UNIVERSITY OF TWENTE.

The Impact of Carbon Emissions on Corporate Financial Performance

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Abstract

This paper is an extension of previously conducted research on the topic of the relationship between corporate environmental performance (CEP) and corporate financial performance (CFP) resulting in the main research question: “Is there a relationship between companies’ financial performance and carbon performance?.” As we are facing the biggest energy transition the world ever encountered, companies need to use their resources more efficiently than ever before and at the same time, public traded companies have the goal to make profits and the responsibility to create value for their shareholders. Is it still possible to be a major polluter and make a lot of money at the same time? Or do consumers and investors punish these major polluters? In this thesis, we will try to answer these questions by applying a fixed effect regression analysis to a global sample of 830 firms with data from years 2017-2021 leading to 4150 firm years. We take the following financial performance indicators Return on assets (ROA), return on equity (ROE), and Tobin’s q (Q) as our dependent variables. For our independent variable we look at the carbon performance of companies measured by dividing the emissions by the sales, this number includes both direct and indirect emissions. The findings of this research indicate that increasing carbon emissions will lead to poorer financial performance in the short and long term. The findings can be a wakeup call for management of companies in industries that are lagging in the energy transition as they are losing money measured in profitability and in value if they are not reducing their emissions.

Keywords: GHG emissions, policies, ETS

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1. INTRODUCTION

1.1 Situation and Complication

The intensification of global environmental issues in the past forty years has led to multiple International Environmental Agreements (IEA) (Mitchell, 2003). These agreements help trans-international cooperation. One of the best-known IEAs is the Kyoto Protocol (KT), which is a highly influential IEA affiliated with the United Nations Framework Convention on Climate Change (UNFCCC) regime. The KT commits state parties to reduce greenhouse gas (GHG) emissions. It was adopted in 1997 in Kyoto, Japan, and entered into force in 2005 (Kuyper & Schroeder, 2018). The KT effectively implemented the objective of the UNFCCC to reduce the GHG concentrations in the atmosphere to "a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC, 2015).

This study refers to the growing field of research on GHG emissions, specifically the CO2 emissions of companies. In business strategy literature it has been a long-standing debate over whether firms profit from reducing their impact on the environment. So far studies have led to various outcomes. The empirical studies either find a negative link between CEP and short-term financial performance, a positive relationship between CEP and long-term financial performance, or a win-win situation. In the literature review, the outcomes of several studies are discussed more extensively. Unlike the studies conducted by Busch et al., (2022) and Delmas et al., (2015), in this study, we will look at the financial performance as well as the carbon performance in the period 2017-2021. Carbon performance applies to GHG emissions that are directly linked to climate change (IPCC 2013). We measure CEP by calculating the carbon performance which is constructed as the total GHG emissions and CO2 equivalents emissions in tonnes divided by total sales/revenues. Corporate financial performance (CFP) is measured with the accounting indicator return on assets (ROA) and return on equity (ROE) and Tobin's q is used as an indicator for investors' perceptions of future market performance. We choose the period of 2017–2021-time frame as COVID-19 in 2019 heightened environmental awareness and policymakers develop stricter policy rules every year. According to Reilly (2022), this unforeseen event accelerated the switch toward renewable energy and changed the situation completely (Reilly, 2022).

In the Netherlands, around four hundred companies must register their CO2 emissions. These 400 companies are responsible for around half of the emissions in the Netherlands. The registration of the CO2 emissions happens in the European Union Emissions Trading System (EU ETS) together with twenty-nine other European countries. The EU ETS is the biggest emission trading system in the world, with around 10.000 European companies being responsible for around 45% of the CO2 emissions in the EU (Emissieautoriteit, 2022).

1.2 Research Goal

Before we discuss the research goal, we first must better understand the working of the EU ETS. Every year the European Commission determines how much CO2 the companies connected to the ETS are legally able to emit. Every year the amount of CO2 will be lower so that eventually the goals of 2030 will be met. These goals state that the EU and its member states are committed to a binding target of a net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990 (European Union, 2020). The amount of CO2 that companies can emit is equal to the number of emission credits that come to market. For every ton of CO2 they emit, companies must hand in one emission right. If a company does not have enough credits it has to buy them, when a company emits less CO2, it can sell its credits. There are multiple ways a company can retrieve these rights. They can buy emissions right at auctions, on trading platforms or they can simply buy them from other companies (Emissieautoriteit, 2022). The research question refers to these two subjects: “Is there a relationship between companies' financial performance and carbon performance?”

This study contributes to the existing scientific knowledge on the relationship between CFP and CEP With the research question, we will try to understand if the financial performance implications of a firm implementing a carbon strategy are positive. The outcome will also determine whether dirty companies that continue to produce enormous amounts of CO2 are financially encouraged to decarbonize.

2. LITERATURE REVIEW

In this chapter, the historical development of the research topic, similar studies, and the research gap of this study will be discussed.

2.1 Historical Development

Multiple international environmental agreements have been the result of the increase in global environmental challenges over the last four decades. These agreements help promote international collaboration. The best-known result of this cooperation is the KT accepted at the UNFCCC in 1997. The KT commits state parties to reducing GHG emissions. The KT entered in to force in 2005 (Kuyper & Schroeder, 2018). The KT achieved the UNFCCC’s goal of lowering GHG concentrations in the atmosphere to “a level that would prevent dangerous anthropogenic interference with climate change (UNFCCC, 2015). In business literature, there has been a long-standing discussion over whether companies profit from limiting their carbon footprint. A lot of studies have tried to seek the linkage between (CFP) and corporate environmental performance (CEP). (Friedman, 1970) states that any investment comes as a cost to firms and detracts the goal of profit maximization, the social responsibility of a business is to increase its profits. The overall hypotheses of these studies are that if financial performance is positively related to environmental performance, firms will have incentives to reduce their carbon footprint.

Some studies provide empirical evidence of a partially or completely negative relationship (Busch et al., 2022; Cordeiro & Sarkis, 1997; Iwata & Okada, 2011; Lee et al., 2015; Liu et al., 2020; Rassier & Earnhart, 2010; Sarkis & Cordeiro, 2001; Wagner, 2003). Other studies look at a more market-orientated measures of financial performance. Several of these studies find a positive linkage between CEP and Tobin’s q. Thus a positive link between CEP and long-term financial performance (Ambec & Lanoie, 2008; Delmas et al., 2015; King & Lenox, 2002; Trumpp & Guenther, 2015). If Tobin’s q is greater than 1.0, then the market value of the company is higher than the company’s recorded assets. This suggests that the market value reflects some unmeasured or unrecorded assets of the company (Wolfe & Aidar Sauaia, 2005). Another study provided empirical evidence that on average, for every additional thousand metric tonnes of carbon emissions, the firm value decreases by $212.000, indicating that markets penalize all firms for their carbon emissions (Matsumura et al., 2014).

Yet other research shows a “win-win” situation, research conducted by (Ambec & Lanoie, 2008) provides several business opportunities for increasing revenue and lowering costs. In this way environmental performance constitutes a latent profit opportunity. Opportunities that would lead to revenue-generating or cost-minimizing innovations that would otherwise be unused. (Porter & Van Der Linde, 2017) also suggests a win-win situation, in which regulations and properly designed environmental standards could lead to innovative solutions that lower the total costs of a product or improve its value. Finally resulting in enhanced resource productivity and better competitiveness.

At the end of this chapter a literature review table is shown, which summarizes the data, the method applied, research and the outcome of respective literature are discussed.

2.2 Closely Related Research in Literature

Several researchers have conducted similar studies in the past. The studies conducted by Busch et al. (2022) and Delmas et al. (2015) match the most. The studies provide related literature on the relationship between CFP and CEP and have been conducted in the recent past, besides that they both use the same methods, namely: ROA to measure short-term financial performance and Tobin's q to measure long-term financial performance.

Delmas et al. (2015) contributed to explaining the link between corporate social and corporate financial performance. Their results suggests that higher carbon emissions are associated with higher ROA, at the same time however investors anticipate the potential of long-term risks with the result of a lower level of Tobin's q. The study by (Delmas et al. 2015) suggests that reducing carbon emissions may not be beneficial in the short-run, but is in the long run. The study by (Busch et al. 2022) is a revision on the study of (Delmas et al. 2015) and seeks to replicate the study for a longer period, larger geographical scope and uses a different set of control variables. The results of this study find that more carbon emissions are indeed associated with better short-term financial performance (ROA), in line with the study of Delmas, but it does not find support for a positive association of higher carbon emissions and less long-term financial performance (Tobin's q).

A third closely related study conducted by (Butselaar, 2020) takes a different approach and tries to answer the question to what extent the relationship between carbon emissions and firm performance is moderated by investment in innovation? The study uses both ROA and Tobin's q and expands the research by also looking at return on equity (ROE) and adding various control variables like liquidity and capital intensity.

2.3 Corporate Environmental Performance

In the research paper "Too Little or too much?" by Trumpp & Guenther (2015) CEP is defined as the 'results of an organization's management of its environmental aspects'. Trumpp & Guenther (2015) see CEP as a multidimensional construct consisting of environmental operational performance (EOP) and environmental management performance (EMP). In this research we focus on the EOP as this is the most objective way to measure CEP, EMP is more subjective. Contrary to the research of Trumpp we only focus on the carbon performance (CP) of the firms in our sample, we use CP to measure companies' CEP. We measure the CP of firms by taking total GHG emissions and CO2 equivalents emissions in tonnes divided by total sales/revenues. In chapter 7 'Further discussion: my own opinion' we will also take EMP into consideration.

2.4 Corporate Financial Performance

Combs et al., (2005) describes CFP as 'economic outcomes resulting from the interplay among an organizations' attributes, actions, and environment'. CFP is also a multidimensional construct, in our case consisting of four separate dimensions, namely: liquidity, profitability, growth and stock market performance. In this research we focus on profitability, measured in ROA, ROE and Tobin's q. ROA and ROE are used as they are two of the most important measures for evaluating how effectively a company's management is doing its job of managing the capital. If a company's ROA is rising, it indicates that the company is doing an excellent job of increasing its profits with their investments, on the other hand if a company's ROA is going down, this indicates that the company might have over-invested in assets that do not succeed in achieving the projected growth numbers. ROE on the other hand provides an insight into business's profitability for owners and investors, so it helps investors understand whether they are getting a good return on their money. If a company's ROE is rising, it suggests that a company is increasing its profit generation without needing as much capital (Maeenuddina et al., 2020). In chapter 3.2 we will discuss Tobin's q more extensively.

2.5 Practical Contributions

The research question: "Is there a relationship between companies' financial performance and carbon performance?" will give insight whether companies that continue to emit large amounts of CO2 are financially encouraged to decarbonize. This will help managers make better formulated decisions on the practical issue whether it is a good idea to invest in decarbonization solutions.

This research can also be interesting for policy makers as they can see precisely how effective their environmental policies work as these policies should encourage companies to reduce emissions. We will further discuss the implications of the outcome of this study in the discussions and limitations section of this research.

2.6 Research Gap

Since the two most recent studies by (Busch et al., 2022) and (Delmas et al., 2015) have been conducted, a lot has changed and climate change has gained immense relevance after 2004-2008 and 2008-2014 (the time frames used by the studies). Due to COVID-19, governments implemented strong restrictive measures which had a substantial effect on the global economy and our mobility. A lot of people went from working at the company's office to working from home and a lot of consumers went from offline shopping to online shopping. This ensured that the COVID-19 pandemic has caused the largest annual decrease of CO2 since 1900 (Liu et al., 2020). This decrease of CO2 emissions has heightened environmental awareness (Kachaner et al., 2020). Societies pressured companies and governments to do more about CO2 emissions, especially now the world is opening again, and people are able to freely travel again. The International Energy Agency (IEA) has a collective emergency response system ensuring a stabilizing influence on markets and global economy. It was activated five times since the agency's creation in 1974. The fourth and the fifth time were both in 2022, after Russia invaded Ukraine. (IEA, 2022). This crisis will likely accelerate the switch towards renewable energy (Reilly, 2022). These recent developments change the situation completely, this research will assess if another time frame and a different geographical scope give different outcomes than the research of(Busch et al., 2022).

