0030)	(0.0024)	(0.0014)	(0.0029)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0082	-0.0112	-0.0106	0.0478	-0.0167	-0.0037	0.1268	-0.0170	0.0827
F	0.32	0.08	0.13	2.39	0.54	0.90	4.01	0.65	2.87

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-3 Portfolio Return Regressions on UK IP, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1545***	1.2490***	-0.0945*	0.9527***	1.0405***	-0.0879	0.9562***	1.0385***	-0.0822
	(0.0824)	(0.0768)	(0.0491)	(0.0458)	(0.0473)	(0.0574)	(0.0459)	(0.0477)	(0.0573)
smb				0.7242***	0.6242***	0.1000*	0.7419***	0.6139***	0.1280**
				(0.0473)	(0.0489)	(0.0593)	(0.0506)	(0.0525)	(0.0631)
hml				-0.0342	0.0639	-0.0982	-0.0048	0.0467	-0.0515
				(0.0729)	(0.0753)	(0.0913)	(0.0788)	(0.0818)	(0.0983)
mom							0.0430	-0.0251	0.0681
							(0.0435)	(0.0451)	(0.0543)
_cons	0.0030	0.0020	0.0010	0.0030*	0.0019	0.0011	0.0028*	0.0020	0.0007
	(0.0035)	(0.0032)	(0.0021)	(0.0016)	(0.0017)	(0.0020)	(0.0017)	(0.0017)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7015	0.7603	0.0316	0.9334	0.9342	0.0429	0.9333	0.9336	0.0498
F	196.06	264.20	3.71	388.55	393.54	2.24	291.58	292.69	2.09

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0732***	1.0059***	0.0673	1.0179***	1.0391***	-0.0212	1.0134***	1.0413***	-0.0279
	(0.0544)	(0.0437)	(0.0788)	(0.0615)	(0.0514)	(0.0907)	(0.0618)	(0.0518)	(0.0910)
smb				0.1578**	0.0134	0.1444	0.1356**	0.0245	0.1111
				(0.0635)	(0.0531)	(0.0937)	(0.0680)	(0.0570)	(0.1002)
hml				0.0232	-0.1005	0.1236	-0.0139	-0.0820	0.0681
				(0.0979)	(0.0819)	(0.1444)	(0.1059)	(0.0888)	(0.1561)
mom							-0.0541	0.0269	-0.0810
							(0.0584)	(0.0490)	(0.0862)
_cons	-0.0028	0.0032*	-0.0060*	-0.0029	0.0034*	-0.0062*	-0.0025	0.0032*	-0.0057*
	(0.0023)	(0.0018)	(0.0033)	(0.0022)	(0.0018)	(0.0032)	(0.0022)	(0.0019)	(0.0033)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8240	0.8646	-0.0033	0.8370	0.8640	0.0370	0.8367	0.8628	0.0356
F	389.71	530.98	0.73	143.06	176.72	2.06	107.32	131.46	1.77

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0027	-0.0025	-0.0002	0.0271	-0.0001	0.0271	0.0306	-0.0059	0.0366
	(0.0455)	(0.0388)	(0.0628)	(0.0532)	(0.0462)	(0.0743)	(0.0535)	(0.0458)	(0.0738)
smb				0.0681	0.0216	0.0465	0.0858	-0.0075	0.0933
				(0.0550)	(0.0477)	(0.0768)	(0.0589)	(0.0504)	(0.0812)
hml				-0.1351	-0.0238	-0.1113	-0.1056	-0.0722	-0.0334
				(0.0847)	(0.0735)	(0.1183)	(0.0917)	(0.0786)	(0.1265)
mom							0.0430	-0.0707	0.1137
							(0.0506)	(0.0434)	(0.0698)
_cons	-0.0032*	0.0011	-0.0042	-0.0030	0.0011	-0.0041	-0.0032*	0.0015	-0.0048*
	(0.0019)	(0.0016)	(0.0026)	(0.0019)	(0.0016)	(0.0027)	(0.0019)	(0.0017)	(0.0027)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0122	-0.0121	-0.0122	-0.0015	-0.0346	-0.0256	-0.0050	-0.0136	-0.0049
F	0.00	0.00	0.00	0.96	0.08	0.31	0.90	0.72	0.90

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-4 Portfolio Return Regressions on UK IP, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1911***	1.2262***	-0.0351	0.9664***	1.0159***	-0.0495	0.9677***	1.0128***	-0.0450
	(0.0773)	(0.0740)	(0.0334)	(0.0365)	(0.0344)	(0.0396)	(0.0368)	(0.0345)	(0.0395)
smb				0.6741***	0.6527***	0.0214	0.6809***	0.6375***	0.0433
				(0.0377)	(0.0356)	(0.0409)	(0.0405)	(0.0379)	(0.0435)
hml				0.0682	0.0463	0.0219	0.0795	0.0210	0.0585
				(0.0582)	(0.0548)	(0.0630)	(0.0631)	(0.0591)	(0.0677)
mom							0.0166	-0.0369	0.0535
							(0.0349)	(0.0326)	(0.0374)
_cons	0.0038	0.0037	0.0001	0.0037***	0.0036***	0.0001	0.0036***	0.0038***	-0.0003
	(0.0032)	(0.0031)	(0.0014)	(0.0013)	(0.0012)	(0.0014)	(0.0013)	(0.0012)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7401	0.7674	0.0012	0.9580	0.9635	-0.0148	0.9576	0.9637	-0.0017
F	237.32	274.88	1.10	632.16	732.13	0.60	469.59	551.33	0.96

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0773***	0.9646***	0.1127	1.0009***	1.0090***	-0.0081	0.9993***	1.0039***	-0.0045
	(0.0489)	(0.0332)	(0.0719)	(0.0557)	(0.0382)	(0.0816)	(0.0561)	(0.0379)	(0.0822)
smb				0.0513	0.0260	0.0253	0.0436	0.0003	0.0433
				(0.0575)	(0.0395)	(0.0843)	(0.0618)	(0.0417)	(0.0905)
hml				0.1656*	-0.1410**	0.3066**	0.1527	-0.1838***	0.3365**
				(0.0886)	(0.0609)	(0.1299)	(0.0963)	(0.0649)	(0.1409)
mom							-0.0188	-0.0625*	0.0437
							(0.0531)	(0.0359)	(0.0778)
_cons	-0.0035*	0.0015	-0.0051*	-0.0038*	0.0017	-0.0055*	-0.0037*	0.0021	-0.0058*
	(0.0020)	(0.0014)	(0.0030)	(0.0020)	(0.0014)	(0.0029)	(0.0020)	(0.0014)	(0.0030)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8539	0.9102	0.0173	0.8628	0.9140	0.0837	0.8612	0.9161	0.0758
F	485.94	842.65	2.46	174.92	294.93	3.53	129.78	227.59	2.70

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.0469	-0.0141	0.0609	0.0331	0.0035	0.0296	0.0380	-0.0019	0.0398
	(0.0368)	(0.0301)	(0.0514)	(0.0436)	(0.0355)	(0.0608)	(0.0435)	(0.0350)	(0.0596)
smb				0.0079	0.0229	-0.0150	0.0322	-0.0037	0.0359
				(0.0451)	(0.0367)	(0.0628)	(0.0479)	(0.0386)	(0.0656)
hml				0.0310	-0.0659	0.0969	0.0717	-0.1102*	0.1819*
				(0.0695)	(0.0566)	(0.0968)	(0.0746)	(0.0601)	(0.1021)
mom							0.0593	-0.0647*	0.1240**
							(0.0412)	(0.0332)	(0.0564)
_cons	-0.0031**	0.0011	-0.0042*	-0.0031**	0.0012	-0.0043*	-0.0035**	0.0015	-0.0050**
	(0.0015)	(0.0013)	(0.0022)	(0.0016)	(0.0013)	(0.0022)	(0.0016)	(0.0013)	(0.0021)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0075	-0.0095	0.0048	-0.0125	-0.0174	-0.0067	0.0009	0.0170	0.0394
F	1.63	0.22	1.40	0.66	0.53	0.82	1.02	1.36	1.85

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-5 Portfolio Return Regressions on UK FF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1199***	1.3482***	-0.2283***	0.9254***	1.1628***	-0.2374***	0.9220***	1.1615***	-0.2394***
	(0.0853)	(0.0808)	(0.0597)	(0.0578)	(0.0573)	(0.0708)	(0.0581)	(0.0578)	(0.0714)
smb				0.6971***	0.6382***	0.0589	0.6803***	0.6314***	0.0489
				(0.0597)	(0.0592)	(0.0731)	(0.0640)	(0.0637)	(0.0786)
hml				-0.0322	-0.0098	-0.0225	-0.0602	-0.0210	-0.0392
				(0.0919)	(0.0913)	(0.1127)	(0.0996)	(0.0992)	(0.1224)
mom							-0.0408	-0.0164	-0.0244
							(0.0550)	(0.0547)	(0.0676)
_cons	0.0082**	-0.0011	0.0093***	0.0082***	-0.0011	0.0093***	0.0085***	-0.0010	0.0095***
	(0.0036)	(0.0034)	(0.0025)	(0.0021)	(0.0020)	(0.0025)	(0.0021)	(0.0021)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6734	0.7698	0.1408	0.8918	0.9161	0.1267	0.8912	0.9151	0.1171
F	172.17	278.52	14.60	228.97	303.04	5.02	170.90	224.72	3.75

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0043***	1.0621***	-0.0579	0.9088***	1.1912***	-0.2824**	0.8930***	1.1949***	-0.3018**
	(0.0787)	(0.0693)	(0.1103)	(0.0914)	(0.0754)	(0.1202)	(0.0894)	(0.0759)	(0.1181)
smb				-0.0184	0.1557**	-0.1741	-0.0966	0.1740**	-0.2707**
				(0.0944)	(0.0779)	(0.1242)	(0.0984)	(0.0836)	(0.1300)
hml				0.2730*	-0.4739***	0.7469***	0.1425	-0.4433***	0.5858***
				(0.1454)	(0.1200)	(0.1913)	(0.1533)	(0.1302)	(0.2025)
mom							-0.1903**	0.0446	-0.2349**
							(0.0846)	(0.0719)	(0.1118)
_cons	-0.0040	-0.0026	-0.0015	-0.0044	-0.0019	-0.0026	-0.0033	-0.0021	-0.0012
	(0.0033)	(0.0029)	(0.0046)	(0.0033)	(0.0027)	(0.0043)	(0.0032)	(0.0027)	(0.0043)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6610	0.7382	-0.0088	0.6694	0.7756	0.1330	0.6853	0.7738	0.1685
F	162.85	235.06	0.28	57.01	96.60	5.24	46.19	71.99	5.21

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.0635	0.1225**	-0.0591	0.0141	0.0999	-0.0859	0.0088	0.0953	-0.0865
	(0.0572)	(0.0594)	(0.0804)	(0.0673)	(0.0675)	(0.0937)	(0.0675)	(0.0678)	(0.0946)
smb				0.0240	0.1916***	-0.1676*	-0.0020	0.1685**	-0.1706
				(0.0695)	(0.0697)	(0.0968)	(0.0743)	(0.0746)	(0.1042)
hml				0.1144	-0.0923	0.2067	0.0710	-0.1307	0.2017
				(0.1071)	(0.1074)	(0.1492)	(0.1157)	(0.1162)	(0.1622)
mom							-0.0633	-0.0560	-0.0073
							(0.0639)	(0.0641)	(0.0895)
_cons	-0.0033	-0.0026	-0.0007	-0.0035	-0.0025	-0.0010	-0.0031	-0.0022	-0.0009
	(0.0024)	(0.0025)	(0.0034)	(0.0024)	(0.0024)	(0.0033)	(0.0024)	(0.0024)	(0.0034)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0028	0.0378	-0.0056	0.0029	0.1008	0.0119	0.0027	0.0981	-0.0006
F	1.23	4.26	0.54	1.08	4.10	1.33	1.06	3.26	0.99

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-6 Portfolio Return Regressions on UK FF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0380***	1.3068***	-0.2687***	0.8846***	1.0924***	-0.2077***	0.8894***	1.0895***	-0.2001***
	(0.0785)	(0.0791)	(0.0488)	(0.0476)	(0.0424)	(0.0566)	(0.0475)	(0.0426)	(0.0560)
smb				0.6998***	0.6815***	0.0184	0.7237***	0.6672***	0.0564
				(0.0492)	(0.0438)	(0.0585)	(0.0523)	(0.0469)	(0.0617)
hml				-0.1456*	0.0342	-0.1798**	-0.1058	0.0105	-0.1162
				(0.0757)	(0.0675)	(0.0901)	(0.0815)	(0.0730)	(0.0961)
mom							0.0581	-0.0346	0.0926*
							(0.0450)	(0.0403)	(0.0531)
_cons	0.0053	0.0040	0.0012	0.0054***	0.0039**	0.0015	0.0051***	0.0041***	0.0009
	(0.0033)	(0.0033)	(0.0020)	(0.0017)	(0.0015)	(0.0020)	(0.0017)	(0.0015)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6767	0.7662	0.2607	0.9141	0.9514	0.2819	0.9148	0.9512	0.2999
F	174.70	273.02	30.27	295.52	542.71	11.86	223.90	405.87	9.89

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0027***	0.9402***	0.0625	0.9644***	1.0445***	-0.0802	0.9546***	1.0484***	-0.0938
	(0.0622)	(0.0431)	(0.0826)	(0.0718)	(0.0440)	(0.0885)	(0.0711)	(0.0441)	(0.0872)
smb				0.1521**	-0.1469***	0.2989***	0.1036	-0.1279**	0.2315**
				(0.0742)	(0.0455)	(0.0914)	(0.0783)	(0.0486)	(0.0960)
hml				-0.0182	-0.1647**	0.1465	-0.0991	-0.1331*	0.0340
				(0.1143)	(0.0701)	(0.1409)	(0.1219)	(0.0756)	(0.1495)
mom							-0.1180*	0.0461	-0.1641*
							(0.0673)	(0.0418)	(0.0825)
_cons	-0.0030	0.0009	-0.0039	-0.0030	0.0012	-0.0042	-0.0023	0.0009	-0.0032
	(0.0026)	(0.0018)	(0.0035)	(0.0026)	(0.0016)	(0.0032)	(0.0026)	(0.0016)	(0.0031)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7574	0.8509	-0.0052	0.7658	0.8876	0.1651	0.7718	0.8879	0.1948
F	260.14	474.76	0.57	91.49	219.48	6.47	71.16	165.36	6.02

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.0186	-0.0166	0.0352	-0.0217	0.0230	-0.0448	-0.0238	0.0190	-0.0428
	(0.0538)	(0.0303)	(0.0615)	(0.0632)	(0.0350)	(0.0711)	(0.0638)	(0.0349)	(0.0717)
smb				0.0474	-0.0064	0.0538	0.0372	-0.0266	0.0638
				(0.0653)	(0.0362)	(0.0735)	(0.0702)	(0.0384)	(0.0789)
hml				0.0712	-0.1020*	0.1732	0.0542	-0.1356**	0.1898
				(0.1007)	(0.0557)	(0.1132)	(0.1093)	(0.0598)	(0.1229)
mom							-0.0248	-0.0490	0.0242
							(0.0603)	(0.0330)	(0.0679)
_cons	-0.0028	-0.0001	-0.0027	-0.0029	0.0001	-0.0029	-0.0027	0.0003	-0.0031
	(0.0023)	(0.0013)	(0.0026)	(0.0023)	(0.0013)	(0.0025)	(0.0023)	(0.0013)	(0.0026)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0107	-0.0085	-0.0082	-0.0122	0.0228	0.0264	-0.0228	0.0373	0.0157
F	0.12	0.30	0.33	0.67	1.65	1.75	0.54	1.80	1.33

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-7 Portfolio Return Regressions on UK FF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.1047***	1.2996***	-0.1949***	0.9191***	1.0768***	-0.1577***	0.9220***	1.0746***	-0.1526***
	(0.0742)	(0.0770)	(0.0440)	(0.0433)	(0.0381)	(0.0517)	(0.0435)	(0.0383)	(0.0517)
smb				0.6363***	0.6642***	-0.0278	0.6511***	0.6536***	-0.0025
				(0.0447)	(0.0394)	(0.0534)	(0.0479)	(0.0422)	(0.0569)
hml				-0.0074	0.0708	-0.0782	0.0172	0.0531	-0.0359
				(0.0689)	(0.0607)	(0.0823)	(0.0746)	(0.0657)	(0.0886)
mom							0.0359	-0.0257	0.0617
							(0.0412)	(0.0363)	(0.0489)
_cons	0.0036	0.0049	-0.0013	0.0036**	0.0047***	-0.0012	0.0033**	0.0049***	-0.0015
	(0.0031)	(0.0032)	(0.0018)	(0.0015)	(0.0014)	(0.0018)	(0.0016)	(0.0014)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7264	0.7737	0.1833	0.9327	0.9599	0.1838	0.9325	0.9597	0.1897
F	221.38	284.71	19.62	384.47	663.30	7.23	287.68	494.51	5.86

Panel B Value-weighted Portfolio

Panel B	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.0885***	1.0011***	0.0874	1.0075***	1.0740***	-0.0665	0.9938***	1.0732***	-0.0795
	(0.0525)	(0.0478)	(0.0783)	(0.0599)	(0.0545)	(0.0868)	(0.0571)	(0.0550)	(0.0856)
smb				0.0525	-0.0524	0.1049	-0.0158	-0.0563	0.0405
				(0.0618)	(0.0563)	(0.0897)	(0.0629)	(0.0606)	(0.0942)
hml				0.1770*	-0.1552*	0.3322**	0.0630	-0.1616*	0.2247
				(0.0953)	(0.0868)	(0.1381)	(0.0979)	(0.0944)	(0.1468)
mom							-0.1663***	-0.0094	-0.1569*
							(0.0540)	(0.0521)	(0.0810)
_cons	-0.0046**	0.0012	-0.0058*	-0.0049**	0.0014	-0.0063**	-0.0039*	0.0014	-0.0053*
	(0.0022)	(0.0020)	(0.0033)	(0.0021)	(0.0019)	(0.0031)	(0.0021)	(0.0020)	(0.0031)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8380	0.8406	0.0030	0.8474	0.8498	0.1136	0.8620	0.8480	0.1430
F	430.36	438.71	1.25	154.67	157.53	4.54	130.65	116.72	4.46

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0027	-0.0029	0.0003	0.0202	0.0298	-0.0096	0.0215	0.0254	-0.0039
	(0.0347)	(0.0454)	(0.0572)	(0.0409)	(0.0536)	(0.0681)	(0.0413)	(0.0537)	(0.0682)
smb				-0.0059	-0.0018	-0.0041	0.0003	-0.0237	0.0240
				(0.0423)	(0.0554)	(0.0703)	(0.0455)	(0.0591)	(0.0751)
hml				-0.0573	-0.0872	0.0299	-0.0470	-0.1238	0.0768
				(0.0652)	(0.0853)	(0.1083)	(0.0708)	(0.0921)	(0.1170)
mom							0.0151	-0.0534	0.0684
							(0.0391)	(0.0508)	(0.0646)
_cons	-0.0032**	0.0016	-0.0048**	-0.0031**	0.0017	-0.0049**	-0.0032**	0.0021	-0.0053**
	(0.0015)	(0.0019)	(0.0024)	(0.0015)	(0.0019)	(0.0024)	(0.0015)	(0.0019)	(0.0025)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0121	-0.0121	-0.0122	-0.0229	-0.0202	-0.0364	-0.0339	-0.0189	-0.0349
F	0.01	0.00	0.00	0.38	0.45	0.03	0.32	0.62	0.30

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-8 Portfolio Return Regressions on UK FF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1503***	1.2651***	-0.1149***	0.9323***	1.0482***	-0.1159***	0.9339***	1.0449***	-0.1110***
	(0.0756)	(0.0755)	(0.0331)	(0.0391)	(0.0313)	(0.0392)	(0.0394)	(0.0313)	(0.0390)
smb				0.6442***	0.6807***	-0.0365	0.6521***	0.6644***	-0.0123
				(0.0404)	(0.0324)	(0.0405)	(0.0434)	(0.0344)	(0.0429)
hml				0.0736	0.0416	0.0320	0.0869	0.0144	0.0725
				(0.0622)	(0.0499)	(0.0624)	(0.0675)	(0.0536)	(0.0668)
mom							0.0193	-0.0397	0.0590
							(0.0373)	(0.0296)	(0.0369)
_cons	0.0027	0.0048	-0.0021	0.0026*	0.0047***	-0.0021	0.0025*	0.0049***	-0.0025*
	(0.0032)	(0.0032)	(0.0014)	(0.0014)	(0.0011)	(0.0014)	(0.0014)	(0.0011)	(0.0014)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7352	0.7712	0.1173	0.9488	0.9715	0.1045	0.9483	0.9718	0.1216
F	231.44	280.70	12.03	513.53	943.49	4.23	381.69	715.16	3.87

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0540***	1.0033***	0.0507	0.9926***	1.0374***	-0.0447	0.9866***	1.0343***	-0.0478
	(0.0380)	(0.0333)	(0.0602)	(0.0429)	(0.0388)	(0.0687)	(0.0424)	(0.0389)	(0.0692)
smb				0.0586	0.0255	0.0331	0.0284	0.0105	0.0179
				(0.0443)	(0.0401)	(0.0710)	(0.0467)	(0.0429)	(0.0762)
hml				0.1190*	-0.1125*	0.2315**	0.0686	-0.1375**	0.2061*
				(0.0683)	(0.0618)	(0.1093)	(0.0727)	(0.0668)	(0.1186)
mom							-0.0735*	-0.0364	-0.0371
							(0.0402)	(0.0369)	(0.0655)
_cons	-0.0024	0.0010	-0.0034	-0.0026*	0.0011	-0.0037	-0.0022	0.0013	-0.0035
	(0.0016)	(0.0014)	(0.0025)	(0.0015)	(0.0014)	(0.0025)	(0.0015)	(0.0014)	(0.0025)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9027	0.9162	-0.0035	0.9100	0.9175	0.0548	0.9126	0.9175	0.0467
F	770.99	908.08	0.71	280.75	308.84	2.60	217.58	231.81	2.02

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.0204	0.0143	0.0060	0.0307	0.0190	0.0117	0.0324	0.0148	0.0175
	(0.0299)	(0.0313)	(0.0456)	(0.0355)	(0.0371)	(0.0541)	(0.0358)	(0.0370)	(0.0540)
smb				-0.0065	0.0325	-0.0390	0.0019	0.0119	-0.0100
				(0.0367)	(0.0383)	(0.0559)	(0.0394)	(0.0407)	(0.0594)
hml				-0.0226	-0.0386	0.0160	-0.0086	-0.0731	0.0644
				(0.0565)	(0.0591)	(0.0861)	(0.0613)	(0.0634)	(0.0925)
mom							0.0204	-0.0502	0.0706
							(0.0338)	(0.0350)	(0.0511)
_cons	-0.0022*	0.0006	-0.0028	-0.0022*	0.0006	-0.0028	-0.0023*	0.0009	-0.0032*
	(0.0013)	(0.0013)	(0.0019)	(0.0013)	(0.0013)	(0.0019)	(0.0013)	(0.0013)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0065	-0.0096	-0.0120	-0.0275	-0.0245	-0.0307	-0.0357	-0.0111	-0.0191
F	0.46	0.21	0.02	0.26	0.34	0.18	0.28	0.77	0.61

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-9 Portfolio Return Regressions on UK DF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1818***	1.2626***	-0.0808	0.9839***	1.0665***	-0.0826	0.9821***	1.0688***	-0.0867
	(0.0821)	(0.0871)	(0.0657)	(0.0568)	(0.0675)	(0.0781)	(0.0573)	(0.0681)	(0.0787)
smb				0.6493***	0.6422***	0.0071	0.6406***	0.6538***	-0.0132
				(0.0587)	(0.0698)	(0.0807)	(0.0631)	(0.0750)	(0.0866)
hml				0.0154	0.0161	-0.0008	0.0008	0.0355	-0.0346
				(0.0905)	(0.1075)	(0.1244)	(0.0983)	(0.1167)	(0.1349)
mom							-0.0212	0.0282	-0.0494
							(0.0542)	(0.0644)	(0.0745)
_cons	0.0073**	0.0026	0.0047*	0.0073***	0.0025	0.0047*	0.0074***	0.0024	0.0050*
	(0.0034)	(0.0037)	(0.0028)	(0.0020)	(0.0024)	(0.0028)	(0.0021)	(0.0025)	(0.0028)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7132	0.7160	0.0062	0.9005	0.8764	-0.0186	0.8994	0.8751	-0.0257
F	207.37	210.27	1.51	251.29	197.16	0.50	186.51	146.42	0.48

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.2240***	1.0681***	0.1560	1.1297***	1.1360***	-0.0063	1.1206***	1.1283***	-0.0077
	(0.0894)	(0.0628)	(0.1188)	(0.1043)	(0.0717)	(0.1352)	(0.1045)	(0.0715)	(0.1364)
smb				-0.0533	0.1344*	-0.1876	-0.0980	0.0965	-0.1945
				(0.1077)	(0.0741)	(0.1397)	(0.1150)	(0.0788)	(0.1502)
hml				0.2981*	-0.2913**	0.5894***	0.2235	-0.3544***	0.5779**
				(0.1660)	(0.1141)	(0.2152)	(0.1791)	(0.1227)	(0.2339)
mom							-0.1087	-0.0920	-0.0167
							(0.0989)	(0.0677)	(0.1291)
_cons	-0.0002	-0.0038	0.0036	-0.0006	-0.0034	0.0028	0.0000	-0.0028	0.0029
	(0.0037)	(0.0026)	(0.0050)	(0.0037)	(0.0026)	(0.0048)	(0.0038)	(0.0026)	(0.0049)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6918	0.7762	0.0086	0.6968	0.7892	0.0711	0.6976	0.7914	0.0596
F	187.28	288.84	1.72	64.57	104.57	3.12	48.86	79.72	2.31

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0190	0.1913***	-0.2103**	0.1212	0.1629**	-0.0417	0.1341	0.1584**	-0.0244
	(0.0776)	(0.0590)	(0.0989)	(0.0861)	(0.0644)	(0.1040)	(0.0850)	(0.0647)	(0.1020)
smb				-0.1547*	0.2542***	-0.4088***	-0.0908	0.2319***	-0.3227***
				(0.0890)	(0.0666)	(0.1075)	(0.0935)	(0.0713)	(0.1123)
hml				-0.2553*	-0.1267	-0.1286	-0.1487	-0.1638	0.0151
				(0.1371)	(0.1026)	(0.1656)	(0.1457)	(0.1110)	(0.1749)
mom							0.1555*	-0.0541	0.2096**
							(0.0804)	(0.0613)	(0.0965)
_cons	-0.0012	-0.0030	0.0019	-0.0008	-0.0029	0.0021	-0.0017	-0.0026	0.0009
	(0.0033)	(0.0025)	(0.0041)	(0.0031)	(0.0023)	(0.0037)	(0.0031)	(0.0023)	(0.0037)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0115	0.1030	0.0407	0.0973	0.2249	0.2317	0.1272	0.2227	0.2658
F	0.06	10.53	4.52	3.98	9.03	9.34	4.02	6.95	8.51

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-10 Portfolio Return Regressions on UK DF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.1824***	1.2604***	-0.0780*	0.9837***	1.0834***	-0.0997*	0.9826***	1.0843***	-0.1017*
	(0.0797)	(0.0797)	(0.0448)	(0.0380)	(0.0517)	(0.0528)	(0.0384)	(0.0521)	(0.0532)
smb				0.7288***	0.6706***	0.0582	0.7234***	0.6752***	0.0482
				(0.0393)	(0.0534)	(0.0545)	(0.0422)	(0.0574)	(0.0586)
hml				-0.0464	-0.0583	0.0119	-0.0554	-0.0507	-0.0047
				(0.0606)	(0.0822)	(0.0840)	(0.0658)	(0.0894)	(0.0912)
mom							-0.0131	0.0111	-0.0242
							(0.0363)	(0.0493)	(0.0504)
_cons	0.0072**	0.0046	0.0026	0.0072***	0.0047**	0.0026	0.0073***	0.0046**	0.0027
	(0.0033)	(0.0033)	(0.0019)	(0.0014)	(0.0018)	(0.0019)	(0.0014)	(0.0019)	(0.0019)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7251	0.7503	0.0239	0.9547	0.9240	0.0195	0.9542	0.9231	0.0100
F	219.89	250.36	3.03	584.26	337.23	1.55	433.47	249.93	1.21

Panel B Value-weighted Portfolio

Panel B	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.0500***	1.1050***	-0.0551	1.0053***	1.1020***	-0.0967	0.9969***	1.0888***	-0.0919
	(0.0574)	(0.0625)	(0.0882)	(0.0676)	(0.0726)	(0.1037)	(0.0672)	(0.0708)	(0.1045)
smb				0.0281	0.1458*	-0.1177	-0.0137	0.0805	-0.0942
				(0.0698)	(0.0750)	(0.1071)	(0.0739)	(0.0780)	(0.1150)
hml				0.0982	-0.1086	0.2069	0.0285	-0.2177*	0.2461
				(0.1076)	(0.1156)	(0.1651)	(0.1151)	(0.1215)	(0.1791)
mom							-0.1017	-0.1590**	0.0573
							(0.0636)	(0.0670)	(0.0989)
_cons	-0.0012	0.0006	-0.0017	-0.0013	0.0007	-0.0020	-0.0007	0.0016	-0.0024
	(0.0024)	(0.0026)	(0.0037)	(0.0024)	(0.0026)	(0.0037)	(0.0024)	(0.0026)	(0.0038)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8008	0.7899	-0.0074	0.8000	0.7944	-0.0083	0.8038	0.8056	-0.0168
F	334.69	313.03	0.39	111.68	107.87	0.77	86.03	86.98	0.66

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0579	0.0507	-0.1086	0.0164	0.0171	-0.0007	0.0222	0.0120	0.0102
	(0.0529)	(0.0618)	(0.0889)	(0.0605)	(0.0722)	(0.1015)	(0.0605)	(0.0725)	(0.1012)
smb				-0.0767	0.1150	-0.1916*	-0.0478	0.0898	-0.1376
				(0.0625)	(0.0746)	(0.1048)	(0.0666)	(0.0798)	(0.1114)
hml				-0.1396	-0.0012	-0.1383	-0.0914	-0.0432	-0.0482
				(0.0963)	(0.1149)	(0.1615)	(0.1037)	(0.1243)	(0.1735)
mom							0.0702	-0.0613	0.1315
							(0.0572)	(0.0686)	(0.0958)
_cons	-0.0015	0.0025	-0.0040	-0.0013	0.0025	-0.0038	-0.0017	0.0029	-0.0046
	(0.0022)	(0.0026)	(0.0037)	(0.0022)	(0.0026)	(0.0036)	(0.0022)	(0.0026)	(0.0036)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0024	-0.0040	0.0059	0.0552	0.0079	0.0623	0.0611	0.0053	0.0725
F	1.20	0.67	1.49	2.62	1.22	2.84	2.35	1.11	2.62

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-11 Portfolio Return Regressions on UK DF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1388***	1.2770***	-0.1383***	0.9539***	1.0499***	-0.0959**	0.9575***	1.0474***	-0.0899*
	(0.0746)	(0.0826)	(0.0398)	(0.0402)	(0.0412)	(0.0460)	(0.0402)	(0.0415)	(0.0456)
smb				0.6593***	0.7244***	-0.0651	0.6771***	0.7121***	-0.0350
				(0.0415)	(0.0426)	(0.0475)	(0.0443)	(0.0457)	(0.0502)
hml				-0.0281	0.0343	-0.0624	0.0016	0.0138	-0.0122
				(0.0640)	(0.0657)	(0.0733)	(0.0690)	(0.0711)	(0.0782)
mom							0.0432	-0.0299	0.0731*
							(0.0381)	(0.0393)	(0.0432)
_cons	0.0045	0.0053	-0.0007	0.0045***	0.0052***	-0.0006	0.0043***	0.0053***	-0.0011
	(0.0031)	(0.0035)	(0.0017)	(0.0014)	(0.0015)	(0.0016)	(0.0015)	(0.0015)	(0.0016)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7367	0.7414	0.1178	0.9446	0.9533	0.1450	0.9448	0.9531	0.1645
F	233.28	238.92	12.09	473.08	566.31	5.69	356.42	422.64	5.08

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0482***	1.1630***	-0.1149	1.0171***	1.1134***	-0.0963	1.0040***	1.1040***	-0.1000
	(0.0523)	(0.0605)	(0.0796)	(0.0615)	(0.0679)	(0.0935)	(0.0591)	(0.0672)	(0.0943)
smb				0.0657	0.2055***	-0.1398	0.0006	0.1587**	-0.1581
				(0.0635)	(0.0702)	(0.0966)	(0.0651)	(0.0740)	(0.1038)
hml				0.0314	-0.0304	0.0618	-0.0772	-0.1085	0.0313
				(0.0979)	(0.1081)	(0.1489)	(0.1014)	(0.1152)	(0.1616)
mom							-0.1584***	-0.1139*	-0.0444
							(0.0560)	(0.0636)	(0.0892)
_cons	-0.0031	-0.0011	-0.0020	-0.0031	-0.0011	-0.0021	-0.0022	-0.0004	-0.0018
	(0.0022)	(0.0025)	(0.0033)	(0.0022)	(0.0024)	(0.0033)	(0.0021)	(0.0024)	(0.0034)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8286	0.8161	0.0128	0.8283	0.8324	0.0149	0.8422	0.8369	0.0055
F	402.38	369.29	2.08	134.51	138.37	1.42	111.72	107.45	1.12

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0180	0.0635	-0.0816	0.0388	0.0105	0.0283	0.0406	0.0049	0.0357
	(0.0453)	(0.0578)	(0.0819)	(0.0525)	(0.0662)	(0.0931)	(0.0530)	(0.0664)	(0.0934)
smb				-0.0294	0.1422**	-0.1716*	-0.0206	0.1144	-0.1351
				(0.0543)	(0.0684)	(0.0962)	(0.0583)	(0.0731)	(0.1028)
hml				-0.1302	0.0295	-0.1597	-0.1155	-0.0168	-0.0987
				(0.0836)	(0.1055)	(0.1482)	(0.0908)	(0.1138)	(0.1601)
mom							0.0214	-0.0675	0.0890
							(0.0501)	(0.0628)	(0.0884)
_cons	-0.0024	0.0012	-0.0036	-0.0022	0.0011	-0.0033	-0.0024	0.0015	-0.0039
	(0.0019)	(0.0024)	(0.0034)	(0.0019)	(0.0024)	(0.0033)	(0.0019)	(0.0024)	(0.0034)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0102	0.0025	-0.0001	0.0184	0.0512	0.0647	0.0082	0.0530	0.0648
F	0.16	1.21	0.99	1.52	2.49	2.91	1.17	2.16	2.44

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-12 Portfolio Return Regressions on UK DF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1551***	1.2596***	-0.1046***	0.9551***	1.0260***	-0.0709*	0.9548***	1.0245***	-0.0697
	(0.0712)	(0.0800)	(0.0360)	(0.0318)	(0.0398)	(0.0420)	(0.0321)	(0.0401)	(0.0423)
smb				0.6379***	0.6858***	-0.0479	0.6365***	0.6784***	-0.0420
				(0.0328)	(0.0411)	(0.0434)	(0.0353)	(0.0442)	(0.0466)
hml				0.0301	0.0827	-0.0527	0.0276	0.0704	-0.0427
				(0.0506)	(0.0634)	(0.0668)	(0.0550)	(0.0688)	(0.0726)
mom							-0.0035	-0.0180	0.0145
							(0.0304)	(0.0380)	(0.0401)
_cons	0.0045	0.0031	0.0014	0.0044***	0.0029**	0.0015	0.0045***	0.0030**	0.0014
	(0.0030)	(0.0034)	(0.0015)	(0.0011)	(0.0014)	(0.0015)	(0.0012)	(0.0014)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7594	0.7485	0.0823	0.9653	0.9549	0.0968	0.9649	0.9545	0.0869
F	262.92	248.01	8.44	771.70	587.14	3.97	571.64	436.14	2.97

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.9337***	1.1222***	-0.1884***	0.9460***	1.0789***	-0.1328*	0.9450***	1.0708***	-0.1258*
	(0.0324)	(0.0453)	(0.0675)	(0.0378)	(0.0499)	(0.0753)	(0.0381)	(0.0490)	(0.0754)
smb				-0.0672*	0.1748***	-0.2420***	-0.0725*	0.1347**	-0.2072**
				(0.0390)	(0.0516)	(0.0778)	(0.0420)	(0.0540)	(0.0830)
hml				0.0205	-0.0230	0.0435	0.0117	-0.0900	0.1016
				(0.0601)	(0.0795)	(0.1199)	(0.0653)	(0.0841)	(0.1292)
mom							-0.0129	-0.0977**	0.0848
							(0.0361)	(0.0464)	(0.0713)
_cons	-0.0016	0.0002	-0.0018	-0.0016	0.0003	-0.0019	-0.0015	0.0008	-0.0024
	(0.0014)	(0.0019)	(0.0028)	(0.0014)	(0.0018)	(0.0027)	(0.0014)	(0.0018)	(0.0027)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9092	0.8805	0.0756	0.9105	0.8951	0.1675	0.9095	0.8994	0.1718
F	831.65	612.46	7.78	282.36	237.17	6.57	209.50	186.61	5.30

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0297	0.0623	-0.0920*	0.0040	0.0215	-0.0175	0.0037	0.0173	-0.0136
	(0.0292)	(0.0391)	(0.0545)	(0.0336)	(0.0445)	(0.0610)	(0.0340)	(0.0446)	(0.0613)
smb				-0.0516	0.0994**	-0.1510**	-0.0530	0.0785	-0.1315*
				(0.0348)	(0.0460)	(0.0630)	(0.0374)	(0.0491)	(0.0675)
hml				-0.0497	0.0308	-0.0805	-0.0521	-0.0042	-0.0479
				(0.0536)	(0.0709)	(0.0971)	(0.0582)	(0.0764)	(0.1051)
mom							-0.0035	-0.0510	0.0475
							(0.0321)	(0.0422)	(0.0580)
_cons	-0.0016	0.0003	-0.0019	-0.0015	0.0003	-0.0018	-0.0015	0.0006	-0.0021
	(0.0012)	(0.0016)	(0.0023)	(0.0012)	(0.0016)	(0.0022)	(0.0012)	(0.0016)	(0.0022)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0004	0.0182	0.0218	0.0406	0.0767	0.1125	0.0286	0.0820	0.1088
F	1.03	2.54	2.85	2.17	3.30	4.51	1.61	2.85	3.53

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, "best" are formed with stocks that perform well on impact ratio (small DF), "worst" are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-13 Portfolio Return Regressions on UK CF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1483***	1.2132***	-0.0650	0.9615***	1.0438***	-0.0823	0.9580***	1.0463***	-0.0883
	(0.0819)	(0.0830)	(0.0646)	(0.0579)	(0.0642)	(0.0767)	(0.0582)	(0.0647)	(0.0770)
smb				0.6498***	0.6307***	0.0191	0.6322***	0.6432***	-0.0111
				(0.0598)	(0.0663)	(0.0793)	(0.0641)	(0.0712)	(0.0847)
hml				-0.0153	-0.0468	0.0315	-0.0446	-0.0258	-0.0188
				(0.0921)	(0.1022)	(0.1222)	(0.0998)	(0.1110)	(0.1320)
mom							-0.0428	0.0305	-0.0734
							(0.0551)	(0.0613)	(0.0729)
_cons	0.0075**	0.0023	0.0052*	0.0075***	0.0023	0.0052*	0.0077***	0.0021	0.0056**
	(0.0034)	(0.0035)	(0.0027)	(0.0021)	(0.0023)	(0.0027)	(0.0021)	(0.0023)	(0.0028)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7022	0.7194	0.0001	0.8923	0.8784	-0.0219	0.8918	0.8772	-0.0218
F	196.68	213.83	1.01	230.20	200.82	0.41	171.95	149.26	0.56

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.2022***	0.9218***	0.2804**	1.1159***	1.0196***	0.0963	1.1062***	1.0110***	0.0951
	(0.0879)	(0.0571)	(0.1151)	(0.1027)	(0.0627)	(0.1291)	(0.1027)	(0.0621)	(0.1303)
smb				-0.0586	0.1317**	-0.1903	-0.1067	0.0895	-0.1962
				(0.1061)	(0.0648)	(0.1334)	(0.1131)	(0.0683)	(0.1435)
hml				0.2804*	-0.3699***	0.6503***	0.2002	-0.4403***	0.6405***
				(0.1635)	(0.0998)	(0.2055)	(0.1761)	(0.1064)	(0.2234)
mom							-0.1171	-0.1027*	-0.0143
							(0.0972)	(0.0588)	(0.1233)
_cons	0.0009	0.0004	0.0005	0.0005	0.0009	-0.0004	0.0012	0.0015	-0.0003
	(0.0037)	(0.0024)	(0.0048)	(0.0037)	(0.0022)	(0.0046)	(0.0037)	(0.0022)	(0.0047)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.6915	0.7580	0.0561	0.6952	0.7887	0.1401	0.6969	0.7940	0.1294
F	187.04	261.01	5.94	64.12	104.26	5.51	48.72	80.97	4.08

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0319	-0.0185	-0.0135	0.1120	-0.0185	0.1305	0.1238	-0.0210	0.1449
	(0.0751)	(0.0508)	(0.0978)	(0.0825)	(0.0584)	(0.1078)	(0.0815)	(0.0588)	(0.1068)
smb				-0.1692*	0.1442**	-0.3134***	-0.1105	0.1316**	-0.2422**
				(0.0852)	(0.0603)	(0.1113)	(0.0897)	(0.0648)	(0.1176)
hml				-0.2538*	-0.1153	-0.1385	-0.1559	-0.1363	-0.0196
				(0.1313)	(0.0929)	(0.1715)	(0.1397)	(0.1008)	(0.1831)
mom							0.1428*	-0.0305	0.1733*
							(0.0771)	(0.0557)	(0.1011)
_cons	-0.0003	0.0027	-0.0030	0.0001	0.0029	-0.0028	-0.0008	0.0030	-0.0038
	(0.0032)	(0.0021)	(0.0041)	(0.0029)	(0.0021)	(0.0039)	(0.0029)	(0.0021)	(0.0039)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0100	-0.0106	-0.0120	0.1197	0.0336	0.1116	0.1456	0.0250	0.1326
F	0.18	0.13	0.02	4.76	1.96	4.47	4.54	1.53	4.17

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-14 Portfolio Return Regressions on UK CF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1957***	1.2360***	-0.0403	0.9884***	1.0500***	-0.0615	0.9856***	1.0516***	-0.0660
	(0.0847)	(0.0787)	(0.0475)	(0.0397)	(0.0499)	(0.0549)	(0.0398)	(0.0503)	(0.0550)
smb				0.7816***	0.6592***	0.1223**	0.7677***	0.6675***	0.1002
				(0.0410)	(0.0515)	(0.0567)	(0.0438)	(0.0554)	(0.0606)
hml				-0.0653	-0.0247	-0.0405	-0.0884	-0.0110	-0.0774
				(0.0631)	(0.0794)	(0.0874)	(0.0683)	(0.0862)	(0.0944)
mom							-0.0338	0.0200	-0.0538
							(0.0377)	(0.0476)	(0.0521)
_cons	0.0073**	0.0047	0.0027	0.0074***	0.0047**	0.0027	0.0076***	0.0046**	0.0030
	(0.0036)	(0.0033)	(0.0020)	(0.0014)	(0.0018)	(0.0020)	(0.0014)	(0.0018)	(0.0020)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7048	0.7477	-0.0034	0.9532	0.9266	0.0318	0.9531	0.9258	0.0326
F	199.14	246.94	0.72	564.47	350.14	1.91	422.51	259.94	1.70

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0482***	1.1451***	-0.0969	1.0023***	1.1623***	-0.1599	0.9944***	1.1560***	-0.1616
	(0.0568)	(0.0657)	(0.0918)	(0.0667)	(0.0773)	(0.1081)	(0.0664)	(0.0775)	(0.1091)
smb				0.0428	0.1027	-0.0598	0.0033	0.0715	-0.0682
				(0.0689)	(0.0798)	(0.1117)	(0.0731)	(0.0853)	(0.1201)
hml				0.0898	-0.1287	0.2184	0.0238	-0.1806	0.2044
				(0.1062)	(0.1230)	(0.1721)	(0.1138)	(0.1328)	(0.1871)
mom							-0.0961	-0.0757	-0.0204
							(0.0628)	(0.0733)	(0.1033)
_cons	-0.0015	0.0003	-0.0018	-0.0016	0.0005	-0.0021	-0.0011	0.0009	-0.0020
	(0.0024)	(0.0028)	(0.0038)	(0.0024)	(0.0028)	(0.0039)	(0.0024)	(0.0028)	(0.0039)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8038	0.7849	0.0014	0.8038	0.7847	-0.0034	0.8070	0.7849	-0.0155
F	341.03	303.84	1.12	114.32	101.83	0.91	87.77	76.70	0.68

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0596	0.0518	-0.1114	0.0129	0.0370	-0.0240	0.0184	0.0342	-0.0159
	(0.0515)	(0.0643)	(0.0901)	(0.0589)	(0.0760)	(0.1045)	(0.0589)	(0.0766)	(0.1048)
smb				-0.0736	0.0769	-0.1505	-0.0467	0.0633	-0.1100
				(0.0608)	(0.0785)	(0.1080)	(0.0648)	(0.0843)	(0.1154)
hml				-0.1373	-0.0214	-0.1160	-0.0924	-0.0440	-0.0484
				(0.0937)	(0.1209)	(0.1663)	(0.1010)	(0.1313)	(0.1797)
mom							0.0654	-0.0331	0.0985
							(0.0557)	(0.0725)	(0.0992)
_cons	-0.0017	0.0021	-0.0038	-0.0015	0.0021	-0.0036	-0.0019	0.0023	-0.0042
	(0.0022)	(0.0027)	(0.0038)	(0.0021)	(0.0027)	(0.0037)	(0.0021)	(0.0028)	(0.0038)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0041	-0.0042	0.0064	0.0568	-0.0160	0.0320	0.0612	-0.0261	0.0318
F	1.34	0.65	1.53	2.67	0.56	1.91	2.35	0.47	1.68

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-15 Portfolio Return Regressions on UK CF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1411***	1.2796***	-0.1385***	0.9521***	1.0376***	-0.0855*	0.9563***	1.0340***	-0.0777*
	(0.0762)	(0.0852)	(0.0415)	(0.0405)	(0.0407)	(0.0476)	(0.0404)	(0.0407)	(0.0467)
smb				0.6762***	0.7480***	-0.0718	0.6970***	0.7302***	-0.0332
				(0.0418)	(0.0420)	(0.0491)	(0.0445)	(0.0449)	(0.0514)
hml				-0.0303	0.0556	-0.0859	0.0044	0.0259	-0.0215
				(0.0645)	(0.0648)	(0.0757)	(0.0693)	(0.0699)	(0.0801)
mom							0.0506	-0.0433	0.0939**
							(0.0383)	(0.0386)	(0.0442)
_cons	0.0046	0.0048	-0.0002	0.0045***	0.0046***	-0.0001	0.0042***	0.0049***	-0.0006
	(0.0032)	(0.0036)	(0.0017)	(0.0014)	(0.0015)	(0.0017)	(0.0015)	(0.0015)	(0.0017)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7292	0.7299	0.1089	0.9446	0.9555	0.1524	0.9451	0.9556	0.1881
F	224.51	225.33	11.15	472.71	594.83	5.97	358.29	447.91	5.81

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0625***	1.1855***	-0.1231	1.0230***	1.1491***	-0.1261	1.0133***	1.1422***	-0.1289
	(0.0476)	(0.0663)	(0.0825)	(0.0552)	(0.0758)	(0.0975)	(0.0540)	(0.0759)	(0.0984)
smb				0.0940	0.1942**	-0.1002	0.0461	0.1601*	-0.1140
				(0.0570)	(0.0783)	(0.1008)	(0.0594)	(0.0835)	(0.1083)
hml				0.0315	-0.0570	0.0884	-0.0484	-0.1139	0.0655
				(0.0879)	(0.1206)	(0.1552)	(0.0925)	(0.1301)	(0.1686)
mom							-0.1165**	-0.0830	-0.0335
							(0.0511)	(0.0718)	(0.0931)
_cons	-0.0019	-0.0009	-0.0009	-0.0019	-0.0009	-0.0011	-0.0013	-0.0004	-0.0009
	(0.0020)	(0.0028)	(0.0035)	(0.0020)	(0.0027)	(0.0035)	(0.0019)	(0.0027)	(0.0035)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.8569	0.7934	0.0146	0.8608	0.8046	0.0025	0.8677	0.8054	-0.0085
F	498.21	319.78	2.23	172.07	114.92	1.07	137.13	86.89	0.83

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0272	0.0703	-0.0974	0.0222	0.0296	-0.0074	0.0249	0.0253	-0.0004
	(0.0389)	(0.0609)	(0.0799)	(0.0451)	(0.0706)	(0.0919)	(0.0453)	(0.0710)	(0.0922)
smb				-0.0173	0.1368*	-0.1541	-0.0037	0.1155	-0.1192
				(0.0465)	(0.0729)	(0.0949)	(0.0499)	(0.0781)	(0.1015)
hml				-0.1196*	0.0006	-0.1202	-0.0969	-0.0349	-0.0620
				(0.0717)	(0.1123)	(0.1462)	(0.0777)	(0.1217)	(0.1580)
mom							0.0331	-0.0517	0.0848
							(0.0429)	(0.0672)	(0.0872)
_cons	-0.0018	0.0009	-0.0027	-0.0016	0.0009	-0.0025	-0.0018	0.0012	-0.0030
	(0.0016)	(0.0026)	(0.0033)	(0.0016)	(0.0025)	(0.0033)	(0.0016)	(0.0026)	(0.0033)
N	84	84	84	84	84	84	84	84	84
AdjR2	-0.0062	0.0040	0.0058	0.0223	0.0328	0.0488	0.0173	0.0279	0.0481
F	0.49	1.33	1.49	1.63	1.94	2.42	1.37	1.59	2.05

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-4-16 Portfolio Return Regressions on UK CF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1549***	1.2599***	-0.1050***	0.9628***	1.0187***	-0.0559	0.9634***	1.0165***	-0.0531
	(0.0706)	(0.0806)	(0.0361)	(0.0315)	(0.0397)	(0.0414)	(0.0318)	(0.0400)	(0.0417)
smb				0.6385***	0.6853***	-0.0468	0.6410***	0.6741***	-0.0330
				(0.0326)	(0.0410)	(0.0428)	(0.0350)	(0.0440)	(0.0459)
hml				0.0081	0.1036	-0.0956	0.0123	0.0849	-0.0727
				(0.0502)	(0.0632)	(0.0660)	(0.0545)	(0.0685)	(0.0714)
mom							0.0061	-0.0272	0.0334
							(0.0301)	(0.0378)	(0.0394)
_cons	0.0044	0.0032	0.0013	0.0044***	0.0030**	0.0014	0.0043***	0.0031**	0.0012
	(0.0030)	(0.0034)	(0.0015)	(0.0011)	(0.0014)	(0.0015)	(0.0011)	(0.0014)	(0.0015)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.7627	0.7459	0.0825	0.9658	0.9553	0.1247	0.9653	0.9550	0.1216
F	267.78	244.58	8.46	781.20	591.91	4.94	578.89	441.39	3.87

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.9495***	1.1021***	-0.1526**	0.9588***	1.0633***	-0.1045	0.9583***	1.0547***	-0.0964
	(0.0319)	(0.0452)	(0.0670)	(0.0376)	(0.0511)	(0.0766)	(0.0380)	(0.0501)	(0.0765)
smb				-0.0453	0.1396***	-0.1849**	-0.0478	0.0969*	-0.1447*
				(0.0389)	(0.0528)	(0.0792)	(0.0418)	(0.0552)	(0.0842)
hml				0.0113	-0.0067	0.0180	0.0071	-0.0779	0.0850
				(0.0599)	(0.0814)	(0.1220)	(0.0651)	(0.0859)	(0.1311)
mom							-0.0061	-0.1039**	0.0978
							(0.0359)	(0.0474)	(0.0724)
_cons	-0.0024*	0.0015	-0.0040	-0.0024*	0.0015	-0.0040	-0.0024*	0.0021	-0.0045
	(0.0013)	(0.0019)	(0.0028)	(0.0013)	(0.0018)	(0.0027)	(0.0014)	(0.0018)	(0.0028)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.9142	0.8773	0.0481	0.9137	0.8864	0.0977	0.9126	0.8915	0.1069
F	885.23	594.49	5.19	293.80	216.86	3.99	217.68	171.57	3.48

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0292	0.0666	-0.0958*	0.0021	0.0282	-0.0261	0.0014	0.0245	-0.0231
	(0.0288)	(0.0402)	(0.0555)	(0.0335)	(0.0464)	(0.0633)	(0.0338)	(0.0465)	(0.0638)
smb				-0.0329	0.0809*	-0.1138*	-0.0363	0.0626	-0.0989
				(0.0346)	(0.0479)	(0.0654)	(0.0372)	(0.0512)	(0.0702)
hml				-0.0583	0.0390	-0.0973	-0.0639	0.0085	-0.0723
				(0.0533)	(0.0739)	(0.1008)	(0.0579)	(0.0798)	(0.1094)
mom							-0.0082	-0.0446	0.0364
							(0.0320)	(0.0441)	(0.0604)
_cons	-0.0020	0.0007	-0.0026	-0.0019	0.0006	-0.0025	-0.0018	0.0009	-0.0027
	(0.0012)	(0.0017)	(0.0023)	(0.0012)	(0.0017)	(0.0023)	(0.0012)	(0.0017)	(0.0023)
N	84	84	84	84	84	84	84	84	84
AdjR2	0.0004	0.0206	0.0233	0.0223	0.0547	0.0784	0.0107	0.0550	0.0710
F	1.03	2.74	2.98	1.63	2.60	3.36	1.23	2.21	2.59

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-1 Portfolio Return Regressions on EX IP, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1055***	1.1936***	-0.0881*	1.0000***	0.9919***	0.0081
	(0.0501)	(0.0417)	(0.0448)	(0.0560)	(0.0434)	(0.0635)
smb				0.6731***	0.5256***	0.1475
				(0.0856)	(0.0663)	(0.0971)
hml				0.0506	0.4046***	-0.3540**
				(0.1224)	(0.0948)	(0.1388)
_cons	0.0034	0.0042**	-0.0008	0.0006	0.0018	-0.0012
	(0.0025)	(0.0021)	(0.0022)	(0.0019)	(0.0015)	(0.0022)
N	84	84	84	84	84	84
r2	0.8558	0.9091	0.0450	0.9189	0.9557	0.1368
F	486.49	820.43	3.86	302.19	574.77	4.23

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0022***	0.9055***	0.0967	1.0391***	1.1171***	-0.0780
	(0.0809)	(0.1035)	(0.1306)	(0.1133)	(0.1487)	(0.1922)
smb				0.5247***	0.2309	0.2938
				(0.1733)	(0.2273)	(0.2939)
hml				-0.3253	-0.7411**	0.4158
				(0.2476)	(0.3249)	(0.4200)
_cons	-0.0056	0.0030	-0.0086	-0.0076*	0.0025	-0.0101
	(0.0040)	(0.0052)	(0.0065)	(0.0039)	(0.0051)	(0.0066)
N	84	84	84	84	84	84
r2	0.6517	0.4830	0.0066	0.6924	0.5193	0.0316
F	153.46	76.60	0.55	60.04	28.81	0.87

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.2006**	0.0137	-0.2143*	-0.0201	0.2129	-0.2330
	(0.0964)	(0.1053)	(0.1221)	(0.1407)	(0.1535)	(0.1806)
smb				0.0485	-0.2574	0.3059
				(0.2151)	(0.2348)	(0.2761)
hml				-0.5720*	-0.5055	-0.0665
				(0.3074)	(0.3355)	(0.3946)
_cons	-0.0090*	-0.0065	-0.0025	-0.0089*	-0.0052	-0.0037
	(0.0048)	(0.0052)	(0.0061)	(0.0048)	(0.0053)	(0.0062)
N	84	84	84	84	84	84
r2	0.0501	0.0002	0.0362	0.0898	0.0435	0.0509
F	4.33	0.02	3.08	2.63	1.21	1.43

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-2 Portfolio Return Regressions on EX IP, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0685***	1.1768***	-0.1083***	0.9565***	0.9821***	-0.0256
	(0.0360)	(0.0339)	(0.0300)	(0.0394)	(0.0299)	(0.0428)
smb				0.4819***	0.4656***	0.0163
				(0.0602)	(0.0457)	(0.0654)
hml				0.1480*	0.4076***	-0.2596***
				(0.0861)	(0.0653)	(0.0934)
_cons	0.0049***	0.0046***	0.0003	0.0029**	0.0025**	0.0004
	(0.0018)	(0.0017)	(0.0015)	(0.0014)	(0.0010)	(0.0015)
N	84	84	84	84	84	84
r2	0.9150	0.9364	0.1367	0.9541	0.9777	0.2129
F	882.20	1207.47	12.99	554.35	1171.36	7.21

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.8519***	0.9701***	-0.1182	0.8130***	1.1840***	-0.3711*
	(0.0579)	(0.1090)	(0.1337)	(0.0854)	(0.1589)	(0.1955)
smb				0.1614	0.0276	0.1338
				(0.1306)	(0.2429)	(0.2989)
hml				0.0539	-0.6658*	0.7198*
				(0.1866)	(0.3471)	(0.4272)
_cons	0.0034	0.0024	0.0010	0.0027	0.0027	0.0000
	(0.0029)	(0.0054)	(0.0067)	(0.0029)	(0.0055)	(0.0067)
N	84	84	84	84	84	84
r2	0.7254	0.4913	0.0094	0.7310	0.5137	0.0465
F	216.64	79.21	0.78	72.45	28.17	1.30

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.2454***	-0.0608	-0.1846	-0.0940	0.0723	-0.1663
	(0.0830)	(0.1110)	(0.1228)	(0.1212)	(0.1574)	(0.1790)
smb				-0.1886	-0.6863***	0.4977*
				(0.1854)	(0.2407)	(0.2737)
hml				-0.3870	-0.1295	-0.2576
				(0.2649)	(0.3439)	(0.3911)
_cons	-0.0024	-0.0040	0.0016	-0.0014	-0.0011	-0.0003
	(0.0041)	(0.0055)	(0.0061)	(0.0042)	(0.0054)	(0.0062)
N	84	84	84	84	84	84
r2	0.0963	0.0036	0.0268	0.1321	0.0981	0.0692
F	8.74	0.30	2.26	4.06	2.90	1.98

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-3 Portfolio Return Regressions on EX IP, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1121***	1.1372***	-0.0251	0.9660***	0.9666***	-0.0006
	(0.0324)	(0.0315)	(0.0204)	(0.0293)	(0.0254)	(0.0301)
smb				0.4880***	0.4795***	0.0085
				(0.0448)	(0.0388)	(0.0461)
hml				0.2497***	0.3280***	-0.0783
				(0.0640)	(0.0555)	(0.0659)
_cons	0.0047***	0.0051***	-0.0004	0.0025**	0.0029***	-0.0004
	(0.0016)	(0.0016)	(0.0010)	(0.0010)	(0.0009)	(0.0010)
N	84	84	84	84	84	84
r2	0.9348	0.9407	0.0181	0.9761	0.9827	0.0354
F	1176.63	1301.60	1.51	1087.20	1514.08	0.98

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.3286***	0.9808***	0.3478**	0.8131***	1.1511***	-0.3381
	(0.1279)	(0.1136)	(0.1719)	(0.1736)	(0.1667)	(0.2330)
smb				0.1622	0.1016	0.0606
				(0.2654)	(0.2549)	(0.3562)
hml				1.5121***	-0.5624	2.0745***
				(0.3793)	(0.3643)	(0.5090)
_cons	0.0067	0.0019	0.0048	0.0052	0.0018	0.0033
	(0.0064)	(0.0057)	(0.0086)	(0.0060)	(0.0057)	(0.0080)
N	84	84	84	84	84	84
r2	0.5682	0.4763	0.0476	0.6420	0.4921	0.2123
F	107.91	74.57	4.10	47.83	25.84	7.19

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.1092	-0.0582	0.1674	-0.0251	0.0391	-0.0642
	(0.0874)	(0.1112)	(0.1301)	(0.1278)	(0.1587)	(0.1883)
smb				-0.1417	-0.6479***	0.5062*
				(0.1954)	(0.2427)	(0.2879)
hml				0.4684*	-0.0357	0.5041
				(0.2792)	(0.3468)	(0.4115)
_cons	-0.0003	-0.0037	0.0034	-0.0000	-0.0010	0.0010
	(0.0044)	(0.0055)	(0.0065)	(0.0044)	(0.0055)	(0.0065)
N	84	84	84	84	84	84
r2	0.0187	0.0033	0.0198	0.0569	0.0853	0.0751
F	1.56	0.27	1.66	1.61	2.49	2.16

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-4 Portfolio Return Regressions on EX IP, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1050***	1.1530***	-0.0480***	0.9617***	0.9824***	-0.0206
	(0.0293)	(0.0319)	(0.0161)	(0.0217)	(0.0252)	(0.0236)
smb				0.4823***	0.4945***	-0.0121
				(0.0332)	(0.0385)	(0.0361)
hml				0.2432***	0.3222***	-0.0790
				(0.0474)	(0.0551)	(0.0517)
_cons	0.0053***	0.0053***	-0.0001	0.0031***	0.0031***	0.0000
	(0.0015)	(0.0016)	(0.0008)	(0.0007)	(0.0009)	(0.0008)
N	84	84	84	84	84	84
r2	0.9454	0.9408	0.0979	0.9865	0.9834	0.1252
F	1420.68	1302.93	8.90	1951.89	1580.40	3.82

