



# Climate Change and Corporate Profitability: The Effects of Greenhouse Gasses and Sustainability Strategies on Stock Price Performance

## Link

<http://nrs.harvard.edu/urn-3:HUL.InstRepos:37736754>

## Terms of use

This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material (LAA), as set forth at

<https://harvardwiki.atlassian.net/wiki/external/NGY5NDE4ZjgzNTc5NDQzMGIzZWZhMGFIOWI2M2EwYTg>

## Accessibility

<https://accessibility.huit.harvard.edu/digital-accessibility-policy>

## Share Your Story

The Harvard community has made this article openly available.  
Please share how this access benefits you. [Submit a story](#)

Climate Change and Corporate Profitability: The Effects of Greenhouse Gasses and  
Sustainability Strategies on Stock Price Performance

Eric P. Hewitt

A Thesis in the Field of Sustainability and Environmental Management  
For the Degree of Master of Liberal Arts in Extension Studies

Harvard University

November 2017



## Abstract

This research tests the hypothesis that a statistically significant relationship exists between a company's direct and indirect greenhouse gas ("GHG") emissions and equity return performance. Approximately 750 international companies, with six years of available and complete emissions data, were analyzed with multilinear regression (MLR) analysis. MLR was also used on sub-sample population data sets categorizing the sample data into smaller industry-level groups. In an effort to increase the model's fit and explain more variance, further regressions incorporated new independent variables representative of total GHG output and GHG emission changes, both in totality and annually, qualitative variables related to corporate managerial practices (the hierarchical level of corporate initiatives and the potential effect of environmental performance incentives), the corporate use of emissions trading schemes in the selected industries, and GHG intensity ratios calculated by dividing Scope 1 and Scope 2 emissions by net income, market capitalization, and revenue.

Key findings are: 1) six year Scope 1 and Scope 2 emissions negatively affect total six year stock price return ( $p < 0.001$ ); 2) Scope 1 emissions are a statistically significant predictor ( $p < 0.001$ ) of six year stock price performance; 3) stock price performance is negatively correlated to GHG emissions (Scope 1  $R = -0.175^{**}$ , Scope 2  $R = -0.118^{**}$ ); 4) in certain industries sustainability matters more than in others; 5) in different industries different predictor variables have statistical significance; and 6) companies that do not emit as much GHG's as others generally fare better in the stock market. Current sustainability trends, reasoning for those trends, and the Paris Agreement

are all discussed in brief and then the results of the statistical analyses described previously are reviewed in detail.

This research is the first to regress stock price performance with Scope 1 and Scope 2 emissions, and provides evidence for the importance for companies to reduce their carbon output. This paper concludes that corporate sustainability strategies preserve shareholder wealth. Furthermore, a long-term corporate sustainability focus equates to improved stock price performance, supported by statistical tests of these three hypotheses: 1) GHG output influences stock price return, 2) GHG output influences stock price return in specific industries when the independent predictor variables that are used better explain variance than GHG emissions alone, and 3) the bottom 100 GHG emitters will outperform the top 100 GHG emitters when their yearly total returns are compared. For global GHG emissions to be reduced, the corporation, a perpetual individual, must also reduce their emissions. Hopefully, this thesis research can serve as a catalyst for GHG reductions, as it provides sound statistical evidence as to why GHG emission reductions are important for a corporation, and identifies carbon output as a risk to increasing stock price performance.

## Author's Biographical Sketch

Eric Hewitt is a Master's candidate for the ALM degree at Harvard University's Extension School. Eric was also admitted as Special Student in the Graduate School of Arts and Sciences (GSAS) and studied at both Harvard Law School and the GSAS. During his four year tenure at Harvard, Eric worked for the University's endowment on the high-yield credit desk, was a faculty aide for two professors, was elected a Senator in the Harvard Graduate Council and tasked to re-write its constitution, and completed a Congressional internship for Congressman Stephen Lynch's (D-MA) office during his U.S. Senate seat race against Ed Markey.

Before attending Harvard, Eric was a finance professional in New York City. He has worked for the United States Treasury, Rothschild, Blackrock, and Morgan Stanley in varied positions ranging from investment banking and restructuring to asset management. Eric started his career in the military, where he served as a non-commissioned officer in a Marine Corps scout/sniper platoon during the invasion of Iraq. After his Honorable discharge from the USMC, he transitioned to the Army and served as a reconnaissance and surveillance specialist while attending ROTC at Georgetown University.

Eric is currently pursuing a dual JD/MBA accelerated degree program at the University of Notre Dame; he is focusing on corporate, criminal, and trial law and has fashioned his own MBA program track with a focus on accounting and finance. Eric received his undergraduate degree from Georgetown University's McDonough School of Business, where he received a perfect GPA in one of his two majors.

## Acknowledgments

First and foremost, I would like to thank Harvard University for the plethora of opportunities they have bestowed on me. Never in my life have I had such a treasure of support. While living on campus, I met a diverse and global network of truly brilliant, well rounded, and cruelly ambitious individuals. I also need to bestow laurels on my two advisors, my research advisor Dr. Mark Leighton who heads the SEM thesis program and my thesis director Richard Goode, Executive Director of Ernst & Young's Sustainability practice. I could not have found a better mix of academic acumen and industry practice; their wisdom, patience, and guidance was paramount to my completion of this academic endeavor – they offered me any help I asked for and conducted my requests with conviction and glee. Many thesis students do not have the flabbergasting experience in which I find myself so graciously in.

At the risk of sounding cliché, I would also like to thank my mother. She has always loved and supported me through any daunting challenge in my life. She never stopped believing in me, no matter what obstacle may have arisen; life has a way of testing my resolve and teasing me to speedily stray from my path, my mother forever being a beacon of light during my quest through dark and stormy waters. That said, and in advanced appreciation of your time, I wish all who read this fair winds and following seas.

Lastly, to those who stayed up with me for countless hours, bore with me through many all-nighters, revisions and editing, and put up with my sleeplessness and crabby demeanor, you know who you are – and thank you! To all: *semper fidelis* and *Hoya Saxa*.

## Dedication

This paper is dedicated to Luke and Gia. You are always in my thoughts and heart, no matter where in the world I am.

## Table of Contents

|                                                                                         |      |
|-----------------------------------------------------------------------------------------|------|
| Abstract.....                                                                           | iii  |
| Author's Biographical Sketch .....                                                      | v    |
| Acknowledgments .....                                                                   | vi   |
| List of Tables.....                                                                     | xii  |
| List of Figures.....                                                                    | xiii |
| Definition of Terms.....                                                                | xiv  |
| I. Introduction .....                                                                   | 1    |
| Research Significance and Objectives.....                                               | 2    |
| Background.....                                                                         | 4    |
| The Business Case for Sustainability .....                                              | 5    |
| Sustainability Indicators: Defining what Sustainability is and What it<br>Affects ..... | 7    |
| The Risks of Climate Change.....                                                        | 10   |
| Corporate GHG Emissions Accounting: Scope 1 and Scope 2 .....                           | 12   |
| Scope 1 and Scope 2 Reporting Data by Industry .....                                    | 16   |
| Risks of Climate Change for Corporations .....                                          | 22   |
| The Current Global Response to Climate Change – the Paris Agreement                     | 23   |
| Key Implications of the Paris Agreement .....                                           | 26   |
| Research Questions, Hypotheses and Specific Aims .....                                  | 28   |
| Specific Aims .....                                                                     | 29   |

|      |                                                                         |    |
|------|-------------------------------------------------------------------------|----|
| II.  | Methods .....                                                           | 30 |
|      | Sample Data Collection and Visualization .....                          | 30 |
|      | Scope 1 and Scope 2 Emissions Data by Country .....                     | 31 |
|      | Stock Price Return and Corporate Fundamentals Data .....                | 33 |
|      | Regression Analysis .....                                               | 34 |
|      | Total Return vs. Scope 1 and Scope 2 Emissions .....                    | 35 |
|      | Yearly Industry Group Regressions .....                                 | 39 |
|      | Top 100 vs. Bottom 100 GHG Emitters .....                               | 48 |
| III. | Results .....                                                           | 52 |
|      | Carbon Output as a Predictor of Stock Price Performance .....           | 52 |
|      | Industry Regression Analysis with Qualitative and Ratio Variables ..... | 56 |
|      | 2015 Industry Regressions .....                                         | 58 |
|      | 2015: Basic Materials .....                                             | 58 |
|      | 2015: Utilities .....                                                   | 59 |
|      | 2014 Industry Regressions .....                                         | 60 |
|      | 2014: Communications .....                                              | 60 |
|      | 2014: Energy .....                                                      | 61 |
|      | 2014: Financial .....                                                   | 61 |
|      | 2013 Industry Regressions .....                                         | 62 |
|      | 2013: Communications .....                                              | 62 |
|      | 2013: Consumer .....                                                    | 63 |
|      | 2013: Energy .....                                                      | 64 |
|      | 2013: Financial .....                                                   | 65 |

|     |                                                                            |    |
|-----|----------------------------------------------------------------------------|----|
|     | 2013: Technology .....                                                     | 65 |
|     | 2012 Industry Regressions .....                                            | 66 |
|     | 2012: Consumer.....                                                        | 66 |
|     | 2012: Utilities .....                                                      | 67 |
|     | 2011 Industry Regressions .....                                            | 68 |
|     | 2011: Basic Materials .....                                                | 68 |
|     | 2011: Consumer.....                                                        | 69 |
|     | 2011: Financial .....                                                      | 69 |
|     | 2011: Utilities .....                                                      | 70 |
|     | Topmost and Bottommost Scope 1 and Scope 2 Carbon Emitters.....            | 70 |
| IV. | Discussion .....                                                           | 73 |
|     | Data Overview .....                                                        | 74 |
|     | Total Scope 1 and Scope 2 Emissions as a Predictor of Total Stock Price    |    |
|     | Return .....                                                               | 76 |
|     | Scope 1 and Scope 2 initial regression model. ....                         | 77 |
|     | Industry Regressions with Intensity Ratios, GHG Emissions Changes, and     |    |
|     | Qualitative Corporate Strategies Included.....                             | 78 |
|     | Intensity ratio analysis example. ....                                     | 79 |
|     | Significant predictor variables by industry.....                           | 81 |
|     | Discussion on the results of the enhanced regression model. ....           | 83 |
|     | Top 100 vs. Bottom 100 Discussion.....                                     | 84 |
|     | Conclusion .....                                                           | 85 |
|     | Appendix 1 2015: Basic Materials Industry Regression Analysis Output ..... | 87 |

|                                                                           |     |
|---------------------------------------------------------------------------|-----|
| Appendix 2 2015: Consumer Industry Regression Analysis Output.....        | 89  |
| Appendix 3 2015: Industrial Industry Regression Analysis Output.....      | 91  |
| Appendix 4 2015: Utilities Industry Regression Analysis Output .....      | 93  |
| Appendix 5 2014: Communications Industry Regression Analysis Output.....  | 95  |
| Appendix 6 2014: Consumer Industry Regression Analysis Output.....        | 97  |
| Appendix 7 2014: Energy Industry Regression Analysis Output .....         | 99  |
| Appendix 8 2014: Financial Industry Regression Analysis Output .....      | 101 |
| Appendix 9 2014: Industrial Industry Regression Analysis Output.....      | 103 |
| Appendix 10 2013: Communications Industry Regression Analysis Output..... | 105 |
| Appendix 11 2013: Consumer Industry Regression Analysis Output.....       | 107 |
| Appendix 12 2013: Energy Industry Regression Analysis Output .....        | 109 |
| Appendix 13 2013: Financial Industry Regression Analysis Output .....     | 111 |
| Appendix 14 2013: Technology Industry Regression Analysis Output.....     | 113 |
| Appendix 15 2012: Consumer Industry Regression Analysis Output.....       | 115 |
| Appendix 16 2012: Utilities Industry Regression Analysis Output .....     | 117 |
| Appendix 17 2011: Basic Materials Industry Regression Analysis .....      | 119 |
| Appendix 18 2011: Consumer Industry Regression Analysis Output.....       | 121 |
| Appendix 19 2011: Financial Industry Regression Analysis Output .....     | 123 |
| Appendix 20 2011: Industrial Industry Regression Analysis.....            | 125 |
| Appendix 21 2011: Utilities Industry Regression Analysis Output .....     | 127 |
| Appendix 22 Carbon Price Graph .....                                      | 129 |
| References .....                                                          | 130 |

## List of Tables

|          |                                                                                                      |    |
|----------|------------------------------------------------------------------------------------------------------|----|
| Table 1  | Industry regression variables identified and defined.....                                            | 40 |
| Table 2  | The Bloomberg industry's frequency and cumulative percentages used in the industry regressions. .... | 41 |
| Table 3  | The manager level variable descriptive frequencies .....                                             | 44 |
| Table 4  | The incentive variable descriptive frequencies .....                                                 | 45 |
| Table 5  | The emissions trading scheme variable frequencies .....                                              | 47 |
| Table 6  | Top 20 companies emitting the most Scope 1 and 2 emissions by industry .....                         | 49 |
| Table 7  | Bottom 20 companies emitting the least Scope 1 and 2 emissions by industry. ....                     | 50 |
| Table 8  | MLR Summary and ANOVA for stock price return vs. Scope 1 and 2 emissions .....                       | 52 |
| Table 9  | Coefficients of the Scope 1 and Scope 2 vs. total return regression .....                            | 53 |
| Table 10 | One-tailed significance test of stock price return vs. Scope 1 and Scope 2 emissions .....           | 55 |
| Table 11 | MLR results for fit analysis of eight industries from 2011 to 2015 .....                             | 57 |
| Table 12 | Total Scope 1 & Scope 2 emissions for the top and bottom 100 GHG emitters. ....                      | 71 |
| Table 13 | Return data for the top 100 and bottom 100 Scope 1 and 2 GHG emitters.                               | 72 |
| Table 14 | The significance of the regression model for each industry and year .....                            | 78 |
| Table 15 | Estimated returns using the 2011 consumer industry MLR model .....                                   | 80 |

## List of Figures

|           |                                                                                            |     |
|-----------|--------------------------------------------------------------------------------------------|-----|
| Figure 1  | The ESG matrix of sustainability indicators. ....                                          | 8   |
| Figure 2  | A visual of the concept of GHG “Scopes” .....                                              | 14  |
| Figure 3  | Reported Scope 1 emissions by country. ....                                                | 15  |
| Figure 4  | Reported Scope 2 emissions by country .....                                                | 16  |
| Figure 5  | 2014 global CO <sub>2</sub> emissions by country. ....                                     | 17  |
| Figure 6  | Number of companies reporting Scope 1 emissions by industry. ....                          | 18  |
| Figure 7  | Number of companies reporting Scope 2 emissions by industry .....                          | 19  |
| Figure 8  | Total number of companies reporting GHG emissions by industry .....                        | 20  |
| Figure 9  | GHG emissions by economic sector .....                                                     | 21  |
| Figure 10 | Number of companies with six years of complete Scope 1 data identified<br>by country ..... | 32  |
| Figure 11 | Number of companies with six years of complete scope 2 data identified<br>by country ..... | 32  |
| Figure 12 | Total return vs. Scope 1 and Scope 2 emissions .....                                       | 36  |
| Figure 13 | Residuals vs. predicted variables .....                                                    | 36  |
| Figure 14 | Log-transformed total return vs. Scope 1 and Scope 2 emissions .....                       | 37  |
| Figure 15 | Log-transformed total return vs. Scope 1 and Scope 2 emissions .....                       | 39  |
| Figure 16 | Ln total return, Scope 1, and Scope 2 emissions data .....                                 | 39  |
| Figure 17 | Estimated returns for 2011 with selected Scope 2 inputs .....                              | 81  |
| Figure 18 | Price of carbon from 1/2010 until 7/2017 .....                                             | 129 |

## Definition of Terms

|         |                                                                                                                                                                                                                                                                                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $\beta$ | Beta coefficient: the standardized coefficient for each predictor variable in multiple regression analysis. Beta values are often used over $B$ values as they are not dependent upon units of measurement                                                                                                                                                  |
| CO2e    | Carbon dioxide equivalent: This figure represents the amount of global warming impact for any greenhouse gas expressed in terms of carbon dioxide (CO <sub>2</sub> ). CO2e allows for all greenhouse gasses to be described in the same units. This paper uses CO2e data, so “carbon” can be used synonymously with “GHG” throughout this paper if need be. |
| ESG     | Environmental, social, and governance: A sustainability framework.                                                                                                                                                                                                                                                                                          |
| GHG     | Greenhouse gas: The compilation of gases that contribute to global warming, mostly made up of Carbon Dioxide (CO <sub>2</sub> ). These are accounted for and delineated as Scope 1 or Scope 2 emissions.                                                                                                                                                    |
| MLR     | Multilinear regression analysis                                                                                                                                                                                                                                                                                                                             |
| Scope 1 | Direct emissions coming from a source’s physical operations                                                                                                                                                                                                                                                                                                 |
| Scope 2 | Indirect emissions from the purchase of energy (i.e., electricity)                                                                                                                                                                                                                                                                                          |

## Chapter I

### Introduction

*“The single biggest risk that exists to the economy today”*~former U.S. Secretary of the Treasury Hank Paulson on climate change

The effects of carbon on the planet have created the impetus for regulation, quantification, and reduction of the greenhouse gases emitted by human activities (Arrow, et al., 1995; Costanza, et al., 2014). In 1987, the World Commission on Environment and Development set out an aspirational goal of sustainable development – describing it as “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). In January of 2016, the World Economic Forum listed “extreme weather events...failure of climate change mitigation and adaptation...and major natural catastrophes” as the second, third, and fifth of the top five global risks in terms of likelihood (World Economic Forum, 2016).

After years of heated debate, most scientific experts agree that global warming above two degrees Celsius will result in irreversible climate change and harm all sectors of civilization – food, water, health, land, national security, energy, and economic prosperity (Rockström, 2009; Steffen, Richardson, Rockström, Cornell, & Ingo Fetzer, 2015; Mann, 2014). On 18 January, 2018 NASA ranked 2017 as the “second warmest since 1880” (NASA, 2018). A separate and independent study by the National Oceanic and Atmospheric Administration (NOAA) concluded 2017 was the 3rd warmest in their history (NASA, 2018). Climate change has complex geopolitical, regulatory, and

economic implications from the internalization of environmental externalities such as weather changes, global warming, the establishment of governmental regulations, and other unforeseen global risks and interconnectivities from environmental challenges. How companies identify environmental risks, formulate model strategies, implement their plans, and gauge performance is now an economic and academic pursuit – the field of environmental economics was established and the term “sustainability” coined.

Although many states, governments, and international agreements have begun to address climate change and enact policies to measure and reduce their carbon footprints by using carbon markets – the commodification of carbon – corporations have not been as proactive. With gross domestic product and reach greater than that of many nations, if global climate change is to be addressed, the corporation – the perpetual individual – must also then formally address climate change as a significant business risk.

Environmental risks have economic repercussions companies need to evaluate, address, and strategize for. Research has shown environmental climate change and carbon-related emission concerns have moved from isolated initiatives driven by volunteers in many corporations, to become a specific and identified risk to firm profitability (Galbreath, 2010; Evans & Tzavara, 2012; Kashmanian, Wells, & Keenan, 2011). This paper analyzes that very risk and asks the question: Will companies’ not practicing sustainability be negatively affected in the stock market?

### Research Significance and Objectives

Companies that adopt a sustainability culture may be able to use a focus on sustainability and climate change risks as a competitive advantage. In previous studies,

companies that embrace corporate environmental, social, and governance issues have been shown to return approximately 20% over their peers (Eccles, Ioannou, & Serafeim, 2011). Using a climate change risk strategy to reduce environmental regulatory risk may allow for a competitive advantage, but limited research has been done on a company's stock price performance in relation to greenhouse gas (GHG) output.

This research examines evidence for the economic benefits included with sustainability, and a framework or strategy to conduct carbon-based environmental risk management. The statistical evidence presented can catalyze further corporate reductions in global GHG emissions, and offers insights into what executives in different industries may need to evaluate and consider when implementing a sustainability strategy.

Two previous studies found statistically significant relationship between oil prices, technology company prices, and interest rates (Kumar, Managi, & Matsuda, 2012; Henriques & Sadosky, 2008); the Kumar study also found no significance of carbon price returns in the stock price movements of clean energy companies (Kumar, Managi, & Matsuda, 2012). Another study examined carbon emissions allowances in the European Union's Emissions Trading Scheme in relation to German stock prices and showed that when carbon credits were given freely, the companies in question had better returns and a positive correlation between carbon output and stock prices (Oestreich & Tsiakas, 2015). However, these studies are limited in scope, and a broader examination of the theory that high carbon output increases stock prices is required, which this thesis provides.