To summarize, the studies conducted so far have led to various outcomes, namely a negative link of CEP and short-term financial performance, a positive relationship between CEP and long-term financial performance and several studies have advocated for a "win-win" situation where decarbonization leads to better financial performance. This study aims to look at company data within a different time frame than the studies conducted by (Busch et al., 2022; Delmas et al., 2015) as environmental awareness rose to new highs since the years 2004-2008 and 2005-2014. In the following section, we describe the data and methods used in detail.

Table 1

Literature review table

Author	Title	Data	Method	Outcome
Delmas et al (2015)	Dynamics of Environmental and Financial Performance: The Case of Greenhouse Gas Emissions	1095 U.S. Corporations from 2004-2008. Environmental data from Trucost, financial data retrieved from Compustat.	Short-term financial performance measured by ROA. Long-term financial performance measured by Tobin's q. Ordinary least square regression analysis.	Short-term financial performance declines if corporate environmental performance is improved. Long-term value of improved environmental performance leads to increase in Tobin's q.
Busch et al (2022)	Corporate Carbon and Financial Performance Revisited	4.873 companies from 2005-2014. Environmental data from Trucost, financial data retrieved from Thomson Reuters Datastream. Different geographical scope than that of Delmas (2015).	Short-term financial performance measured by ROA; long-term financial performance measured by Tobin's q. Ordinary least square regression analysis.	More carbon emissions are associated with better short-term financial performance (ROA) as well as long-term performance (Tobin's q).

Iwata & Okada (2011)	How does environmental performance affect financial performance? Evidence from Japanese manufacturing firms	Japanese manufacturing firm from 2004-2008.	Measuring the effects of environmental performance on financial performance with ROE, ROA, ROI, ROIC< ROS, Tobin's q -1	Waste emissions do not have significant effect on financial performance, but GHG reduction leads to an increase in financial performance in the whole sample. As the firm growth rate increases, the partial effects of waste missions on financial performance decrease, whereas the partial effects of GHG emissions on financial performance increase.
Lee et al (2015)	The impacts of carbon (CO2) emissions and environmental research and development(R&D) investment on firm performance	362 Japanese firms analyzed observations for the years 2003 to 2010 from Report Plaza, Japanese government.	Relationship between CEP and CFP with differentiation that Lee explores the role of Research & Development investment. ROA for profitability and Tobin's q for market response. Ordinary least square regression analysis.	Carbon emissions persistently decrease firm value, besides those markets punish firms for negative environmental performance more consistently than its positive performance.
Liu et al (2020)	Near-real-time monitoring of global CO2 emissions reveals the effects of the COVID-19 pandemic	TomTom dataset	Calculating emissions and impact of COVID-19 on emissions per country and per sector.	An 8,8% decrease in global CO2 emissions, with emissions still declining in countries where restrictions are in effect.
Trumpp & Guenther (2015)	Too Little or too much? Exploring U-shaped Relationships between Corporate Environmental Performance and Corporate Financial Performance	International sample of 696 and 2361 firm years from 2008 to 2012.	Non-linear regression model with variables: CEP (CO2), CEP (waste), CFP (TSR), CFP (ROA) with control variables: growth, cash flow and legal origin as novelties.	Evidence indicates that the type of relationship (negative, positive) depends on the level of CEP. There is a negative CEP-CFP relationship for companies with low CEP and a positive association for high CEP.

King & Lenox (2002)	Exploring the Locus of Profitable Pollution Reduction	614 U.S. firms analyzed observations for the years 1991-1996.	Standard OLS regression. Financial performance measured in two ways: ROA and Tobin's q. Applies different control variables including the variable: credits which entails firm environmental credits over firm size.	Negative relationship between firm emission and financial performance. Firms underexploit one means of reducing pollution (waste prevention).

3. HYPOTHESES FORMULATION

The main research question is defined as: "Is there a relationship between companies' financial performance and carbon performance?" In the next section, hypotheses are formulated and derived from the knowledge obtained during the literature review, the defined sub-questions, and the theories.

Sub question:

1. Does a company financially benefit from emitting more CO2?
2. Does a company's environmental performance have a negative effect on its short-term financial performance measured in return on assets (ROA) and return on equity (ROE)?
3. Does a company's carbon performance have a negative effect on its long-term financial performance measured in Tobin's q?

3.1 Corporate Environmental Performance – Corporate Financial Performance

When a company emits more CO2 than it has emission credits, thus emits more CO2 than it is legally allowed to do, the company has the choice between two strategies: a pollution prevention strategy, the company will then work on decarbonization solutions, or the company buys more emission credits. The hypothesis here is that a company has a financial incentive to keep the CO2 numbers as low as possible, so that it does not have to buy the emission credits or invest in decarbonization solutions. Many financial performance indicators exist, including earnings per share (EPS), return on investment (ROI), profit margin, Altman's Z-score, ROA, and ROE. For this research we choose the latter two as ROA and ROE are two financial performance measures that are widely accepted by academics around the world. ROA is defined as net income by the average of last year's and current year's total assets times 100. While ROA takes into account the profitability of the economic resources and assets on the balance, ROE measures the profitability of shareholder investment in the firm. Return on Equity could support ROA as a higher ROE along with higher ROA and manageable debt is producing decent profits. However higher ROE can be misleading with lower ROA and huge debt carried by a company. In this research ROE is defined as the net income divided by the average of last year's and current year's common equity times 100.

H1: Improved corporate environmental performance negatively impacts the corporate financial performance

3.2 Corporate Environmental Performance – Investors' Perceptions of Future market Performance

To measure the long-term financial performance implications, we will use Tobin's q. This also takes in to account the potential future cash flows and profitability. Tobin's q is used in several other similar studies as well (Busch et al., 2022; Butselaar, 2020; Delmas et al., 2015; King & Lenox, 2002). In the stock market frenzy of 2020 when the market first crashed tremendously and after that exploded, more emphases was put on ESG investing. Both Goldman Sachs and UBS said that prior to the crisis there was a meaningful and increasing focus on ESG investing and that this focus will only increase following the coronavirus (CNBC, 2020; UBS, 2020). According to UBS higher rated ESG funds fared better in the COVID-19 induced market downturn. These instances demonstrate that investors' estimates of future market conditions factor in the likelihood of carbon emissions being more regulated, and therefore a higher likelihood of firm's GHG emission profile affecting probability or loss. Firms that can reduce their GHG emissions show investors that they have internal capabilities to be more competitive in a business context where legislation, standards, and norms aimed at mitigating climate change are introduced.

H2: Corporate environmental performance positively impacts the investors 'perceptions of future market performance

3.3 Firm Size

The number of resources a company owns is reflected in its size. The larger a company is, the more resources it has (Bae Choi et al., 2013). In this study the size of a firm is measured by the total current assets (TCA). Because larger firms have a longer history and more assets, they are less likely to default (Jung et al., 2014). This makes firm size one of the factors that investors take into consideration when investing. For this research we use firm size as a control variable and see if firm size indeed has a positive and significant impact on probability measured in ROA and ROE. We use ROA and ROE to measure the financial performance of a firm.

H3: The size of a company positively impacts the financial performance

3.4 Leverage

The amount to which a corporation leverages loan capital to finance investment possibilities is referred to as financial leverage. (Afolabi et al., 2019). An entity's use of debt capital will boost its returns on equity capital to the extent that the revenue generate from its use exceeds the cost of funding the project. Leverage is expressed as the ratio of a company's debt to its assets. A firm must search for an optimal level between debt capital and equity capital. A company with a high level of debt must choose between the cost of bankruptcy and the tax benefits that accrue from interest expense charging (Ahmed et al., 2018). Higher level of leverage might impact the financial performance.

H4: A high level of leverage has a negative effect on the financial performance

3.5 Capital Intensity

A company with a high capital intensity invests in growth prospects and is more profitable than one with a lower capital intensity. We measure capital intensity as the company's total assets divided by its revenue/sales. We expect a positive association between capital intensity and financial performance. Prior research has shown that capital intensity is a determinant of CFP, however there are also empirical results for a positive as well as negative effect (Harts, 1995; King & Lenox, 2002).

H5: Capital intensity negatively effects financial performance

4. RESEARCH METHODS AND VARIABLES

The methods used to answer the main research question and hypotheses are detailed in this chapter. The primary research questions and hypotheses are provided first. The variables’ operationalization and measurement are then discussed. The variables are derived from the hypothesis. To predict firm performance, the hypotheses are assessed using a single model that includes all the independent and control variables.

4.1 Data Collection

This research will look at the financial performance data and carbon performance of companies. The financial data for this research is collected from the Worldscope database and data on carbon emissions from the ESG database, both of which are accessible through Refinitiv Eikon. The ESG database contains environmental, social and governance data like waste production, water abstraction, natural resource use, and raw material extraction. The years 2020 and 2021 are especially of interest as COVID-19 took over the world in 2020 and caused a massive drop in carbon emissions. Data beyond 2020 is interesting as the unanticipated occurrence of COVID-19 has raised environmental consciousness of people and accelerated the transition to renewable energy and radically altered the scenario. Therefore, the timeframe 2017-2021 was chosen for this study, unfortunately complete data from the year 2022 was not available yet. To make up for missing values, this study focuses on secondary data such as balance sheets and income statements. These balance sheets and income statements are retrieved from the annual reports of the companies. The control variables used together with the financial variables are in line with prior literature (Busch et al., 2022; Delmas et al., 2015; King & Lenox, 2002; Liu et al., 2020).

4.2 Sample

For this research, the financial data is retrieved from the Worldscope database, the carbon emissions score and data on carbon emissions is retrieved from the ESG database (previously known as Asset4). These two databases are both available on Refinitiv Eikon. The database contains 1035 firms with complete data on the defined corporate carbon emissions for the years 2017-2021. After adding all the financial ratios and other control variables we are left with 830 companies. Transforming the data to a long format results in a final sample of 830 firms and 4150 firm years. There are 20 different sectors present in the sample. Table 2 shows the firm-level total CO_2 and CO_2 equivalents emissions in tonnes divided by net sales/revenue in US dollars in millions. The global sample is constructed from 37 countries and contains companies that operate in 20 different sectors. The most frequent supersectors in the sample are Industrial goods and Services, Technology and Basic Resources, with respectively 167, 69 and 63 firms. The most frequent countries in the sample are Japan (JP), Great Britain (GB) and the United States (US), with respectively 173, 137 and 74 firms. Note that the supersectors utilities, energy, construction and materials, basic resources and chemicals make the top five of sectors with the highest carbon intensity measures as carbon emissions divided by sales.