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.4377***	1.0462***	0.3915***	1.1728***	1.1469***	0.0259
	(0.1040)	(0.1241)	(0.1337)	(0.1489)	(0.1825)	(0.1910)
smb				0.3400	0.3011	0.0388
				(0.2277)	(0.2790)	(0.2920)
hml				0.6730**	-0.4300	1.1031***
				(0.3253)	(0.3987)	(0.4173)
_cons	0.0011	0.0024	-0.0013	-0.0007	0.0014	-0.0021
	(0.0052)	(0.0062)	(0.0067)	(0.0051)	(0.0063)	(0.0066)
N	84	84	84	84	84	84
r2	0.6996	0.4643	0.0947	0.7231	0.4788	0.1680
F	190.95	71.06	8.58	69.62	24.50	5.38

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.2491***	0.0187	0.2304*	0.1643	0.0708	0.0935
	(0.0937)	(0.1248)	(0.1319)	(0.1390)	(0.1839)	(0.1935)
smb				0.0505	-0.3830	0.4335
				(0.2126)	(0.2812)	(0.2959)
hml				0.2390	-0.0044	0.2435
				(0.3038)	(0.4018)	(0.4229)
_cons	-0.0014	-0.0037	0.0023	-0.0018	-0.0021	0.0004
	(0.0047)	(0.0062)	(0.0066)	(0.0048)	(0.0063)	(0.0067)
N	84	84	84	84	84	84
r2	0.0794	0.0003	0.0359	0.0873	0.0230	0.0657
F	7.07	0.02	3.05	2.55	0.63	1.87

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the impact ratio (IP) criterion, “best” are formed with stocks that perform well on impact ratio (small IP), “worst” are formed with stocks that perform bad on impact ratio (big IP). Long-short portfolio returns= the best IP portfolio returns – the worst IP portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-5 Portfolio Return Regressions on EX FF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1404***	1.2056***	-0.0652	0.9367***	1.0244***	-0.0877
	(0.0532)	(0.0380)	(0.0412)	(0.0624)	(0.0370)	(0.0611)
smb				0.6027***	0.5238***	0.0789
				(0.0954)	(0.0566)	(0.0934)
hml				0.3793***	0.3426***	0.0367
				(0.1364)	(0.0808)	(0.1334)
_cons	0.0050*	0.0040**	0.0010	0.0023	0.0017	0.0006
	(0.0027)	(0.0019)	(0.0021)	(0.0021)	(0.0013)	(0.0021)
N	84	84	84	84	84	84
r2	0.8485	0.9248	0.0297	0.9062	0.9679	0.0394
F	459.31	1008.67	2.51	257.56	803.30	1.09

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.8526***	0.8658***	-0.0132	0.7868***	1.0948***	-0.3079
	(0.0917)	(0.1036)	(0.1390)	(0.1335)	(0.1453)	(0.2019)
smb				0.4016*	0.4069*	-0.0053
				(0.2042)	(0.2222)	(0.3087)
hml				0.0386	-0.8655***	0.9042**
				(0.2917)	(0.3174)	(0.4412)
_cons	0.0047	0.0064	-0.0017	0.0030	0.0052	-0.0022
	(0.0046)	(0.0052)	(0.0069)	(0.0046)	(0.0050)	(0.0070)
N	84	84	84	84	84	84
r2	0.5130	0.4599	0.0001	0.5357	0.5220	0.0500
F	86.36	69.82	0.01	30.77	29.12	1.40

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.1600	-0.0445	-0.1155	-0.0638	0.1946	-0.2583
	(0.1085)	(0.1029)	(0.1320)	(0.1608)	(0.1489)	(0.1953)
smb				0.0866	-0.0825	0.1690
				(0.2458)	(0.2277)	(0.2987)
hml				-0.3296	-0.6983**	0.3687
				(0.3513)	(0.3254)	(0.4268)
_cons	-0.0038	-0.0036	-0.0002	-0.0039	-0.0029	-0.0011
	(0.0054)	(0.0051)	(0.0066)	(0.0055)	(0.0051)	(0.0067)
N	84	84	84	84	84	84
r2	0.0258	0.0023	0.0093	0.0376	0.0588	0.0228
F	2.17	0.19	0.77	1.04	1.67	0.62

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-6 Portfolio Return Regressions on EX FF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.1231***	1.1316***	-0.0085	0.9658***	0.9855***	-0.0197
	(0.0379)	(0.0289)	(0.0274)	(0.0396)	(0.0266)	(0.0403)
smb				0.5089***	0.4121***	0.0968
				(0.0605)	(0.0407)	(0.0616)
hml				0.2755***	0.2803***	-0.0048
				(0.0865)	(0.0581)	(0.0880)
_cons	0.0061***	0.0044***	0.0016	0.0038***	0.0026***	0.0012
	(0.0019)	(0.0014)	(0.0014)	(0.0014)	(0.0009)	(0.0014)
N	84	84	84	84	84	84
r2	0.9145	0.9492	0.0012	0.9581	0.9807	0.0311
F	876.72	1530.78	0.10	609.44	1352.18	0.86

Panel B Value-weighted Portfolio

Panel B	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	0.9933***	0.9216***	0.0717	0.8128***	1.0629***	-0.2501
	(0.1077)	(0.0960)	(0.1394)	(0.1547)	(0.1411)	(0.2006)
smb				0.5290**	0.0756	0.4534
				(0.2365)	(0.2157)	(0.3068)
hml				0.3384	-0.4631	0.8015*
				(0.3380)	(0.3083)	(0.4384)
_cons	0.0045	0.0037	0.0008	0.0021	0.0037	-0.0016
	(0.0054)	(0.0048)	(0.0069)	(0.0053)	(0.0049)	(0.0069)
N	84	84	84	84	84	84
r2	0.5090	0.5290	0.0032	0.5443	0.5424	0.0702
F	85.01	92.11	0.26	31.86	31.61	2.01

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0557	-0.0115	-0.0442	-0.0275	0.0125	-0.0400
	(0.1206)	(0.1060)	(0.1339)	(0.1792)	(0.1549)	(0.1947)
smb				0.1575	-0.4218*	0.5793*
				(0.2741)	(0.2368)	(0.2977)
hml				-0.1502	0.0973	-0.2474
				(0.3917)	(0.3384)	(0.4254)
_cons	-0.0021	-0.0043	0.0023	-0.0026	-0.0026	0.0000
	(0.0060)	(0.0053)	(0.0067)	(0.0062)	(0.0053)	(0.0067)
N	84	84	84	84	84	84
r2	0.0026	0.0001	0.0013	0.0083	0.0388	0.0493
F	0.21	0.01	0.11	0.22	1.08	1.38

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-7 Portfolio Return Regressions on EX FF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1301***	1.1286***	0.0015	0.9704***	0.9561***	0.0143
	(0.0351)	(0.0295)	(0.0218)	(0.0314)	(0.0226)	(0.0317)
smb				0.5317***	0.4460***	0.0857*
				(0.0480)	(0.0345)	(0.0485)
hml				0.2735***	0.3474***	-0.0739
				(0.0685)	(0.0493)	(0.0693)
_cons	0.0058***	0.0045***	0.0013	0.0035***	0.0025***	0.0010
	(0.0018)	(0.0015)	(0.0011)	(0.0011)	(0.0008)	(0.0011)
N	84	84	84	84	84	84
r2	0.9266	0.9468	0.0001	0.9736	0.9860	0.0489
F	1035.51	1459.24	0.00	985.06	1884.06	1.37

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.9724***	0.9127***	0.0597	0.8271***	0.9997***	-0.1726
	(0.1113)	(0.1060)	(0.1400)	(0.1581)	(0.1563)	(0.2039)
smb				0.6726***	0.1972	0.4753
				(0.2418)	(0.2390)	(0.3117)
hml				0.1727	-0.3461	0.5188
				(0.3455)	(0.3416)	(0.4455)
_cons	0.0052	0.0039	0.0013	0.0024	0.0033	-0.0009
	(0.0055)	(0.0053)	(0.0070)	(0.0054)	(0.0054)	(0.0070)
N	84	84	84	84	84	84
r2	0.4820	0.4750	0.0022	0.5297	0.4856	0.0479
F	76.30	74.20	0.18	30.04	25.17	1.34

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0586	-0.0080	-0.0506	-0.0289	-0.0076	-0.0213
	(0.1213)	(0.1036)	(0.1298)	(0.1796)	(0.1520)	(0.1875)
smb				0.2521	-0.3694	0.6214**
				(0.2747)	(0.2324)	(0.2866)
hml				-0.1927	0.1483	-0.3410
				(0.3925)	(0.3320)	(0.4096)
_cons	-0.0014	-0.0024	0.0010	-0.0023	-0.0010	-0.0014
	(0.0060)	(0.0052)	(0.0065)	(0.0062)	(0.0052)	(0.0065)
N	84	84	84	84	84	84
r2	0.0028	0.0001	0.0018	0.0157	0.0324	0.0633
F	0.23	0.01	0.15	0.43	0.89	1.80

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-8 Portfolio Return Regressions on EX FF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1250***	1.1338***	-0.0088	0.9603***	0.9834***	-0.0231
	(0.0330)	(0.0285)	(0.0166)	(0.0249)	(0.0223)	(0.0238)
smb				0.5354***	0.4438***	0.0916**
				(0.0380)	(0.0342)	(0.0364)
hml				0.2873***	0.2809***	0.0064
				(0.0544)	(0.0488)	(0.0521)
_cons	0.0059***	0.0047***	0.0011	0.0035***	0.0028***	0.0007
	(0.0016)	(0.0014)	(0.0008)	(0.0009)	(0.0008)	(0.0008)
N	84	84	84	84	84	84
r2	0.9341	0.9509	0.0034	0.9831	0.9864	0.0770
F	1162.49	1586.74	0.28	1555.06	1929.21	2.23

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.8297***	0.9313***	0.8983***	1.2934***	1.0244***	0.2690
	(0.1493)	(0.1034)	(0.1501)	(0.2034)	(0.1526)	(0.2009)
smb				0.7760**	0.1659	0.6101*
				(0.3110)	(0.2333)	(0.3073)
hml				1.3273***	-0.3518	1.6791***
				(0.4445)	(0.3334)	(0.4391)
_cons	-0.0001	0.0035	-0.0036	-0.0041	0.0030	-0.0071
	(0.0074)	(0.0052)	(0.0075)	(0.0070)	(0.0053)	(0.0069)
N	84	84	84	84	84	84
r2	0.6467	0.4976	0.3039	0.7049	0.5072	0.4388
F	150.10	81.20	35.80	63.71	27.44	20.85

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.4060***	0.0154	0.3906***	0.2506	0.0284	0.2222
	(0.1227)	(0.1018)	(0.1254)	(0.1797)	(0.1487)	(0.1769)
smb				0.4096	-0.4018*	0.8115***
				(0.2747)	(0.2274)	(0.2704)
hml				0.3100	0.1231	0.1870
				(0.3926)	(0.3250)	(0.3865)
_cons	-0.0025	-0.0029	0.0004	-0.0043	-0.0013	-0.0030
	(0.0061)	(0.0051)	(0.0063)	(0.0062)	(0.0051)	(0.0061)
N	84	84	84	84	84	84
r2	0.1177	0.0003	0.1058	0.1491	0.0389	0.1995
F	10.94	0.02	9.70	4.67	1.08	6.65

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the first-tier footprint (FF) criterion, “best” are formed with stocks that perform well on impact ratio (small FF), “worst” are formed with stocks that perform bad on impact ratio (big FF). Long-short portfolio returns= the best FF portfolio returns – the worst FF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-9 Portfolio Return Regressions on EX DF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0822***	1.2446***	-0.1624***	0.9537***	1.0231***	-0.0694
	(0.0425)	(0.0404)	(0.0453)	(0.0535)	(0.0334)	(0.0653)
smb				0.4323***	0.6003***	-0.1680*
				(0.0818)	(0.0510)	(0.0999)
hml				0.2184*	0.4352***	-0.2168
				(0.1169)	(0.0729)	(0.1427)
_cons	0.0069***	0.0024	0.0045**	0.0050***	-0.0003	0.0054**
	(0.0021)	(0.0020)	(0.0023)	(0.0018)	(0.0011)	(0.0022)
N	84	84	84	84	84	84
r2	0.8876	0.9206	0.1357	0.9199	0.9756	0.1899
F	647.29	950.12	12.87	306.19	1065.04	6.25

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0594***	1.0864***	-0.0269	0.9072***	1.0415***	-0.1344
	(0.0751)	(0.1085)	(0.1383)	(0.1087)	(0.1576)	(0.2042)
smb				0.2540	0.4973**	-0.2433
				(0.1663)	(0.2410)	(0.3122)
hml				0.3633	-0.0641	0.4274
				(0.2376)	(0.3444)	(0.4462)
_cons	0.0025	0.0043	-0.0018	0.0013	0.0023	-0.0010
	(0.0037)	(0.0054)	(0.0069)	(0.0037)	(0.0054)	(0.0070)
N	84	84	84	84	84	84
r2	0.7080	0.5500	0.0005	0.7248	0.5727	0.0184
F	198.82	100.20	0.04	70.22	35.75	0.50

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0169	0.0703	-0.0872	0.0020	0.1040	-0.1020
	(0.0977)	(0.1001)	(0.1263)	(0.1445)	(0.1486)	(0.1858)
smb				-0.2533	0.1444	-0.3978
				(0.2209)	(0.2272)	(0.2840)
hml				0.0445	-0.1617	0.2062
				(0.3157)	(0.3247)	(0.4059)
_cons	-0.0036	-0.0054	0.0018	-0.0026	-0.0059	0.0033
	(0.0049)	(0.0050)	(0.0063)	(0.0050)	(0.0051)	(0.0064)
N	84	84	84	84	84	84
r2	0.0004	0.0060	0.0058	0.0166	0.0137	0.0320
F	0.03	0.49	0.48	0.45	0.37	0.88

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-10 Portfolio Return Regressions on EX DF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.1233***	1.1671***	-0.0438	0.9990***	1.0234***	-0.0244
	(0.0305)	(0.0323)	(0.0291)	(0.0334)	(0.0271)	(0.0423)
smb				0.3823***	0.5131***	-0.1308**
				(0.0511)	(0.0414)	(0.0647)
hml				0.2258***	0.2322***	-0.0064
				(0.0730)	(0.0592)	(0.0924)
_cons	0.0057***	0.0032*	0.0026*	0.0041***	0.0010	0.0031**
	(0.0015)	(0.0016)	(0.0014)	(0.0012)	(0.0009)	(0.0015)
N	84	84	84	84	84	84
r2	0.9432	0.9408	0.0269	0.9692	0.9813	0.0745
F	1360.72	1302.51	2.26	838.97	1397.82	2.15

Panel B Value-weighted Portfolio

Panel B	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	0.9209***	1.2467***	-0.3258**	0.9113***	1.1907***	-0.2794
	(0.0653)	(0.0993)	(0.1294)	(0.0958)	(0.1473)	(0.1927)
smb				0.2358	0.1820	0.0538
				(0.1464)	(0.2253)	(0.2947)
hml				-0.0661	0.0978	-0.1638
				(0.2092)	(0.3219)	(0.4211)
_cons	0.0052	-0.0002	0.0054	0.0042	-0.0010	0.0053
	(0.0033)	(0.0049)	(0.0065)	(0.0033)	(0.0051)	(0.0066)
N	84	84	84	84	84	84
r2	0.7080	0.6577	0.0717	0.7174	0.6610	0.0738
F	198.83	157.57	6.34	67.69	51.99	2.12

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0996	0.1270	-0.2266**	-0.0013	0.1056	-0.1069
	(0.0887)	(0.0960)	(0.1117)	(0.1307)	(0.1423)	(0.1655)
smb				-0.2136	-0.1899	-0.0236
				(0.1999)	(0.2175)	(0.2530)
hml				-0.2146	0.1424	-0.3570
				(0.2857)	(0.3109)	(0.3616)
_cons	-0.0002	-0.0070	0.0068	0.0008	-0.0063	0.0071
	(0.0044)	(0.0048)	(0.0056)	(0.0045)	(0.0049)	(0.0057)
N	84	84	84	84	84	84
r2	0.0152	0.0209	0.0478	0.0365	0.0323	0.0595
F	1.26	1.75	4.12	1.01	0.89	1.69

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-11 Portfolio Return Regressions on EX DF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1753***	1.1521***	0.0233	1.0012***	0.9876***	0.0136
	(0.0346)	(0.0297)	(0.0230)	(0.0338)	(0.0238)	(0.0343)
smb				0.4647***	0.4471***	0.0176
				(0.0517)	(0.0364)	(0.0524)
hml				0.3448***	0.3223***	0.0225
				(0.0739)	(0.0520)	(0.0749)
_cons	0.0064***	0.0037**	0.0027**	0.0043***	0.0017**	0.0026**
	(0.0017)	(0.0015)	(0.0011)	(0.0012)	(0.0008)	(0.0012)
N	84	84	84	84	84	84
r2	0.9336	0.9484	0.0123	0.9714	0.9850	0.0149
F	1152.14	1507.90	1.02	906.94	1755.44	0.40

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0012***	1.2322***	-0.2311	0.9401***	1.1382***	-0.1981
	(0.0898)	(0.1046)	(0.1440)	(0.1283)	(0.1549)	(0.2128)
smb				0.5227***	0.1715	0.3512
				(0.1962)	(0.2369)	(0.3254)
hml				-0.0247	0.2183	-0.2430
				(0.2804)	(0.3386)	(0.4650)
_cons	0.0051	0.0001	0.0051	0.0030	-0.0008	0.0038
	(0.0045)	(0.0052)	(0.0072)	(0.0044)	(0.0053)	(0.0073)
N	84	84	84	84	84	84
r2	0.6023	0.6286	0.0304	0.6347	0.6331	0.0470
F	124.19	138.81	2.57	46.33	46.02	1.32

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0391	0.1323	-0.1714	-0.0012	0.0750	-0.0761
	(0.1038)	(0.0955)	(0.1267)	(0.1542)	(0.1414)	(0.1866)
smb				0.1244	-0.1587	0.2831
				(0.2358)	(0.2163)	(0.2854)
hml				-0.1664	0.2398	-0.4062
				(0.3369)	(0.3091)	(0.4078)
_cons	-0.0011	-0.0044	0.0033	-0.0015	-0.0039	0.0024
	(0.0052)	(0.0048)	(0.0063)	(0.0053)	(0.0049)	(0.0064)
N	84	84	84	84	84	84
r2	0.0017	0.0229	0.0218	0.0079	0.0361	0.0445
F	0.14	1.92	1.83	0.21	1.00	1.24

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-12 Portfolio Return Regressions on EX DF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1712***	1.0896***	0.0817***	0.9880***	0.9565***	0.0315
	(0.0342)	(0.0275)	(0.0180)	(0.0267)	(0.0210)	(0.0253)
smb				0.5314***	0.4471***	0.0843**
				(0.0409)	(0.0321)	(0.0386)
hml				0.3458***	0.2263***	0.1195**
				(0.0584)	(0.0459)	(0.0552)
_cons	0.0059***	0.0047***	0.0013	0.0036***	0.0027***	0.0009
	(0.0017)	(0.0014)	(0.0009)	(0.0009)	(0.0007)	(0.0009)
N	84	84	84	84	84	84
r2	0.9346	0.9504	0.2014	0.9820	0.9870	0.2891
F	1172.68	1572.77	20.68	1455.39	2021.60	10.84

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1133***	1.2207***	-0.1074	0.9371***	1.1080***	-0.1709
	(0.1042)	(0.1083)	(0.1389)	(0.1469)	(0.1598)	(0.2050)
smb				0.6556***	0.2565	0.3991
				(0.2247)	(0.2444)	(0.3134)
hml				0.2741	0.2412	0.0329
				(0.3210)	(0.3493)	(0.4478)
_cons	0.0047	0.0007	0.0041	0.0019	-0.0005	0.0024
	(0.0052)	(0.0054)	(0.0069)	(0.0051)	(0.0055)	(0.0071)
N	84	84	84	84	84	84
r2	0.5817	0.6076	0.0072	0.6260	0.6155	0.0272
F	114.05	126.95	0.60	44.63	42.68	0.74

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.0134	0.1145	-0.1012	0.0199	0.0655	-0.0456
	(0.1154)	(0.0937)	(0.1237)	(0.1714)	(0.1385)	(0.1814)
smb				0.1986	-0.1987	0.3973
				(0.2620)	(0.2117)	(0.2773)
hml				-0.1004	0.2305	-0.3308
				(0.3745)	(0.3025)	(0.3963)
_cons	-0.0005	-0.0044	0.0039	-0.0013	-0.0037	0.0025
	(0.0058)	(0.0047)	(0.0062)	(0.0059)	(0.0048)	(0.0062)
N	84	84	84	84	84	84
r2	0.0002	0.0179	0.0081	0.0080	0.0348	0.0400
F	0.01	1.49	0.67	0.21	0.96	1.11

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the direct emissions footprint (DF) criterion, “best” are formed with stocks that perform well on impact ratio (small DF), “worst” are formed with stocks that perform bad on impact ratio (big DF). Long-short portfolio returns= the best DF portfolio returns – the worst DF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-13 Portfolio Return Regressions on EX CF, 10% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0371***	1.2246***	-0.1875***	0.9163***	1.0297***	-0.1134*
	(0.0428)	(0.0387)	(0.0433)	(0.0520)	(0.0335)	(0.0634)
smb				0.4846***	0.5799***	-0.0953
				(0.0795)	(0.0512)	(0.0969)
hml				0.1737	0.3618***	-0.1880
				(0.1136)	(0.0731)	(0.1385)
_cons	0.0068***	0.0024	0.0044**	0.0047**	-0.0002	0.0049**
	(0.0021)	(0.0019)	(0.0022)	(0.0018)	(0.0012)	(0.0022)
N	84	84	84	84	84	84
r2	0.8775	0.9243	0.1862	0.9186	0.9745	0.2149
F	587.61	1000.74	18.76	300.88	1020.46	7.30

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.9331***	1.0926***	-0.1595	0.9030***	1.0523***	-0.1493
	(0.0818)	(0.1081)	(0.1473)	(0.1201)	(0.1574)	(0.2191)
smb				0.2854	0.4719*	-0.1864
				(0.1836)	(0.2407)	(0.3351)
hml				-0.0236	-0.0676	0.0440
				(0.2624)	(0.3440)	(0.4788)
_cons	0.0030	0.0034	-0.0004	0.0019	0.0016	0.0003
	(0.0041)	(0.0054)	(0.0073)	(0.0041)	(0.0054)	(0.0075)
N	84	84	84	84	84	84
r2	0.6135	0.5545	0.0141	0.6248	0.5750	0.0180
F	130.17	102.08	1.17	44.42	36.08	0.49

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0882	0.0813	-0.1695	0.0057	0.1172	-0.1116
	(0.1003)	(0.1000)	(0.1265)	(0.1484)	(0.1486)	(0.1871)
smb				-0.2067	0.1143	-0.3210
				(0.2269)	(0.2272)	(0.2861)
hml				-0.2037	-0.1564	-0.0473
				(0.3242)	(0.3247)	(0.4088)
_cons	-0.0029	-0.0062	0.0033	-0.0020	-0.0066	0.0046
	(0.0050)	(0.0050)	(0.0063)	(0.0051)	(0.0051)	(0.0064)
N	84	84	84	84	84	84
r2	0.0093	0.0080	0.0214	0.0249	0.0137	0.0369
F	0.77	0.66	1.79	0.68	0.37	1.02

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 10% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-14 Portfolio Return Regressions on EX CF, 20% cut-off

Panel A Equally-weighted Portfolio

Panel A	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	1.1108***	1.1396***	-0.0288	1.0125***	1.0070***	0.0054
	(0.0305)	(0.0316)	(0.0289)	(0.0348)	(0.0257)	(0.0419)
smb				0.3820***	0.5167***	-0.1346**
				(0.0533)	(0.0393)	(0.0641)
hml				0.1464*	0.1967***	-0.0503
				(0.0761)	(0.0562)	(0.0915)
_cons	0.0058***	0.0032**	0.0026*	0.0042***	0.0010	0.0032**
	(0.0015)	(0.0016)	(0.0014)	(0.0012)	(0.0009)	(0.0014)
N	84	84	84	84	84	84
r2	0.9417	0.9405	0.0119	0.9658	0.9823	0.0681
F	1325.30	1297.14	0.99	753.68	1481.46	1.95

Panel B Value-weighted Portfolio

Panel B	**Best**	**Worst**	**Long-short**	**Best**	**Worst**	**Long-short**
rmrf	0.9640***	1.2304***	-0.2664**	0.9461***	1.1746***	-0.2285
	(0.0695)	(0.1011)	(0.1335)	(0.1015)	(0.1499)	(0.1988)
smb				0.2760*	0.2026	0.0734
				(0.1553)	(0.2291)	(0.3040)
hml				-0.0569	0.0889	-0.1458
				(0.2219)	(0.3274)	(0.4344)
_cons	0.0056	-0.0006	0.0062	0.0045	-0.0015	0.0060
	(0.0035)	(0.0050)	(0.0067)	(0.0035)	(0.0052)	(0.0068)
N	84	84	84	84	84	84
r2	0.7013	0.6437	0.0463	0.7128	0.6476	0.0483
F	192.53	148.15	3.98	66.18	49.00	1.35

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0720	0.1148	-0.1867	0.0178	0.0928	-0.0750
	(0.0880)	(0.0965)	(0.1138)	(0.1299)	(0.1431)	(0.1687)
smb				-0.1868	-0.1703	-0.0165
				(0.1987)	(0.2188)	(0.2580)
hml				-0.1990	0.1362	-0.3352
				(0.2839)	(0.3127)	(0.3687)
_cons	0.0001	-0.0071	0.0072	0.0010	-0.0065	0.0075
	(0.0044)	(0.0048)	(0.0057)	(0.0045)	(0.0049)	(0.0058)
N	84	84	84	84	84	84
r2	0.0081	0.0170	0.0318	0.0255	0.0263	0.0418
F	0.67	1.41	2.69	0.70	0.72	1.16

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 20% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-15 Portfolio Return Regressions on EX CF, 30% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1481***	1.1350***	0.0131	0.9880***	0.9815***	0.0066
	(0.0324)	(0.0292)	(0.0224)	(0.0311)	(0.0238)	(0.0333)
smb				0.4465***	0.4457***	0.0008
				(0.0475)	(0.0364)	(0.0510)
hml				0.3091***	0.2894***	0.0197
				(0.0679)	(0.0520)	(0.0729)
_cons	0.0061***	0.0038**	0.0023**	0.0041***	0.0018**	0.0023**
	(0.0016)	(0.0015)	(0.0011)	(0.0011)	(0.0008)	(0.0011)
N	84	84	84	84	84	84
r2	0.9388	0.9486	0.0042	0.9746	0.9846	0.0051
F	1257.81	1513.54	0.34	1022.90	1704.02	0.14

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.0519***	1.2238***	-0.1719	0.9463***	1.1301***	-0.1838
	(0.0847)	(0.1055)	(0.1367)	(0.1200)	(0.1563)	(0.2021)
smb				0.5293***	0.1812	0.3481
				(0.1835)	(0.2390)	(0.3091)
hml				0.1090	0.2135	-0.1045
				(0.2622)	(0.3416)	(0.4417)
_cons	0.0056	-0.0002	0.0058	0.0033	-0.0011	0.0044
	(0.0042)	(0.0053)	(0.0068)	(0.0041)	(0.0054)	(0.0070)
N	84	84	84	84	84	84
r2	0.6527	0.6212	0.0189	0.6864	0.6259	0.0346
F	154.10	134.46	1.58	58.37	44.61	0.96

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	-0.0158	0.1272	-0.1430	0.0073	0.0690	-0.0617
	(0.0997)	(0.0957)	(0.1216)	(0.1481)	(0.1418)	(0.1791)
smb				0.1349	-0.1485	0.2834
				(0.2264)	(0.2168)	(0.2739)
hml				-0.1253	0.2382	-0.3636
				(0.3236)	(0.3098)	(0.3914)
_cons	-0.0007	-0.0045	0.0038	-0.0012	-0.0041	0.0029
	(0.0050)	(0.0048)	(0.0061)	(0.0051)	(0.0049)	(0.0062)
N	84	84	84	84	84	84
r2	0.0003	0.0211	0.0166	0.0064	0.0334	0.0389
F	0.03	1.77	1.38	0.17	0.92	1.08

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 30% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Table 3-5-16 Portfolio Return Regressions on EX CF, 50% cut-off

Panel A Equally-weighted Portfolio

Panel A	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1749***	1.0860***	0.0889***	0.9948***	0.9500***	0.0448*
	(0.0342)	(0.0274)	(0.0178)	(0.0274)	(0.0202)	(0.0252)
smb				0.5292***	0.4492***	0.0800**
				(0.0419)	(0.0309)	(0.0386)
hml				0.3372***	0.2345***	0.1026*
				(0.0598)	(0.0441)	(0.0551)
_cons	0.0060***	0.0047***	0.0013	0.0036***	0.0027***	0.0009
	(0.0017)	(0.0014)	(0.0009)	(0.0009)	(0.0007)	(0.0009)
N	84	84	84	84	84	84
r2	0.9349	0.9505	0.2340	0.9813	0.9879	0.3045
F	1177.86	1573.94	25.05	1395.69	2175.67	11.67

Panel B Value-weighted Portfolio

Panel B	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	1.1058***	1.2139***	-0.1081	0.9284***	1.1024***	-0.1740
	(0.1048)	(0.1090)	(0.1402)	(0.1478)	(0.1608)	(0.2070)
smb				0.6580***	0.2666	0.3914
				(0.2259)	(0.2459)	(0.3165)
hml				0.2768	0.2333	0.0435
				(0.3228)	(0.3514)	(0.4522)
_cons	0.0049	0.0005	0.0045	0.0021	-0.0008	0.0028
	(0.0052)	(0.0054)	(0.0070)	(0.0051)	(0.0055)	(0.0071)
N	84	84	84	84	84	84
r2	0.5758	0.6019	0.0072	0.6206	0.6101	0.0261
F	111.30	124.00	0.59	43.62	41.73	0.71

Panel C Industry-Adjusted Value-weighted Portfolio

Panel C	Best	Worst	Long-short	Best	Worst	Long-short
rmrf	0.0116	0.1103	-0.0987	0.0109	0.0611	-0.0502
	(0.1162)	(0.0938)	(0.1243)	(0.1726)	(0.1388)	(0.1824)
smb				0.2045	-0.1873	0.3918
				(0.2639)	(0.2122)	(0.2790)
hml				-0.0805	0.2262	-0.3067
				(0.3770)	(0.3032)	(0.3986)
_cons	-0.0003	-0.0045	0.0042	-0.0011	-0.0039	0.0027
	(0.0058)	(0.0047)	(0.0062)	(0.0059)	(0.0048)	(0.0063)
N	84	84	84	84	84	84
r2	0.0001	0.0166	0.0076	0.0080	0.0321	0.0374
F	0.01	1.38	0.63	0.21	0.88	1.04

These tables show the results of portfolio excess returns on the CAPM (column2-4), Fama-French 3 Factors (column5-7), and Carhart 4 Factors(column8-10), basing on the carbon only footprint (CF) criterion, “best” are formed with stocks that perform well on impact ratio (small CF), “worst” are formed with stocks that perform bad on impact ratio (big CF). Long-short portfolio returns= the best CF portfolio returns – the worst CF portfolio returns. Standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01. At 50% cut-off, portfolios in Panel A are formed by equally weighting, portfolios in Panel B are formed by value weighting, while portfolios in Panel C is the excess return over the industry benchmark that formed by value weighting.

Chapter 4 Firm- Level Financial Market Evaluations

4.1 Introduction

There is debate as to whether corporate social responsibility (CSR)/environmental investments reduce firms' value or actually improve it. As we stated earlier, there are two branches in respect to the investigation of CSR and environmental issues; the first one focuses on detecting the financial market reaction corresponding to this relationship in terms of portfolio returns; and the second branch devoted to identifying specific success factors for CSR/environmental strategies that are able to influence firms' value. We have already discussed the environmental/carbon performance in the financial market in relation to investors in chapter 3, thereafter, our main objective in this chapter will be to focus on identifying the factors in environmental/carbon strategies that could potentially affect firm value.

According to Margolis et al. (2007) work, more than 200 empirical research investigations have been performed on the relationship between corporate social performance (CSP) and corporate financial performance (CFP) over the last 40 years. However, most of these studies have used stock returns in their estimations; only few of these have adopted firm value as a proxy for the CFP. In this chapter, we argue that it is important to focus on firm value in order to disclose more financial implications of CSP, or more specifically for our research, the implications of corporate environmental performance (CEP) and corporate carbon performance (CCP).

The CEP-CFP Association

Research examining the association between CEP-CFP, is not new. Many scholars use US data, employing the KLD environmental score as the proxy for corporate environmental performance (for example, Waddock and Graves, 1997; Galema, Plantiga and Scholtens, 2008; and Fernando, Sharfman and Uysal, 2010), however, other environmental indicators from a variety of sources have also been adopted.

Guenster et al. (2011) exploit Innovest eco-efficiency data as the environmental performance indicators, while Al-Najjar and Anfimiadou (2011) introduce the international standardization environmental certificate (ISO 14001) to define the eco-efficiency variable.

The environmental capital expenditures (ECE) are the costs that companies spend on improving their environmental performance, which can either relate to compliance with federal regulations or simply voluntary activities (over-compliance). Johnston (2005), Clarkson et al. (2004), and Gao (2011) use this measure to represent the CEP.

Other measures of a company's environmental performance include the use of natural resources or emissions (Figge and Hahn, 2004), the US Toxic Release Inventory (Hamilton, 1995; Konar and Cohen (2001)) and external environmental awards (Klassen and McLaughlin, 1996).

In this chapter, we will use the Trucost defined environmental variable, which is the environmental output that includes greenhouse gas (GHG) emissions, water abstraction, waste generation, volatile organic compounds, heavy metals and other emissions. According to Trucost, all the emissions have been transferred into dollar denoted values, which are referred to as 'external environmental-damage-cost'. By adopting this variable, it allows us to conduct a comparison between firms having different types of emissions on one platform. For example, firms in Chemicals and Construct & Material produce pollutions in different ways, and it is difficult to compare them in terms of their emission quantities. Therefore, expressing all emissions as damage cost can be a satisfactory resolution to this problem.

Regarding the results of the CEP-CFP association, so far, it has been inconclusive according to existing literature. Some scholars support a positive relationship between CEP-CFP, for example, Guenster et al. (2011) find that in the US, eco-efficient firms enjoy better operating performances; Dowell et al. (2000) report that US-based multi-national firms with stringent environmental standards have higher Tobin's Q; and Clarkson, Fang, Li and Richardson (2011) suggest there is a significantly positive association between firm valuation and environmental disclosure measures. The arguments for a negative CEP-CFP relationship stem from the cost that is associated with environmental activities (e.g. Freedman and Jaggi, 1982; Ingram and Frazier, 1980; and Walley and Whitehead, 1994); whilst other arguments also support an insignificant association between CEP-CFP (e.g. Galema, Plantiga and Scholtens, 2008; Fernando, Sharfman and Uysal, 2010).

In this work, we only examine the CEP-CFP relationship as an ancillary investigation; therefore we do not specifically focus on it. However, an examination of the corporate environmental performance is a good starting point for further insight into corporate carbon performance. In practice, environmental issues have existed longer and are more influential than climate issues. Literally, far more research has been done on the environment topic than the carbon emission topic, which is relatively new in the finance arena. Importantly, in our results, by comparing the corporate carbon performance with the corporate environmental performance, we try to determine a connection between the two.

The CCP-CFP Association

Research into the association between CCP-CFP is relatively new. The proxies for corporate carbon performance that have been adopted so far can be divided into two categories, quantitative and qualitative indicators. The qualitative indicators mainly refer to the guidance from corporate climate policy, i.e. whether the company has made a clear carbon reduction statement (e.g. Ziegler et al., 2009; Clark and Crawford, 2012), or whether the company claims its membership of a carbon reduction body (e.g. Fisher-Vanden and Thorburn, 2011). However, most of these are used as a selecting criterion rather than a value-relevant variable. In contrast, quantitative indicators involve the amount of carbon dioxide (or equivalent) emissions. For example, Busch and Hoffmann (2011) use the firm’s carbon intensity, i.e. the ratio between the firm’s total GHG emissions and a firm’s sales, and Gao (2011) introduces carbon emissions output ratio i.e. the ratio between firm’s carbon emissions and firm’s generation.

In this chapter, we continue use the Trucost defined carbon emission data, which are the direct and first tier supply chain carbon emissions, direct carbon dioxide and equivalent emissions and carbon dioxide (no equivalent) emissions only. According to Trucost, all the emissions are denoted in tonnes. Adopting the quantitative data, we can introduce the carbon outputs into the valuation model as the independent variables, and also numerically define the influence of the carbon emissions on the firm’s value.

In regard to the results of the CCP-CFP association, so few studies have been done on this topic, making it hard to draw conclusions. Among the existing literature, Busch and Hoffmann (2011) report inconsistent results when using different financial performance proxies. They find larger carbon emission firms generate a better financial performance using Returen on Assets (ROA); however, when using Return on Equity (ROE), the indications are that the smaller carbon emission firms generate better financial performances. Gao (2011) concludes that the equity markets assign a positive value to environmental capital expenditures by companies with relatively low rates of carbon emissions, however, a negative value to environmental capital expenditures by companies with relatively high rates of carbon emissions. Using an event-study, Fisher-Vanden and Thorburn (2011) argue that the announcing of carbon reduction activities are interpreted as impeding economic growth by increasing costs to consumers and firms, specifically to those high growth firms.

In this research, the CCP-CFP relationship is our main concern. Therefore, it is important to examine the corporate carbon performance using the three measurements that we state above. By doing this, we will try to indentify which measure is the most effective. Further, for different climate policy regimes, we try to reveal the impact of the imposed policy. Owing to the different actions taken to constraining carbon emissions by governments, the difference between the US, the UK and the EU is obvious. Following our discussion of energy efficiency and reputational effects in chapter 2, in this chapter, we note that where there is no emission constraint present in the market, such as in the US, the emission reduction activities may be a signal of energy efficiency or may bring a positive reputation to the performing firms. Therefore, when the market negatively values carbon outputs at firm-level, the emission reduction performers can benefit from these emission reduction activities. However, for the market, where there is emission constraint, such as in the UK, the energy efficiency and the positive reputational effect may both been weakened, as all the companies in this market have to undertake the emission reduction activities. This may explain why there is no significant valuation attached to carbon output variables for the UK market. Moreover, we compare the corporate carbon performance with the corporate environmental performance, attempting to uncover the link between the two.

The rest of this chapter has been structured as follows: the second section reviews the value indicators that have been adopted from the existing evidence and the performance from current research. The third section introduces the data. The fourth section considers and compares the general models and their limitations; while in the fifth section, we discuss in more detail the variables involved. The sixth section describes the empirical results and the final section draws conclusions and identifies areas for further discussion.

4.2 Theoretical Background

Initially, empirical studies that focus on the relationship between firm performance and their corporate social or environmental performance predominantly use either the event study methodology or the cross-sectional regression analysis at firm level. As a productive research method, an event study explores the immediate effect on how a firm's performance is affected after a CSR-related event (e.g. Hamilton, 1995; Klassen and McLaughlin, 1996; Shane and Spicer, 1983; Dasgupta, et al. 2001), by investigating short-run changes in stock prices. However, it is critiqued by other academics, who argue that event study methodology is less clear about the reason for such an impact (Renneboog et al., 2008), for example, it always fails to control for the cash-flow content of the environmental signals. Therefore, they argue that the conclusion cannot be unequivocally drawn that the environmental event per se is priced by the markets. McWilliams and Siegel (2000) and McWilliams et al. (2001) also criticize the use of the event study method as unreliable because of the research design problem.

Most of the studies that implement cross-sectional regression analysis predict the CFP from the CSP aligning with other control variables, by introducing an accounting measure of profitability as a dependent variable. Others treat the CSP measure as the dependent variable and investigate the influence of the CFP. The most prevalent measures of CFP are Tobin's Q and ROA, but other measures such as ROE and return on sales (ROS) etc are used as well. Examples of these include, Dowell et al. (2000), who conclude that the US-based multi-national enterprises which complied with the stringent environmental standards lead to higher Tobin's Q; Konar and Cohen (2001) breakdown Tobin's Q into tangible and intangible asset values, and report a positive relationship between corporate environmental performance and their intangible asset values, by comparing the environmental and financial performance of manufacturing firms in the S&P 500; Waddock and Graves (1997), using KLD data (all companies in S&P 500), find a positive reciprocal association between CFP and CSP on all three measures, ROA, ROE and ROS. However, critics (e.g. Byun and Oh, 2012; Zyglidopoulos, Georgiadis, Carroll and Siegel, 2012) suspect that higher value firms tend to improve their environmental or social performance results by media coverage or alternative means.

In this section, we introduce some of the existing approaches that have been used to investigate the influence of CSR or corporate environmental responsibility (CER) on CFP. As the research conducted on the CEP-CFP association or CCP-CFP association do not adequately represent the literature that has been done in this area, we include papers examining the CSP-CFP association. However, those papers that investigate the CFP impact on CSR/CER will not be considered in our work. The papers which examine the dual-way effect between CFP and CSR/CER may be included depending on our focus. Further, as we are going to conduct a firm-level analysis, only past evidence based on firm/industry regression analysis and involving firms' accounting data is being collected.

4.2.1 Accounting-Based Earnings' Performance Measures

Earnings' performance refers to the firms accounting ratios, the most common measures are ROA and ROE; others are rarely used, such as return on invested capital (ROIC) and ROS, etc.

Early work by Waddock and Graves in 1997, show the dual-effect between CFP and CSP, using KLD data (all companies in S&P 500). The CFP measures including ROA, ROE and ROS, are used as dependent variables respectively, when examining CSP impact on CFP. The independent variables are CSP obtained from KLD rating data, and other control variables, such as debt-to-total-asset, total-sales, total-asset and number-of-employees. All results support the hypothesis that CSP leads to better financial performance, however, results based on ROA and ROS show a significant positive relationship between firms' profitability and CSP, while results based on ROE only imply an insignificant positive linkage. Although these results are encouraging, they are not reliable using only one-year cross-sectional data, i.e. financial performance data were collected in 1991 and CSP and other control variables in 1990, which is also suggested by the low R-square values. Hence, this positive relationship needs to be further investigated.

In line with Waddock and Graves' (1997) work, Guenster et al. (2011) introduce Innovest eco-efficiency data, ranging from the end of 1996 to the September 2004, and capture the association between CEP and CFP. Earnings' performances are represented by ROA, while control variables include book-value-of-asset, debt-to-asset and sales. Their cross-sectional analyses suggest that eco-efficient US firms symbolize better operating performances than their eco-inefficient counterparts; further, these results are robust after adjustment for industry effect.

While there is lots of evidence available on US firms (e.g., Cochran and Wood, 1984; Hart and Ahuja, 1996; Russo and Fouts, 1997 and King and Lenox, 2002), Guney and Schilke (forthcoming) test the dual-effect between CFP and CSP based on an UK sample. Using the non-public FTSE4GOOD index, they analyse the 1900 data files of daily constituent lists for the period August 2001 to December 2007. Their accounting-based CFP measures are ROA, ROE and ROIC; they also introduce CAPM-beta, size factor, current-ratio, sales-growth, etc as control variables, in addition to the CSP measures (CSP, CSP-square and CSP-cube). They detect a non-linear relationship between CFP and CSP (U-shape), which indicates that CSP improves CFP at first then reduces CFP at certain values. Hence, they suggest there is an optimal CSR intensity.

All the previous studies are focused on the CSP and CFP relationship, but none of them has really looked into the climate changing issues. Busch and Hoffmann (2011) fill this gap by investigating the Dow Jones Global 2500, a worldwide sample. They apply both ROA and ROE as the proxy of CFP, and adopt firm size, financial risk (leverage), 4 country dummies and 9 industry dummies as control variables. Pertaining to the CCP, carbon-intensity (-1) and carbon-management variables are introduced as the outcome-based and process-based CCP measures, respectively, further, the product of the two variables is also calculated and used as a third CCP measure to reflect the aggregate effect of the two different CCP measures. Cross-sectional regression yields different coefficients for the outcome-based CCP associated with ROA and ROE. While using ROA as the dependent variable, it suggests a negative relationship between CFP and CCP (larger carbon emissions firm generate better financial performance). However, results based on ROE suggest a positive relationship between CFP and CCP (smaller carbon emissions firms generate better financial performances). None of these are significant. On the other hand, with respect to the process-based CCP measures, both ROA and ROE results indicate a significant negative relationship between CCP and CFP, which means more carbon management firms underperform compared to their less carbon management counterparts. Busch and Hoffmann's CCP analysis refers to both carbon quantity and quality data, however as they discuss later, ensuring the validity and reliability of the data is a key step in their study because of the subjectivity of the self-report data.

Although the accounting-based performance measures are universally accepted, they may be subject to managers' discretion. Consequently, the majority of these studies also examine the relationship with regard to a market-based measure along with the aforementioned accounting measures, where most of them adopt Tobin's Q, while others employ the parameter of market-value-added (MVA).

4.2.2 Market-Based Performance Measures

Tobin's Q is the most predominant measure in the CSP-CFP relationship studies. The concept is developed in Tobin's (1969) paper, involving both financial market and accounting data. The definition of Tobin's Q is the ratio between the market value and the replacement cost on the same asset. However, in the following applications, it has become common practice in the finance literatures to calculate the Q ratio using approximations, for example, Dowell et al. (2000) use the sum of firm equity value, book value of long-term debt, and net current liabilities as the proxy for firm market value, while the replacement costs of tangible assets is represented by the sum of the book value of the inventory and net value of physical plant and equipment. Others give more accurate estimation of Tobin's Q, such as Lindenberg and Ross (1981).

There is various evidence that show the US CSR/environment impact on companies' Tobin's Q. Using the general definition of Tobin's Q, Dowell et al. (2000) conclude that US-based multi-national enterprises which complied with stringent environmental standards, lead to higher Tobin's Q; however, their residual regressions do not support an upgrading in environmental standards leading to higher Tobin's Qs in future years. In line with this general definition of Tobin's Q, King and Lenox (2001 and 2002) both report significant positive associations between the higher Tobin's Q and lower total emissions, and further support the argument that 'it pays to be green', using the US manufacturing sample.

Following the same form Tobin's Q definition, Busch and Hoffmann (2011) examine this market-based financial performance for their global sample, in addition to the other accounting-based measures. Using Tobin's Q as the dependent variable, it supports the hypothesis that the outcome-based CCP (measured by carbon intensity (-1)) is positively associated with CFP; while it also suggests that process-based CCP (measured by carbon management) is negatively associated with CFP. These results indicate that, as the authors discuss later, capital market participants consider better corporate carbon performance based on lower corporate carbon emissions quantity as an advantage, in contrast to those inconclusive earning's performance measures. On the other hand, based on carbon management performance, the negative relationship may be either due to investors' being less confident in the predicting ability of process-based CCP to the future CFP, or because stockholders might consider process-based CCP as nothing but a marketing strategy.

Other version of Tobin's Q definition can be found in Kaplan and Zingales (1997), Guenster et al. (2011) and Fernando, Sharfman and Uysal (2010) works. They define Tobin's Q as firms' market value of assets divided by their book value of assets, where the market value of assets is further calculated as the sum of the book value of assets, the different between market value of equity and book value of equity, and deferred tax assets. Under this definition, Guenster et al. (2011) find that for US firms, their financial performances measured by Tobin's Q are positively correlated with their eco-efficient scores; further, the higher eco-efficient firms can achieve significantly better economic and statistical performances over their lower score counterparts. The results are robust after considering industry effects or replacing Tobin's Q by its natural logarithm or trimmed values. In addition, using a KLD US sample from 1997 to 2007, Fernando, Sharfman and Uysal (2010) show that green (firms having one or more environmental strengths and no environmental concerns) and toxic (firms having one or more environmental concerns and no environmental strengths) firms both have lower Tobin's Qs than environmentally neutral firms (firms having no environmental strengths or concerns). However, these environmental performance measures have no significant impact on Tobin's Q at industry levels.

In another strand of Tobin's Q application, Konar and Cohen (2001) breakdown market value into tangible and intangible assets, by following the Lindenberg and Ross (1981) method. They employ the reporting of toxic emission data and the number of environmental lawsuits as CEP information and pronounce a positive relationship between corporate environmental performance and their intangible asset values, using the sample of S&P 500 manufacturing firms.

Another frequently used market-based performance measure is market-value-added (MVA) (e.g. Hillman and Keim, 2001; Guney and Schilke, forthcoming). MVA is defined as the difference between capital market value and capital book value, where capital market value is the sum of the market value of equity and the market value of debt, and capital book value is the sum of net asset values and book value of debt. For UK FTSE4GOOD firms, Guney and Schilke (forthcoming) conclude that in general, CSP does not predict CFP (measured by MVA) concurrently. However, this result might be changed, as the single-year regressions show the coefficient on CSP variables getting more negative over time (from 2001 to 2007).

Whilst most existing published research use Tobin's Q as a CFP measure, the results are various. According to Gregory and Whittaker (2013), who point out issues in relation to the implementation of the Q ratio, these inconsistent results may be attributed to the differences in the choices of operational models (e.g. for different firms within the same industry, the choice of keeping substantial property, plant and equipment or not, which in turn affects their asset composition and cost structures) and accounting policies (e.g. firms can choose different depreciation policies, which can change the timing of earnings (or profit) recognition, which in turn can lead to higher (or lower) net book values.). Both choices can distort the relationship between earnings and book values.

Further, the adoption of the Q ratio will introduce an omitted variable bias (for detail, see appendix 16) if earnings are significant in explaining the cross-section of returns in the presence of other variables of interest, based on Peasnell (1982) and Ohlson (1995) model.

4.2.3 Ohlson model

To avoid these aforementioned shortcomings, other studies introduce a well-defined and comprehensively used model, the Ohlson model and its variants. Since Ohlson published his research in 1995, there have been plenty of studies adopting this model (e.g. Barth et al., 1998; Gregory et al., 2007), but not until recently, when it has been applied to test the association between CSP and CFP (Clarkson, Fang, Li and Richardson, 2011; Gregory, Whittaker and Yan, 2011; Gregory, Tharyan and Whittaker, 2011; Gregory and Whittaker, 2013). More details about the Ohlson model and its variants will be discussed in the methodology section.

Using Collins et al. (1999) valuation framework, Gregory, Whittaker and Yan (2011) find that most of the CSR factors are value-added indicators, except governance, for the full KLD sample over an 18 year period ending in 2008. Further, Gregory, Tharyan and Whittaker (2011) confirm this result by dissecting the CSR standards into strengths and concern indicators. Except the human right factor, other CSR constituents show strong value-added abilities on the strength indicators over the concern indicators.

Using both the Ohlson (1995) model and the Collins et al. (1999) version, Clarkson, Fang, Li and Richardson (2011) document a significantly positive association between firm valuation and environmental disclosure measures. In addition, firm’s current environmental performances that are proxied by the firm’s Toxic Releases Inventory emission generate negative coefficients, which further indicate the positive relationship between firm valuation and environmental performances.

So far, these researches are the only existing works using the Ohlson framework to capture the CSP-CFP nexus, but none of them has really focused on the GHGs issue. So our contribution to the existing literatures will be the valuation models using the Ohlson framework, with respect to corporate carbon performance measured in quantitative data.

4.3 Data description

4.3.1 Corporate Financial Performance Data

In this chapter, for majority models, CFP is measured by the company's market value on a per share basis; control variables include company's accounting data on the per share basis too, and Industry dummies are also introduced (see Appendices 1 and 2 for detail).

Since CDP carbon emission data are released on the CDP website in the month of September and supply chain carbon emission data are published in the following year in January, our financial market data (market value pre share) are collected in the following year at the end of June. The half-year (or more) gap is to ensure all financial information for the financial year ending in year t has been embedded in share prices and also, in our case, to ensure that carbon information for year t has been fully reflected in the share prices (e.g. El Ghoul et al. 2010; Gergory and Whittaker, 2013). The accounting data are simply collected at the same fiscal-year end.

Based on our international panel data, we quote different databases for the US, UK and EU. Price (Market value per share, MVPS, denoted in dollar per share) of the US companies is from CRSP, while other accounting variables of the US are from COMPUSTAT North America. For the EU and UK, all variables, financial and accounting variables, are from DATASTREAM. All accounting variables are expressed as dollar per share, including Closing Book Value per share (BVPS), Earnings per share (EPS), Dividend per share (DPS), Research-and-Development per share (adj_RD), Advertising per share (adj_AD, this is only available for the US), net capital contributions received per share (CAPCONPS), total debt per share (TDPPS), and capital expenditure per share (CAPEXPS).

The following adjustments are made due to the concerns about the influence of outliers. We first drop those extreme observations according to Cohen et al. (2003) conclusion and standards, leaving a reasonable range of market value to book value ratio from 0.01 to 100. This is essentially trying to get rid of spurious observations, as well as negative book value firms (Gregory, Tharyan and Whittaker, 2011b). The observation numbers after this action are 5040 for the US, 134 being excluded; 2290 for the rest of the EU, 7 being excluded; and 2007 for the UK, 74 being excluded.

Secondly, we examine the extreme EPS observations. In the case where an observation's EPS absolute value exceeds its MVPS absolute value; we refer to its published financial statements, such as the annual report. We drop the observation if the EPS is incorrectly recorded, but keep the ones that are correct. Further, both Research-and-Development and Advertising (if available) variables are adjusted for the missing observations, which means we replace the value with zero where this is missing.

To test the robust-nature of the results, we introduce the sales deflation variables. The definition of the financial and accounting variables are in the following forms, MSA is the market value over sales, BSA is the year end net book value over sales, ESA is the earnings over sales, DSA is the dividends over sales, and CCSA is the net capital contributions received over sales.

4.3.2 Corporate Environmental Performance Data

To evaluate the environmental/carbon influence at firm-level, we adopt the Trucost environmental performance and carbon emission quantitative data in this chapter as well. For the US, UK and EU, we employ four corporate environmental performance measures in this study, in which one is the measure of full-environmental performance and the other three are the measures of carbon emissions, using a 7-year sample period, 2002 to 2008. However, to keep in line with the financial variables, all environmental measures are defined on per share basis in the share number deflating models.

Firstly, the full-environmental performance measure is the Impact Ratio per share (IPPS), which is based on the Total Environmental Damage Cost that is described in Chapter 1, deflated by the company's share numbers. However, Total Environmental Damage Cost is subject to analyst estimation; therefore, we only report it as a comparison.

The other consideration is the data volatility. Even though the volatile data doesn't affect the ranking result on a large scale, when it is applied to the valuation model, we can perceive that the extreme IP values will have significant influence on the regression results. Therefore, we check the IP values within each company, and make sure that they are consistent (as they should possess the same 'sticky' feature as the accounting variables). We compute the standard deviation of the IP values for each company, and identify the extreme IP if the standard deviation is bigger than 0.5. After confirming these extreme values with Trucost, we use the winzorized IP (WIPPS) for the UK and the rest of the EU. A 99.5% winsorisation is adopted to adjust the IP, which means that the values of IP below the 0.5th percentile are set to the 0.5th percentile, and the values above the 99.5th percentile are set to the 99.5th percentile. Compared to the trimming method, the winzorising method preserves the sample size, while eliminating the impact of extreme values at the same time. However, we only apply this method to the variables that tend to be 'sticky', whereas for the financial variables and earnings per share, extreme values may appear more frequently and unpredictably, therefore will have to be trimmed. For the US, the underlying IP values suggest a relatively stable environmental performance for each of the companies across our observation period; therefore, no adjustment is necessary.

Secondly, the three carbon emission variables are based on the three CCP measures that are described in Chapter 1, deflated by the company's share number. We quote these variables as the first-tier and direct carbon emission quantities per share (FFPS), the direct carbon emission quantities per share (DFPS), and the carbon dioxide emission quantities per share (CFPS).

To test the robust-nature of the results, the sales deflated environmental/carbon variables are defined as follows; the environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) (IPSA), the carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA).

4.4 Methodology

4.4.1 Ohlson Framework

In this section, we introduce the major models under the Ohlson framework, though the majority of them include the book-value and earnings factors, there is debate on whether to include the dividends factor, and/or other accounting-based measures; discussions also involve the 'other-information', where, for different research purposes, various proxies have been adopted. Our main contribution is to examine whether the environmental/carbon information is a value-added factor for the firms' market value, based on the Ohlson framework, when combined with other accounting measures.

a. Ohlson model

Appleyard (1980) suggests that "It is well known that (conventionally measured) accounting income cannot be related to a firm's capital stock in a simple way". Thereafter, Peasnell (1982) develops a common analytical framework, which is known as the 'residual income model', with respect to the mathematical connections between the conventional economic concepts of value and yield and accounting models of profit and return.

$$P_t = b_t + \sum_{\tau}^{\infty} \frac{x_{t+\tau}^a}{(1+r)^\tau} \quad (4.1)$$

Where,

P_t= the market value of the companies' equity value at time t.

x_t^a= the abnormal earnings (or residual income) at time t.

b_t= the closing book value at time t.

r = the cost of equity.

Following Peasnell (1982) framework, the Ohlson (1995) model is derived, with the inclusion of the 'other information' term:

$$P_t = b_t + \alpha_1 x_t^a + \alpha_2 v_t \quad (4.2)$$

Where:

$$\alpha_1 = \frac{\omega}{1 + r - \omega} \quad (4.2.1)$$

$$\alpha_2 = \frac{1 + r}{(1 + r - \omega)(1 + r - \gamma)} \quad (4.2.2)$$

And

P_t= the market value of the companies' equity value at time t.

x_t^a= the abnormal earnings (or residual income) at time t.

v_t= non-accounting information, abbreviate for the 'other information', at time t.

$\omega \ and \ \gamma$ are the autoregressive parameters.

There are three assumptions pre-set to ensure the validity of this model. Firstly, the market value is determined by the present value of the expected dividends (PVED); this pre-condition links the firm's market value directly to its equity value and cost of capital and also suggests using the risk-free rate as the discount factor.

$$P_t = \sum_{\tau=1}^{\infty} \frac{d_{t+\tau}}{(1+r)^{\tau}} \quad \textit{(PVED)} \quad (4.3)$$

Secondly, the clean surplus restriction is applied to simplify the calculations, which also indicates the equivalents of formula (4.1) and (4.3). Thirdly, the abnormal earnings are expressed in the form of a linear model, which focuses the valuation on the prediction of abnormal earnings rather than dividends.

The abnormal earnings, by its definition, can be written as follow:

$$x_t^a = x_t - rb_{t-1} \quad (4.3.1)$$

Along with the clean-surplus restriction:

$$b_t = x_t - d_t + b_{t-1} \quad (4.3.2)$$

Where:

x_t = the net income at time t.

b_{t-1}= the opening book value at time t, or the closing book value at time t-1.

b_t= the closing book value at time t.

d_t= the dividends at time t.

r = the cost of equity.

Substituting equation (4.3.1) and (4.3.2) into (4.2), we have a weighted average form of the Ohlson model, in terms of the closing book value, current earnings, dividends and the 'other information': (The derived procedure will be demonstrated in Appendix 5.)

$$P_t = (1-\alpha_1 r)b_t + \alpha_1 r[\frac{x_t(1+r)}{r} - d_t] + \alpha_2 v_t \tag{4.4}$$

We can also simplify it into a multi-variables regression form:

$$P_t = \beta_1 b_t + \beta_2 x_t + \beta_3 d_t + \beta_4 v_t + \varepsilon_t \tag{4.4.1}$$

Based on an additional assumption that the dividend is irrelevant to the 'other information', in his 1995 work, Ohlson also suggests that the abnormal earnings and the 'other information' follow an autoregressive stochastic process:

$$x_{t+1}^a = \omega x_t^a + v_t + \varepsilon_{1,t+1} \tag{4.4.2}$$

$$v_{t+1} = \gamma v_t + \varepsilon_{2,t+1} \tag{4.4.3}$$

Where, x_t^a is the abnormal earnings, v_t is the 'other information' which capture all non-accounting information that is used to predict the future abnormal earnings; and ω and γ are the autoregressive parameters of abnormal earnings and 'other information', respectively, both of which have a value from 0 to 1. In this way, the inter-connection between the abnormal earnings and the 'other information' is set up. The empirical implementation of these parameter constraints can be found in DeChow, Hutton and Sloan (1999) and Gregory, Saleh and Tucker (2004).

Ohlson (1995) model is used in this chapter in the following form:

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 v_{it} + \varepsilon_{it} \tag{4.5}$$

Where,

P_{it} is the the market value for firm i for time t,

IND_{jt} is the industry dummy for industry j for year t,

b_{it} is the the closing book value for firm i for time t,

x_{it} is the the earnings for firm i for time t,

d_{it} is the the dividends for firm i for time t,

v_{it} is the the other information for firm i for time t,

ε_{it} is the the error term.

b. Strong et al. (1996) and Collins et al. (1999) Version

Strong et al. (1996) and Collins et al. (1999) demonstrate a variation of the Ohlson (1995) model, which includes dividends in the dependent variable, and are stated in terms of earnings and opening book values:

$$P_t + d_t = b_{t-1}(1 - \alpha_1 r) + (1 + \alpha_1)x_t + \alpha_2 v_t \qquad (4.6)$$

Where

P_t= the market value of the companies' equity value at time t.

d_t= the dividends at time t.

x_t = the net income at time t.

b_{t-1}= the opening book value at time t.

r = the cost of equity.

α_1 *and* $\alpha_2$are the same definition as equation (4.2.1) and (4.2.2).

We can also simplify this version into the following regression form:

$$P_t + d_t = \beta_1 b_{t-1} + \beta_2 x_t + \beta_3 v_t + \varepsilon_t \qquad (4.6.1)$$

Strong et al. (1996) measure the cum-dividend price at the accounting year end based on the per share values. Firstly, they test the impact of various variables by setting each coefficient to zero. Test results suggest that the omission of the book-value would lead to serious misspecification of the model. They also presume that the exclusion of the earnings' variable would leave the model (with the book-value variable present) be misspecified as well, though no such evidence is provided. Secondly, they examine the impact of including an intercept. In comparison to the intercept-free models, these results show the trend of an aggregate lower explanatory power of the variables due to both the marginal reduction of the estimated coefficient values and the increase of the corresponding standard errors. However, they also note that they could compensate for the omitted variables or other model misspecifications by including an intercept. They further deflate the model by the opening-book-value, which also results in a lower explanatory power of the model. Finally, the earnings persistence performance is found to have a significant influence on the coefficient estimations.