It is necessary to demonstrate the benefits of this strategy to a profit-maximizing company in order to catalyze change. Therefore, the main objective of this research is to

investigate if a company's commitment to GHG reduction is compatible with profitability.

Do companies with a sustainable focus outperform those that do not have sustainable synergies? This question is answered by regressing stock price return data against environmental risk factors, such as carbon output evidenced by Scope 1 and Scope 2 emissions.

### Background

*“What you can measure, you can manage”*

~McKinsey Maxim

The environment is a perishable and often unnoticed asset, diminished without thought and requiring quantification for its benefits and accountability for its destruction and depletion. This theory is profoundly exposed in the “tragedy of the commons,” a concept first delivered in a discourse at Oxford University in 1832 by English economist and professor William Forester Lloyd in “Two Lectures on the Checks to Population” (Lloyd, 1832). The idea was further developed by Hardin (1968):

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, “What is the utility *to me* of adding one more animal to my herd?” This utility has one negative and one positive component. 1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds

from the sale of the additional animal, the positive utility is nearly 11. 2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsman, the negative utility for any particular decision-making herdsman is only a fraction of 21. Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited.

Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

It is hard to have a better conception than an Oxford professor; yet what is said must be a concern first, understood second, implemented third, and reviewed fourth. Change management theory must be implicit as any sustainability endeavor will undoubtedly require a change very distant from the natural human behavior pronounced in Hardin.

### The Business Case for Sustainability

Sustainable business practices are implemented to create long-term shareholder value in a resource-limited world while bringing to light opportunities and risks companies must eventually address – due to unavoidable climate change and the resulting impending regulation. Still, many corporations are hesitant to take on a sustainability business strategy. Often the detractors involve new changes and short-term capital costs. Sustainability is seen as “doing good,” but not necessarily essential to a corporation’s profit-maximizing goals. This leads to the paradox of corporate theory between shareholder (short-term) and stakeholder (long-term) approaches. Today, corporate

theory has moved to a multi-stakeholder approach where social, environmental, and economic objectives within a company's operations and operational linkages reach beyond the firm itself and extend to multiple parties, both within and without the corporation. Stakeholder theory encompasses the company's entire supply chain and also includes the global communities it operates, both in and around (Moratis, 2016).

Sustainability has moved from marginalized philanthropic concepts into complex interdisciplinary academic studies. In 1953, the concept of sustainability and "social responsibility" was first discussed by Bowen (1953). This radical concept was expanded to include the theory that organizations are complex and integrated systems involving more than the corporation itself, but also the people who form it and the world around it, similarly influenced by business.

Later, the moniker "corporate social responsibility" was coined and "CSR" was born; its progress defined in four significant epochs: the philanthropic era (up to the 1950s), the awareness era (1953-1967), the issue era (1968-1973), and the responsiveness era (1974-1978) (Rahdari & Rostamy, 2015). Today, CSR is codified and defined by the International Organization for Standardization (ISO) in ISO 26000's 100 pages (ISO, 2010). Companies are given a framework for sustainability, but many still fail to implement a systematic approach to CSR and corporate sustainability strategy.

Coming out of the academic focus on sustainability has been the methodology to define the qualitative and quantitative aspects of sustainability by using sustainability indicators, sustainability rankings, and reporting frameworks. The Global Reporting Initiative (GRI) is the brainchild of the attempt to quantify and communicate the often hard to measure effects of a business on critical sustainability issues like climate change,

social governance, worker health, and many others. Regardless of the difficulties in reporting sustainability, 92% of the world's largest 250 companies report on their sustainability performance (GRI, 2017).

Companies are now building an entire industry solely based on identifying companies that practice sustainability. Ranking systems and indexes such as MSCI ESG Research, the Dow Jones Sustainability Index, Bloomberg's ESG Data, and Thompson Reuters, gather data about a company and allow investors the ability to rank companies based on proprietary sustainability methodologies in order to make socially responsible investment decisions. Almost all of the indicators, rankings, and sustainability frameworks trying to isolate sustainability strategies are categorized by academics and sustainability practitioners alike into three sections: environmental, social, and governance or "ESG." However, what sustainability strategies actually influence performance is hard to define. Discovering materiality and finding the drivers of performance related to sustainability has been a dilemma for most corporations (Rahdari & Rostamy, 2015).

#### Sustainability Indicators: Defining what Sustainability is and What it Affects

A recent study analyzing the most common sustainability indicators was published by Rahdari and Rostamy (2015) for the ESG matrix (Figure 1). As management moves towards performance based on sustainability issues as budding risk factors for corporate performance, these indicators narrow ESG performance metrics from a total indicator universe of 1,826 raw indicators. The indicators are sourced from diverse databases such as indexes, rating agencies, and guidelines into a hierarchal

normative framework (Rahdari & Rostamy, 2015). This model represents the most important areas of focus on each leg of the ESG sustainability framework (Figure 1).

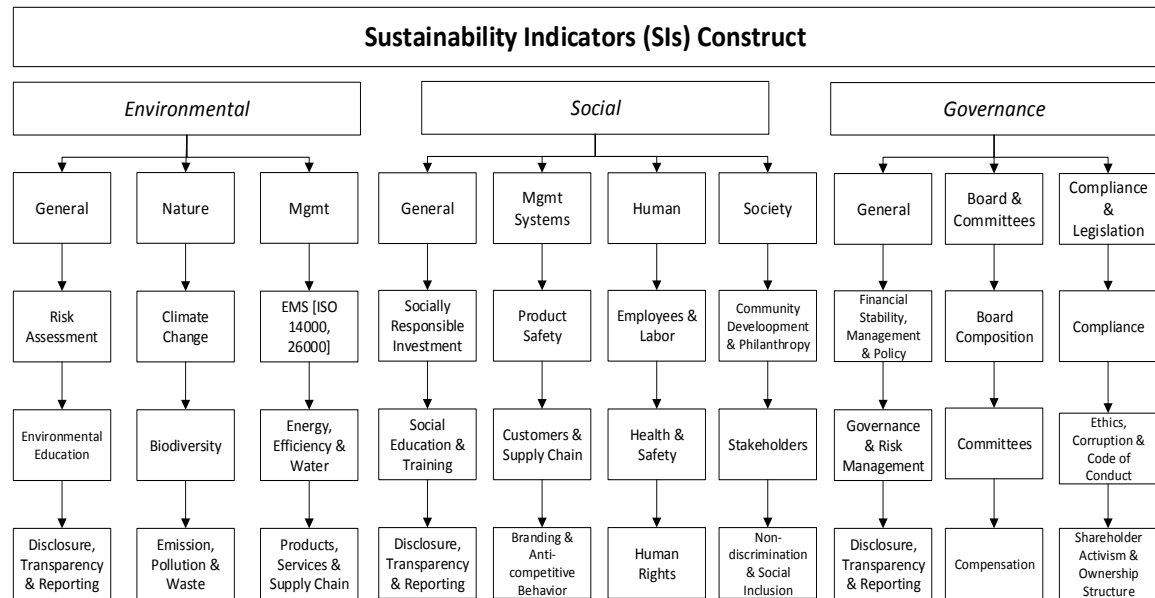


Figure 1. The ESG matrix of sustainability indicators (Rahdari & Rostamy, 2015).

According to this research, when it comes to environmental impacts corporations should focus general attention on risk assessment, environmental education, and transparency with the disclosure of environmental impacts. The environment issues to be evaluated are a company's effect on climate change, biodiversity, GHG emissions, pollution, and waste. Management can use indicators from the GRI and ISO guidelines to measure and manage their use of energy, efficiency, water, and materials in their product and services supply chains (Rahdari & Rostamy, 2015).

General social factors include socially responsible investment, social issue education and training, and disclosure of the corporation's influence on social issues. Management systems should encompass product safety measures, the effects on customers and supply chains, how a company brands its products, and any potential or

current issues with anti-competitive behavior. Human capital should be analyzed for employee and labor benefits, employee health and safety concerns, and any human rights risks or violations. The external societal effects of operations encompasses community development, philanthropy, stakeholder engagement, diversity and inclusiveness, etc. – a corporation's external impacts to society should be known and defined (Rahdari & Rostamy, 2015).

General governance issues of the corporation include the company's financial stability, management strategy, and the policies and procedures in place. The long-term survival and operation of the company is its paramount goal. To ensure survival, governance structures need to be established and reviewed. The board should be comprised of independent and experienced directors, committees established to undertake initiatives, and compensation linked to performance. Compliance departments should be fashioned and focus on ethics, corruption, code of conduct reporting, and violations. The equity structure and ownership percentages of stockholders needs to be recognized and evaluated in order to defend against shareholder activism and private equity influences focused on short-term profit-maximizing strategies and the exploitation of take-over vulnerabilities inherent within corporate bylaws (Rahdari & Rostamy, 2015). Each section of the ESG framework should be disclosed and made transparent, holding managers and executives accountable for their sustainability performance.

The goal of this thesis is to evaluate a limited part of the business case for sustainability identified as a conglomerate of corporate issues related to ESG. The measuring and management of the sustainability indicators ESG matrix is one way a company can begin to evaluate and manage their own sustainable performance within the

ESG framework. Sustainability issues are long-term issues and there is no short-term solution, nevertheless let us not forget the words of William Edwards Deming when he stated, “the most important things cannot be measured.” The sustainability business concept is put into action with strategy and measurements, and monitored and revised only with dedicated and involved management. All of the externalities of this concept cannot be measured; this paper attempts to evaluate if they do indeed exist.

### The Risks of Climate Change

Climate change occurs when greenhouse gases (GHGs) trap some of the heat that would normally radiate back into space after allowing the sun to pass through the Earth’s atmosphere and heat the planet. Carbon dioxide (CO<sub>2</sub>) is the principal and most significant GHG; methane, nitrous oxide, are other significant global warming emissions (International Panel on Climate Change, 2007). Worldwide, net emissions of GHGs have increased 35% from 1990 to 2010 and the majority of the world’s emissions result from electricity generation, transportation, and other forms of energy production and use (United States Environmental Protection Agency, 2017). The GHG increase is almost solely attributed to human activities and has caused a 37% increase in the warming effect on the Earth’s between 1990 and 2015 (United States Environmental Protection Agency, 2017). The effects of global warming have been scientifically measured and documented in: weather and climate changes, the oceans, snow and ice accumulation, health and societal issues, and biological ecosystems. A summary of the major effects of climate change with a focus on the United States is highlighted below (United States Environmental Protection Agency, 2017):

#### *Weather and Climate:*

- An increase in average temperatures and an increase in the rate of warming – 8 of the top 10 warmest years are since 1998 (In the U.S., the North, the West and Alaska increased the most)
- Extreme weather conditions (more high temperatures and more low temperatures)
- An increase in overall rain and an increase in draught areas (Southwest U.S.) due to shifting weather patterns
- A higher percentage of heavy and intense single-day precipitation

#### *Oceans:*

- An increase in the heat stored in the ocean and higher sea surface temperatures
- Sea level rises
- More frequent coastal flooding
- Higher acidity in the ocean affecting the balance of minerals in the water

#### *Snow and Ice:*

- A decrease and thinning of Arctic sea ice – 2012 was the smallest ever recorded
- An increase of Antarctic sea ice – 2014 was the largest extent ever recorded
- Glacier shrinking and associated rises in sea level
- Changes in lake freezing and thawing dates
- Decrease in the amount of snowfall
- A 2 week shorter length of time when snow covers the ground
- The depth of packed snow has reduced more than 90% between 1955 and 2016

#### *Health and Society:*

- More than 9,000 Americans died as a direct result of heat-related illnesses
- 28,000 heat-related hospitalizations from 2001 to 2010
- Less energy is needed for heating and more energy is needed for cooling (an opposite pattern exists in the Southeast)
- Lyme disease cases have doubled since 1991 and tick habitat is influenced by climate
- The length of the growing season for crops has increased in almost every state

#### *Ecosystems:*

- An increase in the acreage burned by wildfires
- Streamflow rate changes in the U.S. and stream temperature increases throughout the Chesapeake Bay region

- Wintering geographic changes by an average of 40 miles north for migrating birds
- Fish and invertebrate marine species have center of biomass shifts more north and deeper down
- Leaf growth and flower bloom date shifts

Climate change and environmental risks have spawned an entire industry devoted to the quantification and accounting of damaging GHG emissions and the affects to the world around us as described above. The following section describes how corporations go about measuring their GHG emissions.

### Corporate GHG Emissions Accounting: Scope 1 and Scope 2

As regulatory bodies begin to tackle the problem of unprecedented climate changes, simultaneously some proactive organizations have published guidelines on how companies can begin to identify and monitor their contributions to the global risk of climate change. Environmental risk analysis should include both internal and externally-controlled amounts of CO<sub>2</sub> disseminated from a source. For the purposes of this paper, “carbon output” and “carbon footprint” are defined correspondingly as “a measure of the exclusive total amount of carbon dioxide emission is directly and indirectly caused by an activity” (Pertsova, 2008). To accurately account for a company’s true GHG emissions, the analysis undertaken in this thesis utilizes both Scope 1 (direct) and Scope 2 (indirect) data.

The notion of “scope” allows companies to delineate between direct and indirect emission sources. Scope 1 is a corporation’s direct GHG emissions, and is the result of the following types of operations (World Resources Institute, 2004):

- The generation of electricity, heat, or steam from combustion of fuels in a stationary source (e.g. boilers, furnaces, air conditioners, and turbines)
- Physical or chemical processing from the manufacture or processing of chemicals and materials (e.g. cement, aluminum, waste processing, and making acids)
- Transportation of materials, products, waste, and employees by company owned/controlled mobile combustion sources (e.g. trucks, ships, buses, trains, cars, and airplanes)
- Fugitive emissions from intentional or unintentional consequences (e.g. equipment leaking and methane leakages when gasoline is transported)

In contrast, Scope 2 emissions are those emissions indirectly associated with the corporation and mainly come from electricity purchases for operations (World Resources Institute, 2004). Although Scope 2 carbon emissions are not created internally by the corporation, their use of the sources directly create indirect emissions bringing the associated climate change affects into their operational boundary and direct control.

Scope 3 emissions are an optional category accounting for other indirect emissions besides power use (World Resources Institute, 2004). Scope 3 data is difficult to ascertain, and many companies still have no way of measuring or accounting for it, thus it was not used in this paper's research but may be an area for future analysis. The relationship among these three emission scopes is illustrated in Figure 2.

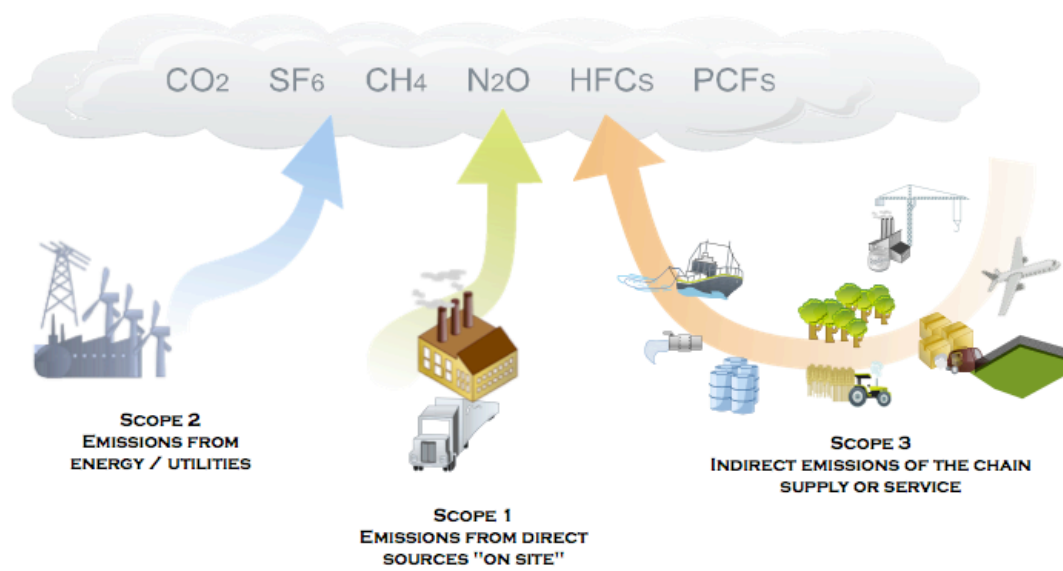


Figure 2. A visual of the concept of GHG “Scopes” (Villar, Hidalgo, Carbolo, & Mejjide, 2012).

Developing and industrializing countries will need to emit significant amounts of carbon as they progress through industrialization. Seventy-two percent (72%) of GHG emissions have been shown to come from household consumption (Hertwich & Peters, 2009). International accords like the Paris Agreement attempt to limit developing countries’ carbon output, restricting their ability to increase standards of living, which creates political strife. The U.S., as the second-highest GHG emitter behind China, does not want to stifle economic growth by limiting its economic machine with environmental regulations. Developed countries are trying to combat this juxtaposed situation by investing in third-world development projects and using the carbon credits created from these projects to offset their own first-world carbon-emitting operations (Wundera, Engel, & Pagiola, 2008; Wara & Victor, 2008).

When looking at the total emissions reported for each country, the countries in the same set with the highest Scope 1 emissions were: the USA, France, Germany, United Kingdom, Italy, Luxembourg, Canada, Russia, Spain, and Switzerland (Figure 3).

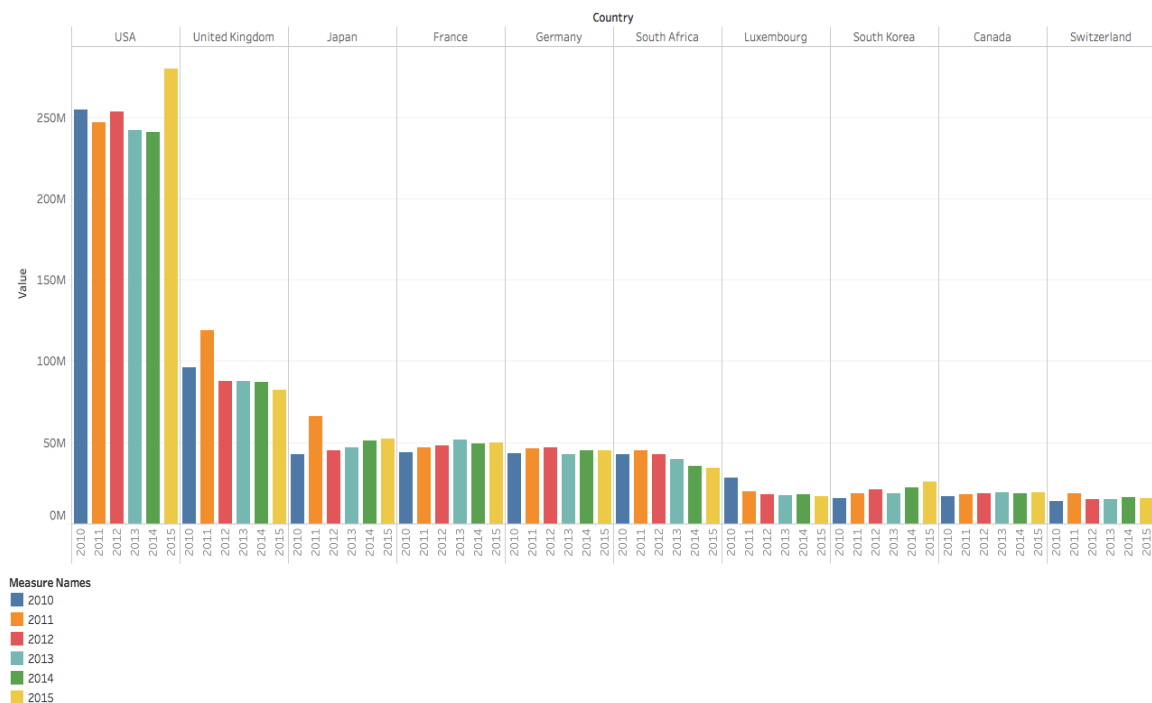


Figure 3. Reported Scope 1 emissions by country (CDP, 2010-2016).

In the sample set, many countries are increasing their Scope 1 emissions, including the U.S. (with a large jump in 2015), Japan, France, and South Korea. The countries keeping their emissions steady are Germany, Canada, and Switzerland. Decreasing Scope 1 emissions are seen in the United Kingdom, South Africa, and Luxembourg.