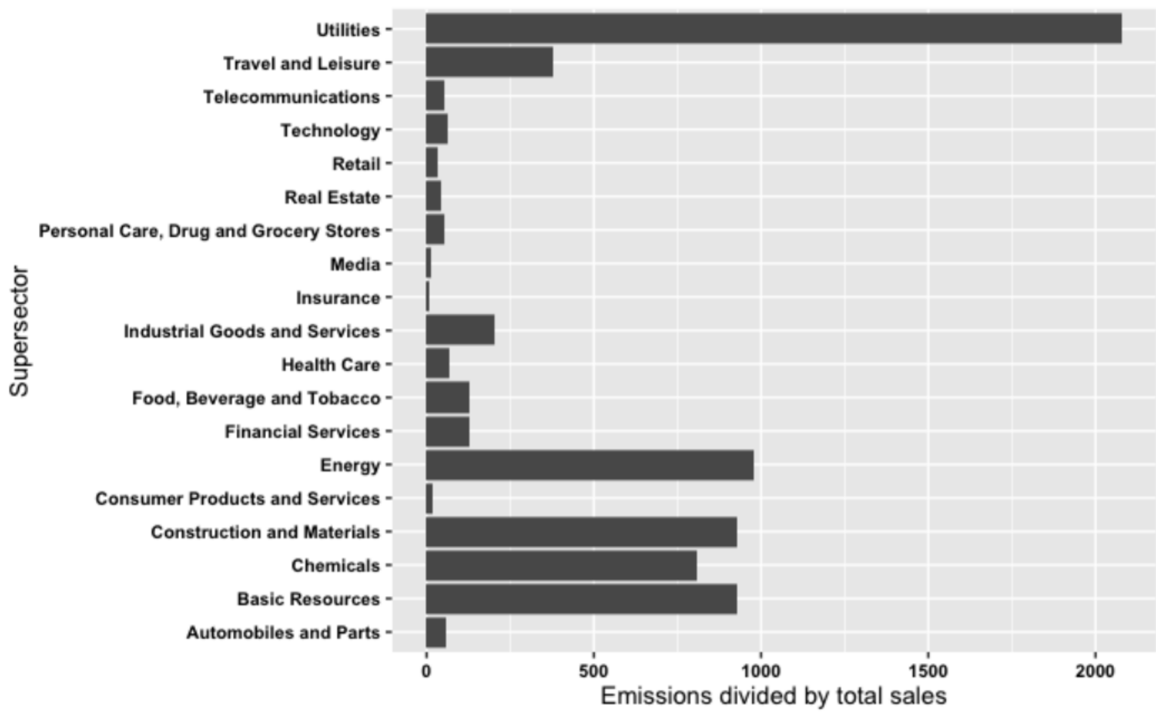
Table 2

Summary statistics firm-level total CO2 and CO2 equivalents emission in tonnes per ICB Supersector.

	ICB.SUPERSECTOR.NAME	Obs.	Mean	Std.Dev.	Min	Max
1	Automobiles and Parts	26	59.78	63.94	10.38	331.00
2	Basic Resources	63	929.30	1141.15	0.06	4642.28
3	Chemicals	35	808.86	1071.17	27.33	4868.70
4	Construction and Materials	54	925.72	2201.42	9.57	8790.75
5	Consumer Products and Services	49	17.49	26.19	1.33	172.28
6	Energy	33	979.77	2298.06	4.60	12623.16
7	Financial Services	5	125.56	138.78	4.24	278.13
8	Food, Beverage and Tobacco	49	129.84	161.82	6.40	900.95
9	Health Care	58	68.06	165.59	0.36	1211.52
10	Industrial Goods and Services	167	201.07	557.12	1.35	4602.40
11	Insurance	2	8.54	3.07	6.37	10.71
12	Media	15	10.63	12.80	0.43	47.43
13	Personal Care, Drug and Grocery Stores	19	50.58	50.71	4.63	219.19
14	Real Estate	8	44.53	45.91	1.52	136.27
15	Retail	47	33.28	46.55	0.83	300.93
16	Technology	69	63.01	107.88	0.41	623.19
17	Telecommunications	41	51.42	57.95	1.97	261.29
18	Travel and Leisure	42	378.05	463.92	4.89	1589.36
19	Utilities	48	2078.06	2850.47	1.69	11738.46

Figure 1

Summary statistics plotted



4.3 Dependent Variables

For this study we use ROA and Tobin's q to approximate short- and long-term success of financial performance, respectively. ROA is a common accounting metric for evaluating financial performance that is computed by dividing profits before interests by total assets (King & Lenox, 2002). While ROA considers the value of the firm's economic resources and assets on the balance sheet, ROE considers the value of shareholder investment in the company. Stronger ROE, in combination with higher ROA and manageable debt, could support ROA. However, a greater ROE might be deceiving if a company's ROA is low, and it has a lot of debt. The ratio of a firm's market value to the replacement cost of its assets is defined as Tobin's q. Tobin's q takes into consideration a firm's market value, allowing it to highlight intangible attributes that an accounting-based measures like ROA and ROE cannot. Both ROA and ROE as well as Tobin's q are used in earlier research papers with the same area of research. (Busch et al., 2022; Delmas et al., 2015; Iwata & Okada, 2011; King & Lenox, 2002)

4.4 Independent Variables

For this study, the independent variable is carbon performance. We apply total GHG emissions in tonnes of CO2-equivalent to measure the independent variable of CEP, which includes both direct and indirect emissions. CO2 is constructed as total GHG in CO2 equivalents emissions in tonnes divided by total sales/revenues. Our research considers all six of the Kyoto Protocol's GHG emissions. Based on global warming potential factors, each of these are converted into CO2-equivalent emissions mass. This means that not only Carbon Dioxide (CO2), but also Methane (CH4), Nitrous Oxide (N20), Hydrofluorocarbons (HFCS), Perfluorinated Compounds (PFCS), Sulfur Hexafluoride (SF6), and Nitrogen Trifluoride (NF3).

4.5 Control Variables

Control variables are used to hold everything else constant and are controlled, because they could influence the outcomes. In the relationship between carbon emissions and firm performance, firm-level factors play a key role. To control for causes of firm-level heterogeneity we look at the following financial variables in this study: Total current assets for firm size as larger firms have a longer history, more assets and are therefore less likely to default. Leverage measured as total debt as percentage of total capital, a high level of leverage might impact the financial performance. Capital intensity (CI) measured as the company's total assets divided by its revenue/total sales as it shows the efficiency of the firm in the use of its assets. We also add quick ratio (QR) as control variable as higher liquidity suggests that a company's operations are more stable. To improve the fit to the normal distribution, firm size, QR and CI are logarithmically adjusted. We use natural logarithm as will be able to interpret the coefficients directly as percentages change. To account for any impact process-based environmental performance variables may have on financial performance, the Refinitiv Eikon emissions score was incorporated as a control. Refinitiv's ESG scores are based on publicly available data and are intended to quantify a company's relative ESG performance, commitment, and effectiveness across ten primary categories (emissions, environmental product innovation, human rights, shareholders, and so on). The underlying ESG data platform is reflected in Refinitiv ESG scores, which are a transparent, data-driven assessment of firm's relative ESG performance and capabilities, incorporating and accounting for industry materiality and company size biases (Eikon, 2022). To account for any time trend effects, we employ year dummy variables. See table 3 for an explanation on the various variables used.

Table 3

Variable construction summary table

Variable	***Measurement / Definition***
Tobin's q (Q)	Market value of firm as captured by enterprise value divided by book value of total assets.
Return On Assets (ROA)	ROA is defined as net income divided by the average of last year's and current year's total assets times 100.
Return On Equity (ROE)	ROE is defined as net income divided by the average of last year's and current year's common equity times 100.
Carbon Performance (E.S)[1]	Carbon performance is used to measure companies' CEP. We calculate carbon performance by taking the natural log of the total GHG emissions in tonnes of CO2-equivalent divided by total sales/revenues. This includes both direct and indirect emissions.
Control Variables / Identifiers	
Firm size (SIZE)	Firm size is measured as the natural logarithm of firm's total current assets. In that way we correct for skewness. With total current assets representing the sum of cash and equivalents, receivables, inventories, prepaid expenses, and other current assets.
Quick ratio (QR)	Quick ratio is defined as the natural logarithm of cash & equivalents + net receivables divided by current liabilities.
Leverage (LEV)	Leverage is expressed as long-term debt + short term debt & current portion of long-term debt divided by total capital + short term debt & current portion of long-term debt times 100.
Capital Intensity (CI)	The capital intensity is measured as the natural logarithm of the company's total assets divided by its revenue/sales.
Year	Years 2017 to 2021 are transformed into year-dummies in the analysis. In our analysis we used factor years so that the model regresses on year dummies.
Emissions score (ES)	Emission category score measures a company's commitment and effectiveness towards reducing environmental emission in the production and operational processes. Companies can score 0 till 100 points.[2]
Country identification code (ISO)	Two-letter codes that represent a certain country composed by the International Organization for Standardization.

[1] Because data is processed in R, a '.' Is used here instead of the / sign.
[2] See figure A1 in Appendix A for elaboration on the emissions score.

ICB industry code	The FTSE/DJ Industry Classification Benchmark (ICB) exists of six numbers hierarchy assigning all public companies to appropriate industry, 'supersector,' sector and subsectors. Transformed into industry-dummies.
Company identification code (ISIN)	The ISIN identifier code consists of 12 numbers unique for each company. The number includes the headquarter country and a specific security identification.

4.6 Data Analysis

The following model is used:

$$\text{Performance}_{it} = \alpha_i + \beta_1 * Emissions_{it} + \beta_2 * Controls_{it} + \varepsilon_{it}$$

In this model i denotes the firm, t the year and eta the error term which captures the residuals of the model. For the analysis we need to work with panel data, also known as longitudinal data or cross-sectional data / time-series data, panel data are a type of data. There are several entities in a panel data set, each of which exhibits a repeating pattern. Panel data analysis uses fixed or random effects model estimation, as opposed to regular time series or cross section regression (Park, 2011). [3] To test this model the statistical computing program R is used. In order to know which of the two models to use: fixed, random or mixed we have to run a Hausman specification test.[4] According to the Hausman, (1978) specification test we can reject the null hypothesis and use the fixed-effects model which appears to be the best fit for our dataset.

The univariate Spearman correlations are shown in table 4. Multicollinearity is assessed using Spearman pairwise correlations and variance inflation factors. A correlation of 1 indicates a perfect positive correlation between two variables and multicollinearity is defined as a positive correlation between two variables with a correlation coefficient greater than 0,7. In the Pearson correlation matrix we see three things of interest, namely a correlation between Q and ROA of 0,71, a correlation between Q and ROE of 0,57 and a correlation between ROA and ROE of 0,77. The correlation between ROA and ROE is higher than ROA, ROE with Q. This indicates that accounting and market-based indicators do not measure the same thing. The independent variables in the correlation matrix have low pairwise correlation. Additionally, a residual analysis is carried out. The results indicate that the panel data shows cross-sectional dependency, autocorrelation and heteroskedasticity in the dataset.[5] When units in the same cross-section are correlated, this is referred to as cross-sectional dependence. The paper "Cross-sectional Dependence in Panel Data Analysis" explains that somewhat almost every cross-section data have cross-section dependence (Sarafidis & Wansbeek, 2012). Unseen common causes may be to blame for this. At the result section we discuss the fixed effects model with robust standard errors that corrects these problems.

[3] Table C1 Fixed vs random effect model in Appendix C
[4] Table C2 in Appendix C
[5] Table D1 in Appendix D

Table 4

Pearson correlation matrix

	E.S	Q	ROA	ROE	LEV	QR	TCA	ES	CI
E.S	1.00	-0.05	-0.08	-0.06	0.05	0.02	0.03	-0.08	0.02
Q	-0.05	1.00	0.71	0.57	-0.11	0.06	-0.16	0.02	-0.02
ROA	-0.08	0.71	1.00	0.77	-0.23	0.04	-0.08	0.06	-0.06
ROE	-0.06	0.57	0.77	1.00	-0.11	0.00	-0.04	0.04	-0.02
LEV	0.05	-0.11	-0.23	-0.11	1.00	-0.26	-0.00	0.00	-0.05
QR	0.02	0.06	0.04	0.00	-0.26	1.00	-0.02	-0.09	0.62
SIZE	0.03	-0.16	-0.08	-0.04	-0.00	-0.02	1.00	0.35	-0.03
ES	-0.08	0.02	0.06	0.04	0.00	-0.09	0.35	1.00	-0.06
CI	0.02	-0.02	-0.06	-0.02	-0.05	0.62	-0.03	-0.06	1.00

5. RESULTS

In the following chapter the most important results of our analysis are presented. The presented descriptive statistics will go into more detail. We have plotted our most important variables in histograms to detect possible outliers, as an extra addition we have added scatterplots for our independent, dependent and control variables. Table 5 is shown as a summary statistic to showcase the final sample that is used for further analysis.