Based on Barth and Kallapur (1996), Penman (1992), Ohlson (1995), Berger et al. (1996) and Barth et al. (1996) views, Collins et al. (1999) emphases the important role that book value plays as a proxy for expected future normal earnings and as a proxy for abandonment or liquidation value, in the cross-sectional valuation models. They argue that the book value of equity serves as a value–relevant variable rather than as an econometric role in controlling for scale differences, by testing the significance of the coefficient of book value, after introducing the alternative scale control variables.

Additionally, to identify the relative importance of earnings and book value for profit and loss firms, Collins et al. adopt the profit/loss dummy variable and the cross product of dummy and earnings and of dummy and book values. The model is interpreted in the following form:

$$P_t + d_t = \beta_0 + \beta_1 b_{t-1} + \beta_2 x_t + \delta_1 D_t + \delta_2 D_t b_{t-1} + \delta_3 D_t x_t + \varepsilon_t \qquad (4.7)$$

Where

P_t= the market value of the companies' equity value at time t.

d_t= the dividends at time t.

x_t = the net income at time t.

b_{t-1}= the opening book value at time t.

D_t= the dummy variable, D_t=1 if a profit firm of the year t, otherwise, D_t=0.

$\delta_1, \delta_2, \delta_3$ are the coefficients capturing the incremental effects of profit firms.

They further argue that, as a value-relevant indicator, book value has a more prominent attribution in evaluating the loss firms than the profit firms, due to the fact that book values contain more useful information on future earnings forecast than current negative earnings. This asymmetric information appraisal leads to a further examination on whether the book value of equity is a proxy for expected future normal earnings or a proxy for abandonment/liquidation value. By introducing two extra variables, FUTX and EXITV, to measure the expected future normal earnings and exit values, the authors conclude that the role the book value plays in firms' valuation depends on the firms' surviving probability.

Collins et al. (1999) model is used in this chapter in the following form:

$$P_{it} + d_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 v_{it} + \varepsilon_{it} \qquad (4.8)$$

Where,

$P_{it} + d_{it}$ is the cum-dividends market value for firm i for time t.

c. Barth et al. (1998) and Rees (1997) Version

Barth et al. (1998) adopt an ex-dividend version of the Ohlson model; their main model can be interpreted in the following form:

$$P_t = \beta_1 b_t + \beta_2 x_t + \beta_3 v_t + \varepsilon_t \qquad (4.9)$$

Where

P_t= share price at fiscal year-end t.

b_t= the closing book value of equity per share at fiscal year-end t.

x_t = earnings per share at fiscal year-end t.

v_t= the 'other information' at fiscal year-end t.

To support this ex-dividend version, Rees (1997) argues that, practically, the market value at the year end is a cum-dividend term due to the final dividends being paid in arrears. Barth et al. (1998) interpret the equation in the Ohlson framework, and further introduce the BRANDS[31] as the 'other information' variable. Hence, they assume that the coefficient BRANDS variable is positive, which captures the value relevant information in addition to the book value per share and earnings per share.

For a 595 observations firm-year US sample from 1991 to 1996, Barth et al. report the significant valuation-relevant on all three variable in the pooled fixed year regression. Earnings provide the most valuable information of the three variables, with a coefficient of 5.23; book value has the influence of 0.64; while brands only account for 0.29 in predicting firms' share price.

In contrast to Barth et al. (1998), Rees (1997) includes the intercept but excludes the 'other information' term in the equation (4.9):

$$P_t = \beta_0 + \beta_1 b_t + \beta_2 x_t + \varepsilon_t \qquad (4.10)$$

In order to test the hypotheses on dividend policy, capital structure and investment expenditure, the above model has been further developed into the following extension:

$$P_t = \delta_0 + \delta_1 DV_t + \delta_2 RE_t + \delta_3 (BV_t + TD_t) - \delta_4 TD_t + \delta_5 IV_t + \mu_t \qquad (4.10.1)$$

Where

P_t= share price for year t.

DV_t = the ordinary dividends for year t.

RE_t= the retained earnings for year t.

BV_t= the closing book value of equity for year t.

TD_t= the total book value of debt including non-ordinary equity capital such as preference shares.

IV_t= the capital expenditure for year t.

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[31] BRANDS are defined as the firms' total estimated value of brand names.

The regression is designed to test, firstly, whether the firms with high dividends exhibit greater value than the firms with high retain earnings; secondly, whether the firms with higher level of debt benefit more through tax advantage; thirdly, whether larger capital expenditure signals greater firm values. Therefore, if the following three conditions are satisfied, equation (4.10.1) will be transformed into equation (4.10), assuming clean surplus, i.e. the ordinary dividends $\mathrm{DV_t}$ + the retained earnings $\mathrm{RE_t}$ = earnings.

$$\delta_1 = \delta_2 \tag{4.10.2}$$

$$\delta_3 = \delta_4 \tag{4.10.3}$$

$$\delta_5 = 0 \tag{4.10.4}$$

The result is reported in six different models, in which different indicators are combined to test the various hypotheses. The author concludes that all the new variables introduced above are value relevant; particularly, the dividends and investment expenditure variables also have a signalling effect on the firm values.

Further tests also involve the segmentation by capitalization and ROE, respectively, based on the following dividend model:

$$P_t = \theta_0 + \theta_1 DV_t + \theta_2 RE_t + \theta_3 BV_t + \epsilon_t \tag{4.11}$$

When segmented by capitalization, the full sample is categorized into five sub-groups, including high-capitalization, medium-high-capitalization, medium-low-capitalization, low-capitalization and low-but-positive-capitalization. When segmented by ROE, there are also five sub-samples, which are high-ROE, medium-high-ROE, medium-low-ROE, low-ROE and negative-earnings-group. As Rees's sample widely covers UK firms from year 1987 to 1995, excluding the financial sector, he concludes that low-capitalisation UK firms (firms who pay low dividends) tend to value retain earnings less than the relatively high capitalization firms, while high-ROE and negative-earnings firms assign a small portion of retain earnings. Dividends, the most influential variable within this UK sample, are relatively strong for most sections, where the only exception is the high-ROE segment. Book value, on the other hand, has a relatively weak impact on the high-capitalization, medium-high-ROE and medium-low-ROE firms.

Barth et al. (1998) model is used in this chapter in the following form:

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 v_{it} + \varepsilon_{it} \qquad (4.12)$$

Rees (1997) model is used in the following form:

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 TD_{it} + \beta_5 IV_{it} + \beta_6 v_{it} + \varepsilon_{it} \qquad (4.13)$$

Where,

TD_{it} is the total debt for firm i for year t,

IV_{it} is the investment/ capital expenditure for firm i for year t.

d. Hand and Landsman (2005) Version

Hand and Landsman (2005) employ the Ohlson (1995) model, but interpret dividends in a different way. In the absence of the ‘other information’, Hand and Landsman’s version can be described as the following form:

$$MV_t = c_0 + c_1 BV_t + c_2 NIBX_t + c_3 DIV_t + c_4 NETCAP_t + e_t \qquad (4.14)$$

Where

MV_t= market value for year t.

BV_t= the closing book value of equity for year t.

$NIBX_t$= core earnings, net income before extraordinary items for year t.

DIV_t = the common dividends declared.

$NETCAP_t$= net capital contribution,

= purchase of common preferred stock - sale of common and preferred stock.

The Hand and Landsman’s Dividend concept consist of two parts, the DIV and the $NETCAP$. The authors especially note that the term $NETCAP$ unavoidably includes the issuing and repurchase of preferred stocks, but excludes DIV. Hence they define the net dividends as the sum of the two parts.

To test how US equity market value the dividends in the period of 1984 to 1995, they run the above regression over the cross-sectional data and conclude that both part of the dividends are reliably positive priced by the market, with coefficient of 3.47 and 0.90, respectively.

Further tests, which Hand and Landsman propose to explain the positive pricing dividends, are involved in the Ohlson (1995) "linear information dynamics". Importing DIV and $NETCAP$ into equation (4.4.2),

$$v_{t+1} = \gamma_0 + \gamma_1 v_t + \gamma_2 DIV_t + \gamma_3 NETCAP_t + n_t \quad (4.14.1)$$

and running the above regression with the presence of the 'other information',

$$MV_t = c_0 + c_1 BV_t + c_2 NIBX_t + c_3 DIV_t + c_4 NETCAP_t + c_5 v_t + c_6 FNIBX_{t+1} + e_t \quad (4.14.2)$$

The authors infer that neither dividends nor net capital contribution is a proxy for the 'other information'. We notice that the one-year-ahead core earnings $FNIBX_{t+1}$ are the multiple of IBES forecast of primary EPS before extraordinary items for year t+1 and common shares at the time the forecast was made. The 'other information' v_t is also a calculated term,

$$v_t = FNIBX_{t+1} - r \times BV_t - \omega_t \times ANIBX_t \quad (4.14.3)$$

$$ANIBX_t = NIBX_t - r \times BV_{t-1} \quad (4.14.4)$$

Expanding equation (4.4.1) and running equation (4.14.2),

$$ANIBX_{t+1} = \omega_0 + \omega_1 ANIBX_t + \omega_2 ANIBX_{t-1} + \omega_3 v_t + \omega_4 DIV_t + \omega_5 NETCAP_t + \omega_6 BV_{t-1} + \varepsilon_t \quad (4.15)$$

Hand and Landsman (2005) also indicate that dividends, including net capital, do not signal profitability or management's private information.

Finally, they modify equation (4.14.2) into the following form,

$$MV_t = c_0 + c_1BV_t + c_2NIBX_t + c_3DIV_t + c_4NETCAP_t + c_5FNIBX_{t+1} + c_6UNIBX_t + e_t \quad (4.16)$$

and conclude that the US market positively price dividends because they are the proxy for the market mis-forecasting.

Hand and Landsman's (2005) results are basically inconsistent with Miller and Modigliani's displacement property[32], but in line with Rees (1997), Fama and French (1998), Giner and Rees (1999) and Akbar and Stark (2003) etc[33], which further prove that dividend is a positive value relevant variable.

The Hand and Landsman (2005) model is used in this chapter in the following form:

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 v_{it} + \varepsilon_{it} \quad (4.17)$$

Where,

ΔC_{it} is the net capital contribution for firm i for year t.

e. Agarwal, Taffler and Brown (2011)

In a most recent paper, Agarwal, Taffler and Brown (2011) use the full-version Ohlson model, designed to test whether the management quality is value relevant. In this research, Agarwal et al. apply the extension equations of the Ohlson model, which is based on the original Ohlson model, and in addition they estimate the autoregressive parameters $\omega\ and\ \gamma$ by running regression on the abnormal earnings and the 'other information'. Their findings show that the better quality of management has a positive relationship with lower cost of capital, more stable earnings and higher profitability that persist over time.

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[32] Under the Modigliani and Miller dividend displacement theorem, firms' equity market values and dividends should be negatively related, dollar-for-dollar (e.g. Miller and Modigliani,1961; Litzenberger and Ramaswamy,1979; Miller and Scholes,1982; Miller and Rock,1985; and Fama and French, 1998).

[33] These recent work find that dividends are materially positively priced in the cross-section of equity market values.

To test whether better managed firms have a higher persistence of abnormal earnings, or in another word, to estimate the parameter ω, they design the pooled panel data regression with centered[34] variables and year dummies:

$$x_{i,t+1}^{'a} = \omega_0 + \omega_1 x_{i,t}^{'a} + \omega_2 QM_{i,t}^{'} + \omega_3 x_{i,t}^{'a} \times QM_{i,t}^{'} + \sum_{j=4}^{19} \omega_j YD_j + \varepsilon_{i,t} \qquad (4.18)$$

Where,

$x_{i,t}^{'a}$ is the centered abnormal earnings for firm i, year t,

$QM_{i,t}^{'}$ is the centered within industry firm i quality of management rank for year t,

YD_j is the year dummies,

And the abnormal earnings are estimated as we state in formula (4.4.2).

To test persistence of the 'other information', or to estimate the parameter γ, they follow the pooled panel data regression with median centred variables and year dummies:

$$v_{i,t+1}^{'} = \gamma_0 + \gamma_1 v_{i,t}^{'} + \gamma_2 QM_{i,t}^{'} + \gamma_3 v_{i,t}^{'} \times QM_{i,t}^{'} + \sum_{j=4}^{19} \gamma_j YD_j + \varepsilon_{i,t} \qquad (4.19)$$

And the one-period forward analysts' earnings forecasts as the proxy of the 'other information', which can be defined as

$$v_t = f_t - rb_t - \omega x_t^a \qquad (4.20)$$

Where,

v_t is the other information

f_t is the median analysts' forecast at time t for the earnings one-year forward.

The autoregressive parameters $\omega \; and \; \gamma$ thus are given by the following equations:

[34] According to Agarwal et al., they centre the variables on median values to reduce the multicollinearity associated with the inclusion of interaction terms in the regression equation (Johnson and Wichern, 2003).

$$\omega = \omega_0 + \omega_3 QM' \quad (4.20.1)$$

$$\gamma = \gamma_1 + \gamma_3 QM' \quad (4.20.2)$$

Finally, they also run a full regression of the Ohlson model, and specifically add research and development expenditures in their valuation model, assuming that it represents a potential value relevant intangible asset and expecting it to have an impact on firm value. Hence, their full version of the valuation equation is expanded into the following form:

$$P'_{i,t} = \beta_0 + \beta_1 b'_{i,t} + \beta_2 x'^{a}_{i,t} + \beta_3 v'_{i,t} + \beta_4 R\&D'_{i,t} + \beta_5 QM'_{i,t} + \beta_6 b'_{i,t} QM'_{i,t} + \beta_7 x'^{a}_{i,t} QM'_{i,t} + \beta_8 R\&D'_{i,t} QM'_{i,t} + \beta_9 v'_{i,t} QM'_{i,t} + \sum_{j=10}^{26} \beta_j YD_j \quad (4.21)$$

We agree that the research and development expenditures contain the representative information; hence we add the R&D variable into our composite model, and also the Advertising expenditures variable for the US. However, due to our data constraint and space limitation, we will not perform the full version of Agarwal, Taffler and Brown (2011) model in our research.

f. Other Composite Models

We also run some composite models to include other control variables, in addition to book-value, earnings, and dividends. The first composite model (composite model 1) has included the extra control variables which have appeared in both Rees (1997) and Hand and Landsman (2005), i.e. the net capital contribution, capital expenditure and total debt variables.

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 v_{it} + \varepsilon_{it} \quad (4.22)$$

Where,

ΔC_{it} is the net capital contribution for firm i for year t,

TD_{it} is the total debt for firm i for year t,

IV_{it} is the investment/ capital expenditure for firm i for year t.

Total debt is measured by the total book value of debt that includes long term and short term debt, long term liabilities, and non-ordinary equity capital such as preference shares. Harris and Raviv (1990) suggest that as a disciplining device, default on debt, grants creditors the option to force a firm into liquidation and therefore generate information to investors. Ross (1977) and Leland and Pyle (1977) proposed a signalling role for debt, however, there is little empirical evidence to support it. Rees (1997) reports a statistically significant negative relationship between firms' debt and their market values for UK companies. Ashton (1991) also point out that even if a tax advantage for firms with high levels of debt exists, it is very modest in the UK.

Investment is defined as the capital expenditure on tangible, intangible and financial assets. Eisner (1964) suggest that capital expenditures is undertaken in order to purse profits and/or reduce the risk associated with expectations of profits. McConnell and Muscarella (1985) support a signalling effect for capital investments by showing the positive link between common stock prices and the announcement of capital expenditure, i.e. when capital expenditure increases, market participants respond positively; and when capital expenditure decreases, market participants respond negatively, regardless of the source of the investment.

Net capital contribution in this chapter is defined as the difference between the purchase of common and preferred stock and the sale of these stocks. As Hand and Landsman (2005) note, the measure of net capital contributions excludes dividends, and the sum of the net capital contribution and dividends equals net-dividends. For the US sample, they report a positive relationship between the net capital contribution and firms' value, though the coefficient is less than that on the dividends variable.

The second composite model (composite model 2) is based on the first one, but also include the extra control variable, research and development expenses.

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 RD_{it} + \beta_8 v_{it} + \varepsilon_{it} \tag{4.23}$$

Where,

RD_{it} is the research and development (R&D) expenditure for firm i for year t.

The choice of R&D as the control variable is because there is an association between the R&D productivity and the scale of firms' operations, the potential technological opportunities and firm specific variables, such as the degree of appropriability (Pakes and Schankerman, 1984). Note that for R&D expenditure, the more investment in this, the lower the expected marginal return from the incremental increases in R&D expenditure, according to the law of diminishing returns. Therefore, we can expect a negative coefficient for the R&D variable (Gugler 2001).

The third composite model (composite model 3, for the US only) is based on the first one, and include the extra control variable, advertising expenses.

$$P_{it} = \sum_{j=1}^{j=N} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 ADV_{it} + \beta_8 v_{it} + \varepsilon_{it} \quad (4.24)$$

Where,

ADV_{it} is the advertising expenses for firm i for year t.

Advertising is the variable only introduced for US model. Investigations on whether advertising expenses are value relevant factors include Abdel-khalik (1975), and Hirschey and Weygandt (1985). Barth et al. (1998) report a significant negative relationship between advertising expenses and firms' market value of equity. Milgrom and Roberts (1986) conclude that advertising may signal product quality, while Bublitz and Ettredge (1989) suggest that benefits from advertising expenditures are short-lived.

g. Summary

In summary, the models that we are going to use in this research are the basic Ohlson model, Barth et al. (1998) model, Collins et al. (1999) model, Rees (1997) model, Hands and Landsman (2005) basic model, and the three composite models. Among all of the above models, we replace 'the other information' with our environmental/carbon indicators to investigate whether they are the value-added factors in relation to certain industries. The profit and loss companies, in terms of their earnings, are also being indentified and analysed in relation to the environmental/carbon effect. Further, in the next section, we will discuss the scale effects and the tests involved.

4.4.2 Scale Effects

The capital markets based accounting research has confronted the potential effects of scale, which can result in spurious inferences. For example, Easton (1998) points out that management has discretion over the number of shares outstanding. By spliting their firm's stock or a reverse stock split, managers can "change the price of shares without changing the economic characteristics of the firm." Therefore, "the magnitude or scale of the dependent variable in price-levels (i.e. per share based) regressions reflects no more than the choice by management of the number of shares outstanding" and "a regression of share price on the firm attributes will lead to coefficients that may capture no more than the fact that all variables have the same scale".

Deng and Lev (1998) also describe a size-related problem. By estimating regressions where all variables are scaled by both share number and book value, they observe that the regression scaled by book value is better specified and more economically meaningful than the regression at price-levels.

Easton and Sommers (2003) suggest that the scale effects are due to the overwhelming influence of large firms, which drives the results of the regressions by a relatively small subset that consists of the very largest firms.

Although the scale effect appears to represent a broad distrust of inferences drawn from samples of firms exhibiting substantial size-related variation, Barth and Clinch (2001) point out that it is per se a distrust that reflects a variety of potential econometric effects. Barth and Kallapur (1996) attribute the scale effects to two econometric problems, i.e. the coefficient bias induced by correlated omitted variables, and inefficient coefficient standard errors induced by heteroscedasticity. Further, Barth and Clinch (2001) summarize these econometric issues into four types, including additive and multiplicative omitted scale variables, scale varying valuation parameters, and heteroscedasticity. Most recently, Barth and Clinch (2009) consider survivorship as an additional econometric scale effect.

To mitigate these scale effects associated with different accounting-based valuation models, Barth and Kallapur (1996) and Barth and Clinch (2001) describe two solutions; deflate all variables in the original model with a scale proxy or introduce the scale proxy as an additional independent variable into the original model. However, Lo (2005) evaluates these two potential solutions using data simulations, and points out that deflation is superior to the alternative using a scale proxy as an independent variable. Therefore, in this research, we adopt the deflation method to accommodate these scale effects.

Early research, such as Barth and Kallapur (1996), Brown, Lo and Lyss (1999), and Barth and Clinch (2001), define scale as the market value of the investment in the firm. They argue that scale is either the amount invested sometime in the past (at the beginning of the firm in Barth and Kallapur, 1996, or at the beginning of the fiscal period in Brown, Lo and Lys, 1999), or new investment during the fiscal period (net new capital contributions in Barth and Clinch, 2001).

To identify the appropriate scale proxy, Christie (1987) proposes that in returns studies, the correct deflator (to control for scale effects) is the market value of equity at the beginning of the returns period. Barth and Kallapur (1996) list total assets, sales, book value of equity, net income, number of shares outstanding, and share prices as proxies for the unknown 'true scale factor', in addition, Barth and Clinch (2001) add net capital contributions by shareholders to this list. Brown, Lo and Lys (1999) cite that lagged price as a proxy for scale, while Easton (1998) suggests the use of market capitalization at the firm level and price per share at the 'per share' level as proxies for scale. Further, Easton and Sommers (2003) consider the use of closing market value. Most recently, Gil-Alana, Iniguez-Sanchez and Lopez-Espinosa (2011) argue that size defined by the employee numbers can be a good deflator.

A shortlist of the deflators includes:

1. Number of shares
2. Sales
3. Number of employees
4. Book value of equity
5. Lagged book value
6. Market value of equity (opening / closing)

7. Total assets
8. Price
9. Lagged price
10. Net capital contributions
11. Net income

The argument over the most effective deflator, so far, remains unsettled. Among all these scale proxies, i.e. the deflators, Gil-Alana et al. (2011) discuss the number of shares, sales, number of employees, book value of equity, opening market value of equity, total assets, net capital contributions, and net income. For the use of the opening market value of equity, they argue that it is not a constant term, the value depending on earnings. By the use of the book value of equity and total assets, they show that these are not good scale proxies either, because the introduction of these deflators can alter relationships in the original model after transformation. Thereby, we infer that the lagged book value is not a good deflator, which can be transferred into a book value expressed form. Further, by conducting the Hausman (1978) test, Gil-Alana et al. (2011) recommend the number of employees as a good deflator, due to the exogeneity characteristic of the variable and the stability performance of the results. However, the number of employees is usually adopted in the cost accounting (service cost, pension cost…), and there is no evidence for its use in the capital markets based accounting research.

Barth and Clinch (2001) report that a model deflated by the number of shares is the most effective method at mitigating the scale effect on coefficient estimations, as measured by the bias and mean squared error. Barth and Clinch (2009) further confirm the above conclusion, but they claim that it is difficult to identify which type of scale effects have been involved in the data.

The above arguments are based on observations in the US, whereas in the UK, Akbar and Stark (2003b) apply the Easton and Sommers (2003) style of analysis, i.e. including the scale proxy as an additional independent variable and introducing the WLS estimators. They conclude that, for UK data, there is no clear evidence that suggests any one of the various deflators is a superior in reducing scale effects. Instead of identifying the econometric performance of models by the introduction of different deflators, Shen and Stark (2011) choose deflators concerned with improving the effectiveness of accounting-based valuation models in terms of out-of-sample proportional valuation error metrics. They suggest that the use of book value as the deflator seems to be a good overall approach. Finally, we note that there is no evidence of the scale effect in value relevance studies for the EU. In summary, it is evident that the adoption of different methods and data can lead to various conclusions as to the choice of deflators.

To test the true scale proxy to mitigate the scale effect concerned with econometric issues, is beyond the scope of this research. Further research is suggested to be done in this area, aiming at indentifying the best deflators for different countries/areas, such as the US, the UK and the EU.

In this research, we adhere to Gil-Alana et al. (2011) judgment, and consider the book value of equity and earnings as two endogeneity variables which cause the aforementioned econometric issues. Further, we consider that the original model to be the Ohlson model at the firm level without any deflation, i.e. the 'true' valuation model. The deflators we choose for removing the endogeneity problems are the variables that correlate with the explanatory variables (i.e. book value of equity and earnings), but independent of the error term of the 'true' model. After this selection process, it leaves us with the following deflators; number of shares, sales, and number of employees.

However, further consideration has been given to the spurious correlation between the explained variable and the explanatory variable, specifically after deflating by the number of employees, which is untabulated here. The high spurious correlation between the variables may jeopardize the results' accuracy. Therefore, in this research, we adopt the number of shares as the main deflator, and use sales deflation to cross-check the results.

Arguments may arise about the above choices, which may not be the best for the country/area involved. But as we discussed above, the number of shares and sales have not been totally rejected as deflators. Also, we are going to introduce the two-way cluster standard errors, which are robust for both heteroskedasticity and intra-group correlation, and will be discussed in the following section. Any further conflicts associated with the choice of deflators will be determined by the goodness and the significance of the fit for the intended models.

4.4.3 Various Tests

Panel data usually refer to a dataset that has more than one dimension, often, where we have data that consist of both time series and cross-sectional elements, then it can be defined as panel or longitudinal data. In our case, we have a dataset with a time series of 7-years and being cross-sectional at the same time, which is considered as panel data.

Even though the adoption of different estimators could yield the same coefficients for one regression, the test statistics (such as the t-statistic, F-statistic) can diverge, which may mislead us when presenting the results. Therefore, the choice of a reasonable test estimator can have a vital effect on test results.

As with the CSR scores, we believe that a firm's carbon emission quantity and the external environmental cost are likely to be "sticky" both across time and in cross-section. Further, Gow et al. (2010) point out that unlike the finance variables, most of the accounting variables also possess great dependence both over time and in cross-section. Hence, the estimator that we choose for the regression has to be robust for both time and inter-firm effect. In this section, we will choose and explain the best test estimator for our dataset.

a. OLS and White Standard Errors

It is well-known that the OLS estimators are unbiased only if the residuals are homoscedastic and uncorrelated across observations. When the residuals are serial correlated or heteroscedasticity, the OLS standard errors can be biased and either under or overestimate the significance of the coefficient. Though the White standard errors (1980) improved the consistency in the presence of heteroscedasticity, it still misspecified true variability of the coefficient estimates. Due to the above defects, neither of these two estimators will be adopted in our panel data regression.

b. Newey-West

Newey and West (1987) is a frequently applied estimator in panel datasets, which generalize the White (1980) estimator to produce a covariance matrix estimator that is believed to be robust for both heteroscedasticity and autocorrelation. However, researches, such as Andrews (1991) and Petersen (2009), have found that Newey-West yield slightly biased estimates of standard errors when time-series dependent. Furthermore, a recent research, Gow et al. (2010), reports that it even produces misspecified test statistics when there is cross-sectional dependence.

c. Fama-MacBeth

Fama and MacBeth (1973) design another approach for dealing with the residuals serial correlated problem. Specifically, T cross-sectional regressions (one for each period) are estimated, and the average of the T estimates is the coefficient estimate. The variance is estimated by the following formula:

$$S^2(\beta_{FM}) = \frac{1}{T}\sum_{1}^{T}\frac{(\hat{\beta}-\hat{\beta}_{FM})^2}{T-1} \qquad (4.25)$$

However, this approach only works when there is no firm effect, i.e. no cross-section dependence, which is not true in our case.

There are other papers (Chakravarty, Gulen, Mayhew,2004; and Fama and French, 2002), which have acknowledged the bias in the Fama-MacBeth approach and try to correct it by estimating the correlation between the yearly coefficient estimates and then multiplying the estimated variance by $(1+\theta)/(1-\theta)$ *, where* $\theta = cor(\beta_t, \beta_{t-1})$, which seems intuitively sensible. However, as Petersen (2009) shows this adjustment is only suitable when the firm effect vanishes fast enough and there are adequate numbers of time periods per firm. Considering that the environmental and accounting variables in our dataset are dependent both over time and in cross-section, and the number of time periods is a maximum of 7 years, we reject the Fama-MacBeth approach for our test statistics methodology.

d. Z2 Test

The Z2 test, which originally appears in Barth (1994) paper and thereafter in other accounting literature, is calculated by the following formula,

$$Z2 = \frac{1}{\sqrt{T}}\sum_{j=1}^{T}\frac{t_j}{\sqrt{k_j/k_{j-2}}} \qquad (4.26)$$

Where, T is number of years, t is the t-statistic, and k is the degrees of freedom for regression in year j.

However, by comparing the Fama-MacBeth approach and Z2 approach, Gow et al. (2010) suggest that Z2 adjustment does not account for cross-regression dependence.

e. One-Way Clustered Test

In a one-way clustering approach, observations can be clustered either along a cross-section or a time-series dimension, which allows the individual error terms that belong to the same group to be correlated, with quite general heteroscedasticity and correlation. This approach has been applied in a number of studies (such as, Bushee and Goodman 2007; Dhaliwal et al. 2007).

By grouping observations into G cluster of $\mathrm{N_g}$ observations, the cluster-robust variance matrix is estimated using the following expression, for g in $\{1, \dots, \mathrm{G}\}$:

$$\hat{V}(\hat{\beta}) = (X'X)^{-1}\left(\sum_{g=1}^{G} X_g' u_g u_g' X_g\right)(X'X)^{-1} \tag{4.27}$$

Where, X_g is the $N_g \times K$ matrix of regressors, and u_g is the N_g -vector of the residuals for cluster g.

The formal theorems are presented by White (1984, pp. 134–142), and later on, Arellano (1987) propose this method for the fixed effects estimator in linear panel models. Most recent research, Hansen (2007), provides asymptotic theory for panel data where $N_g \rightarrow \infty$ in addition to $G \rightarrow \infty$.

Although the one-way clustering approach allows for correlations within cluster, it is unsuitable for correlation across clusters. As Gow et al. (2010) point out, when both time and firm effect exist, separate consideration of time clustering and firm clustering (or industry cluster) will not produce unbiased statistics.

f.Two-Way Clustered Test

Therefore, it is important to be able to cluster along more than one dimension in the case of both time-series and cross-section dependence. This problem has been solved by Thompson (2006, 2009) and Cameron et al. (2006, 2011), and Petersen (2006) popularized this method in applied econometrics by incorporating it in Stata.

When there are two dimensions, say firm and year, the two-way clustering by both firm and year allows for within-firm dependence (time effect) and within-year dependence (firm effect). The variance-covariance matrix, proposed by Thompson (2006) and Cameron et al. (2006), is estimated by the following expression, which has been adjusted by a White variance-covariance matrix.

$$V_{firm\,\&\,time} = V_{firm} + V_{time} - V_{White} \tag{4.28}$$

The first term on the right-hand side is the standard errors clustered by firm, which captures the residual correlation between the same firm observations for different years (e.g., correlations between ε_{it} and ε_{is}).

The second term on the right-hand side is the standard errors clustered by time, which captures the residual correlation between the same year observations for different firms (e.g., correlations between ε_{it} and ε_{kt}).

Further, an 'intersection' cluster has to be subtracted off, since both the firm- and time-clustered variance-covariance matrix include a diagonal of the variance-covariance matrix. In this case, the White variance-covariance matrix is taken out to avoid the double counting problem.

However, we have noticed that this approach may not be perfect either. In support Petersen (2009) points out, as the number of clusters- firms or years - reduces, the standard errors clustered by firm and time are producing misleading results, though the magnitude of the bias is not large.

Cameron et al. (2008) also document that cluster robust methods will over-reject a true null-hypothesis when the number of clusters is small, so they suggest using bootstrap procedures to obtain more accurate cluster robust inference when there are small number of clusters.

In our circumstances, where we only have 7 time-clusters but large number of firm-clusters, the best estimator that we can choose is the two-way clustering, and in support Gow et al. (2010) emphasize that the two-way clustering yield unequivocally better inferences than any other methods they have tested even with as few as 10 clusters. Hence, even though without the bootstrap procedures, we can still access relatively well-specified standard errors in our panel data simulations.

4.4.4 Summary

To summarize, the models that we are going to use in this research are the basic Ohlson model, Barth et al. (1998) model, Collins et al. (1999) model, Lees (1999) model, Hands and Landsman (2005) basic model, and some combinations of the above models. In addition, for all of these models, we adopt two-way clustering statistics. By clustering alone both time-series (year) and cross-section (firm), we intend to generate the best estimations for our combined accounting and environmental dataset.

A separate section on the effect of the dividends term and other control variables will be discussed and the different dividend theories will be reviewed as well. By comparing the implementation of these theories in each country/area, we will have a concise idea of the most appropriate model for each of these.

4.5 Empirical Implementation

In this section, we will explain our valuation results based on the Ohlson framework. Differences in regions and sectors are related to the perceived risk that emission policies pose to a firm. Therefore, we examine the regions by different levels of applied carbon emission constraint. The countries (or areas) investigated are the US, the UK and the EU, in which the US is considered as the less constraint regime, and the EU and UK are considered as more constraint regimes. Specifically, for the EU, we first separate the UK from the rest of the EU countries, and then we combine them to observe any differences for the environmental and carbon outputs. We include a statistics summary of all variables for each country/area (see tables 4-1-2, 4-2-2 and 4-3-2). From these tables, we find that the UK has the best carbon performance on a per share basis, while the US is slightly better than the rest of the EU when comparing the mean value of the FFPS, DFPS and CFPS.

In respect of the sectors, we introduce industry dummies to remove the influence that emissions have on the different sectors. We include a sector based environmental/carbon performance analysis for each country/area (see tables 4-1-1, 4-2-1 and 4-3-1).

As to the choices of deflators, the share number deflated variables are tested in all models; in addition, sales deflation has been adopted in the sensitivity testing. Considering the environmental/carbon performance difference between the profit and loss firms, further tests have been conducted on these two kinds of corporations in terms of their earnings. Specifically, for the EU ETS countries/areas, i.e. the UK and the rest of the EU, a final test based on the different ETS stages, i.e. the pre-ETS period, ETS Phase I and ETS Phase II, has been used to examine the time variation effect.

4.5.1 US

a. Statistics Summary

Table 4-1-1 presents descriptive statistics of the environmental and carbon variables, classified by industry. For the US, the industry code is from Kenneth R. French 17-industry classification based on SIC codes (See Appendix 2). The environmental performance measure is impact ratio per share (IPPS), equal to the total environmental damage cost divided by company's share number. Note that the unit of the IPPS is dollar per share, which is different from the three carbon variables. Judging by the mean value of the IPPS, the biggest environmental damage industry is Mining and Minerals ($16.16 per share), followed by Utilities ($8.62 per share) and Steel Works etc ($7.10 per share). The least environmental damage industry is Banks, Insurance Companies and Other Financials ($0.10 per share), which is quite plausible as the financial industry do not have too many channels to generate pollution except through their employees travelling. The median values of the IPPS are basically telling the same story. However, we notice that the industry whose median IPPS is much less than its mean IPPS, indicates that there are big environmental consumption companies within the industry, which generate large amount of pollution and drag the industry mean IPPS figure up, such as the Mining and Minerals industry.

The carbon performance measures have three dimensions: i.e. FF, DF, and CF. All carbon measures are on a per thousand shares basis (PS), i.e. equal to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's share number (in units of thousand). The biggest carbon emission industry is Utilities, indicated by the FFPS (mean value is 114.03 tonnes per thousand shares, and median value is 86.49 tonnes per thousand shares). Steel Works etc is the second biggest carbon emission industry (mean value is

110.02 tonnes per thousand shares, and median value is 37.52 tonnes per thousand shares). The significant difference between the mean and median values as well as the large standard deviation figure implies that there are large carbon emission steel companies within the industry. The other large emission industries by FFPS are Mining and Minerals, Chemicals and Oil and Petroleum Products. All of the big-5 FFPS emission industries are heavy industries that generate carbon dioxide in both their production and distribution activities.

Turning to the DFPS variable, the big-5 emission industries in terms of mean values are; Utilities, Steel Works etc, Mining and Minerals, Chemicals and Oil and Petroleum Products, listed in descending order of emissions. However, in terms of median values, they are; Utilities, Mining and Minerals, Chemicals, Oil and Petroleum Products and Transportation. Steel Works etc has dropped out of the big-5 emission industries rankings, indicating that a great proportion of emissions in the Steel industry is from their first tier suppliers, for example, the electricity that consumed during the production process. In contrast, the transportation industry has been included in the big-5, because most of the carbon emissions in transportation are directly generated from the owned or controlled sources (vehicles), which empirically is reasonable.

As for the CFPS variable, the big-5 emission industries are; Utilities, Mining and Minerals, Chemicals, Oil and Petroleum Products and Transportation, indicated by the mean values. Obviously, the deduction of the other GHGs do not affect the ranking greatly.

Considering for all the carbon emission variables, the least emission industry is Banks, Insurance Companies and Other Financials, which is pre-determined by the characteristic of the industry.

In table 4-1-2, we summarize the statistics of the financial, accounting and environmental variables, pooling industries and years. All financial and accounting variables are based on dollars per share; the only exception is the size variable, which is based on employee numbers in thousands.

Table 4-1-3 describes the correlation coefficients based on the pooled dataset. It is very clear that the three carbon variables are highly correlated to each other, while the environmental variable is positively correlated to the carbon variables. We note that the higher the environmental (and carbon) figure, the more environmental damage the company produces. Most of the accounting variables are positively correlated to the market value, except the size and R&D variables, which are negative but insignificantly correlated to the market value. Further, we find that the size variable is negatively correlated to all the environmental and carbon variables, which is consistent with the existing evidence. Negative correlations are found between the net capital contribution variable and all the environmental and carbon variables as well. Interestingly, the advertising variable is negatively correlated to all the carbon variables, but not to the environmental variable.

b. Regressions based on share number deflation

In order to isolate the industry effect on the emission quantities, we introduce the industry dummies for all the models we adopted. However, we do not report the individual industry coefficients in our result tables.

Results of the three basic models, which are the Ohlson (1995) model (the ex-div model), the Barth et al. (1998) model (the dividends exclusion model) and the Collins et al. (1999) model (the cum-div model), are reported in tables 4-1-4 to 4-1-6, respectively. For the US, observations fit best under the ex-div model by the R-square values; whereas using the F-test, the best fitted one is the dividends-exclusion model. In comparison, the cum-div model does not fit as well as the other two models. Therefore, we conclude that for the US, either introducing the dividends variable as the control variable or not will not affect the model significantly. However, it is less appropriate to introduce the dividends as part of the dependence variable. Further, we find that the dividend per share (DPS) has a positive but insignificant influence on the US firms' market price according to the ex-div model, which may be due to the double tax on dividends as Renneboog and Trojanowski (2009) suggest. Moreover, the coefficients on book value per share (BVPS) and earnings per share (EPS) are significantly positive indicated by all three pooled estimations.

The additional models, based on the ex-div model, involves one or more extra variables, such as total debt per share (TDPS), capital expenditure per share (CAPEXPS), net capital contribution per share (CAPCONPS), research and development per share (adj_RD) and advertising expenses per share (adj_AD).

These results are reported in table 4-1-7 to 4-1-11. According to the results, TDPS, CAPEXPS and adj_AD have a negative but insignificant influence on companies' price, whereas the CAPCONPS is significantly (at 90% confidence interval) positive in relation to the companies' market value. The other significance factor is the adj_RD variable with an average coefficient around -5.5, which indicates that the expenditure spend on R&D can remarkably reduce the firms' value. The involvement of these extra variables improves the models' goodness of fit to some extent; however, as not all variables have a significant influence on market price, the F-statistics have been reduced in most of cases.

The average value of the IPPS coefficients from result tables 4-1-7 to 4-1-11 is -0.32 (-0.33 if plus the result in table 4-1-4) with 99% confidence intervals at least. This implies that a $1 increase in the environmental damage cost will incur a $0.32 reduction in the firms' market value. As to the FFPS, the average coefficient is -0.044 (-0.045 if plus the result in table 4-1-3) with 99.9% confidence intervals. It is notable that the variables FFPS, DFPS and CFPS are all described in tonnes per thousand shares. Therefore, the implication is that an increase of 1 tonne carbon dioxide (or equivalent) emission will incur a $44 reduction in the firms' market value, i.e. an implied carbon value of $44 per tonne. Similarly, the DFPS results indicate an average implied carbon value of $40 per tonne, and it is $42 per tonne for the CFPS. Further, all carbon variables are robust for all alternative specifications; therefore, it appears that the US market does value the environmental/carbon outputs negatively.

c. Regressions based on sales deflation

In order to test the robustness of these results, we introduce a sales deflation version, adopting the composite model 1 only (see table 4-1-13). The results for most accounting variables are robust after deflated by the companies' sales; except the net capital contribution and capital expenditure variables have the opposite coefficients now, particularly the capital expenditure, which becomes a value-added factor after sales deflating. The results of those carbon variables are robust in the sales deflation model, and even economically larger than before the deflation. In contrast, the result of the environmental variable is not significant any more after deflated by the sales, even though the coefficient is still negative.

Presumably, even though there is no carbon emission trading on the US market, the market may still negatively value carbon outputs because it reflects energy efficiency. The market considers the firm which conducts carbon emission reductions as an energy efficient user. Therefore, the carbon reduction performers may be exposed less to energy prices volatility. Further, in the market, carbon reduction performers may also enjoy a positive reputation, which could bring them more customers and new market opportunities.

d. Regressions based on share number deflation for profit/loss firms

Finally, we analyse the profit/loss firms effect (tables 4-1-14 to 4-1-17), which means we divide the firms into two groups by whether their current EPS is positive or not. The Hand and Landsman (2005) model and the composite model 1 have been applied (tables 4-1-14 and 4-1-16). By comparing results of profit firms with that of the entire sample, we find that the profit firms have enjoyed a strong performance in their earnings. On the contrary, their BVPS is less value-relevant than the entire sample, even though it is still significantly positive in relation to market value. Other accounting variables are in line with the results of the entire sample. As to the environmental variable, it indicates an average of $0.35 per environmental damage cost, a little higher than that of the entire sample. Consequently, the results of the carbon variables are also greater in terms of absolute value for the profit companies than for the entire sample ($57 per tonne as indicted by FFPS, $53 per tonnes by DFPS and $57 per tonnes by CFPS, according to the Hand and Landsman model). In general, the profit companies' market values are more sensitive to changes in their carbon emissions and environmental damage.

As to the loss companies (tables 4-1-15 and 4-1-17), we have been left with a relatively small sample, around 400 firm-year observations, so there needs to be more subtle approach when presenting the significance of the results. As predicted, the EPS is not the value-added factor for the loss companies' market values. Alternatively, the BVPS becomes the main value-relevant factor, and in fact, the only significant one in both of the test models. Most of the other accounting variables such as DPS, CAPCONPS (becomes insignificant), and TDPS (becomes significant), are in line with the full sample results. The only exception is the capital expenditure variable, which is insignificant positive now. The environmental variable still follows the main stream but with an insignificant small figure. Interestingly, all of the carbon variables have changed their sign, indicating the carbon outputs as a value-added factor for these loss firms. The possible explanation may be that the market does not care about the carbon outputs when the companies are already involved in obvious financial trouble. Further, although we do not focus on the environmental variable, the potential inference is that emissions still have to be controlled within an acceptable range because of environmental regulations in the US; though, this is not as important as a value-relevant factor in the case of a loss firm.

e. Summary

In summary, our results suggest that carbon outputs are value-relevant factors in the US market. Recalling the results at the portfolio analysis level, we find no abnormal returns from the US market, based on either the environmental criterion or the carbon criteria. Both returns and valuation results indicate that carbon is consistently priced in the US market.

In particular, the profit firms should pay extra attention to reducing their emissions, specifically their carbon emissions, which account for a significant proportion in determining the firms' market values as indicated by our results. As to the loss firms, the Ohlson model and its variations may be less reliable for these.

4.5.2 UK

a. Statistics Summary

In table 4-2-1, we report the descriptive statistics of the environmental and carbon variables, classified by industry. For the UK, the industry code is from DataStream Level-3 19-industry classification code (See Appendix 1). The environmental performance measure is winsorized (at 99.5% and 0.5%) impact ratio per share (WIPPS), denoted in dollars per share[35]. Therefore, the mean value and the median value for each individual industry are very close. For the mean value of the WIPPS, the biggest environmental damage industry is Food & Beverage ($2.10 per share), followed by Basic Resources ($1.70 per share) and Utilities ($1.17 per share). The least environmental damage industries are

[35] For the variables that involve in currency, we transfer all of them into dollars, for the UK and other EU countries.

Financial Services ($0.011 per share) and Banks ($0.013 per share), which is consistent with the US. However, we note that other industries, such as Technology, Real Estate and Telecommunications, also produce relatively small environmental damage.

The biggest carbon emission industry is Utilities, measured by the FFPS (mean value is 18.53 tonnes per thousand shares, and median value is 9.99 tonnes per thousand shares). As we discussed earlier, the significant difference between the mean and median values as well as the large standard deviation figures are attributed to the large carbon emission companies within the Utilities industry. Basic Resources is the second biggest carbon emission industry (mean value is 9.10 tonnes per thousand shares, and median value is 7.99 tonnes per thousand shares). The other large emission industries according to FFPS are Food & Beverage, Travel & Leisure and Chemicals. The situation is much different from that of the US, as all the big-5 FFPS emission industries are heavy industries in the US, whereas in the UK, industries such as Food & Beverage and Travel & Leisure, have even greater emissions than Oil & Gas.

By analysing the DFPS, we find that the big-5 emission industries in terms of mean values are Utilities, Basic Resources, Travel & Leisure, Oil & Gas and Chemicals, listed the descending order of emissions. It is obvious that Utilities, Basic Resources, Travel & Leisure, Oil & Gas and Chemicals are heavy carbon emission industries in terms of their direct emissions, i.e. the GHGs generated during their production processes or service providing processes. Whereas Food & Beverage only ranks in seventh place according to DFPS, which implies that a big proportion of carbon emissions for the Food & Beverage industry may come from their first-tier suppliers. However, considering the median values from DFPS, the big-5 are Utilities, Basic Resources, Chemicals, Oil & Gas and Food & Beverage. Travel & Leisure drops out of the big-5 emission industries rankings, suggesting that there are large carbon emission companies in the industry drag the mean figure up.

As to the CFPS variable, the big-5 emission industries are Utilities, Travel & Leisure, Basic Resources, Oil & Gas and Chemicals, indicating by their mean values. Whilst by the median values, they are Utilities, Chemicals, Basic

Resources, Food & Beverage and Oil & Gas. By excluding other carbon dioxide gases, it does not change the ranking greatly.

For all the carbon emission variables, the least emission industries are Banks, Insurance and Financial Services. Even though the industry classification is different between the US and the UK, this result is still in line with that of the US.

Table 4-2-2 presents the statistics of the financial, accounting and environmental variables, pooling industries and years. All financial and accounting variables are based on dollars per share; the only exception is the size variable, which is based on employee numbers in thousands. Compared to US companies, UK companies are relatively small in both financial and accounting terms. Therefore, the environmental/carbon emission quantities of these UK companies are smaller than those of the US companies.

Table 4-2-3 describes the correlation coefficients based on the pooled dataset. Again, the three carbon variables are highly correlated to each other, and the environmental variable is positively correlated to the carbon variables. All the accounting variables are positively correlated to the market value.

As to the relationship with the environmental and carbon variables, a positive correlation has been reported between the size variable and all the environmental and carbon variables, which contradicts existing evidence. The only consistent negative correlation has been found between the R&D variable and all the environmental and carbon variables. It may be that the investment on the research and development does help to reducing the environmental damage and the carbon emission to some extent. However, we need to note that due to the scarcity of data, the R&D variable has been set to zero where values are missing.

b. Regressions based on share number deflation

As for US firms, industry dummies have also been included for UK companies, but not reported in the results tables. Note that the industry classification is from a different source, i.e. the DataStream Level-3 Industry code, rather than the SIC code. (See Appendices 1 and 2 for detail)

Results of the three basic models, the Ohlson (1995) model (the ex-div model), the Barth et al. (1998) model (the dividends exclusion model) and the Collins et al. (1999) model (the cum-div model), are reported in tables 4-2-4 to 4-2-6, respectively. For the UK, observations fit best under the ex-div model as indicated by both the R-square values (0.54) and the F-statistics. In comparison, the cum-div model and the dividends exclusion model have R-squares around 0.4 and much lower F-statistics. The omission of the dividends term is the major reason for the two less fitted models. As we report in the Ohlson model (table 4-2-4) results, the dividends variable is both economically and statistically significant, indicating that firms' market value increase about 18 times per dividend incremental. It implies that the UK investors favour dividends payment rather than other forms, such as retain earnings. Therefore, we conclude that for the UK, it is important to include the dividends as a control variable. Further, we report that the earnings per share (EPS) has positive but insignificant influence on the UK firms' price according to the ex-div model, whereas the book value per share (BVPS) is significantly positive in relation to the UK firms' market value (coefficient around 0.6).

Additional models, based on the ex-div model, involve one or more extra variables, such as total debt per share (TDPS), capital expenditure per share (CAPEXPS), net capital contribution per share (CAPCONPS), and research and development per share (adj_RD), all defined in dollars. These results are reported in table 4-2-7 to 4-2-10. According to the results, TDPS and CAPEXPS have negative but insignificant influence on companies' price, whereas the CAPCONPS is insignificantly positive in relation to the companies' market value. All of the above results are in line with that of the US results. The only difference between the US and UK accounting variables is on the adj_RD variable, which is reported to be significantly positive in relation to market value, with an average coefficient around 4.2. This indicates that an increase in expenditure on R&D can dramatically increase UK companies' market value. The involvement of these extra variables improves the models' goodness of fit as suggested by the R-squares, and subsequently, the F-statistics have been reduced. The only exception is the Hand and Landsman's (2005) model (table 4-2-8), where both R-squares and the F-statistics have been improved.

Thereafter, for the environmental and carbon results, we concentrate on this model.

It appears that the UK market values the environmental and carbon outputs negatively at the firm level valuation as well. For example, the coefficient of the WIPPS from result table 4-2-8 is -0.43, and the coefficients of the FFPS, the DFPS and the CFPS are -0.10, -0.12 and -0.13, respectively. However, in contrast to that of the US market, this negative relationship is not statistically significant. These negative but insignificant relationships between the environmental/carbon outputs and firms' value are consistent in most of the other models, except in Barth et al. (1998) and Collins et al. (1999) models, which can be due to the influence of the dividends.

c. Regressions based on sales deflation

In the sales deflation model (table 4-2-12), we find that most of the accounting variables are robust after deflating by the companies' sales; except the earnings variable, which turns out to be negatively related to the market value after deflation. The results of both environmental and carbon variables are robust using the sales deflation model, but still statistically insignificant. The R-squares have been largely improved, as well as the F-statistics.

d. Regressions based on share number deflation for profit/loss firms

Further, we examine the profit/loss firms' effect by dividing the firms into two groups according to their EPS. The Hand and Landsman (2005) model and the composite model 1 have been applied (table 4-2-13 to table 4-2-16). According to the Hand and Landsman (2005) model (table 4-2-13), we find that all accounting variables are in line with the results of the entire sample. As to the environmental variable, the coefficient is -0.34 now, lower than that of the entire sample in absolute value. The carbon variables are also reduced in absolute value for the profit companies compared to the entire sample. However, no significant change has been reported.

As to the loss companies, we have a very small sample with 235 firm-year observations. According to the composite model 1 (table 4-2-16), the net capital contribution variable (CAPCONPS) has significantly changed at both the economic and statistics level, which now indicates that a $1 increase in the CAPCONPS adds a value of $2.3 to loss firms, whereas per $1 increase in the total debt (TDPPS) significantly decreases the company value of $0.39. Under the same model, most of the other accounting variables only drift away marginally. However, the environmental and FFPS variables have changed their sign, particularly the environmental variable, which has a significant positive coefficient. The implication is that, for the loss firms, the Olson model and its variations may be less reliable.

e. Regressions based on share number deflation for three ETS stages

Finally, our tests are conducted based on different ETS stages, i.e. the pre-ETS period, which refers to year 2002 to 2004; the ETS Phase I, which refers to year 2005 to 2007, and the ETS Phase II, which refers to year 2008 to 2012. However, for the ETS Phase II, our data are only available for year 2008. Regression results use the composite model 1 only.

We mainly focus on the coefficients' change for the carbon variables. In table 4-2-17, we report the result of pre-ETS period. Our results suggest that before ETS comes into force, the market negatively values the carbon outputs, and these valuations are statistically significant for FFPS, DFPS and CFPS. For both ETS Phase I and II (tables 4-2-18 and 4-2-19), the market still negatively values the carbon outputs, but no more significance has been found.

Compared to the full data sample (table 4-2-9), we find that these sub-period results are mostly in line with the entire period, where negative but insignificant coefficients have been reported for all three carbon variables.

We assume that, in the UK market, it negatively values carbon outputs which may signal energy efficiency. However, this signalling effect may have been weakened due to the introduction of the carbon trading scheme (EU ETS). Also, the market may not consistently price the carbon emissions, which may leave the UK investors an arbitrage profit opportunity to explore (in terms of portfolio returns).

f. Summary

In summary, based on the results of the entire data period, both the environmental and carbon outputs are not value-relevant factors in the UK market. Further, these results are robust for most of the share-number deflated models and the sales deflated model.

None of the environmental/carbon outputs are value-relevant factors for profit firms. Though it appears that for the loss firms, the environmental output might be a value-relevant variable; given that the Ohlson model is less reliable when applying it to the negative earning companies, we do not take account of these results.

The sub-period results indicate that the UK market negatively values carbon outputs, particularly in the pre-ETS period, which may indicate that the UK market has captured the carbon effect before introducing the EU-ETS. However, the introduction of the EU-ETS may interfere with the market's ability in carbon pricing.

4.5.3 EU excluding UK

a. Statistics Summary

As to the EU countries, in this chapter, we include Austria, Belgium, Germany, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, Luxemburg, Netherlands, Poland, Portugal and Sweden. Due to the small dataset, we put all the EU countries together to examine the environmental/ carbon effect. For comparison with the UK and the US, we transfer all the currency into US dollar.

For the EU countries, the industry code is from DataStream Level-3 19-industry classification code (See Appendix 1). The environmental performance is measured by the winsorized (at 99.5% and 0.5%) impact ratio per share (WIPPS), denoted in dollars per share. In columns 2-4 table 4-3-1, we report the statistics of the environmental variables, classified by 19 industries.

Using the mean value of the WIPPS, the large environmental damage industries include Food & Beverage ($9.34 per share), Construct & Material ($6.59 per share), Chemicals ($5.56 per share), Basic Resources ($5.38 per share), Utilities ($5.07 per share) and Automobiles & Parts ($4.99 per share). For the median value, these industries are Automobiles & Parts ($5.27 per share), Food & Beverage ($5.26 per share), Chemicals ($4.29 per share) and Basic Resources ($3.13 per share). We find that the Automobiles & Parts industry has a higher median value than mean value, which indicates that there are very small environmental emission companies in this industry. The least environmental damage industry is Banks with a mean value of $0.035 per share and median value of $0.015 per share. Other examples of small environmental damage industries are Financial Services, Real Estate and Telecommunications, which is in line with that of the UK.

The large carbon emission industries, as indicated by mean values of FFPS (columns 5-7 table 4-3-2), are Construct & Material (100.49 tonnes per thousand shares), Basic Resources (55.27 tonnes per thousand shares), Chemicals (54.90 tonnes per thousand shares), and Utilities (50.57 tonnes per thousand shares). For median values, they are Chemicals (33.77 tonnes per thousand shares), Basic Resources (31.85 tonnes per thousand shares), and Construct & Material (17.56 tonnes per thousand shares).

Comparing the FFPS results with that of the DFPS, we find that Automobiles & Parts, Food & Beverage, Basic Resources, and Oil & Gas etc industries significantly reduce their emission when we only take direct carbon emissions into account, which implies that a remarkable proportion of their carbon emissions are from their first-tier suppliers. The industries, such as Utilities and Travel & Leisure, that do not involve large differences between their FFPS and DFPS, are in fact the main GHG producers themselves.

As to the CFPS, only one industry has been found to have significantly changed emission quantities, which is Chemicals. This indicates that a larger proportion of the industry's emission is other GHGs rather than carbon dioxide, which is quite plausible due to the peculiarity of the chemical industry.

The least emission industries basically include Banks, Insurance, Financial Services, Real Estate and Telecommunications, which is in line with the UK.

In table 4-3-2, we summarize the statistics of all the involved variables. On average, the EU companies are larger than UK companies, therefore, they can be bigger environmental and carbon emission generators.

Table 4-3-3 describes the correlation coefficients based on the pooled dataset. The correlations between the three carbon variables are close to 1, and the correlations between the environmental variable and each of the three carbon variables are positive. All the accounting variables are positively correlated to the market value.

While most of the variables are positively related with the environmental and carbon variables, negative correlations have been reported between the R&D variable and two of the carbon variables (DFPS and CFPS), and also between the net capital contribution variable and two of the carbon variables (FFPS and CFPS), although the scale is very small.

b. Regressions based on share number deflation

The industry dummies have also been adopted for the EU countries, and the industry code is the same as the UK industry code, which both derive from the DataStream Level-3 Industry code. (See Appendix 1 for detail)

In tables 4-3-4 to 4-3-6, we report the results of the three basic models for the EU countries (excluding UK), i.e. the Ohlson (1995) model (the ex-div model), the Barth et al. (1998) model (the dividends exclusion model) and the Collins et al. (1999) model (the cum-div model), respectively. For the other EU countries, the highest R-squares have been found in the ex-div model; however, the largest F-statistic is reported in the cum-div model. The dividends exclusion model has generated the median R-square and F-statistic. Further, we observe that the dividends variables are neither economically nor statistically significant in the Ohlson model (table 4-3-4). Therefore, the omission of the dividends term is not a problem at all for the other EU countries. Note that, even though the other variation models are based on the ex-div model, it is only because the model has the best goodness of fit, and we do not consider the dividend variable as a value-relevant factor. Finally, we note that the earnings per share (EPS) has a significant positive influence on the EU firms' price according to all three models, especially the cum-div one; and the book value per share (BVPS) are also significantly positive in relation to the firms' market value (coefficient around 0.9).

The additional models, based on the ex-div model, involve one or more extra variables, which are the same as we introduced for the UK, and all defined in dollars. These results are reported in table 4-3-7 to 4-3-10. According to these results, TDPS has negative but insignificant influence on companies' price, whereas the adj_RD is insignificantly positive in relation to the companies' market value. The CAPCONPS and CAPEXPPS variables are found to be significantly positive in relation to market value, as indicated by the Rees (1997) model and the composite models 1 &2. The average coefficient on CAPCONPS is around 0.225, at the 95% confidence intervals, which means per dollar net capital contribution increments can increase the companies' market value by $0.225. The average coefficient on CAPEXPPS is around 0.5, at minimum 95% confidence intervals, which means per dollar capital expenditure increments can increase the companies' market value by $0.5. Except for the result of the CAPEXPPS variable, most of these results are similar to those of the UK. However, as the R-squares and F-statistics indicate, the involvement of these extra variables reduces the models' goodness of fit somewhat; we assume that this might be due to the shrinkage of data size.

For the environmental/carbon variables, we focus on the Hand and Landsman's model. The coefficient of the WIPPS from result table 4-3-8 is 0.54, at the 95% confidence intervals. This implies that a $1 increase in the environmental damage cost might cause a $0.54 rise in the EU firms' market value. As to the FFPS, the coefficient is 0.0183, at the 95% confidence intervals, which suggests that the increment of 1 tonnes carbon dioxide (or equivalent) emission may incur an $18.3 increase in the firms' market value. However, positive but insignificant coefficients have been reported for the DFPS and the CFPS, which are 0.0114 and 0.0103, respectively. These results are mostly consistent in alternative models (may vary on the significance level).

c. Regressions based on sales deflation

As we can see in the sales deflation model (table 4-3-12), negative valuations appear in both environmental (insignificantly) and carbon variables (significantly). These imply that for the rest of the EU market, the models are very sensitive to deflators. Further, we note that all of the accounting and financial variables are now negatively related to the environmental and carbon variables, as indicated in table 4-3-11. Accounting variables, such as earnings and total debt, also turn out to be negatively related to the market value after deflating. The R-squares, have slightly improved in the sales deflation model.

d. Regressions based on share number deflation for profit/loss firms

Further, we examine the profit/loss firms' effect by dividing the firms into two groups according to their EPS. The Hand and Landsman (2005) model and the composite model 1 have been applied (table 4-3-13 to table 4-3-16). According to both models, we find that all accounting variables are in line with the results of the entire sample. As to environmental/carbon variables, all the results indicate that environmental/carbon outputs have less significant positive relationships with the market value of profit firms than with that of the entire sample.

As for the loss companies, we have a very small sample with only 148 firm-year observations, according to the composite model 1 (table 4-3-16). Total debt and dividends (DPS) become value-added factors, whereas earnings (EPS) and net capital expenditure variables (CAPEXPPS) are negatively related to the market value for the loss firms. The environmental variable is insignificant but negatively related to firm value, whereas the three carbon variables are significantly positive in relation to firm value. The fact that the EU market positively values the carbon outputs of the loss firms, indicate that for the loss firms to promote their profit, purchasing more emission allowances seems reasonable.

e. Regressions based on share number deflation for three ETS stages

Finally, our tests are conducted based on different ETS stages, i.e. the pre-ETS period (2002-2004), the ETS Phase I (2005-2007), and the ETS Phase II (2008).

We mainly focus on the coefficients' change for the carbon variables. In table 4-3-17, we report the results of pre-ETS period. These suggest that before ETS comes into force, the market positively values the carbon outputs, though none of these valuations are significant, which are in line with that of the entire period results.

For ETS Phase I (table 4-3-18), the market still negatively values carbon outputs. All results are found to be economically significant, specifically, the result for the FFPS, which is even statistically significant. As the results are mostly in line with that of the entire sample, this could have been anticipated.

However, when it comes to the ETS Phase II (table 4-3-19), we find that the valuations for all three carbon variables change to negative values, and all of these (FFPS, DFPS and CFPS) are significant. Although we change the estimation method, which can affect the significance level to some extent (we use the robust standard error instead of the two-way cluster, as we have only one year data have been tested in this period), it will not affect the coefficient values.

Therefore, the separate stage results give us a clue that the introduction of the EU ETS may be associated with other issues. As we demonstrate in Chapter 2, there are a few failings of the EU ETS, such as over-allocation and price volatility (Sépibus, 2007).

After the establishment of the EU ETS in January 2005, the price of permits had tripled since the scheme's launch, however, it had dropped back by more than half by the end of April 2006. Later in the same year, 'The Economist' published an article, in which it pointed out that 'the numbers reflect not the scheme's success in cutting pollution, but industry's success in getting itself allocated more permits than actual emissions warranted when the scheme was launched.'