Scope 2 emissions reported by country (Figure 4) have stark differences from the Scope 1 figure. The U.S. still leads the data set and with highest Scope 2 emissions,

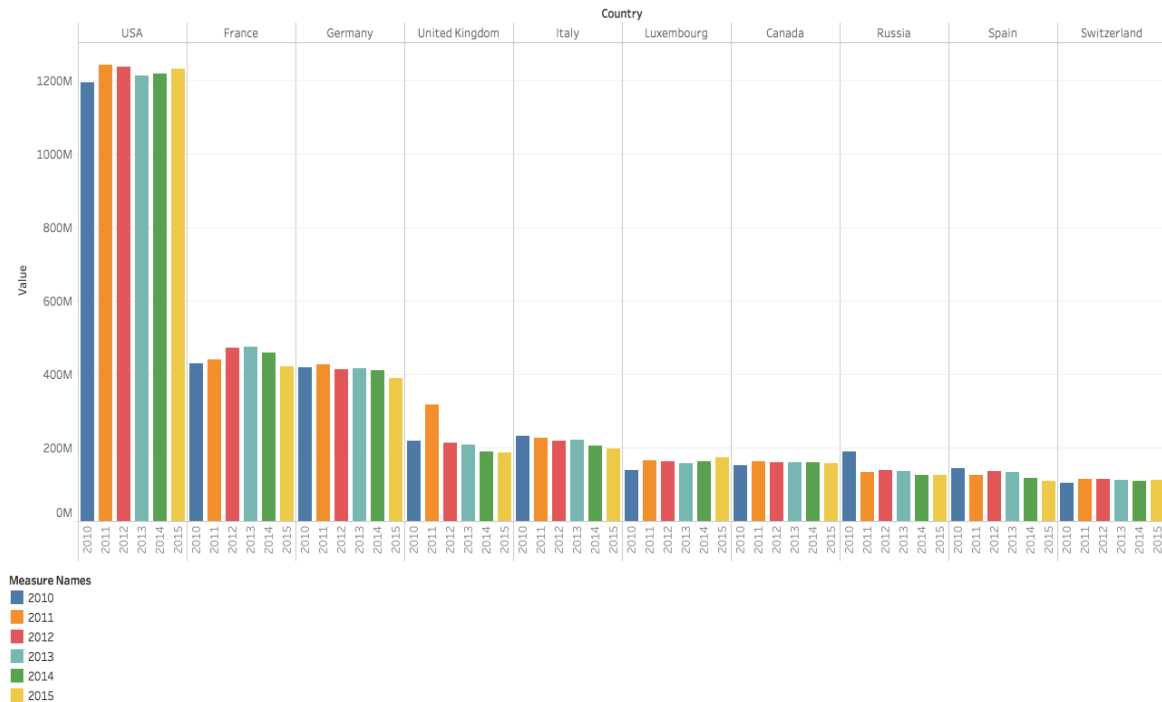


Figure 4. Reported Scope 2 emissions by country (CDP, 2010-2016).

although it is now followed by France and Germany, both countries surpassing the United Kingdom. Analyzing this data visually with a pie chart of 2014 global emissions (Figure 5), we can see that the United States is nearly double the EU; the sample set is representative of the reporting world-at-large.

### Scope 1 and Scope 2 Reporting Data by Industry

The industries reporting the most Scope 1 emissions data by number of companies reporting were the 1) banking, 2) oil & gas, 3) electric utilities, 4) technology manufacturing, and 5) chemicals industries (Figure 6). The industries who do not yet have very many companies reporting their Scope 1 emissions are: 1) water transportation services and sea ports, 2) coal mining, 3) ground transportation – trucking, highways, and rails, 4) air transportation, and 5) water utilities.

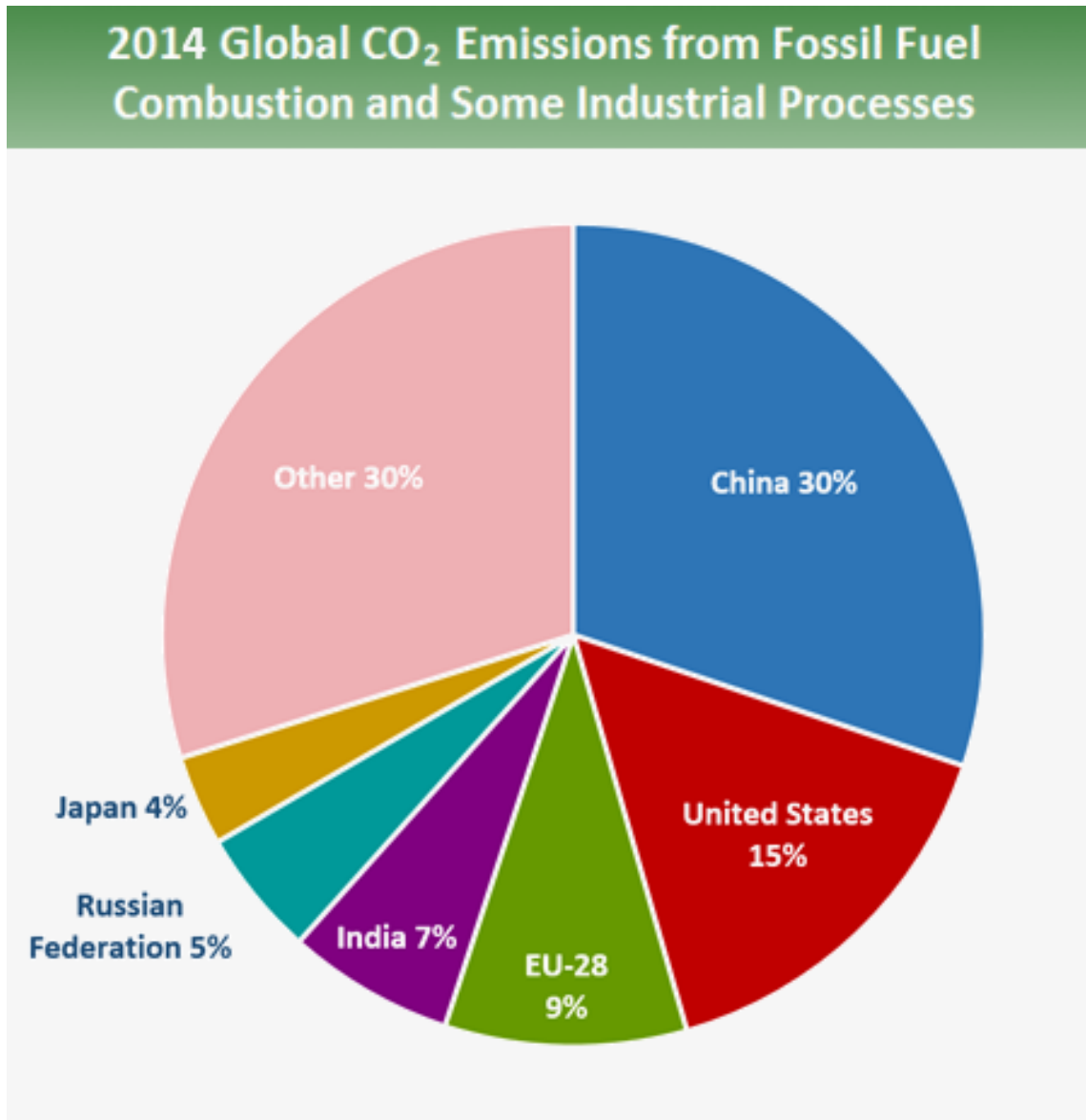


Figure 5. 2014 global CO<sub>2</sub> emissions by country (Boden, Marland, & Andres, 2017).

It seems counterintuitive the banking industry has the highest number of companies with complete Scope 1 data. One would surmise that heavy GHG emitting industries such as oil & gas, electric companies, and manufacturers would be present near the top. Yet, heavy GHG emitting industries such as transportation (ground and air), mining, and water utilities are found near the bottom. These industries may be less

regulated and do not have regulations requiring them to report, or they do not see any benefits from reporting and voluntarily choose not to.

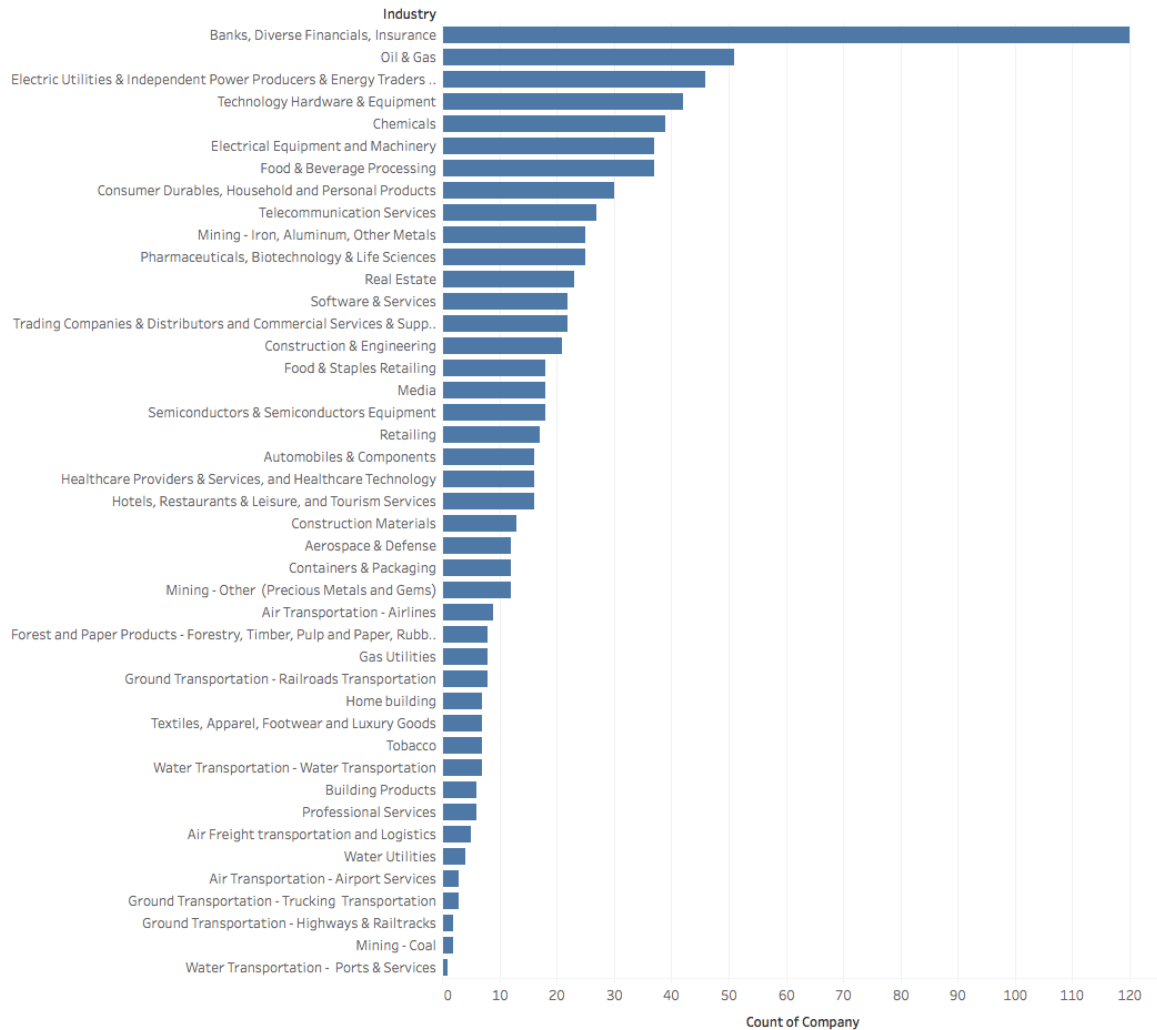


Figure 6. Number of companies reporting Scope 1 emissions by industry (CDP, 2010-2016).

The industries reporting the most Scope 2 emissions data by the number of companies reporting were the 1) banking, 2) oil & gas, 3) technology manufacturing, 4) electrical equipment, and 5) food & beverage processing industries. In contrast, underrepresented are the 1) water transportation, 2) mining, 3) ground transport, 4) air

transport, and 5) water utilities (Figure 7). The cause could be simply an error in accurately representing the amount of companies in a true population.

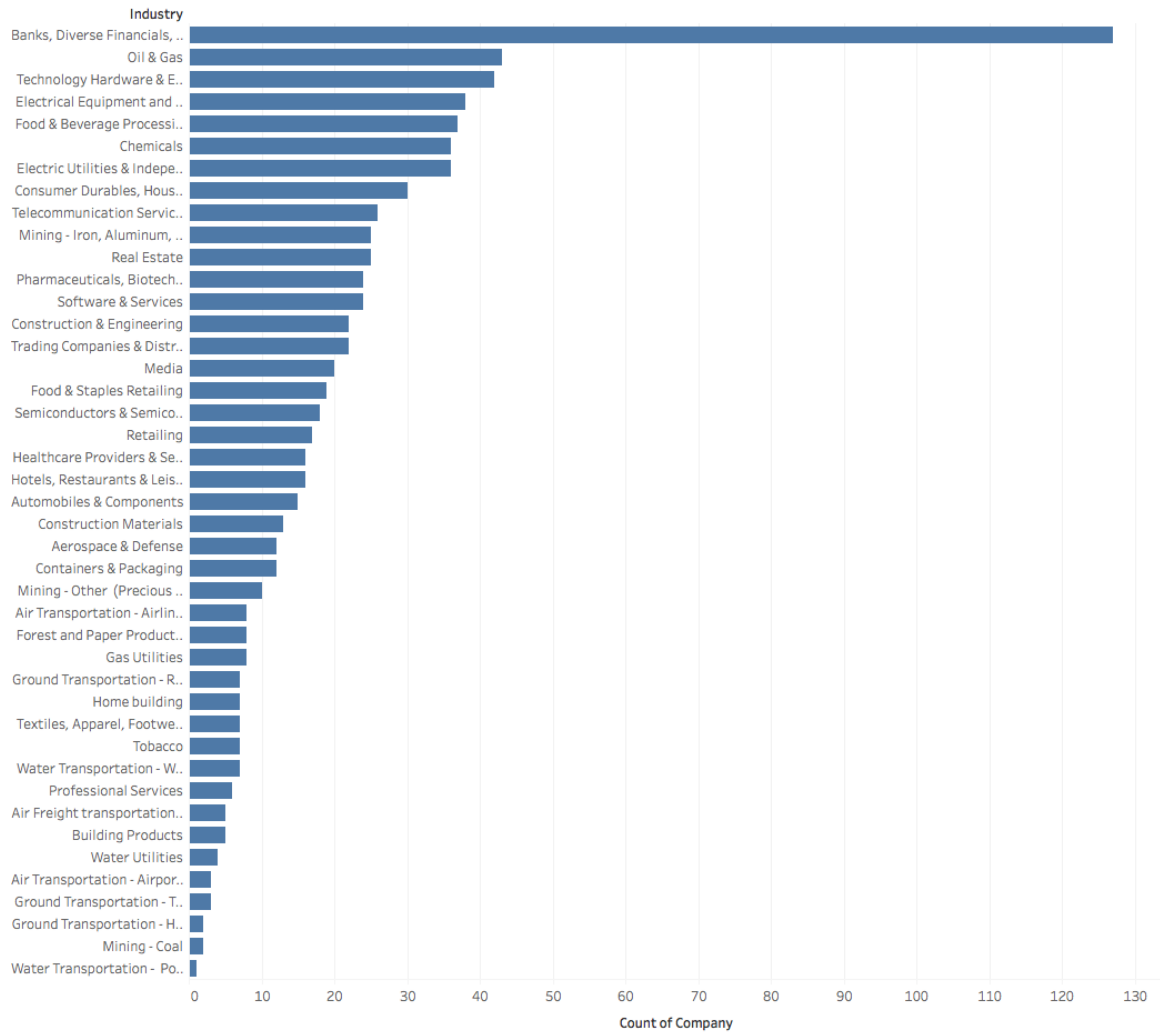


Figure 7. Number of companies reporting Scope 2 emissions by industry (CDP, 2010-2016).

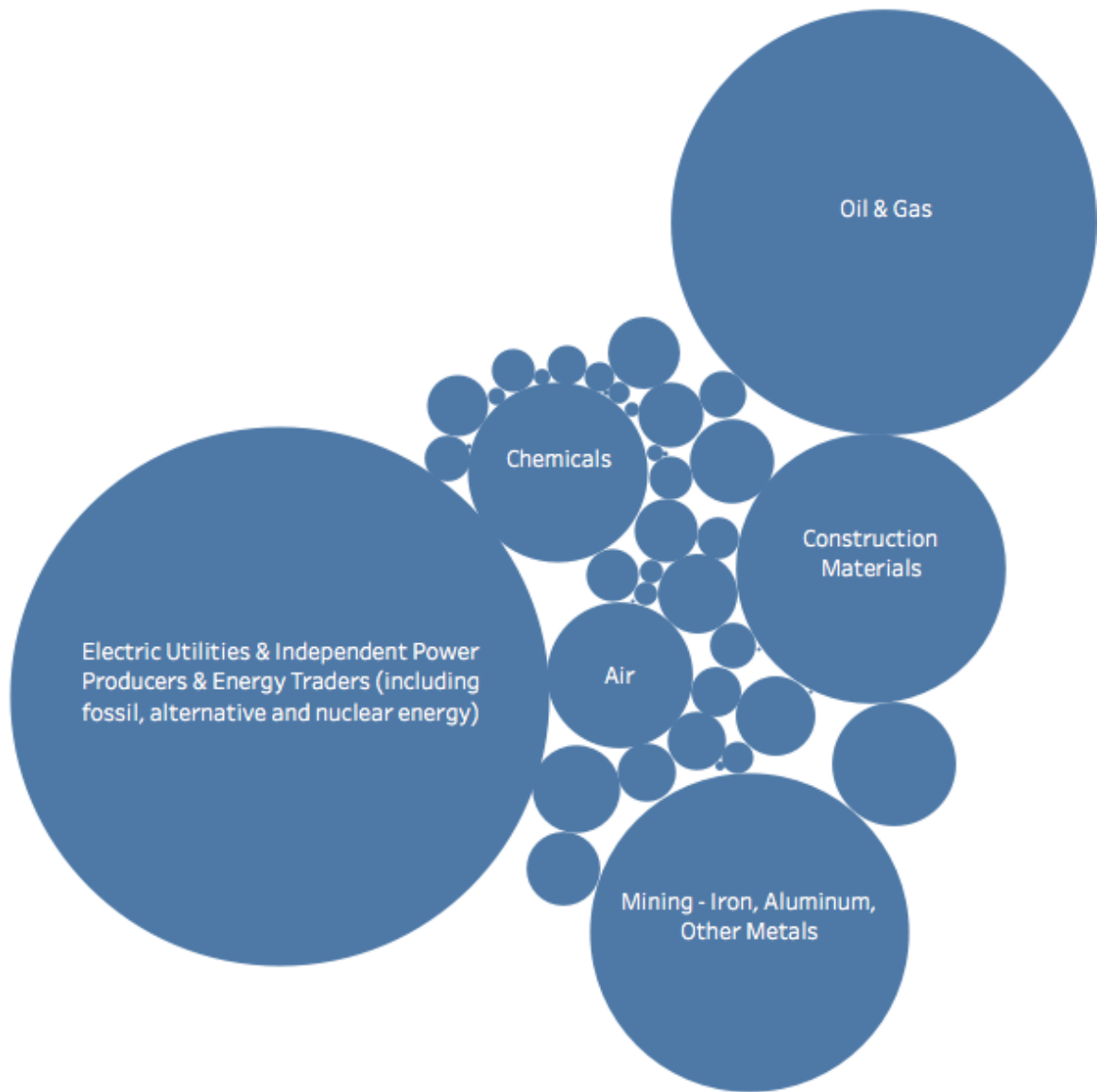


Figure 8. Total number of companies reporting GHG emissions by industry (CDP, 2010-2016).

By looking at the same industries, except now representing them by the total amount of reported GHG emissions (Figure 8), we can see the top offenders are: 1) electric utilities, power producers, and energy traders, 2) oil & gas, 3) mining, 4) construction materials, 5) chemicals, and 6) air. Looking at the globally collected data

(Figure 9), we can see once again the sample data set is in relative alignment with the population data (although forestry and land use is underweighted).