5.1 Descriptive Statistics I

To illustrate the major features of the distribution of our data we have plotted our most important variables in histograms. Figure 2 shows the histogram of our dependent variable ROA, in order to show all values in one graph we have taken all values lower or equal to -18 and binged those values together, we did the same for all values higher or equal to 30. These values would have not been visible otherwise. The data in figure 2 follows a normal distribution. In figure 3 the histogram of our variable ROE is shown, in this graph we applied the same methods, we have taken all values lower or equal to -71 and binged those values together, we did the same for all values higher or equal to 94. The data of our dependent variable ROE has a normal distribution.

Figure 4 shows the distribution of our dependent variable Tobin's q, the data shows a right-skewed distribution, a large number of data values occur on the left side with fewer number of data values on the right side, mostly due the range boundary on the left-hand side of the histogram. To show all values in one graph we have taken all values higher or equal to 6 and binged them together. The histogram of our dependent variable is shown in figure 5, it follows a right-skewed distribution. We have binged together all values higher or equal to 3875. Skewed data degrades regression-based model's ability to describe typical cases as it must deal with rare cases on extreme values. In this case right skewed data will predict better on data points with lower values as compared to those with higher values, because of this we used the natural log of our variable E.S in our data analysis.

Figure 2

Histogram of ROA

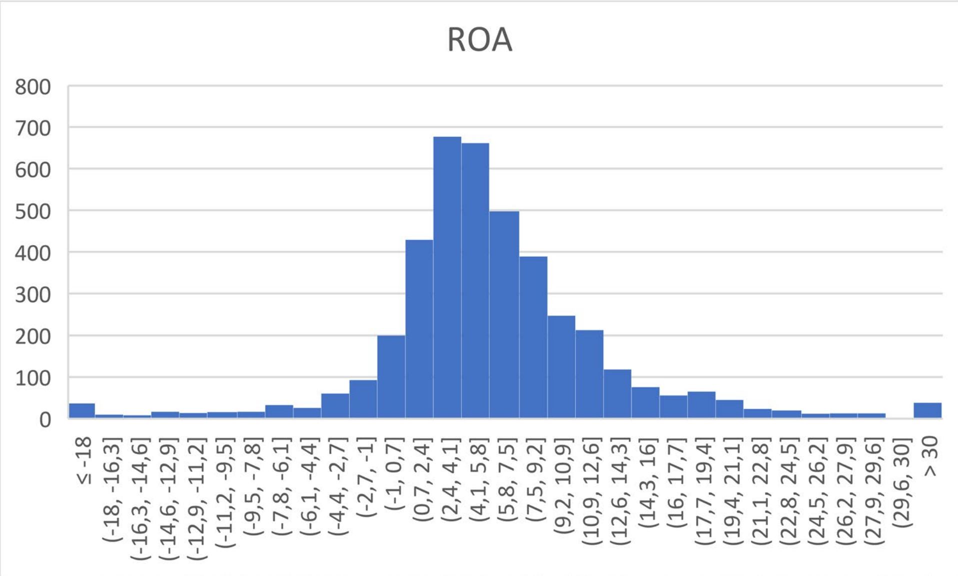


Figure 3

Histogram of ROE

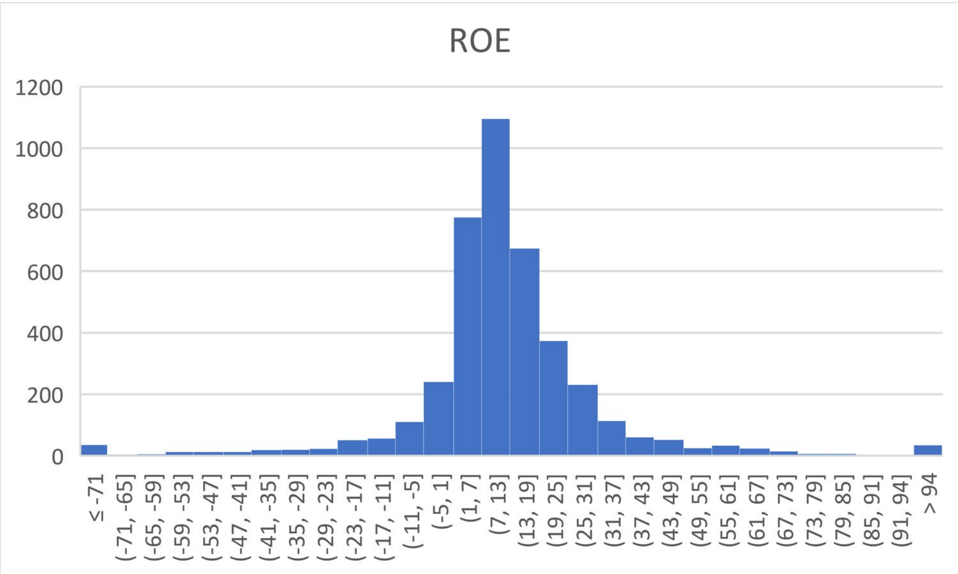


Figure 4

Histogram of Tobin's Q

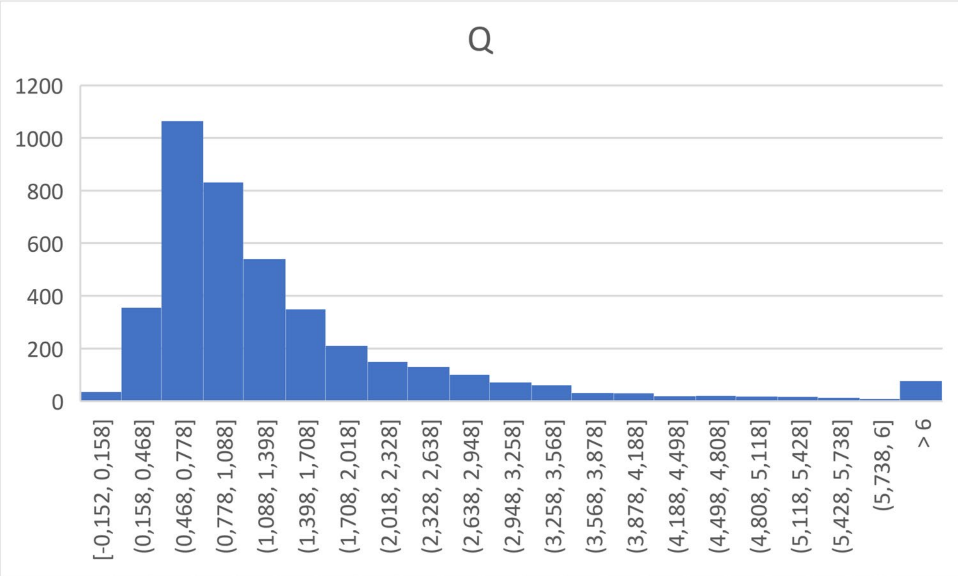
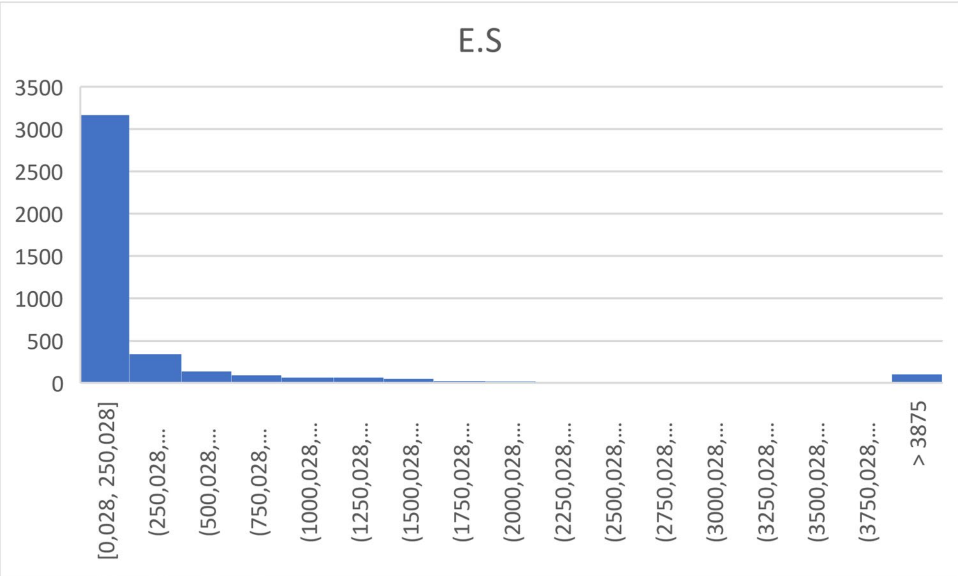


Figure 5

Histogram of E.S



5.2 Descriptive Statistics II

To detect for possible outliers and act on them, when necessary, we plot our variables in histograms and scatterplots. Figure 6 shows the scatterplot of our variable Q, it contained five outliers all accounted by the same company called Rightmove. We checked the data of this company from multiple sources and concluded that the data is incorrect. As a result, we have deleted the outliers from our sample. In the scatterplot a clear pattern can be discovered, Tobin's q increases slightly over the years. Because of this pattern it becomes clear that we used data in the longitudinal format, which was needed for our analysis, which puts the years 2017-2021 beneath each other.

Figure 8 shows the scatterplot of our variable emissions divided by total sales / revenues representing the carbon performance of companies in our research. We observe one excessive outlier from the company Capricorn Energy, active in the energy sector, after doing some research we noticed that sales dropped significantly in 2020 due to the corona crisis, however this could not justify the high number 61537,05. As a result, we dropped the outlier due to incorrect data. If we look at figure 8, we see an interesting pattern, the carbon performance of companies is improving over the years. This could either mean that companies' sales improved or that companies emit less CO_2. In figure 9 we see some outliers on both the positive as well the negative side, however the effect of these outliers does not change the results, nor assumptions, so we decided to keep them in the sample.

More outliers are seen in the scatterplot of our dependent variables ROA shown in figure 10. In this case the company Rightmove is responsible for half of the outlier values. As discussed earlier, this company is deleted from our sample.

The other outliers are accounted by the following companies: Altron, Modern Times Group, Atlas Copco, Vivendi, Top Glove, Svenska Cellulosa Aktiebolaget and Schibsted. After looking up the values at the annual reports, the values of the companies Modern Times Group and Svenska Cellulosa Aktiebolaget seem to be incorrect, as a result these companies were deleted from our sample. The values of the rest of the companies seem to be correct, removing the values did not have a significant impact on the outcome of the graph so we keep the companies in our sample.

In the scatterplot about our dependent variable ROE, we discovered some outliers accounted by the company Rightmove. The result of deleting the companies that were responsible for the outliers give a completely different graph. What is most striking is that the ROE numbers are very negative in the year 2020, this most probably has to do with the corona crisis when the profit of a lot of companies turned negative, as a consequence did the ROE. Figure 11 is a scatterplot of our variable size. In our research, size is measured in total current assets. As the size of the companies in our sample did not change that much, a pattern can be discovered. The pattern has the same origin as the pattern seen in figure 2. Because of the pattern it becomes clear that we used data in the longitudinal format which was needed for our analysis. To conclude in figure 7, figure 13 and figure 14 we do not observe any notable outliers.