Further, in a cap-and-trade [36]system, there are three options for the allocation of emission allowances; grandfathering[37], benchmarking[38] and auctioning[39].

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[36] Under such a system, there are 3 main options for coping with the CO2 allowances for each of the generators: one option is to improve carbon emission technologies and sell the unused CO2 allowances, or generators can choose to produce less and sell the unused CO2 allowances, and the last option is to generate more and buy the necessary CO2 allowances (Sijm, Neuhoff and Chen, 2006).

[37] Grandfathering – an allocation mechanism in which allowances are provided for free to each installation on the basis of either historical or expected future requirements. Grandfathering was the most commonly used method of allocation in phase 1 and is still widely used in phase 2, albeit with more countries using benchmarking especially for the power sector. A report for WWF by Point Carbon Advisory Services (2008)

[38] Benchmarking – an allocation mechanism in which allowances are provided for free to the installation on the basis of specific benchmarks. A report for WWF by Point Carbon Advisory Services (2008)

[39] Auctioning – an allocation mechanism in which allowances are provided to the installation on the basis of prices that the installation is willing to pay in an auction. A report for WWF by Point Carbon Advisory Services (2008)

Because the two free allocations (grandfathering and benchmarking) are commonly adopted under the current EU ETS, the CO_2 price becomes an opportunity cost for the generator. Consequently, a windfall profit can be earned by some of the generators. Although, later on in a report (2008) for the WWF, Point Carbon concludes that the windfall profit, which is calculated for the wholesale market only, may not reflect the position of vertically integrated utilities. The profitability is more dependent on how much generation costs suppliers can pass-through to end-customers. This ability is different for various systems, mainly depending on the end-user tariffs regulated by government.

The disclosure of the over-allocation and windfall profit issues may have attributed to our unreliable EU (excluding UK) results. Especially during ETS Phase I, we find that the market positively values carbon outputs, particularly the FFPS, which may indicate that the market adds value to the large emission companies because of the over allocated emission allowance.

As we only have one year data for the ETS Phase II, we cannot draw any conclusions about the association between the carbon valuation and those emission issues. Further research will be required to clarify this.

f. Summary

In summary, for the rest of the EU market, we suggest that the results on the environmental output and carbon outputs are not very reliable: in the share number deflation models, neither the environmental output nor carbon outputs is a value-relevant factor; further, when deflating all variables with sales, the carbon variables become negative value-relevant factors, indicating an unstable relationship between EU firms' value and their carbon outputs.

At the portfolio analysis level, we find that abnormal returns exist in the EU market for the carbon screening policies (DF and CF) at 10%, 20% and 30% cut-off levels. Interestingly, in this chapter, we report that the EU market values the carbon outputs positively at the firm level. Coincidentally, we also observe that this positive valuation does not persist, but becomes negative and significant (negative and insignificant for FFPS) in the year 2008. This valuation revision may explain why the 'long low carbon, short high carbon' strategy can make a profit. Portfolio returns are positive because of the market valuation change for carbon outputs. However, we do not test this at the portfolio level as we only have one year data for ETS Phase II.

As to the underlying reason behind this perverse positive valuation of carbon emissions, it may be attributable to issues, such as over-allocation and windfall profit. However, we cannot provide further evidence as we only have one year data for ETS Phase II.

4.5.4 EU including UK

Finally, we combine the EU and UK firms together to observe all the changes. We note that UK companies account for a large proportion of the full sample, for example, in an entire sample of 4265 firm-year observations, the number of UK companies is 1990 and the number of other EU companies is 2275.

Within the three basic models, the ex-div model (table 4-4-4) fits the best as suggested by the R-squares, whereas by F-statistics, the cum-div model is the best one. According to the ex-div model, both the environmental and carbon variables have a positive relationship with the firms' market value, particularly the IPPS and FFPS variables, which are significantly positive in relation to the market value. These results are supported by the dividends-excluding model, whereas the cum-div model suggests even stronger positive relationships. Other variations report similar results as well. In contrast, both the environmental and carbon variables exhibit negative coefficients after deflating all variables with firm sales. The above results are consistent with that of the EU excluding the UK, which indicate that carbon valuation is sensitive to the choice of deflators. Therefore, for all the EU countries, the conclusion is still ambiguous for the market effect on the introduction of the EU ETS and the carbon reduction activities.

4.6 Conclusion

In this chapter, we have employed Ohlson's accounting-based equity valuation model and its variations to test environmental and carbon influence on the firms' market value, for the US, the UK and the EU. By adopting the Ohlson framework, we consider the firm's market value (price) as the value indicator. In addition, our environmental variable is the environmental output that includes GHG emissions, water abstraction, waste generation, volatile organic compounds, heavy metals and other emissions, which is denoted as an environmental-damage-cost calculated by Trucost. The carbon variables are based on carbon outputs, which involve the carbon dioxide and/or equivalent quantities (in tonnes). A regression method has been introduced to test the influence of the environmental/ carbon variables on the firms' value.

For the US, we analyse a substantial sample of 4000 firm-years drawn from all industries from year 2002 to 2008. According to the basic model, i.e. the Ohlson (1995) model, we find that the carbon outputs are good indicators of the US firms' value, as well as the environmental output, both indicating significant negative relationships. These results are found to be robust in other models, such as the Barth et al. (1998), Collins et al. (1999), Rees (1997), Hand and Landsman (2005) and other composite models. Results also indicate that the Hand and Landsman's (2005) model is the best fit for the US sample.

The model is also tested using sales-deflation. On the one hand, we report that the environmental variable is sensitive to this approach, as the coefficient turns to an insignificant positive value in the sales-deflated model. On the other hand, we find that all carbon variables exhibit robust results in the deflating version. As there are no carbon emission regulations in the US market, this may suggest that the market considers carbon emissions as a proxy for energy efficiency, and therefore, a value-relevant factor for US firms.

For the UK, the sample size is about 1990 firm-years from year 2002 to 2008. Within the three basic models, the Ohlson (1995) model fits the best, whereas the other two, the Barth et al. (1998) and Collins et al. (1999) model are not appropriate for the UK sample, due to the strong dividends influence. We find that neither the environmental nor the carbon variables are good indicators for UK firms' values, with insignificant negative coefficients. This result has also been proved by the other models; Rees (1997), Hand and Landsman (2005) and two composite models. Hand and Landsman's (2005) model is also the best fit for our UK sample.

The results do not change significantly using the sales-deflation model. Both the environmental variable and carbon variables are only economically greater after removing the sales influence away. Further, the sub-period tests also suggest that the UK market negatively values carbon outputs at all three stages. As the UK market applies the carbon emissions trading scheme (EU ETS), it may be that the carbon signalling effect has been weakened since all companies in the market have to comply with the scheme.

For the rest of the EU, based on a sample of 2275 firm-years from year 2002 to 2008, we consider the results are diverse due to the opposing outcomes from different models. We find a positive association between the environmental/carbon outputs and firms’ market value. However, after deflating by sales, significant negative valuations can be attached to all carbon variables; also a negative but insignificant valuation emerges for the environmental variable. Therefore, it stays inconclusive for EU companies on the influence for the carbon reduction activities that have been undertaken due to the introduction of the carbon emissions trading scheme (EU ETS).

The sub-period tests suggest a negative carbon valuation occurred in the year 2008, while positive valuations are attached in both pre-ETS and ETS Phase I stages, which may be attributable to the over-allocation issue. However, we cannot draw any further conclusion due to our data limitation.

Finally, considering the carbon portfolios’ performance that we derived in chapter 3, we conclude that for the US market, carbon is consistently priced, as there is no arbitrage opportunity and carbon outputs are negatively valued. However, in the UK market, due to the introduction of the EU ETS, carbon may not be consistently priced. As to the rest of the EU market, the issues such as over-allocation and windfall profit may make the situation more complicated. Although, this may present investors with an opportunity to make profits by ‘long low carbon, short high carbon’ strategies, it cannot be the original intention of the ETS.

4.7 Discussion

Our firm-level study has reviewed the environmental/carbon emissions influence on corporations, and helped to determine whether underlying companies have realised increases in the firm’s value in accordance with their reduced carbon emissions quantities for different policy regimes. There are still drawbacks in this method.

As Gregory et al. (2011b) point out, we cannot use this approach to determine whether a firm’s systematic risk and/or specific risk has been affected by the actions taken to reduce carbon emissions. That is we cannot identify whether there is a cash flow effect in the long-term that incurs with carbon emission reduction activities, neither can we decide whether the firm's cost of capital has been changed due to the reduced carbon emission quantities.

For example, if a company reduces the likelihood of an environmental accident by taking carbon emission reduction activities, then the risk of cash flow shock is lowered, further, the company's expected future cash flows can be raised as a result. Using the stock market returns, we can determine the lowered cash flow risk, i.e. a firm-specific risk or unsystematic risk. In contrast to firm-specific risk, the market risk, i.e. systematic risk, is likely to affect most companies to some degree. The systematic risk has been considered as a macroeconomic term in nature, which is normally influenced by economic growth rate shocks, interest rate shocks, inflation shocks and so on.

Past sources have suggested that CSR policies are unlikely to reduce a company's vulnerability to systematic risk (McGuire, Sundgren, and Schneeweis, 1988). However, recent researches indicate that the firms' implied cost of capital, representing firms' systematic risk, can be affected by the high level of CSR activities taken by companies (Sharfman and Fernando, 2008 and El Ghoul, Guedhami, Kwok, and Mishra, 2010).

Therefore, in the next chapter, we will investigate the influence of the environmental/carbon emissions on firm-specific risk and the market risk, represented by the cash flow expectation and implied cost of equity capital, respectively.

Further, given the fact that there is currently no authoritative literature from either the Financial Accounting Standards Board (FASB) or the International Accounting Standards Board (IASB) [40] on accounting for emission

[40] Although both entities have previously attempted to address the issue, none has really been adopted. In 2003, the Emerging Issues Task Force (EITF) contemplated emission accounting questions in EITF 03-14, but the item was removed from its agenda in short order. In 2004, the International Financial Reporting Interpretations Committee (IFRIC) issued IFRIC 3 to address emission accounting issues, but the interpretation was withdrawn six months later, in part due to criticism about potential

allowances/obligations, companies adopt inconsistent accounting practices and rarely disclose their accounting treatment of emissions (e.g. Bebbington and Larrinaga-González, 2008; Warwick and Ng, 2012). Therefore, we simply assume that emission allowances and emission obligations are not recognised on balance sheet[41].

However, there are papers which argue that since emission allowances add firm value, it should be recognized on the balance sheet, e.g. Johnston et al. (2008) suggest that the emission allowances of SO2 have, at least, an asset component that is assigned a positive value by the US market. Whereas other studies suggest that emission allowances are, at best, contingent assets (Milne, 1996). We agree that emission allowance may add firm value (as our results may have the same implication, i.e. the over-allocated allowances have added firm value); but to identify whether/how the emission allowances and obligations should be recognized on financial statements, is beyond the scope of this research. Therefore we leave these questions for future research to address.

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income matching issues. Source from Deloitte 2009, Carbon Accounting Challenges: Are You Ready?

[41] In a recent research, Warwick and Ng (2012) have identified the most common way that companies tend to report their emission allowances and obligations: 1. granted emissions allowances as intangible assets, with a nil value recorded upon receipt; 2. purchased emissions allowances initially at cost price, but without any clear trend for their subsequent reporting at the end of the reporting period; 3. the obligation to deliver allowances to their national authorities as a provision (or liability) at either the carrying amount or the purchase cost for allowances held at the end of the reporting period, and the amount outstanding at the market price at the end of the reporting period.
Although, in their sample, companies' recognition of the obligation to surrender emission allowances is consistent with the IFRIC 3, companies' measure of the granted allowances is at nil value, which is not IFRIC 3 recommended. Further, their investigation has been based on a very small sample, whereas the majority of companies choose not to disclose their accounting treatment, therefore have not been included in their sample set.

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Table 4-1-1 Summary Environment and Carbon Performance for Each US Industry

SICCLASS	IPPS			FFPS			DFPS			CFPS		
	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN
Cars	1.625277	1.544821	0.969347	9.906537	10.54044	5.564034	1.091211	0.736158	0.974614	1.005613	0.657543	0.944318
Chems	3.605121	2.196508	2.996505	39.48039	37.204	30.14428	24.59973	30.92695	11.95366	18.15249	20.31309	11.15972
Clths	1.258716	1.990861	0.309046	7.982276	13.47364	1.834145	4.253879	8.068028	0.68263	4.089179	7.837345	0.630996
Cnstr	2.059149	2.497803	1.281052	12.47041	16.39674	6.020702	5.818615	12.79282	1.300567	5.623429	12.67681	1.213415
Cnsum	0.685357	0.834214	0.335238	3.253226	5.260389	1.204945	1.056688	2.323379	0.346272	1.000991	2.199854	0.335898
Durbl	1.356265	1.643847	0.763955	9.838766	14.37061	4.447873	1.757047	2.38	0.871557	1.576799	2.143488	0.825644
Fabpr	1.701451	0.96076	1.678998	13.3744	8.089601	12.07171	1.764357	0.858423	1.384924	1.689061	0.832834	1.302635
Finan	0.104156	0.173779	0.05877	0.564019	2.034595	0.188153	0.20531	1.817562	0.022153	0.196186	1.796527	0.019533
Food	5.814168	7.226431	2.952912	20.06558	30.96806	7.316077	1.933922	2.109615	1.242282	1.75791	1.45682	1.218708
Machn	0.595763	0.825765	0.296867	4.593941	9.254436	1.892054	1.127699	5.865584	0.335514	1.063822	5.75708	0.288699
Mines	16.16316	20.6988	7.619316	45.97502	39.47282	30.31609	35.31548	38.63181	13.06194	5.723441	4.283206	4.319608
Oil	2.161546	3.401022	0.718525	31.82083	53.11472	9.798397	16.83182	25.3707	7.462475	15.71302	24.72815	6.078846
Other	0.60924	1.276687	0.148804	4.734154	12.84915	0.682642	2.486225	10.23365	0.159476	2.369306	10.04116	0.139798
Rtail	0.691271	0.604054	0.483327	3.487273	2.485887	2.847673	0.723208	0.608126	0.569005	0.536329	0.498382	0.401955
Steel	7.102789	7.899998	4.723795	110.0248	162.4419	37.52149	75.45218	142.9393	5.655421	72.93429	140.3321	4.902957
Trans	1.526454	1.496433	1.019057	18.59975	26.30471	11.61316	15.25384	25.9111	6.608835	14.69912	25.40302	6.173772
Utils	8.619545	9.396135	6.7248	114.0338	109.2444	86.4926	104.0777	102.7014	78.05449	99.97405	101.8302	75.32732

The Environmental performance measure is impact ratio per share (IPPS), equals to the Total Environmental Damage Cost divided by company's share number. The Carbon performance measures have three dimensions: first-tier + direct carbon emissions quantities (FF) includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); direct carbon emissions quantities (DF) includes CO2e emission from direct emission (scope 1); carbon dioxide emissions only (CF) includes Carbon Dioxide (no equivalent) from direct emission (scope 1). All carbon measures are on per thousand shares basis (PS), i.e. equal to the Carbon Dioxide Equivalent (CO2e) (in terms of tonnes) divided by the company's share number (in unit of thousand). Data cover the seven years 2002-2008. Industry abbreviations see appendix 2.

Table 4-1-2 Summary Financial Statistics for the US

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD
MVPS	44.27872	37.22	1.16	930.01	45.76766
BVPS	17.1238	13.20615	.1138	363.72	20.91375
EPS	1.986491	1.71369	-33.80909	41.37	2.992811
DPS	.631148	.34505	0	25.165	.966763
CAPCONPS	.4520912	.0940421	-42.40784	46.12724	2.35429
TDPPS	18.6485	7.33747	0	1199.055	66.30262
CAPEXPPS	1.819227	.8304963	0	36.31987	2.783226
SIZE	31.55162	11	0	2100	82.33489
SALEPS	32.38223	20.83908	-1.803201	472.8952	38.14152
adj_RD	-.0240668	0	-7.234786	.0528648	.2533873
adj_AD	.250313	0	0	16.66313	.7625005
IPPS	1.908617	.3542006	.0000404	96.04858	5.150999
FFPS	17.50661	2.085954	.0002345	651.9666	49.95396
DFPS	12.2853	.4375539	0	561.7367	43.97033
CFPS	11.18519	.3669634	0	550.9363	42.46132
COMSH	453.9538	169.273	4.763	10862	939.9005

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividend per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, adj_AD (ADV_{it}), advertising expense per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousand. The environmental performance measure is IPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June of the following year.

Table 4-1-3 Correlation between each two share-number-deflated variables for the US

	MVPS	BVPS	EPS	DPS	CAPCO	TDPPS	CAPEXP	SIZE	SALEPS	adj_RD	adj_AD	IPPS	FFPS	DFPS	CFPS	COMSH
MVPS	1.0000															
BVPS	0.7119	1.0000														
EPS	0.5604	0.5718	1.0000													
DPS	0.2449	0.3060	0.2020	1.0000												
CAPCO N	0.1701	0.0443	0.2218	-0.0405	1.0000											
TDPPS	0.1114	0.1942	0.1477	0.1806	-0.0637	1.0000										
CAPEXP	0.1657	0.2782	0.1949	0.1083	-0.0475	0.0432	1.0000									
SIZE	-0.0113	-0.0204	0.0103	0.0214	0.0501	-0.0176	0.0213	1.0000								
SALEPS	0.3183	0.4327	0.3545	0.0850	0.1280	0.1032	0.2269	0.1061	1.0000							
adj_RD	-0.0058	0.0202	0.0998	0.0383	0.0124	0.0125	0.0339	0.0216	0.0432	1.0000						
adj_AD	0.0356	0.0359	0.0295	0.0104	0.0578	-0.0230	0.0173	0.0943	0.1126	0.0186	1.0000					
IPPS	0.0294	0.0821	0.0575	0.1208	-0.0847	0.0211	0.2482	-0.0345	0.2368	0.0276	0.0074	1.0000				
FFPS	0.0048	0.0927	0.0771	0.1496	-0.0879	0.0421	0.3042	-0.0431	0.2292	0.0293	-0.0451	0.7291	1.0000			
DFPS	-0.0146	0.0690	0.0448	0.1391	-0.0944	0.0472	0.2806	-0.0511	0.1329	0.0254	-0.0639	0.6698	0.9736	1.0000		
CFPS	-0.0171	0.0724	0.0475	0.1418	-0.0885	0.0491	0.2738	-0.0476	0.1318	0.0239	-0.0647	0.5988	0.9623	0.9887	1.0000	
COMSH	-0.0838	-0.0886	-0.0586	0.0143	0.0206	-0.0080	-0.0782	0.3800	-0.1200	0.0052	0.0060	-0.0835	-0.0727	-0.0621	-0.0571	1.0000

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividend per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, adj_AD (ADV_{it}), advertising expense per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousand. The environmental performance measure is IPPS, and three carbon performance measures are FFPS, DFPS and CFPS.

Table 4-1-4 Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS	1.2337***	1.2327***	1.2299***	1.2300***
	(0.2103)	(0.2096)	(0.2090)	(0.2088)
EPS	3.7906***	3.8118***	3.7950***	3.7970***
	(0.8444)	(0.8467)	(0.8436)	(0.8445)
DPS	2.0839	2.1617	2.1076	2.1258
	(2.1926)	(2.2151)	(2.2098)	(2.2123)
IPPS	-0.3738***			
	(0.0961)			
FFPS		-0.0499***		
		(0.0127)		
DFPS			-0.0456***	
			(0.0138)	
CFPS				-0.0494***
				(0.0127)
IND	Various	Various	Various	Various
_cons	18.6456***	18.4347***	18.1179**	18.0990**
	(7.0944)	(7.0984)	(7.1621)	(7.1633)
N	5004	5004	5004	5004
r2	0.5393	0.5400	0.5393	0.5394
F	29.49	29.70	29.63	29.65

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 5004 observations in total.

Table 4-1-5 Regression of Share Price on Environment/Carbon and Financial Variables from Barth et al. (1998) Model for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	BART_IP	**BART_FF**	**BART_DF**	**BART_CF**
BVPS	1.2562***	1.2556***	1.2525***	1.2527***
	(0.2331)	(0.2329)	(0.2322)	(0.2321)
EPS	3.8203***	3.8451***	3.8285***	3.8306***
	(0.8385)	(0.8413)	(0.8379)	(0.8389)
IPPS	-0.3564***			
	(0.0950)			
FFPS		-0.0469***		
		(0.0122)		
DFPS			-0.0432**	
			(0.0131)	
CFPS				-0.0465***
				(0.0121)
IND	Various	Various	Various	Various
_cons	19.5531***	19.3769***	19.0561***	19.0461***
	(6.8678)	(6.8626)	(6.9226)	(6.9226)
N	5010	5010	5010	5010
r2	0.5378	0.5383	0.5378	0.5379
F	30.72	30.90	30.85	30.86

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test.5010 observations in total.

Table 4-1-6 Regression of Share Price on Environment/Carbon and Financial Variables from Collins et al. (1999) Model for the US

$$P_{it} + d_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it-1} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	CLNS_IP	CLNS_FF	CLNS_DF	CLNS_CF
LAG_BPS	1.0665***	1.0674***	1.0644***	1.0646***
	(0.2157)	(0.2157)	(0.2153)	(0.2153)
EPS	5.7763***	5.7948***	5.7779***	5.7785***
	(1.0933)	(1.0964)	(1.0934)	(1.0942)
IPPS	-0.2796***			
	(0.0940)			
FFPS		-0.0415***		
		(0.0112)		
DFPS			-0.0377***	
			(0.0112)	
CFPS				-0.0393***
				(0.0114)
IND	Various	Various	Various	Various
_cons	16.8869**	16.7754**	16.5266**	16.5197**
	(6.9182)	(6.9014)	(6.9509)	(6.9519)
N	4919	4919	4919	4919
r2	0.4935	0.4942	0.4937	0.4937
F	28.91	29.04	29.00	29.01

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, DPS (d_{it}), dividends per share, LAG_BPS (b_{it-1}), year beginning net book value per share, EPS (x_{it}), earnings per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4919 observations in total.

Table 4-1-7 Regression of Share Price on Environment/Carbon and Financial Variables from Rees (1997) Model for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 TD_{it} + \beta_5 IV_{it} + \beta_6 Carbon_{it} + \varepsilon_{it}$$

	REES_IP	REES_FF	REES_DF	REES_CF
BVPS	1.2757***	1.2742***	1.2719***	1.2720***
	(0.2444)	(0.2436)	(0.2432)	(0.2431)
EPS	3.8822***	3.9031***	3.8877***	3.8883***
	(0.8951)	(0.8966)	(0.8943)	(0.8952)
DPS	2.0746	2.1504	2.0974	2.1111
	(2.1463)	(2.1671)	(2.1630)	(2.1664)
TDPPS	-0.0113	-0.0110	-0.0111	-0.0111
	(0.0123)	(0.0122)	(0.0123)	(0.0123)
CAPEXPPS	-0.3164	-0.3020	-0.3240	-0.3254
	(0.5778)	(0.5715)	(0.5717)	(0.5736)
IPPS	-0.3725***			
	(0.1032)			
FFPS		-0.0500***		
		(0.0115)		
DFPS			-0.0455***	
			(0.0119)	
CFPS				-0.0475***
				(0.0119)
IND	Various	Various	Various	Various
_cons	18.3767**	18.1453**	17.8961**	17.8846**
	(7.2698)	(7.2792)	(7.3243)	(7.3259)
N	4804	4804	4804	4804
r2	0.5420	0.5427	0.5420	0.5421
F	29.06	29.27	29.18	29.18

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4804 observations in total.

Table 4-1-8 Regression of Share Price on Environment/Carbon and Financial Variables from Hands & Landsman (2005) for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS	1.2490***	1.2490***	1.2467***	1.2468***
	(0.2166)	(0.2161)	(0.2156)	(0.2155)
EPS	3.2190***	3.2339***	3.2178***	3.2181***
	(0.7021)	(0.7062)	(0.7035)	(0.7042)
DPS	2.5851	2.6390	2.5932	2.6053
	(2.2747)	(2.2939)	(2.2873)	(2.2901)
CAPCONPS	1.7783*	1.7718*	1.7778*	1.7787*
	(0.9992)	(0.9940)	(0.9958)	(0.9959)
IPPS	-0.3177***			
	(0.1095)			
FFPS		-0.0432***		
		(0.0117)		
DFPS			-0.0396***	
			(0.0123)	
CFPS				-0.0422***
				(0.0121)
IND	Various	Various	Various	Various
_cons	17.5011**	17.3442**	17.0925**	17.0791**
	(6.8000)	(6.7995)	(6.8425)	(6.8438)
N	4484	4484	4484	4484
r2	0.5780	0.5787	0.5782	0.5783
F	27.34	27.54	27.48	27.49

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4484 observations in total.

Table 4-1-9 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 1 for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	BOTH_IP	BOTH _FF	BOTH _DF	BOTH _CF
BVPS	1.2943***	1.2936***	1.2919***	1.2920***
	(0.2503)	(0.2497)	(0.2495)	(0.2494)
EPS	3.1582***	3.1720***	3.1578***	3.1581***
	(0.7043)	(0.7075)	(0.7056)	(0.7063)
DPS	2.5908	2.6400	2.5984	2.6100
	(2.2205)	(2.2383)	(2.2329)	(2.2359)
CAPCONPS	1.7780*	1.7721*	1.7776*	1.7783*
	(0.9870)	(0.9823)	(0.9834)	(0.9834)
TDPPS	-0.0063	-0.0060	-0.0061	-0.0061
	(0.0138)	(0.0137)	(0.0138)	(0.0138)
CAPEXPPS	-0.5478	-0.5286	-0.5508	-0.5503
	(0.4802)	(0.4726)	(0.4728)	(0.4746)
IPPS	-0.2972***			
	(0.1096)			
FFPS		-0.0413***		
		(0.0109)		
DFPS			-0.0372***	
			(0.0112)	
CFPS				-0.0399***
				(0.0112)
IND	Various	Various	Various	Various
_cons	18.2109***	18.0365***	17.8334***	17.8195***
	(6.6370)	(6.6408)	(6.6746)	(6.6757)
N	4440	4440	4440	4440
r2	0.5706	0.5713	0.5708	0.5709
F	26.95	27.12	27.06	27.07

Table 4-1-10 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 2 for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 RD_{it} + \beta_8 Carbon_{it} + \varepsilon_{it}$$

	RNDS_IP	RNDS_FF	RNDS_DF	RNDS_CF
BVPS	1.2888***	1.2882***	1.2864***	1.2866***
	(0.2509)	(0.2503)	(0.2501)	(0.2500)
EPS	3.2190***	3.2328***	3.2187***	3.2191***
	(0.7144)	(0.7175)	(0.7156)	(0.7163)
DPS	2.6315	2.6808	2.6393	2.6509
	(2.2352)	(2.2531)	(2.2477)	(2.2506)
CAPCONPS	1.7742*	1.7682*	1.7737*	1.7744*
	(0.9850)	(0.9802)	(0.9814)	(0.9813)
TDPPS	-0.0065	-0.0062	-0.0063	-0.0063
	(0.0138)	(0.0137)	(0.0138)	(0.0138)
CAPEXPPS	-0.5386	-0.5193	-0.5413	-0.5408
	(0.4803)	(0.4727)	(0.4730)	(0.4747)
adj_RD	-5.5499***	-5.5574***	-5.5642***	-5.5668***
	(1.7777)	(1.7751)	(1.7795)	(1.7782)
IPPS	-0.2959***			
	(0.1094)			
FFPS		-0.0412***		
		(0.0109)		
DFPS			-0.0372***	
			(0.0112)	
CFPS				-0.0399***
				(0.0112)
IND	Various	Various	Various	Various
_cons	18.0685***	17.8949***	17.6918***	17.6777***
	(6.6296)	(6.6333)	(6.6669)	(6.6681)
N	4440	4440	4440	4440
r2	0.5716	0.5723	0.5718	0.5718
F	26.03	26.20	26.14	26.14

Table 4-1-11 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 3 for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 RD_{it} + \beta_8 ADV_{it} + \beta_9 Carbon_{it} + \varepsilon_{it}$$

	ADVS_IP	ADVS_FF	ADVS_DF	ADVS_CF
BVPS	1.2895***	1.2889***	1.2871***	1.2873***
	(0.2516)	(0.2509)	(0.2507)	(0.2506)
EPS	3.2205***	3.2343***	3.2203***	3.2207***
	(0.7154)	(0.7185)	(0.7166)	(0.7173)
DPS	2.6364	2.6858	2.6444	2.6563
	(2.2424)	(2.2603)	(2.2549)	(2.2581)
CAPCONPS	1.7784*	1.7724*	1.7780*	1.7788*
	(0.9891)	(0.9843)	(0.9854)	(0.9853)
TDPPS	-0.0065	-0.0062	-0.0063	-0.0063
	(0.0138)	(0.0137)	(0.0137)	(0.0137)
CAPEXPPS	-0.5274	-0.5078	-0.5297	-0.5287
	(0.4745)	(0.4667)	(0.4666)	(0.4683)
adj_RD	-5.5206***	-5.5277***	-5.5340***	-5.5357***
	(1.7746)	(1.7718)	(1.7766)	(1.7756)
adj_AD	-0.4152	-0.4205	-0.4265	-0.4399
	(1.2954)	(1.2990)	(1.2980)	(1.2997)
IPPS	-0.2952**			
	(0.1096)			
FFPS		-0.0412***		
		(0.0109)		
DFPS			-0.0372***	
			(0.0112)	
CFPS				-0.0400***
				(0.0112)
IND	Various	Various	Various	Various
_cons	18.0985***	17.9257***	17.7231***	17.7098***
	(6.6068)	(6.6101)	(6.6437)	(6.6458)
N	4440	4440	4440	4440
r2	0.5716	0.5723	0.5718	0.5719
F	27.72	27.82	27.77	27.77

COMPOSITE MODELS 1, 2 AND 3. Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, adj_AD (ADV_{it}), advertising expense per share, this is the value after adjusted for the missing observations. IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4440 observations in total.

Table 4-1-12 Correlation between each two sales-deflated variables for the US

	PSA	BSA	ESA	DSA	CESA	TSA	CCSA	IPSA	FFSA	DFSA	CFSA
PSA	1.0000										
BSA	0.5667	1.0000									
ESA	0.0241	-0.2261	1.0000								
DSA	0.1793	0.2921	0.0931	1.0000							
CESA	0.1465	0.1140	0.0036	-0.0567	1.0000						
TSA	0.0708	0.3015	-0.2629	0.3413	0.0363	1.0000					
CCSA	-0.3153	-0.5837	0.2463	-0.0525	-0.0464	-0.0178	1.0000				
IPSA	-0.0488	-0.0293	-0.0073	0.0216	0.1341	0.0044	-0.0115	1.0000			
FFSA	-0.1128	-0.0483	-0.0162	0.0095	0.1458	0.0114	-0.0113	0.4780	1.0000		
DFSA	-0.0981	-0.0326	-0.0128	0.0140	0.1498	0.0207	-0.0121	0.4646	0.9931	1.0000	
CFSA	-0.0951	-0.0274	-0.0118	0.0176	0.1409	0.0225	-0.0114	0.4133	0.9821	0.9899	1.0000

Financial variables are deflated by sales; PSA, the market value over sales, BSA, year-end net book value over sales, ESA, earnings over sales, DSA, dividend over sales, CCSA, net capital contributions over sales, TSA, total debt over sales, CESA, capital expenditure over sales. The environmental performance measure is IPSA, IP over sales; and three carbon performance measures are FFSA, FF over sales, DFSA, DF over sales, and CFSA, CF over sales.

Table 4-1-13 Regression of Share Price on Environment/Carbon and Financial Variables, Composite Model with sales deflated for US

$$P_{it}/s = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 TL_{it}/s + \beta_6 IV_{it}/s + \beta_7 Carbon_{it}/s + \varepsilon_{it}$$

	DFLA_IP	DFLA_FF	DFLA_DF	DFLA_CF
BSA	1.6063***	1.6051***	1.6062***	1.6065***
	(0.3162)	(0.3158)	(0.3160)	(0.3162)
ESA	1.3756**	1.3750**	1.3763**	1.3763**
	(0.5496)	(0.5492)	(0.5495)	(0.5497)
DSA	1.7270	1.7519	1.7403	1.7444
	(1.0717)	(1.0732)	(1.0724)	(1.0735)
CESA	2.7224***	2.7200***	2.7290***	2.7253***
	(0.7755)	(0.7715)	(0.7705)	(0.7708)
TSA	-0.0872**	-0.0863**	-0.0865**	-0.0865**
	(0.0395)	(0.0394)	(0.0394)	(0.0394)
CCSA	-0.0991	-0.1005	-0.0996	-0.0992
	(0.4093)	(0.4089)	(0.4091)	(0.4093)
IPSA	0.0027			
	(0.2020)			
FFSA		-0.0741**		
		(0.0231)		
DFSA			-0.0683***	
			(0.0233)	
CFSA				-0.0713***
				(0.0237)
IND	Various	Various	Various	Various
_cons	0.5865***	0.5987***	0.5874***	0.5873***
	(0.1952)	(0.1951)	(0.1950)	(0.1950)
N	4429	4429	4429	4429
r2	0.3996	0.4004	0.4002	0.4002
F	159.13	158.38	158.32	158.27

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales, TSA (TD_{it}/s), total debt over sales, CESA (IV_{it}/s), capital expenditure over sales. IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) (IPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4429 observations in total.

Table 4-1-14 Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for Profit Firms for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAPF_IP	HAPF_FF	HAPF_DF	HAPF_CF
BVPS	1.1367***	1.1334***	1.1327***	1.1324***
	(0.2471)	(0.2457)	(0.2456)	(0.2453)
EPS	4.7820***	4.8679***	4.8143***	4.8227***
	(1.3172)	(1.3278)	(1.3216)	(1.3213)
DPS	2.4529	2.5301	2.4745	2.4903
	(2.4117)	(2.4364)	(2.4304)	(2.4343)
CAPCONPS	1.5885*	1.5656*	1.5790*	1.5781*
	(0.9519)	(0.9394)	(0.9436)	(0.9433)
IPPS	-0.3499***			
	(0.1221)			
FFPS		-0.0572***		
		(0.0129)		
DFPS			-0.0526***	
			(0.0145)	
CFPS				-0.0572***
				(0.0140)
IND	Various	Various	Various	Various
_cons	14.6788**	14.4276**	14.1618**	14.1292**
	(6.8235)	(6.8240)	(6.8894)	(6.8918)
N	4079	4079	4079	4079
r2	0.5819	0.5833	0.5824	0.5826
F	23.63	23.77	23.76	23.78

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4079 observations in total.

Table 4-1-15 Regression of Share Price on Environment/Carbon and Financial Variables from H & L (2005) for Loss Firms for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HALS_IP	HALS_FF	HALS_DF	HALS_CF
BVPS	0.9920***	0.9893***	0.9911***	0.9909***
	(0.1902)	(0.1907)	(0.1908)	(0.1908)
EPS	0.2638	0.2645	0.2639	0.2665
	(0.1764)	(0.1801)	(0.1800)	(0.1804)
DPS	0.4113	0.2679	0.2913	0.2715
	(1.0442)	(0.9933)	(1.0223)	(1.0199)
CAPCONPS	0.5509	0.5669	0.5663	0.5670
	(0.6175)	(0.6134)	(0.6156)	(0.6148)
IPPS	-0.0256			
	(0.1008)			
FFPS		0.0112		
		(0.0079)		
DFPS			0.0115	
			(0.0091)	
CFPS				0.0131
				(0.0091)
IND	Various	Various	Various	Various
_cons	12.8670***	12.7912***	12.8734***	12.8925***
	(1.9569)	(2.1306)	(2.0327)	(2.0345)
N	404	404	404	404
r2	0.3169	0.3177	0.3176	0.3178
F	13.50	13.48	13.51	13.49

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 404 observations in total.

Table 4-1-16 Regression of share price from composite model for Profit Firms for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	PROF_IP	PROF_FF	PROF_DF	PROF_CF
BVPS	1.1804***	1.1761***	1.1761***	1.1757***
	(0.2862)	(0.2846)	(0.2846)	(0.2844)
EPS	4.7765***	4.8551***	4.8071***	4.8153***
	(1.4176)	(1.4244)	(1.4200)	(1.4195)
DPS	2.5204	2.5917	2.5407	2.5559
	(2.3717)	(2.3952)	(2.3901)	(2.3943)
CAPCONPS	1.5787*	1.5571*	1.5696*	1.5686*
	(0.9387)	(0.9281)	(0.9309)	(0.9305)
TDPPS	-0.0123	-0.0121	-0.0121	-0.0121
	(0.0156)	(0.0156)	(0.0156)	(0.0156)
CAPEXPPS	-0.7529	-0.7136	-0.7422	-0.7401
	(0.6073)	(0.5916)	(0.5924)	(0.5947)
IPPS	-0.3139**			
	(0.1225)			
FFPS		-0.0537***		
		(0.0114)		
DFPS			-0.0485***	
			(0.0125)	
CFPS				-0.0531***
				(0.0121)
IND	Various	Various	Various	Various
_cons	15.7070**	15.4303**	15.2244**	15.1899**
	(6.5255)	(6.5304)	(6.5843)	(6.5863)
N	4040	4040	4040	4040
r2	0.5747	0.5760	0.5752	0.5754
F	23.85	24.00	23.95	23.96

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4040 observations in total.

Table 4-1-17 Regression of share price from composite model for Loss Firms for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	LOSS_IP	LOSS_FF	LOSS_DF	LOSS_CF
BVPS	0.9864***	0.9840***	0.9856***	0.9854***
	(0.1803)	(0.1809)	(0.1807)	(0.1807)
EPS	0.2700	0.2692	0.2688	0.2712
	(0.1758)	(0.1780)	(0.1780)	(0.1783)
DPS	0.6261	0.4812	0.5006	0.4811
	(1.0870)	(1.0356)	(1.0630)	(1.0610)
CAPCONPS	0.4652	0.4811	0.4809	0.4816
	(0.6592)	(0.6536)	(0.6557)	(0.6547)
TDPPS	-0.0119**	-0.0120*	-0.0120*	-0.0120*
	(0.0059)	(0.0062)	(0.0061)	(0.0061)
CAPEXPPS	0.2808	0.2669	0.2688	0.2687
	(0.3646)	(0.3607)	(0.3616)	(0.3617)
IPPS	-0.0409			
	(0.1018)			
FFPS		0.0103		
		(0.0084)		
DFPS			0.0108	
			(0.0094)	
CFPS				0.0124
				(0.0094)
IND	Various	Various	Various	Various
_cons	12.2655***	12.2005***	12.2732***	12.2920***
	(2.0728)	(2.2142)	(2.1335)	(2.1358)
N	399	399	399	399
r2	0.3222	0.3228	0.3227	0.3229
F	12.56	12.52	12.56	12.53

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 399 observations in total.

Table 4-2-1 Summary Environment and Carbon Performance for Each UK Industry

INDM3	WIPPS			FFPS			DFPS			CFPS		
	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN
Autopt	0.212548	0.030664	0.207619	1.322125	0.203865	1.314733	0.104454	0.017344	0.106596	0.102626	0.017065	0.104771
Bankss	0.012944	0.007184	0.011266	0.048196	0.037145	0.034358	0.00682	0.004238	0.005595	0.006053	0.004062	0.004995
Basres	1.698344	1.685198	1.100047	9.098459	9.560233	7.987972	5.052537	5.902257	2.577218	2.890295	3.844732	0.744829
Chemcs	0.853235	1.368144	0.322273	4.307554	4.537464	1.833625	1.27189	1.055705	1.057091	0.919881	0.640476	0.851657
Conmat	0.626927	0.693542	0.261102	3.205587	3.110229	1.281869	0.755033	0.87574	0.378044	0.706893	0.820374	0.356064
Finsvs	0.010637	0.008872	0.009257	0.037684	0.037091	0.028966	0.007154	0.012693	0.002247	0.006586	0.01197	0.001978
Foodbv	2.102862	1.724166	1.455137	8.39485	8.655704	4.015852	0.657345	0.696847	0.467091	0.625366	0.665256	0.457349
Health	0.063641	0.064203	0.047632	0.331107	0.301319	0.264472	0.10614	0.100418	0.085221	0.097715	0.096157	0.083189
Indsgs	0.151471	0.196412	0.085148	1.146872	1.599245	0.53082	0.401581	0.833363	0.112209	0.343396	0.63211	0.101785
Insura	0.028255	0.030638	0.015673	0.051119	0.045615	0.028347	0.007069	0.009055	0.00298	0.006378	0.008564	0.002531
Medias	0.044925	0.055849	0.016063	0.224917	0.272947	0.092119	0.024888	0.028428	0.010401	0.023119	0.026798	0.009361
Oilgas	0.315408	0.748806	0.119355	3.774139	9.954983	1.082049	1.800323	4.503136	0.501624	1.649005	4.304193	0.413159
Pershs	0.265427	0.194039	0.210459	1.090742	0.806612	0.887387	0.20193	0.175908	0.174638	0.186188	0.168135	0.156174
Realet	0.020784	0.03068	0.011581	0.173558	0.280463	0.09138	0.034895	0.051704	0.017799	0.033159	0.049651	0.017037
Retail	0.151707	0.194235	0.088036	0.684913	0.490421	0.500948	0.175195	0.172098	0.118357	0.115765	0.092007	0.081608
Techno	0.017935	0.024533	0.01148	0.091144	0.124626	0.049029	0.022801	0.035915	0.011434	0.020194	0.032242	0.010121
Teleco	0.015914	0.009373	0.010708	0.079612	0.043523	0.063966	0.015285	0.012664	0.008595	0.014109	0.011699	0.008267
Travel	0.442421	0.524913	0.333853	6.041877	10.38472	1.485536	4.981572	9.942199	0.30202	4.744848	9.804139	0.284934
Utlits	1.171961	1.061653	0.675595	18.52757	22.16948	9.990319	17.22774	20.92267	9.452089	16.72782	20.57147	9.100011

The Environmental performance measure is impact ratio per share after winsorising (WIPPS), equals to the Total Environmental Damage Cost divided by company's share number. The Carbon performance measures have three dimensions: first-tier + direct carbon emissions quantities (FF) includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); direct carbon emissions quantities (DF) includes CO2e emission from direct emission (scope 1); carbon dioxide emissions quantities only (CF) includes Carbon Dioxide (no equivalent) from direct emission (scope 1). All carbon measures are on per thousand shares basis (PS), i.e. equal to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's share number (in unit of thousand). Data cover the seven years 2002-2008. Industry abbreviations see appendix 1.

Table 4-2-2 Summary Financial Statistics for the UK

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD
MVPS_USD	7.990579	5.216586	.0402602	143.4837	10.04728
BVPS_USD	3.565285	2.079672	.0276281	105.3888	5.546801
EPS_USD	.473949	.2882602	-9.327994	17.31834	1.056497
DPS_USD	.2142409	.1377366	0	3.390805	.2662045
CAPCONPS_USD	.1185201	.0091164	-1.417866	13.11194	.521582
TDPPS_USD	3.969609	1.139422	0	318.5325	13.97215
CAPEXPPS_USD	.4351747	.1878394	0	39.00994	1.219341
SIZE	17.02149	3.473	.004	561.876	44.93514
SALEPS_USD	7.284626	4.545758	-8.815747	130.7995	9.98082
adj_RD	.0551847	0	0	3.467035	.2006406
WIPPS	.3036229	.0637272	.0001246	5.579016	.753644
FFPS	2.112321	.4021896	.0001386	76.24109	6.142655
DFPS	1.079306	.0795184	0	68.04248	4.792713
CFPS	.9440634	.068554	0	65.70143	4.567291
COMSH	868.8108	209.3705	8.214	60000	2968.714

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS_USD, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June at the following year.

Table 4-2-3 Correlation between each two share-number-deflated variables for the UK

	MVPS_	BVPS_U	EPS_US	DPS_U	CAPCO	TDPPS_	CAPEXP	SIZE	SALEPS	adj_RD	WIPPS	FFPS	DFPS	CFPS	COMSH
MVPS_USD	1.0000														
BVPS_USD	0.5623	1.0000													
EPS_USD	0.4887	0.6097	1.0000												
DPS_USD	0.6572	0.5343	0.5186	1.0000											
CAPCONPS_USD	0.1768	0.1898	0.0090	0.2139	1.0000										
TDPPS_USD	0.1663	0.2517	0.1590	0.2999	0.2280	1.0000									
CAPEXPPS_USD	0.2890	0.4187	0.1853	0.3845	0.5754	0.2196	1.0000								
SIZE	0.0529	0.0188	0.0699	0.1471	0.0022	0.0986	0.0304	1.0000							
SALEPS_USD	0.2935	0.1920	0.3283	0.4313	0.0402	0.1208	0.2106	0.1319	1.0000						
adj_RD	0.2191	0.0138	0.1247	0.2352	-0.0101	-0.0434	-0.0122	0.0698	0.0515	1.0000					
WIPPS	0.2208	0.1371	0.2457	0.2632	0.0148	-0.0051	0.1730	0.0799	0.4075	-0.0005	1.0000				
FFPS	0.1797	0.1169	0.2537	0.2786	-0.0072	-0.0013	0.1848	0.0516	0.3987	-0.0189	0.7402	1.0000			
DFPS	0.1181	0.0802	0.1790	0.2055	-0.0105	0.0023	0.1235	0.0304	0.2290	-0.0346	0.4808	0.8898	1.0000		
CFPS	0.0982	0.0730	0.1662	0.1966	-0.0136	0.0010	0.1119	0.0261	0.2167	-0.0321	0.4237	0.8680	0.9865	1.0000	
COMSH	0.0015	-0.0025	0.0120	0.0652	0.0034	0.0920	-0.0017	0.3642	-0.0008	0.0191	0.0033	0.0251	0.0185	0.0186	1.0000

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS_USD, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS, and three carbon performance measures are FFPS, DFPS and CFPS.

Table 4-2-4 Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS_USD	0.6001***	0.5901***	0.5926***	0.5923***
	(0.2066)	(0.2054)	(0.2059)	(0.2060)
EPS_USD	0.2784	0.3416	0.3078	0.3090
	(0.9347)	(0.9204)	(0.9339)	(0.9325)
DPS_USD	18.3140***	18.5845***	18.4340***	18.4282***
	(1.2995)	(1.1596)	(1.2056)	(1.2199)
WIPPS	-0.4231			
	(0.5687)			
FFPS		-0.0997		
		(0.0687)		
DFPS			-0.1175	
			(0.0841)	
CFPS				-0.1262
				(0.0868)
IND	Various	Various	Various	Various
_cons	-0.4503	-0.4455	-0.5394**	-0.5378**
	(0.2827)	(0.2821)	(0.2349)	(0.2346)
N	1990	1990	1990	1990
r2	0.5419	0.5437	0.5434	0.5436
F	27.87	27.98	28.16	28.23

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1990 observations.

Table 4-2-5 Regression of Share Price on Environment/Carbon and Financial Variables from Barth et al. (1998) Model for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	BART_IP	BART_FF	BART_DF	BART_CF
BVPS_USD	0.9642***	0.9698***	0.9694***	0.9692***
	(0.2921)	(0.2901)	(0.2918)	(0.2920)
EPS_USD	1.2628	1.2848	1.3342	1.3418
	(0.9985)	(0.9983)	(0.9877)	(0.9835)
WIPPS	0.7179			
	(0.7241)			
FFPS		0.0463		
		(0.0677)		
DFPS			0.0139	
			(0.0734)	
CFPS				0.0036
				(0.0725)
IND	Various	Various	Various	Various
_cons	0.8840***	0.9593**	1.0061**	1.0054**
	(0.3384)	(0.4013)	(0.4347)	(0.4347)
N	2001	2001	2001	2001
r2	0.4014	0.4004	0.3999	0.3999
F	19.96	19.05	19.14	19.08

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 2001 observations.

Table 4-2-6 Regression of Share Price on Environment/Carbon and Financial Variables from Collins et al. (1999) Model for the UK

$$P_{it} + d_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it-1} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	CLNS_IP	CLNS_FF	CLNS_DF	CLNS_CF
LAG_BVPS_USD	0.7566***	0.7622***	0.7631***	0.7631***
	(0.1996)	(0.1975)	(0.1967)	(0.1965)
EPS_USD	2.8681***	2.9171***	2.9455***	2.9521***
	(1.0860)	(1.0666)	(1.0594)	(1.0549)
WIPPS	0.6395			
	(0.6136)			
FFPS		0.0208		
		(0.0617)		
DFPS			-0.0067	
			(0.0644)	
CFPS				-0.0184
				(0.0649)
IND	Various	Various	Various	Various
_cons	0.9323***	1.0172***	1.0358***	1.0351***
	(0.1649)	(0.2337)	(0.2532)	(0.2528)
N	1928	1928	1928	1928
r2	0.4029	0.4017	0.4016	0.4016
F	18.75	17.98	18.08	18.02

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, DPS_USD (d_{it}), dividends per share, LAG_BPS_USD (b_{it-1}), year beginning net book value per share, EPS_USD (x_{it}), earnings per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after wizorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1928 observations.

Table 4-2-7 Regression of Share Price on Environment/Carbon and Financial Variables from Rees (1997) Model for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 TD_{it} + \beta_5 IV_{it} + \beta_6 Carbon_{it} + \varepsilon_{it}$$

	REES_IP	REES_FF	REES_DF	REES_CF
BVPS_USD	0.5285***	0.5163***	0.5201***	0.5199***
	(0.1367)	(0.1327)	(0.1340)	(0.1341)
EPS_USD	0.3670	0.4399	0.4009	0.4021
	(0.8495)	(0.8278)	(0.8449)	(0.8424)
DPS_USD	19.8549***	20.1160***	20.0073***	20.0059***
	(2.0290)	(1.9310)	(1.9205)	(1.9227)
TDPPS_USD	-0.0222	-0.0238	-0.0234	-0.0237
	(0.0196)	(0.0197)	(0.0197)	(0.0198)
CAPEXPPS_USD	-0.3110	-0.2834	-0.3128	-0.3143
	(0.2654)	(0.2648)	(0.2797)	(0.2815)
WIPPS	-0.3793			
	(0.5354)			
FFPS		-0.0992		
		(0.0649)		
DFPS			-0.1170	
			(0.0826)	
CFPS				-0.1267
				(0.0854)
IND	Various	Various	Various	Various
_cons	-0.4329	-0.4240	-0.5146**	-0.5127**
	(0.2864)	(0.2823)	(0.2401)	(0.2398)
N	1921	1921	1921	1921
r2	0.5890	0.5911	0.5908	0.5910
F	27.33	28.01	28.26	28.43

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1921 observations.

Table 4-2-8 Regression of Share Price on Environment/Carbon and Financial Variables from Hands & Landsman (2005) for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS_USD	0.5053***	0.4942***	0.4969***	0.4965***
	(0.1260)	(0.1222)	(0.1229)	(0.1230)
EPS_USD	0.4375	0.5029	0.4665	0.4682
	(0.8424)	(0.8206)	(0.8397)	(0.8377)
DPS_USD	19.2712***	19.5771***	19.3993***	19.3898***
	(1.9958)	(1.8596)	(1.8567)	(1.8564)
CAPCONPS_USD	-0.0739	-0.1028	-0.0908	-0.0862
	(0.7269)	(0.7316)	(0.7305)	(0.7332)
WIPPS	-0.4346			
	(0.5710)			
FFPS		-0.1041		
		(0.0714)		
DFPS			-0.1185	
			(0.0861)	
CFPS				-0.1275
				(0.0887)
IND	Various	Various	Various	Various
_cons	-0.4571	-0.4520	-0.5478**	-0.5455**
	(0.2910)	(0.2847)	(0.2591)	(0.2584)
N	1918	1918	1918	1918
r2	0.5872	0.5894	0.5888	0.5890
F	28.00	28.91	28.98	29.09

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1918 observations.

Table 4-2-9 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 1 for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	BOTH_IP	BOTH _FF	BOTH _DF	BOTH _CF
BVPS_USD	0.5262***	0.5147***	0.5180***	0.5176***
	(0.1370)	(0.1328)	(0.1343)	(0.1344)
EPS_USD	0.4029	0.4695	0.4374	0.4396
	(0.8284)	(0.8091)	(0.8233)	(0.8206)
DPS_USD	19.8312***	20.0916***	19.9910***	19.9911***
	(2.0554)	(1.9516)	(1.9426)	(1.9450)
CAPCONPS_USD	0.5794	0.4988	0.5597	0.5695
	(0.6807)	(0.6789)	(0.6793)	(0.6788)
TDPPS_USD	-0.0252	-0.0264	-0.0263	-0.0266
	(0.0200)	(0.0202)	(0.0202)	(0.0203)
CAPEXPPS_USD	-0.4624	-0.4141	-0.4576	-0.4615
	(0.3828)	(0.3668)	(0.3920)	(0.3932)
WIPPS	-0.3399			
	(0.5415)			
FFPS		-0.0949		
		(0.0657)		
DFPS			-0.1138	
			(0.0826)	
CFPS				-0.1239
				(0.0847)
IND	Various	Various	Various	Various
_cons	-0.3931	-0.3880	-0.4703*	-0.4679*
	(0.3030)	(0.2956)	(0.2631)	(0.2624)
N	1918	1918	1918	1918
r2	0.5896	0.5915	0.5913	0.5915
F	26.20	27.04	27.16	27.32

Table 4-2-10 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 2 for the UK

	RNDS_IP	RNDS_FF	RNDS_DF	RNDS_CF
BVPS_USD	0.5512***	0.5402***	0.5432***	0.5428***
	(0.1365)	(0.1323)	(0.1339)	(0.1340)
EPS_USD	0.3257	0.3879	0.3591	0.3617
	(0.8217)	(0.8041)	(0.8181)	(0.8149)
DPS_USD	18.5588***	18.8338***	18.7403***	18.7439***
	(2.3979)	(2.3193)	(2.3035)	(2.3058)
CAPCONPS_USD	0.5918	0.5190	0.5731	0.5813
	(0.6762)	(0.6742)	(0.6761)	(0.6756)
TDPPS_USD	-0.0226	-0.0237	-0.0237	-0.0239
	(0.0202)	(0.0204)	(0.0204)	(0.0206)
CAPEXPPS_USD	-0.4130	-0.3712	-0.4097	-0.4129
	(0.3953)	(0.3802)	(0.4057)	(0.4072)
adj_RD	4.2860***	4.1460***	4.1599***	4.1570***
	(1.1696)	(1.1614)	(1.1715)	(1.1750)
WIPPS	-0.2930			
	(0.5443)			
FFPS		-0.0841		
		(0.0650)		
DFPS			-0.1008	
			(0.0804)	
CFPS				-0.1109
				(0.0822)
IND	Various	Various	Various	Various
_cons	-1.1489**	-1.1188**	-1.1943**	-1.1919**
	(0.4975)	(0.5032)	(0.4880)	(0.4883)
N	1918	1918	1918	1918
r2	0.5955	0.5970	0.5969	0.5970
F	26.13	26.62	26.75	26.87

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 RD_{it} + \beta_8 Carbon_{it} + \varepsilon_{it}$$

COMPOSITE MODELS 1 AND 2. Financial variables are expressed as dollar per share; MVPS ($\mathrm{P_{it}}$), the market value per share or share price, BVPS ($\mathrm{b_{it}}$), year end net book value per share, EPS ($\mathrm{x_{it}}$), earnings per share, DPS ($\mathrm{d_{it}}$), dividends per share, CAPCONPS ($\Delta\mathrm{C_{it}}$), net capital contributions received per share, TDPPS ($\mathrm{TD_{it}}$), total debt per share, CAPEXPS ($\mathrm{IV_{it}}$), capital expenditure per share, adj_RD ($\mathrm{RD_{it}}$), research and development per share, this is the value after adjusted for the missing observations. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1918 observations.

Table 4-2-11 Correlation between each two sales-deflated variables for the UK

	PSA	BSA	ESA	DSA	CESA	TSA	CCSA	WIPSA	FFSA	DFSA	CFSA
PSA	1.0000										
BSA	0.5652	1.0000									
ESA	-0.0728	0.1918	1.0000								
DSA	0.1976	0.5371	0.2747	1.0000							
CESA	0.3117	0.6848	0.1876	0.4354	1.0000						
TSA	0.1535	0.6274	0.1128	0.4205	0.6452	1.0000					
CCSA	0.6688	0.3008	-0.1823	0.0211	0.2831	0.0444	1.0000				
WIPSA	-0.0106	-0.0462	0.0134	-0.0390	-0.0061	-0.0370	0.0107	1.0000			
FFSA	-0.0100	-0.0247	0.0117	-0.0200	-0.0014	-0.0051	0.0016	0.6644	1.0000		
DFSA	-0.0027	-0.0109	0.0113	-0.0089	0.0027	0.0139	0.0059	0.5725	0.9787	1.0000	
CFSA	-0.0027	-0.0083	0.0110	-0.0057	0.0016	0.0181	0.0049	0.5263	0.9661	0.9908	1.0000

Financial variables are deflated by sales; PSA, the market value over sales, BSA, year-end net book value over sales, ESA, earnings over sales, DSA, dividend over sales, CCSA, net capital contributions over sales, TSA, total debt over sales, CESA, capital expenditure over sales. The environmental performance measure is WIPSA, winzorized IP over sales; and three carbon performance measures are FFSA, FF over sales, DFSA, DF over sales, and CFSA, CF over sales.

Table 4-2-12 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model with sales deflated

$$P_{it}/s = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 TL_{it}/s + \beta_6 IV_{it}/s + \beta_7 Carbon_{it}/s + \varepsilon_{it}$$

	DFLA_IP	DFLA_FF	DFLA_DF	DFLA_CF
BSA	1.5880***	1.5920***	1.5937***	1.5943***
	(0.2366)	(0.2384)	(0.2389)	(0.2392)
ESA	-0.7017	-0.6836	-0.6816	-0.6814
	(0.8641)	(0.8494)	(0.8492)	(0.8506)
DSA	-3.7866	-3.6287	-3.5519	-3.4739
	(5.0826)	(4.9861)	(4.9807)	(4.9730)
CESA	-1.5905*	-1.6244*	-1.6357*	-1.6409*
	(0.9593)	(0.9700)	(0.9758)	(0.9780)
TSA	-0.8569***	-0.8606***	-0.8599***	-0.8608***
	(0.2660)	(0.2639)	(0.2639)	(0.2643)
CCSA	6.4934***	6.4645***	6.4671***	6.4690***
	(1.9644)	(1.9360)	(1.9355)	(1.9362)
WIPSA	-5.0849			
	(3.3348)			
FFSA		-0.5204		
		(0.3468)		
DFSA			-0.5321	
			(0.3727)	
CFSA				-0.5242
				(0.3771)
IND	Various	Various	Various	Various
_cons	0.6184**	0.5518***	0.4465***	0.4448***
	(0.2406)	(0.2025)	(0.1407)	(0.1399)
N	1898	1898	1898	1898
r2	0.6583	0.6598	0.6596	0.6593
F	31.99	30.49	32.95	32.83

Financial variables are expressed as dollar over sales(dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales, TSA (TD_{it}/s), total debt over sales, CESA (IV_{it}/s), capital expenditure over sales. IND are dummies for the 19 industries delineated by DS Level-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1898 observations.

Table 4-2-13 Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for Profit Firms for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAPF_IP	HAPF_FF	HAPF_DF	HAPF_CF
BVPS_USD	0.4945***	0.4791***	0.4859***	0.4849***
	(0.1557)	(0.1534)	(0.1560)	(0.1562)
EPS_USD	0.4535	0.5606	0.4928	0.4969
	(1.3987)	(1.3853)	(1.4026)	(1.3916)
DPS_USD	18.9469***	19.2109***	19.0385***	19.0551***
	(2.6699)	(2.5750)	(2.5931)	(2.6032)
CAPCONPS_USD	-0.3107	-0.3361	-0.3214	-0.3212
	(0.9988)	(1.0136)	(1.0047)	(1.0092)
WIPPS	-0.3426			
	(0.6095)			
FFPS		-0.0920		
		(0.0741)		
DFPS			-0.0959	
			(0.0882)	
CFPS				-0.1128
				(0.0895)
IND	Various	Various	Various	Various
_cons	-0.4203	-0.4199	-0.4973**	-0.4979**
	(0.3147)	(0.2914)	(0.2535)	(0.2538)
N	1662	1662	1662	1662
r2	0.5677	0.5696	0.5688	0.5693
F	24.11	24.49	24.58	24.73

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS Level-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1662 observations.

Table 4-2-14 Regression of Share Price on Environment/Carbon and Financial Variables from H & L (2005) for Loss Firms for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HALS_IP	HALS_FF	HALS_DF	HALS_CF
BVPS_USD	0.8132*	0.7997*	0.7877*	0.7822*
	(0.4351)	(0.4299)	(0.4231)	(0.4205)
EPS_USD	0.0248	0.0198	0.0158	0.0206
	(0.2308)	(0.2295)	(0.2292)	(0.2293)
DPS_USD	4.0189	4.7611	5.1458	5.2683
	(9.8330)	(9.6355)	(9.4765)	(9.4132)
CAPCONPS_USD	1.7083***	1.6561***	1.6396***	1.6347***
	(0.5121)	(0.5260)	(0.5310)	(0.5255)
WIPPS	0.9971**			
	(0.4633)			
FFPS		0.0471		
		(0.1412)		
DFPS			-0.0725	
			(0.1873)	
CFPS				-0.2482
				(0.2142)
IND	Various	Various	Various	Various
_cons	-0.4600	-0.3487	-0.2911	-0.2699
	(0.2941)	(0.2670)	(0.2353)	(0.2299)
N	235	235	235	235
r2	0.6140	0.6107	0.6109	0.6129
F	.	.	.	.

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS Level-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 235 observations.