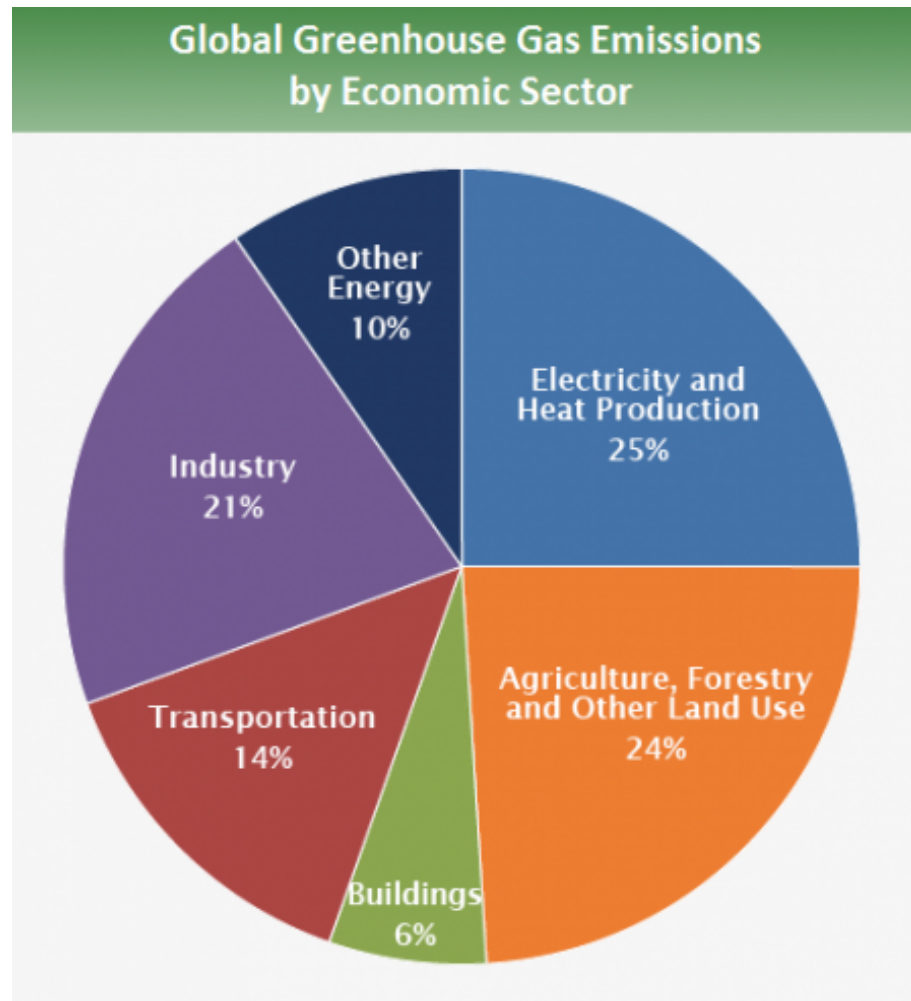


Figure 9. GHG emissions by economic sector (Intergovernmental Panel on Climate Change, 2014).

The important points to make are the following:

- Although banking and diverse financial companies came up as the most transparent and this seemed counterintuitive at first, “energy traders” may have to report emissions influences as they are listed in the industry with the most

emissions accounted for. This may explain the banking industry's propensity to report.

- One would assume the heavily GHG emitting industries would have many of the top reporting spots, this is not the case with the air transportation industry. They made the top six emitting industries yet are severely underrepresented in the number of companies reporting.
- The water industry has few companies reporting their emission data.
- The sample set does not include many companies from the "Agriculture, Forestry, and Other Land Use" sector. "Forestry and Paper Products" is an industry listed in the sample set but not near the top as they should be. This is an area for further research.

### Risks of Climate Change for Corporations

The risks of climate change and its associated affects can be identified in some examples from industry. In a recent class at Harvard Business School, a pedagogical shift was present – rather than analyze a case presented to them, students were asked to research and present their own cases on climate change from different industries (Nobel, 2017). The assignment read, "Describe how the organization is likely to be affected, the steps the organization is taking to address those effects and describe and justify what additional steps you think the organization should consider implementing". Some of the climate change concerns from the "more than 900 examples of how climate change affects business" (Nobel, 2017) were:

- Coca Cola: water scarcity issues in foreign countries

- Allstate: property and casualty claims from extreme weather events
- Nike: foreign supply chain locations using significant amounts of water and energy
- Impossible Foods: companies attempting to capitalize on climate-related issues

Detailed analysis of these case studies is beyond the scope of this paper (the student's case studies can be accessed at <https://rctom.hbs.org/assignment/climate-change-challenge/>) yet the message is crystal-clear: climate change impacts business.

A recent international treaty on climate change will also impact businesses. Global corporations will now be involuntarily required to evaluate environmental business risk in their operations due to the ratification of a new climate change treaty, the Paris Agreement (or “the agreement”). This is just one more example of the importance of a sustainability strategy in a firms' business model in order to anticipate future and unknown ESG issues, and is discussed in the next section.

### The Current Global Response to Climate Change – the Paris Agreement

Global responses to climate change have become standard risk assessments for corporations. The Paris Agreement (“the treaty”), enacted on 12 December 2015 is an example of this global response and was ratified by 195 countries within the United Nations Framework Convention on Climate Change (United Nations, 2015). The treaty's aims for the international community are stated in Article 2 of the treaty and are as follows (United Nations, 2015):

1. Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks of climate change;

2. Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and
3. Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

The Paris Agreement represents long-awaited confirmation of the importance of recognizing the inherent and subsequent consequences and effects of world-wide increasing temperatures from human interaction with the environment. In the agreement, each nation “shall account for their nationally determined contributions... [and] promote environmental integrity, transparency, accuracy, completeness, comparability and consistency” (United Nations, 2015).

The treaty has significant consequences for carbon output accountability and use. It is already a significant political agenda and the current United States President, Donald Trump, has environmentalists confused and concerned about the United States’ future and participation in the agreement. Recently, U.S. President Donald Trump had The State Department notify the United Nations that it would be pulling out of the agreement unless it was changed to better serve U.S. interests (Natter, 2017).

Many journalists and experts go as far as even suggesting that United States’ involvement might hinder global progress (Meyer, 2017). The ambiguity inherent in the agreement, and domestic policies currently weakening the previous administration’s domestic programs, such as Obama’s Clean Power Program for the electricity sector and the greenhouse-gas CAFÉ standard for cars, might cause loose regulatory policies that if unmet showcase the treaty as mere “suggestions for improvements” rather than firm laws with consequences (Meyer, 2017).

Regardless of the political atmosphere regarding involvement in global climate change policies, it is evident that United States corporations believe in the importance of carbon regulation and accountability. From November, 2015, when the agreement was enacted, until May, 2017, 69 Fortune 500, 33 Fortune 100, and 20 of the Fortune 50 companies, representing 8,595,255 employees and total global annual revenue of \$3,739,026,000,000, have all issued public statements, quotes, sign-on letters, advertisements, and public pledges expressing support for the treaty and its goals (Ceres, 2017). On 10 May 2017, CEO's of 30 major corporations paid for full-page advertisements in the Wall Street Journal and New York Times stating that remaining in the agreement is in their best interests (CEO's of 30 Major Corporations, 2017). They cite the treaty benefiting American companies in the following ways (CEO's of 30 Major Corporations, 2017):

- It strengthens our competitiveness in global markets.
- It benefits American manufacturing as we modernize to new, more efficient technologies.
- It supports investment by setting clear goals which enable long-term planning.
- It expands global and domestic markets for clean, energy-efficient technologies which will generate jobs and economic growth.
- It encourages market-based solutions and innovation to achieve emissions reductions at low cost.

Notwithstanding if the United States maintains its national support for the Paris Agreement, the global and long-term implications will impact multinational firms and investments – the world is moving towards a carbon-constrained economy with or without U.S. political involvement (Bloomberg, 2017). Even if the U.S. does not involve itself in the treaty, U.S. firms will need to understand and prepare for its effects.

## Key Implications of the Paris Agreement

The treaty is a heated debate at best. It has been said that “the December 2015 Paris Climate Agreement is better than no agreement. This is perhaps the best that can be said about it” (Clemencon, 2016). Some of the criticisms about the agreement are: 1) it lets the developed world off the hook for massive contributions to climate change, 2) it pressures developing countries to control their emissions while exposing them to the harmful effects of climate change they had no hand in creating, and 3) it is built of a completely voluntary model which even if pledges are met would still not achieve the objectives the treaty defines (Clemencon, 2016).

The U.S.’s key response to these criticisms is that “nothing developed countries do will matter if the large emerging economies are not held accountable for their rapidly growing emissions” (Clemencon, 2016). We can see a dichotomy in the responses from developed and non-developed countries – the developed want developing countries (such as China and India) to curb carbon emissions, and the developing countries would like the opportunity to industrialize using the same benefits of unrestrained carbon output experienced by developed countries throughout history. The intense debate highlights the poignant problem of the perils of unrestrained climate change colluded with the challenges of multinational negotiations. Even still, it was signed and became law.

The Paris Agreement is 25 pages long, contains 16 preambles outlining the reasoning for the agreement, and 29 operative “Articles” on how the agreement is to function (United Nations, 2015). The key elements of the treaty are (United Nations, 2015):

1. to pursue efforts to limit temperature increase to 1.5 °C (Article 2.1(a)),

2. have zero emissions by the second half of the century (Article 4.1),
3. voluntary implementation of nationally determined [climate] contributions (Article 6.1),
4. a 5-year review cycle after an initial accounting of a party's implementation efforts in 2023 (Article 14.2).

Criticisms are the agreement lacks 1) legally binding emissions targets, 2) specifics on the financial support needed for developing countries, 3) liability provisions for financial compensation covering the loss and damage experienced by developing countries from countries historically responsible for climate change, and 4) no definitive changes on the basic international economics that foster fossil-fuel-based short-to-medium term economic growth (Clemencon, 2016).

The strategic implications of these benefits and drawbacks for corporations and investors are:

1. Positive economic signals for GHG reduction technology that will help to limit climate change to 1.5 °C;
2. An increase in “green financing” as finance flows move towards development with a climate change focus;
3. Recognizing climate change as a systemic risk as nations develop regulations to voluntarily meet their individualized targets;
4. Transparency and accounting of GHG emissions which will favor companies with a sustainability focus and increase the costs of companies without a sustainability strategy;

5. The movement of high GHG emitting industries to poorer and less developed countries.

With the implementation of this landmark international treaty, it is important for research to support corporate efforts and it is academia's responsibility to provide practitioners with the tools and strategies they will need to implement reductions in GHG emissions. This paper will look at some questions companies may be having as new regulatory bodies enact restrictions and laws implementing the Paris Agreement.

### Research Questions, Hypotheses and Specific Aims

My research examined the following questions and hypotheses:

1. Can direct or indirect GHG emissions predict stock price returns?

If not, are there other climate-related variables then simply total emissions that are better predictors?

If not, are there specific industries in which GHG output does influence stock price returns?

2. Does a sustainability strategy focused on climate change craft better performing companies?

Hypothesis 1: GHG output influences stock price return.

Alternative Hypothesis (H1<sub>A</sub>): Scope 1 and Scope 2 emissions have a negative effect on stock price performance.

Hypothesis 2: GHG output influences stock price return in specific industries when the independent predictor variables that are used better explain variance than GHG emissions alone.

Alternative Hypothesis (H2<sub>A</sub>): Within certain industries, intensity ratios, the change in GHG output, and/or qualitative sustainability strategies will have an effect on stock price return.

Hypothesis 3: The bottom 100 GHG emitters will outperform the top 100 GHG emitters when their yearly total returns are compared:

Alternative Hypothesis (H3<sub>A</sub>): The bottom 100 GHG emitters do not outperform the top 100 GHG emitters in the stock market.

### Specific Aims

To address these questions and hypotheses, I completed the following steps;

1. Researched the data available in relation to corporate carbon output.
2. Formulated hypotheses that could be answered within the data universe.
3. Selected the CDP and Bloomberg as data sets with accurate carbon emissions data and corporate fundamentals.
4. Ran regressions on and compiled the available data in order to test the hypotheses.
5. Analyzed and published the results.

## Chapter II

### Methods

To scientifically determine if the effects of GHG emissions and/or a focus on managerial sustainability strategies would impact corporate performance, research questions and hypotheses were tested using multiple linear regression and correlation analysis. Multiple linear regression (MLR) allowed identification of the relative contributions from independent variables in explaining the variance in corporate performance. Before detailing these, I describe the process of creating a database of companies and associated variables for analysis.

#### Sample Data Collection and Visualization

For the last 15 years the Carbon Disclosure Project (“CDP”), an international non-profit, has been providing, collecting, and analyzing environmental data. The CDP currently collects questionnaire responses from over 5,600 international companies requested by investors managing \$100 trillion in assets (CDP, 2017). Data from the CDP was sourced for companies that reported at least six years of Scope 1 and Scope 2 GHG emissions data using data from 2010 until the most recent available disclosure in 2015. The companies with both Scope 1 and Scope 2 data for six years were selected from the complete data set along with the company’s industry and industry-group. The CDP’s questions used for Scope 1 and Scope 2 emissions data were (Carbon Disclosure Project, 2015):

CC8.2. Please provide your gross global Scope 1 emissions figures in metric tons  
CO<sub>2</sub>e

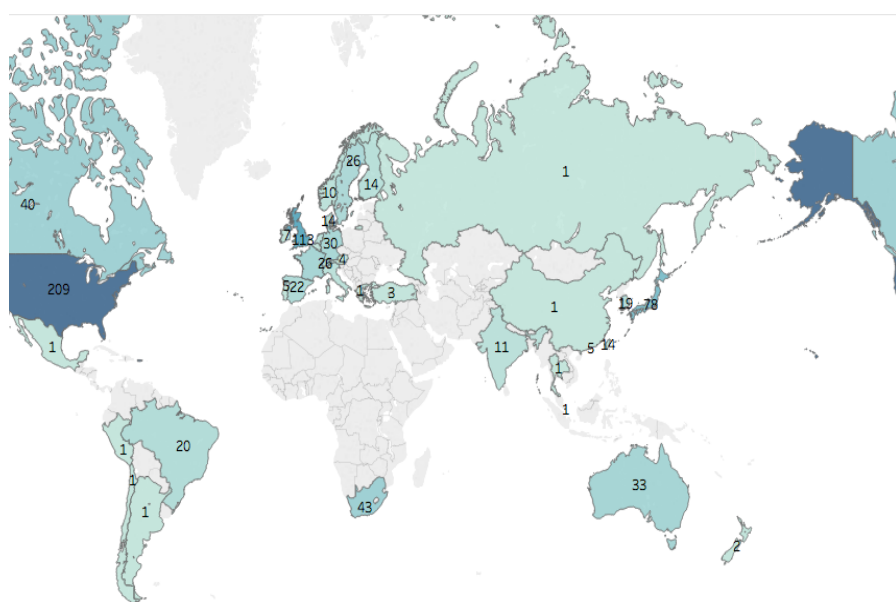
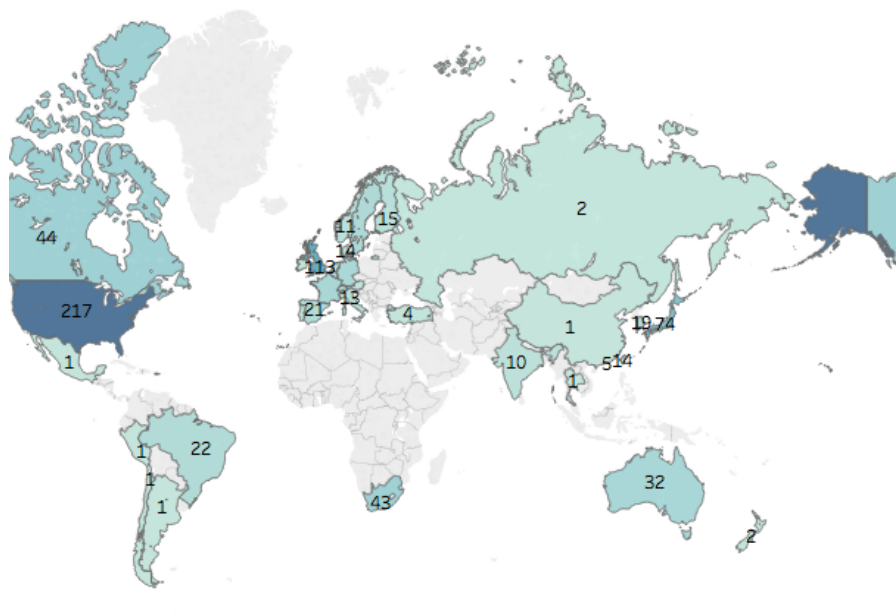
CC8.3. Please provide your gross global Scope 2 emissions figures in metric tons  
CO<sub>2</sub>e

Bloomberg was then used to supplement the emissions data with corporate fundamentals for the selected companies, taken from their annual filings. Yearly stock market return, net income, sales, and market cap were sourced from a Bloomberg data query. The raw data was split between Scope 1 and Scope 2 emission data to analyze whether or not any reporting or other relevant differences existed between the two emissions data sets when analyzed.

#### Scope 1 and Scope 2 Emissions Data by Country

Scope 1 data from the CDP data set included 828 companies reporting Scope 1 emissions data for six years between 2010 and 2015. The top five reporting countries by company with at least six years of Scope 1 emissions data were the United States, United Kingdom, Japan, Canada and South Africa (Figure 10). Scope 2 data by country was almost exactly the same but with South Africa overtaking Canada (Figure 11).

There seems to be a correlation between governmental sophistication and reporting. First-world developed countries are much more transparent than those industrializing and countries with non-democratic forms of governance. Moreover, the size of the country has no basis on whether or not they report. Eastern Europe, Asia, Africa, South America, and the Middle East all are underrepresented and lack a significant body of transparent companies.



The complete data set was then compiled to find the companies with six years of Scope 1 emissions data, six years of Scope 2 emissions data, and six years of stock price return data. The Scope 1 and Scope 2 emissions data came from the CDP questionnaires. The stock price return data, net income, sales, and market capitalization all came from Bloomberg. In total there were 39,909 selected data points before any data transformations added additional variables to be evaluated.

#### Stock Price Return and Corporate Fundamentals Data

The Bloomberg Excel Add-In data query used for the return data in the sample set was:

```
=BDP(xx,"CUST_TRR_RETURN_HOLDING_PER","CUST_TRR_STA  
RT_DT",TEXT(BAddPeriods(yy,"per=d","numberofperiods=365"),"YYY  
YMMDD"),"CUST_TRR_END_DT",TEXT(yy,"YYYYMMDD"),"CUS  
T_TRR_CRNCY=USD")
```

Where “xx” is a placeholder for the appropriate Excel cell with a Bloomberg equity ticker (e.g. ABE SM Equity) and “yy” is the cell with the date. This query included the effects of dividends on return and standardized all currencies into dollar amounts. The six years of annual Bloomberg stock price return data from the Bloomberg query was calculated into a total return figure using the formula:

$$Total\ Return = ((1 + r_1) * (1 + r_2) * (1 + r_3) \dots x (1 + r_n)) - 1$$

where  $r$  is the yearly return for a specific company, in the  $n^{th}$  year. Bloomberg was also queried for straightforward corporate fundamentals using the following formulas:

Net income

=BDP(xx,"NET\_INCOME","EQY\_FUND\_YEAR=20yy","FA\_ADJUSTED=ADJ", "EQY\_FUND\_CRNCY=USD")

Revenue

=BDP(xx,"SALES\_REV\_TURN", "EQY\_FUND\_YEAR=20yy", "EQY\_FUND\_CRNCY=USD")

Market Capitalization

=BDP(xx,"HISTORICAL\_MARKET\_CAP", "EQY\_FUND\_YEAR=20xx", "EQY\_FUND\_CRNCY=USD")

where “xx” is the appropriate cell with a Bloomberg equity ticker listed, and “yy” is the last two digits of the year of the data needed. The net income data was adjusted by Bloomberg’s financial analysts. All of the data was converted into dollars by Bloomberg to account for currency issues. With the total six year return calculated and with reliable greenhouse gas emissions data, enough records were sourced to run simple and straightforward Multiple Linear Regression (MLR) models.

### Regression Analysis

Three hypotheses were tested, two with multilinear regression and one with stock price six-year return data for the highest carbon emitting companies compared to the return data of the lowest carbon emitting companies. A one-tailed bivariate Pearson Correlation directional test was used to accept or reject the first alternative hypothesis, evaluating whether a statistically significant linear relationship exists and measuring the strength of the relationship.

The outcome of the first and second hypotheses were tested with multiple linear regression at the 95% significance level. A one-tailed correlation significance test was run to test the directional hypothesis that GHGs negatively affect stock prices. Hypothesis 3 was tested by adding the returns for the top and bottom 100 GHG emitters. If the annual returns of the bottom 100 GHG emitting companies are greater than the top 100 carbon emitters, we accept the null hypothesis.