Figure 6

Scatterplot of Tobin's q

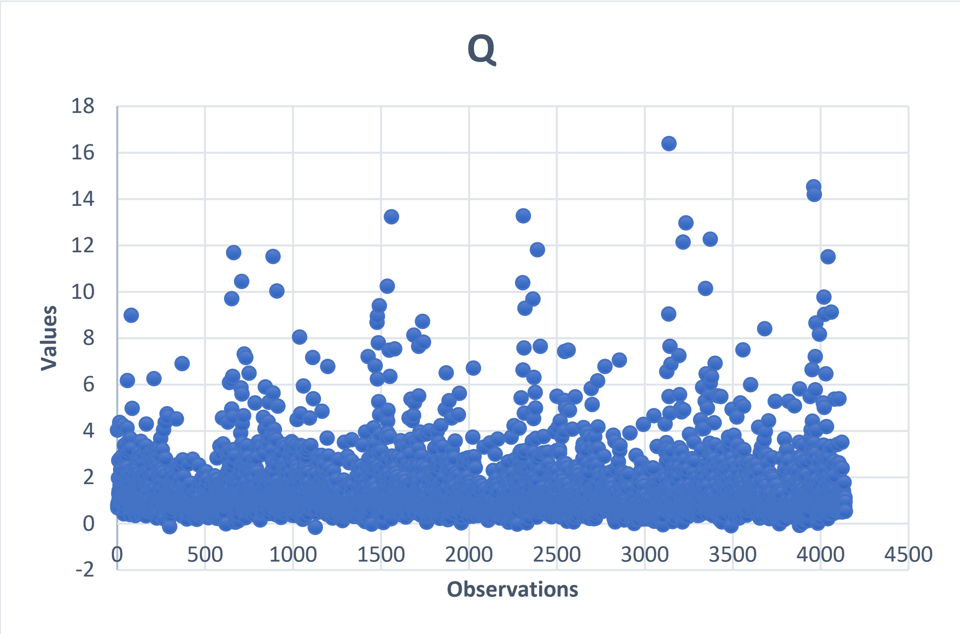


Figure 7

Scatterplot Leverage in %

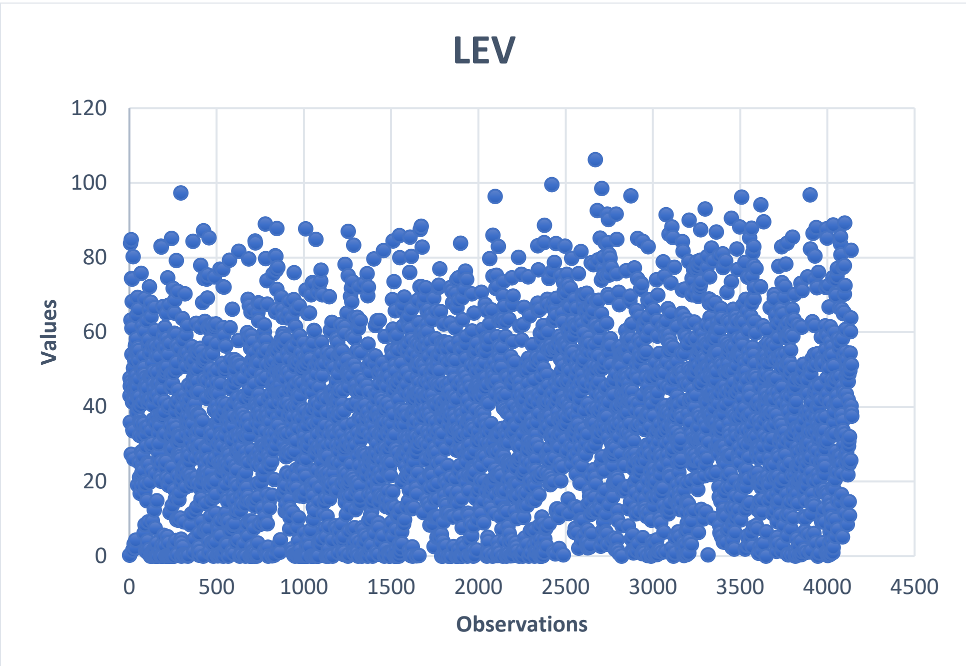


Figure 8

Scatterplot E.S: Firm level total CO_2 and CO_2 equivalents emissions in tonnes divided by sales/revenues in US dollars in millions

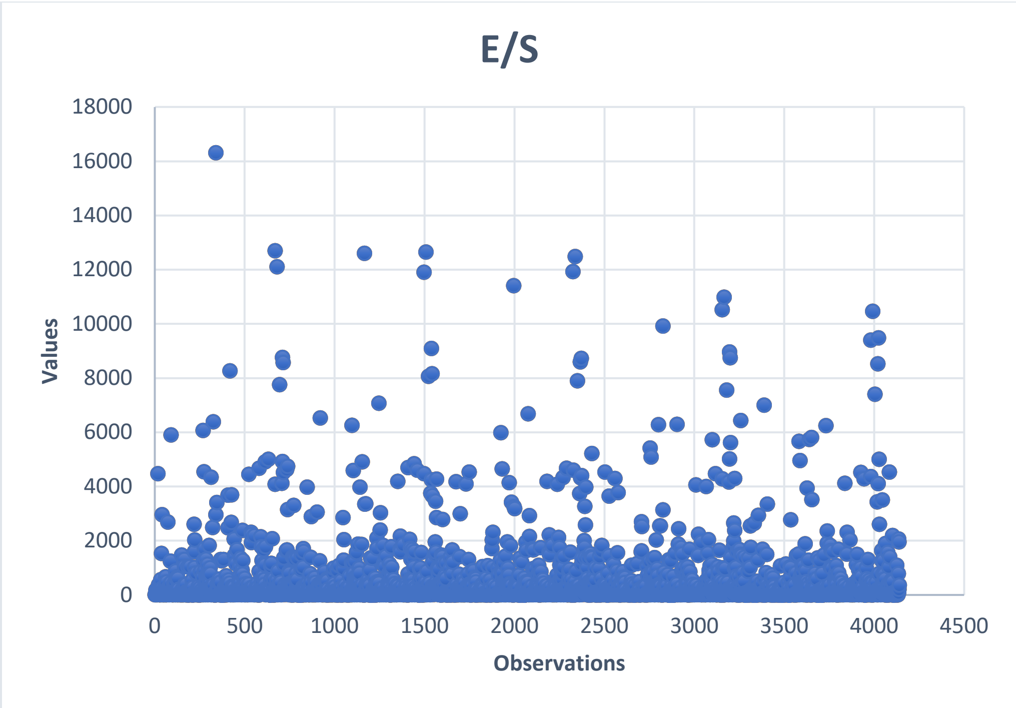


Figure 9

Scatterplot Quick ratio: the natural logarithm of cash & equivalents + net receivables divided by current liabilities

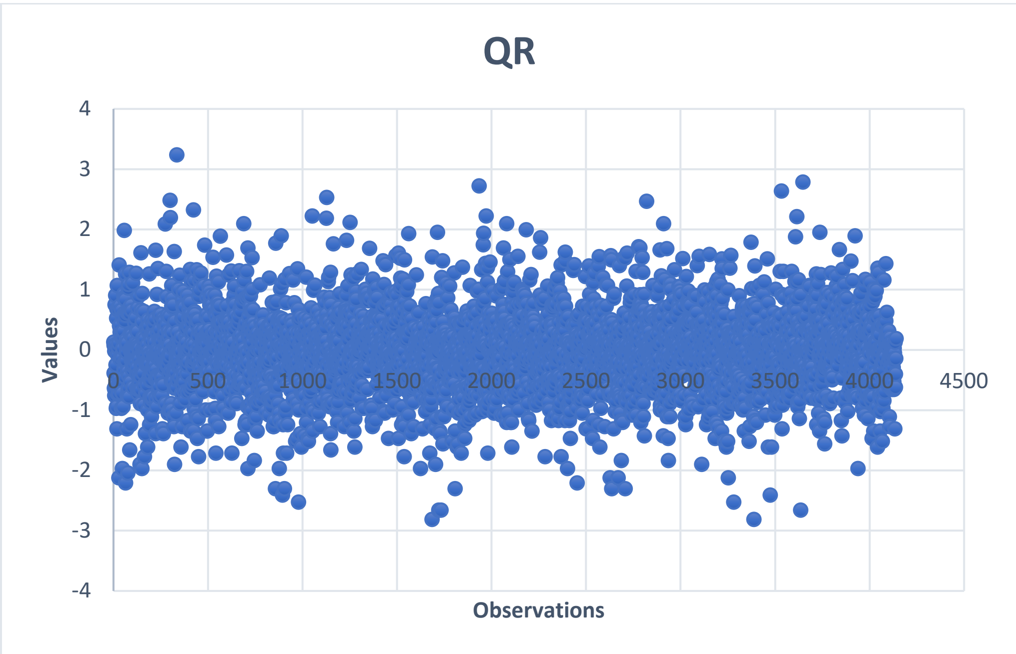


Figure 10

Scatterplot ROA in %

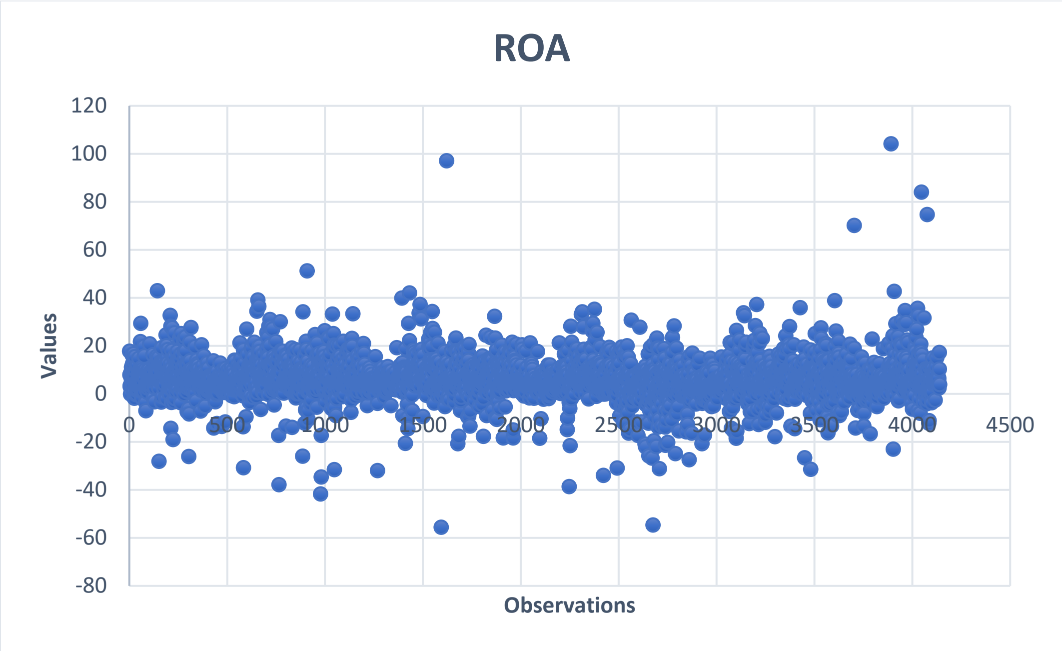


Figure 11

Scatterplot Size measured as the natural logarithm of firm's total current assets