Table 4-2-15 Regression of share price from composite model for Profit Firms for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	PROF_IP	PROF_FF	PROF_DF	PROF_CF
BVPS_USD	0.4988***	0.4848***	0.4892***	0.4880***
	(0.1581)	(0.1556)	(0.1576)	(0.1579)
EPS_USD	0.6227	0.7182	0.6829	0.6902
	(1.4041)	(1.4043)	(1.4158)	(1.4052)
DPS_USD	19.7675***	19.9902***	19.9213***	19.9492***
	(2.5776)	(2.5197)	(2.5038)	(2.5106)
CAPCONPS_USD	0.4575	0.3928	0.4485	0.4530
	(0.5923)	(0.5898)	(0.5897)	(0.5908)
TDPPS_USD	-0.0192	-0.0205	-0.0204	-0.0208
	(0.0176)	(0.0178)	(0.0177)	(0.0179)
CAPEXPPS_USD	-0.9660	-0.9015	-0.9655	-0.9699
	(0.7918)	(0.8063)	(0.8306)	(0.8365)
WIPPS	-0.1853			
	(0.5445)			
FFPS		-0.0780		
		(0.0647)		
DFPS			-0.0915	
			(0.0851)	
CFPS				-0.1105
				(0.0860)
IND	Various	Various	Various	Various
_cons	-0.2899	-0.2868	-0.3466	-0.3474
	(0.3553)	(0.3359)	(0.2872)	(0.2892)
N	1662	1662	1662	1662
r2	0.5718	0.5733	0.5731	0.5736
F	22.79	23.00	23.20	23.36

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 1662 observations.

Table 4-2-16 Regression of share price from composite model for Loss Firms for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	LOSS_IP	LOSS_FF	LOSS_DF	LOSS_CF
BVPS_USD	0.9424**	0.9318**	0.9169**	0.9118**
	(0.4334)	(0.4351)	(0.4229)	(0.4191)
EPS_USD	-0.1546	-0.1587	-0.1624	-0.1566
	(0.2132)	(0.2130)	(0.2155)	(0.2166)
DPS_USD	5.4444	6.1523	6.5842	6.5997
	(10.2451)	(10.1285)	(9.9219)	(9.8722)
CAPCONPS_USD	2.3717***	2.3654***	2.3203***	2.2812***
	(0.8726)	(0.8608)	(0.8722)	(0.8704)
TDPPS_USD	-0.3907*	-0.3899*	-0.3884*	-0.3847*
	(0.2112)	(0.2143)	(0.2070)	(0.2016)
CAPEXPPS_USD	0.3874	0.3690	0.3769	0.3851
	(0.6797)	(0.6774)	(0.6718)	(0.6675)
WIPPS	1.0065**			
	(0.4946)			
FFPS		0.0706		
		(0.1223)		
DFPS			-0.0591	
			(0.1382)	
CFPS				-0.1878
				(0.1973)
IND	Various	Various	Various	Various
_cons	-0.3587	-0.2696	-0.1899	-0.1760
	(0.2420)	(0.2608)	(0.1945)	(0.1999)
N	235	235	235	235
r2	0.6419	0.6388	0.6386	0.6397
F	.	.	.	.

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. Financial data cover the seven years 2003-2009, while environmental/carbon data cover the seven years 2002-2008., totalling 235 observations.

Table 4-2-17 Regression of Share Price (pre-ETS period) on Environment/Carbon and Financial Variables, Composite Model 1 for UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	A2002_IP	A2002_FF	A2002_DF	A2002_CF
BVPS_USD	0.7267*	0.7271*	0.7319*	0.7308*
	(0.4314)	(0.4272)	(0.4231)	(0.4209)
EPS_USD	1.8556	1.8365	1.8310	1.8998
	(1.1700)	(1.1694)	(1.1789)	(1.2032)
DPS_USD	15.4756***	15.3990***	15.1962***	15.0817***
	(3.6803)	(3.6991)	(3.5624)	(3.4604)
CAPCONPS_USD	1.3560***	1.3057***	1.2512***	1.2724***
	(0.2305)	(0.2175)	(0.2353)	(0.2307)
TDPPS_USD	-0.0794**	-0.0786**	-0.0785**	-0.0787**
	(0.0380)	(0.0378)	(0.0378)	(0.0378)
CAPEXPPS_USD	0.0428	0.1080	0.1991	0.2361
	(0.9043)	(0.8876)	(0.8480)	(0.8736)
WIPPS	-0.4308			
	(0.2996)			
FFPS		-0.0750***		
		(0.0166)		
DFPS			-0.1386**	
			(0.0546)	
CFPS				-0.1652*
				(0.0926)
IND	Various	Various	Various	Various
_cons	-1.1999***	-1.1927***	-1.2831	-1.3048
	(0.1287)	(0.1676)	(.)	(.)
N	667	667	667	667
r2	0.5068	0.5069	0.5075	0.5078
F	33.01	32.49	32.72	32.73

Table 4-2-18 Regression of Share Price (ETS phase I) on Environment/Carbon and Financial Variables, Composite Model 1 for UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	A2005_IP	A2005_FF	A2005_DF	A2005_CF
BVPS_USD	0.7191***	0.6959***	0.6984***	0.6959***
	(0.2175)	(0.2178)	(0.2217)	(0.2231)
EPS_USD	-0.8574	-0.6860	-0.7117	-0.7011
	(1.1658)	(1.2136)	(1.2035)	(1.1885)
DPS_USD	20.7296***	21.0985***	21.0802***	21.1378***
	(3.2199)	(3.0760)	(3.0508)	(3.0400)
CAPCONPS_USD	-0.0590	-0.1547	-0.1258	-0.1279
	(0.9863)	(0.9889)	(0.9669)	(0.9696)
TDPPS_USD	-0.0150	-0.0166	-0.0167	-0.0171
	(0.0186)	(0.0188)	(0.0189)	(0.0190)
CAPEXPPS_USD	-0.6018*	-0.5300	-0.5530	-0.5521
	(0.3573)	(0.3398)	(0.3658)	(0.3689)
WIPPS	0.2999			
	(0.8894)			
FFPS		-0.0671		
		(0.1046)		
DFPS			-0.0961	
			(0.1329)	
CFPS				-0.1202
				(0.1295)
IND	Various	Various	Various	Various
_cons	-0.3417	-0.2681	-0.3376	-0.3427
	(0.6824)	(0.6440)	(0.5167)	(0.5159)
N	981	981	981	981
r2	0.5612	0.5619	0.5622	0.5627
F	13.10	13.57	13.58	13.69

Table 4-2-19 Regression of Share Price (ETS phase II, 2008) on Environment/Carbon and Financial Variables, Composite Model1 for UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	A2008_IP	A2008_FF	A2008_DF	A2008_CF
BVPS_USD	0.2996*	0.2921*	0.2943*	0.2978*
	(0.1537)	(0.1536)	(0.1555)	(0.1554)
EPS_USD	-0.0232	-0.0058	0.0047	0.0070
	(0.3430)	(0.3421)	(0.3404)	(0.3400)
DPS_USD	20.6923***	20.7789***	20.8300***	20.8145***
	(2.2978)	(2.3088)	(2.2811)	(2.2721)
CAPCONPS_USD	0.3773	0.3840	0.3769	0.3805
	(0.3170)	(0.3178)	(0.3201)	(0.3196)
TDPPS_USD	-0.0136	-0.0148	-0.0164	-0.0177
	(0.0348)	(0.0345)	(0.0348)	(0.0344)
CAPEXPPS_USD	-2.1912*	-2.0622	-2.0951	-2.1184
	(1.3079)	(1.2586)	(1.3140)	(1.3173)
WIPPS	0.0416			
	(0.4673)			
FFPS		-0.0232		
		(0.0481)		
DFPS			-0.0572	
			(0.0414)	
CFPS				-0.0632
				(0.0426)
IND	Various	Various	Various	Various
_cons	0.2593	0.2662	0.2549	0.2602
	(0.3142)	(0.3190)	(0.3140)	(0.3141)
N	319	319	319	319
r2	0.7865	0.7869	0.7881	0.7884
F	.	.	.	.

UK. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Pre-ETS period refers to year 2002 to 2004; ETS phase I refers to year 2005 to 2007, and ETS phase II refers to year 2008 to 2012, however, data only available for year 2008. For pre-ETS period and ETS phase I, two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. For ETS phase II, robust standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. vce(robust) uses (sigma-hat_j)^2={n/(n-k)}(u_j)^2 as an estimate of the variance of the jth observation, where u_j is the calculated residual and n/(n-k) is included to improve the overall estimate's small-sample properties.

Table 4-3-1 Summary Environment and Carbon Performance for Each EU exclude UK (EX) Industry

INDM3	WIPPS			FFPS			DFPS			CFPS		
	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN
Autopt	4.989945	2.822642	5.274927	19.0866	14.68254	13.94951	3.683781	4.361085	2.421187	3.572907	4.290036	2.36045
Bankss	0.035249	0.050849	0.015383	0.110212	0.159497	0.043907	0.017787	0.031417	0.006785	0.015707	0.02796	0.005963
Basres	5.37809	6.275298	3.130555	55.26739	63.27954	31.85345	27.6934	46.98549	7.88047	24.06438	44.86314	6.882142
Chemcs	5.566021	3.909049	4.291961	54.89835	51.68328	33.76799	32.36053	40.21966	19.42887	22.65354	27.00854	15.52013
Conmat	6.593875	11.92626	2.018419	100.4882	214.9238	17.5633	81.27353	186.9549	4.681378	80.32658	185.74	3.921396
Finsvs	0.185659	0.491796	0.034267	0.828121	1.857289	0.176856	0.288345	0.95225	0.020743	0.277955	0.936111	0.01828
Foodbv	9.34034	15.86553	5.261671	26.04971	41.589	11.81778	8.868706	24.76008	2.095346	3.867813	4.902794	2.072644
Health	0.43651	0.524584	0.214128	1.949812	2.541158	1.11944	0.570895	0.768035	0.258898	0.501933	0.687001	0.21413
Indsgs	1.945021	5.616824	0.644634	14.35768	33.15072	4.252837	7.400536	24.15136	0.68543	6.112404	21.12282	0.643169
Insura	0.256504	0.285553	0.1539	0.511163	0.603079	0.291726	0.050582	0.059466	0.032507	0.042499	0.051419	0.028865
Medias	0.840914	5.824135	0.086856	1.581119	3.304927	0.330228	0.266182	0.632682	0.039354	0.229354	0.57974	0.033317
Oilgas	1.418041	1.675303	0.63084	18.04004	23.83126	5.425335	9.139328	13.06377	2.075143	8.405303	12.07803	1.880143
Pershs	1.136723	1.114129	0.86493	4.530915	3.926711	3.209408	0.833635	1.418467	0.384271	0.638117	0.900119	0.28551
Realet	0.108537	0.1145	0.071729	0.885368	0.741441	0.678887	0.156163	0.145976	0.102326	0.148986	0.138785	0.0981
Retail	2.612589	2.223068	2.033599	10.33008	8.042356	9.764775	2.365886	1.975772	1.896308	1.733784	1.601518	1.366721
Techno	0.298156	0.426795	0.185174	1.636676	2.062689	0.76722	0.391643	0.599079	0.134038	0.32615	0.526175	0.10436
Teleco	0.084187	0.055382	0.080348	0.363382	0.235656	0.35384	0.059019	0.048105	0.046462	0.055144	0.045025	0.043636
Travel	1.649141	1.960596	0.683206	25.51948	34.35411	6.831744	22.91454	33.16466	1.687123	22.58812	32.63374	1.646473
Utlits	5.069613	9.191006	0.974225	50.5704	84.26075	12.25293	45.27395	76.06926	8.853163	42.81519	73.69013	8.129466

The Environmental performance measure is impact ratio per share after winsorising (WIPPS), equals to the Total Environmental Damage Cost divided by company's share number. The Carbon performance measures have three dimensions: first-tier + direct carbon emissions quantities (FF) includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); direct carbon emissions quantities (DF) includes CO2e emission from direct emission (scope 1); carbon dioxide emissions quantities only (CF) includes Carbon Dioxide (no equivalent) from direct emission (scope 1). All carbon measures are on per thousand shares basis (PS), i.e. equal to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's share number (in unit of thousand). Data cover the seven years 2002-2008. Industry abbreviations see appendix 1.

Table 4-3-2 Summary Financial Statistics for the EX

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD
MVPS_USD	39.49479	25.4697	.0254762	996.9515	45.40576
BVPS_USD	19.52785	11.1189	.2372468	262.6783	24.30055
EPS_USD	2.607056	1.529066	-22.7053	60.98158	4.695605
DPS_USD	1.092049	.6553549	0	66.27328	2.134185
CAPCONPS_USD	.8457095	.0097773	-.0795413	107.1467	4.856967
TDPPS_USD	40.199	10.00196	0	2448.98	118.1247
CAPEXPPS_USD	2.926193	1.211188	0	181.9467	6.386355
SIZE	41.15429	16.933	.004	583.83	67.22521
SALEPS_USD	47.33113	24.22951	.2280117	549.6333	63.01456
adj_RD	.6499824	0	0	17.54938	1.594253
WIPPS	2.349559	.3683091	.0029173	64.5375	6.415794
FFPS	20.52324	2.210505	.0006402	1383.105	71.89142
DFPS	13.58076	.4125336	0	1249.544	61.05647
CFPS	12.47193	.3246897	0	1244.662	59.76939
COMSH	656.0469	228.046	6.077	19380.64	1449.313

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS_USD, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June of the following year.

Table 4-3-3 Correlation between each two share-number-deflated variables for the EX

	MVPS_USD	BVPS_USD	EPS_USD	DPS_USD	~NPS_USD	TDPPS_~D	CAPEXP..	SIZE	SALES	adj_RD	WIPPS	FFPS	DFPS	CFPS	COMSH
MVPS_USD	1.0000														
BVPS_USD	0.6611	1.0000													
EPS_USD	0.6499	0.6619	1.0000												
DPS_USD	0.3762	0.4909	0.3689	1.0000											
CAPCONPS_USD	0.1125	0.1930	0.0869	0.0671	1.0000										
TDPPS_USD	0.2069	0.3837	0.2505	0.1575	0.4603	1.0000									
CAPEXPPS_USD	0.3666	0.4696	0.3799	0.2116	0.0466	0.1651	1.0000								
SIZE	0.0896	0.1676	0.0438	0.0471	0.0291	0.1584	0.2114	1.0000							
SALEPS_USD	0.4510	0.5668	0.3746	0.2185	0.1163	0.3295	0.3769	0.4495	1.0000						
adj_RD	0.2173	0.2788	0.2040	0.0872	-0.0164	0.0196	0.2786	0.3146	0.4073	1.0000					
WIPPS	0.2275	0.2437	0.1426	0.0955	0.0028	0.0042	0.3130	0.0970	0.3608	0.1246	1.0000				
FFPS	0.2035	0.2431	0.1708	0.0891	-0.0005	0.0035	0.1736	0.0528	0.2270	0.0315	0.6634	1.0000			
DFPS	0.1614	0.2054	0.1388	0.0650	0.0005	0.0090	0.1491	0.0426	0.1621	-0.0102	0.6028	0.9871	1.0000		
CFPS	0.1566	0.1993	0.1403	0.0643	-0.0019	0.0114	0.1430	0.0429	0.1470	-0.0183	0.5614	0.9764	0.9932	1.0000	
COMSH	-0.1971	-0.1751	-0.1297	-0.0937	-0.0223	-0.0155	-0.1019	0.1445	-0.1717	-0.0889	-0.0977	-0.0708	-0.0509	-0.0470	1.0000

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS_USD, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS, and three carbon performance measures are FFPS, DFPS and CFPS.

Table 4-3-4 Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS_USD	0.8274***	0.8524***	0.8610***	0.8629***
	(0.1010)	(0.1015)	(0.1002)	(0.1010)
EPS_USD	3.4973***	3.4770***	3.4804***	3.4795***
	(0.7508)	(0.7513)	(0.7518)	(0.7517)
DPS_USD	1.0545	1.0104	0.9971	0.9920
	(1.2287)	(1.2146)	(1.2033)	(1.2044)
WIPPS	0.5051*			
	(0.2596)			
FFPS		0.0184***		
		(0.0070)		
DFPS			0.0112	
			(0.0114)	
CFPS				0.0090
				(0.0117)
IND	Various	Various	Various	Various
_cons	-6.8622	-5.6671	-5.7650	-5.8333
	(7.2989)	(7.4233)	(7.6190)	(7.6167)
N	2275	2275	2275	2275
r2	0.5661	0.5628	0.5623	0.5622
F	43.07	43.23	42.79	42.76

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2275 observations in total.

Table 4-3-5 Regression of Share Price on Environment/Carbon and Financial Variables from Barth et al. (1998) Model for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	BART_IP	BART_FF	BART_DF	BART_CF
BVPS_USD	0.8677***	0.8908***	0.8989***	0.9005***
	(0.0781)	(0.0805)	(0.0800)	(0.0806)
EPS_USD	3.5485***	3.5271***	3.5298***	3.5288***
	(0.7342)	(0.7343)	(0.7348)	(0.7349)
WIPPS	0.4933*			
	(0.2547)			
FFPS		0.0174**		
		(0.0074)		
DFPS			0.0098	
			(0.0125)	
CFPS				0.0079
				(0.0126)
IND	Various	Various	Various	Various
_cons	-7.4773	-6.2944	-6.3966	-6.4549
	(7.6956)	(7.8140)	(8.0140)	(8.0090)
N	2280	2280	2280	2280
r2	0.5638	0.5606	0.5601	0.5601
F	45.15	45.35	44.91	44.90

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2280 observations in total.

Table 4-3-6 Regression of Share Price on Environment/Carbon and Financial Variables from Collins et al. (1999) Model for the EX

$$P_{it} + d_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it-1} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	CLNS_IP	CLNS_FF	CLNS_DF	CLNS_CF
LAG_BVPS_USD	0.8552***	0.8783***	0.8867***	0.8885***
	(0.1041)	(0.1107)	(0.1123)	(0.1131)
EPS_USD	4.6215***	4.6248***	4.6362***	4.6369***
	(0.6705)	(0.6777)	(0.6782)	(0.6784)
WIPPS	0.5299**			
	(0.2432)			
FFPS		0.0193***		
		(0.0071)		
DFPS			0.0117	
			(0.0135)	
CFPS				0.0095
				(0.0139)
IND	Various	Various	Various	Various
_cons	-7.0951	-5.7776	-5.8669	-5.9333
	(8.0678)	(8.1774)	(8.3938)	(8.3941)
N	2234	2234	2234	2234
r2	0.5622	0.5586	0.5581	0.5580
F	49.59	49.43	49.11	49.10

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, DPS_USD (d_{it}), dividends per share, LAG_BPS_USD (b_{it-1}), year beginning net book value per share, EPS_USD (x_{it}), earnings per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after wizorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2234 observations in total.

Table 4-3-7 Regression of Share Price on Environment/Carbon and Financial Variables from Rees (1997) Model for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 TD_{it} + \beta_5 IV_{it} + \beta_6 Carbon_{it} + \varepsilon_{it}$$

	REES_IP	REES_FF	REES_DF	REES_CF
BVPS_USD	0.8016***	0.8152***	0.8247***	0.8266***
	(0.0992)	(0.0988)	(0.0991)	(0.1001)
EPS_USD	3.4480***	3.4152***	3.4172***	3.4160***
	(0.7689)	(0.7647)	(0.7645)	(0.7645)
DPS_USD	1.0708	1.0390	1.0251	1.0204
	(1.2218)	(1.2080)	(1.1972)	(1.1989)
TDPPS_USD	-0.0103	-0.0112	-0.0119	-0.0120
	(0.0217)	(0.0224)	(0.0227)	(0.0227)
CAPEXPPS_USD	0.4070**	0.4989***	0.5012***	0.5022***
	(0.1798)	(0.1766)	(0.1794)	(0.1794)
WIPPS	0.4280**			
	(0.2167)			
FFPS		0.0170*		
		(0.0087)		
DFPS			0.0097	
			(0.0146)	
CFPS				0.0077
				(0.0150)
IND	Various	Various	Various	Various
_cons	-10.0249	-9.8338	-9.9695	-10.0418
	(8.3791)	(8.3665)	(8.6243)	(8.6158)
N	2172	2172	2172	2172
r2	0.5621	0.5599	0.5594	0.5594
F	40.55	40.29	39.93	39.91

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2172 observations in total.

Table 4-3-8 Regression of Share Price on Environment/Carbon and Financial Variables from Hands & Landsman (2005) for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS_USD	0.7884***	0.8184***	0.8274***	0.8287***
	(0.0802)	(0.0825)	(0.0819)	(0.0824)
EPS_USD	3.5991***	3.5711***	3.5740***	3.5730***
	(0.8314)	(0.8290)	(0.8279)	(0.8276)
DPS_USD	0.9492	0.8972	0.8837	0.8798
	(1.1118)	(1.0969)	(1.0859)	(1.0865)
CAPCONPS_USD	0.1390	0.1261	0.1196	0.1190
	(0.1723)	(0.1768)	(0.1793)	(0.1796)
WIPPS	0.5377**			
	(0.2635)			
FFPS		0.0183**		
		(0.0073)		
DFPS			0.0114	
			(0.0118)	
CFPS				0.0103
				(0.0124)
IND	Various	Various	Various	Various
_cons	-6.8634	-5.6577	-5.7683	-5.8135
	(7.5253)	(7.6496)	(7.8562)	(7.8523)
N	2061	2061	2061	2061
r2	0.5571	0.5531	0.5527	0.5526
F	37.24	37.34	36.84	36.83

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2061 observations in total.

Table 4-3-9 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 1 for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	BOTH_IP	BOTH _FF	BOTH _DF	BOTH _CF
BVPS_USD	0.7672***	0.7833***	0.7929***	0.7940***
	(0.0822)	(0.0849)	(0.0858)	(0.0865)
EPS_USD	3.5702***	3.5299***	3.5319***	3.5309***
	(0.8506)	(0.8413)	(0.8399)	(0.8398)
DPS_USD	0.9601	0.9238	0.9098	0.9066
	(1.1134)	(1.0997)	(1.0892)	(1.0904)
CAPCONPS_USD	0.2257**	0.2258**	0.2230**	0.2231**
	(0.0933)	(0.0993)	(0.0989)	(0.0991)
TDPPS_USD	-0.0138	-0.0148	-0.0154	-0.0154
	(0.0242)	(0.0249)	(0.0251)	(0.0251)
CAPEXPPS_USD	0.4285**	0.5332***	0.5358***	0.5366***
	(0.1956)	(0.1943)	(0.1970)	(0.1969)
WIPPS	0.4503**			
	(0.2227)			
FFPS		0.0166*		
		(0.0091)		
DFPS			0.0095	
			(0.0146)	
CFPS				0.0087
				(0.0150)
IND	Various	Various	Various	Various
_cons	-10.4694	-10.4189	-10.5717	-10.6149
	(8.5966)	(8.6322)	(8.8908)	(8.8771)
N	2030	2030	2030	2030
r2	0.5569	0.5544	0.5540	0.5539
F	35.47	35.17	34.81	34.81

Table 4-3-10 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 2 for the EX

	RNDS_IP	RNDS_FF	RNDS_DF	RNDS_CF
BVPS_USD	0.7481***	0.7609***	0.7700***	0.7711***
	(0.0719)	(0.0743)	(0.0755)	(0.0762)
EPS_USD	3.5530***	3.5122***	3.5143***	3.5131***
	(0.8391)	(0.8301)	(0.8290)	(0.8287)
DPS_USD	0.9898	0.9593	0.9463	0.9431
	(1.0992)	(1.0848)	(1.0740)	(1.0751)
CAPCONPS_USD	0.2357**	0.2371**	0.2344**	0.2346**
	(0.1063)	(0.1120)	(0.1119)	(0.1122)
TDPPS_USD	-0.0132	-0.0140	-0.0146	-0.0146
	(0.0243)	(0.0251)	(0.0252)	(0.0252)
CAPEXPPS_USD	0.4278**	0.5287***	0.5312***	0.5321***
	(0.1977)	(0.1986)	(0.2011)	(0.2010)
adj_RD	1.4224	1.5578	1.5592	1.5592
	(1.3307)	(1.3320)	(1.3353)	(1.3352)
WIPPS	0.4370**			
	(0.2205)			
FFPS		0.0171*		
		(0.0094)		
DFPS			0.0106	
			(0.0151)	
CFPS				0.0099
				(0.0155)
IND	Various	Various	Various	Various
_cons	-18.4278*	-19.1082*	-19.2465*	-19.2883*
	(9.9918)	(10.1377)	(10.2311)	(10.2209)
N	2030	2030	2030	2030
r2	0.5580	0.5557	0.5553	0.5553
F	34.51	34.36	34.07	34.08

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 RD_{it} + \beta_8 Carbon_{it} + \varepsilon_{it}$$

COMPOSITE MODELS 1 AND 2. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2030 observations in total.

Table 4-3-11 Correlation between each two sales-deflated variables for the EX

	PSA	BSA	ESA	DSA	CESA	TSA	CCSA	WIPSA	FFSA	DFSA	CFSA
PSA	1.0000										
BSA	0.6537	1.0000									
ESA	0.1714	0.4005	1.0000								
DSA	0.2633	0.4369	0.2811	1.0000							
CESA	0.3283	0.3932	0.3015	0.2169	1.0000						
TSA	0.1557	0.2286	0.1998	0.1489	0.2373	1.0000					
CCSA	0.5421	0.4297	0.0508	0.0022	0.2492	0.1321	1.0000				
WIPSA	-0.0598	-0.0537	-0.0456	-0.0154	-0.0112	-0.1406	-0.0130	1.0000			
FFSA	-0.0743	-0.0370	-0.0167	-0.0189	-0.0024	-0.1132	-0.0251	0.6180	1.0000		
DFSA	-0.0648	-0.0294	-0.0123	-0.0295	0.0075	-0.0833	-0.0270	0.5939	0.9884	1.0000	
CFSA	-0.0622	-0.0281	-0.0109	-0.0284	0.0067	-0.0788	-0.0259	0.5834	0.9852	0.9972	1.0000

Financial variables are deflated by sales; PSA, the market value over sales, BSA, year-end net book value over sales, ESA, earnings over sales, DSA, dividend over sales, CCSA, net capital contributions over sales, TSA, total debt over sales, CESA, capital expenditure over sales. The environmental performance measure is WIPSA, winzorized IP over sales; and three carbon performance measures are FFSA, FF over sales, DFSA, DF over sales, and CFSA, CF over sales.

Table 4-3-12 Regression of Share Price on Environment/Carbon and Financial Variables, Composite Model with sales deflated for the EX

$$P_{it}/s = \sum_{j=1}^{j=19}\beta_{0j}IND_{jt} + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 TL_{it}/s + \beta_6 IV_{it}/s + \beta_7 Carbon_{it}/s + \varepsilon_{it}$$

	DFLA_IP	DFLA_FF	DFLA_DF	DFLA_CF
BSA	0.8551***	0.8567***	0.8570***	0.8568***
	(0.1117)	(0.1123)	(0.1123)	(0.1122)
ESA	-0.7862	-0.7842	-0.7837	-0.7834
	(1.3798)	(1.3755)	(1.3753)	(1.3752)
DSA	1.3521	1.3444	1.3302	1.3331
	(0.8530)	(0.8529)	(0.8466)	(0.8467)
CESA	0.6839**	0.6690**	0.6739**	0.6739**
	(0.3079)	(0.3058)	(0.3055)	(0.3054)
TSA	0.0744	0.0743	0.0745	0.0745
	(0.0571)	(0.0564)	(0.0564)	(0.0564)
CCSA	1.9240**	1.9223**	1.9201**	1.9205**
	(0.9117)	(0.9108)	(0.9116)	(0.9116)
WIPSA	-0.2337			
	(1.0333)			
FFSA		-0.0860**		
		(0.0335)		
DFSA			-0.0866**	
			(0.0355)	
CFSA				-0.0839**
				(0.0356)
IND	Various	Various	Various	Various
_cons	0.2117	0.2172	0.2071	0.2070
	(0.1914)	(0.1881)	(0.1864)	(0.1864)
N	2014	2014	2014	2014
r2	0.5573	0.5581	0.5579	0.5579
F	29.65	29.76	29.75	29.71

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales, TSA (TD_{it}/s), total debt over sales, CESA (IV_{it}/s), capital expenditure over sales. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 2014 observations in total.

Table 4-3-13 Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for Profit Firms for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAPF_IP	HAPF_FF	HAPF_DF	HAPF_CF
BVPS_USD	0.6682***	0.6930***	0.7022***	0.7034***
	(0.1065)	(0.1093)	(0.1107)	(0.1111)
EPS_USD	4.3666***	4.3914***	4.3931***	4.3921***
	(1.1851)	(1.1876)	(1.1883)	(1.1886)
DPS_USD	0.9195	0.8764	0.8641	0.8610
	(0.9975)	(0.9801)	(0.9699)	(0.9702)
CAPCONPS_USD	0.0721	0.0591	0.0527	0.0524
	(0.1556)	(0.1609)	(0.1637)	(0.1643)
WIPPS	0.5587*			
	(0.2925)			
FFPS		0.0177**		
		(0.0079)		
DFPS			0.0109	
			(0.0132)	
CFPS				0.0101
				(0.0138)
IND	Various	Various	Various	Various
_cons	-6.6734	-5.4879	-5.6141	-5.6523
	(8.5451)	(8.7752)	(8.9931)	(8.9845)
N	1905	1905	1905	1905
r2	0.5647	0.5611	0.5606	0.5606
F	40.52	39.65	39.12	39.12

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1905 observations in total.

Table 4-3-14 Regression of Share Price on Environment/Carbon and Financial Variables from H & L (2005) for Loss Firms for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HALS_IP	HALS_FF	HALS_DF	HALS_CF
BVPS_USD	0.6355***	0.5734***	0.5749***	0.5788***
	(0.1406)	(0.1348)	(0.1316)	(0.1298)
EPS_USD	-0.2152	-0.0460	-0.0471	-0.0667
	(0.3440)	(0.3267)	(0.3285)	(0.3351)
DPS_USD	4.1222**	5.3655*	5.3510*	5.2483*
	(1.7243)	(2.9490)	(3.0322)	(3.0466)
CAPCONPS_USD	0.5100**	0.5875**	0.5887**	0.5811**
	(0.2513)	(0.2402)	(0.2404)	(0.2377)
WIPPS	-0.1699			
	(0.2745)			
FFPS		0.0344*		
		(0.0175)		
DFPS			0.0442***	
			(0.0146)	
CFPS				0.0447***
				(0.0130)
IND	Various	Various	Various	Various
_cons	-2.4145	-1.4101	-0.9187	-1.0902
	(4.4167)	(4.1527)	(4.1828)	(4.1234)
N	154	154	154	154
r2	0.6523	0.6530	0.6531	0.6527
F	5.23	5.92	6.17	5.98

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 154 observations in total.

Table 4-3-15 Regression of share price from composite model for Profit Firms for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	PROF_IP	PROF_FF	PROF_DF	PROF_CF
BVPS_USD	0.6576***	0.6707***	0.6806***	0.6816***
	(0.1001)	(0.1001)	(0.1025)	(0.1031)
EPS_USD	4.3261***	4.3225***	4.3232***	4.3221***
	(1.2279)	(1.2281)	(1.2291)	(1.2296)
DPS_USD	0.9267	0.8983	0.8857	0.8832
	(1.0046)	(0.9908)	(0.9814)	(0.9823)
CAPCONPS_USD	0.1828**	0.1832**	0.1805**	0.1808**
	(0.0745)	(0.0786)	(0.0795)	(0.0794)
TDPPS_USD	-0.0155	-0.0167	-0.0172	-0.0173
	(0.0282)	(0.0289)	(0.0291)	(0.0290)
CAPEXPPS_USD	0.3685*	0.4740**	0.4763**	0.4770**
	(0.2058)	(0.2105)	(0.2130)	(0.2130)
WIPPS	0.4708*			
	(0.2515)			
FFPS		0.0161		
		(0.0101)		
DFPS			0.0091	
			(0.0159)	
CFPS				0.0085
				(0.0164)
IND	Various	Various	Various	Various
_cons	-9.6713	-9.6243	-9.7880	-9.8232
	(9.7566)	(9.8386)	(10.1031)	(10.0846)
N	1877	1877	1877	1877
r2	0.5641	0.5618	0.5614	0.5614
F	38.26	37.04	36.65	36.66

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1877 observations in total.

Table 4-3-16 Regression of share price from composite model for Loss Firms for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	LOSS_IP	LOSS_FF	LOSS_DF	LOSS_CF
BVPS_USD	0.5395***	0.4758**	0.4796**	0.4833**
	(0.1496)	(0.1573)	(0.1543)	(0.1499)
EPS_USD	-0.4111	-0.2825	-0.2858	-0.3070
	(0.2709)	(0.3044)	(0.3118)	(0.3155)
DPS_USD	5.4329*	7.0895	7.0730	6.9187
	(2.7118)	(4.3066)	(4.3426)	(4.2384)
CAPCONPS_USD	0.1543	0.2216	0.2242	0.2151
	(0.2386)	(0.2448)	(0.2466)	(0.2440)
TDPPS_USD	0.0249***	0.0273**	0.0270**	0.0270**
	(0.0066)	(0.0100)	(0.0100)	(0.0096)
CAPEXPPS_USD	-0.0833	-0.3561	-0.3759	-0.3461
	(0.9317)	(0.9933)	(1.0018)	(0.9897)
WIPPS	-0.1560			
	(0.2465)			
FFPS		0.0440*		
		(0.0225)		
DFPS			0.0560**	
			(0.0257)	
CFPS				0.0567**
				(0.0237)
IND	Various	Various	Various	Various
_cons	-0.0413	4.8544	5.7345	5.1208
	(11.4351)	(13.5075)	(13.9460)	(13.5297)
N	151	151	151	151
r2	0.6359	0.6393	0.6395	0.6388
F	6.77	7.41	7.62	7.46

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 151 observations in total.

Table 4-3-17 Regression of Share Price (pre-ETS period) on Environment/Carbon and Financial Variables, Composite Model 1 for EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	A2002_IP	A2002_FF	A2002_DF	A2002_CF
BVPS_USD	0.6460***	0.6671***	0.6711***	0.6718***
	(0.0583)	(0.0796)	(0.0749)	(0.0738)
EPS_USD	2.6202	2.5437	2.5426	2.5419
	(1.6210)	(1.6068)	(1.6055)	(1.6029)
DPS_USD	9.7925**	9.7033**	9.6845**	9.6811**
	(4.4959)	(4.4995)	(4.5157)	(4.5228)
CAPCONPS_USD	0.1131	0.1017	0.1001	0.0997
	(0.1337)	(0.1313)	(0.1332)	(0.1329)
TDPPS_USD	0.0097	0.0089	0.0087	0.0086
	(0.0099)	(0.0096)	(0.0097)	(0.0097)
CAPEXPPS_USD	-0.4708	-0.4408	-0.4388	-0.4379
	(0.5191)	(0.5349)	(0.5367)	(0.5384)
WIPPS	0.1322			
	(0.1146)			
FFPS		0.0041		
		(0.0156)		
DFPS			0.0027	
			(0.0164)	
CFPS				0.0022
				(0.0154)
IND	Various	Various	Various	Various
_cons	1.1201	1.0331	0.9678	0.9382
	(6.3431)	(6.5399)	(6.5602)	(6.6118)
N	691	691	691	691
r2	0.6606	0.6598	0.6598	0.6597
F	31.68	34.57	33.92	33.89

Table 4-3-18 Regression of Share Price (ETS phase I) on Environment/Carbon and Financial Variables, Composite Model 1 for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	A2005_IP	A2005_FF	A2005_DF	A2005_CF
BVPS_USD	0.7848***	0.8074***	0.8212***	0.8237***
	(0.1271)	(0.1175)	(0.1183)	(0.1202)
EPS_USD	4.0903***	4.1107***	4.1260***	4.1235***
	(0.6502)	(0.6699)	(0.6692)	(0.6739)
DPS_USD	0.3056	0.2622	0.2462	0.2401
	(0.9251)	(0.9004)	(0.8847)	(0.8869)
CAPCONPS_USD	0.2959***	0.3102***	0.3077***	0.3083***
	(0.0253)	(0.0546)	(0.0544)	(0.0544)
TDPPS_USD	-0.0297	-0.0329	-0.0339	-0.0340
	(0.0359)	(0.0372)	(0.0374)	(0.0374)
CAPEXPPS_USD	0.3018	0.5233***	0.5229***	0.5239***
	(0.2341)	(0.1908)	(0.1959)	(0.1959)
WIPPS	0.9651***			
	(0.2750)			
FFPS		0.0292***		
		(0.0105)		
DFPS			0.0182	
			(0.0181)	
CFPS				0.0162
				(0.0185)
IND	Various	Various	Various	Various
_cons	-4.9996	-5.0549	-5.2739	-5.3667
	(16.1871)	(15.7703)	(16.2164)	(16.2014)
N	1129	1129	1129	1129
r2	0.5784	0.5726	0.5716	0.5715
F	25.03	24.77	24.91	24.93

Table 4-3-19 Regression of Share Price (ETS phase II, 2008) on Environment/Carbon and Financial Variables, Composite Model1 for EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	A2008_IP	A2008_FF	A2008_DF	A2008_CF
BVPS_USD	0.2885***	0.3076***	0.3061***	0.3060***
	(0.1111)	(0.1113)	(0.1102)	(0.1106)
EPS_USD	0.4980	0.5507	0.5476	0.5435
	(0.7303)	(0.7570)	(0.7494)	(0.7475)
DPS_USD	9.1430***	8.9290***	8.9328***	8.9186***
	(1.3761)	(1.3654)	(1.3595)	(1.3690)
CAPCONPS_USD	0.1754	0.1673	0.1668	0.1740
	(0.2596)	(0.2766)	(0.2763)	(0.2737)
TDPPS_USD	0.0080	0.0071	0.0072	0.0070
	(0.0170)	(0.0169)	(0.0169)	(0.0169)
CAPEXPPS_USD	0.7988*	1.0207**	1.0297**	1.0223**
	(0.4185)	(0.4556)	(0.4569)	(0.4572)
WIPPS	0.2008			
	(0.3032)			
FFPS		-0.0326*		
		(0.0167)		
DFPS			-0.0438**	
			(0.0199)	
CFPS				-0.0434**
				(0.0214)
IND	Various	Various	Various	Various
_cons	-8.8703	-12.1234	-12.4903	-12.3329
	(11.9133)	(12.9040)	(12.9134)	(12.9208)
N	247	247	247	247
r2	0.6768	0.6789	0.6797	0.6792
F	23.70	29.07	27.12	26.49

EX, EU excluding UK. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Pre-ETS period refers to year 2002 to 2004; ETS phase I refers to year 2005 to 2007, and ETS phase II refers to year 2008 to 2012, however, data only available for year 2008. For pre-ETS period and ETS phase I, two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. For ETS phase II, robust standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. vce(robust) uses (sigma-hat_j)^2={n/(n-k)}(u_j)^2 as an estimate of the variance of the jth observation, where u_j is the calculated residual and n/(n-k) is included to improve the overall estimate's small-sample properties.

Table 4-4-1 Summary Environment and Carbon Performance for Each EU include UK (EA) Industry

INDM3	WIPPS			FFPS			DFPS			CFPS		
	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN	MEAN	SD	MEDIAN
Autopt	4.549922	3.02618	5.037318	17.45039	14.9064	12.79258	3.354106	4.281307	2.104636	3.253276	4.207988	2.01335
Bankss	.0316445	.0473981	.0143527	.1002656	.148606	.0427366	.0160279	.0291082	.006625	.0141582	.0259067	.0058244
Basres	3.847019	5.220788	2.200423	35.44024	53.27741	12.51769	17.97033	37.3488	5.718894	14.97121	35.49427	3.539054
Chemcs	4.014624	3.985972	3.240639	37.85724	48.43992	17.85966	21.88857	35.85391	6.61126	15.33273	24.24676	6.115621
Conmat	5.15622	10.08083	1.507674	79.41778	194.3102	7.731322	63.83404	168.6776	2.03271	63.08176	167.5509	1.744735
Finsvs	.0716248	.3007504	.0144753	.3132079	1.154587	.0465342	.1051693	.5751907	.0046761	.1011775	.5648756	.0041096
Foodbv	5.81753	10.84075	3.121758	18.17947	32.62739	9.081247	5.20822	18.84375	1.105345	2.422385	4.00824	1.066233
Health	.2592855	.4249281	.1015443	1.180382	2.018298	.4967009	.34998	.6058915	.1429732	.3097937	.5402967	.1237011
Indsgs	.7527616	2.304773	.1711232	6.153565	21.41022	1.147215	3.054077	15.25132	.2537868	2.529762	13.29871	.2251304
Insura	.1800028	.2569902	.0826326	.3569722	.5378105	.1462665	.035998	.0528756	.0163066	.0303927	.0454916	.0122911
Medias	.4431624	3.712799	.054171	.9763259	2.553268	.2232173	.1585779	.4855732	.0263003	.1373844	.4431856	.0221858
Oilgas	.9701289	1.480728	.261166	12.18588	20.55331	2.278099	6.122428	11.01685	.9298614	5.627325	10.20473	.8246304
Pershs	.7444515	.9410591	.4446624	2.982093	3.417664	1.693583	.549231	1.102413	.2516282	.4346508	.7122426	.2122367
Realet	.0457981	.0770808	.015479	.3764568	.561008	.1299754	.0694622	.1045048	.0251473	.0661747	.0996591	.0234163
Retail	.9899109	1.749269	.1438461	3.970166	6.556471	.7378072	.921369	1.55577	.1776632	.6668809	1.209272	.1279781
Techno	.1439138	.3174942	.0267933	.7850591	1.578716	.1401101	.1884263	.4404936	.0310002	.1576476	.3832795	.0275069
Teleco	.0695355	.0567182	.0563596	.3025745	.2399981	.2278138	.049647	.0466034	.031472	.0463505	.0436273	.0284184
Travel	.8403845	1.327274	.3552594	12.46534	23.26747	2.381575	10.89564	22.27833	.4361592	10.62933	21.96346	.3916462
Utlits	4.188353	7.93838	.8656628	43.78486	76.56148	11.67632	39.33475	69.11319	9.234348	37.29081	66.89851	8.676657

The Environmental performance measure is impact ratio per share after winsorising (WIPPS), equals to the Total Environmental Damage Cost divided by company's share number. The Carbon performance measures have three dimensions: first-tier + direct carbon emissions quantities (FF) includes the CO2e emission from the first-tier supply chain (both scope 2 and scope 3) and from direct emission (scope 1); direct carbon emissions quantities (DF) includes CO2e emission from direct emission (scope 1); carbon dioxide emissions quantities only (CF) includes Carbon Dioxide (no equivalent) from direct emission (scope 1). All carbon measures are on per thousand shares basis (PS), i.e. equal to the Carbon Dioxide Equivalent (CO2e) Quantity (in terms of tonnes) divided by the company's share number (in unit of thousand). Data cover the seven years 2002-2008. Industry abbreviations see appendix 1.

Table 4-4-2 Summary Financial Statistics for the EA

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD
MVPS_USD	24.75753	12.03879	.0254762	996.9515	37.30141
BVPS_USD	12.06077	4.957189	.0276281	262.6783	19.8004
EPS_USD	1.609216	.6452573	-22.7053	60.98158	3.658863
DPS_USD	.6821445	.2912137	0	66.27328	1.628579
CAPCONPS_USD	.4935217	.0093909	-1.417866	107.1467	3.525071
TDPPS_USD	23.31581	3.618494	0	2448.98	88.69695
CAPEXPPS_USD	1.750736	.4707735	0	181.9467	4.876813
SIZE	29.87744	8.2035	.004	583.83	59.1206
SALEPS_USD	28.62072	9.435105	-8.815747	549.6333	50.6062
adj_RD	.3717437	0	0	17.54938	1.208033
WIPPS	1.274527	.1473204	.0004804	31.31914	3.491426
FFPS	11.91085	.7825316	.0001386	1383.105	53.40568
DFPS	7.732739	.1591537	0	1249.544	45.09197
CFPS	7.079343	.1333952	0	1244.662	44.08769
COMSH	755.5751	218.8905	6.077	60000	2291.418

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS_USD, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June of the following year.

Table 4-4-3 Correlation between each two share-number-deflated variables for the EA

	MVPS_USD	BVPS_USD	EPS_USD	DPS_USD	~NPS_USD	TDPPS_~D	CAPEXP..	SIZE	SALES	adj_RD	WIPPS	FFPS	DFPS	CFPS	COMSH
MVPS_USD	1.0000														
BVPS_USD	0.7180	1.0000													
EPS_USD	0.6821	0.6964	1.0000												
DPS_USD	0.4477	0.5407	0.4213	1.0000											
CAPCONPS_USD	0.1463	0.2164	0.1112	0.0938	1.0000										
TDPPS_USD	0.2797	0.4307	0.2982	0.2119	0.4658	1.0000									
CAPEXPPS_USD	0.4300	0.5193	0.4211	0.2706	0.0814	0.2168	1.0000								
SIZE	0.1615	0.2120	0.1040	0.1028	0.0457	0.1813	0.2234	1.0000							
SALEPS_USD	0.5444	0.6296	0.4469	0.3064	0.1468	0.3831	0.4356	0.4299	1.0000						
adj_RD	0.3014	0.3460	0.2631	0.1535	0.0114	0.0777	0.3217	0.3076	0.4600	1.0000					
WIPPS	0.3524	0.3685	0.2528	0.1931	0.0296	0.0651	0.3748	0.1724	0.4935	0.2340	1.0000				
FFPS	0.2561	0.2877	0.2136	0.1343	0.0180	0.0445	0.2111	0.0826	0.2787	0.0762	0.7517	1.0000			
DFPS	0.2044	0.2409	0.1733	0.1018	0.0153	0.0418	0.1791	0.0662	0.2058	0.0277	0.6786	0.9862	1.0000		
CFPS	0.1968	0.2325	0.1723	0.0992	0.0122	0.0423	0.1713	0.0646	0.1892	0.0181	0.6437	0.9754	0.9933	1.0000	
COMSH	-0.0958	-0.0877	-0.0645	-0.0453	-0.0143	-0.0069	-0.0548	0.2133	-0.0869	-0.0476	-0.0616	-0.0369	-0.0275	-0.0255	1.0000

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS_USD, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS, and three carbon performance measures are FFPS, DFPS and CFPS.

Table 4-4-4 Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS_USD	0.8672***	0.9134***	0.9234***	0.9258***
	(0.1300)	(0.1263)	(0.1247)	(0.1255)
EPS_USD	3.3892***	3.3706***	3.3757***	3.3745***
	(0.6917)	(0.6901)	(0.6908)	(0.6904)
DPS_USD	1.3708	1.3414	1.3283	1.3223
	(1.4515)	(1.4350)	(1.4237)	(1.4242)
WIPPS	1.0067*			
	(0.5286)			
FFPS		0.0239**		
		(0.0100)		
DFPS			0.0149	
			(0.0097)	
CFPS				0.0120
				(0.0094)
IND	Various	Various	Various	Various
_cons	-9.9587	-7.6219	-7.6956	-7.7715
	(6.1892)	(6.4302)	(6.5903)	(6.5887)
N	4265	4265	4265	4265
r2	0.6168	0.6116	0.6109	0.6108
F	57.39	55.73	55.46	55.33

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4265 observations in total.

Table 4-4-5 Regression of Share Price on Environment/Carbon and Financial Variables from Barth et al. (1998) Model for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	BART_IP	BART_FF	BART_DF	BART_CF
BVPS_USD	0.9213***	0.9665***	0.9760***	0.9779***
	(0.0972)	(0.0947)	(0.0938)	(0.0944)
EPS_USD	3.4545***	3.4352***	3.4395***	3.4382***
	(0.6707)	(0.6707)	(0.6717)	(0.6715)
WIPPS	0.9961*			
	(0.5220)			
FFPS		0.0227**		
		(0.0100)		
DFPS			0.0133	
			(0.0106)	
CFPS				0.0106
				(0.0103)
IND	Various	Various	Various	Various
_cons	-10.7701	-8.4515	-8.5313	-8.5976
	(6.6489)	(6.8357)	(7.0018)	(6.9978)
N	4281	4281	4281	4281
r2	0.6135	0.6084	0.6078	0.6077
F	60.32	58.74	58.52	58.41

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4281 observations in total.

Table 4-4-6 Regression of Share Price on Environment/Carbon and Financial Variables from Collins et al. (1999) Model for the EA

$$P_{it} + d_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it-1} + \beta_2 x_{it} + \beta_3 Carbon_{it} + \varepsilon_{it}$$

	CLNS_IP	CLNS_FF	CLNS_DF	CLNS_CF
LAG_BVPS_USD	0.9145***	0.9622***	0.9722***	0.9744***
	(0.1078)	(0.1160)	(0.1176)	(0.1186)
EPS_USD	4.6293***	4.6585***	4.6726***	4.6736***
	(0.5917)	(0.5962)	(0.5966)	(0.5965)
WIPPS	1.0568**			
	(0.4734)			
FFPS		0.0241***		
		(0.0082)		
DFPS			0.0145	
			(0.0108)	
CFPS				0.0115
				(0.0107)
IND	Various	Various	Various	Various
_cons	-11.0493	-8.5970	-8.6774	-8.7531
	(6.8997)	(6.9893)	(7.1659)	(7.1650)
N	4162	4162	4162	4162
r2	0.6130	0.6074	0.6067	0.6066
F	66.27	64.22	64.00	63.88

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, DPS_USD (d_{it}), dividends per share, LAG_BPS_USD (b_{it-1}), year beginning net book value per share, EPS_USD (x_{it}), earnings per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after wizorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4162 observations in total.

Table 4-4-7 Regression of Share Price on Environment/Carbon and Financial Variables from Rees (1997) Model for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 TD_{it} + \beta_5 IV_{it} + \beta_6 Carbon_{it} + \varepsilon_{it}$$

	REES_IP	REES_FF	REES_DF	REES_CF
BVPS_USD	0.8386***	0.8728***	0.8835***	0.8858***
	(0.1243)	(0.1229)	(0.1227)	(0.1238)
EPS_USD	3.3447***	3.3065***	3.3090***	3.3075***
	(0.7083)	(0.7022)	(0.7019)	(0.7016)
DPS_USD	1.3797	1.3511	1.3369	1.3313
	(1.4392)	(1.4186)	(1.4075)	(1.4084)
TDPPS_USD	-0.0115	-0.0137	-0.0145	-0.0146
	(0.0194)	(0.0204)	(0.0207)	(0.0207)
CAPEXPPS_USD	0.4250***	0.5417***	0.5473***	0.5490***
	(0.1629)	(0.1800)	(0.1849)	(0.1855)
WIPPS	0.8987*			
	(0.4817)			
FFPS		0.0217**		
		(0.0101)		
DFPS			0.0128	
			(0.0121)	
CFPS				0.0101
				(0.0121)
IND	Various	Various	Various	Various
_cons	-12.7383*	-11.6044	-11.7368	-11.8208
	(6.8589)	(7.0641)	(7.2773)	(7.2747)
N	4093	4093	4093	4093
r2	0.6148	0.6108	0.6102	0.6101
F	51.76	50.23	49.96	49.84

Financial variables are expressed as dollar per share; MVPS_USD ($\mathrm{P_{it}}$), the market value per share or share price, BVPS_USD ($\mathrm{b_{it}}$), year end net book value per share, EPS_USD ($\mathrm{x_{it}}$), earnings per share, DPS_USD ($\mathrm{d_{it}}$), dividends per share, TDPPS_USD ($\mathrm{TD_{it}}$), total debt per share, CAPEXPS_USD ($\mathrm{IV_{it}}$), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 4093 observations in total.

Table 4-4-8 Regression of Share Price on Environment/Carbon and Financial Variables from Hands & Landsman (2005) for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS_USD	0.8309***	0.8870***	0.8976***	0.8995***
	(0.1150)	(0.1127)	(0.1116)	(0.1120)
EPS_USD	3.4797***	3.4469***	3.4507***	3.4494***
	(0.7637)	(0.7536)	(0.7520)	(0.7514)
DPS_USD	1.2729	1.2349	1.2214	1.2166
	(1.3507)	(1.3294)	(1.3181)	(1.3178)
CAPCONPS_USD	0.1397	0.1123	0.1043	0.1035
	(0.1713)	(0.1783)	(0.1800)	(0.1803)
WIPPS	1.0882**			
	(0.5360)			
FFPS		0.0237**		
		(0.0095)		
DFPS			0.0151	
			(0.0092)	
CFPS				0.0133
				(0.0092)
IND	Various	Various	Various	Various
_cons	-10.2137*	-7.7983	-7.8885	-7.9467
	(6.1676)	(6.3744)	(6.5392)	(6.5334)
N	3979	3979	3979	3979
r2	0.6117	0.6055	0.6048	0.6048
F	52.27	50.29	49.91	49.80

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3979 observations in total.

Table 4-4-9 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 1 for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	BOTH_IP	BOTH _FF	BOTH _DF	BOTH _CF
BVPS_USD	0.8081***	0.8483***	0.8590***	0.8606***
	(0.1117)	(0.1130)	(0.1133)	(0.1140)
EPS_USD	3.4485***	3.3973***	3.3994***	3.3981***
	(0.7779)	(0.7623)	(0.7604)	(0.7599)
DPS_USD	1.2666	1.2322	1.2177	1.2136
	(1.3338)	(1.3088)	(1.2978)	(1.2980)
CAPCONPS_USD	0.2290*	0.2213*	0.2182*	0.2182*
	(0.1174)	(0.1219)	(0.1215)	(0.1218)
TDPPS_USD	-0.0149	-0.0170	-0.0176	-0.0177
	(0.0222)	(0.0232)	(0.0234)	(0.0234)
CAPEXPPS_USD	0.4394**	0.5744***	0.5803***	0.5817***
	(0.1771)	(0.1926)	(0.1969)	(0.1973)
WIPPS	0.9622*			
	(0.4974)			
FFPS		0.0211**		
		(0.0101)		
DFPS			0.0124	
			(0.0118)	
CFPS				0.0109
				(0.0118)
IND	Various	Various	Various	Various
_cons	-13.2677*	-12.2479*	-12.4008*	-12.4607*
	(6.8645)	(7.1350)	(7.3461)	(7.3363)
N	3948	3948	3948	3948
r2	0.6112	0.6066	0.6061	0.6060
F	48.17	46.64	46.36	46.28

Table 4-4-10 Regression of Share Price on Environment/Carbon and Financial Variables from Composite Model 2 for the EA

	RNDS_IP	RNDS_FF	RNDS_DF	RNDS_CF
BVPS_USD	0.7700***	0.7998***	0.8093***	0.8106***
	(0.0949)	(0.0943)	(0.0944)	(0.0950)
EPS_USD	3.4202***	3.3705***	3.3726***	3.3709***
	(0.7748)	(0.7618)	(0.7602)	(0.7595)
DPS_USD	1.3041	1.2812	1.2695	1.2657
	(1.3056)	(1.2799)	(1.2687)	(1.2690)
CAPCONPS_USD	0.2462*	0.2420*	0.2394*	0.2397*
	(0.1280)	(0.1321)	(0.1319)	(0.1324)
TDPPS_USD	-0.0132	-0.0148	-0.0154	-0.0155
	(0.0226)	(0.0235)	(0.0237)	(0.0237)
CAPEXPPS_USD	0.4255**	0.5445***	0.5497***	0.5511***
	(0.1827)	(0.2017)	(0.2053)	(0.2054)
adj_RD	2.6498*	2.9537**	2.9678**	2.9698**
	(1.3706)	(1.4018)	(1.4094)	(1.4108)
WIPPS	0.8788*			
	(0.4762)			
FFPS		0.0216**		
		(0.0101)		
DFPS			0.0145	
			(0.0126)	
CFPS				0.0134
				(0.0127)
IND	Various	Various	Various	Various
_cons	-26.2118***	-26.7191***	-26.8961***	-26.9587***
	(8.9353)	(9.1449)	(9.2244)	(9.2281)
N	3948	3948	3948	3948
r2	0.6150	0.6114	0.6109	0.6108
F	48.27	47.83	47.69	47.66

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TD_{it} + \beta_6 IV_{it} + \beta_7 RD_{it} + \beta_8 Carbon_{it} + \varepsilon_{it}$$

COMPOSITE MODELS 1 AND 2. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3948 observations in total.

Table 4-4-11 Correlation between each two sales-deflated variables for the EA

	PSA	BSA	ESA	DSA	CESA	TSA	CCSA	WIPSA	FFSA	DFSA	CFSA
PSA	1.0000										
BSA	0.6289	1.0000									
ESA	-0.5013	-0.0809	1.0000								
DSA	0.1373	0.4098	0.1699	1.0000							
CESA	0.2316	0.5313	0.1206	0.2645	1.0000						
TSA	0.0850	0.3561	0.0923	0.2232	0.4290	1.0000					
CCSA	0.4366	0.3127	-0.0805	0.0124	0.2628	0.0896	1.0000				
WIPSA	0.0015	-0.0350	-0.0259	-0.0202	-0.0092	-0.0971	-0.0020	1.0000			
FFSA	-0.0283	-0.0355	0.0053	-0.0191	-0.0065	-0.0614	-0.0136	0.6748	1.0000		
DFSA	-0.0215	-0.0248	0.0054	-0.0218	-0.0004	-0.0345	-0.0119	0.6171	0.9834	1.0000	
CFSA	-0.0209	-0.0231	0.0054	-0.0202	-0.0015	-0.0301	-0.0119	0.5899	0.9762	0.9942	1.0000

Financial variables are deflated by sales; PSA, the market value over sales, BSA, year-end net book value over sales, ESA, earnings over sales, DSA, dividend over sales, CCSA, net capital contributions over sales, TSA, total debt over sales, CESA, capital expenditure over sales. The environmental performance measure is WIPSA, winzorized IP over sales; and three carbon performance measures are FFSA, FF over sales, DFSA, DF over sales, and CFSA, CF over sales.

Table 4-4-12 Regression of Share Price on Environment/Carbon and Financial Variables, Composite Model with sales deflated for EA

$$P_{it}/s = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 TL_{it}/s + \beta_6 IV_{it}/s + \beta_7 Carbon_{it}/s + \varepsilon_{it}$$

	DFLA_IP	DFLA_FF	DFLA_DF	DFLA_CF
BSA	1.6492***	1.6498***	1.6501***	1.6500***
	(0.3130)	(0.3132)	(0.3133)	(0.3133)
ESA	-4.7130**	-4.7061**	-4.7056**	-4.7058**
	(1.4871)	(1.4836)	(1.4833)	(1.4834)
DSA	0.4365	0.4175	0.4035	0.4101
	(1.9582)	(1.9547)	(1.9662)	(1.9671)
CESA	-0.0369	-0.0514	-0.0489	-0.0498
	(0.6759)	(0.6727)	(0.6732)	(0.6731)
TSA	-0.4172**	-0.4157**	-0.4157**	-0.4158**
	(0.1891)	(0.1891)	(0.1893)	(0.1893)
CCSA	3.4680***	3.4642***	3.4631***	3.4635***
	(1.1054)	(1.1025)	(1.1030)	(1.1034)
WIPSA	-0.9750			
	(0.9300)			
FFSA		-0.1743**		
		(0.0807)		
DFSA			-0.1666*	
			(0.0892)	
CFSA				-0.1595*
				(0.0867)
IND	Various	Various	Various	Various
_cons	0.5149**	0.5086**	0.4875**	0.4873**
	(0.2169)	(0.2167)	(0.2142)	(0.2141)
N	3917	3917	3917	3917
r2	0.6696	0.6700	0.6698	0.6698
F	26.84	25.91	25.97	25.99

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales, TSA (TD_{it}/s), total debt over sales, CESA (IV_{it}/s), capital expenditure over sales. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3917 observations in total.

Table 4-4-13 Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for Profit Firms for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAPF_IP	HAPF_FF	HAPF_DF	HAPF_CF
BVPS_USD	0.6987***	0.7530***	0.7638***	0.7655***
	(0.1264)	(0.1306)	(0.1312)	(0.1316)
EPS_USD	4.3244***	4.3304***	4.3328***	4.3314***
	(1.1189)	(1.1291)	(1.1302)	(1.1305)
DPS_USD	1.2156	1.1870	1.1752	1.1712
	(1.2222)	(1.2032)	(1.1930)	(1.1924)
CAPCONPS_USD	0.0664	0.0391	0.0313	0.0307
	(0.1359)	(0.1426)	(0.1446)	(0.1451)
WIPPS	1.1182*			
	(0.5753)			
FFPS		0.0226**		
		(0.0092)		
DFPS			0.0141	
			(0.0101)	
CFPS				0.0126
				(0.0101)
IND	Various	Various	Various	Various
_cons	-10.0609	-7.6681	-7.7775	-7.8310
	(7.1788)	(7.4586)	(7.6343)	(7.6232)
N	3567	3567	3567	3567
r2	0.6179	0.6120	0.6114	0.6114
F	53.06	50.65	50.24	50.14

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3567 observations in total.

Table 4-4-14 Regression of Share Price on Environment/Carbon and Financial Variables from H & L (2005) for Loss Firms for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HALS_IP	HALS_FF	HALS_DF	HALS_CF
BVPS_USD	0.6831***	0.6483***	0.6567***	0.6603***
	(0.1704)	(0.1562)	(0.1528)	(0.1518)
EPS_USD	-0.6548**	-0.6351***	-0.6443***	-0.6653***
	(0.2412)	(0.1651)	(0.1594)	(0.1630)
DPS_USD	2.1558*	2.7539	2.6174	2.5221
	(1.1428)	(1.7790)	(1.8225)	(1.8670)
CAPCONPS_USD	0.7184***	0.7597***	0.7533***	0.7458***
	(0.2617)	(0.2651)	(0.2666)	(0.2639)
WIPPS	0.0933			
	(0.4617)			
FFPS		0.0432**		
		(0.0201)		
DFPS			0.0494***	
			(0.0167)	
CFPS				0.0505***
				(0.0137)
IND	Various	Various	Various	Various
_cons	-4.5795	-3.7513	-3.4689	-3.5911
	(3.0227)	(3.2267)	(3.2920)	(3.2682)
N	389	389	389	389
r2	0.6651	0.6694	0.6687	0.6684
F	8.53	10.02	9.78	9.44

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 389 observations in total.