#### Total Return vs. Scope 1 and Scope 2 Emissions

The first regression ran included three continuous variables: six-year stock price total return, six year total Scope 1 emissions, and six year total Scope 2 emissions. The initial multiple linear regression model evaluating the effect of Scope 1 and Scope 2 emissions data on corporate performance is:

$$y = \beta_0 + \beta_1 * S16YrTot + \beta_2 * S26YrTot + \varepsilon$$

where the dependent variable  $y$  is stock price return,  $S16YrTot$  is the total amount of Scope 1 emissions emitted and reported by an individual company for six years, and  $S26YrTot$  is the total Scope 2 emissions emitted and reported by an individual company for six years. The regression model was run in IBM's SPSS Statistics and each of the statistical assumptions were tested.

The model showed there was independence of residuals, as assessed by a Durbin-Watson statistic of 1.941 (the range is from 0 to 4 and a value near 2 indicates there is no correlation between residuals). Linearity was tested with scatterplots and inserting a fitted regression line into the graph (Figures 12 & 13).

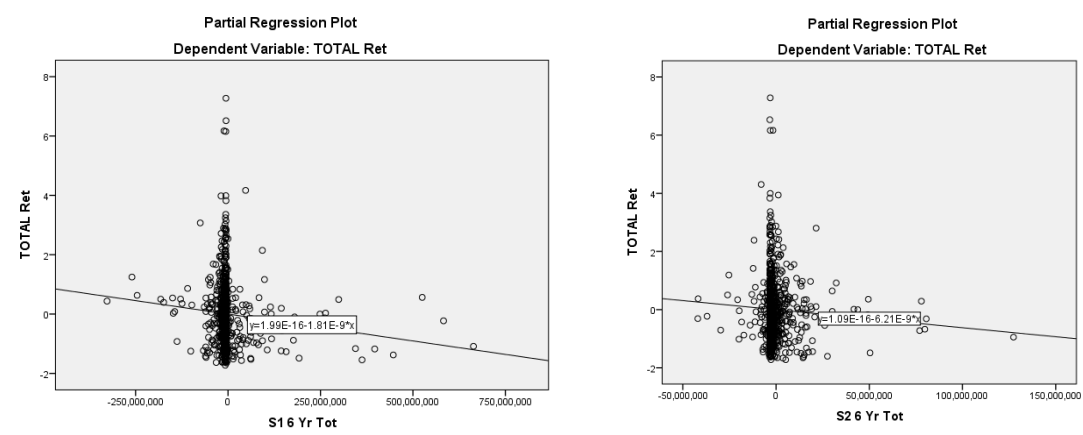


Figure 12. Total return vs. Scope 1 and Scope 2 emissions (CDP, 2010-2016).

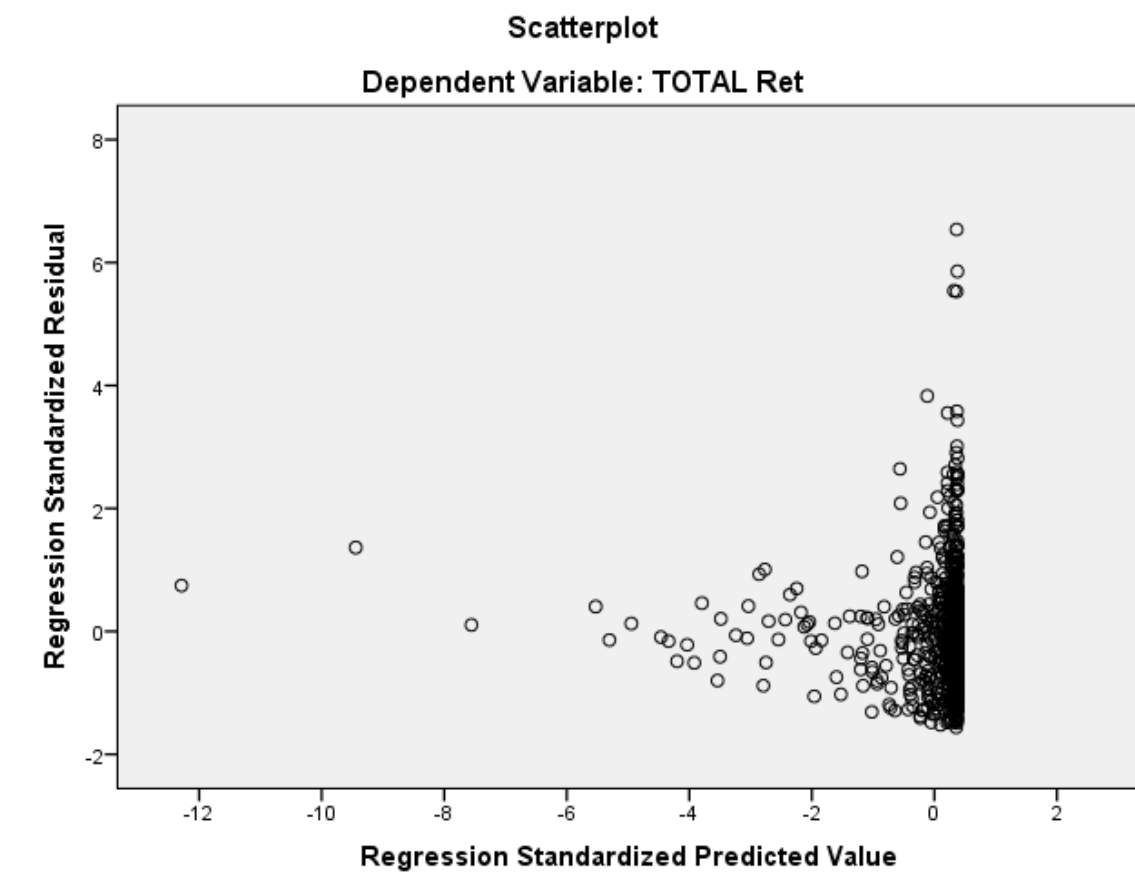


Figure 13. Residuals vs. predicted variables (CDP, 2010-2016). Enlarged to read

The regression initially showed heteroscedasticity. The stock price return data was then weighted by adding 1 (there cannot be a negative stock price return less than -0.999) to all of the return samples thereby making every sample positive, and allowing for a natural logarithm transformation (Ln) on all three variables. A new regression analysis was run after the variables were log-transformed to correct the violation of the homoscedasticity assumption. The new Durbin-Watson statistic (2.025) was found to be still near 2, evidencing the continuing independence of the variables. A visual inspection of the new scatterplots with the log-transformed variables displayed weak linear

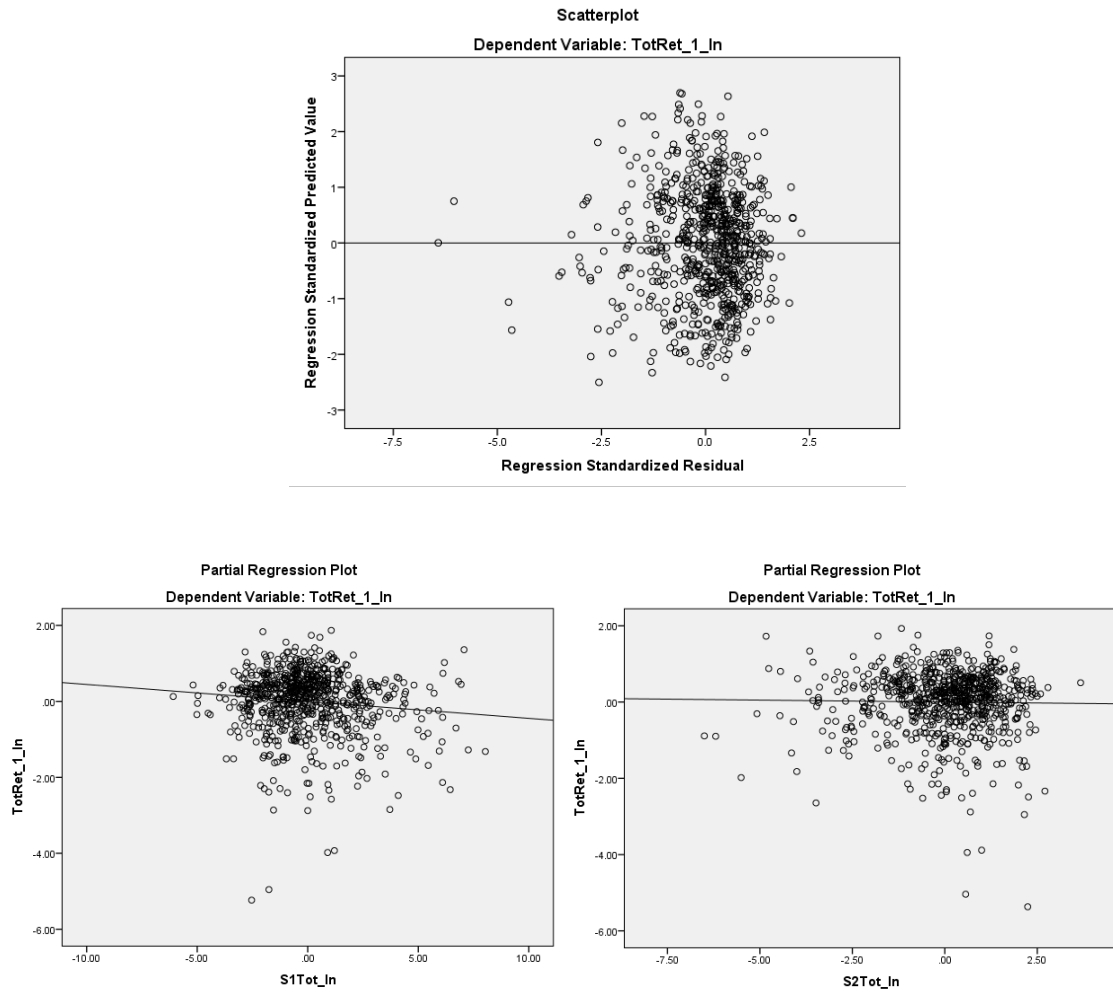


Figure 14. Log-transformed total return vs. Scope 1 and Scope 2 emissions (CDP, 2010-2016).

relationships and the heteroscedasticity violation had been corrected (Figure 14).

A scatterplot of the residuals vs. predicted values now evidenced homoscedasticity. The “Correlations” table showed there are no correlations larger than 0.7. Scope 1 and Scope 2 emissions are very close to being correlated. Collinearity is not present in this analysis as the tolerance is greater than 0.01 and the variance inflation factor is less than 10 (0.512 and 1.953). There were nine outliers (greater than 3 standard deviations) and they were removed to improve the model. Removing the outliers did not significantly change the model’s results, although it did improve linearity and homoscedasticity:

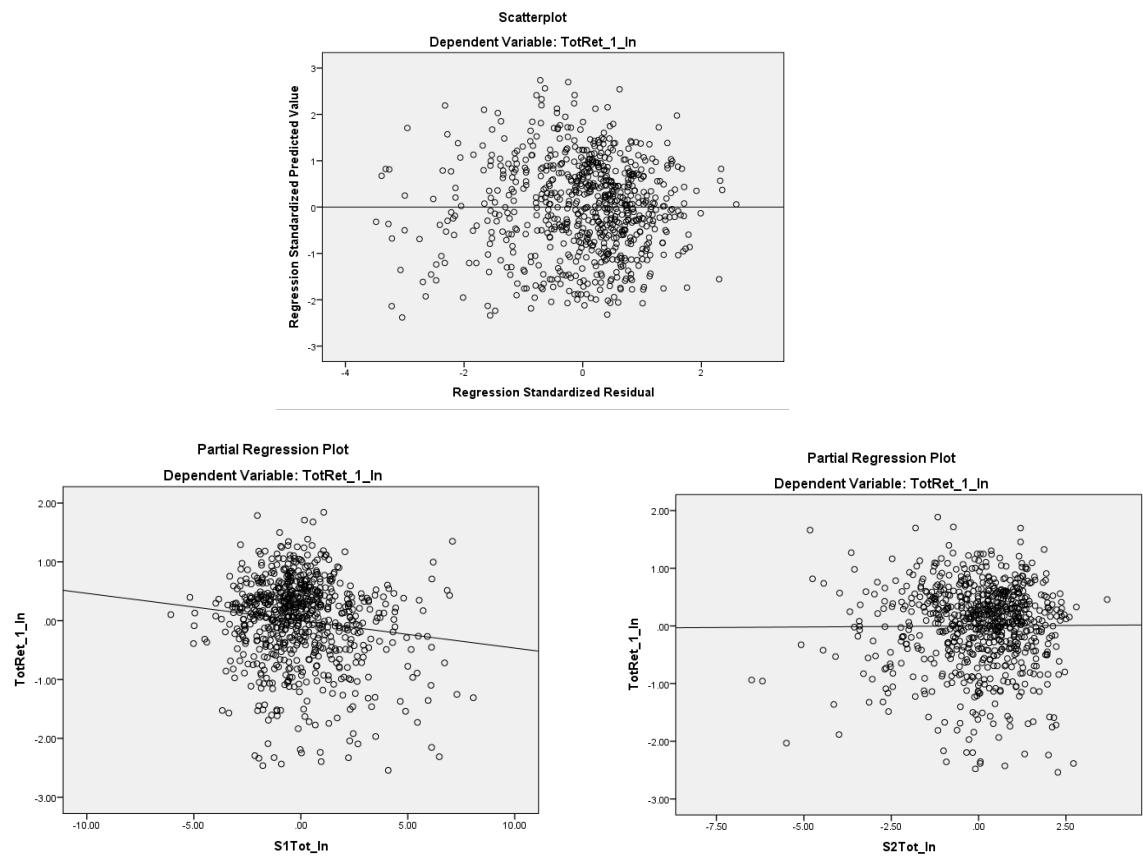


Figure 15. Ln total return vs. Scope 1 and Scope 2 emissions (CDP, 2010-2016).

Next, the normality assumption was checked with a histogram and P-Plot; both displayed normal distribution (Figure 16). After reviewing all statistical assumptions, the MLR model met all of the parametric tests.

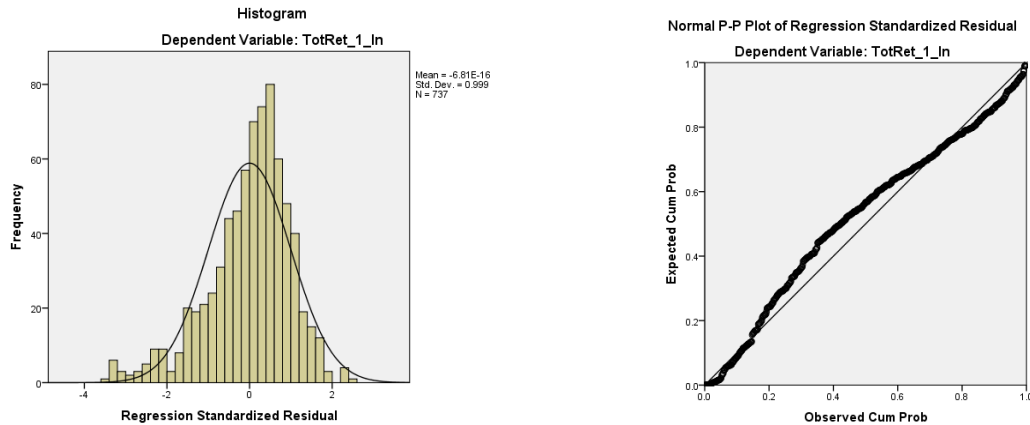


Figure 16. Ln total return, Scope 1, and Scope 2 emissions data (CDP, 2010-2016).

### Yearly Industry Group Regressions

After analyzing whether Scope 1 and Scope 2 emissions influence stock price return, more variables were included in a new and more robust regression equation. The GHG output figures were used in conjunction with historical financial data to see if intensity ratios would significantly affect stock price return. A new MLR model was designed to include sales, revenue, market cap, the change in prior year emissions, the change in total emissions, the highest sustainability manager level inclusion, whether or not incentives were tied to sustainability, and if the companies participated in an emissions trading scheme (ETS). The new regression equation tested was:

$$y_{x_t} = \beta_0 + \beta_1 * S1_{x_t} + \beta_2 * \frac{S1_{x_t}}{REV_{x_t}} + \beta_3 * \frac{S1_{x_t}}{NI_{x_t}} + \beta_4 * \frac{S1_{x_t}}{MC_{x_t}} + \beta_5 * S2_{x_t} + \beta_6 * \frac{S2_{x_t}}{REV_{x_t}} + \beta_7 * \frac{S2_{x_t}}{NI_{x_t}} + \beta_8 * \frac{S2_{x_t}}{MC_{x_t}} + \beta_9 * \% \Delta S1_{x_{t-1}} + \beta_{10} * \% \Delta S2_{x_{t-1}} + \beta_{11} * \% \Delta Tot S1_{x_{t+5}} + \beta_{12} * \% \Delta Tot S2_{x_{t+5}} + \beta_{13} * MgrLvl_x + \beta_{14} * Incentive_x + \beta_{15} * ETS_x + \varepsilon$$

The variables for this regression are described in Table 1.

Table 1. Industry regression variables identified and defined (by author).

| Variable                                                                  | Description                                                                                                                  | Methodology                                                                                                                                         |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Dependent Variable                                                        |                                                                                                                              |                                                                                                                                                     |
| $y_{x_t}$                                                                 | Annual return of company x in year t (2011-2015)                                                                             | The dependent variable is the yearly total stock price return                                                                                       |
| Independent Variables                                                     |                                                                                                                              |                                                                                                                                                     |
| $S1_{x_t}$                                                                | Scope 1 emissions of company x in year t (2011-2015)                                                                         | Yearly Scope 1 emissions may impact stock price return                                                                                              |
| $S2_{x_t}$                                                                | Scope 2 emissions of company x in year t (2011-2015)                                                                         | Yearly Scope 2 emissions may impact stock price return                                                                                              |
| Scope 1 Intensity Variables                                               |                                                                                                                              |                                                                                                                                                     |
| $\frac{S1_{x_t}}{REV_{x_t}}$                                              | Scope 1 emissions of company x in year t (2011-2015) divided by the revenue of company x in year t (2010-2015)               | Revenue per metric ton of Scope 1 carbon dioxide emitted. This ratio accounts for differences in revenue                                            |
| $\frac{S1_{x_t}}{NI_{x_t}}$                                               | Scope 1 emissions of company x in year t (2011-2015) divided by the net income of company x in year t (2010-2015)            | Income per metric ton of Scope 1 carbon dioxide emitted. This ratio shows how much income could be available to invest in Scope 1 reduction efforts |
| $\frac{S1_{x_t}}{MC_{x_t}}$                                               | Scope 1 emissions of company x in year t (2011-2015) divided by the market capitalization of company x in year t (2010-2015) | Capitalization per metric ton of Scope 1 carbon dioxide emitted. This ratio accounts for a company's size difference                                |
| Scope 2 Intensity Variables                                               |                                                                                                                              |                                                                                                                                                     |
| $\frac{S2_{x_t}}{REV_{x_t}}$                                              | Scope 2 emissions of company x in year t (2011-2015) divided by the revenue of company x in year t (2010-2015)               | Revenue per metric ton of Scope 2 carbon dioxide emitted. This ratio accounts for differences in revenue                                            |
| $\frac{S2_{x_t}}{NI_{x_t}}$                                               | Scope 2 emissions of company x in year t (2011-2015) divided by the net income of company x in year t (2010-2015)            | Income per metric ton of Scope 2 carbon dioxide emitted. This ratio shows how much income could be available to invest in Scope 1 reduction efforts |
| $\frac{S2_{x_t}}{MC_{x_t}}$                                               | Scope 2 emissions of company x in year t (2011-2015) divided by the market capitalization of company x in year t (2010-2015) | Capitalization per metric ton of Scope 2 carbon dioxide emitted. This ratio accounts for a company's size difference                                |
| GHG % Change                                                              |                                                                                                                              |                                                                                                                                                     |
| $\% \Delta S1_{x_{t-1}}$                                                  | Company x's Scope 1 percentage change from the prior year's reported Scope 1 emissions                                       | Looks at whether or not prior changes in Scope 1 emissions are correlated to stock price movements                                                  |
| $\% \Delta S2_{x_{t-1}}$                                                  | Company x's Scope 2 percentage change from the prior year's reported Scope 2 emissions                                       | Looks at whether or not prior changes in Scope 2 emissions are correlated to stock price movements                                                  |
| $\% \Delta Tot S1_{x_{t+5}}$                                              | The total 6 year percentage change in Scope 1 emissions (2010-2015)                                                          | Does the total 6 year change in Scope 1 emissions correlate to stock price movements?                                                               |
| $\% \Delta Tot S2_{x_{t+5}}$                                              | The total 6 year percentage change in Scope 2 emissions (2010-2015)                                                          | Does the total 6 year change in Scope 2 emissions correlate to stock price movements?                                                               |
| Qualitative Corp. Sustainability Strategies (categorical dummy variables) |                                                                                                                              |                                                                                                                                                     |
| $MgrLvl_x$                                                                | The highest level of direct responsibility for climate change within company x                                               | Do companies with higher levels of manager involvement outperform those that do not?                                                                |
| $Incentive_x$                                                             | Does company x provide incentives for the management of climate change issues, including the attainment of targets           | Does incentivizing climate change have an effect on stock prices?                                                                                   |
| $ETS_x$                                                                   | Does company x participate in any emissions trading schemes ("ETS")                                                          | Will involvement in an ETS improve stock price performance?                                                                                         |

The annual regression equation was run for each of 5 years (2011-2015) for the Bloomberg industries listed in the table below (Table 2) except for “diversified” which did not have a large enough sample size. The sample sizes for each industry ranged from a low of 40 companies in the “Communications” industry to a high of 207 companies in the “Consumer” industry (Table 2).