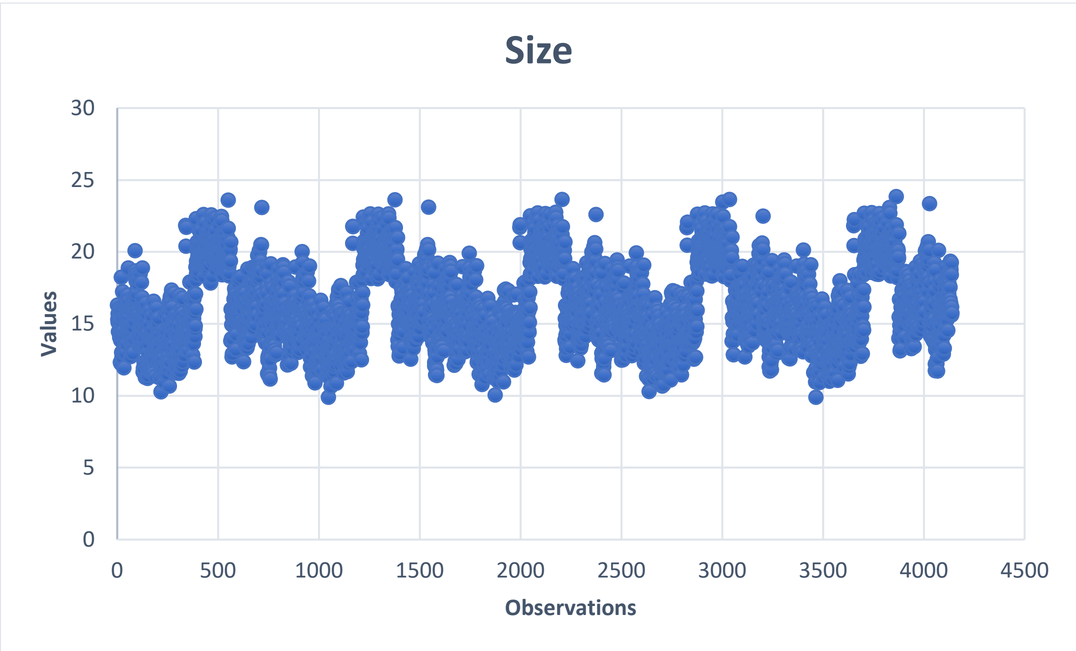


Figure 12

Scatterplot ROE in %

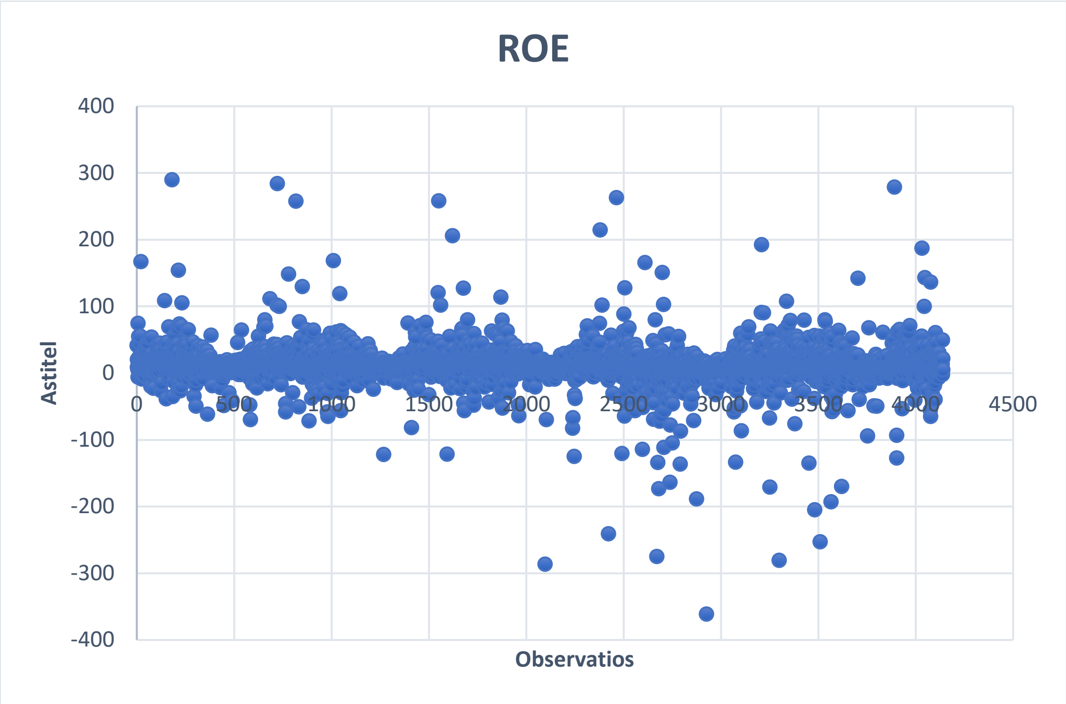


Figure 13

Scatterplot Emission score (ES) Companies can score 0 till 100 points

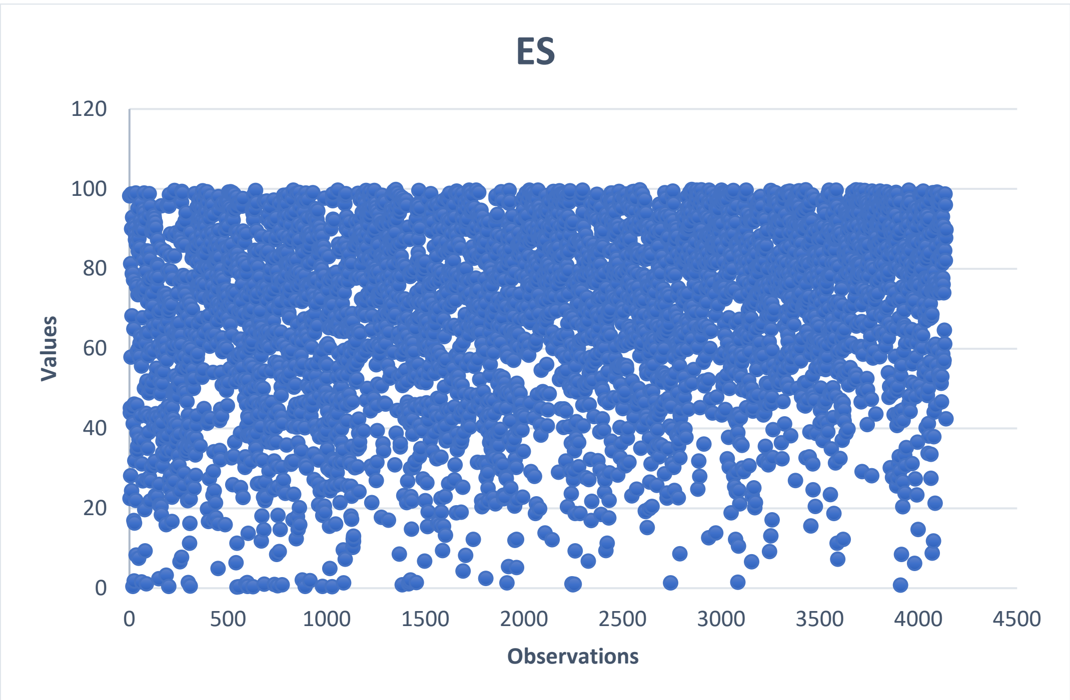
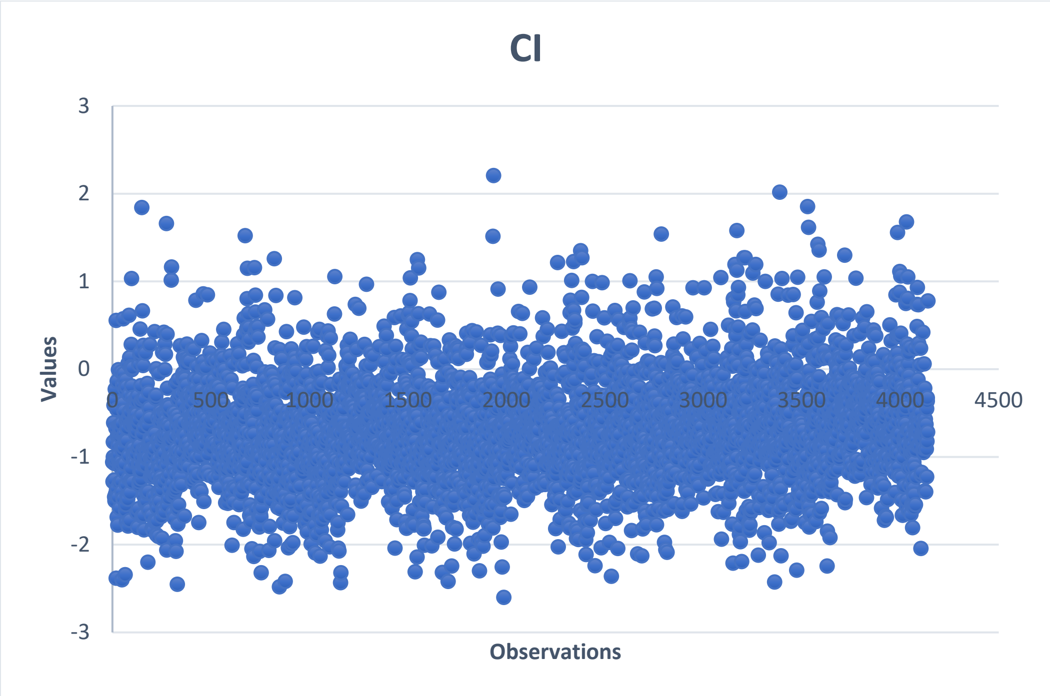


Figure 14

Scatterplot Capital intensity (CI) measured as the natural logarithm of the company's total assets divided by its revenue/sales



5.3 Descriptive Statistics III

We have plotted our dependent variables against the independent variable E.S, the graphs are shown in figures 11, 12 and 13. The scatterplot of ROA vs E.S shows a weak to moderate, negative, relationship with a linear form. As the independent variable increases, the dependent variable tends to decrease. There appear to be some outliers that do not fit the general pattern. Something similar is seen in figure 12, the scatterplot of ROE vs E.S, this graph however, shows a very weak negative, with a linear form and some values that seem a bit far away from the pattern. In figure 13, the scatterplot of Q vs E.S, shows a weak, negative, linear association between Tobin's q and carbon performance. Pretty interesting the outliers can be traced back to two cement companies, both which are based in India. The companies have high emissions, but investors do not punish the companies for their high emissions as a higher Tobin's q suggests that the market value reflects some unmeasured or unrecorded assets of the company.