Table 4-4-15 Regression of share price from composite model for Profit Firms for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	PROF_IP	PROF_FF	PROF_DF	PROF_CF
BVPS_USD	0.6880***	0.7294***	0.7405***	0.7420***
	(0.1154)	(0.1190)	(0.1206)	(0.1213)
EPS_USD	4.2741***	4.2444***	4.2446***	4.2430***
	(1.1580)	(1.1670)	(1.1684)	(1.1688)
DPS_USD	1.2096	1.1852	1.1727	1.1694
	(1.2128)	(1.1934)	(1.1837)	(1.1837)
CAPCONPS_USD	0.1810**	0.1752*	0.1722*	0.1724*
	(0.0852)	(0.0916)	(0.0923)	(0.0926)
TDPPS_USD	-0.0164	-0.0189	-0.0196	-0.0197
	(0.0256)	(0.0267)	(0.0268)	(0.0268)
CAPEXPPS_USD	0.3736*	0.5115**	0.5170**	0.5182**
	(0.2038)	(0.2220)	(0.2260)	(0.2262)
WIPPS	0.9996*			
	(0.5352)			
FFPS		0.0202**		
		(0.0102)		
DFPS			0.0117	
			(0.0127)	
CFPS				0.0104
				(0.0127)
IND	Various	Various	Various	Various
_cons	-12.5835	-11.5862	-11.7528	-11.8066
	(8.0926)	(8.4330)	(8.6535)	(8.6377)
N	3539	3539	3539	3539
r2	0.6173	0.6128	0.6123	0.6123
F	48.61	46.68	46.38	46.31

Profit firms are the firm with positive earnings, i.e. EPS >0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3539 observations in total.

Table 4-4-16 Regression of share price from composite model for Loss Firms for the EA

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 TL_{it} + \beta_6 IV_{it} + \beta_7 Carbon_{it} + \varepsilon_{it}$$

	LOSS_IP	LOSS_FF	LOSS_DF	LOSS_CF
BVPS_USD	0.5789***	0.5395***	0.5506***	0.5544***
	(0.1721)	(0.1624)	(0.1590)	(0.1571)
EPS_USD	-0.7761***	-0.7668***	-0.7755***	-0.7972***
	(0.2156)	(0.1731)	(0.1718)	(0.1754)
DPS_USD	3.0748	3.8946	3.7012	3.5760
	(2.2499)	(2.9354)	(2.9034)	(2.8865)
CAPCONPS_USD	0.3992	0.4394	0.4351	0.4264
	(0.2805)	(0.2902)	(0.2908)	(0.2894)
TDPPS_USD	0.0191	0.0204	0.0199	0.0198
	(0.0135)	(0.0150)	(0.0147)	(0.0145)
CAPEXPPS_USD	0.1772	0.1037	0.1115	0.1230
	(0.4027)	(0.4508)	(0.4539)	(0.4526)
WIPPS	0.1044			
	(0.4125)			
FFPS		0.0481***		
		(0.0183)		
DFPS			0.0541***	
			(0.0181)	
CFPS				0.0552***
				(0.0157)
IND	Various	Various	Various	Various
_cons	-4.9707	-3.3023	-3.0913	-3.3383
	(4.2400)	(4.6816)	(4.7685)	(4.6700)
N	386	386	386	386
r2	0.6462	0.6519	0.6507	0.6503
F	8.49	9.78	9.42	9.12

Loss firms are the firm with negative earnings, i.e. EPS <0. Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPS_USD (IV_{it}), capital expenditure per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 386 observations in total.

Chapter 5 Implied Cost of Equity (ICC) and Cash Flow Expectation

5.1 Introduction

We have determined the firms' value and their carbon emissions relationship in the previous chapter, however, we still have questions as to what is the source of this negative (positive) valuation, and why the market assigns such negative (positive) valuations to firms according to their emission levels? We endeavour to find out the answers to the above questions.

Sharfman and Fernando (2008) define the firms' environmental actions influences on corporate financial perfomance (CFP) as internal and external effects, in which the internal effect refers to the fundamentals in a firm's performance, such as enterprise value or profitability, while the external effect is specifically used to describe the cost of capital in their paper. We have already analysed the corporate environmental/carbon performance effects on firm's value, i.e. the internal effect, in the previous chapter. In this chapter, we specifically focus on the corporate environmental/carbon performance effect on a firm's cost of equity, i.e. firm's systematic risk, which is represented by the implied cost of equity (ICC), derived from the Lee, Myers and Swaminathan (1999) model.

Further, Naver (1971) suggests that cash flow expectation can be the other factor associated with firms' socially motivated actions. Therefore, we propose to divide the companies' development into three periods on a time horizon, and examine the corporate environmental/carbon performance influence on a firm's cash flow expectation, at short-term (1 and 2 year), medium-term (3 to 5 year), and long-term (5 year onwards). The cash flow effect at these three time-horizons are then proxied by the forward year-1 and year-2 analysts' forecast return-on-equity (FROE1 and FROE2), analysts' forecast medium-term earnings growth rates and the implied long-run growth rate (LGR) derived from the Lee, Myers and Swaminathan (1999) model, respectively.

In general, it supposes that a higher value firm is associated with higher ROE (profitability), higher medium-term growth rate, higher long-run growth rate, and/or lower cost of equity capital (systematic risk). Therefore, if an activity adopted by a firm could improve its value in a financial market, we wonder whether it is because the activity increases the firm's expected profitability, future cash flow, or even reduces the firm's systematic risk.

First of all, companies' profitability can be a good indicator of their cash flow expectation. As a proxy for firms' profitability, ratios are commonly adopted in research, such as return on asset (ROA), return on equity (ROE), return on net operating assets (RONA) (e.g. Clarkson et al., 2011; Ho, Wang and Vitell, 2012; He, Li and Tang, 2012; Clacher and Hagendorff, 2012). Figures from the income statement can also be used as proxies, such as the operating income (OI), EBIT, earnings after tax (EAT), which largely reflect the historical based firms' profitability. However, in this research, we introduce the analysts' forecast return on equity (FROE) to reflect firms' profit expectation shortly after their environmental/carbon outputs information is disclosed (1 and 2 year). We assume that the analysts' forecast has already taken the relevant information into consideration, as we collect our data in the June of the following year, which leave enough time for the information to be disseminated. Further, we suggest that the analysts' cash flow expectation in a firm's medium term can be represented by a 3-5 years earnings growth rate. Therefore, we also include the test of the earnings growth estimation from IBES. Finally, to measure a firm's growth rate, Clarkson et al. (2011), Ho, Wang and Vitell (2012) and He, Li and Tang (2012) both adopt the percentage change in sales, while other research introduces growth measurements, such as earnings growth rate and economic (GDP) growth rate. In this research, we suggest the use of the growth rate of residual income as a proxy for the long-term cash flow prospects, which can be developed by a residual income (RI) model (to be more precise, the use of a five-year terminal value).

As to the calculation of the cost of capital, there are a few ways to determine it. Firstly, the most common method is proposed by Lee, Myers and Swaminathan (1999), who adopt a finite RI model. This model consists of three terms, i.e. the current book value, the sum of the present value of N periods' residual incomes, and a terminal value. The cost of equity is adopted as the discount rate in this model; therefore, it can be estimated by assigning values to all the other parameters. This methodology is employed by Hou, van Dijk, and Zhang (2010), El Ghoul, Guedhami, Kwok and Mishra (2011) and Gregory, Whittaker and Yan (2011). The second stream methodology involves a simultaneous estimation of the ICC and LGR, used by O'Hanlon and Steele (2000), Easton et al. (2002) and Ashton and Wang (2010). However, our concern is that the development of these models involves scale effects. Also, these models assume a constant growth rate from the following year (t+1) to infinity. Therefore, we will not adopt this method in our research. Other methods of calculation are more straightforward, such as those of; Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001), and Ohlson and Juettner-Nauroth (2005). However, we will not apply these due to our data limitation or the model limitation.

Finally, the data examined in this chapter is only a subsample of the data used in the valuation chapter. Due to the unavailability of the forecast earnings and growth rate, we lost a certain number of observations (e.g., for the US, the firm-year observation number is 5004 in chapter 4, however, decreses to 3481 in this chapter; similar to the UK and the rest of EU). Recognizing this data limitation, we define a subsample for each country/area, which only includes the observations that have 3-year forward forecast earnings per share (FEPS) and forecast medium term growth rate. To further demonstrate the relationship between the companies' value and the source of this value, we run two basic regression models for the subsamples, the Ohlson (1995) model and the Hand and Landsman (2005) model, with both share number deflation and sales deflation. With regard to the results, because of different level of carbon emission constraints, the US, the UK and the EU countries will be discussed separately, which is in line with previous chapters.

The rest of this chapter has been structured as follows: the second section reviews the existing literature that has adopted the ICC and LGR indicators. The third section considers existing models that are used to estimate ICC and LGR, and also introduces the analytical methodology applied to the ICC and LGR results. The fourth section introduces a myriad of data. While in the fifth section, we describe the empirical results; and the final section draws conclusions and identifies areas for further research.

5.2 Literature Review

In this section, we review the empirical research that focuses on investigating whether and how corporate social performance (CSP), corporate environmental performance (CEP) and corporate carbon performance (CCP) influence firms' ICC and LGR.

5.2.1 Implied Cost of Capital

By acting as the discount rate, cost of capital, or the so called investors expected return, is used to convert a stream of expected income into the firms' present value. Therefore, the estimation of firms' cost of capital is as important as any other financial parameter in a firm's valuation and financial decision making. In this section, we review the literature that analyses the influence of corporate social responsibility on the firms' cost of capital.

Porras (2011) defines the cost of capital as the expected return that investors receive on their investments, so that the higher the profit desired by the investors, the greater the cost to the firm. An 'investor' refers to anyone who lends money to a firm in exchange for some 'profit', such as the stockholders and bondholders (creditors). Both of them are investors, but a stockholder is defined as a shareholder, and a creditor as a stakeholder. The conflict between the two types of investors has been revolved around the issue of whether it is the firms' responsibility to be socially or environmentally friendly. According to the shareholder theory, to make profit, firm managers have to invest until the marginal project's return exceeds its cost of capital. By comparison, according to the stakeholder theory, managers are required to reach the balance point where the aggregate welfare of all stakeholders is maximized. However, there is no explicit solution on how to aggregate welfare or how to make the trade-off between stakeholders. The advocators of shareholder theory suggest that CSR lowers firms' profits due to compromises with stakeholders, whereas to maximum shareholders benefit, firms should charge lower prices and allow consumers to make their own charitable contributions. In this section, we will discuss this issue from another perspective, i.e. the firms' cost of capital.

We will go through the existing literature that investigates how CSP/CEP influences the cost of capital of firms and their investment decisions. Thereafter, we will discuss the implication of these influences on shareholders and stakeholders disagreements.

As early as 1995, Wall in his paper argues that in an inefficient capital market, SRI can affect corporate investment decisions through firms' cost of capital.

Later on, Heonkel et al. (2001) show that even in an efficient capital market, such an effect still exists. They employ an equilibrium model and prove that social investing can affect corporate behaviour, which means exclusionary investing that is based on environmental performance, can stimulate polluting companies to voluntarily stop polluting by undertaking reforms. However, they also point out that this is the case only when the higher cost of capital (the polluting firm would have to endure) exceeds the cost of reforming (i.e., a polluting firm cleaning up its activities). Their research analyses are limited to an experimental level, and no valid empirical evidence has been provided.

Garber and Hammitt (1998) test the effect on costs of equity for 73 chemical firms listed on either the NYSE or AMEX with identified Superfund liabilities, their sample period being from January 1976 to December 1992. The federal Superfund program requires those sites involved to present particularly serious environmental and public-health risks. Consequently, failure to fulfil Superfund liability can impose financial risk on investors and thereby increase firms' costs of capital. For 23 larger firms, they observe an average increase in cost of capital of between 0.25 to 0.40 percentage points per year for the test period. However, no relationship between the liabilities and costs of equity for small firms has been reported. The limitation of their paper, as Sharfman and Fernando (2008) point out, is that they are using a short-term parameter, i.e. the Superfund charges from balance sheet liability, to represent the generalized environmental risk management, which is a long-term phenomenon and neither quantifiable nor transparent .

Hong and Kacperczyk (2005) document that 'sin' stocks in the US, i.e. public trade companies involved in producing alcohol, tobacco and gambling, imply a higher cost of capital. However, they do not provide any empirical evidence on whether firms meeting superior CSR standards have lower cost of capital.

However, it is only in most recent years that studies start to focus on the relationship between CSR and cost of (equity) capital, in which the valuation models are involved in ICC estimations. Sharfman and Fernando (2008) investigate the CEP-CFP relationship by using 267 U.S. firms. Instead of using the traditional environmental performance variables, which present the environmental performance from a better resource utilization perspective, they adopt environmental risk management variables from Toxic Releases Inventory Emission data and KLD. They show that the improvements in environmental risk management benefit firms through the reduction of firms' cost of capital. Disregarding the fact of the increasing cost of debt, which can be simply a short-term cost, their regression results exhibit a considerable reward in terms of the augmented environmental risk management by the markets, that is the lower firms' cost of equity. They also observe a decrease in beta, which means lower systematic risk and less volatility in financial performance for the involved firms. This is consistent with the declining cost of equity, the major grounds of the falling cost of capital.

While their research is only for US companies, they suggest that in the European markets where there is stricter regulation and stronger public opinion towards firms' environmental risk management, a similar result would be derived for the cost of equity. However, they do not provide any empirical evidence of this.

Dhaliwal, Li, Tsang and Yang (2010) examine the relationship between firms' cost of equity capital and the initiation of voluntary disclosure of corporate social responsibility (CSR) activities by running regressions. Their sample data is from KLD STATS (CSR variables) and COMPUSTAT (financial variables) for year 1993 to 2007, while their standalone CSR reports are from combined resources, which mainly include Corporate Social Responsibility Newswire, CorporateRegister.com, Internet searches, and company websites. The dependent variable, cost of equity capital, is the average value of three estimation models, namely Gebhardt et al. (2001), Claus and Thomas (2001), and Easton (2004), which are all calculated in the year prior to first-time CSR disclosure.

Dhaliwal, et al. (2010) show that firms with the initiation of voluntary disclosure of CSR activities could potentially reduce their cost of equity capital. Especially, in the case of firms with a high cost of equity capital in the previous year, initiate the disclosure of CSR activities in the current year, subsequently, the initiating firms with superior social responsibility performance will enjoy a reduction in the cost of equity capital. Further, their results indicate that those CSR disclosure initiators can extract more benefits from the reduction in the cost of equity capital rather than solely increasing their financial values, such as attracting dedicated institutional investors and analyst coverage, achieving low absolute forecast errors and dispersion, and raising a significantly large amount of equity capital. However, they also add that their research results might be restricted by the use of standalone and voluntary disclosure CSR reports, which are neither derived from a single website nor adopted from a standardized report.

El Ghoul et al. (2010) use a panel data of 12,915 US firm-year observations with sample years from 1992 to 2007, controlling for other firm-specific determinants as well as industry and year fixed effects. Their estimation of the ICC involves four models, including Claus and Thomas (2001), Gebhardt, Lee, and Swaminathan (2001), Ohlson and Juettner-Nauroth (2005) and Easton (2004). They find that higher CSR firms have a lower equity cost of capital than lower CSR firms. Furthermore, by allocating KLD social performance scores into six dimensions, they record that CSR investment in employee relations, environmental policies, and product strategies enjoy a negative relationship with firms' cost of equity, while CSR-related actions in the areas of community relations, diversity, and human rights are positively related to firms' cost of equity. In particular, firms related to the tobacco and nuclear power industries have higher equity financing costs.

Using the Easton, Taylor, Shroff and Sougiannis (2002) model, Gregory, Tharyan and Whittaker (2011) estimate the ICC and the LGR (detail in next section) simultaneously. They adopt KLD as the CSR performance measurement as well, observing a 19,050 US firm-year dataset for the period of 18-years ending in 2008. According to the Easton et al. (2002) model, they report similar results to El Ghoul et al. (2010) in the dimension of environmental policies and product strategies, whereas the negative relationship between the overall score and ICC is insignificant. These results are robust when adjusted for industry effect, using portfolio analysis. Further, Gregory, Whittaker and Yan (2011) use Lee et al. (1999) model and show that higher CSR firms enjoy lower cost of equity, by holding the LGR constant. This result is entirely consistent with previous studies.

In summary, most of the existing evidence shows that there is a negative relationship between the CSP and ICC, or particularly, CEP and ICC.

Researches prior to 2008 mostly emphasize the importance of corporate governance and the accessing of external financing to firms' valuation. The ICC-CSP relationship provides us with a new perspective on the analysis of the CSP-CFP association. Thus, we can also understand why some CSR studies find that firms investing in CSR create shareholder value in the long run, whereas the stock markets undervalue CSR in the short term. Because in the long-term, firms' cost of equity is reduced by CSR actions, the decreasing cost of equity may take a longer time to be recognized by the markets.

Further, the analysis of the ICC-CSP relationship also creates a reconciliation point in the debate between shareholder and stakeholders theories on whether firms should make CSR investments. As Renneboog et al. (2008) point out, if a firm invests in the projects that generate positive net present values to shareholders as well as positive externalities to other stakeholders (e.g. a more healthy or safe environment or more social cohesion at the community level), the firm may have a higher share price, which consequently can be translated into better financial performance.

By investing in CSR, especially in environmental activities, firms improve other stakeholder benefits, and these actions are in turn attracting dedicated institutional investors and analyst coverage, achieving low absolute forecast errors and dispersion, and raising a significantly large amount of equity capital (Dhaliwal et al., 2010). As a result, the improved CSR enhances firms' value by reducing firms' cost of equity capital in the long-term, so that shareholders' benefits are also maximized by the lower discount rate. In support, El Ghoul et al. (2010) suggest that the investment in CSR activities is important to firms because the ability to explain a firm's cost of equity beyond corporate governance and other risk factors. Subsequently, shareholder's welfare and other stakeholders' welfare have been balanced at a minimal cost of equity capital that is created by CSR activities.

While all of these studies are encouraging, for most of them show that the firms taking environmental action can lower their cost of equity capital. We are going to focus on the question of whether the firms taking carbon reduction actions can lower their cost of equity capital as well.

To the best of our knowledge, the only previous evidence that analysis of the ICC-CSR relationship for the UK is from work by Buckingham, Gregory and Whittaker (2011), in which they employ the Easton, Taylor, Shroff and Sougiannis (2002) model, but find no significant differences in ICC between CSR groups. However, there is no such evidence for other EU countries so far, though Sharfman and Fernando (2008) have mentioned it in their paper. We will provide the empirical analyse of the ICC-CCP and ICC-CEP relationships for the EU countries, including the UK. Due to our focus, we will not analysis the ICC-CSP association.

Therefore, our contribution to the CCP-CFP and CEP-CFP relationships will be based on three facets; portfolios' valuation, firms' financial market evaluation and firms' cost of equity. Consequently, our research will provide a full view on this CCP-CFP relationship for the US, the UK and the rest of EU countries.

5.2.2 Implied Long-Run Growth Rate

There are only a few studies examining the association between CFP and their LRG. Two examples are given in this section, one each for the US and the UK.

For the US, Gregory, Tharyan and Whittaker (2011) examine the LGR, as a proxy for the cash flow effects of the CSR. They employ the Easton, Taylor, Shroff and Sougiannis (2002) model, estimating the ICC and the LRG simultaneously. Within the six CSR dimensions, they find that 'diversity', 'human rights' and 'employee relations' are positively related to the LGR; however, the result is only significant with the 'employee relations' dimension. No significant LGR difference has been found between the different levels of CSR groups after industry adjustments.

When applying the Lee et al. (1999) model, they estimate the implied LGR, allowing the cost of equity to be constant across firms within each year. Their findings show that higher levels of CSR appear to be associated with higher LGR within the dimensions of 'environmental policies', 'human rights', 'community relations', 'product strategies' and 'employee relations', as well as the overall CSR score. Accordingly, they suggest that the higher CSR score firms can be expected to have longer term abnormal incomes.

Buckingham, Gregory and Whittaker (2011) also employ the Easton et al. (2002) model to estimate the ICC and the LRG simultaneously for a sample of 2,170 firm-year UK observations. To estimate the LGR, they also run then Lee, Myers and Swaminathan (1999) model with 1,686 firm-year observations, using two-year forward IBES forecast earnings. The cost of equity is estimated by mapping the ICB industries on to the 35 industries in Gregory and Michou (2009) and introducing their estimates of industry beta. The regression tests imply that the long-run growth in residual income is higher for the firms engaging in more CSR activities in the 'community relations' dimension and in the composite (six) dimension, whereas the grouping tests show no significant difference between CSR groups.

To summarize, the results from Easton et al. (2002) model do not indicate any LRG-CSR relationship for either the US or the UK. However, the results from Lee et al. (1999) suggest that the LRG might be associated with firms' environmental activities for the US.

5.3 Methodology

In this section, we mainly introduce the residual income model (RI) and its variants. Using the RI model, we will be able to calculate firms' ICC and LRG, respectively. Other variants of the ICC and LGR developments have also introduced. Moreover, we conduct the analysis on firms' forecast return on equity forward year one and two (FROE1 and FROE2), and the forecast medium-term growth rate, both from the IBES analysts forecast data.

In order to examining the effect that the environmental/carbon information changes the firms' cost of capital and cash flow expectation, we analysis relevant rates and ratios by forming two portfolios, namely the best environmental/carbon and the worst environmental/carbon portfolios. Further, a subsample regression analysis has been conduct to examine the link between firms' value and the source of this value.

Hence, our main contribution in this chapter is to identify whether or not the firms' environmental/carbon performances have any influence on the firms' ICC, medium- and long-term growth rate and short-term forecast ROE, using the portfolio method and matching with the subsample regression analysis.

5.3.1 Residual Income Model and its Variants

Our investigation in this chapter starts with the estimation of the ex ante cost of equity, which is implied by current price and analyst forecasts. The question of finding the appropriate proxies for the expected return has been raised by Elton (1999). The ICC approach has been proved to be a useful one, which isolates the ICC effects from the growth or cash flow effects (Hail and Leuz, 2006 and 2009, Chen et al. 2009). Therefore, it has been comprehensively adopted in the finance area, where El Ghoul et al., (2010) use it for tax enforcement and Chen et al. (2009) use it in corporate governance. However, it is only in recent years that this approach has been used in the CSR area. In this section, we are going to explain a variety of models that are used for estimating ICC, and their intrinsic limitations as well.

a. Lee, Myers and Swaminathan (1999) Version

In order to derive the ICC and LGR, we employ the residual income model, which was originated by Preinreich (1938), Edwards-Bell (1961) and Peasnell (1982), then further developed by Ohlson(1995). Therefore the approach is sometimes denoted as the EBO valuation equation. In the previous chapter, we have already introduced a number of variations of the original Ohlson model.

In Lee et al. (1999), they adopt the EBO model to estimate the intrinsic value of the Dow. The model they used is expressed in the following form:

$$\begin{aligned} V_t^* &= B_t + \sum_{j=1}^{\infty} \frac{E_t[NI_{t+j} - (r_e * B_{t+j-1})]}{(1+r_e)^j} \\ &= B_t + \sum_{j=1}^{\infty} \frac{E_t[(ROE_{t+j} - r_e) * B_{t+j-1}]}{(1+r_e)^j} \end{aligned} \qquad (5.1)$$

Where,

V_t^* is the intrinsic value at time t,

B_t is the book value at time t,

$E_t[\cdot]$ is the expectation based on information available at time t,

NI_{t+j} is the net income for period t+j, b

r_e is the cost of equity,

ROE_{t+j} is the after-tax return on book equity for period t+j.

Although they claim that this model is based on a series of Ohlson's work, (Ohlson 1990, 1991, 1995); to be more precise, it actually follows the Peasnell (1982) model given the absence of the 'other information'.

The model consists of the two terms, the first term on the right-hand side represents the book value of the capital that is invested (B_t), while the second term indicates the present value of all future residual income to infinity. The residual income can be calculated by the following formula,

$$RI_t = NI_t - (r_e * B_{t-1}) = (ROE_t - r_e) * B_{t-1} \tag{5.2}$$

To implement the model, Lee et al. (1999) further develop it into a finite horizon version, as in the following expression, where the second term in the infinite model has been divided into two parts, a sum of N periods and a terminal value (TV).

$$\widehat{V_t} = B_t + \sum\nolimits_{j=1}^{N} \frac{\left(FROE_{t+j} - r_e\right) * B_{t+j-1}}{(1 + r_e)^j} + TV \tag{5.3}$$

Where, the $FROE_{t+j}$ is the forecast ROE for period t+j, and TV is estimated using the equation below,

$$TV = \frac{\left(FROE_{i,t+N} - r_e\right) B_{i,t+N-1}(1 + g)}{(r_e - g)(1 + r_e)^N} \tag{5.4}$$

The TV is estimated by taking the period N residual income as a perpetuity, i.e. assuming there is no growth beyond period N, i.e. $g = 0$. However, there are previous studies, e.g. Penman and Sougiannis (1997) and Francis, Olsson and Oswald (2000) which both argue that the results derived from RI model are less sensitive in terms of the assumptions made about the long-run growth rate compared to the other valuation models.

Though the model is well-known, the most common application of the model has focused on estimating firms' intrinsic value, as in Lee et al. (1999) paper. Other examples can be found in Penman and Sougiannis (1997), Frankel and Lee (1997 and 1998), and Dechow et al. (1999), in which most simply apply a constant discount rate as the cost of equity.

However, as Lee et al. (1999) point out, the value of future earnings (residual income) depend critically on the interest rate (the cost of equity) used to discount them, which indicates the importance of the cost of equity as an intrinsic property of the firms. Most recently, there are researches focused on the firms' cost of equity capital, which start to use the above model or other similar models to estimate the ICC, such as those by Hou, van Dijk, and Zhang (2010), El Ghoul, Guedhami, Kwok and Mishra (2011) and Gregory, Tharyan and Whittaker (2011).

In this chapter, we adopt the following form of the RI model, in which the 5-year period of forecast earnings per share has been accessed from IBES. We substitutes the forecast EPS by combining this with other variables such as price and book value per share, aiming to estimate the ICC and LGR, respectively.

$$P_{it} = b_{it} + \sum_{j=1}^{5} \frac{(FROE_{i,t+j} - r_{ei,t})}{(1 + r_{ei,t})^{j}} b_{i,t+j-1} + \frac{\left(FROE_{i,t+5} - r_{ei,t}\right) b_{i,t+4}(1 + g_{i,t})}{(r_{ei,t} - g_{i,t})(1 + r_{ei,t})^{5}} \quad (5.5)$$

The above model implies that the price of the firm at the current year-end is the sum of opening book value per share, the present value of a five year period residual incomes and the estimated terminal value thereafter. In line with Lee et al. (1999) work, we can assume that the residual income stops growing after the fifth year and use the fifth year residual income as perpetuity when estimating the ICC.

On the other hand, the model can be also used to estimate the LGR, if we have an estimate of cost of equity (r_e) by the CAPM, the detail of which is described in Data section.

b. Easton and Sommers (2007) Version

A way of simultaneously estimating the ICC and LGR is introduced by O'Hanlon and Steele (2000) and Easton et al. (2002). Easton and Sommers (2007) adapt both of these previous studies, and further develop three methods for estimating the ICC, which are based on analysts' forecast earnings at t+1, realized earnings at t and the perfect foresight forecast earnings at t+1.

In Easton and Sommers (2007) work, the method above is introduced because the problem arising with estimating growth rate, is avoided. However, in this paper, we aim to estimate both the ICC and LGR; hence, the simultaneous way is an ideal approach for these estimations.

Both O'Hanlon and Steele (2000) and Easton et al. (2002) methods are derived from the RI model, as we showed in formula (5.1). Further, they both develop the RI model into a finite horizon version. The difference is mainly about the earnings and growth rate: in Easton et al. (2002), they use the IBES one-year forward forecast earnings and the perpetual growth rate starting from the next-period residual income (as show in 5.5); whereas in O'Hanlon and Steele (2000), they choose the current earnings and the perpetual growth rate starting from the current residual income (as show in 5.6).

$$P_{it} = b_{it} + \frac{FEPS_{i,t+1} - r_{ei,t} \times b_{i,t}}{(r_{ei,t} - g_{i,t})} \tag{5.6}$$

$$P_{it} = b_{it} + \frac{(EPS_{i,t} - r_{ei,t} \times b_{i,t-1})(1 + g'_{i,t})}{(r_{ei,t} - g'_{i,t})} \tag{5.7}$$

The above models are further transformed into the following regression relations,

$$\frac{FEPS_{i,t+1}}{b_{it}} = \gamma_0 + \gamma_1 \frac{P_{it}}{b_{it}} + \mu_{it} \tag{5.8}$$

$$\frac{EPS_{i,t}}{b_{it-1}} = \delta_0 + \delta_1 \frac{(P_{it} - b_{it})}{b_{it-1}} + \epsilon_{it} \tag{5.9}$$

Where, the coefficients of the regressions are representing the parameters $r \text{ and } g(g')$ in the following expressions,

$$\gamma_0 = g, \qquad \gamma_1 = r - g \tag{5.10}$$

$$\delta_0 = r, \quad \delta_1 = (r - g')/(1 + g') \tag{5.11}$$

However, as Easton and Sommers point out, the analysts' forecasts are pervasively optimistic, the estimations, therefore, can be significantly upward biased. Moreover, as the optimism degrees are varying for different observations, it is even harder to judge the degree that estimations are being affected. Therefore, they suggest avoiding the bias by using the realized earnings rather than the forecast earnings, which can result in the growth rate estimation only for the short-term. Also, the Easton and Sommer (2007) base the valuation on just one year ahead earnings. Easton et al. (2002) use a four-year compound growth which would be an alternative, but the long-run growth assumptions are subtly different, as they relate to the growth in four-year RI at the time the forecast is made, as opposed to the forecast growth in terminal RI.

Other authors try to avoid using assumptions of terminal values and future growth rate. In most recent studies, Ashton and Wang (2010) and Ashton, Gregory and Wang (2011), they adopt a less restrictive model and express the price as a linear function of current accounting fundamentals and an unspecified variable to summarize the information that is not captured by the linear function. Instead of deflating all the variables (dependent and independent) with book-value-per-share or lag-book-value-per-share, they deflate the variables with the price (market-value-per-share), as show in (5.11), which reduces the bias in estimating the ICC and the LGR that is caused by optimistic analysts' forecasts. They attribute this result to the mitigating effects of endogeneity.

$$\frac{FEPS_{i,t+1}}{P_{it}} = \delta_1 + \delta_2 \frac{EPS_{it}}{P_{it}} + \delta_3 \frac{BPS_{it}}{P_{it}} + \delta_4 \frac{BPS_{it-1}}{P_{it}} + \delta_5 \frac{P_{it-1}}{P_{it}} + \epsilon_{it} \qquad (5.12)$$

$$\frac{FEPS_{i,t+1}}{BPS_{it}} = \delta_1 \frac{P_{it}}{BPS_{it}} + \delta_2 \frac{EPS_{it}}{BPS_{it}} + \delta_3 + \delta_4 \frac{BPS_{it-1}}{BPS_{it}} + \delta_5 \frac{P_{it-1}}{BPS_{it}} + \epsilon_{it} \qquad (5.13)$$

To avoid estimations of the ICC and LGR from the bias in the earnings forecasts, Ashton, Gregory and Wang (2011) also show that the different weighting methods can result in a significant difference in test statistics. Based on Ashton and Wang (2010) models (deflated by book value), Ashton, Gregory and Wang (2011) document an insignificant bias of 0.4% using value-weighted regression rather than the significant bias of 0.4% yielded by the equally-weighted regression. As for the Easton and Sommers (2007) models, they also report a superior performance of the value-weighted regressions due to the inclusion of price related information as well as the undue influence of small firms.

Further, they identify the persistence of earnings in earnings forecasts, the timing of explanatory variables and the potential impact of accounting policy as the factors that can statistically affect the biases in the estimation of the cost of capital and the long-term growth. In addition, they point out that the adoption of realized earnings as a benchmark for ‘perfect forecasts’ can be used to quantify the impact of the biases. Models shown in (5.13 & 5.14).

$$\frac{rEPS_{i,t+1}}{P_{it}} = \delta_1 + \delta_2 \frac{EPS_{it}}{P_{it}} + \delta_3 \frac{BPS_{it}}{P_{it}} + \delta_4 \frac{BPS_{it-1}}{P_{it}} + \delta_5 \frac{P_{it-1}}{P_{it}} + \epsilon_{it} \tag{5.14}$$

$$\frac{rEPS_{i,t+1}}{BPS_{it}} = \delta_1 \frac{P_{it}}{BPS_{it}} + \delta_2 \frac{EPS_{it}}{BPS_{it}} + \delta_3 + \delta_4 \frac{BPS_{it-1}}{BPS_{it}} + \delta_5 \frac{P_{it-1}}{BPS_{it}} + \epsilon_{it} \tag{5.15}$$

However, these models are based on one year ahead or realized earnings, which result in the growth rate estimation only for the short-term.

c. Other Versions

Other papers involved in estimating the ICC include Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001), and Ohlson and Juettner-Nauroth (2005).

Claus and Thomas (2001) apply a variation of Lee, Myers and Swaminathan’s (1999) model, assuming clean surplus accounting as well.

$$P_{it} = b_{it} + \sum_{j=1}^{5} \frac{ae_{i,t+j}}{(1 + r_{ei,t})^j} + \frac{ae_{i,t+5}(1 + g_{i,t})}{(r_{ei,t} - g_{i,t})(1 + r_{ei,t})^5} \tag{5.16}$$

Where,

$ae_{i,t+j} = FEPS_{i,t+j} - r_{ei,t} b_{i,t+j-1}$,

$BPS_t = BPS_{t-1} + FEPS_t(1 - DPR)$, $\quad DPR = 0.5$

The forecast horizon is set to five years in their paper, as we do in this chapter. However, beyond five-years, they apply the expected inflation rate as the forecast residual earnings growth rate, whereas we assume the residual earnings at the fifth year to be the perpetuity value. One more difference is that when applying clean surplus accounting to estimate book value, Claus and Thomas (2001) assume a constant dividends payout ratio, whereas we use the forecast dividends from IBES in formula (5.16).

$$BPS_t = BPS_{t-1} + FEPS_t - FDPS_t \quad (5.17)$$

Later on, Gebhardt, Lee and Swaminathan (2001) adjust their estimation of the dividend payout ratio as well, where they set the payout ratio as

$$DPR = DPS_0/EPS_0 \quad (5.18)$$

Gode and Monhanram (2003) apply Ohlson and Juettner-Nauroth's (2005) cost of capital formula, which is derived from the Gordon constant growth model. They assume the dividends per share to be constant and LR growth rate the same as inflation rate.

The Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001) and and Ohlson and Juettner-Nauroth (2005) models are basically the same as Lee et al. (1999), except that they assume a constant dividends payout ratio. As we have the forecast dividends per share data from IBES, which is more consistent with our calculation of book-value-per-share, we do not adopt the assumption of constant dividends payout ratio.

d. Summary

The justification for using Lee, Myers and Swaminathan (1999) model to estimate ICC and implied LR growth rates, is to produce consistent estimations for both target variables. While the Easton and Sommer (2007) model can also generate these simultaneously, it bases the valuation on just one year ahead earnings. Claus and Thomas (2001), Gebhardt, Lee and Swaminathan (2001) and and Ohlson and Juettner-Nauroth (2005) have used a constant payout ratio assumption, which is less consistent with the BPS calculations.

5.3.2 Portfolio Analysis

The target variables considered in the portfolio analysis in this chapter are the ICC, which reflects the companies' risk character, and implied LGR, forecast medium-term growth rate and forecast short-term profitability, which reflect the companies' cash flow effect from the long, medium and short perspective. The ICC and LGR are both derived from the Lee, Myers and Swaminathan (1999) model, while the forecast medium-term growth rate and forecast short-term profitability are directly downloaded from IBES, which are proxied by the analysts' forecast medium-term earning growth rates and forward year-1 and year-2 analysts' forecast return-on-equity (FROE1 and FROE2), respectively.

For each of the target variables, four screening criteria are adopted, which are impact-ratio per share (IPPS), first-tier and direct carbon emissions quantities per share (FFPS), direct carbon emissions quantities per share (DFPS) and carbon dioxide emissions quantities per share (CFPS). We use the equally-weighted portfolio, at the 10%, 20% and 50% cut-off levels. The portfolios are constructed in two different ways; one is at an industry-free level, and the other is at an industry-adjusted level. In line with the portfolios' analysis we performed in chapter 3, we adopt the best-in-class strategy to introduce the industry adjustment, which means we take the top (bottom) 10%/20%/50% in each industries to form the best (worst) environmental/carbon performance portfolios. In comparison, raw estimates, which do not involves industry effects in the estimation, have been used to show the actual difference between the target variables for the two categories.

We perform two-group mean-comparison analysis for these target variables, and in addition, the t-test has been applied to these estimations. Thereafter, in the results tables, we report the the t-statistics under the results of the differences.

5.3.3 Regression Analysis

Due to a significant loss of observations after introducing IBES data (e.g., for the US, the firm-year observation number is 5004 in chapter 4, however, has been reduced to 3481 in this chapter; for the UK, this number is reduced to 1163 from 1990 and for the rest of the EU, it is now 1883 instead of 2275), we define three subsamples for the US, the UK, and the rest of the EU, respectively, in which only the observations that have 3-year forward FEPS and forecast medium term growth rate have been included. This is to ensure that we have a matched dataset in both the portfolio measures and regression analysis.

Consequently, the valuation results can be significantly affected by the reduced sample size, due to the missing FEPS and/or forecast medium term growth rate. The original conclusions from Chapter 4 may not stand anymore for these subsamples. To further demonstrate the relationship between the companies' value and the source of this value, we perform the regression analysis for the three country/area (the US, the UK and the rest of EU countries), based on the Ohlson model (1995) and the Hand and Landsman (2005) model. In this chapter, we adopt both the share number deflation and sales deflation (for details of these models see chapter 4). The only difference here is that, to match the portfolio analysis, we introduce both the industry-unadjusted and industry-adjusted analyses in the regressions.

5.4 Data description

5.4.1 Corporate Financial Performance Data

a. Data for the Lee, Myers and Swaminathan (1999) model

Within the existing data, the financial market data, i.e. market value per share, are collected in the following year in June, to ensure that carbon information for year t has been fully reflected in prices. The accounting data, i.e. book value per share, are simply collected at the same fiscal-year end. Our quoted databases are still different for the US, UK and EU. Market value per share of the US companies is from CRSP, while accounting variables for the US are from COMPUSTAT North America. For the EU and UK, financial and accounting variables are both from DataStream.

As for the forecasting data, for both the EU and US, we can access the 3-year forward forecast earnings per share (FEPS), forecast book value per share (FBVPS) and forecast dividends per share (FDPS) all from IBES, predicted in the following year in June. Lee et al. (1999) suggest that the forecast book value per share from IBES may not be available when IBES updates its year-end forecasting, because of the earnings announcement preceding the release of firms' financial statements. Therefore, to avoid the estimation being based on unpublished information, we apply the clean-surplus accounting approach and create a synthetic book-value per share, see formula (5.16).

$$BPS_t = BPS_{t-1} + FEPS_t - FDPS_t$$

The opening book-value per share B_{t-1} is the actual report value from COMPUSTAT (for the US) or DataStream (for the UK and EU).

The analysts' forecast earnings growth rates from IBES is a medium term (Year 3-5) estimation. Therefore, we use this medium term (Yr3-5) earnings growth rates to compare with our LGR results. Also, due to the scarcity of forecast data in the fourth and fifth year, we adopt this medium term (Yr3-5) earnings growth to calculate the forecast EPS at year-4 and year-5, attempting to maximise the number of observations as well as ensuring the accuracy. The calculations follow the equations below:

$$FEPS_4 = FEPS_3 \times (1 + g) \tag{5.19}$$

$$FEPS_5 = FEPS_3 \times (1 + g)^2 \tag{5.20}$$

The same adjustments as in the previous chapter have been made to remove the outliers: We first drop those extreme observations according to Cohen et al. (2003) conclusion and standards, which provides a reasonable range of market value to book value ratio from 0.01 to 100. This allows eliminating implausible observations, as well as the negative book value firms.

Then we examine the extreme EPS observations. In the case where an observation's EPS absolute value exceeds its MVPS absolute value; we refer to its published financial statements, such as the annual report. We drop the observation if the EPS is incorrectly recorded, but keep the ones that are correct. In addition, we also delete the companies with negative forecast earnings-per-share at the fifth year and negative forecast book-value-per-share at the fourth year onwards, which is incompatible with further calculation of ICC and LGR.

In order to get the best estimation results, we also winsorize the target variable at 2.5%, which means that we take the top and bottom 2.5% data and replace them with the value at the 2.5% and 97.5%, respectively. For example, for the US, 3487 observations in total, there are 87 observations on each side, of which the target variables have been reset at the nearest values. For the UK, 29 observations on each side (total 1163) have been reset; and for the rest of the EU, 47 on each side (total 1883) have been changed. The rationale for this is to remove the unreasonable outliers, while maintaining the size of the dataset.

To facilitate the estimation of the ICC, we set the long-run (LR) growth rate at zero in the residual income model (RI). In other words, we solve for ICC by equating the present value of the right hand side of (5.1) to the actual share price in June of each year, whilst holding growth in long run residual income constant at zero across all firms. Firstly, the rationale for using price instead of intrinsic value is that, in the long run, arbitrage forces cause price to converge to value. Secondly, the justification for using zero long run residual income growth rates is assuming the residual income x_t^a remains constant in perpetuity at year 5 value. This assumption is common practice for the computation of terminal values in empirical applications of the residual income valuation model using finite horizon data, and has been previously adopted in Penman and Sougiannis (1997), Frankel and Lee (1998), Lee et al. (1999), and Francis et al. (2000). Although there are other assumptions can be adopted for the calculation of terminal value (Dechow et al. 1999), such as assuming residual income is transitory, i.e. $x_t^a = 0$ after period N, or residual income converges to zero or grows at some nominal rate, these will involve the autoregressive procedures between the residual income and the 'other information'. For simplicity, we only use the period N residual income in perpetuity i.e. $g = 0$ when estimating the ICC.

Using the same model, we estimate the implied LR growth rate as well, by setting the cost of equity to equal the countries' local risk-free rate plus a market risk premium. Although Claus and Thomas (2001) set the market risk premium at 3.4 percent; we adopt a 3.5 percent as the equity risk premium, and sensitize our results using alternative estimates of 4 percent and 5 percent, this broad range being consistent with Dimson, Marsh and Staunton (2011). Hence, we introduce the CAPM to estimate the cost of equity (r) more precisely, as in the following equation.

$$r = R_f + \beta \times MRP \tag{5.21}$$

For the US, we adopt the risk-free rate and market risk premium from the Fama-French monthly factors in the Kenneth R. French website[42]. We also introduce the monthly industry value-weighted returns from the same website as the dependent variable, and then run the regression using the CAPM model to access the US industry betas; presumably this approach can generate more accurate betas than using a single value across industries.

For the UK, we map the DS Level-3 19 sectors onto the 35 industries from Gregory and Michou (2009) work and adopt their estimations of industry betas. For the EU, as we have no access to any of the data sources that can produce

[42] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html

more precise beta, we simply assign the market beta as ‘1’. As to the risk-free rate for EU and UK, it is the redeem yield of the countries’ 10-year benchmark bond.

The market risk premium is set at 3.5%, or alternatively, 4% and 5% which are also used for sensitivity testing.

b. Financial Data from IBES

The estimation of FROE1 and FROE2 follows the equations below:

$$FROE_1 = FEPS_1 / BVPS_0 \quad (5.22)$$

$$FROE_2 = FEPS_2 / FBVPS_1 \quad (5.23)$$

The medium term (Yr3-5) earnings growth rates are directly downloaded from IBES, as we have already introduced in Lee et al. (1999) model.

5.4.2 Corporate Environmental Performance Data

In this chapter, we use the corporate environmental/carbon data both as the selecting criterion in the portfolios analysis and as the control variables in the subsample regressions. We state the detail below.

In the portfolios analysis, all environmental measures are defined on a per share basis; the full-environmental performance measure is impact ratio per share (IPPS), first-tier and direct carbon emissions quantities per share (FFPS), direct carbon emissions quantities per share (DFPS) and carbon dioxide emissions quantities per share (CFPS). For the US, UK and EU, all of the four measures have 7-years sample periods from year 2002 to year 2008.

By adopting the Trucost environmental performance and carbon emission quantitative data, we investigate the environmental/carbon influence on the ICC and LGR at portfolio level, which means the environmental measures are used as the selecting criterion. In line with the previous portfolio analysis, we choose the cut-off levels at 10%, 20% and 50%, respectively; i.e. two portfolios (top and bottom) of the same magnitude have been constructed for each of the environmental/carbon criteria. Two strategies have been employed to separate the observations into the best environmental performance portfolio or the worst environmental performance portfolio. The raw estimates show the actual growth/cost-of-capital estimates without considering industry effects, i.e. pooling all the industries together and ranking all the companies using a specific environmental/carbon criteria. The Industry-adjusted (IND) estimates show the implied growth/cost-of-capital estimates after taking the effect of the membership of industry groups (see Appendices 1 and 2) into account.

5.4.3 Data Used in Subsample Regressions

To match the two strategies in the portfolios analysis, we also run the subsample regressions with and without industry dummies. However, as these regressions are either based on the share number deflation or sales deflation, both of the financial/accounting variables and the environmental/carbon measures are defined either on a per share basis or on a per dollar sale basis. The share number deflation variables have been described in the above sections. Whereas the sales deflation variables are defined by the following expressions; MSA is the market value over sales, BSA is the year end net book value over sales, ESA is the earnings over sales, DSA is the dividends over sales, and CCSA is the net capital contributions received over sales. IND, if applied, are the dummies for the 17 industries delineated by SIC codes in the US, and for the 19 industries delineated by DataStream Level-3 codes in the EU and UK. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) (IPSA), the carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA).

5.5 Empirical Implementation

In this section, we compare the results of the cost of capital, growth rate and profitability between the best and worst environmental/carbon performance portfolios. Further, we examine the valuation results based on the subsamples, in which all companies have ICC and LGR. We examine the regimes for the different levels of applied carbon emission constraints. The countries (or areas) investigated are the US, the UK, and the EU, in which the US is considered as the least constraint regime, and the EU and UK are considered as more constraint regimes. As the UK data have performed quite differently from the rest of the EU countries, we will consider separately the UK and the other EU countries, when we observe the influence of the environmental and carbon outputs on the companies' systematic risk, cash flow effect, and profitability. With respect to the sectors, we include both the industry-unadjusted and industry-adjusted analyses in portfolio and regression valuations.

We conduct both portfolio analysis and subsample regression analysis. In the portfolio analysis, the target variable portfolios are formed at the 10%, 20% and 50% cut-off levels, based on the environmental/carbon performance (IP, FF, DF, and CF). In each section, the left column includes the average value of the target variable for the best environmental/carbon performance portfolio (large environmental/carbon emissions), the middle column reports the average value of the target variable for the worst environmental/carbon performance portfolio (small environmental/carbon emissions), while the right column shows the difference between the worst and the best portfolios. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. In each table, the raw estimates (IP, FF, DF, and CF) show the actual target variable estimates without considering the industry effects (industry-free level), whilst the Industry-adjusted results (IP IND, FF IND, DF IND, and CF IND) show the effect once membership of the industry groups is allowed for (17-industries SIC codes for the US and 19-industries DataStream level-3 codes for the EU and UK).

In the subsample regression analysis, we employ the Ohlson model and the Hand and Landsman model, both deflated by share number and sales. In the Ohlson model, we introduce book value, earnings and dividends as control variables, and in the Hand and Landsman model, the net capital contribution variable has been included in addition. In each table, columns 2 to 5 include the results of the industry-free regressions, while columns 6 to 9 include the results of the industry-adjusted regressions.

5.5.1 Empirical Test for the US

Tables 5-1-1 to 5-1-12 contain the US results, where tables 5-1-1 to 5-1-7 are the portfolios results, table 5-1-8 is the result of the subsample statistics summary, and tables 5-1-9 to 5-1-12 include the regression results for the US subsample. The total number of observations for the US is 3487.

a. Implied cost of capital

In table 5-1-1, we show the result of ICC in terminal (year 5) residual income implied by solving the following equation:

$$P_{it} = b_{it} + \sum_{j=1}^{5} \frac{(FROE_{i,t+j} - r_{ei,t})}{(1 + r_{ei,t})^j} b_{i,t+j-1} + \frac{\left(FROE_{i,t+5} - r_{ei,t}\right) b_{i,t+4} (1 + g_{i,t})}{(r_{ei,t} - g_{i,t})(1 + r_{ei,t})^5} \quad (5.24)$$

We assume the growth rate is zero at long term, i.e. $g_{i,t}$=0. The ICC is winsorized at the 2.5% level. Only firms with a positive implied residual income in Year t+3 and onward are included.

For the US, at the industry-free level, the result at the 10% cut-off has an ICC of 7.75% for the best environmental performance portfolios, and 7.40% for the worst, the difference between the two is significant. The worst has a significant lower ICC than the best, at higher cut-off levels. At the 10% cut-off level, the results of the worst carbon performance portfolios have an average ICC of 7.62%, whilst 8.20% is the average for the best portfolios.

The differences between the best and worst carbon performance portfolios are even larger at the 20% cut-off level. The worst have relatively lower ICC than the best, despite the environmental criterion or the carbon criteria being applied. Further, the t-test results for the IP, DF and CF criteria suggest significant differences between the two portfolios at 20% and 50% cut-off levels, whereas the t-test results of the FF criterion only suggest more significant differences between the two portfolios at 20% cut-off level.

Focusing on the industry-adjusted portfolios, the ICC for the worst environment/carbon performance portfolios is still lower than the best (except for the IP criterion at the 20% cut-off level), but there are almost no significant differences (the only exception is at the 20% cut-off level, for the CF criterion, at a confidence interval of 90%).

The implication for the US is that, when the firms classified by carbon emissions without industry effect, there can be a reward for the larger emission companies in the form of reduced cost of equity capital, where there is no carbon emission constraint. However, more importantly, we find that firms' carbon outputs do not have any great influence on their cost of equity after considering the industry effect.

b. Implied long-run growth rate

Tables 5-1-2 to 5-1-4 show the results of analysing the implied long-run residual income (or abnormal earnings) growth portfolios. The estimated LGR in terminal (year 5) residual income is implied by solving the equation (5.23), assuming market risk premium is 3.5%, 4.0% and 5.0%, respectively, added to the local risk-free rate. The LGR is then winsorized at the 2.5% level. Only firms with a positive implied residual income in Year t+3 and onward are included.

Although, we assume growth rate in the long-term is zero when we estimate the cost of capital; the actual growth rate values (with market risk premium at 3.5%, at 10% cut-off level) before industry adjustment are 2.45% and 0.78% for the best and worst environmental performance portfolios, respectively, as shown in table 5-1-2. The worst portfolio has a significantly lower LGR than the best. At 10% cut-off level, the raw results of the best carbon performance portfolios have LGR in a range 2.12% to 2.39%; whilst for the worst portfolios, the range is -0.03% to -0.75%. Again, a significant difference between the worst and the best is evident, despite which carbon criteria are applied.

In regard to the industry-balanced portfolios, all significant differences have disappeared under the carbon criteria. The results at the 20% and 50% cut-off levels are mostly consistent with the above results.

When we increase the market risk premium to 4.0%, the actual growth rate values are significant different between the best and worst environmental/carbon performance portfolios before industry adjustment, at all cut-off levels, as shown in table 5-1-3. When the market risk premium is 5.0%, the differences are mostly significant, at all cut-off levels, as shown in table 5-1-4. Therefore, without industry-balance, the best portfolios have significantly greater growth potential than the worst in the long run.

However, after industry-balancing, the growth expectation is reduced for the best group, but raised for the worst group (with the market risk premium at 4.0% or 5.0%), which in turn leads to a better growth potential for the worst rather than for the best, even though these differences are insignificant (except when the market risk premium is 5.0%, at the 20% cut-off level, where the worst carbon portfolios have significantly higher growth rates than the best).

The above results indicate that for the US, at the industry-free level, the LGR for the best group are significantly higher than those of the worst, whatever environmental or carbon criteria are applied. However, when the industry effect is considered, there is no longer a significant difference between the two.

c. Forecast medium-term growth rate

To capture the medium term cash flow expectation, we conduct the medium term earnings growth analysis, and in table 5-1-5 we show the results of these estimations. The medium term earnings growth rate has also been winsorized at the 2.5% level to remove the outlier effect. In line with the previous portfolio analysis, we adopt both raw estimations and industry-adjusted (IND) estimations.

We find that the results from the analysts' forecast are encouraging. At the industry-free level, we report that at 10% cut-off level, the worst environmental/carbon performance portfolios generate an earnings growth rate around 9%, whereas the best environmental/carbon performance portfolios yield a rate around 14%. The 5% difference is economically and statistically significant. After adjusting for industries, the differences are around 4.7% between the best and worst environmental/carbon performance portfolios, which are still significant. At the 20% and 50% cut-off levels, the results are in line with the above results, only the differences are smaller in scale.

According to the above results, we infer that the IBES analysts are fairly confident that the less environmental/carbon emissions companies for the medium term (3-5 years) will have better growth prospects.

d. Forecast short-term profitability

To capture the short term cash flow expectation, we analyse the short term forecast return on equity at year-1 and year-2. In tables 5-1-6 and 5-1-7 we show the results of these estimations. The short term forecast returns on equity (FROE1 and FROE2) have been winsorized at the 2.5% level, to remove the outlier effect.

At the 10% cut-off level, we find that the results from the analysts' forecast are still very optimistic for the better environmental/carbon performing companies. At the industry-free level, the forecast ROEs at year 1 for the worst environmental/carbon performance portfolios are around 14%, whereas for the best environmental/carbon performance portfolios, these are around 18%. The forecast ROEs at year 2 are slightly higher than that for the first year for both the best and worst environmental/carbon portfolios. The differences between the two environmental/carbon groups are significant at both first and second year. These results are mostly consistent at 20% and 50% cut-off levels.

After adjusting by industries, the differences between the worst and the best environmental/carbon groups are even more significant at both years. These results are robust at all cut-off levels.

According to the above results, we suggest that the IBES analysts are most likely to have confidence in the short term (1-2 years) profitability prospects of the less environmental/carbon emission companies.

e. Subsample regression

According to the share number deflation results (tables 5-1-9 and 5-1-10), at the industry-adjusted level, the US subsample results are consistent with those of the entire sample, all carbon outputs and environmental output have been negatively valued by the market. By reference to the Ohlson model results, the value of the IPPS coefficients from result tables 5-1-9 is -0.566 lie within the 99.9% confidence interval. This implies that a $1 increase in the environmental damage cost will incur a $0.566 reduction in the firms' market value. As to the FFPS, the coefficient is -0.065 lie within the 99.9% confidence interval, which implies that an increase of 1 tonne carbon dioxide (or equivalent) emission will incur a $65 reduction in the firms' market value for this subsample. Similarly, the DFPS results indicate an implied carbon value of $57 per tonne, and it is $59 per tonne for the CFPS. These results are robust when applying the Hands and Landsman model.

When we remove the industry dummies, the valuation of the carbon outputs are still significantly negative and greater in absolute values than thoes with industry-adjustment, however, the valuation of the environmental output is less significant and smaller in absolute value than thoes with industry-adjustment.

Replacing the share number deflation with the sales deflation (see table 5-1-11 and 5-1-12), the results of those carbon variables are consistent with that of the share number deflation, and more significant than that of the entire sample. In contrast, the result of the environmental variable is not significant anymore after sales deflation, even though the coefficient is still negative. Therefore, the results for the carbon variables are robust in a sales deflation form.

Comparing the regression and portfolio results, we find that for the US, the subsample regressions show that the market negatively values the carbon outputs, while the analysts have optimistic forecasting for the companies that have better carbon emission performances in the short and medium term. However, neither of the companies' LGR or systematic risk has been affected by their carbon emission performance after considering the industry effects. The implication is that, even though carbon emission reduction activities can bring the performing companies greater profit and cash flow and better market valuation in the near future, these activities cannot change the companies' cost of capital on an industry-adjusted basis. However, as long as low carbon companies can improve their short and medium term profits, they can enhance their values even without long term growth and cost of capital advantages. Therefore, the regression and portfolio results are consistent.

5.5.2 Empirical Test for the UK

Tables 5-2-1 to 5-2-12 contain the UK results, in which tables 5-2-1 to 5-2-7 are the portfolios results, table 5-2-8 is the result of the subsample statistics summary, and tables 5-2-9 to 5-2-12 include the regressions results for the UK subsample. The total number of observations for the UK is 1163.

a. Implied cost of capital

In table 5-2-1, we show the result of ICC in the terminal (year 5) residual income produced by solving equation (5.23).We assume the growth rate is zero at long term, i.e. $g_{i,t}$=0. ICC is winsorized at the 2.5% level. Only firms with a positive implied residual income in Year t+3 and onwards are included.

For the UK, at the industry-free level, the results are consistent at all cut-off levels. The result at the 10% cut-off level for the best environmental performance portfolio has an ICC of 7.89%, whilst it is 10.60% for the worst portfolio. The difference between the worst and the best is significant, with the worst having a relatively higher ICC than the best. At the 10% cut-off level, the results of the best carbon performance portfolios have an average ICC of 9.0%, whilst it is an average of 10.4% for the worst, and the differences are significant. The worst have relatively higher ICC than the best, despite the environmental criterion or the carbon criteria being applied.

Considering the industry-adjusted portfolios, at the 10% cut-off level, the ICC for the best environmental performance portfolio is 8.39%, whilst it is 10.27% for the worst. The difference of 1.82% is statistically significant. At the other two cut-off levels, the difference between the two is still statistically significant. At the 10% cut-off level, in the carbon screening portfolios, the best carbon performance portfolios enjoy an average low cost of equity of 8.37%, while their worst counterparts have an average cost of equity of 10.08 %. The differences between the two are statistically significant (1.71% on average), and these results are consistent at 20% and 50% cut-off levels as well.

These results indicate that for the UK, possibly because there are strict emissions constraints in place, the emission reduction activities can actually benefit the performing companies by reducing their cost of equity, change their cost of capital structure and lower the companies' systematic risk. Further, we report that these results are robust with or without industry balance.

b. Implied long-run growth rate

Tables 5-2-2 to 5-2-4 show the results of analysing the implied long-run residual income (or abnormal earnings) growth portfolios. The estimated LGR in terminal (year 5) residual income is implied by solving the equation (5.23), assuming the market risk premium is 3.5%, 4.0% and 5.0%, respectively, added to the local risk-free rate. The LGR is then winsorized at the 2.5% level. Only firms with a positive implied residual income in Year t+3 and onwards are included.

At 10% cut-off level, the actual growth rate values (with market risk premium at 3.5%) at industry-free level are 6.91% and -0.67% for the best and worst environmental performance portfolios, respectively, as shown in table 5-2-2. The best portfolio has a significantly higher long-run growth rate than the worst. However, this is the only significant difference at all cut-off levels. At 10% cut-off level, the raw results of the best carbon performance portfolios have higher but insignificant LGR than the worst, and the results are mostly consistent at the other two cut-off levels.

With regard to the industry-balanced portfolios, we only find that the best enviorment portfolio shows a significantly higher growth potential than the worst, at the 50% cut-off level. Notably, though the results are somewhat diverse, no consistently significant difference has been found when applying carbon criteria.

When we increase the market risk premium to 4.0%, we only find that the best enviorment portfolio shows a significantly higher growth rate than the worst, at the 50% cut-off level after industry-adjustment, as shown in table 5-2-3. No significant difference has been identified for carbon portfolios at any cut-off level, before or after industry-adjustment.

When the market risk premium is 5.0%, we note that there are some significant differences between the best and worst environmental performance portfolios. However, when applying carbon criteria, we find no significant difference at any cut-off level, either before or after industry-adjustment, as shown in table 5-2-4.

Therefore, we conclude that the best carbon portfolios do not have better growth potential than the worst in the long run, whether at industry-free or industry-balanced level. However, when applying the environmental criterion, the best portfolio can have superior growth potential.

The above results indicate that for the UK, companies' long-run growth prospects have not been influenced by carbon reduction activities. However, these may be affected by the environmental emission cut-down activities.

c. Forecast medium-term growth rate

To capture the medium term cash flow expectation, we conduct the medium term earnings growth analysis. In table 5-2-5 we show the results of these estimations. The medium term earnings growth rate has also been winsorized at the 2.5% level, to remove the outlier effect. In line with the previous portfolio analysis, we adopt both estimations at both industry-free and industry-adjusted (IND) levels.

At 10% cut-off levels, we report that the worst environmental performance portfolios generate an earnings growth rate of 10.28%, whereas the best environmental performance portfolios yield a rate of 9.83%, without industry-adjustment; though the difference between the two portfolios is insignificant. However, this situation has been reversed at the 20% cut-off level, and significantly so at the 50%. As to the carbon criteria, the best carbon performance portfolio only shows superior growth potential when applying the FF criterion, with growth differences of 0.09%. However, differences become more positive and significant at higher cut-off levels.

After adjusting for the industries, the best groups have better growth prospects in all criteria, and the differences between the two are all significant. The results are robust at all cut-off levels.

These results for the UK show that the IBES analysts have confidence in the medium term (3-5 years) growth prospect of the less environmental/carbon emissions companies after considering the industry effect.

d. Forecast short-term profitability

To capture the short term cash flow expectation, we analyse the short term forecast return on equity at year-1 and year-2. In tables 5-2-6 and 5-2-7 we show the results of these estimations. The short term forecast returns on equity (FROE1 and FROE2) have been winsorized at the 2.5% level, to remove the outlier effect.

At the 10% cut-off level, we find that the results from the analysts' forecast are not very optimistic for the better environmental/carbon performance companies. At the industry-free level, all the forecast ROEs at year 1 for the worst portfolios have higher profitability prospects than for their best. The differences between the two groups range from 0.56% to 7.59%, and are significant when applying IP criterion. Results are mostly consistent with the above results at the other two cut-off levels, i.e. the worst portfolios have higher profitability prospects than the best.

At year 2, the worst groups still have higher ROEs than the best at the 10% cut-off level when applying IP and FF criteria. At the 20% and 50% cut-off level, the worst portfolios show even more significant profitability than the best.