Table 2. The Bloomberg industry’s frequency and cumulative percentages used in the industry regressions (CDP, 2010-2016).

| <b>B INDUSTRY</b> |                        |           |         |               |                    |
|-------------------|------------------------|-----------|---------|---------------|--------------------|
|                   |                        | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid             | Basic Materials        | 73        | 9.8     | 9.8           | 9.8                |
|                   | Communications         | 40        | 5.4     | 5.4           | 15.1               |
|                   | Consumer, Cyclical     | 79        | 10.6    | 10.6          | 25.7               |
|                   | Consumer, Non-cyclical | 128       | 17.2    | 17.2          | 42.9               |
|                   | Diversified            | 6         | .8      | .8            | 43.7               |
|                   | Energy                 | 44        | 5.9     | 5.9           | 49.6               |
|                   | Financial              | 129       | 17.3    | 17.3          | 66.9               |
|                   | Industrial             | 148       | 19.8    | 19.8          | 86.7               |
|                   | Technology             | 54        | 7.2     | 7.2           | 94.0               |
|                   | Utilities              | 45        | 6.0     | 6.0           | 100.0              |
|                   | Total                  | 746       | 100.0   | 100.0         |                    |

The Bloomberg industry groups displayed in Table 1 above allowed for the regression equation to analyze if the selected sustainability factors are relevant in specific industries. The sub-hypotheses tested were:

Sub-H<sub>1</sub>: Do certain industries show significant correlations with GHG output?

Sub-H<sub>2</sub>: Are intensity variables statistically significant and a predictor of stock price performance?

Sub-H<sub>3</sub>: Do changes in emissions output affect market performance?

Sub-H<sub>4</sub>: Are management decisions related to sustainability linked to overall market performance?

Regressions were run for each year with smaller sample sizes taking into account a more inclusive regression equation. Compared to the regressions for Scope 1 and 2 emissions, it was hypothesized that the inclusion of intensity ratios, changes in carbon output, and more qualitative variables defining managerial strategy would lead to stronger results. Statistical significance might be improved by grouping shared corporate strategies and similar companies into smaller sample sizes.

Furthermore, it seemed against common sense to regress GHG output without taking into account the idiosyncrasies in each company relative to each other, such as firm size, capital availability differences, and corporate accounting. GHG intensity ratios were calculated using Scope 1 and Scope 2 annual emissions in the numerator, and dividing by market cap, net income, and gross sales or revenue. Top line sales or revenue is the amount of gross income a company produces. Bottom line net income is the amount of profit leftover after expenses and taxes for reinvestment, capital improvements, or dividends to shareholders. Market capitalization, the issued stock multiplied by the stock price, is how one would determine the relative size of the company. By creating ratios, the companies could then be better compared to one another. However, ratio analysis is often used against a benchmark, and since there are no benchmarks further research and data would need to be completed in order to have a full analysis (Nissim & Penman, 2001).

To estimate the reduction efforts and change in carbon emissions by the sample set, four new percentage variables were introduced for each company. Subtracting 2015

emissions from 2010 emissions and dividing the sum by 2010 emissions created the total carbon emission percentage change from 2010 until 2015:

$$\% \Delta TotS1_{x_{t+s}} = \frac{(S12015 - S12010)}{S12010}$$

This formula was repeated for Scope 2 emissions and also the change in prior year emissions for 2011 until 2015, as 2010 could not be calculated with prior year data.

Finally, qualitative variables were selected from the CDP questionnaire. Three questions were selected for inclusion in the regression analysis (Carbon Disclosure Project, 2015):

CC1.1: Where is the highest level of direct responsibility for climate change within your organization?

CC1.2: Do you provide incentives for the management of climate change issues, including the attainment of targets?

CC13.1: Do you participate in any emissions trading schemes?

These three questions created three qualitative variables that were used to test whether or not organizational level, incentives, and usage of emissions trading schemes would impact stock price performance.

The 2015 answers were used for all years, as not all prior year's questionnaires incorporated these questions, and this represented the most recent picture of the corporation's sustainability strategy, and ETS participation plans could be evaluated for the strategy's same affect with prior year's emissions, return, and fundamental data numbers.

The manager level ( $MgrLvl_x$ ) qualitative variable sample set contained a total of 746 samples ( $N=746$ ) divided into two separate levels of management; either the

company included climate change strategy into their board and executive decision-making or they placed climate change managerial responsibility onto lower levels. Companies incorporating sustainability decisions into the corporation's board and executives (646 companies out of 746) made up 87% of the data set. Ten percent (10%) of the sample set had middle or lower-level management responsible for sustainability decisions. Only a mere 10 companies (1%) did not have an individual or committee responsible for climate change. Considering this, nearly all companies reporting to the CDP perceptibly have a sustainability focus and this may have skewed the data; the sample set may not have been representative of the population at large. A table of the *MgrLvl<sub>x</sub>* variable descriptive statistical frequencies is produced below:

Table 3. The manager level variable descriptive frequencies (by author).

|       |                                                                                    | <b>MgrLvl</b> |         |               |                    |
|-------|------------------------------------------------------------------------------------|---------------|---------|---------------|--------------------|
|       |                                                                                    | Frequency     | Percent | Valid Percent | Cumulative Percent |
| Valid |                                                                                    | 16            | 2.1     | 2.1           | 2.1                |
|       | Board committee or other executive body                                            | 646           | 86.6    | 86.6          | 88.7               |
|       | Other, lower level departments                                                     | 74            | 9.9     | 9.9           | 98.7               |
|       | There is no individual or committee with overall responsibility for climate change | 10            | 1.3     | 1.3           | 100.0              |
|       | Total                                                                              | 746           | 100.0   | 100.0         |                    |

The manager level (*MgrLvl<sub>x</sub>*) qualitative variable was then recoded into three categorical dummy variables with binary values of 0 or 1 assigned dependent upon the answer to the CDP's survey question. To avoid the dummy variable trap, the dummy variable representing "no individual or committee with overall responsibility for climate

change” was removed, leaving two new dummy variables (*MgrLvl\_Board* and *MgrLvl\_LowLvl*) which were added to the regression equation in place of the *MgrLvl<sub>x</sub>* variable in the original regression equation enumerated earlier:

*MgrLvl\_Board* = 1 if there is board or executive oversight, and 0 if there is no oversight.

*MgrLvl\_LowLvl* = 1 if there is lower-level manager oversight then the board, and 0 if there is no oversight.

As identified above, most companies have executive or board-level management. To further identify manager-level influence on stock price performance, a variable was created (*Incentive<sub>x</sub>*) to see if incentivized managerial goals relating to climate change made a statistically significant impact on stock price performance. Sixty-percent (60%) of the sample set had manager incentives for climate change issues and 37% did not (Table 4).

Table 4. The incentive variable descriptive frequencies (by author).

| <b>Incentive</b> |           |         |               |                    |
|------------------|-----------|---------|---------------|--------------------|
|                  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid            | 16        | 2.1     | 2.1           | 2.1                |
| 0                | 1         | .1      | .1            | 2.3                |
| No               | 279       | 37.4    | 37.4          | 39.7               |
| Yes              | 450       | 60.3    | 60.3          | 100.0              |
| Total            | 746       | 100.0   | 100.0         |                    |

The manager incentive (*Incentive<sub>x</sub>*) qualitative variable was then recoded into two categorical dummy variables with binary values of 1 or 0 assigned. To avoid the

dummy variable trap, the dummy variable representing “No” was removed, leaving one new dummy variable (*Incentive\_Yes*) which was added to the regression equation in place of the *Incentive<sub>x</sub>* variable in the original regression equation previously described:

*Incentive\_Yes* = 1 if there are managerial incentives aligned with climate change, and 0 if there are no incentives.

Two methods of curbing carbon emissions have been proposed by legislatures, direct taxes on carbon emissions (a negative reinforcement regulatory scheme) or regulation that caps the total amount of carbon emissions for a locale and a marketplace in which permits to emit are traded – “cap-and-trade,” a positive reinforcement regulatory scheme. These schemes are based on either “price,” cap-and-trade policies would create a carbon market, or “quantity,” a tax on the amount of carbon emitted; results from academia insist on a hybrid model (Pizer, 2002). Examples of emissions trading schemes are the EU ETS, Tokyo Cap-and-Trade, and the Regional Greenhouse Gas Initiative.

With the advent of emissions trading schemes (ETS) and the start of cap-and-trade regulatory inclusion into the economic marketplace, especially with the amount of countries participating in the Paris Agreement as discussed previously, I thought it wise to incorporate a variable testing whether or not usage of the trading schemes would influence stock price return in certain industries.

The CDP questionnaires ask companies about their inclusion in any specific ETS scheme (Table 5). A variable was created (*ETS<sub>x</sub>*) to identify the three answers given by the corporations surveyed. Thirty-one-percent (30%) of companies in the sample do participate in at least one ETS, whereas (18%) do not engage in any ETS, but plan on

participating in the next 2 years. Lastly, 48% of the sample do not participate or have any plans to participate in an ETS in the near future.

Table 5. The emissions trading scheme variable frequencies (by author).

| ETS                                                                                                                              |           |         |               |                    |
|----------------------------------------------------------------------------------------------------------------------------------|-----------|---------|---------------|--------------------|
|                                                                                                                                  | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid                                                                                                                            | 27        | 3.6     | 3.6           | 3.6                |
| No, we don't participate nor do we currently anticipate participating in any emissions trading scheme within the next two years. | 360       | 48.3    | 48.3          | 51.9               |
| We don't currently, but anticipate participating in emissions trading within the next two years.                                 | 133       | 17.8    | 17.8          | 69.7               |
| Yes                                                                                                                              | 226       | 30.3    | 30.3          | 100.0              |
| Total                                                                                                                            | 746       | 100.0   | 100.0         |                    |

The emissions trading scheme ( $ETS_x$ ) qualitative variable was then recoded into three categorical dummy variables with binary values of 1 or 0 assigned. To avoid the dummy variable trap, the dummy variable representing “no, we don’t participate nor do we currently anticipate participating in any emissions trading scheme within the next two years” was removed, leaving two new dummy variables which were added to the regression equation in place of the  $ETS_x$  variable in the original regression equation:

$ETS\_No2Yr = 1$  if the company does not use an ETS now, but anticipates using one in 2 years, and 0 if they do not anticipate using an ETS.

*ETS\_Yes* = 1 if the company uses an ETS, and 0 if they do not anticipate using an ETS.

In addition to Scope 1 and Scope 2 emissions, the new regression model incorporated three new sets of independent variables testing the second hypothesis and four sub-hypotheses in smaller samples selected by their industry. One set of variables looked at changes in GHG emissions, in totality and in the prior year, to see if long-term emissions changes statistically differed from short-term emissions changes. Another set of variables was created to see if intensity ratios could predict either present or future performance and attempted to normalize some of the differences in the sample companies. The last set of variables looked at sustainability strategies and managerial influence. The new regression model was run once for each industry in every year from 2011 until 2015 (5 years).

#### Top 100 vs. Bottom 100 GHG Emitters

Looking at the entire data set, the top 100 and bottom 100 carbon emitting companies were identified by the total six year emissions for Scope 1 and Scope 2 output. The returns for these same 100 companies were summed for each of the six years between 2010 and 2015.

Not surprising, the industries for the companies in the top 20 Scope 1 emitters (Table 6) come from the mining, oil & gas, electric utilities & power producers, and construction industries. The human production and use of energy, and building the infrastructure necessary for manufacturing and human existence, creates the most carbon output in this sample set – a common sense yet relevant point for thought. When Scope 2

companies are evaluated, we see that anthropomorphic carbon creation moves away from energy production and manufacturing, and into stabilizing human existence: food, communication, travel, and chemicals (clothing, food preservation, etc.).

Table 6. Top 20 companies emitting the most Scope 1 and 2 emissions by industry (by author).

| Industry                                                                                                             | Company                     |             | Industry                                                                             | Company                      |             |
|----------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------|--------------------------------------------------------------------------------------|------------------------------|-------------|
| Mining - Iron, Aluminum, Other Metals                                                                                | Arcelor Mittal              | 959,707,670 | Mining - Iron, Aluminum, Other Metals                                                | BHP Billiton                 | 141,772,168 |
|                                                                                                                      | POSCO                       | 418,422,000 |                                                                                      | Arcelor Mittal               | 117,749,202 |
|                                                                                                                      | United States Steel Corpo.. | 241,128,915 |                                                                                      | Alcoa Inc.                   | 98,204,517  |
| Oil & Gas                                                                                                            | Exxon Mobil Corporation     | 783,000,000 |                                                                                      | Rio Tinto                    | 93,837,000  |
|                                                                                                                      | Royal Dutch Shell           | 437,000,000 |                                                                                      | Anglo American               | 58,355,185  |
|                                                                                                                      | Petrobras                   | 393,612,341 | Food & Staples Retailing                                                             | Wal-Mart Stores, Inc.        | 86,956,556  |
|                                                                                                                      | Sasol                       | 381,364,240 |                                                                                      | Verizon Communications I..   | 81,600,348  |
|                                                                                                                      | Chevron Corporation         | 355,455,421 | Telecommunication Services                                                           | AT&T Inc.                    | 47,796,049  |
|                                                                                                                      | BP                          | 349,420,000 |                                                                                      | Toyota Motor                 | 47,468,000  |
|                                                                                                                      | Total                       | 290,300,000 | Automobiles & Componen..                                                             | Exxon Mobil Corporation      | 80,000,000  |
|                                                                                                                      | ConocoPhillips              | 254,031,602 |                                                                                      | Royal Dutch Shell            | 58,000,000  |
| Electric Utilities & Independent Power Producers & Energy Traders (including fossil, alternative and nuclear energy) | E.ON AG                     | 757,686,071 |                                                                                      | Sasol                        | 55,968,000  |
|                                                                                                                      | Electricite de France (EDF) | 457,191,932 |                                                                                      | BP                           | 50,120,000  |
|                                                                                                                      | NRG Energy Inc              | 409,282,124 |                                                                                      | Occidental Petroleum Cor..   | 35,700,000  |
|                                                                                                                      | Xcel Energy Inc.            | 325,666,357 | Chemicals                                                                            | Linde AG                     | 66,520,000  |
|                                                                                                                      | Endesa                      | 278,053,354 |                                                                                      | Praxair, Inc.                | 66,397,047  |
| Construction Materials                                                                                               | CLP Holdings                | 270,991,300 |                                                                                      | Air Products & Chemicals, .. | 60,508,679  |
|                                                                                                                      | HeidelbergCement AG         | 295,832,860 |                                                                                      | Air Liquide                  | 58,250,000  |
| Water Transportation - W..                                                                                           | CEMEX S.A.B. de C.V         | 256,215,910 |                                                                                      | Dow Chemical Company         | 50,243,000  |
|                                                                                                                      | A.P. Moller - Maersk        | 226,956,421 | Water Utilities                                                                      | Veolia Environnement         | 43,447,130  |
| Water Utilities                                                                                                      | Veolia Environnement        | 220,675,240 |                                                                                      | Technology Hardware & E..    | 35,157,055  |
| S1 6 Yr Tot                                                                                                          |                             |             | S2 6 Yr Tot                                                                          |                              |             |
|                                   |                             |             |  |                              |             |
| 221M 960M                                                                                                            |                             |             | 35,157,055 142M                                                                      |                              |             |

Also important to note is “water sourcing and transportation” is listed in both of the Scope 1 and 2 top carbon emitting industry lists. We can easily visualize through this table that base human existence – shelter, food, and clothing – are reasons for carbon emissions. This data solidifies that which was presented previously; human existence

influences the environment. The bottom 20 GHG producing companies from the sample set are identified in Table 7.

Table 7. Bottom 20 companies emitting the least Scope 1 and 2 emissions by industry (by author).

| Industry                             | Company                     |       | Industry                             | Company                        |        |
|--------------------------------------|-----------------------------|-------|--------------------------------------|--------------------------------|--------|
| Banks, Diverse Financials, Insurance | Santam Ltd                  | 312   | Banks, Diverse Financials, Insurance | Industrial Alliance Ins. & F.. | 547    |
|                                      | Sanlam                      | 402   |                                      | BEKB / BCBE                    | 1,325  |
|                                      | Henderson Group             | 493   |                                      | Basellandschaftliche Kant..    | 2,561  |
|                                      | AMP Ltd                     | 823   |                                      | Vontobel Holding AG            | 2,709  |
|                                      | Basellandschaftliche Kant.. | 1,144 |                                      | StoreBrand ASA                 | 5,379  |
|                                      | Genworth Financial, Inc.    | 1,519 |                                      | BM&F Bovespa                   | 9,536  |
|                                      | BM&F Bovespa                | 1,662 |                                      | Cnp Assurances                 | 11,493 |
|                                      | Bankinter                   | 1,747 |                                      | Porto Seguro S.A.              | 11,527 |
|                                      | StoreBrand ASA              | 1,931 |                                      | Henderson Group                | 12,827 |
|                                      | Legg Mason, Inc.            | 2,919 |                                      | St.James Place                 | 13,515 |
|                                      | BEKB / BCBE                 | 3,178 |                                      |                                |        |
| Real Estate                          | Growthpoint Properties      | 456   | Water Transportation - W..           | D/S Norden                     | 2,946  |
| Software & Services                  | Tieto Oyj                   | 856   | Electric Utilities & Indepe..        | Cia Energetica de Sao Pau..    | 3,223  |
|                                      | Akamai Technologies Inc     | 2,120 | Home building                        | Bovis Homes Group              | 5,045  |
| Retailing                            | Clas Ohlson AB              | 924   |                                      | JM AB                          | 13,289 |
|                                      | Truworths International     | 2,742 |                                      | Redrow                         | 13,940 |
| Technology Hardware & E..            | Asustek Computer Inc        | 1,356 | Real Estate                          | Growthpoint Properties         | 9,359  |
| Media                                | Euromoney Institutional I.. | 1,493 | Oil & Gas                            | Premier Oil                    | 9,650  |
|                                      | Modern Times Group MTG..    | 3,670 |                                      | PTT Exploration & Product..    | 11,004 |
| Semiconductors & Semico..            | ARM Holdings                | 2,741 | Healthcare Providers & Se..          | Straumann Holding AG           | 12,897 |

**S1 6 Yr Tot**



312                      3,670

**S2 6 Yr Tot**



547                      13,940

Banks, insurance agencies, and financial companies are listed in both Scope 1 and Scope 2 groups as companies that do not create large sums of GHG emissions. It makes sense that intellectual activities of human existence, such as the financial markets which operate almost exclusively outside of the physical realm, are not large emitters of carbon. Software, technology, the media, real estate (buying and selling homes), semiconductors etc. are also listed and harken to the point that as humanity creates more intellectual

pursuits, less carbon is needed for these industries. We can notice that some companies in the same industry are listed on the top emitters and also that industry is on the bottom emitters list. This is evident with the “oil & gas” industry in the Scope 2 emissions list and a case for further study.

Looking at the selection of “oil & gas” companies in the bottom vs. the top emitters, one significant difference was noted almost immediately; the companies in the bottom 20 are both exploration companies, “upstream” companies that do not operate in the refining and retail process of the sector’s supply chain (Premier Oil, 2017). It is idiosyncrasies like this that would need to be accounted for in a robust analysis, yet this is outside of the scope and direction of this paper.

## Chapter III

### Results

The results of the three hypotheses testing the impact of corporate carbon output on stock price return are reviewed in this section.