Figure 15

Scatterplot ROA – E.S

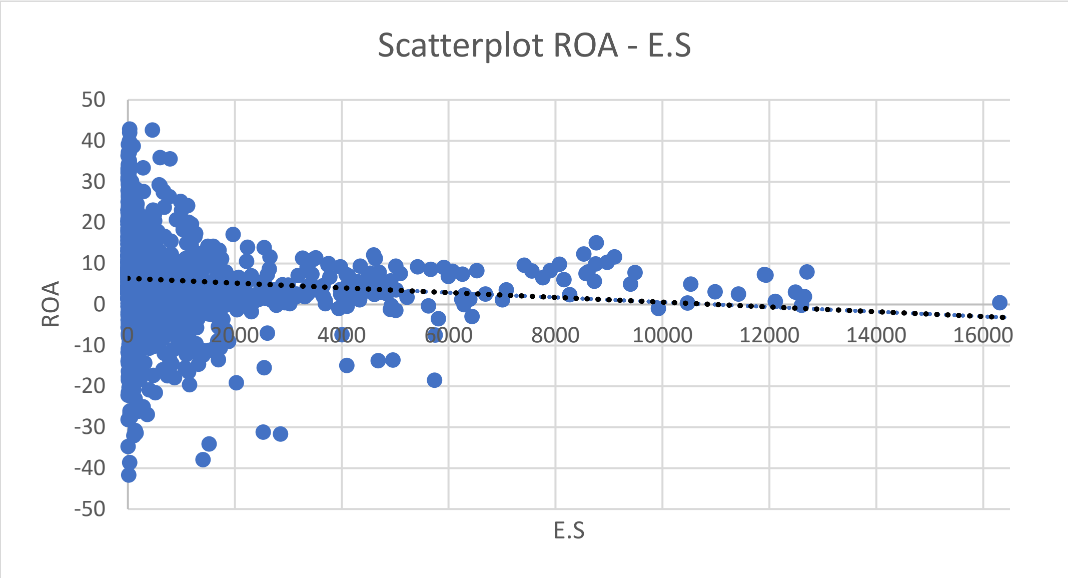


Figure 16

Scatterplot ROE – E.S

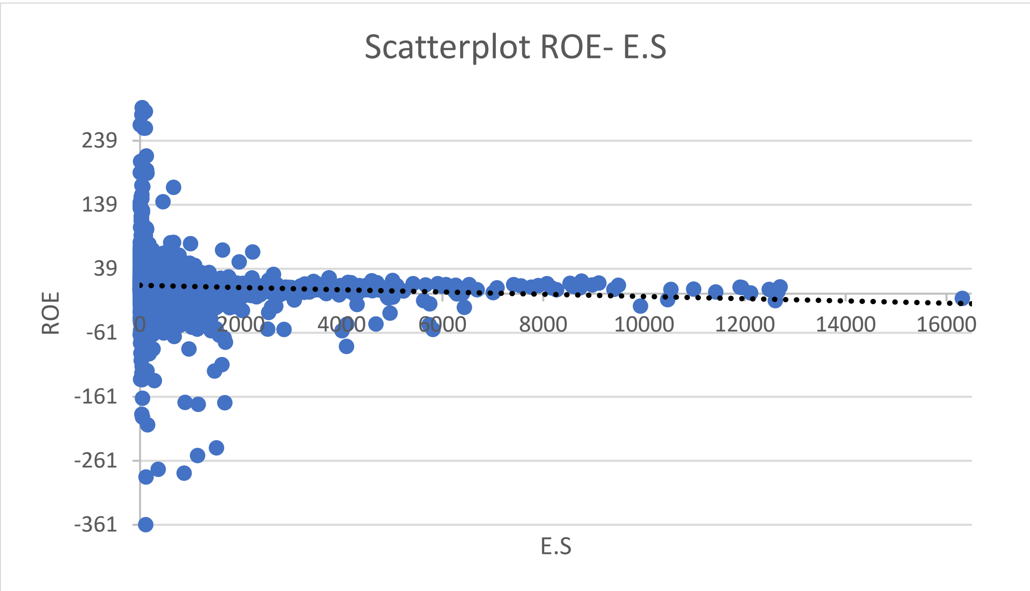
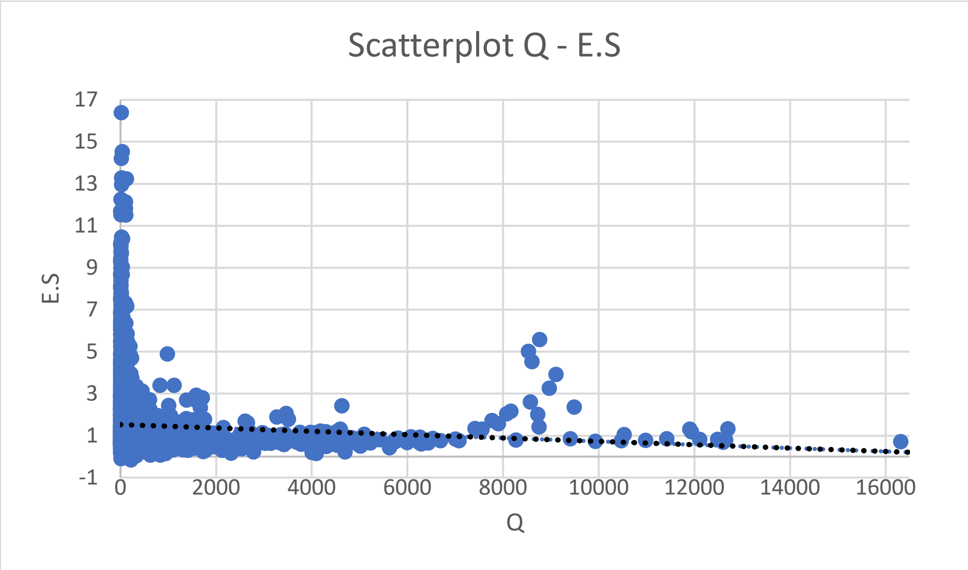


Figure 17

Scatterplot Q – E.S



5.4 Descriptive Statistics IV

Table 5 presents the descriptive statistics as an expansion of table 2 and figure 1 that show the summary statistic. The final sample exists of 830 firms times 5 years makes up for 4150 firm years = 4150 observations.

Table 5

Summary Statistics

	Obs.	Mean	Std.Dev	Median	Min	Max
E.S	4150	411.14	1166,53	46.86	0.03	16309.64
Q	4150	1.49	2.42	0.99	-0.21	16.39
ROA	4150	6.15	10.70	5.20	-55.57	46.03
ROE	4150	11.98	42.79	10.67	-360,95	290.15
LEV	4150	36.00	21.45	35.52	0.00	106.22
QR	4150	1.24	1.68	0.96	0.06	49.90
Size	4150	16.21	2.72	15.72	9.89	23.85
ES	4150	68.04	23.22	72.68	0.31	99.87
CI	4150	0.91	10.49	0.49	0.07	1.843

5.5 Test of Hypotheses

Table 6 presents the results of various fixed effects regressions performed to estimate the relationship between firm performance and carbon emissions. Model 1 is used for return on assets as dependent variable, model 2 for Tobin's q as a dependent variable and model 3 for return on equity as dependent variable. When we first analyzed the results, we were not that satisfied with the outcomes and the corresponding coefficients as the numbers were very low. As a result, we decided to take the natural logarithm of E.S instead which gave better outcomes, because we take the natural log of our independent variable, the interpretation of the coefficient will be different. For every 1% increase in the independent variable, our dependent variable increases by coefficient x/100(Ford, 2018).

Positive coefficients indicate that as the value of the independent variable (E.S) increases, the mean of the dependent variable(ROA/ROE/Q) also tends to increase. Negative coefficients suggest that as the independent variable (E.S) increases, the dependent variable (ROA/ROE/Q) tends to decrease. The results from model 1 provides empirical support for a negative effect of CO_2 on firm performance. The coefficient of CO_2 in model 1(-1,342) has a significance level of 1%. This means that if carbon emissions increase by 1%, ROA decreases with 1,342/100= 0,01342. By that we can conclude that increasing GHG emissions are unprofitable from a short-term perspective. The coefficient of CO_2 in model 3 (-0,449) is not significant. As we have taken ROE as one of the variables for CFP, we cannot fully reject our hypothesis that state that improved CEP negatively impacts the CFP as only one of the two models' outcomes for CO_2, namely ROA is significant. For hypothesis 2, we have to look at model 2. The coefficient of CO_2 in model 2(-0,046) is not significant. This indicates that there is no relationship between CEP and investors' perceptions of future market performance. Because the relationship is not significant, we do not find evidence for our hypothesis that CEP impacts the investors' perceptions of future market performance.

Three of our hypotheses existed of control variables to research if they have any significant impact on the financial performance of a firm. The coefficients of Size, LEV and CI are all significant for model 1, 2 and 3, the only difference being that for model 2 the coefficient of LEV and CI are not 1% significant, but 5% and 10% respectively. For our first hypothesis: "The size of a company positively impacts the financial performance." The coefficient of the control variables is positive for all three models, indicating that size has a positive impact on the financial performance of a company. The coefficients of LEV for all three models are negative, in line with our hypothesis stating that a high level of leverage has a negative effect on the financial performance. Only for Tobin's q the level of significance is greater than 1% and the effect is very low. For our last hypothesis we look at the control variable CI, normally a company with higher capital intensity ratios relative to that of peers is more likely to have lower margins from the greater spending. Lower margins can indicate lower profits. The results of our test are in line with that of the hypothesis with the coefficient CI for Tobin's q only being significant at a 10% level together with a very low effect. To conclude, the results provide strong support for Hypotheses 3,4 and 5.

Concludingly fixed effect regressions with robust standard errors are used to test the findings' robustness. Also taken into account by robust standard errors are heteroskedasticity and autocorrelation. [6] The results of this fixed effect regression with robust standard errors give somewhat of a different picture as the coefficient for E.S for models 1, 2 and 3 are all negative now, all being significant with $p<0,01$. The negative coefficients suggest that as the independent variable, in our case E.S, increases, the dependent variables (ROA/ROE/Q) of our models tends to decrease. To

[6] Table E1 in Appendix E

conclude this means that there is an indication of a negative effect of carbon emissions on firm performance. With that we find strong evidence to reject our first hypothesis, however at the same time we find strong evidence in favor of our second hypothesis. Decreased GHG emissions have a positive effect on Tobin's q.

Table 6
Fixed-Effects regressions

	Dependent variable:		
	ROA	Q	ROE
	(1)	(2)	(3)
ES	−0.023*	−0.003***	−0.135**
	(0.012)	(0.001)	(0.056)
LEV	−0.158***	−0.003**	−0.728***
	(0.013)	(0.001)	(0.062)
Size	3.838***	0.196***	24.623***
	(0.591)	(0.061)	(2.799)
QR	2.738***	−0.085*	6.157***
	(0.430)	(0.044)	(2.037)
E.S	−1.342***	−0.046	−0.449
	(0.323)	(0.033)	(1.530)
CI	−5.201***	−0.102*	−26.582***
	(0.566)	(0.058)	(2.679)
factor(year)2018	−0.640**	0.068**	−3.331**
	(0.320)	(0.033)	(1.516)
factor(year)2019	−0.866***	−0.061*	−4.772***
	(0.331)	(0.034)	(1.570)
factor(year)2020	−2.428***	−0.128***	−7.662***
	(0.352)	(0.036)	(1.667)
factor(year)2021	−0.153	0.054	−3.441*
	(0.376)	(0.039)	(1.781)
Observations	4,150	4,150	4,150
R^2	0.134	0.027	0.106
Adjusted R^2	−0.085	−0.220	−0.121
F Statistic (df = 10; 3310)	51.308***	9.129***	39.081***

Note: *p<0.1; **p<0.05; ***p<0.01

6. DISCUSSION AND CONCLUSION

In this chapter we will summarize the most essential results from the previous chapter based on the research question: "Is there a relationship between companies' financial performance and carbon performance?" and the corresponding sub questions. To answer this research question carbon emissions data together with firm performance data for a global sample over 5 years was analyzed. In this analysis we used Tobin's q, ROA, and ROE as CFP indicators. We have found no support for the first hypothesis; we did however find support for our second hypothesis. The results of this research have a slightly different outcome than previous papers, as most of the previously conducted research concluded that improved corporate environmental performance would lead to a decrease in ROA. The relationship between GHG emissions and Tobin's q are in line with that of previous papers. The results indicate that investors value lower GHG emissions, indicating that they foresaw a shift in the way businesses that take a proactive approach to climate change are rewarded. Tobin's q measures whether a firm is relatively over-or undervalued, it is the relationship between market valuation and intrinsic value.

To sum up we can conclude that a company does not financially benefit from emitting more CO2, this is contrary to what previous papers concluded like Busch et al. (2022); Delmas et al. (2015) and in line with research conducted by (Lee et al., 2015). Emitting more CO2 results in lower ROA and ROE, thus a company's environmental performance has impact on its short-term financial performance measured in ROA and ROE. Besides that, investors also anticipate on companies with reduced GHG emissions, as the results indicate that they place a premium on such companies.

6.1 Practical Implications and Future Research

The findings contribute to the body of knowledge about financial and environmental performance as the findings suggest that firms with high GHG emissions are punished, not only on the long-term, but also on the short-term. The findings can be a wakeup call for management of companies in industries that are lagging in the energy-transition as they are losing money measured in profitability and in value if they are not reducing their emissions. The urgency to come up with decarbonization plans is rising with the year as societies pressure companies and governments to do more about CO2 emissions. An extension of this research can have practical implications for policy makers as future research about the influence of incentives in the form of subsidies can be interesting. A possible research question could be: Do incentives help lower carbon emissions? With the overall hypothesis: that incentives for business with high emissions, will make sure that GHG emissions are reduced, and that incentives for companies with low emissions, will make sure that those businesses will not increase GHG emissions. Unfortunately, we cannot answer these questions with our data.

Future research would profit from the use of more variables, it would be interesting to do research about the impact effect of the ETS. Due to the scope of this research one data component was left out, namely the Carbon offsets/credits. This variable is the equivalent of the CO2 offsets, credits and allowances in tonnes purchased and/or produced by the company during the fiscal year. Companies evolving in certain sectors have a limit on the amount of emissions if they exceed this limit, they purchase credit to balance it and if they are short from this limit, they can sell the remainder of the allowance. Future research would benefit from including this variable as it gives insights into how far companies or certain industries are on the road to becoming CO2 neutral. It would also be interesting to do several other tests with the sample of this research, but then excluding certain sectors and measuring the impact of that.