After adjusting for industries, the best environmental and carbon performance portfolios all have higher ROEs than their worst counterparts, which indicates the importance of controlling for the industry effects. Specifically, at the 10% and 20% cut-off levels, the best group have superior profitability at both year 1 and year 2 when applying IP and FF. At the 50% cut-off level, the best group have superior profitability at both year 1 and year 2 when applying DF and CF.

From the results above, we suggest that the IBES analysts still believe in low carbon emission companies, who have better profitability prospects in the short term (1-2 years), after considering industry effects, even though these confidences are not as strong as those for US companies.

e. Subsample regression

According to the share number deflation results (tables 5-2-9 and 5-2-10), at the industry-adjusted level, all carbon outputs have significantly negative multiplier on firms' value, whereas the environmental output has a negative but insignificant multiplier on firms' value. In reference to the Ohlson model, for example, the value of the FFPS coefficients from result tables 5-2-8 is -0.1481 lie within the 95% confidence intervals, which means an increase of 1 tonne carbon dioxide (or equivalent) emission will incur a $148 reduction in the firms' market value for this subsample. Similarly, the DFPS results indicate an implied carbon value of $178 per tonne, and it is $203 per tonne for the CFPS. Comparing this to the entire sample, these results are more significant both economically and statistically. Results are robust when applying the Hands and Landsman model.

However, after removing the industry dummies, the valuation of the carbon outputs are still negative and but insignificant, and the valuation of the environmental output is now insignificant and positive.

Replacing the share number deflation with the sales deflation (see table 5-2-11 and 5-2-12), the coefficients of all environmental/carbon variables are insignificant, which implies that in the UK, market valuations are sensitive to the choice of deflators.

Compared to the entire sample, in which all coefficients in the sales deflation are negative but insignificant, we infer that the carbon signalling effect may have been weakened. As we have suggested before, in the UK market, the carbon outputs can be a signal of the energy efficiency. However, due to the introduction of the carbon emissions trading scheme (EU ETS), this signalling effect may have been weakened since all companies in the market have to comply with the scheme.

Comparing the portfolio and regression results, we find that for the UK, the subsample regressions deflated by share numbers are consistent with the portfolio results. The valuation results show that the market negatively values carbon outputs after industry-adjustment, which is consistent with the analysts' forecast at the short (1-2 years) and medium (3-5 years) term and companies' lowered systematic risk. Therefore, it suggests that carbon emission reduction activities ought to be preferred by companies, because of the influence on the companies' cost of capital structure, particularly, in a country with strict emission constraints, such as the UK.

However, our results do not suggest that the carbon reduction activities can improve the companies' long term growth prospects. Further, we assume that the energy efficiency effect of the carbon outputs may have been weakened, and the short run profitability may be offset by the cost consideration to some extent.

5.5.3 Empirical Test for the EU excluding UK

Tables 5-3-1 to 5-3-12 contain the rest of the EU results, in which tables 5-3-1 to 5-3-7 are the portfolio results, table 5-3-8 is the result of the subsample statistics summary, and tables 5-3-9 to 5-3-12 include the regressions results for the EU subsample. The total number of observations for the rest of the EU is 1883.

a. Implied cost of capital

In table 5-3-1, we show the result of ICC in terminal (year 5) residual income implied by solving equation (5.23).We assume the growth rate is zero at long term, i.e. $g_{i,t}$=0. ICC is winsorized at the 2.5% level. Only firms with a positive implied residual income in Year t+3 and onwards are included.

For the rest of the EU, at the industry-free level, the best has an ICC of 9.96%, whilst it is 9.6% for the worst portfolio, at the 10% cut-off level. The difference between the two is 0.36%, which is insignificant. At the 20% cut-off level, the worst has a relatively higher ICC than the best, but the difference is insignificant. However, at the 50% cut-off level, the worst has a significantly higher ICC than the best.

At the 10% cut-off level, when applying carbon criteria, the results of the best portfolios have an average ICC of 10.01%, while it is an average of 9.40% for the worst. The latter have a significantly lower ICC than the best, when applying the FF and DF criteria. At the 20% cut-off level, the worst still have a significantly lower ICC, when applying the DF and CF criteria. However, this situation reverses at the 50% cut-off level, where the best have lower ICC.

Considering the industry-adjusted portfolios, the ICC for all the best environmental/carbon performance portfolios are lower than that of their worst counterparts. Specifically, the differences between the two groups are both statistically and economically significant at the 10% and 20% cut-off level (around 1.2%), while at 50% cut-off level, these differences are still statistically significant (around 0.60%).

The above results indicate that for the EU, possibly because of carbon emission constraints, the carbon emission reduction activities can actually benefit the better performing companies by reducing their cost of equity, change their cost of capital structure and lower the companies' systematic risk, when considering the industry effect. However, at industry-free level, this advantage for the better reduction performing firms disappears, and can be even replaced by a higher systematic risk. Therefore, it is important to introduce the industry control in the EU market as well.

b. Implied long-run growth rate

Tables 5-3-2 to 5-3-4 show the results of analysing the implied long-run residual income (or abnormal earnings) growth portfolios. The estimated LGR in terminal (year 5) residual income is implied by solving the equation (5.23), assuming the market risk premium is 3.5%, 4.0% and 5.0%, respectively, added to the local risk-free rate. The LGR is then winsorized at the 2.5% level. Only firms with a positive implied residual income in Year t+3 and onwards are included.

With market risk premium at 3.5%, at industry-free level, the actual growth rates have only been found significant difference between the best and worst environmental performance portfolios at 50% cut-off level, as shown in table 5-

3-2. The worst portfolio has a significantly higher LGR than the best, though both of these have negative growth prospects. The raw results of the best carbon performance portfolios have lower LGR than the worst, generally. However, none of these differences is significant.

After industry-adjustment, there is still no significant difference, irrespective of which criteria are applied. Even though, some of the best environmental/carbon performance portfolios show higher growth rates.

When we increase the market risk premium to 4.0%, before industry-adjustment, no significant difference is indentified. After industry-adjustment, the best groups have slightly higher growth prospects. However, there is still no significant difference, as shown in table 5-3-3.

When the market risk premium is 5.0%, before industry-adjustment, there is still no significant difference between the two groups. After considering industry effect, the best has been found to have higher growth prospects at the 10% cut-off level when applying the DF criterion. However, no other significant difference has been identified, as shown in table 5-3-4.

The above results indicate that for the EU, the environmental/carbon performance portfolios have no influence on companies' long term growth prospects, either before or after industry-adjustment.

Since no consistent significant performance has been found, we conclude that the best carbon portfolios do not have better growth potential than the worst in the long run, whether at an industry-free or industry-balanced level, no matter which criterion is applied.

c. Forecast medium-term growth rate

To capture the medium term cash flow expectation, we conduct a medium term earnings growth analysis, in table 5-3-5 we show the results of these estimations. The medium term earnings growth rate has also been winsorized at the 2.5% level to remove the outlier effect. In line with the previous portfolio analysis, we adopt both estimations at both industry-free and industry-adjusted (IND) levels.

At the 10% cut-off level, without industry-adjustment, we report that the best environmental performance portfolios generate an earnings growth rate of 11.51%, whereas the worst yield a rate of 8.91%. The difference of 2.6% between the two is statistically significant. From the carbon prospective, the best carbon performance portfolios have an average growth rate of 10.79%, while the worst have an average of 7.89 %. The best group show superior growth potential, with an average significant difference of 2.9%. These results are robust at the 20% and 50% cut-off levels.

After industry-adjustment, at the 10% cut-off level, the difference between the two environmental groups increases to 3.1%, which is still significant. However, the differences between the carbon groups are both economically and statistically significant, which are 3.84%, 2.33% and 2.23%, when applying FF, DF and CF respectively. These results of the carbon groups are robust at the 20% and 50% cut-off levels.

In contrast to the UK, these results for the EU show that the IBES analysts have confidence in the medium term (3-5 years) growth prospects of the low environmental/carbon emissions companies, both at industry-free and industry-balanced levels.

d. Forecast short-term profitability

To capture the short term cash flow expectation, we analyse the short term forecast return on equity at year-1 and year-2. In tables 5-3-6 and 5-3-7 we show the results of these estimations. The short term forecast returns on equity (FROE1 and FROE2) have been winsorized at the 2.5% level, to remove the outlier effect.

At the 10% cut-off level, we find that the results from the analysts' forecast are optimistic for the better environmental/carbon performers. At the industry-free level, all the forecast ROEs at year 1 for the best portfolios have superior profitability prospects than their worst counterparts. The differences between the two groups are in the range 1.11% to 2.45%, mostly statistically significant. At year 2, the best groups are predicted to have even stronger ROE than the worst, with the differences in the range 1.95% to 3.14%, and all statistically significant. At the 20% and 50% cut-off levels, results are mostly in line with those at the 10% cut-off level, and even more significant.

After adjusting by industries, the analysts show more confidence in the best groups' performances. The results are robust at all cut-off levels, and even more significant than before.

From the above results, we suggest that the IBES analysts have strong confidence in the short term (1-2 years) profitability prospects of the less environmental emission companies, whether with industry-adjustment or not.

e. Subsample regression

According to the share number deflation results (tables 5-3-9 and 5-3-10), at the industry-adjusted level, all carbon outputs have positive multipliers for firms' value, especially, the FFPS variable, which has a significant positive multiplier for firms' value. These results are in line with those of the EU entire sample, where all carbon outputs have been positively valued, whether with industry-adjustment or not. As we have suggested in the EU market, the introduction of the carbon emission trading scheme (EU ETS) may involve an over-allocation issue, which may be attributable to this positive valuation.

Further, we replace the share number deflation with the sales deflation (see table 5-2-11 and 5-2-12). The results are in line with those of the entire sample, in which the coefficients of all environmental/carbon variables are significantly negative at both the industry-free and industry-adjusted levels. This indicates that the valuation is sensitive to deflators.

Comparing the portfolio results, our regression results indicate that for the rest of the EU market, there may be value added by the introduction of the EU ETS, however, the increased value may not be the result of decreased carbon emissions.

5.6 Discussion and Conclusion

Our contribution in this chapter is to identify the source of the carbon valuation for each different carbon policy regimes. To achieve this, we have employed various proxies to detect the relationship between firms' environmental/carbon emission performance and their cash flow expectation and systematic risk. These include the short-term forecast ROE, the medium-term forecast earnings growth rate, and the long-term residual income growth rate as proxies for the cash flow expectation; and the cost of equity measuring systematic risk.

Portfolios of these target variables have been constructed at the 10%, 20%, and 50% cut-off levels, according to each environmental/carbon criteria. The LGR and the ICC are the results of calculation using the residual income model; whilst, the short-term forecast ROE and the medium-term forecast earnings growth rate are direct downloaded data from IBES.

The cost of equity is the main parameter in our estimations. To calculate this, we assume the growth rate is zero and use forecast earnings up to the third year; thereafter, the estimations of the fourth and fifth year residual incomes involve the forecast earnings growth rate. Hence, the subsample size for each of the regimes depends on the number of observations that have both forecast growth rate and forecast earnings up to the third year. In the estimation of the LGR, we employ the same model, but in turn, making assumption for the discount rate (cost of equity).

To summarize the portfolio results, at the industry-adjusted level, considering all three regimes, the US, the UK and the rest of the EU, we find that the cost of equity, as the firms' intrinsic feature, is associated with the regimes' emission constraints, i.e. low carbon firms' cost of equity can be reduced if there are strict emission constraints in place, but this is only the case for the UK and EU. However, for the US, where there is no emission constraint, firms' cost of equity cannot be reduced by carbon reduction activities. Further, we infer that the long-run growth prospects do not change with the enforcement of carbon reduction regulations. However, these results are derived from inconsistent beta development methods for different countries/areas; therefore the underlying implication for comparison purpose has been weakened. Finally, we report that the IBES analysts consistently forecast high profitability for the short and medium term for the low environmental/carbon emissions companies, irrespective of whether there are strict emission constraints in place. However, as to the extent of these forecasts, it is probably influenced by other factors, such as the cost of carbon reduction.

In order to identify the link between these portfolios' results and their counterpart valuation performances, the Ohlson's accounting-based equity valuation model and Hand and Landsman's valuation model have also been employed to test environmental and carbon influence on the firms' market value, for each subsample of the US, the UK and the EU (excluding the UK).

The share number deflation variables have been introduced into the regressions. Also, we deflate all the variables with the companies' sales, and run the same regressions using these sales-deflated variables. However, because of scale effects, the adoption of different deflators might alter the valuation parameters, i.e. the results can be sensitive to deflators.

For the US, both share number deflation and sales deflation subsample regressions indicate that the market negatively value the environmental/carbon outputs. On an industry-adjusted basis, the source of these negative valuations can be attributed to the analyst's optimistic expectations on short- and medium-term cash flow that is generated by those companies who produce less carbon emissions. Even though the companies' long-run growth prospects have not been influenced by their carbon performance, these may still contribute to the valuation, once combined with the terminal year residual incomes. However, the systematic risk has not been affected by their carbon emission reduction activities, and therefore, has no influence on the valuation.

For the UK, as the results from the sales deflated regressions are insignificant, we quote the share number deflation subsample regressions, which indicate that the market assigns significantly negative values to carbon outputs. On an industry-adjusted basis, the source of these negative valuations may be attributed to the analyst's optimistic expectation of the short and medium-term cash flow that is generated by those companies who produce less carbon emissions. Further, the lowered systematic risk can be another reason that causes the higher valuation for the more carbon emission reduction performers. Even though the companies' long-run growth prospects have not been affected by these carbon emission reduction activities, these still have an influence on the terminal value, which can float the valuation results.

For the rest of the EU, the valuation results are not robust when adopting different deflators. As to these unreliable results, our concern is still the over-allocation and windfall profit issues that we have mentioned in the previous chapter, by which a company may actually benefit even without further carbon reduction activities. On an industry-adjusted basis, even though the low carbon companies have better analysts' expectations for short- and medium-term cash flow and systematic risk, it is difficult to decide whether these are the effect of their emission reduction activities or the result of their extra emission allowances and generated windfall profits.

In summary, the share-number deflated subsample regression results show that the market negatively values the carbon outputs for the US and UK, while it positively values these for the rest of the EU. Whereas the sales deflated subsample regression results show that the market negatively values the carbon outputs for the US and the rest of the EU, while it insignificantly values these for the UK. However, the sources of these valuations are various. For the US, it's the short and medium term analysts' profitability forecast. For the UK, we suggest that the analysts' profitability expectation in the short and medium term and the ICC are the sources. However, for the EU, the analysts' profitability expectation in the short and medium term and the ICC may not be simply linked to carbon emission performance, and therefore, the relationship between carbon outputs and firms' market value is still unclear.

However, there are a few limitations in this portfolio and valuation matched method. First of all, consider that we only conduct these analyses based on a subsample for each of the regimes due to the limited data available, so the results may not be sufficiently robust to represent the entire market. As we can see in the EU subsample regressions, the significance of the carbon variables have changed; and in the UK subsample regressions, even the sign of the carbon variables has changed. Secondly, the results from the share number deflation and sales deflation are only robust for the US sample; however, for the UK and the EU samples, where the share number deflation and sales deflation results are in conflict, we have not identified which method is superior. It appears that for the UK it is the share number deflation and for the EU it is the sales deflation, which produce stronger and more significant results. Finally, to be consistent, we only choose the share number deflation and sales deflation for the three regimes. There might be better deflators for one or more regimes that we have not explored; therefore, future research is required to examine thoroughly the econometric issues for the different deflators.

Moreover, as to the debate between shareholder and stakeholder theory, our results are in line with the Renneboog et al. (2008) assertion, i.e. if a firm invests in projects that generate positive net present values to shareholders as well as positive externalities to other stakeholders (in our case, the better environment with less GHG effects), the firm may have a higher share price, which consequently can be translated into a better financial performance.

According to our results, we suggest that in a regime with strict emission constraints, firms may be able to improve other stakeholders' benefits by engaging in carbon reduction activities, and maximise shareholders' benefit through the reduced cost of capital, increased medium-term cash flow expectations and short-term profitability, on an industry-adjusted basis. Therefore, shareholders' and other stakeholders' welfare may be reconciled in this way. However, on an industry-adjusted basis, in a regime without emission constraints, though firms can improve other stakeholders' benefits by engaging in carbon reduction activities, their shareholders' benefit can be only improved through increased medium-term cash flow expectation and short-term profitability. Although this may result in an equilibrium between shareholders' and other stakeholders' welfare, we consider this status as temporary and unstable. Because the companies' systematic risk remains, these superior medium-term cash flow expectation and short-term profitability can be subject to cost consideration, energy price, policy intensity and public expectation, etc, which cause alterations in cash flow expectations.

Though we cannot draw any strong conclusion, a strict and well-defined carbon emission policy does seem to be a necessity for the company engaged in carbon reduction activities in order to create a relatively stable and permanent equilibrium between their shareholders and other stakeholders.

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Table 5-1-1 Estimation of Implied Cost of Capital for the US

	Implied cost of capital with LR growth = 0, winsorize at 2.5%, 10% cut-off			Implied cost of capital with LR growth = 0, winsorize at 2.5%, 20% cut-off			Implied cost of capital with LR growth = 0, winsorize at 2.5%, 50% cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0775	0.0740	0.0035*	0.0777	0.0744	0.0033**	0.0754	0.0732	0.0022**
			1.7345			2.3681			2.5712
FF	0.0813	0.0770	0.0043**	0.0810	0.0734	0.0076***	0.0747	0.0738	0.0009
			2.1894			5.4719			1.0857
DF	0.0821	0.0765	0.0056***	0.0823	0.0734	0.0089***	0.0754	0.0731	0.0023***
			2.8904			6.5585			2.7098
CF	0.0824	0.0751	0.0073***	0.0826	0.0731	0.0095***	0.0755	0.0731	0.0024***
			3.8203			6.9949			2.7672
IP IND	0.0751	0.0739	0.0012	0.0736	0.0756	-0.0021	0.0743	0.0743	0.0000
			0.5688			-1.5190			0.0224
FF IND	0.0738	0.0722	0.0016	0.0737	0.0715	0.0022	0.0747	0.0739	0.0008
			0.7816			1.5865			0.8868
DF IND	0.0754	0.0732	0.0022	0.0735	0.0722	0.0013	0.0747	0.0738	0.0009
			1.0535			0.9128			1.0747
CF IND	0.0759	0.0730	0.0029	0.0742	0.0718	0.0024*	0.0748	0.0737	0.0011
			1.3859			1.7009			1.2765

The table shows the result of analysing implied cost of capital estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming growth rate is zero at long term. The raw estimates show the actual cost-of-capital estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-2 Estimation of Implied Growth Rate for the US I

	Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%, 10% cut-off			Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%, 20% cut-off			Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%, 50% cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0245	0.0078	0.0167**	0.0202	0.0060	0.0142**	0.0194	0.0092	0.0102***
			2.1243			2.4010			2.8707
FF	0.0212	-0.0075	0.0287***	0.0168	0.0115	0.0053	0.0200	0.0084	0.0116***
			3.3012			0.8526			3.2934
DF	0.0239	-0.0047	0.0286***	0.0175	0.0045	0.0130**	0.0187	0.0099	0.0088**
			3.1379			2.0789			2.4835
CF	0.0226	-0.0003	0.0229**	0.0191	0.0080	0.0111*	0.0186	0.0099	0.0087**
			2.4982			1.7538			2.4531
IP IND	0.0099	0.0229	-0.0135*	0.0160	0.0115	0.0045	0.0147	0.0147	-0.0009
			-1.6977			0.7932			-0.2595
FF IND	0.0129	0.0219	-0.0092	0.0154	0.0194	-0.0042	0.0140	0.0150	-0.0015
			-1.1881			-0.7710			-0.4158
DF IND	0.0169	0.0165	0.0004	0.0153	0.0183	-0.0031	0.0141	0.0151	-0.0017
			0.0505			-0.5450			-0.4848
CF IND	0.0178	0.0167	0.0011	0.0136	0.0186	-0.0059	0.0135	0.0155	-0.0024
			0.1259			-1.0595			-0.6876

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 3.5% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-3 Estimation of Implied Growth Rate for the US II

	Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%, 10% cut-off			Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%, 20% cut-off			Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%, 50% cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0329	0.0197	0.0132**	0.0295	0.0165	0.0130***	0.0276	0.0202	0.0074**
			1.9751			2.5801			2.4292
FF	0.0297	0.0078	0.0219***	0.0252	0.0214	0.0038	0.0277	0.0201	0.0076**
			2.9680			0.7184			2.5068
DF	0.0308	0.0084	0.0224***	0.0264	0.0161	0.0103*	0.0270	0.0208	0.0062**
			2.9030			1.9457			2.0360
CF	0.0316	0.0126	0.0190**	0.0279	0.0193	0.0086	0.0270	0.0208	0.0062**
			2.4544			1.6107			2.0306
IP IND	0.0214	0.0264	-0.0059	0.0253	0.0201	0.0052	0.0241	0.0236	0.0005
			-0.8550			1.0760			0.1800
FF IND	0.0235	0.0275	-0.0040	0.0241	0.0281	-0.0040	0.0236	0.0246	-0.0014
			-0.5923			-0.8493			-0.4469
DF IND	0.0262	0.0261	0.0001	0.0240	0.0270	-0.0031	0.0238	0.0248	-0.0018
			0.0178			-0.6274			-0.6044
CF IND	0.0270	0.0263	0.0007	0.0232	0.0282	-0.0055	0.0232	0.0252	-0.0026
			0.1014			-1.1336			-0.8476

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 4.0% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-4 Estimation of Implied Growth Rate for the US III

	Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 10% cut-off			**Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 20% cut-off**			**Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 50% cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0518	0.0448	0.0070	0.0537	0.0425	0.0112***	0.0513	0.0454	0.0059**
			1.2584			2.8106			2.4240
FF	0.0520	0.0356	0.0164***	0.0512	0.0472	0.0040	0.0514	0.0452	0.0062**
			2.7673			0.9769			2.5474
DF	0.0547	0.0381	0.0166***	0.0531	0.0433	0.0098**	0.0514	0.0452	0.0062**
			2.7106			2.3963			2.5694
CF	0.0552	0.0433	0.0119*	0.0543	0.0464	0.0079*	0.0516	0.0451	0.0065***
			1.9471			1.9031			2.6755
IP IND	0.0425	0.0525	-0.0101*	0.0464	0.0484	-0.0025	0.0482	0.0492	-0.0018
			-1.7692			-0.6199			-0.7597
FF IND	0.0446	0.0526	-0.0085	0.0455	0.0545	-0.0093**	0.0482	0.0492	-0.0017
			-1.5118			-2.3925			-0.7002
DF IND	0.0465	0.0525	-0.0061	0.0460	0.0540	-0.0088**	0.0474	0.0494	-0.0022
			-1.0059			-2.2075			-0.9092
CF IND	0.0473	0.0523	-0.0054	0.0450	0.0550	-0.0105***	0.0468	0.0498	-0.0030
			-0.8813			-2.6930			-1.2421

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 5.0% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-5 Analysts' Medium Term (Yr3-5) Earnings Growth Estimates for the US

	IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 10% cut-off			**IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 20% cut-off**			**IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 50% cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1458	0.0909	0.0549***	0.1335	0.0944	0.0391***	0.1369	0.1112	0.0257***
			11.5063			13.0700			14.4518
FF	0.1347	0.0878	0.0469***	0.1332	0.0959	0.0373***	0.1361	0.1119	0.0242***
			10.3069			12.5702			13.5608
DF	0.1379	0.0861	0.0518***	0.1285	0.0952	0.0333***	0.1346	0.1135	0.0211***
			11.4225			11.4087			11.7356
CF	0.1380	0.0800	0.0580***	0.1283	0.0939	0.0344***	0.1345	0.1135	0.0210***
			13.8784			12.3275			11.6840
IP IND	0.1570	0.1076	0.0494***	0.1458	0.1119	0.0339***	0.1325	0.1156	0.0169***
			10.7482			11.1103			9.3162
FF IND	0.1530	0.1058	0.0472***	0.1430	0.1083	0.0347***	0.1331	0.1150	0.0181***
			10.2419			11.2509			9.9849
DF IND	0.1545	0.1082	0.0463***	0.1431	0.1084	0.0347***	0.1311	0.1170	0.0141***
			9.8558			11.3565			7.7744
CF IND	0.1546	0.1077	0.0469***	0.1433	0.1074	0.0359***	0.1314	0.1167	0.0147***
			10.1726			12.0094			8.0688

The table shows the result of analysing IBES medium-term (year 3-5) earnings growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-6 Analysts' Short Term Return on Equity Forecasts for the US I

	FROE1, winsorize at 2.5%, 10% cut-off			**FROE1, winsorize at 2.5%, 20% cut-off**			**FROE1, winsorize at 2.5%, 50% cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1827	0.1345	0.0482***	0.1644	0.1623	0.0021	0.1811	0.1732	0.0079*
			5.7122			0.3405			1.8659
FF	0.1743	0.1393	0.0350***	0.1657	0.1476	0.0181***	0.1847	0.1697	0.0150***
			4.5239			3.1451			3.5559
DF	0.1739	0.1408	0.0331***	0.1669	0.1530	0.0139**	0.1861	0.1683	0.0178***
			4.0044			2.3972			4.2270
CF	0.1770	0.1373	0.0397***	0.1657	0.1512	0.0145**	0.1838	0.1705	0.0133***
			4.9160			2.5221			3.1591
IP IND	0.1935	0.1441	0.0494***	0.1922	0.1556	0.0366***	0.1893	0.1652	0.0241***
			5.8863			5.7851			5.7311
FF IND	0.1914	0.1414	0.0500***	0.1911	0.1417	0.0494***	0.1915	0.1630	0.0285***
			5.8819			7.9118			6.7892
DF IND	0.2061	0.1490	0.0571***	0.1967	0.1440	0.0527***	0.1930	0.1614	0.0316***
			5.7651			7.8740			7.5370
CF IND	0.2071	0.1453	0.0618***	0.2002	0.1442	0.0560***	0.1935	0.1609	0.0326***
			6.3265			8.3249			7.7905

The table shows the result of analysing the forecast first year return on equity (FROE1) implied by IBES earnings estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is 3.5%. The base estimates show the actual ROE estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-7 Analysts' Short Term Return on Equity Forecasts for the US II

	FROE2, winsorize at 2.5%, 10%cut-off			**FROE2, winsorize at 2.5%, 20%cut-off**			**FROE2, winsorize at 2.5%, 50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1885	0.1422	0.0463***	0.1687	0.1626	0.0061	0.1799	0.1692	0.0107***
			6.1762			1.1536			3.0994
FF	0.1785	0.1468	0.0317***	0.1681	0.1495	0.0186***	0.1827	0.1663	0.0164***
			4.5644			3.8298			4.7778
DF	0.1778	0.1467	0.0311***	0.1683	0.1541	0.0142***	0.1837	0.1653	0.0184***
			4.2680			2.8717			5.3410
CF	0.1802	0.1369	0.0433***	0.1674	0.1493	0.0181***	0.1819	0.1672	0.0147***
			6.4296			3.7822			4.2734
IP IND	0.1977	0.1447	0.0530***	0.1931	0.1542	0.0389***	0.1871	0.1619	0.0252***
			7.4876			7.4448			7.3660
FF IND	0.1940	0.1441	0.0499***	0.1914	0.1434	0.0480***	0.1884	0.1607	0.0277***
			6.9395			9.3341			8.1111
DF IND	0.2081	0.1504	0.0577***	0.1965	0.1454	0.0511***	0.1897	0.1594	0.0303***
			6.9569			9.2284			8.8654
CF IND	0.2088	0.1468	0.0620***	0.1999	0.1444	0.0555***	0.1909	0.1582	0.0327***
			7.5608			10.0890			9.5799

The table shows the result of analysing the forecast second year return on equity (FROE2) implied by IBES earnings estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is 3.5%. The base estimates show the actual ROE estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the SIC 17 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=3487 is the total number of observations.

Table 5-1-8 Subsample Financial Statistics Summary for the US

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD	N
MVPS	45.52219	39.03	2.88	930.01	43.79168	3481
BVPS	17.51838	14.2284	.1138	331.325	17.0918	3481
EPS	2.17558	1.897315	-22.48127	40.74636	2.721098	3481
DPS	.6787742	.46	0	10	.8322375	3481
CAPCONPS	.6228571	.2524992	-25.60672	46.12724	2.257677	3224
TDPPS	19.19536	8.033349	0	1064.969	65.39759	3451
CAPEXPPS	1.897744	.8972975	0	36.31987	2.792299	3427
SIZE	37.25305	14.5	0	2100	94.01869	3436
SALEPS	37.69863	23.58743	.714345	472.8952	44.75745	3464
adj_RD	-.0206548	0	-7.234786	0	.2314926	3481
adj_AD	.2814581	0	0	16.66313	.7663282	3481
IPPS	2.021076	.4477002	.0021498	96.04858	5.163533	3481
FFPS	18.54668	2.651098	.0056868	651.9666	52.42262	3481
DFPS	12.93941	.5310239	0	561.7367	46.23913	3481
CFPS	11.75666	.4562589	0	550.9363	44.8067	3481
COMSH	512.3757	198.8	9.799	10862	1021.097	3481

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividend per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, TDPPS (TD_{it}), total debt per share, CAPEXPS (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS, sales per share, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, adj_AD (ADV_{it}), advertising expense per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is IPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June of the following year.

Table 5-1-9 Subsample Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the US

$$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS	1.4420***	1.4460***	1.4430***	1.4442***	1.5133***	1.5102***	1.5030***	1.5032***
	(0.4203)	(0.4159)	(0.4156)	(0.4150)	(0.4004)	(0.3974)	(0.3973)	(0.3970)
EPS	3.5548***	3.6013***	3.5623***	3.5663***	3.6334***	3.6669***	3.6442***	3.6461***
	(1.0119)	(1.0004)	(1.0073)	(1.0054)	(0.9195)	(0.9151)	(0.9179)	(0.9175)
DPS	0.9732	1.4082	1.4020	1.4433	2.7793	2.9520	2.8897	2.9031
	(2.0318)	(2.0731)	(2.0871)	(2.0928)	(2.5371)	(2.5574)	(2.5481)	(2.5487)
IPPS	-0.3681*				-0.5659***			
	(0.2189)				(0.1671)			
FFPS		-0.0706***				-0.0654***		
		(0.0223)				(0.0174)		
DFPS			-0.0755***				-0.0568***	
			(0.0244)				(0.0174)	
CFPS				-0.0825***				-0.0589***
				(0.0238)				(0.0175)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	12.6108**	12.7098**	12.5181**	12.4525**	13.5964	13.1228	12.7896	12.7644
	(5.2176)	(5.1578)	(5.2043)	(5.2193)	(9.1359)	(9.2171)	(9.3305)	(9.3332)
N	3481	3481	3481	3481	3481	3481	3481	3481
r2	0.5169	0.5220	0.5212	0.5220	0.5474	0.5482	0.5468	0.5468
F	67.41	68.42	68.42	68.47	25.83	26.08	26.01	26.02

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3481 observations in total.

Table 5-1-10 Subsample Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for the US

$P_{it} = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS	1.4277***	1.4313***	1.4290***	1.4303***	1.5032***	1.5022***	1.4959***	1.4965***
	(0.4461)	(0.4418)	(0.4415)	(0.4410)	(0.4309)	(0.4285)	(0.4283)	(0.4280)
EPS	2.7377***	2.8001***	2.7640***	2.7678***	2.8519***	2.8662***	2.8410***	2.8413***
	(0.9304)	(0.9106)	(0.9231)	(0.9229)	(0.7656)	(0.7593)	(0.7670)	(0.7667)
DPS	2.1449	2.5130	2.5220	2.5691	3.7027	3.8127	3.7656	3.7768
	(1.8640)	(1.9259)	(1.9370)	(1.9423)	(2.4018)	(2.4280)	(2.4189)	(2.4207)
CAPCONPS	1.5782*	1.4780*	1.4891*	1.4895*	1.2527	1.2570*	1.2732*	1.2776*
	(0.8126)	(0.8127)	(0.8143)	(0.8201)	(0.7636)	(0.7544)	(0.7529)	(0.7528)
IPPS	-0.2667				-0.5104***			
	(0.2256)				(0.1785)			
FFPS		-0.0587***				-0.0563***		
		(0.0214)				(0.0175)		
DFPS			-0.0640***				-0.0488***	
			(0.0235)				(0.0171)	
CFPS				-0.0714***				-0.0518***
				(0.0234)				(0.0176)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	12.1213**	12.3197**	12.1596**	12.1106**	14.0338	13.6362	13.3447	13.3167
	(5.5847)	(5.5268)	(5.5748)	(5.5905)	(8.9219)	(9.0142)	(9.1218)	(9.1239)
N	3224	3224	3224	3224	3224	3224	3224	3224
r2	0.5479	0.5522	0.5519	0.5527	0.5775	0.5783	0.5771	0.5773
F	59.92	60.16	60.27	60.31	24.79	24.99	24.94	24.95

Financial variables are expressed as dollar per share; MVPS (P_{it}), the market value per share or share price, BVPS (b_{it}), year end net book value per share, EPS (x_{it}), earnings per share, DPS (d_{it}), dividends per share, CAPCONPS (ΔC_{it}), net capital contributions received per share, IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost per share (IPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3224 observations in total.

Table 5-1-11 Subsample Regression of Price on Environment/Carbon and Financial Variables, Ohlson Model with sales deflated for US

$$P_{it}/s = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 Carbon_{it}/s + \varepsilon_{it}$$

	DFOL_IP	DFOL_FF	DFOL_DF	DFOL_CF	DFOL_IP	DFOL_FF	DFOL_DF	DFOL_CF
BSA	2.1050***	2.0940***	2.1017***	2.1039***	2.1742***	2.1740***	2.1754***	2.1761***
	(0.2192)	(0.2180)	(0.2188)	(0.2191)	(0.2250)	(0.2252)	(0.2253)	(0.2254)
ESA	4.8232***	4.7970***	4.8015***	4.8034***	4.9167***	4.9174***	4.9202***	4.9199***
	(1.1877)	(1.1703)	(1.1725)	(1.1718)	(1.2331)	(1.2295)	(1.2310)	(1.2308)
DSA	-3.1249*	-3.0291*	-3.0507*	-3.0451*	-1.8587	-1.8256	-1.8412	-1.8367
	(1.7683)	(1.7596)	(1.7603)	(1.7594)	(1.6627)	(1.6624)	(1.6632)	(1.6636)
IPSA	-0.4112				-0.1884			
	(0.2634)				(0.1634)			
FFSA		-0.1349***				-0.0712***		
		(0.0279)				(0.0182)		
DFSA			-0.1403***				-0.0670***	
			(0.0288)				(0.0196)	
CFSA				-0.1500***				-0.0725***
				(0.0258)				(0.0195)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	0.5407***	0.5946***	0.5726***	0.5681***	0.1165	0.1226	0.1116	0.1112
	(0.1075)	(0.1065)	(0.1050)	(0.1041)	(0.1494)	(0.1491)	(0.1496)	(0.1496)
N	3464	3464	3464	3464	3464	3464	3464	3464
r2	0.2949	0.2988	0.2986	0.2989	0.3374	0.3381	0.3379	0.3380
F	68.93	86.18	83.83	84.13	49.04	48.75	48.74	48.76

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales. IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) (IPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3464 observations in total.

Table 5-1-12 Subsample Regression of Share Price on Environment/Carbon and Financial Variables, HL Model with sales deflated, US

$$P_{it}/s = \sum_{j=1}^{j=17} \beta_{0j} IND_{jt} + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 Carbon_{it}/s + \varepsilon_{it}$$

	DFHL_IP	DFHL_FF	DFHL_DF	DFHL_CF	DFHL_IP	DFHL_FF	DFHL_DF	DFHL_CF
BSA	BSA	1.9934***	1.9832***	1.9913***	1.9940***	2.0664***	2.0676***	2.0688***
		(0.1775)	(0.1764)	(0.1775)	(0.1780)	(0.1938)	(0.1935)	(0.1936)
ESA	ESA	5.2117***	5.1793***	5.1823***	5.1834***	5.3189***	5.3111***	5.3139***
		(1.2887)	(1.2727)	(1.2756)	(1.2754)	(1.3241)	(1.3212)	(1.3229)
DSA	DSA	-3.2253	-3.1273	-3.1482	-3.1405	-1.9133	-1.8784	-1.8932
		(2.2038)	(2.1857)	(2.1891)	(2.1896)	(2.0816)	(2.0795)	(2.0808)
CCSA	CCSA	-1.7795	-1.8367	-1.8303	-1.8221	-2.2267	-2.2259	-2.2252
		(1.9573)	(1.9646)	(1.9630)	(1.9600)	(2.0013)	(1.9998)	(2.0003)
IPSA	IPSA	-0.4575				-0.1487		
		(0.3275)				(0.1920)		
FFSA	FFSA		-0.1409***				-0.0680***	
			(0.0327)				(0.0179)	
DFSA	DFSA			-0.1462***				-0.0629***
				(0.0333)				(0.0194)
CFSA	CFSA				-0.1555***			
					(0.0296)			
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	0.6120***	0.6694***	0.6459***	0.6405***	0.1915	0.1982	0.1876	0.1872
	(0.1259)	(0.1298)	(0.1267)	(0.1250)	(0.1780)	(0.1790)	(0.1791)	(0.1790)
N	3218	3218	3218	3218	3218	3218	3218	3218
r2	0.2980	0.3026	0.3024	0.3027	0.3489	0.3495	0.3494	0.3495
F	69.77	81.76	80.17	80.57	45.17	44.83	44.84	44.86

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales. IND are dummies for the 17 industries delineated by SIC codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) (IPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 3218 observations in total.

Table 5-2-1 Estimation of Implied Cost of Capital for the UK

	Implied cost of capital with LR growth = 0, winsorize at 2.5%, 10%cut-off			Implied cost of capital with LR growth = 0, winsorize at 2.5%, 20%cut-off			Implied cost of capital with LR growth = 0, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0789	0.1060	-0.0271***	0.0818	0.1003	-0.0185***	0.0864	0.0943	-0.0079***
			-5.5131			-5.8620			-4.0978
FF	0.0904	0.1030	-0.0126***	0.0842	0.0986	-0.0144***	0.0866	0.0941	-0.0075***
			-2.6963			-4.5887			-3.8935
DF	0.0897	0.1051	-0.0154***	0.0864	0.0964	-0.0100***	0.0870	0.0936	-0.0066***
			-3.2602			-3.1344			-3.4394
CF	0.0899	0.1040	-0.0141***	0.0868	0.0973	-0.0105***	0.0875	0.0932	-0.0057***
			-3.0179			-3.3182			-2.9693
IP IND	0.0839	0.1021	-0.0182***	0.0849	0.0970	-0.0121***	0.0879	0.0927	-0.0048**
			-4.1343			-4.0383			-2.4831
FF IND	0.0839	0.1003	-0.0164***	0.0846	0.0980	-0.0134***	0.0870	0.0935	-0.0065***
			-3.6898			-4.3916			-3.3621
DF IND	0.0840	0.1004	-0.0164***	0.0852	0.0969	-0.0117***	0.0867	0.0939	-0.0072***
			-3.5090			-3.8793			-3.7217
CF IND	0.0832	0.1016	-0.0184***	0.0846	0.0975	-0.0129***	0.0865	0.0941	-0.0076***
			-4.0019			-4.2266			-3.9677

The table shows the result of analysing implied cost of capital estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming growth rate is zero at long term. The raw estimates show the actual cost-of-capital estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-2 Estimation of Implied Growth Rate for the UK I

	Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%, 10%cut-off			Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%, 20%cut-off			Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0691	-0.0067	0.0758*	0.0424	0.0047	0.0377	0.0332	0.0083	0.0249
			1.9089			1.3579			1.5729
FF	0.0333	0.0121	0.0212	0.0411	0.0077	0.0334	0.0290	0.0125	0.0165
			0.5735			1.3044			1.0427
DF	0.0346	0.0270	0.0076	0.0337	0.0183	0.0154	0.0281	0.0134	0.0147
			0.2119			0.5855			0.9295
CF	0.0273	0.0277	-0.0004	0.0245	0.0039	0.0206	0.0277	0.0138	0.0139
			-0.0119			0.8205			0.8762
IP IND	0.0168	-0.0148	0.0316	0.0078	0.0028	0.0050	0.0371	0.0046	0.0325**
			1.0229			0.2079			2.0582
FF IND	0.0163	0.0048	0.0115	0.0216	0.0234	-0.0018	0.0260	0.0155	0.0105
			0.3354			-0.0696			0.6632
DF IND	0.0330	0.0435	-0.0105	0.0142	0.0274	-0.0132	0.0213	0.0202	0.0011
			-0.2529			-0.5173			0.0675
CF IND	0.0234	0.0373	-0.0139	0.0098	0.0323	-0.0225	0.0186	0.0229	-0.0043
			-0.3493			-0.8664			-0.2728

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 3.5% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-3 Estimation of Implied Growth Rate for the UK II

	Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%, 10%cut-off			Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%, 20%cut-off			Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0816	0.0184	0.0632	0.0564	0.0199	0.0365	0.0411	0.0222	0.0189
			1.5640			1.2917			1.1872
FF	0.0536	0.0343	0.0193	0.0571	0.0295	0.0276	0.0374	0.0260	0.0114
			0.5045			1.0583			0.7141
DF	0.0533	0.0497	0.0036	0.0529	0.0411	0.0118	0.0406	0.0228	0.0178
			0.0959			0.4420			1.1158
CF	0.0486	0.0501	-0.0015	0.0438	0.0257	0.0181	0.0403	0.0231	0.0172
			-0.0409			0.7179			1.0781
IP IND	0.0289	0.0082	0.0207	0.0145	0.0246	-0.0101	0.0465	0.0170	0.0295*
			0.6622			-0.4167			1.8512
FF IND	0.0293	0.0323	-0.0030	0.0257	0.0475	-0.0218	0.0361	0.0274	0.0087
			-0.0875			-0.8260			0.5466
DF IND	0.0520	0.0701	-0.0181	0.0214	0.0408	-0.0194	0.0292	0.0340	-0.0048
			-0.4202			-0.7508			-0.2983
CF IND	0.0442	0.0617	-0.0175	0.0271	0.0486	-0.0215	0.0265	0.0368	-0.0103
			-0.4217			-0.8206			-0.6450

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 4.0% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-4 Estimation of Implied Growth Rate for the UK III

	Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 10%cut-off			Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 20%cut-off			Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0844	0.0324	0.0520	0.0542	0.0167	0.0375*	0.0451	0.0217	0.0234*
			1.6328			1.7078			1.8218
FF	0.0346	0.0504	-0.0158	0.0593	0.0380	0.0213	0.0397	0.0271	0.0126
			-0.5041			1.0001			0.9798
DF	0.0479	0.0616	-0.0137	0.0499	0.0538	-0.0039	0.0400	0.0268	0.0132
			-0.4432			-0.1787			1.0257
CF	0.0461	0.0615	-0.0154	0.0499	0.0428	0.0071	0.0404	0.0264	0.0140
			-0.4980			0.3383			1.0882
IP IND	0.0227	-0.0009	0.0236	0.0155	0.0168	-0.0013	0.0526	0.0144	0.0382***
			0.9570			-0.0682			2.9847
FF IND	0.0264	0.0226	0.0038	0.0118	0.0292	-0.0174	0.0432	0.0237	0.0195
			0.1488			-0.8388			1.5197
DF IND	0.0290	0.0104	0.0186	0.0224	0.0218	0.0006	0.0370	0.0298	0.0072
			0.5683			0.0298			0.5573
CF IND	0.0211	0.0050	0.0161	0.0262	0.0289	-0.0027	0.0352	0.0315	0.0037
			0.5110			-0.1281			0.2900

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 5.0% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-5 Analysts' Medium Term (Yr3-5) Earnings Growth Estimates for the UK

	IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 10%cut-off			IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 20%cut-off			IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0983	0.1028	-0.0045	0.0944	0.0843	0.0101	0.0879	0.0802	0.0077**
			-0.4025			1.5226			2.1548
FF	0.0993	0.0984	0.0009	0.0926	0.0861	0.0065	0.0894	0.0787	0.0107***
			0.0871			0.9672			3.0106
DF	0.0943	0.0998	-0.0055	0.0891	0.0862	0.0029	0.0872	0.0808	0.0064*
			-0.5198			0.4361			1.7998
CF	0.0923	0.0953	-0.0030	0.0907	0.0840	0.0067	0.0874	0.0807	0.0067*
			-0.2908			0.9937			1.8734
IP IND	0.1025	0.0698	0.0327***	0.0929	0.0764	0.0165***	0.0891	0.0791	0.0100***
			3.8107			2.8903			2.8040
FF IND	0.1020	0.0677	0.0343***	0.0943	0.0751	0.0192***	0.0879	0.0803	0.0076**
			3.8850			3.2903			2.1280
DF IND	0.0930	0.0713	0.0217***	0.0947	0.0769	0.0178***	0.0887	0.0794	0.0093***
			2.6435			3.0903			2.6165
CF IND	0.0907	0.0716	0.0191**	0.0939	0.0754	0.0185***	0.0891	0.0791	0.0100***
			2.3076			3.2668			2.8125

The table shows the result of analysing IBES medium-term (year 3-5) earnings growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-6 Analysts' Short Term Return on Equity Forecasts for the UK I

	FROE1, winsorize at 2.5%, 10%cut-off			**FROE1, winsorize at 2.5%, 20%cut-off**			**FROE1, winsorize at 2.5%, 50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1887	0.2646	-0.0759***	0.2157	0.2563	-0.0406**	0.2380	0.2639	-0.0259**
			-2.8171			-2.0561			-2.0046
FF	0.2115	0.2450	-0.0335	0.2142	0.2488	-0.0346*	0.2378	0.2640	-0.0262**
			-1.4346			-1.9456			-2.0239
DF	0.2371	0.2500	-0.0129	0.1995	0.2457	-0.0462***	0.2386	0.2634	-0.0248*
			-0.4831			-2.8022			-1.9165
CF	0.2397	0.2453	-0.0056	0.2026	0.2469	-0.0443***	0.2435	0.2585	-0.0150
			-0.2172			-2.6952			-1.1585
IP IND	0.3356	0.2372	0.0984***	0.2879	0.2319	0.0560***	0.2539	0.2481	0.0058
			2.8369			2.6122			0.4466
FF IND	0.3076	0.2302	0.0774**	0.2871	0.2333	0.0538**	0.2528	0.2491	0.0037
			2.3210			2.4120			0.2850
DF IND	0.2606	0.2483	0.0123	0.2732	0.2612	0.0120	0.2619	0.2403	0.0216*
			0.4131			0.5398			1.6689
CF IND	0.2657	0.2652	0.0005	0.2734	0.2531	0.0203	0.2623	0.2398	0.0225*
			0.0161			0.9289			1.7420

The table shows the result of analysing the forecast first year return on equity (FROE1) implied by IBES earnings estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is 3.5%. The base estimates show the actual ROE estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-7 Analysts' Short Term Return on Equity Forecasts for the UK II

	FROE2, winsorize at 2.5%, 10% cut-off			FROE2, winsorize at 2.5%, 20% cut-off			FROE2, winsorize at 2.5%, 50% cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1809	0.2397	-0.0588***	0.2022	0.2323	-0.0301**	0.2195	0.2386	-0.0191**
			-2.8612			-2.0437			-1.9755
FF	0.2062	0.2255	-0.0193	0.2033	0.2273	-0.0240*	0.2196	0.2384	-0.0188*
			-1.0493			-1.7636			-1.9422
DF	0.2272	0.2248	0.0024	0.1928	0.2228	-0.0300**	0.2197	0.2383	-0.0186*
			0.1164			-2.3239			-1.9270
CF	0.2305	0.2250	0.0055	0.1957	0.2240	-0.0283**	0.2229	0.2351	-0.0122
			0.2681			-2.2039			-1.2635
IP IND	0.2898	0.2160	0.0738***	0.2555	0.2122	0.0433***	0.2309	0.2272	0.0037
			2.9127			2.7517			0.3805
FF IND	0.2687	0.2115	0.0572**	0.2514	0.2132	0.0382**	0.2302	0.2279	0.0023
			2.3508			2.3375			0.2334
DF IND	0.2401	0.2249	0.0152	0.2467	0.2333	0.0134	0.2374	0.2207	0.0167*
			0.6725			0.8038			1.7276
CF IND	0.2441	0.2389	0.0052	0.2474	0.2270	0.0204	0.2377	0.2204	0.0173*
			0.2192			1.2421			1.7929

The table shows the result of analysing the forecast second year return on equity (FROE2) implied by IBES earnings estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is 3.5%. The base estimates show the actual ROE estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1163 is the total number of observations.

Table 5-2-8 Subsample Financial Statistics Summary for the UK

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD	N
MVPS_USD	8.955987	6.229338	.1099262	76.84967	8.814399	1163
BVPS_USD	3.802918	2.330427	.0558013	40.73897	4.262348	1163
EPS_USD	.5616043	.3634992	-9.327994	13.32596	1.091363	1163
DPS_USD	.2548034	.1778561	0	2.159768	.2658206	1159
CAPCONPS_USD	.1021367	.0103551	-1.417866	7.21839	.3902226	1147
TDPPS_USD	5.184895	1.4931	0	318.5325	17.13065	1151
CAPEXPPS_USD	.468237	.2346957	0	9.035105	.7479219	1150
SIZE	26.06732	7.651	.015	561.876	56.40631	1151
SALEPS_USD	8.351827	5.520875	.0506213	130.7995	10.09827	1151
adj_RD	.0703264	0	0	3.467035	.2478411	1163
WIPPS	.3877222	.0893577	.0014447	7.19712	.9225157	1163
FFPS	2.612045	.5191078	.0048677	76.24109	6.963646	1163
DFPS	1.340907	.0958266	.0002029	68.04248	5.263879	1163
CFPS	1.186849	.0816081	0	65.70143	5.014866	1163
COMSH	1290.985	351.586	25.9	60000	3788.954	1163

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS, sales per sahre, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June of the following year.

Table 5-2-9 Subsample Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS_USD	0.2415**	0.2432**	0.2417**	0.2396**	0.2666*	0.2602*	0.2587*	0.2584*
	(0.1109)	(0.1096)	(0.1077)	(0.1074)	(0.1447)	(0.1406)	(0.1370)	(0.1355)
EPS_USD	1.3177**	1.4449***	1.4495***	1.4638***	0.9812**	1.0790**	1.0277**	1.0310**
	(0.5344)	(0.5072)	(0.5083)	(0.4986)	(0.4769)	(0.4452)	(0.4722)	(0.4644)
DPS_USD	17.4380***	17.9914***	18.0600***	18.1762***	17.8901***	18.3799***	18.1514***	18.1641***
	(2.0816)	(1.9128)	(1.8789)	(1.8318)	(1.4862)	(1.3851)	(1.4089)	(1.3917)
WIPPS	0.5122				-0.5339			
	(0.6690)				(0.5759)			
FFPS		-0.0391				-0.1481**		
		(0.0779)				(0.0680)		
DFPS			-0.0804				-0.1783**	
			(0.0898)				(0.0825)	
CFPS				-0.1188				-0.2027**
				(0.0781)				(0.0788)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	2.6734***	2.7560***	2.7473***	2.7510***	0.0039	-0.0085	-0.1357	-0.1362
	(0.6685)	(0.6878)	(0.6855)	(0.6833)	(0.3710)	(0.3035)	(0.2626)	(0.2641)
N	1159	1159	1159	1159	1159	1159	1159	1159
r2	0.5130	0.5112	0.5125	0.5147	0.5787	0.5848	0.5837	0.5850
F	52.38	64.75	63.87	64.89	23.42	25.17	24.80	25.01

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1159 observations in total.

Table 5-2-10 Subsample Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for the UK

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS_USD	0.2194**	0.2214**	0.2199**	0.2180**	0.2376*	0.2322*	0.2305*	0.2304*
	(0.1075)	(0.1066)	(0.1049)	(0.1050)	(0.1416)	(0.1386)	(0.1352)	(0.1337)
EPS_USD	1.3122**	1.4352***	1.4416***	1.4557***	0.9992**	1.0931**	1.0435**	1.0469**
	(0.5357)	(0.5127)	(0.5140)	(0.5044)	(0.4730)	(0.4455)	(0.4717)	(0.4638)
DPS_USD	17.5960***	18.1261***	18.2014***	18.3159***	18.0586***	18.5322***	18.3106***	18.3237***
	(2.0319)	(1.8695)	(1.8389)	(1.7947)	(1.4431)	(1.3471)	(1.3708)	(1.3546)
CAPCONPS_USD	1.7488**	1.7448**	1.7349**	1.7151**	1.3635***	1.2874***	1.2985***	1.2894***
	(0.6781)	(0.7356)	(0.7350)	(0.7307)	(0.3532)	(0.3304)	(0.3376)	(0.3359)
WIPPS	0.5114				-0.5189			
	(0.6507)				(0.5590)			
FFPS		-0.0359				-0.1439**		
		(0.0770)				(0.0666)		
DFPS			-0.0770				-0.1731**	
			(0.0894)				(0.0816)	
CFPS				-0.1146				-0.1973**
				(0.0772)				(0.0769)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	2.5126***	2.5957***	2.5888***	2.5939***	0.0098	-0.0026	-0.1260	-0.1266
	(0.6242)	(0.6395)	(0.6347)	(0.6324)	(0.3774)	(0.3128)	(0.2714)	(0.2733)
N	1145	1145	1145	1145	1145	1145	1145	1145
r2	0.5236	0.5217	0.5230	0.5250	0.5864	0.5922	0.5912	0.5924
F	45.30	55.23	54.12	54.82	23.59	25.25	24.88	25.11

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1145 observations in total.

Table 5-2-11 Subsample Regression of Price on Environment/Carbon and Financial Variables, Ohlson Model with sales deflated, UK

$P_{it}/s = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt}/s + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 Carbon_{it}/s + \varepsilon_{it}$

	DFOL_IP	DFOL_FF	DFOL_DF	DFOL_CF	DFOL_IP	DFOL_FF	DFOL_DF	DFOL_CF
BSA	0.4547***	0.4540***	0.4540***	0.4540***	0.4108*	0.4113*	0.4099*	0.4097*
	(0.1468)	(0.1485)	(0.1486)	(0.1486)	(0.2209)	(0.2148)	(0.2148)	(0.2148)
ESA	0.7092	0.7108	0.7105	0.7106	0.6880	0.6879	0.6881	0.6882
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
DSA	14.2588***	14.2665***	14.2667***	14.2670***	13.6934***	13.6809***	13.7100***	13.7158***
	(1.9919)	(1.9983)	(1.9956)	(1.9962)	(2.2361)	(2.1486)	(2.1480)	(2.1482)
WIPSA	0.2755				0.2652			
	(0.8433)				(0.9845)			
FFSA		0.0023				0.0136		
		(0.0376)				(0.0369)		
DFSA			0.0107				0.0294	
			(0.0356)				(0.0319)	
CFSA				0.0089				0.0328
				(0.0356)				(0.0308)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	0.6929***	0.7053***	0.7038***	0.7044***	0.0499	0.0565	0.0587	0.0586
	(0.0711)	(0.0759)	(0.0761)	(0.0762)	(.)	(.)	(.)	(.)
N	1146	1146	1146	1146	1146	1146	1146	1146
r2	0.6292	0.6290	0.6291	0.6290	0.6849	0.6849	0.6850	0.6851
F	55.35	55.20	55.57	55.47	48.71	48.69	48.63	48.63

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1146 observations in total.

Table 5-2-12 Subsample Regression of Share Price on Environment/Carbon and Financial Variables, HL Model with sales deflated, UK

$$P_{it}/s = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt}/s + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 Carbon_{it}/s + \varepsilon_{it}$$

	DFHL_IP	DFHL_FF	DFHL_DF	DFHL_CF	DFHL_IP	DFHL_FF	DFHL_DF	DFHL_CF
BSA	0.4379***	0.4378***	0.4378***	0.4378***	0.3927*	0.3916*	0.3903*	0.3901*
	(0.1473)	(0.1497)	(0.1498)	(0.1498)	(0.2228)	(0.2184)	(0.2184)	(0.2183)
ESA	0.6613	0.6615	0.6613	0.6613	0.6528	0.6533	0.6536	0.6537
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)
DSA	14.6267***	14.6275***	14.6271***	14.6272***	14.1311***	14.1552***	14.1820***	14.1880***
	(2.1305)	(2.1487)	(2.1465)	(2.1472)	(2.1590)	(2.0982)	(2.0970)	(2.0970)
CCSA	2.0797**	2.0845**	2.0799**	2.0808**	1.6682**	1.6613**	1.6569**	1.6562**
	(0.8859)	(0.8716)	(0.8750)	(0.8747)	(0.7560)	(0.7391)	(0.7420)	(0.7425)
WIPSA	0.0087				-0.0463			
	(0.7969)				(0.9618)			
FFSA		-0.0060				0.0094		
		(0.0355)				(0.0357)		
DFSA			0.0017				0.0245	
			(0.0330)				(0.0305)	
CFSA				0.0002				0.0280
				(0.0328)				(0.0292)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	0.6577***	0.6602***	0.6578***	0.6581***	0.0551	0.0511	0.0525	0.0523
	(0.0636)	(0.0695)	(0.0699)	(0.0701)	(.)	(.)	(.)	(.)
N	1144	1144	1144	1144	1144	1144	1144	1144
r2	0.6378	0.6378	0.6378	0.6378	0.6903	0.6904	0.6905	0.6905
F	40.49	40.25	40.64	40.54	46.60	46.48	46.48	46.47

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1144 observations in total.