#### Carbon Output as a Predictor of Stock Price Performance

The first hypothesis tested is whether or not GHG emissions would affect stock price return. The first objective of the multiple linear regression analysis was to determine how much of the variation in the dependent variable (stock price return) was explained by the independent variables (a company's Scope 1 and Scope 2 emissions). Scope 1 and Scope 2 total emissions as independent variables statistically significantly predicted stock price returns ( $F(2,734) = 11.660$ ,  $***p < 0.001$ ) (Table 8).

Table 8. MLR Summary and ANOVA for stock price return vs. Scope 1 and 2 emissions.

| ANOVA <sup>a</sup> |            |                |     |             |        |                   |
|--------------------|------------|----------------|-----|-------------|--------|-------------------|
| Model              |            | Sum of Squares | df  | Mean Square | F      | Sig.              |
| 1                  | Regression | 12.470         | 2   | 6.235       | 11.660 | .000 <sup>b</sup> |
|                    | Residual   | 392.492        | 734 | .535        |        |                   |
|                    | Total      | 404.962        | 736 |             |        |                   |

a. Dependent Variable: TotRet\_1\_In

b. Predictors: (Constant), S2Tot\_In, S1Tot\_In

| Model Summary <sup>b</sup> |                   |          |                   |                            |               |
|----------------------------|-------------------|----------|-------------------|----------------------------|---------------|
| Model                      | R                 | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson |
| 1                          | .175 <sup>a</sup> | .031     | .028              | .73125                     | 1.966         |

a. Predictors: (Constant), S2Tot\_In, S1Tot\_In

b. Dependent Variable: TotRet\_1\_In

The regression equation used was  $y = \beta_0 + \beta_1 * S16YrTot + \beta_2 * S26YrTot$  where  $\beta_0$  is the y-intercept (i.e. constant) and  $\beta_1$  and  $\beta_2$  are the slope coefficients (one for each variable). Only the value of the Scope 1 coefficient is statistically significant ( $p < 0.001^{***}$ ) (Table 9) and can predict stock price return. We can interpret the MLR model as:

- For every one percent increase in total six year metric tons of CO2e by a company, there will be a -0.181% ( $[1.01^{-.182} - 1] * 100$ ) decrease in six year total stock return ( $\sim 2/10^{\text{th}}$ s of a percent), holding Scope 2 total emissions constant.

Table 9. Coefficients of the Scope 1 and Scope 2 vs. total return regression.

| Coefficients <sup>a</sup> |            |                             |            |                           |        |      |
|---------------------------|------------|-----------------------------|------------|---------------------------|--------|------|
|                           |            | Unstandardized Coefficients |            | Standardized Coefficients |        |      |
| Model                     |            | B                           | Std. Error | Beta                      | t      | Sig. |
| 1                         | (Constant) | .884                        | .193       |                           | 4.579  | .000 |
|                           | S1Tot_In   | -.047                       | .013       | -.182                     | -3.580 | .000 |
|                           | S2Tot_In   | .004                        | .019       | .010                      | .189   | .851 |

a. Dependent Variable: TotRet\_1\_In

An example will highlight these results;  $B$  can be used as an approximation of the resulting changes. For example, in 2014 Abbott Laboratories (ABT US) reported Scope 1 emissions of 487,000 CO2e (CDP, 2014). In 2015, they reported Scope 1 emissions of 518,000 CO2e (CDP, 2015). Their 2015 annual Scope 1 emissions increased by 31,000 CO2e (or 6.36%). The six year total emissions reported by ABT is 4,030,757 CO2e (CDP, 2010-2015) and dividing that total output number by 31,000 gives us the percentage increase (0.008) in  $S1Tot$ . ABT's 2015 increase in Scope 1 emissions

reduced their six year total return -0.0145% ( $[1.008^{-.182} - 1] * 100$ ), when holding Scope 2 emissions constant. A small change, but nevertheless the direction is significant.

Looking at the same company, in 2010 ABT reported Scope 1 emissions 824,822 CO2e (CDP, 2010). In 2015, their emissions were reduced to an annual output of 518,000 CO2e (CDP, 2015). Yearly, their emissions continued to be reduced from 2010 until 2015 ( $S12011 = 838,000$ ;  $S12012 = 834,000$ ;  $S12013 = 528,935$ ;  $S12014 = 487,000$ ) and showed a noticeable downward trend (CDP, 2010-2015). The difference in annual output ( $S1TotSav$ ) between 2010 and 2015, starting with 2010 as a baseline ( $Bl$ ), is:

$$S1TotSav = (Bl_n - S1_{n+1}) + (Bl_n - S1_{n+2}) \dots (Bl_n - S1_{n+x})$$

where the  $Bl$  is the Scope 1 ( $S1$ ) emissions in year  $n$ , and  $x$  is the number of years. The total annual Scope 1 emissions saved from the baseline ( $Bl_n$ ) amount in 2010 is 918,175.

This means by implementing sustainability strategies ABT had a  $\frac{918175}{4030757}$  (or 22.779%) decrease in total annual emissions from the baseline, equating to a six year stock price return increase of 4.822% ( $[(1 - 0.228)^{-.182} - 1] * 100$ ). Sustainability strategies can improve corporate stock price performance as described above.

In conclusion, multiple linear regression was run to predict six year stock price return from total six year Scope 1 and Scope 2 emissions. The model met all of the statistical assumptions needed for a valid test. There was linearity as assessed by partial regression plots and a plot of residuals against the predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.966. There was homoscedasticity, as assessed by visual inspection of a plot of residuals versus unstandardized predicted values. The dependent variable was weighted by adding 1 and all of the variables were transformed with a natural log that corrected the

heteroscedasticity. After the data transformations, a new regression was run without outliers. There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1 and a VIF statistic of less than 10. The assumption of normality was met, as assessed by P-P Plot and histogram.

The multiple regression model statistically significantly predicted *TotRet\_1\_In*,  $F(2,734) = 11.660$ ,  $***p = 0.000$ ; Scope 1 returns are a statistically significant predictor ( $p < 0.05$ ). The model has weak correlation coefficients as evidenced by  $R$  of 0.175,  $R^2 = 0.031$ ,  $adj. R^2 = 0.028$ . MLR was used to test the hypothesis that carbon emissions have a negative effect on stock price performance. The results of the MLR are that we REJECT the null hypothesis ( $H_0$ ), Scope 1 and Scope 2 total GHG emissions have no effect on stock price performance.

To test the  $H_A$ , that Scope 1 and Scope 2 emissions have a negative effect on stock price performance, a one-tailed directional correlation test was completed and evaluated. The results of the directional test are reproduced in Table 10.

Table 10. One-tailed significance test of Stock Price Return vs. Scope 1 and Scope 2 emissions.

| Correlations |                     |             |          |          |
|--------------|---------------------|-------------|----------|----------|
|              |                     | TotRet_1_In | S1Tot_In | S2Tot_In |
| TotRet_1_In  | Pearson Correlation | 1           | -.175**  | -.118**  |
|              | Sig. (1-tailed)     |             | .000     | .001     |
|              | N                   | 737         | 737      | 737      |
| S1Tot_In     | Pearson Correlation | -.175**     | 1        | .700**   |
|              | Sig. (1-tailed)     | .000        |          | .000     |
|              | N                   | 737         | 737      | 737      |
| S2Tot_In     | Pearson Correlation | -.118**     | .700**   | 1        |
|              | Sig. (1-tailed)     | .001        | .000     |          |
|              | N                   | 737         | 737      | 737      |

\*\* . Correlation is significant at the 0.01 level (1-tailed).

The *Sig. (p)* values for the directional one-tailed test for Scope 1 and Scope 2 emissions are \*\*0.000 and \*\*0.001 respectively. The *R* values, -0.175 for Scope 1 and -0.118 for Scope 2, although both significant at least the 1% level, are very weak. Still, the linear relationship is both directionally negative and statistically significant, confirming the alternative hypothesis. Therefore, we ACCEPT the alternative hypothesis ( $H_A$ ), that Scope 1 and Scope 2 emissions have a negative effect on stock price performance.

#### Industry Regression Analysis with Qualitative and Ratio Variables

To test the second hypothesis, the new independent variables discussed previously were generated and included in an attempt to see if limiting the population sample to certain industries and including intensity ratios, changes in GHG output, and qualitative managerial strategies would produce statistically significant results. The main results of each of the eight industries regressed for five years each (40 regressions were run), with both the quantitative and qualitative variables described in the new MLR model, are displayed in Table 11.

Starting with the results in 2015 and working backwards, each year's selected and significant MLR equation results are explained in the following pages with the complete results of the significant MLR's listed in this paper's Appendix (not all of the MLRs were selected for evaluation due to poor fit). The regression equation was the same for each MLR and discussed in Chapter II. To determine which models were statistically significant, the author started with Cohen's standard for a "large" effect size (Cohen, 1992) and also evaluated statistical significance; chosen were MLR models with *R* values

Table 11. MLR results for fit analysis of eight industries from 2011 to 2015.

| Industry        | 2015     |          |                       |                            |                          | 2014     |          |                       |                            |                          |
|-----------------|----------|----------|-----------------------|----------------------------|--------------------------|----------|----------|-----------------------|----------------------------|--------------------------|
|                 | <i>n</i> | <i>R</i> | <i>R</i> <sup>2</sup> | <i>Adj. R</i> <sup>2</sup> | <i>Sig.</i> <sup>1</sup> | <i>n</i> | <i>R</i> | <i>R</i> <sup>2</sup> | <i>Adj. R</i> <sup>2</sup> | <i>Sig.</i> <sup>1</sup> |
| Basic Materials | 71       | 68%      | 46%                   | 30%                        | **0.002                  | 72       | 54%      | 30%                   | 9%                         | 0.156                    |
| Communications  | 39       | 78%      | 61%                   | 30%                        | 0.073                    | 39       | 82%      | 66%                   | 39%                        | *0.027                   |
| Consumer        | 207      | 40%      | 16%                   | 9%                         | **0.007                  | 207      | 41%      | 17%                   | 9%                         | **0.005                  |
| Energy          | 44       | 70%      | 49%                   | 16%                        | 0.183                    | 44       | 77%      | 59%                   | 32%                        | *0.033                   |
| Financial       | 128      | 42%      | 18%                   | 5%                         | 0.159                    | 129      | 52%      | 27%                   | 16%                        | **0.003                  |
| Industrial      | 148      | 44%      | 20%                   | 9%                         | *0.027                   | 148      | 43%      | 18%                   | 8%                         | *0.048                   |
| Technology      | 53       | 55%      | 30%                   | -3%                        | 0.579                    | 54       | 61%      | 37%                   | 7%                         | 0.280                    |
| Utilities       | 45       | 80%      | 65%                   | 44%                        | *0.003                   | 45       | 71%      | 50%                   | 18%                        | 0.140                    |

| Industry        | 2013     |          |                       |                            |                          | 2012     |          |                       |                            |                          |
|-----------------|----------|----------|-----------------------|----------------------------|--------------------------|----------|----------|-----------------------|----------------------------|--------------------------|
|                 | <i>n</i> | <i>R</i> | <i>R</i> <sup>2</sup> | <i>Adj. R</i> <sup>2</sup> | <i>Sig.</i> <sup>1</sup> | <i>n</i> | <i>R</i> | <i>R</i> <sup>2</sup> | <i>Adj. R</i> <sup>2</sup> | <i>Sig.</i> <sup>1</sup> |
| Basic Materials | 72       | 55%      | 30%                   | 10%                        | 0.133                    | 72       | 56%      | 32%                   | 12%                        | 0.106                    |
| Communications  | 39       | 89%      | 79%                   | 62%                        | ***0.001                 | 39       | 67%      | 45%                   | 0%                         | 0.486                    |
| Consumer        | 207      | 60%      | 36%                   | 30%                        | ***0.000                 | 207      | 52%      | 28%                   | 21%                        | ***0.000                 |
| Energy          | 44       | 96%      | 93%                   | 88%                        | ***0.000                 | 44       | 70%      | 48%                   | 15%                        | 0.201                    |
| Financial       | 129      | 51%      | 26%                   | 14%                        | **0.006                  | 129      | 46%      | 21%                   | 9%                         | 0.052                    |
| Industrial      | 148      | 32%      | 10%                   | -2%                        | 0.610                    | 148      | 35%      | 12%                   | 1%                         | 0.386                    |
| Technology      | 54       | 75%      | 56%                   | 35%                        | **0.007                  | 54       | 60%      | 36%                   | 5%                         | 0.339                    |
| Utilities       | 45       | 68%      | 46%                   | 13%                        | 0.224                    | 45       | 76%      | 58%                   | 31%                        | *0.036                   |

| Industry        | 2011     |          |                       |                            |                          |
|-----------------|----------|----------|-----------------------|----------------------------|--------------------------|
|                 | <i>n</i> | <i>R</i> | <i>R</i> <sup>2</sup> | <i>Adj. R</i> <sup>2</sup> | <i>Sig.</i> <sup>1</sup> |
| Basic Materials | 72       | 60%      | 36%                   | 18%                        | *0.036                   |
| Communications  | 39       | 73%      | 54%                   | 16%                        | 0.216                    |
| Consumer        | 207      | 53%      | 28%                   | 21%                        | ***0.000                 |
| Energy          | 44       | 73%      | 53%                   | 26%                        | 0.063                    |
| Financial       | 129      | 58%      | 34%                   | 24%                        | ***0.000                 |
| Industrial      | 148      | 49%      | 24%                   | 14%                        | **0.003                  |
| Technology      | 54       | 58%      | 34%                   | 2%                         | 0.419                    |
| Utilities       | 45       | 77%      | 59%                   | 34%                        | **0.024                  |

<sup>1</sup>Note: \**p* < .05. \*\**p* < .01. \*\*\**p* < .001

greater than 0.5 and at least a 95% significance level. The *R*-value descriptions used in the following section were:

“Very Strong” = *R* between 0.8 and 1.0

“Strong” = *R* between 0.6 and 0.8

|             |                           |
|-------------|---------------------------|
| “Moderate”  | = $R$ between 0.4 and 0.6 |
| “Weak”      | = $R$ between 0.2 and 0.4 |
| “Very Weak” | = $R$ between 0.0 and 0.2 |

## 2015 Industry Regressions

In 2015, two industries were selected out of the eight having relatively high prediction intervals ( $R^2$ ) and were found to be statistically significant: Basic Materials and Utilities. These two MLRs were evaluated further and the results presented and explained in the following sections.

*2015: Basic Materials.* In 2015, the 71 companies in the Basic Materials industry had a multiple correlation coefficient ( $R$ ) of 0.679 (see Appendix 1). This shows a high Pearson correlation coefficient between stock prices predicted by the model and the actual values of the dependent variable. As such,  $R$  is a measure of the strength of the linear association between stock prices and the independent variables and can give an indication of the model’s fit with a value between -1 and 1. However,  $R$  is not a common measure used to assess a good model; instead the total variation explained, adjusted  $R^2$  – the coefficient of determination – indicates that 30% of the variability of stock price return is explained by the model (Appendix 1).

The model as a whole statistically significantly predicted stock price return ( $F(16, 54) = 2.891$ ,  $**p = 0.002$ ,  $n = 71$ ) (Appendix 1). Thus the alternative hypothesis (within certain industries, intensity ratios, the change in GHG output, and qualitative sustainability strategies have an effect on stock price performance) for the Basic

Materials industry in 2015 is supported. The statistically significant independent variables were: Scope 1 emissions, Scope 1 emissions divided by net income, Scope 1 emissions divided by market cap, Scope 2 emissions divided by market cap, and if the companies used an emissions trading scheme (“ETS”).

Therefore, we can interpret the following for companies in the Basic Materials industry in 2015:

- A one ton 2015 CO<sub>2</sub>e increase in Scope 1 emissions would decrease 2015 return by -0.358%, all else equal.
- A one-unit increase in the Scope 1 divided by net income ratio would increase 2015 return by 0.344%, all else equal.
- A one unit increase in standard deviation of the Scope 1 emissions divided by market cap ratio is associated with an increase in 2015 stock price return by 1.466%, and a one unit standard deviation increase in the Scope 2 emissions divided by market cap ratio is associated with a decrease in 2015 stock price return by -1.303% for companies in the basic materials industry, all else equal.
- Those companies using an ETS had 2015 stock price returns that were 22.264% higher than those that did not use an ETS in 2015, all else equal.

*2015: Utilities.* In 2015, the 44 companies in the Utilities industry had a multiple correlation coefficient ( $R$ ) of 0.804 (see Appendix 4). The adjusted- $R^2$  of 44% (Appendix 4) indicates the variability of stock price return explained by the model. The model as a whole significantly predicted stock price return ( $F(16, 28) = 3.199$ ,  $**p = 0.003$ ,  $n = 44$ )

(Appendix 4). The statistically significant independent variables were Scope 1 emissions divided by market cap and if the companies used an emissions trading scheme (ETS).

Therefore, we can interpret the following for companies in the Utilities industry in 2015:

- A one-unit standard deviation increase in the Scope 1 emissions divided by market cap ratio is associated with a decrease in 2015 stock price return by - 1.056%, all else equal.
- On average, those utility companies using an ETS had 2015 stock price returns that were 26.92% higher than those that did not use an ETS in 2015, all else equal.

#### 2014 Industry Regressions

In 2014, three industries were selected out of the eight having relatively high prediction intervals ( $R^2$ ) and were found to be statistically significant: Communications, Financial, and Energy. These three MLRs were evaluated further and the results presented and explained in the following sections.

*2014: Communications.* In 2014, the 39 companies in the Communications industry had a multiple regression correlation coefficient ( $R$ ) of 0.815 (see Appendix 5). The model's  $R$ -value of 82% (Appendix 5) shows a very strong level of association. The  $R^2$  of this model explained 66% of the variability of stock price return with an adjusted- $R^2$  of 39% (Appendix 5). The model as a whole statistically significantly predicted stock price return ( $F(17, 21) = 2.445$ ,  $*p = 0.027$ ,  $n = 39$ ) (Appendix 5). Thus the alternative

hypothesis for the Communications industry in 2014 is true and we would REJECT the null. Even so, there were no statistically significant variables.

*2014: Energy.* In 2014, the 44 companies in the Energy industry had a multiple correlation coefficient ( $R$ ) of 0.769 (see Appendix 7, showing a very strong level of association). The adjusted- $R^2$  of the model was 32% (Appendix 7). The model as a whole statistically significantly predicted stock price return ( $F(17, 26) = 2.208$ ,  $*p = 0.033$ ,  $n = 44$ ) (Appendix 7). Thus the alternative hypothesis for the Energy industry in 2014 is true and we would REJECT the null. The statistically significant independent variables were the Scope 2 emissions change from the prior year and the total six-year change in Scope 1 emissions.

Therefore, the following could be interpreted for companies in the Energy industry in 2014:

- A 1% increase in the percentage change of Scope 2 emissions from the prior year equates to a decrease in 2014 stock price return by -0.479%, all else equal.
- A 1% increase in the annual Scope 1 output change in emissions from 2010 to 2015 equates to an increase in 2014 returns by 0.355%, all else equal. (Note: The increase should relate heavily to the profit and therefore return, the author presumes Scope 1 emissions should be positively correlated in the Energy industry to stock price returns.)

*2014: Financial.* In 2014, the 129 companies in the Financial industry had a multiple regression correlation coefficient ( $R$ ) of 0.519 (see Appendix 8). The model's R-value of

52% (Appendix 8) shows a moderate level of association. The adjusted- $R^2$  was 16% (Appendix 8). The model as a whole statistically significantly predicted stock price return ( $F(17,111) = 2.405$ ,  $**p = 0.003$ ,  $n = 129$ ) (Appendix 8). Thus the alternative hypothesis for the financial industry in 2014 is true and we would REJECT the null. The statistically significant independent variables were Scope 1 emissions and whether or not an ETS was utilized.

Therefore, the following could be interpreted for companies in the financial industry in 2014:

- An increase in one ton of Scope 1 CO<sub>2</sub>e emitted by financial companies reduced their 2014 stock price return by -0.821%, all else equal.
- The utilization of an ETS over other financial companies that did not use an ETS lowered the 2014 stock price returns of financial companies using ETSs by -11%, all else equal. (Note: This reduction may be from carbon trading losses in ETSs by financial companies, see the carbon price graph in Appendix 22).

### 2013 Industry Regressions

In 2013, five industries were selected out of the eight having relatively high prediction intervals ( $R^2$ ) and were found to be statistically significant: Communications, Consumer, Financial, Energy, and Technology. These five MLRs were evaluated further and the results presented and explained in the following sections.