The literature review of this research was an extension of existing research with the use of standard methods. The theoretical contribution could be improved by using more advanced methods or new methods. 2022 can be seen as a turning point with the Ukraine crisis leading to an energy crisis in Europe not seen since the Libyan war in 2011, on top of that commodity prices are rising, overall inflationary pressures are giving central banks a lot of stress and COVID-19 is still present in our daily lives. All these *'problems'* are urging the need for clean and cheaper energy. Because of the rapidly changing energy situation, it would be remarkably interesting to include data from the years 2022 and beyond.

6.2 My Point of View

In the previous parts we talked about the EOP of companies. The EOP dimension is the objective dimension of CEP in this research as it exists of data and results. In this part we will take a broader look and discuss the EMP of companies, which is the subjective dimension of CEP. In this chapter, I will focus on the situation in the Netherlands as that allows zooming in a bit, in that way I can share my point of view about the complex CO2 emissions discussion. In order to meet "a level that would prevent dangerous anthropogenic interference with the climate system" GHG concentrations in the atmosphere have to be reduced drastically (UNFCCC, 2015).

6.2.1 EU ETS

To reduce the high GHG concentrations the KT was implemented in 1995, as a result the EU needed to come up with a way to meet the set targets. This led to the EU ETS, since then it has been the EU's flagship initiative to reach its climate targets. The EU ETS has finished its third phase, goals of the third phase included a single EU-wide cap on emissions in place of the previous system of national caps, auction as the default method for allocating allowances (emission credits) instead of free allocation and more sectors and gases are included.

Like mentioned previously in the Netherlands around 400 companies have to register their CO2 emissions. These 400 companies are responsible for around half of the emissions in the Netherlands. This happens in the EU ETS. To meet the goals of 2030, a net domestic reduction of at least 55% GHG emissions is needed by 2030 compared to 1990 (European Union, 2020). The amount of CO2 that companies can emit is equal to the number of emission credits that come to market. For every tonnes of CO2 they emit, companies have to hand in one emission credit. If a company does not have enough credits, it must buy them, when a company emits less CO2, it can sell its credits. Since the beginning of the EU ETS in 2005, the total CO2 emissions have been reduced by 44% (Emissieautoriteit, 2022). Companies are left to the number of CO2 credits that have been assigned to a certain sector. So, the idea is that companies have an incentive to decrease their GHG emissions and comply to regulation.

6.2.2 Role of the Government

Urgenda is a Dutch non-profit action group that has the goal to make the Netherlands more sustainable faster. Urgenda has taken the Dutch state to court multiple time. Both parties want to achieve the same goal: a more sustainable country, they however do not agree on the pace. [7] In 2020 the reduction of emissions with respect to 2019 was in line with the Urgenda goal of 25%, however the emissions of 2021 are 2.1% higher than that of 2020, below the Urgenda reduction goal (Emissieregistratie, 2022).

6.2.3 Role of Corporations

As COVID-19 has shut down the world, people had to work from home, because of lockdowns, had more free time and thus more time to think, this increased the environmental awareness among people.[8] The role of big corporations on climate change became more relevant. One of those

[7] Rechtspraak, "Urgenda", retrieved July 11th, 2022, from:https://www.rechtspraak.nl/Bekende-rechtszaken/klimaatzaak-urgenda

[8] BCG, "The pandemic Is Heightening Environmental Awareness", retrieved October 30th, 2021, from:

companies, Shell plc, was the first company in the Netherlands and the first oil company worldwide that has been held liable for climate change. The company was part of one of the biggest lawsuits related to climate change in history. The Hague District Court ordered Shell to reduce its CO2 emissions by a net 45% in 2030, compared to 2019 levels.[9] Shell was taking to court by Milieudefensie, an independent association striving for a more “sustainable, honest and open Netherland”. Milieudefensie has a list of the 30 biggest emitters in the Netherlands. All the companies on the list have received a letter from Milieudefensie with the request to share their action plan to tackle their emissions.

6.2.4 Hypotheses and Research Question

In this research we did not make a differentiation between direct and indirect emissions, however the difference is certainly important. When discussing carbon emissions, the terminology Scopes 1,2 and 3 emissions is used regularly. Emissions from sources that an organization directly owns, or controls are included in scope 1 emissions. Scope 2 are emissions that a company causes indirectly when it purchases energy that is produced, to conclude scope 3 include emissions from the use of the energy products that a company sells. Organizations like Milieudefensie want companies to take responsibility over scope 3 emissions. They argue that you could see parties like Shell as essential system players, if they change the products they sell and only offer green alternatives, their emissions of scope 1 and 2 will also drop. Parties like Milieudefensie are partially right as emissions of companies are scope 3 emissions. In that perspective companies like shell still benefit from emitting more CO2, the more products Shell sells, the more profit it makes. Continuing that reasoning, it is also true that improved CEP negatively impacts the CFP of Shell, of course this is a specific example of one company, but it is more relevant than ever as the ‘oil majors’ (ExxonMobil, Shell, Chevron, BP, Total and ConocoPhillips, the legacy energy companies) around the world are making record profits. On the other hand, I do not agree with Milieudefensie as these companies are only providing the demand that is requested and maintained by governments. Everyone is blaming the big corporation for the soaring prices, while they should blame governments instead, because the governments should stimulate consumers and companies to use less energy and use resources more efficiently sot that demand will be decreased, and energy becomes more affordable for the average consumers.

6.2.5 Conclusion

A more active role of the government is needed, big corporations demand clarity in the road to net zero. We should not live in a society where big corporation can be taken to court by independent non-government clubs, in my eyes that is not how a healthy capitalism country works. The governments should set out the rules and communicate a logical plan that corporations can act upon. Because we need corporations like Shell, Ahold Delhaize, RW, Unilever and ING. These companies deliver products and services that we use daily, but if they are not stimulated or bound by legislation to change those products / services into cleaner alternatives then we, the consumer, will also not be stimulated to change the products we use. The consumer will go for the best quality cheap alternative. These companies should be stimulated to be innovative and create products that are green, payable, and sustainable. Besides that, the government should offer incentives for businesses with high emissions, so that they will reduce their GHG emissions. The same accounts for companies with low emissions, policies should give those businesses incentives so that they will not increase their emissions. To conclude, the EU ETS is a system to achieve the EU’s ambition on

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https://www.bcg.com/publications/2020/pandemic-is-heightening-environmental-awareness

[9] Rechtspraak, “Royal Dutch Shell must reduce CO2 emissions”, retrieved July 12th, 2022, from: https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Rechtbanken/Rechtbank-Den-Haag/Nieuws/Paginas/Royal-Dutch-Shell-must-reduce-CO2-emissions.aspx

reducing greenhouse gas emissions to at least 55% below 1990 levels in 2030 so that the path to becoming climate neutral by 2050 becomes visible. However, the EU ETS will not be enough, national governments need to come up with clearer legislation and plans to guide the companies that provide the products and services that we all use, hopefully more sustainable in the future.

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APPENDIX A

Figure A1

Elaboration on emissions scores

Score range	Description	
0 to 25	First Quartile	Scores within this range indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.
> 25 to 50	Second Quartile	Scores within this range indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly.
> 50 to 75	Third Quartile	Scores within this range indicates good relative ESG performance and above average degree of transparency in reporting material ESG data publicly.
> 75 to 100	Fourth Quartile	Score within this range indicates excellent relative ESG performance and high degree of transparency in reporting material ESG data publicly.

APPENDIX B

Table B1

Data description & Acronyms

Variable	Variable label
Q	Tobin's q
ROA	Return on Assets
ROE	Return on Equity
ROI	Return on investment
EPS	Earnings per share
CP	Carbon Performance
E.S	Emissions divided by total sales/revenue
SIZE	Company Size Indicator
TCA	Total Current Assets
CFP	Corporate Financial Performance
CEP	Corporate Environmental Performance
EOP	Environmental Operational Performance
EMP	Environmental Management Performance
QR	Quick Ratio
LEV	Leverage
CI	Capital Intensity
Year	Year between 2017 and 2021
ES	Emissions score
ISO	Country Identification Code
ICB	Industry Classificaiton Benchmark
ISIN	Company identification code
EU ETS	European Union Emissions Trading-System
KT	Kyoto Protocol
GHG	Greenhouse gas

APPENDIX C

Table C1

Differences between Fixed Effect and Random Effect model

	Fixed Effect Model	Random Effect Model
Functional form	$y_{it} = (\alpha + u_i) + X_{it}^{'}\beta + v_{it}$	$y_{it} = \alpha + X_{it}^{'}\beta + (u_i + v_{it})$
Assumption	-	Individual effects are not correlated with regressors
Intercepts	Varying across group and/or time	Constant
Error variances	Constant	Randomly distributed across group and/or time
Slopes	Constant	Constant
Estimation	LSDV, within effect estimation	GLS, FGLS (EGLS)
Hypothesis test	F test	Breusch-Pagan LM test

Table C2

Hausman Test for Endogeneity (Hausman Specification test)

Table C2

Hausman Specification Test

	fe	re	Difference	S.E.
ES	-0,4236743	-0,0246231	-0,3990512	0,3260151
LEV	-0,1601327	-0,0126309	-0,1475018	0,3882917
Size	-0,0832754	-0,0284391	-0,0548363	0,0026513
QR	-0,0567539	0,0074493	-0,0642032	0,0039403
E.S	0,0493821	-0,1532233	0,2026054	0,0182912
CI	0,0029346	-0,0042912	0,0072258	0,0032601
Year				
2018	-0,0224879	-0,0259776	0,0034897	
2019	0,3032525	0,4375126	-0,1342601	
2020	-0,2914008	0,1355319	-0,4269327	
2021	0,0655572	0,4294715	-0,3639143	

Test Ho: difference in coefficients not systematic

chi2(12) = (b-B)'{(V_b-V_B) ^ (-1)} (b-B)

=80.89

Prob>chi2 =0.00245

Note

Ho: Random effect model is consistent.

Ha: Fixed effect model is consistent.

APPENDIX D

Table D1

Summary Pesaran’s test, Wooldridge test and Modified Wald test

	Peseran's test of cross-sectional independence	Wooldridge test for autocorrelation	Modified Wald test for groupwise heteroskedasticity
H0	Cross sectional independence	No first-order autocorrelation	Homoskedasticity
Test	Corss sectional dependencev = 83.322	F (1, 829) = 3.011	Chi2 (830) = 7.6e-05
P-value	Prob = 0.0000	Prob > F = 0.000001	Prob>chi2 = 0.00000
Result	As p-value are less than alpha hence Null hypothesis is rejected, the data shows cross-sectional dependence	As p-values are less than 0 hence Null hypothesis is rejected, the data shows first-order autocorrelation	As p values are less than alpha hence the Null hypothesis is rejected, thus, the data shows first-order Groupwise heteroscedasticity

APPENDIX E

Table E1

Fixed Effects with robust SE

Table 11

	Dependent variable:		
	ROA	ROE	Q
	(1)	(2)	(3)
LEV	−0.744***	−2.947***	−0.199***
	(0.082)	(0.341)	(0.019)
QR	−0.077***	−0.105***	−0.004*
	(0.008)	(0.034)	(0.002)
SIZ	2.762***	6.194***	0.584***
	(0.307)	(1.272)	(0.071)
ES	−0.258***	−0.476*	−0.138***
	(0.063)	(0.261)	(0.015)
CI	0.042***	0.122***	0.007***
	(0.007)	(0.031)	(0.002)
E.S.	−3.440***	−10.137***	−0.491***
	(0.299)	(1.237)	(0.069)
Observations	4,150	4,150	4,150
R^2	0.110	0.048	0.084
Adjusted R^2	0.108	0.046	0.081
F Statistic (df = 6; 4139)	85.434***	34.875***	62.894***
Note:	*p<0.1; **p<0.05; ***p<0.01		