Table 5-3-1 Estimation of Implied Cost of Capital for the EX

	Implied cost of capital with LR growth = 0, winsorize at 2.5%, 10%cut-off			**Implied cost of capital with LR growth = 0, winsorize at 2.5%, 20%cut-off**			**Implied cost of capital with LR growth = 0, winsorize at 2.5%, 50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.0996	0.0960	0.0036	0.0921	0.0941	-0.0024	0.0878	0.0908	-0.0032**
			1.1806			-1.1532			-2.4961
FF	0.1005	0.0934	0.0071**	0.0960	0.0926	0.0034	0.0889	0.0899	-0.0014
			2.4631			1.6417			-1.1043
DF	0.1013	0.0945	0.0068**	0.0972	0.0913	0.0059***	0.0882	0.0902	-0.0020
			2.4068			2.9481			-1.5259
CF	0.0986	0.0940	0.0046	0.0964	0.0912	0.0052***	0.0884	0.0904	-0.0023*
			1.6262			2.6060			-1.8010
IP IND	0.0796	0.0956	-0.0168***	0.0840	0.0960	-0.0124***	0.0863	0.0923	-0.0062***
			-5.7707			-6.1429			-4.9106
FF IND	0.0829	0.0939	-0.0115***	0.0829	0.0949	-0.0123***	0.0870	0.0920	-0.0056***
			-3.8616			-6.2123			-4.3955
DF IND	0.0830	0.0960	-0.0131***	0.0838	0.0948	-0.0113***	0.0863	0.0923	-0.0062***
			-4.5630			-5.6563			-4.9040
CF IND	0.0844	0.0964	-0.0126***	0.0845	0.0945	-0.0100***	0.0863	0.0923	-0.0062***
			-4.3072			-4.9950			-4.8786

The table shows the result of analysing implied cost of capital estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming growth rate is zero at long term. The raw estimates show the actual cost-of-capital estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-2 Estimation of Implied Growth Rate for the EX I

	Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%,10%cut-off			**Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%,20%cut-off**			**Implied Growth Rate with cost of equity =rf+ 3.5%, winsorize at 2.5%,50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	-0.0344	-0.0244	-0.0100	-0.0379	-0.0219	-0.0166	-0.0266	-0.0036	-0.0235*
			-0.3028			-0.7500			-1.8297
FF	-0.0414	-0.0154	-0.0267	-0.0367	-0.0317	-0.0054	-0.0212	-0.0092	-0.0124
			-0.8314			-0.2374			-0.9649
DF	-0.0355	-0.0125	-0.0230	-0.0390	-0.0370	-0.0025	-0.0187	-0.0117	-0.0074
			-0.6754			-0.1073			-0.5780
CF	-0.0239	-0.0139	-0.0109	-0.0340	-0.0340	-0.0009	-0.0191	-0.0111	-0.0085
			-0.3110			-0.0402			-0.6602
IP IND	0.0086	-0.0224	0.0310	-0.0210	-0.0221	0.0011	-0.0162	-0.0142	-0.0024
			1.1270			0.0540			-0.1885
FF IND	-0.0144	-0.0124	-0.0028	-0.0231	-0.0262	0.0031	-0.0125	-0.0183	0.0058
			-0.0934			0.1541			0.4533
DF IND	-0.0017	-0.0179	0.0162	-0.0242	-0.0323	0.0081	-0.0153	-0.0153	-0.0001
			0.5524			0.4039			-0.0088
CF IND	-0.0085	-0.0100	0.0015	-0.0098	-0.0336	0.0238	-0.0160	-0.0140	-0.0027
			0.0502			1.1260			-0.2129

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 3.5% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-3 Estimation of Implied Growth Rate for the EX II

	Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%,10%cut-off			**Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%,20%cut-off**			**Implied Growth Rate with cost of equity =rf+ 4.0%, winsorize at 2.5%,50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	-0.0153	-0.0135	-0.0018	-0.0257	-0.0138	-0.0119	-0.0088	0.0005	-0.0093
			-0.0575			-0.5912			-0.7904
FF	-0.0208	-0.0053	-0.0155	-0.0223	-0.0271	0.0048	-0.0050	-0.0032	-0.0018
			-0.5268			0.2307			-0.1540
DF	-0.0139	0.0058	-0.0197	-0.0184	-0.0271	0.0087	-0.0030	-0.0052	0.0022
			-0.6239			0.4085			0.1843
CF	-0.0035	-0.0031	-0.0004	-0.0144	-0.0249	0.0105	-0.0039	-0.0044	0.0005
			-0.0134			0.4945			0.0462
IP IND	0.0253	-0.0151	0.0404	-0.0082	-0.0161	0.0079	-0.0010	-0.0071	0.0061
			1.5995			0.4264			0.5171
FF IND	0.0029	-0.0117	0.0146	-0.0087	-0.0173	0.0086	0.0035	-0.0116	0.0151
			0.5504			0.4833			1.2847
DF IND	0.0162	-0.0086	0.0248	-0.0045	-0.0196	0.0151	0.0025	-0.0107	0.0132
			0.9347			0.8238			1.1247
CF IND	0.0111	-0.0011	0.0122	0.0057	-0.0206	0.0263	0.0009	-0.0090	0.0099
			0.4470			1.3650			0.8439

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 4.0% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-4 Estimation of Implied Growth Rate for the EX III

	Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 10%cut-off			Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 20%cut-off			Implied Growth Rate with cost of equity =rf+ 5.0%, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	-0.0077	-0.0038	-0.0039	0.0018	0.0129	-0.0111	0.0140	0.0223	-0.0083
			-0.1834			-0.7878			-1.0013
FF	-0.0138	0.0089	-0.0227	-0.0027	0.0061	-0.0088	0.0141	0.0223	-0.0082
			-1.1261			-0.6138			-0.9914
DF	-0.0159	0.0189	-0.0348	-0.0071	0.0004	-0.0075	0.0150	0.0214	-0.0064
			-1.5637			-0.5104			-0.7796
CF	-0.0074	0.0128	-0.0202	-0.0075	0.0013	-0.0088	0.0146	0.0219	-0.0073
			-0.9105			-0.6076			-0.8879
IP IND	0.0271	-0.0008	0.0279	0.0090	0.0062	0.0028	0.0184	0.0180	0.0004
			1.5808			0.2237			0.0478
FF IND	0.0179	0.0021	0.0158	0.0089	0.0042	0.0047	0.0239	0.0124	0.0115
			0.8410			0.3806			1.4005
DF IND	0.0267	-0.0081	0.0348*	0.0138	0.0024	0.0114	0.0202	0.0163	0.0039
			1.8709			0.8961			0.4668
CF IND	0.0160	-0.0022	0.0182	0.0165	0.0013	0.0152	0.0189	0.0175	0.0014
			0.9591			1.1518			0.1748

The table shows the result of analysing the implied long-run residual income (or abnormal earnings) growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is a 5.0% in addition to the local risk-free rate. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-5 Analysts' Medium Term (Yr3-5) Earnings Growth Estimates for the EX

	IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 10%cut-off			IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 10%cut-off			IBES Analysts Estimate Medium Term (Yr3-5) Growth, winsorize at 2.5%, 50%cut-off		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1151	0.0891	0.0260***	0.1088	0.0836	0.0252***	0.1031	0.0849	0.0182***
			3.0284			4.5206			5.3877
FF	0.1090	0.0791	0.0299***	0.1056	0.0781	0.0275***	0.1034	0.0845	0.0189***
			3.6377			4.9706			5.6054
DF	0.1072	0.0783	0.0289***	0.1003	0.0772	0.0231***	0.0996	0.0883	0.0113***
			3.6198			4.2268			3.3377
CF	0.1076	0.0793	0.0283***	0.1031	0.0777	0.0254***	0.0998	0.0881	0.0117***
			3.6183			4.6104			3.4638
IP IND	0.1140	0.0830	0.0310***	0.1130	0.0832	0.0298***	0.1020	0.0859	0.0161***
			3.7338			5.3261			4.7761
FF IND	0.1163	0.0779	0.0384***	0.1086	0.0820	0.0266***	0.1027	0.0853	0.0174***
			4.5781			4.8196			5.1570
DF IND	0.1034	0.0801	0.0233***	0.1016	0.0798	0.0218***	0.1002	0.0878	0.0124***
			2.9687			4.0259			3.6536
CF IND	0.1013	0.0790	0.0223***	0.1007	0.0794	0.0213***	0.1002	0.0879	0.0123***
			2.8704			4.0009			3.6190

The table shows the result of analysing IBES medium-term (year 3-5) earnings growth estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance. The raw estimates show the actual growth estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-6 Analysts' Short Term Return on Equity Forecasts for the EX I

	FROE1, winsorize at 2.5%,10%cut-off			**FROE1, winsorize at 2.5%,20%cut-off**			**FROE1, winsorize at 2.5%,50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1505	0.1335	0.0170**	0.1752	0.1447	0.0305***	0.1921	0.1682	0.0239***
			2.2525			4.5126			4.7354
FF	0.1588	0.1477	0.0111	0.1725	0.1502	0.0223***	0.1948	0.1654	0.0294***
			1.3906			3.3260			5.8428
DF	0.1658	0.1443	0.0215***	0.1804	0.1492	0.0312***	0.1923	0.1679	0.0244***
			2.6965			4.7707			4.8402
CF	0.1735	0.1490	0.0245***	0.1818	0.1500	0.0318***	0.1921	0.1682	0.0239***
			2.8859			4.8970			4.7358
IP IND	0.1791	0.1569	0.0222**	0.2056	0.1623	0.0433***	0.1951	0.1652	0.0299***
			2.0067			5.2983			5.9572
FF IND	0.1827	0.1630	0.0197*	0.2070	0.1672	0.0398***	0.1972	0.1632	0.0340***
			1.7499			4.8499			6.7887
DF IND	0.1956	0.1613	0.0343***	0.2060	0.1648	0.0412***	0.1991	0.1613	0.0378***
			3.0095			5.1247			7.5679
CF IND	0.2009	0.1601	0.0408***	0.2032	0.1667	0.0365***	0.1973	0.1630	0.0343***
			3.6787			4.6596			6.8451

The table shows the result of analysing the forecast first year return on equity (FROE1) implied by IBES earnings estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is 3.5%. The base estimates show the actual ROE estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-7 Analysts' Short Term Return on Equity Forecasts for the EX II

	FROE2, winsorize at 2.5%, 10%cut-off			**FROE2, winsorize at 2.5%, 20%cut-off**			**FROE2, winsorize at 2.5%, 50%cut-off**		
	best	worst	diff	best	worst	diff	best	worst	diff
IP	0.1600	0.1361	0.0239***	0.1788	0.1457	0.0331***	0.1942	0.1677	0.0265***
			3.5783			5.6638			6.1727
FF	0.1657	0.1462	0.0195***	0.1770	0.1487	0.0283***	0.1966	0.1654	0.0312***
			2.9595			4.9737			7.2981
DF	0.1705	0.1451	0.0254***	0.1847	0.1484	0.0363***	0.1940	0.1680	0.0260***
			3.8811			6.4605			6.0502
CF	0.1796	0.1482	0.0314***	0.1864	0.1489	0.0375***	0.1936	0.1683	0.0253***
			4.2555			6.6933			5.8947
IP IND	0.1893	0.1575	0.0318***	0.2060	0.1613	0.0447***	0.1971	0.1650	0.0321***
			3.3206			6.4674			7.5182
FF IND	0.1923	0.1615	0.0308***	0.2086	0.1659	0.0427***	0.1988	0.1634	0.0354***
			3.1711			6.1347			8.3000
DF IND	0.1994	0.1621	0.0373***	0.2071	0.1634	0.0437***	0.2004	0.1618	0.0386***
			3.7868			6.4295			9.0826
CF IND	0.2044	0.1611	0.0433***	0.2045	0.1653	0.0392***	0.1988	0.1634	0.0354***
			4.5008			5.8713			8.2982

The table shows the result of analysing the forecast second year return on equity (FROE2) implied by IBES earnings estimates portfolios formed at the 10%, 20%, and 50% cut-off levels, on the basis of environmental/carbon performance, assuming cost of equity is 3.5%. The base estimates show the actual ROE estimates without considering industry effects, whilst the Industry-adjusted (IND) results show the effect once membership of the DS LEVEL-3 19 industry groups is allowed for. Figures under differences are t-statistics, calculated using simple t-tests for differences in the estimates. *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10%. N=1883 is the total number of observations.

Table 5-3-8 Subsample Financial Statistics Summary for the EX

VARIABLE	MEAN	MEDIAN	MIN	MAX	SD	N
MVPS_USD	41.2255	27.3919	.836158	996.9515	46.49085	1883
BVPS_USD	20.65002	12.12229	.3073258	262.6783	24.76536	1883
EPS_USD	2.758952	1.673105	-22.7053	60.98158	4.721384	1883
DPS_USD	1.160104	.7228948	0	66.27328	2.245937	1881
CAPCONPS_USD	.8606719	.0103737	-.0795413	107.1467	5.237859	1740
TDPPS_USD	42.02343	10.76553	0	2448.98	120.1675	1876
CAPEXPPS_USD	3.085057	1.38366	0	181.9467	6.482548	1834
SIZE	46.53675	19.983	.016	583.83	71.60427	1862
SALEPS_USD	51.04464	27.12217	.3317584	549.6333	65.14276	1871
adj_RD	.7247885	0	0	17.54938	1.685914	1883
WIPPS	2.497306	.451463	.0043424	65.66138	6.684395	1883
FFPS	21.96842	2.442115	.0020772	1383.105	76.36911	1883
DFPS	14.72136	.4413712	0	1249.544	65.28031	1883
CFPS	13.49037	.3449757	0	1244.662	63.94242	1883
COMSH	656.35	238.734	7.984	19380.64	1412.039	1883

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividend per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, TDPPS_USD (TD_{it}), total debt per share, CAPEXPPS_USD (IV_{it}), capital expenditure per share, SIZE, employees in thousands, SALEPS, sales per sahre, adj_RD (RD_{it}), research and development per share, this is the value after adjusted for the missing observations, COMSH, common share outstanding in thousands. The environmental performance measure is WIPPS in unit of dollar per share, and three carbon performance measures are FFPS, DFPS and CFPS, all in unit of Tonnes per thousand shares. Financial data cover the seven years 2002-2008 (collected at each year end), except MVPS, which is collected at June of the following year.

Table 5-3-9 Subsample Regression of Share Price on Environment/Carbon and Financial Variables from Ohlson (1995) Model for the EX
$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 Carbon_{it} + \varepsilon_{it}$

	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF	OHLS_IP	OHLS_FF	OHLS_DF	OHLS_CF
BVPS_USD	0.7557***	0.7683***	0.7755***	0.7779***	0.8886***	0.9067***	0.9142***	0.9163***
	(0.1058)	(0.1034)	(0.1014)	(0.1019)	(0.1071)	(0.1076)	(0.1064)	(0.1073)
EPS_USD	3.5106***	3.4830***	3.4876***	3.4854***	3.4763***	3.4551***	3.4559***	3.4545***
	(0.8791)	(0.8721)	(0.8712)	(0.8702)	(0.8077)	(0.8052)	(0.8044)	(0.8040)
DPS_USD	0.9692	0.9681	0.9626	0.9572	0.8125	0.7829	0.7730	0.7676
	(1.2397)	(1.2249)	(1.2147)	(1.2150)	(1.1616)	(1.1558)	(1.1460)	(1.1470)
WIPPS	0.4210				0.3900*			
	(0.3037)				(0.2114)			
FFPS		0.0245				0.0167***		
		(0.0153)				(0.0024)		
DFPS			0.0190				0.0111	
			(0.0137)				(0.0074)	
CFPS				0.0160				0.0089
				(0.0137)				(0.0081)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	13.8020***	14.1351***	14.2378***	14.2632***	-8.9240	-7.9667	-8.0344	-8.1051
	(2.1569)	(2.1838)	(2.2115)	(2.2214)	(7.5742)	(7.5522)	(7.7278)	(7.7310)
N	1881	1881	1881	1881	1881	1881	1881	1881
r2	0.5251	0.5232	0.5224	0.5221	0.5595	0.5577	0.5573	0.5572
F	87.31	83.13	87.55	88.35	40.05	39.90	39.59	39.55

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1881 observations in total.

Table 5-3-10 Subsample Regression of Share Price on Environment/Carbon and Financial Variables from H&L (2005) for the EX

$$P_{it} = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt} + \beta_1 b_{it} + \beta_2 x_{it} + \beta_3 d_{it} + \beta_4 \Delta C_{it} + \beta_5 Carbon_{it} + \varepsilon_{it}$$

	HAND_IP	HAND_FF	HAND_DF	HAND_CF	HAND_IP	HAND_FF	HAND_DF	HAND_CF
BVPS_USD	0.7198***	0.7369***	0.7452***	0.7472***	0.8544***	0.8786***	0.8871***	0.8884***
	(0.0950)	(0.0924)	(0.0906)	(0.0908)	(0.0890)	(0.0913)	(0.0905)	(0.0912)
EPS_USD	3.7161***	3.6807***	3.6842***	3.6818***	3.6771***	3.6484***	3.6495***	3.6483***
	(0.9879)	(0.9768)	(0.9739)	(0.9728)	(0.9118)	(0.9065)	(0.9041)	(0.9039)
DPS_USD	0.8943	0.8913	0.8846	0.8803	0.7311	0.6930	0.6811	0.6774
	(1.1422)	(1.1268)	(1.1161)	(1.1159)	(1.0620)	(1.0564)	(1.0459)	(1.0465)
CAPCONPS_USD	0.0097	-0.0081	-0.0169	-0.0181	0.0331	0.0151	0.0087	0.0080
	(0.1414)	(0.1498)	(0.1572)	(0.1581)	(0.1265)	(0.1333)	(0.1390)	(0.1395)
WIPPS	0.4530				0.4232**			
	(0.3073)				(0.2118)			
FFPS		0.0243				0.0160***		
		(0.0153)				(0.0023)		
DFPS			0.0184				0.0097	
			(0.0139)				(0.0082)	
CFPS				0.0164				0.0086
				(0.0137)				(0.0091)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	13.9146***	14.2795***	14.3854***	14.4064***	-9.8084	-8.8727	-8.9927	-9.0368
	(2.1700)	(2.1807)	(2.2042)	(2.2134)	(8.0113)	(7.9874)	(8.1866)	(8.1893)
N	1739	1739	1739	1739	1739	1739	1739	1739
r2	0.5205	0.5181	0.5172	0.5170	0.5555	0.5532	0.5528	0.5528
F	62.42	60.92	64.68	65.43	34.19	34.13	33.76	33.76

Financial variables are expressed as dollar per share; MVPS_USD (P_{it}), the market value per share or share price, BVPS_USD (b_{it}), year end net book value per share, EPS_USD (x_{it}), earnings per share, DPS_USD (d_{it}), dividends per share, CAPCONPS_USD (ΔC_{it}), net capital contributions received per share, IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost per share after winsorising (WIPPS). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions per thousand shares (FFPS), direct carbon emissions per thousand shares (DFPS), and carbon dioxide emissions per thousand shares (CFPS). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1739 observations in total.

Table 5-3-11 Subsample Regression of Price on Environment/Carbon and Financial Variables, Ohlson Model with sales deflated, EX

$$P_{it}/s = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt}/s + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 Carbon_{it}/s + \varepsilon_{it}$$

	DFOL_IP	DFOL_FF	DFOL_DF	DFOL_CF	DFOL_IP	DFOL_FF	DFOL_DF	DFOL_CF
BSA	0.8424***	0.8435***	0.8446***	0.8445***	0.8322***	0.8338***	0.8342***	0.8340***
	(0.0582)	(0.0583)	(0.0585)	(0.0584)	(0.0356)	(0.0369)	(0.0367)	(0.0365)
ESA	1.6470**	1.6722**	1.6773**	1.6786**	1.7519**	1.7852**	1.7863**	1.7870**
	(0.7166)	(0.7198)	(0.7215)	(0.7211)	(0.7108)	(0.7078)	(0.7084)	(0.7078)
DSA	0.7633	0.7360	0.7166	0.7167	0.8275	0.8190	0.7995	0.8018
	(0.8689)	(0.8737)	(0.8767)	(0.8763)	(0.8817)	(0.8878)	(0.8858)	(0.8853)
WIPSA	-1.2859***				-1.4409**			
	(0.4246)				(0.5958)			
FFSA		-0.1133***				-0.1076***		
		(0.0232)				(0.0339)		
DFSA			-0.1148***				-0.1150***	
			(0.0238)				(0.0377)	
CFSA				-0.1171***				-0.1168***
				(0.0234)				(0.0370)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	0.8824***	0.8700***	0.8548***	0.8528***	0.2394	0.2040	0.1926	0.1925
	(0.1603)	(0.1537)	(0.1516)	(0.1511)	(0.1842)	(0.1764)	(0.1740)	(0.1739)
N	1869	1869	1869	1869	1869	1869	1869	1869
r2	0.6243	0.6243	0.6235	0.6235	0.6640	0.6630	0.6628	0.6628
F	97.65	105.61	100.78	101.70	49.56	48.69	48.84	48.78

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1869 observations in total.

Table 5-3-12 Subsample Regression of Share Price on Environment/Carbon and Financial Variables, HL Model with sales deflated, EX

$$P_{it}/s = \sum_{j=1}^{j=19} \beta_{0j} IND_{jt}/s + \beta_1 b_{it}/s + \beta_2 x_{it}/s + \beta_3 d_{it}/s + \beta_4 \Delta C_{it}/s + \beta_5 Carbon_{it}/s + \varepsilon_{it}$$

	DFHL_IP	DFHL_FF	DFHL_DF	DFHL_CF	DFHL_IP	DFHL_FF	DFHL_DF	DFHL_CF
BSA	0.8224***	0.8243***	0.8255***	0.8254***	0.8018***	0.8027***	0.8030***	0.8028***
	(0.0579)	(0.0580)	(0.0581)	(0.0581)	(0.0269)	(0.0276)	(0.0274)	(0.0273)
ESA	1.7348***	1.7737***	1.7797***	1.7813***	1.8096***	1.8464***	1.8484***	1.8493***
	(0.5988)	(0.6033)	(0.6054)	(0.6051)	(0.6611)	(0.6577)	(0.6583)	(0.6580)
DSA	0.7271	0.6823	0.6627	0.6637	0.8148	0.7973	0.7813	0.7845
	(0.8003)	(0.8029)	(0.8065)	(0.8064)	(0.8351)	(0.8370)	(0.8375)	(0.8371)
CCSA	-0.4339*	-0.4385	-0.4382	-0.4378	-0.3746	-0.3779	-0.3780	-0.3775
	(0.2635)	(0.2672)	(0.2691)	(0.2695)	(0.2751)	(0.2777)	(0.2788)	(0.2793)
WIPSA	-1.7302***				-1.6050***			
	(0.4032)				(0.4987)			
FFSA		-0.1165***				-0.0958***		
		(0.0240)				(0.0289)		
DFSA			-0.1153***				-0.0979***	
			(0.0245)				(0.0320)	
CFSA				-0.1140***				-0.0960***
				(0.0240)				(0.0320)
IND	NA	NA	NA	NA	Various	Various	Various	Various
_cons	0.9016***	0.8719***	0.8551***	0.8523***	0.2556	0.2129	0.2025	0.2023
	(0.1660)	(0.1602)	(0.1579)	(0.1576)	(0.1903)	(0.1825)	(0.1805)	(0.1804)
N	1732	1732	1732	1732	1732	1732	1732	1732
r2	0.6284	0.6276	0.6266	0.6264	0.6684	0.6675	0.6672	0.6671
F	98.29	99.01	95.03	94.83	46.61	45.86	45.96	45.97

Financial variables are expressed as dollar over sales (dollar); MSA (P_{it}/s), the market value over sales, BSA (b_{it}/s), year end net book value over sales, ESA (x_{it}/s), earnings over sales, DSA (d_{it}/s), dividends over sales, CCSA ($\Delta C_{it}/s$), net capital contributions received over sales. IND are dummies for the 19 industries delineated by DS LEVEL-3 codes. The environmental performance variable is the total environmental damage cost (dollar) over sales (dollar) after winsorising (WIPSA). Carbon information variables are the quantities for first-tier supplier and direct carbon emissions (tonnes) over sales (thousand dollars) (FFSA), direct carbon emissions (tonnes) over sales (thousand dollars) (DFSA), and carbon dioxide emissions (tonnes) over sales (thousand dollars) (CFSA). Two-way clustered standard errors are shown in parentheses, *** indicates a p-value less than 1%, ** indicates a p-value less than 5% and * indicates a p-value less than 10% for a two-tailed test. 1732 observations in total.

Chapter 6 Carbon Prospects

6.1 The Conclusion

In this work, we have analysed the influences of carbon emission reduction activities in relation to the corporation's financial performance both at portfolio- and firm-level.

At the portfolio-level, we find that financial markets are affected by carbon emission constraints. Investors may be able to screen firms' management efficiency and corporate governance through firms' carbon emission performance, and make profits by implementing a long-short strategy, in markets where there are carbon emission constraints. However, investors do not enjoy these advantages where there is no carbon emission constraint in the market. Therefore, market anomalies have been reported for the UK and EU (ETS applied regimes), but not for the US (no carbon constraint regime).

At firm-level, our findings suggest that carbon outputs are value-relevant factors for the US, while for the UK, carbon variables are not significant value-relevant factors. For the EU, the results do not give clear evidence that carbon outputs can be value-relevant factors, as the share number deflated model and the sales deflated model generate diverse results. A possible implication is that in a market, where there is no carbon emission constraint, firms' carbon emission reduction activities may be a signal for their energy efficiency and may also generate positive reputational effects. However, any such signal effect appears to be weakened when there are carbon emission constraints in the market.

Moreover, at firm-level, we conduct investigations on the cash flow expectation and cost of capital effect, which can be the source of the incremental firm values. The results indicate that, on an industry-adjusted basis, for the US, the value added by the carbon reduction activities results from the short-term and medium-term cash flow expectations; for the UK, the potential value that can be added by carbon reduction activities derives from short-term and medium-term growth prospects and the reduced cost of equity; while for the EU, the sources of the potential value are the short-term and medium-term cash flow expectations and the reduced cost of equity, however, these may not be the results of reduced carbon emissions. We have noted that there are several failings in the EU ETS, such as the over-allocation and windfall profit issues, which may affect our valuations.

Specifically for the UK, the short term cash flow expectations may be affected by the cost incurred conducting these carbon reduction activities; whilst for the US and the rest of the EU, this appears not to be concern. Medium-term cash flow expectations are the source of potential incremental firm values for all markets; whereas the cost of equity is only reduced in markets where carbon emission constraints have been imposed. Finally, the carbon emission reduction activities do not change the companies' long-run growth prospects, whether there is carbon emission constraint or not. However, this final implication is subject to the inconsistent beta calculation methods.

6.2 The Role of Different Market Participants

Our analyses indicate that the imposing of carbon emission constraints can be critical, which may change companies' cost of equity. Therefore, governments play an important role in firms' carbon emission performance, by enforcing such emission regulations or not. The Stern Review (2006) points out that "Policy to reduce emissions should be based on three essential elements: carbon pricing, technology policy, and removal of the barriers to behavioural change."

Based on the resource-based review, Hamel and Prahalad (1989, 1994), who have emphasized the "competing for the future" as an important dimension of competitive advantage, suggest that firms should be concerned not only with profitability in the short term and growth in the medium term, but also with its future position and source of competitive advantage. Consequently, our work argues that carbon reduction activities are such a source, which can create a competitive advantage for the performing firms, on an industry-adjusted basis.

Again, the Stern Review (2006) argues that, by implementing carbon reduction activities, companies draw attention to yet more money-saving opportunities, i.e. root out the existing inefficient use of energy. In line with this argument, our findings suggest that the performance of the emission reduction can be a proxy for energy efficiency, particularly in a regime with no carbon emission constraints. However, we find no such signal effect in regimes with carbon emission constraint at firm-level, which may be the result of the climate-change policy on improving the inefficient energy usage across industries.

Further, Bush and Shirvastava (2011) believe that investors are becoming more actively engaged in assessing climate change risks, to which companies are exposed. One of the notable changes for institutional investors, is an increased trend in demanding for more carbon disclosure data and relevant carbon reduction strategies. They claim that statements on carbon emission reduction targets and implementation plans on carbon management practise, are clearly required by more and more institutional investors. Coincidently, we have shown that investors can profit by screening firms' carbon performance and implementing a long-short strategy in the market, where there are carbon emission constraints. Doing so, they indirectly screen firms' management efficiency and corporate governance performance.

Finally, the sensitivity to climate change of other market intermediaries (e.g. banks and insurance companies), suppliers, distributors, customers and business clients, may continue to rise in the future. Evidence shows that companies operating in regions with a high exposure to climate risk, confront additional insurance premiums (Swiss Re, 2006), which indicate the insurance companies' increasing concern in the field of climate change. Moreover, Bush and Shirvastava (2011) demonstrate that consumer preferences have been influenced the low-carbon concept. In the meantime, corporate clients have increased their requirement for detailed information about emission charges in their supply chains (e.g. Walmart). Companies within these supply chains are under pressure to report their GHG emission levels and corporate carbon reduction strategies. In accordance with the above evidence, we can expect a low-carbon society to develop in the future.

6.3 Carbon Future

Public expectations on climate change have been rising since the Kyoto protocol was initially adopted in 1997. In 2001, the Intergovernmental Panel on Climate Change (IPCC) has concluded in their third assessment report summary for policy makers that: "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities." Thereafter, the launch of EU ETS in 2005 has become the first large emission trading scheme in the world, but also provokes debate on climate issues and economic growth. In 2006, public attention has been drawn to the Stern review (October, 2006), which assesses a climate-economic integrated model. It concludes that “we can be ‘green’ and grow”, and “if we are not ‘green’, we will eventually undermine growth, however measured”. Shortly after, the IPCC fourth assessment report in 2007, describes a more severe global warming situation, once again evoking the general expectation of more stringent carbon reduction regulations.

> “Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.”
>
> “… without major policy changes, from an emissions perspective, we are not on track for meeting the objectives of UNFCCC Article 2.”

However, the general public has overvalued policy makers’ determination to launch stringent carbon regulations. In 2009, the United Nations Climate Change Conference was held in Copenhagen, commonly known as the Copenhagen Summit, where a framework for climate changes mitigation beyond 2012 was to be agreed. However, the climate talks were "in disarray". Only a "weak political statement" came out at the conclusion of the conference, with details, actions and time frame remaining unclear.

But, this is not the end of the story. “The move to green growth is no longer in doubt”. A recent trend shows that China has suggested engaging in more stringent emission constraints[43], which could trigger another wave of climate action in both Annex I and II countries. Further, for the US, Bush and Shirvastava (2011) indicate that a potential cap-and-trade system is under debate and may come into force in the near future. In the mean time, the other largest emission country, India[44], has also agreed to cut their carbon emissions.

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[43]Conway-Smith Erin, Dec 2011,

http://www.globalpost.com/dispatch/news/regions/africa/south-africa/111205/china-surprise-good-guy-at-durban-climate-conferenc

[44] Gray Louise, Dec 2011, Durban climate change conference: Big three of US, China and India agree to cut carbon emissions,

http://www.telegraph.co.uk/earth/environment/climatechange/8949317/Durban-climate-change-conference-Big-three-of-US-China-and-India-agree-to-cut-carbon-emissions.html

Moreover, Bush and Shirvastava (2011) classify low-carbon innovations into two categories; the process-based innovation (e.g. the use of renewable energy in a production system instead of fossil fuel) and the product-/service-oriented innovation (e.g. end-products that emit a minimum of carbon dioxide). Our work is based on the corporations' general carbon emission performance, without identifying the difference between the two categories. Future research is suggested to investigate the contributions of different innovations relating to corporate carbon performance and to compare the better drivers for corporate financial valuation, using developed financial models, when relevant data becomes available.

Climate change policy is under development at both international and national level. In addition, other stakeholder pressures mean that there are multi-factorial influences on companies to address climate change. Consequently, in the future the impact on companies financial performance maybe more significant and therefore we suggest further research be conducted in relation to these new trends, using up-to-date emission data. With this research we provide a robust theoretical framework for future empirical work in this area.

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APPENDICES

Appendix 1 DataStream Level 3 industry classification code (INDM3)

Mnem	LVL	English Abbreviation
Medias	3	Media
Retail	3	Retail
Chemcs	3	Chemicals
Conmat	3	Construct. & Material
Utlits	3	Utilities
Insura	3	Insurance
Finsys	3	Financial Services(3)
Pershs	3	Personal & Household Goods
Foodbv	3	Food & Beverage
Indsgs	3	Ind. Goods & Services
Basres	3	Basic Resources
Bankss	3	Banks
Autopt	3	Automobiles & Parts
Teleco	3	Telecommunications
Health	3	Healthcare
Techno	3	Technology
Oilgas	3	Oil & Gas
Travel	3	Travel & Leisure
Realet	3	Real Estate
EQWTS	3	Equity Warrants
OTWTS	3	Other Warrants
SUSEQ	3	Suspended Equities

Note that we exclude the dimension of Suspended Equities, Equity Warrants and Other Warrants.

Appendix 2 Kenneth R. French 17-industry classification based on SIC code (SICCLASS)

Name	Abbreviation
Food	Food
Mining and Minerals	Mines
Oil and Petroleum Products	Oil
Textiles, Apparel & Footware	Clths
Consumer Durables	Durbl
Chemicals	Chems
Drugs, Soap, Prfums, Tobacco	Cnsum
Construction and Construction Materials	Cnstr
Steel Works Etc	Steel
Fabricated Products	FabPr
Machinery and Business Equipment	Machn
Automobiles	Cars
Transportation	Trans
Utilities	Utils
Retail Stores	Rtail
Banks, Insurance Companies, and Other Financials	Finan
Other	Other

Appendix 3 DataStream Variables Definition

CAPITAL EXPENDITURES (additions to fixed assets)

Capital expenditures represent the funds used to acquire fixed assets other than those associated with acquisitions. It includes but is not restricted to: additions to property, plant and equipment and investments in machinery and equipment.

TOTAL DEBT

Total debt represents all interest bearing and capitalized lease obligations. It is the sum of long and short term debt.

NET PROCEEDS FROM SALE/ISSUE OF COMMON & PREFERRED

Net proceeds from sale/issue of common & preferred represents the amount a company received from the sale of common and/or preferred stock. It includes amounts received from the conversion of debentures or preferred stock into common stock, exchange of common stock for debentures, sale of treasury shares, shares issued for acquisitions and proceeds from stock options.

EMPLOYEES

Employees represent the number of both full and part time employees of the company. It excludes: seasonal employees and emergency employees.

Appendix 4 COMPUSTAT Variables Definition

CAPITAL EXPENDITURES

This item represents the funds used for additions to property, plant, and equipment, excluding amounts arising from acquisitions (for example, fixed assets of purchased companies). This item includes property & equipment expenditures.

PURCHASE OF COMMON AND PREFERRED STOCK

This item represents any use of funds which decreases common and/or preferred stock.

This item includes: conversion of class a, class b, special stock, and others, into common/ordinary stock (capital); conversion of preferred stock into common/ordinary stock (capital); purchase of treasury stock; retirement or redemption of common/ordinary stock; retirement or redemption of preferred stock; retirement or redemption of redeemable preferred stock.

This item excludes: purchase of warrants and reduction in stocks of a subsidiary.

SALE OF COMMON AND PREFERRED STOCK

U.S. and Canadian GAAP Definition

This item represents funds received from issuance of common and preferred stock.

This item includes: conversion of class a, class b, special stock, etc., into common/ordinary stock (capital); conversion of preferred stock and/or debt into common/ordinary stock (capital); exercise of stock options and/or warrants; increase in capital surplus due to stock issuance; related tax benefits due to issuance of common and/or preferred stock; sale of common/ordinary stock (capital); sale of preferred stock; sale of redeemable preferred stock; sale of stock; stock issued for an acquisition.

This item excludes: issuance of warrants and stock of subsidiary company.

EMPLOYEES

This item represents the actual number of people employed by the company and its consolidated subsidiaries.

DEBT IN CURRENT LIABILITIES

U.S. and Canadian GAAP Definition

This item represents the total amount of short-term notes and the current portion of long-term debt (debt due in one year).

This item is a component of current liabilities total.

This item is the sum of: long-term debt due in one year; notes payable (short-term borrowings) (np).

This item includes: bank acceptances and overdrafts; loans payable to the officers of the company; loans payable to stockholders; loans payable to parents, and consolidated and unconsolidated subsidiaries; notes payable to banks and others; instalments on a loan; sinking fund payments; brokerage companies' drafts payable.

LONG-TERM DEBT - TOTAL

U.S. and Canadian GAAP Definition

The item represents debt obligations due more than one year from the company's balance sheet date.

This item is a component of Liabilities Total (LT).

This item includes: Purchase obligations and payments to officers, when listed as long-term liabilities; Notes payable, due within one year and to be refunded by long-term debt when carried as a non-current liability; Long-term lease obligations (capitalized lease obligations); Industrial revenue bonds; Advances to finance construction; Loans on insurance policies; Indebtedness to affiliates; Bonds, mortgages, and similar debt; All obligations that require interest payments; Publishing companies' royalty contracts payable; Timber contracts for forestry and paper; Extractive industries' advances for exploration and development; Production payments and advances for exploration and development.

This item excludes: Subsidiary preferred stock, included in Minority Interest; The current portion of long-term debt, included in Current Liabilities; Accounts payable due after one year, included in other Liabilities; Accrued interest on long-term debt, included in other Liabilities; Customers' deposits on bottles, kegs, and cases, included in Other Liabilities; Deferred compensation

Long-term debt should be reported net of premium or discount. Standard & Poor's will collect the net figure.

LIABILITIES - OTHER - TOTAL

U.S. and Canadian GAAP Definition

This item represents all noncurrent liabilities that are not debt, deferred taxes, investment tax credits, minority interest or shareholders' equity.

This item is a component of Total Liabilities.

This item includes: Accounts payable due after one year; Contingent liabilities; Accounts receivable assigned; Notes receivable discounted; Guarantees; Customers' deposits on bottles, cases, and kegs; Negative goodwill; Reserves not shown elsewhere; Foreign exchange losses; Facility realignment and relocation; Reserves for self-insurance, when reported in Other Liabilities; Film producers' film contracts; Accrued taxes; Accrued expenses; Dividends payable; Unearned income.

This item excludes: Deferred taxes; Investment tax credit; Long-term debt; Minority interest; Shareholders' Equity; Valuation reserves for loans and securities (as non liabilities, they are recorded in their own specific account); Capital notes and debentures (considered part of total capital); Gain/losses resulting from extraordinary items or discontinued operations; Provision for losses on accounts receivable; Earnings/losses of unconsolidated subsidiaries; Income/loss allocated to minority interest; Items that are not gains or losses; Unrealized gains and losses; Disposal of property, plant and equipment included in operations, reported separately from income/expense items; Deferred gains and losses; Dilution gain or loss; Proceeds from sale of assets, PP&E, etc.

PREFERRED/PREFERENCE STOCK (CAPITAL)

U.S. and Canadian GAAP Definition

This item represents the net number of preferred shares at year-end multiplied by the par or stated value per share as presented in the company's Balance Sheet.

This item is a component of Shareholders' Equity (SEQ).

This item includes: Preferred stock subscriptions; Utilities subsidiary preferred stock; Redeemable preferred stock; Preference stock; Receivables on preferred stock; Adjustment for redeemable preferred treasury stock; Excess over par value of preferred stock when a separate breakout is not available.

This item excludes: Preferred stock sinking funds reported in current liabilities; Secondary classes of Common/Ordinary Stock (Capital); Subsidiary preferred stock.

Appendix 5 Derived procedure of the weighted average Ohlson model

$P_t = b_t + \alpha_1 x_t^a + \alpha_2 v_t$ (4.2)

$\alpha_1 = \frac{\omega}{1+r-\omega}$ (4.2.1)

$\alpha_2 = \frac{1+r}{(1+r-\omega)(1+r-\gamma)}$ (4.2.2)

$x_t^a = x_t - rb_{t-1}$ (4.3.1)

$b_t = x_t - d_t + b_{t-1}$ (4.3.2)

From equation (4.3.2), $b_{t-1} = b_t - x_t + d_t$

Substituting equation (4.3.1) into (4.2),

$P_t = b_t + \alpha_1(x_t - rb_{t-1}) + \alpha_2 v_t$

Substituting the transformation of (4.3.2) into the above formula,

$P_t = b_t + \alpha_1[x_t - r(b_t - x_t + d_t)] + \alpha_2 v_t$

Reorganizing,

$P_t = (1 - \alpha_1 r)b_t + \alpha_1(x_t + rx_t - rd_t) + \alpha_2 v_t$

Segregating,

$P_t = (1 - \alpha_1 r)b_t + \alpha_1 r(\frac{x_t}{r} + x_t - d_t) + \alpha_2 v_t$

Finalizing,

$P_t = (1 - \alpha_1 r)b_t + \alpha_1 r[\frac{x_t(1+r)}{r} - d_t] + \alpha_2 v_t$ (4.4)

Appendix 6 Share Number Definitions

a. Common shares outstanding from DATASTREAM, for EU and UK

Common shares outstanding represent the number of shares outstanding at the company's year end. It is the difference between issued shares and treasury shares. For companies with more than one type of common/ordinary share, common shares outstanding represents the combined shares adjusted to reflect the par value of the share type identified in field 6005 - Type of Share.

b. Number of Common Shares Outstanding from COMPUSTA North America , for the US

U.S. and Canadian GAAP Definition. This item represents the net number of all common shares outstanding at year-end, excluding treasury shares and scrip. For foreign companies trading on a U.S. exchange, this item represents the number of American Depositary Receipts or American Depositary Shares.

Common treasury shares carried on the asset side of the balance sheet are netted against the number of common shares issued.

Common shares paid in stock dividends are included when the ex-dividend date falls within the year and the payment date the next year.

Common Shares Outstanding will not be the same as Common Shares for Basic Earnings per Share when the company reports earnings per share based on average shares, when there has been a change in the shares over the year, when more than one class of common stock is outstanding or when the company reports earnings per share based on common stock equivalents.

Common shares will be excluded when a company nets shares held by a consolidated subsidiary against the capital account.

Appendix 7 Carbon Disclosure Project (CDP)

Carbon Disclosure Project (CDP) is an independent not-for-profit organisation holding the largest database of primary corporate climate change information in the world. Some 3,000 organizations across the world's largest economies now measure and disclose their greenhouse gas emissions and climate change strategies through CDP, in order that they can set reduction targets and make performance improvements. This data is gathered on behalf of 534 institutional investors, with combined assets under management in excess of $64 trillion, as well as purchasing organisations and government bodies and made available for integration into business and policy decision making.

For the years used in this research, i.e. 2002 to 2008, there were no government requirements in the EU and US for companies to reveal their carbon footprint and therefore raw data only for companies who have volunteered this. However, Trucost complete the data gaps with advanced EEIO modelling (see appendix 9).

Reporting timeline

Climate change program: CDP sends out its annual information request to companies worldwide on 1 February, after which the online response system is open for data input from disclosing companies. Corporations should submit their CDP response by the 30 May deadline. Publicly disclosed data will be published on our website in the month of September.

Supply chain program: CDP sends out its annual information request to companies worldwide on 1 April, after which the online response system is open for data input from disclosing companies. Suppliers should submit their CDP response by the 31 July deadline. Publicly disclosed data will be published on our website in the month of January.

Appendix 8 Trucost Methodology for Supply Chain Estimation

Trucost research, standardize and validate company disclosed data (via environmental reports, financial reports, websites) and carbon disclosure project (CDP) responses (Trucost is a CDP Gold partner). Trucost also engage directly with companies to verify their research and collect non-disclosed data.

Trucost use some input-output model to try to estimate supply chain effects, which is important as we have explained in the context that for some industry the supply-chain can produce even more emission then the company itself.

Trucost Methodology for Pricing Environmental Impact

Trucost has developed a comprehensive approach to calculating environmental impacts across operations, supply chains and investment portfolios.

At the heart of the process is Trucost's advanced environmental profiling model which accounts for 464 industries worldwide and tracks over 100 environmental impacts. The model also examines the interactions and cash flows between sectors in order to map each sector's supply chain.

With the help of our international academic advisory panel, Trucost has built an environmental profile for each of the 464 sectors. These profiles quantify the environmental impacts associated with a sector, based on the nature of its business activities.

This data model is the foundation for the assessment that Trucost does of an organisation's environmental impacts. However, the model is privileged.

How the Process Works

1. Analyse company data

2. Map company data

3. Incorporated reported data

4. Prioritise environmental impacts

5. Quantifying environmental impacts in financial terms

Appendix 9 Environmentally Extended Input output (EEIO) Modelling

Environmentally Extended Input output (EEIO) Modelling

Where companies do not disclose natural capital data, Trucost complete the data gaps with advanced EEIO modelling which converts business information related to activities and revenues into detailed natural capital metric. However, this EEIO model is privileged.

Indices covered

MSCI WORLD, S&P 500, MSCI EMERGING MARKETS, MSCI EUROPE, STOXX EUROPE 600, S&P/IFCI LARGEMIDCAP, MSCI ASIA EX-JAPAN, FTSEALL-SHARE, NIKKEI 225, TOPIX 150, BOVESPA, ASX 200, CAC40, SMI, KOSPI, IBEX, AEX AND FTSEMIB

Verification

Trucost have developed a robust verification process which includes independent analyst quality checks, identification of data outliers and sector level comparisons. They also engage directly with companies as part of the research process to verify their assessment.

For more information, see

http://www.trucost.com/_uploads/EBoard/EBoard%20product%20brochure.pdf

Appendix 10 Trucost Products and Applications

Trucost has been researching, standardising and validating data on companies' carbon emissions, water usage, waste disposal, pollutants and natural resource dependency, since 2000.

Investors, companies, governments, NGOs and academic institutions use Trucost data in many different ways, including constructing new investment products, assessing the environmental footprint of procurement decisions and conducting bespoke research projects.

Trucost data is used by investors to construct investment indices and funds that reduce risk from environmental issues and reward environmentally efficient companies. Investors also use Trucost data to identify risk and opportunity alongside traditional financial metrics.

These Investors include BofA Merrill Lynch Carbon Leaders, Europe Index GLG Environment Fund, LGIM UK Equity Carbon Optimized Index Fund, NYSE Euronext Low Carbon 100 Europe Index, S&P US Carbon Efficient Index, UBS Europe Carbon Optimised Index and Virgin Money Climate Change Fund, etc.

For more information, see

http://www.trucost.com/_uploads/downloads/How_does_Trucost_use_data_on_my_company.pdf

Appendix 11 Other Environmental Databases

ASSET4

ASSET4, a Thomson Reuters business, provides objective, relevant and systematic environmental, social and governance (ESG) information based on 250+ key performance indicators (KPIs) and 750+ individual data points along with their original data sources.

Issues such as climate change, executive remuneration and employee rights are becoming as important as traditional metrics for companies and investors, that is why having access to an objective and comparable database and analysis tools is so important.

http://thomsonreuters.com/products_services/financial/content_news/content_overview/content_az/content_esg/#tab4

EIRIS

EIRIS is a leading global provider of research into corporate environmental, social and governance performance.

EIRIS is an independent, not-for-profit organisation, whose mission is to empower responsible investors with independent assessments of companies and advice on integrating them with investment decisions.

http://www.eiris.org/index.html

KLD

"KLD was founded in 1989 by Peter Kinder, Steve Lydenberg and Amy Domini. They offer institutional investors easy-to-use, comprehensive and accurate social research on U.S. companies. They are committed to giving investment managers exactly what they need.

KLD maintains the largest body of research available, and profiles companies applying both positive and negative social investing criteria. KLD presents its findings in formats specifically designed for investment portfolio managers.Their consulting services help clients make more out of social investing. These clients include money managers, mutual funds, banks and pension funds.

Appendix 12 Greenhouse Gas Protocol (GHGP)

Companies responding to the CDP have to report according to the reporting guidelines set out by the Greenhouse Gas Protocol (GHGP). GHGP is a non-profit organisation that has established a reporting system for carbon, because it was needed and no government authority seemed to provide it.

Calculation Tools

The calculations tools are electronic Excel spreadsheets with accompanying step-by-step guidance documents. A guidance document includes:

- An overview of the protocol with information on the sector, sources, and process(es) that it covers;
- One or more approaches for determining CO2 and other GHG emissions, e.g., direct measurement, mass balance, etc.;
- Guidance on collecting activity data and selecting appropriate emission factors;
- Likely emissions sources and the scopes they fall under (specific to a particular sector);
- Additional information, such as quality control practices and program specific information.

The spreadsheets help carry out any necessary emissions calculations.

These tools were developed in partnership with industry experts and represent best practice quantification methodologies. The calculation tools are available on the GHG Protocol website and are meant to complement the Protocol and make calculations easier, but their use is not mandatory.

Direct and Indirect Emissions

The GHG Protocol defines direct and indirect emissions as follows:

- Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity.

- Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

The GHG Protocol further categorizes these direct and indirect emissions into three broad scopes:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. T&D losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

Reporting and Verification

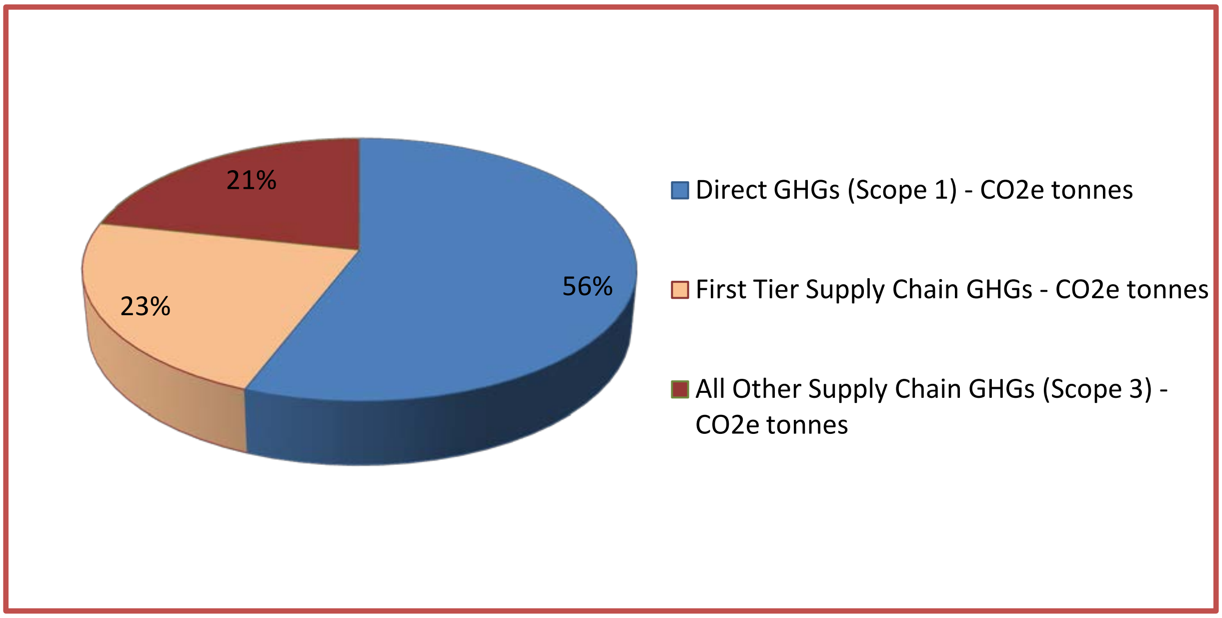
The GHG Protocol focuses only on accounting and reporting of GHG emissions. However, the Protocol does offer guidelines on how to develop your inventory in order to make it more amenable to verification.

The GHG Protocol was designed to help companies meet multiple reporting objectives. It was therefore inappropriate for the GHG Protocol to set a “one size fits all” materiality threshold. A materiality threshold is best set by a GHG program/initiative. If however a company is reporting outside a GHG program, this does not preclude a company from determining its own threshold in collaboration with a third party verifier, consistent with the nature of its sources and reporting objectives.

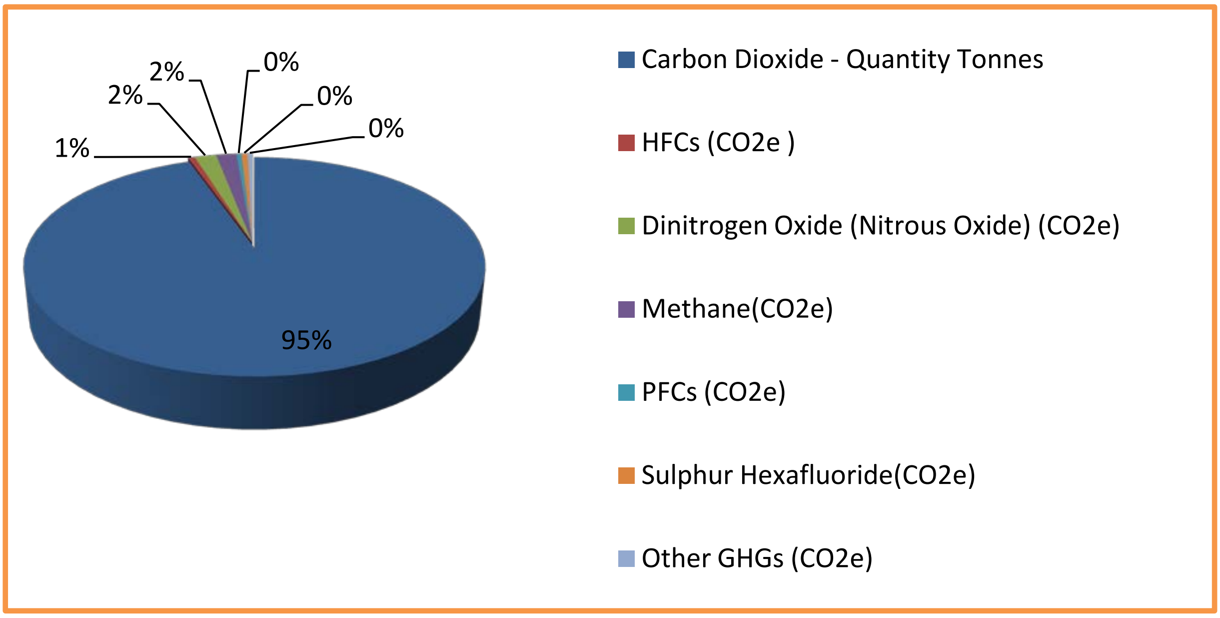
The GHG Protocol does not certify verifiers. Many registries and programs have listings of certified verifiers. A company or organization participating in a GHG program or registry would need to check to see whether the program requires verification of GHG inventories and what verifiers are certified.

Appendix 13 Example of All GHGs Category

GHG Emission 2008 All Companies



Direct GHG Emission 2008 all companies

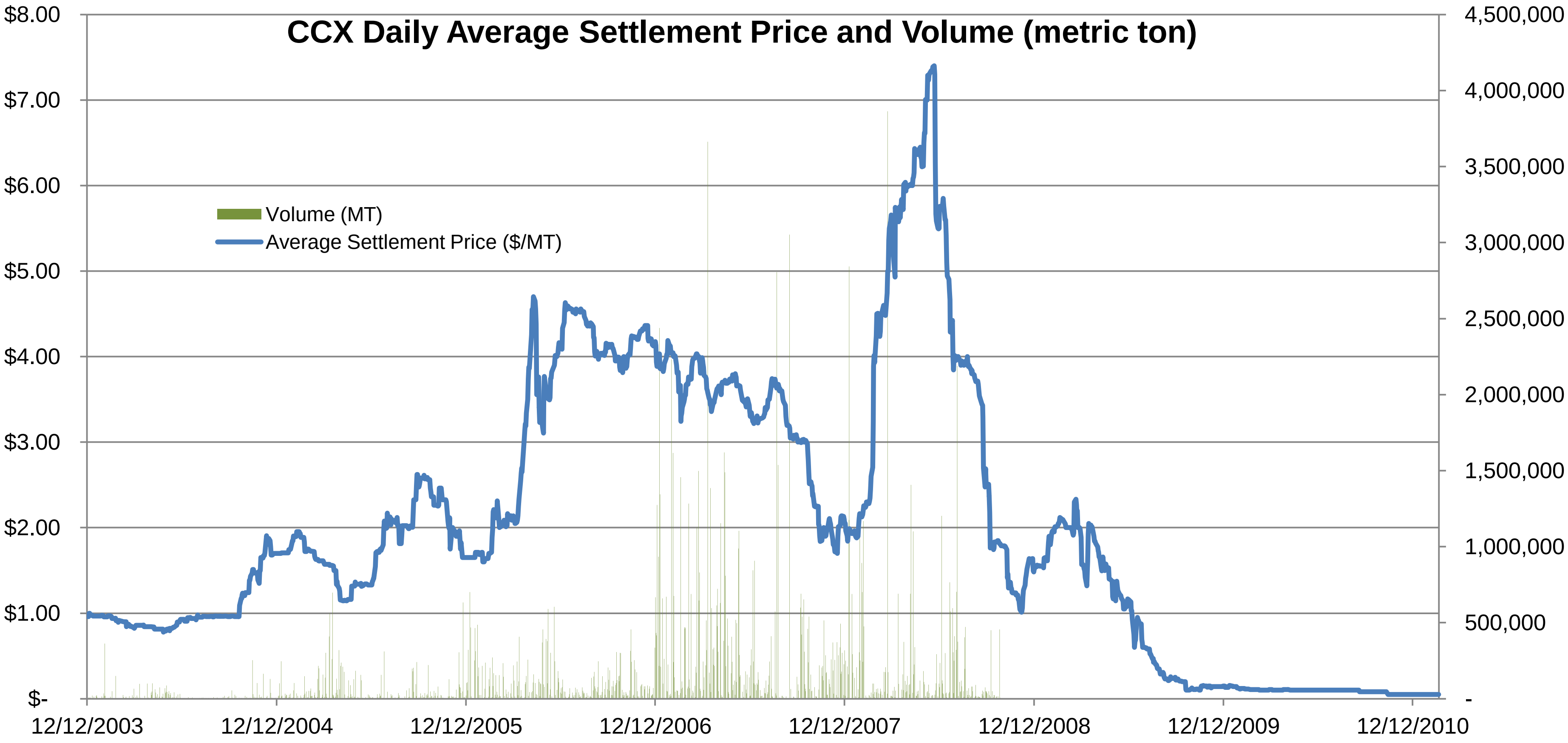


Appendix 14 Example of Four Criteria Calculation

Company Name	reportDate	Sales(mUSD)	Carbon Dioxide - Quantity Tonnes	Direct GHGs Quantity- CO2e tonnes	Direct + First Tier Supply Chain GHGs -	Total Environmental Damage Cost $m
COMPANY A	2008	55	10349	12213	16719	1.24
COMPANY B	2008	1010	177820	181856	264084	20.59
COMPANY C	2008	1210	5541	6112	180588	22.59
COMPANY D	2008	75390	15039125	15476119	29128634	2401.00
COMPANY E	2008	15723	5486827	6484446	7727373	450.18
Company Name	**reportDate**	**Sales(thUSD)**	**CF tonnes/thUSD**	**DF tonnes/thUSD**	**FF tonnes/thUSD**	**IP USD/USD**
COMPANY A	2008	55000	0.187	0.221	0.302	0.02
COMPANY B	2008	1010000	0.176	0.180	0.262	0.02
COMPANY C	2008	1210000	0.005	0.005	0.149	0.02
COMPANY D	2008	75390000	0.199	0.205	0.386	0.03
COMPANY E	2008	15723000	0.349	0.412	0.491	0.03

- Impact Ratio(IP) = Total Environmental Damage Cost (mUSD) / Sales (mUSD)
- First-tier Footprint(FF) = Direct + First Tier Supply Chain Quantity (tonnes) / Sales (thUSD)
- Direct Footprint(DF) = Direct GHGs Quantity (tonnes) / Sales (thUSD)
- Carbon Footprint(CF) = Carbon Dioxide Quantity (tonnes) / Sales (thUSD)

Appendix 15 Chichago Climate Exchange (Dec 2003 to Dec 2010)



Source from https://www.theice.com/ccx.jhtml historical data

Appendix 16 Supporting arguments for not using Tobin's Q

Accroding to Gregory and Whittabker (2013), "when using other deflators, such as deflate by book value, an omitted variable bias will be introduced if Tobin's Q has been used as dependent variable. This part is used to explain how this can happen.

Following Barth and Clinch (2009), dropping the intercept term from Ohlson 1995 model, preserving the ''other information'' parameter as independent, and dividing through by book value, we have:

$$\frac{P_{it}}{b_{it}} = \beta_1 + \beta_2 \frac{x_{it}}{b_{it}} + \beta_3 v_{it} + \epsilon_{2it}$$

This regression is of interest as a robustness check, though not used in this research. However, we can also see how this deflation relates to a regression of Tobin's Q on variables of interest.

Studies, which examine the relationship of ''Tobin's Q'' to measures of CSP invariable, employ the price to book ratio as a proxy for Q. (Galema et al. 2008; Guenster et al. 2011; Kim and Statman 2012)

In the form of a regression test, this amounts to dropping the second earnings deflated by book value term from above regression and running the regression as bellow:

$$\frac{P_{it}}{b_{it}} = \beta_1 + \beta_3 v_{it} + \epsilon_{3it}$$

From this it can readily be seen that if the earnings over book value term in the first regression has a significant role to play in explaining price to book value, then we have an omitted variables problem in the second regression, and if ''other information'' and earnings over book value are correlated, a particular misspecification problem in the second regression."

GLOSSARY

General Terms

CCP: Corporate Carbon Performance

CEP/CER: Corporate Environmental Performance/Responsible

CFP: Corporate Financial Performance

CO2e: carbon dioxide equivalent

CSP/CSR: Corporate Social Performance/Responsible

EA: EU include UK

ECE: Environmental Capital Expenditures

EX: EU exclude UK

GDP: Gross Domestic Product

GHG: Greenhouse Gases

GHG protocol: Greenhouse Gases Protocol

SRI: Social Responsible Investment

NGO: Non Government Organization

Institutions and Mechanisms

CCA: Climate Change Agreement

CCL: UK Climate Change Levy

CCX: Chicago Climate Exchange

CDM: Clean Development Mechanism

CL: Climate Leader Programme

COP: Conference Of the Parties

EMU: European Monetary Union

ET: Emissions Trading

EU ETS: EU Emissions Trading Scheme

HMRC: HM Revenue and Customs

IPCC: Intergovernmental Panel on Climate Change

JI: Joint Implementation

NAPS: National Allowance Plans

UNFCCC: United Nations Framework Convention on Climate Change

US EPA: US Environmental Protection Agency

Models, Variables and Tests

APT: Asset Pricing Theory

CAPM: Capital Asset Pricing Model

CH4F: Carhart Four Factors Model

CL2: Two-Way Cluster

CML: Capital Market Line

FF3F: Fama-French Three Factors Model

HML: High Minus Low (book to market value)

MOM: Momentum

OLS: Ordinary Least Sqaure

RMRF/MKTRF: Market Return minus Risk-Free

TRI: Total Return Index

SCR: Small Cap minus market Return (for EU excluding UK)

SMB: Small Minus Big (market capital)

SML: Security Market Line

VG: Value minus Growth (for EU excluding UK)

Stock Market Indices

AMEX: American Stock Exchang

DJG 2500: Dow Jones Global 2500

DSI 400: KLD 400 Social Index

DJSI STOXX: Dow Jones Sustainability Index

FTA: Financial Times All-share

FTSE 350: FTSE largest 350 companies

HGSC: Hoare Govett Small Company Index

MSCI: Morgan Stanley Composite Index

NASDAQ: National Association of Securities Dealers Automated Quotation

NYSE: New York Stock Exchange

S&P 500: Standard and Poor's 500

Databases

CDP: Carbon Disclosure Project

COMPUSTAT: Standard & Poor's Compustat is a database of financial, statistical and market information on active and inactive companies throughout the world. The service began in 1962.

CRSP: Center for Research in Security Prices

DS: DataStream

EIRIS: Ethical Investment Research Service

IBES: The Institutional Brokers' Estimate System (I/B/E/S) is a service founded by the New York brokerage firm Lynch, Jones & Ryan and Technimetrics, Inc. I/B/E/S began collecting earnings estimates for U.S. companies around 1976 and used the raw data to calculate statistical time series for each company.

KLD: Kinder, Domini and Lydenberg Database

LSPD: London Share Price Database

Accounting Terms

EBIT: Earnings before Interests and Taxes

EAT: Earnings after Taxes

EP: Earnings-Price ratio

MVA: Market Value Added

OI: Operating Income

PEG: Price-Earnings-Growth

RI: Residual Income

ROA: Return on Assets

ROE: Return on Equity

ROIC: Return on Invested Capital

RONA: Return on Net operating Assets

ROS: Return on Sales

Other Variables Defined In This Research

A2002: Apply composit model 1 for period 2002 to 2004

A2005: Apply composit model 1 for period 2005 to 2007

A2008: Apply composit model 1 for period 2008

ADV: Advertisment expense

ADVS: Models include Advertisment as independent variable

ANIBX: Abnormal earnings

BART: Barth et al. 1998 model

BOTH: Included variables from both Rees 1997 and Hands and Landsman 2005 model

BRANDS: The firms total estimated value of brand names

CAPCONPS: Capital contribution pershare

CF: The carbon dioxide footprint

CLNS: Collins et al. 1999 model

DF: The direct carbon footprint

DFHL: Apply Hands and Landsman 2005 model and all variables are deflated by Sales

DFLA: Apply composite model 1 and all variables are deflated by Sales

DFOL: Apply Ohlson 1995 model and all variables are deflated by Sales

DPS: Dividends pershare

EXITV: Exit values

FBVPS: Forecast book-value pershare

FDPS: Forecast dividends pershare

FEPS: Forecast earnings pershare

FF: The direct plus first tier supply chain carbon footprint

FNIBX: Forecast net core earnings

FROE: Forecast return on equity

FUTX: Expected future normal earnings

HALS: Apply Hands and Landsman 2005 model on Loss firms

HAND: Hands and Landsman 2005 model

HAPF: Apply Hands and Landsman 2005 model on Profit firms

ICC: Implied cost of equity

INDM3/SICCLASS: see appendices 1 & 2

IP: Impact ratio

IP/FF/DF/CFPS: IP/FF/DF/CF on per share basis

IP/FF/DF/CFA: IP/FF/DF/CF deflated by Sales

LGR: Implied long-run growth rate

LOSS: Apply composit model 1 on Loss firms

NETCAP: Net capital contribution

NIBX: Net core earnings, net income before extraordinary items

OHLS: Ohlson 1995 model

PROF: Apply composit model 1 on Profit firms

R&D: Research and Development

REES: Rees 1997 model

RNDS: Models include R&D as independent variable

UNIBX: Forecast error

WIPPS: winzorized IPPS