*2013: Communications.* In 2013, the 39 companies in the Communications industry had a multiple correlation coefficient ( $R$ ) of 0.887 (see Appendix 10). The model's R-value of

89% (Appendix 10) shows a very strong level of association. The adjusted- $R^2$  was 62% (Appendix 10). The model as a whole statistically significantly predicted stock price return ( $F(17, 21) = 4.563$ , \*\*  $p = 0.001$ ,  $n = 39$ ) (Appendix 10). Thus, the alternative hypothesis for the Communications industry in 2013 is true and we would REJECT the null. The statistically significant independent variables were Scope 1 emissions divided by net income and the total six-year change in Scope 1 emissions.

Therefore, the following could be interpreted for companies in the Communications industry in 2013:

- A one standard deviation increase in the Scope 1 divided by net income ratio would reduce 2013 stock price return by -1.676%, all else equal.
- A 1% increase in the six year change in Scope 1 annual emissions from 2010 to 2015 reduced 2013 stock price returns by -0.459%, all else equal.

*2013: Consumer.* In 2013, the 207 companies in the Consumer industry had a multiple correlation coefficient ( $R$ ) of 0.599 (see Appendix 11). The model's  $R$ -value of 60% (Appendix 11) shows a moderate level of association. The adjusted- $R^2$  was 30% (Appendix 11). The model as a whole statistically significantly predicted stock price return ( $F(17, 189) = 6.232$ , \*\*\* $p < 0.001$ ,  $n = 207$ ) (Appendix 11). Thus, the alternative hypothesis for the Consumer industry in 2013 is true and we would REJECT the null. The statistically significant independent variables were the 2013 Scope 1 emissions and the 2013 Scope 1 emissions divided by revenue, net income, and market cap.

Therefore, the following could be interpreted for companies in the Consumer industry in 2013:

- A one ton CO<sub>2</sub>e increase in the 2013 Scope 1 emissions would increase six year stock price return by 0.402%, all else equal.
- A one unit standard deviation increase in the 2013 Scope 1 emissions divided by revenue ratio would decrease 2013 stock performance by -0.402%, all else equal.
- A one unit standard deviation increase in the 2013 Scope 1 emissions divided by net income ratio would increase 2013 stock performance by 0.656%, all else equal.
- A one unit standard deviation increase in the 2013 Scope 1 emissions divided by market cap ratio would decrease 2013 stock performance by 0.226%, all else equal.

*2013: Energy.* In 2013, the 44 companies in the Energy industry had a multiple correlation coefficient ( $R$ ) of 0.962 (see Appendix 12). The model's  $R$  value of 96% (Appendix 12) shows a very strong level of association. The adjusted- $R^2$  was 88% (Appendix 12). The model as a whole statistically significantly predicted stock price return ( $F(17, 26) = 18.861$ ,  $***p < 0.001$ ,  $n = 44$ ) (Appendix 12). Thus the alternative hypothesis for the Energy industry in 2013 is true and we would REJECT the null. The statistically significant independent variables were: the Scope 1 emissions divided by net income ratio, the Scope 2 emissions divided by net income ratio, and the total six year change in Scope 2 emissions.

Therefore, the following could be interpreted for companies in the Energy industry in 2013:

- A one unit standard deviation increase in the 2013 Scope 1 output divided by net income would increase 2013 stock prices by 0.955%, all else equal.

- A one unit standard deviation increase in the 2013 Scope 2 output divided by net income would decrease 2013 stock prices by -1.634%, all else equal.
- A 1% increase in the six year change in Scope 2 annual emissions from 2010 to 2015 would increase 2013 stock prices by 0.142%, all else equal.

*2013: Financial.* In 2013, the 129 companies in the Financial industry had a multiple correlation coefficient ( $R$ ) of 0.506 (see Appendix 13). The model's  $R$  value of 51% (Appendix 13) shows a moderate level of association. The adjusted- $R^2$  was 14% (Appendix 13). The model as a whole statistically significantly predicted stock price return ( $F(17,111) = 2.245$ ,  $**p = 0.006$ ,  $n = 129$ ) (Appendix 13). Thus the alternative hypothesis for the financial industry in 2013 is true and we would REJECT the null. The only statistically significant independent variable was Scope 2 emission's six-year change in annual emission output.

Therefore, the following would be true for companies in the financial industry in 2013: A 1% increase in the six year percentage change for Scope 2 emissions from 2010 to 2015 would equate to a drop in 2013 stock prices for finance companies of -0.413%, all else equal.

*2013: Technology.* In 2013, the 54 companies in the Technology industry had a multiple correlation coefficient ( $R$ ) of 0.745 (see Appendix 14). The model's  $R$ -value of 75% (Appendix 14) shows a strong level of association. The adjusted- $R^2$  was 35% (Appendix 14). The model as a whole statistically significantly predicted stock price return ( $F(17, 36) = 2.640$ ,  $**p = 0.007$ ,  $n = 54$ ) (Appendix 14). Thus, the alternative hypothesis for the

Technology industry in 2013 is true and we would REJECT the null hypothesis. No independent variables were significant.

## 2012 Industry Regressions

In 2012, two industries were selected out of the eight having relatively high prediction intervals ( $R^2$ ) and were found to be statistically significant, the Consumer and Utilities industries. These two MLRs were evaluated further and the results presented and explained in the following sections.

*2012: Consumer.* In 2012, the 207 companies in the Consumer industry had a multiple correlation coefficient ( $R$ ) of 0.524 (see Appendix 15). The model's R-value of 52% (Appendix 15) shows a moderate level of association. The adjusted- $R^2$  was 21% (Appendix 15). The model as a whole statistically significantly predicted stock price return ( $F(17,189) = 4.209$ ,  $***p < 0.001$ ,  $n = 207$ ) (Appendix 15). Thus the alternative hypothesis for the Consumer industry in 2012 is true and we would REJECT the null. The statistically significant independent variables were the Scope 1 emissions divided by revenue and market cap and the Scope 2 emissions divided by revenue.

Therefore, the following could be interpreted for companies in the Consumer industry in 2012:

- A one unit standard deviation increase in the 2012 Scope 1 emissions divided by revenue ratio would decrease 2012 stock performance by -0.405%, all else equal.

- A one unit standard deviation increase in the 2012 Scope 1 emissions divided by market cap ratio would increase 2012 stock performance by 0.572%, all else equal.
- A one unit standard deviation increase in the 2012 Scope 2 emissions divided by revenue ratio would increase 2012 stock performance by 0.239%, all else equal.

*2012: Utilities.* In 2012, the 45 companies in the Utilities industry had a multiple correlation coefficient ( $R$ ) of 0.759 (see Appendix 16). The model's R-value of 76% (Appendix 16) shows a strong level of association. The adjusted- $R^2$  was 31% (Appendix 16). The model as a whole statistically significantly predicted stock price return ( $F(17, 27) = 2.161, *p = 0.036, n = 45$ ) (Appendix 16). Thus the alternative hypothesis for the Utilities industry in 2012 is true and we would REJECT the null. The statistically significant independent variables were: Scope 1 emissions divided by revenue and net income, the change in the prior year's Scope 2 emissions, and if the companies used an ETS.

Therefore, the following could be interpreted for companies in the Utilities industry in 2012:

- A one unit standard deviation increase in the 2012 Scope 1 emissions divided by revenue ratio is associated with an increase in 2012 stock price return by 1.253%, all else equal.
- A one unit standard deviation increase in the 2012 Scope 1 emissions divided by net income ratio is associated with an increase in 2012 stock price return by 0.829%, all else equal.

- A 1% increase in the change from the prior year's Scope 2 emissions would equate to a 0.56% increase in 2012 stock price return, all else equal.
- Utility companies who participated in an ETS outperform those with no participation in an ETS in 2012 returns by 26.271%, all else equal.

## 2011 Industry Regressions

In 2011, four industries were selected out of the eight having relatively high prediction intervals ( $R^2$ ) and were found to be statistically significant, the Basic Materials, Consumer, Financial, and Utilities industries. These four MLRs were evaluated further and the results presented and explained in the following sections.

*2011: Basic Materials.* In 2011, the 72 companies in the Basic Materials industry had a multiple correlation coefficient ( $R$ ) of 0.601 (see Appendix 17). The model's R-value of 60% (Appendix 17) shows a strong level of association. The adjusted- $R^2$  was 18% (Appendix 17). The model as a whole statistically significantly predicted stock price return ( $F(16, 55) = 1.942$ ,  $*p = 0.036$ ,  $n = 72$ ) (Appendix 17). Thus, the alternative hypothesis for the Basic Materials industry sample in 2011 is true and we would REJECT the null. The only statistically significant independent variable was if the companies were planning on using an ETS in the next two years relative to those who did not use an ETS nor had any desire to in the future.

Therefore, the following could be interpreted for companies in the Basic Materials industry in 2011: Those companies that planned on utilizing an ETS outperformed those who had no ETS participation in 2011 return by 22.378%, all else equal.

*2011: Consumer.* In 2011, the 207 companies in the Consumer industry had a multiple correlation coefficient ( $R$ ) of 0.527 (see Appendix 18). The model's R-value of 53% (Appendix 18) shows a moderate level of association. The adjusted- $R^2$  was 21% (Appendix 18). The model as a whole statistically significantly predicted stock price return ( $F(17,189) = 4.279$ ,  $***p < 0.001$ ,  $n = 207$ ) (Appendix 18). Thus, the alternative hypothesis for the Consumer industry in 2011 is true and we would REJECT the null. The statistically significant independent variable was the Scope 2 emissions divided by market cap variable.

Therefore, the following could be interpreted for companies in the Consumer industry in 2011: A one unit standard deviation increase in the 2011 Scope 2 emissions divided by market cap ratio would decrease 2011 stock performance by -1.001%, all else equal.

*2011: Financial.* In 2011, the 129 companies in the Financial industry had a multiple correlation coefficient ( $R$ ) of 0.582 (see Appendix 19). The model's R-value of 58% (Appendix 19) shows a moderate level of association. The adjusted- $R^2$  was 24% (Appendix 19). The model as a whole statistically significantly predicted stock price return ( $F(16,112) = 3.577$ ,  $***p < 0.001$ ,  $n = 129$ ) (Appendix 19). Thus, the alternative hypothesis for the Financial industry in 2011 is true and we would REJECT the null. The statistically significant independent variables were: Scope 1 divided by revenue, the total six year change in Scope 2 emissions, and participation in an ETS when compared to those who do not use an ETS.

Therefore, the following could be interpreted for companies in the Financial industry in 2011:

- A one unit standard deviation increase in the 2011 Scope 1 divided by revenue ratio would equate to a 2.975% increase in 2011 stock price performance, all else equal.
- A 1% increase in the six year percentage change for Scope 2 emissions from 2010 to 2015 would equate to a drop in 2011 stock prices by -0.231%, all else equal.

Usage of an ETS would have dropped 2011 stock prices by -13.526% on average versus those financial companies that did not use an ETS, all else equal. (Note: 2011 had a severe drop in carbon prices, see Appendix 22).

*2011: Utilities.* In 2011, the 45 companies in the Utilities industry had a multiple correlation coefficient ( $R$ ) of 0.771 (see Appendix 21). The model's  $R$ -value of 77% (Appendix 21) shows a strong level of association. The adjusted- $R^2$  was 34% (Appendix 21). The model as a whole statistically significantly predicted stock price return ( $F(17, 27) = 2.325$ ,  $*p = 0.024$ ,  $n = 45$ ) (Appendix 21). Thus, the alternative hypothesis for the Utilities industry in 2011 is true and we would REJECT the null. There were no statistically significant independent variables.

#### Topmost and Bottommost Scope 1 and Scope 2 Carbon Emitters

The final hypothesis tested was to evaluate if companies that practiced sustainability. Would those companies that reduced their GHG and carbon output, relative to others in their industry, outperform those that were unsustainable? The total

Scope 1 and Scope 2 GHG emissions outputs and the cumulative returns for the most and least sustainable companies were compiled and tabled (see Table 12).

Table 12. Total Scope 1 & Scope 2 emissions for the top and bottom 100 GHG emitters.

| Year | Emissions     |            |           |             |            |           |
|------|---------------|------------|-----------|-------------|------------|-----------|
|      | Scope 1       |            |           | Scope 2     |            |           |
|      | Top 100       | Bottom 100 | B100/T100 | Top 100     | Bottom 100 | B100/T100 |
| 2010 | 2,440,646,518 | 234,441    | 0.01%     | 472,794,897 | 944,917    | 0.20%     |
| 2011 | 2,582,005,909 | 229,143    | 0.01%     | 502,807,582 | 965,494    | 0.19%     |
| 2012 | 2,487,454,286 | 244,264    | 0.01%     | 464,152,664 | 1,011,566  | 0.22%     |
| 2013 | 2,444,885,799 | 243,905    | 0.01%     | 451,436,246 | 943,157    | 0.21%     |
| 2014 | 2,472,771,819 | 284,377    | 0.01%     | 444,406,624 | 842,147    | 0.19%     |
| 2015 | 2,457,644,483 | 272,496    | 0.01%     | 486,641,797 | 885,466    | 0.18%     |

Table 13. Return data for the top 100 and bottom 100 Scope 1 and 2 GHG emitters.

| Year | Returns   |            |            |           |            |            |
|------|-----------|------------|------------|-----------|------------|------------|
|      | Scope 1   |            |            | Scope 2   |            |            |
|      | Top 100   | Bottom 100 | Difference | Top 100   | Bottom 100 | Difference |
| 2010 | 137,032%  | 218,254%   | 81,222%    | 141,116%  | 270,839%   | 129,723%   |
| 2011 | -131,247% | -128,428%  | 2,819%     | -125,597% | -97,404%   | 28,194%    |
| 2012 | 77,800%   | 243,169%   | 165,369%   | 101,883%  | 251,466%   | 149,583%   |
| 2013 | 216,610%  | 328,726%   | 112,116%   | 188,388%  | 346,874%   | 158,486%   |
| 2014 | 18,533%   | 40,005%    | 21,472%    | 25,185%   | -3,161%    | -28,346%   |
| 2015 | -184,538% | -53,550%   | 130,988%   | -131,098% | -30,783%   | 100,315%   |

In every year between 2010 and 2015 (except for the Scope 2 companies in 2014) low-carbon emitting companies outperform high-carbon emitting companies (Table 13). In the 12 periods measured and identified, only one period had results that were inconsistent with the hypothesis that high-carbon and GHG output negatively influences stock price return. Therefore, this supports the hypothesis that the bottom 100 carbon

emitters outperform the top 100 carbon emitters in the stock market. In summation, in all three MLR evolutions, it has been proven sustainability strategy does affect stock price performance. In the next chapter, the results of these MLR regressions are discussed and evaluated for their merits.

## Chapter IV

### Discussion

The initial research objective of this paper was to determine the effects of carbon credit trading and sustainability strategies relative to corporate performance as evidenced by the equity market. After a data review, the thesis was altered to incorporate what could be evaluated with the data available, as carbon credit trading data is significantly hard to find (the EU ETS has much more data available; however, in the U.S. carbon credit trading data is severely limited). The paper's main hypothesis then became: GHG emissions (carbon equivalent emissions) impacts stock prices.

After the initial regression was run on three variables (stock prices, Scope 1 emissions, Scope 2 emissions), a new model was created to see if there were better predictors (independent variables) for variability and if sub-sets of the data sample, selected by industry, improved the first model's results. Finally, a simple analysis of high-GHG emitters vs. low-GHG emitters was presented. Each hypothesis is discussed in the following sections.

It bears noting the inherent complexities of market performance lead to difficulty in finding a statically significant determinant (independent variable) predicting sustainability performance. It is a daunting needle-in-the-haystack search. Sustainability seems to be externality derived from multiple different corporate strategies and initiatives, all aligning and working in unison with a shared goal and vision. The individual components of positive sustainability performance are challenging to quantify

and define, although studies in addition to this one have proven a small positive relationship exists (Peloza, 2009).

### Data Overview

This thesis evaluated three hypotheses theorized to include one of these elusive mechanisms. As an elegant Swiss watch movement is made up of over 115 individual parts, so too do the machineries of sustainability work in unison to move a corporation in the direction of a more encompassing definition of profitability. Catalysts of sustainability performance data selected for analysis in this research were: 1) a company's carbon footprint determined by its Scope 1 and Scope 2 emissions; 2) carbon output transmuted with a company's fundamentals included (intensity ratios), 3) changes in GHG output; 4) qualitative indicators of sustainability strategy within an organization (environmental performance incentives and ETS utilization); and 5) the performance of companies grouped as high-carbon emitters vs. those determined to be low-carbon emitters from the sample set. The results of each potential catalyst are discussed in the following sections.

The data used were sourced from a database of the answers to the annual CDP questionnaires and a Bloomberg terminal. One problem I found was that the questions changed annually. More specifically, the more recent questionnaires added new questions and sub questions, and sections were changed as time progressed. This limited the number of companies that could be used in the population sample to 746, those with a complete variable data set; those with any missing answers in any of the predictors were eliminated. The 2015 data were used for the qualitative variables as this was the most

complete version and the author assumed the answers would not significantly change in prior years. Also, the six-year total Scope 1 and Scope 2 figures, and the change in Scope 1 and 2 annual emissions were added into the yearly regressions to see if future performance predicted past results. In the future, regressions with limited questionnaire responses should be used to increase the sample size and focus the analysis.

As discussed in the methods chapter, the data fairly approximated global industry emissions percentages and GHG output by country. The database was somewhat skewed with only data from companies voluntarily reporting and some companies may purposely not report for compromising reasons and those that do not report most likely do not have a sustainability strategy; the results of this paper's MLR analysis are weakened by this point and the missing data.

However, the data did reveal some interesting points:

- Large continents, countries and areas of the world were not represented by any, or extremely small percentages of companies reporting six year data. Developing countries such as China, Russia, South America, and Africa, were almost non-existent in this analysis.
- The United Kingdom is the second highest emitter of Scope 1 emissions in the sample data set, and the fourth highest emitter of Scope 2 emissions; either the U.K. emits significantly less Scope 2 emissions or their companies simply do not report as many Scope 2 emissions. The regression shows that Scope 1 and Scope 2 emissions are significantly correlated ( $R=0.7^{**}$ ) so it follows that their rankings would be equal in both data sets.

- Common-sense industries assumed to be heavily regulated had a greater proportion of companies reporting to the CDP.
- Industries geared to anthropomorphic pursuits produced the most carbon.
- The use of land, forestry, and agricultural industries were underrepresented.
- The banking and finance industry was at the top of the companies disclosing to the CDP but not an industry producing large portions of relative GHG emissions.
- Industries with a large amount of companies disclosing to the CDP centered on those industries that were involved in heavy manufacturing, energy production, and high technology – commercial pursuits. Industries with a moderate-to-large level of companies disclosing focused on human sustenance; these industries concentrated on food processing, medical care, housing, entertainment, and construction – retail pursuits. The industries that had a low level of companies performing were involved with commercial transportation.

#### Total Scope 1 and Scope 2 Emissions as a Predictor of Total Stock Price Return

The first regression was purposely broad in data, yet tested a short and simple question: Does carbon output effect stock prices? The first regression equation testing Hypothesis 1's null hypothesis ( $H_0$ ) revealed statistically significant results ( $p < 0.001$ ); GHG emissions as evidenced by Scope 1 and Scope 2 data did predict a company's stock price performance, but the amount of variance explained was next to nothing ( $R^2 = 0.031$ ); we can say although it is a significant model, it is a very poor predictor of stock prices. The Scope 1 emissions are negatively correlated and even a simple three variable model as this proves that Scope 1 GHG emissions reduce stock price return. More

important than stock prices being able to be predicted by this model (if an individual can give me a model that predicts stock prices the author can give you all the money in the world), is the direction of the slope.

This paper empirically proves that GHG emissions are correlated to negative stock price performance; however, correlation does not infer causation. The hypothesis supported by this study is that stock prices are negatively correlated to GHGs and carbon output (1-tailed *Sig. S1Tot\_Ln* = 0.000, *R* = -0.175\*\*\*, 1-tailed *Sig. S2Tot\_Ln* = 0.001, *R* = -0.118\*\*\*). Again, the strength of the model was “very weak” (Cohen, 1992), yet the goal of this paper was to determine if a statistical significance exists, not the strength of significance. As the model did not include those companies who did not report data to the CDP, it can be posited the model would improve if that data was somehow able to be added, but this is beyond the scope of this paper.

*Scope 1 and Scope 2 initial regression model.* A synopsis of what can be determined from the Scope 1 and Scope 2 regressions is that:

- GHG emissions negatively influence stock price return, although it is a weak affect.
- Scope 1 emissions (direct emissions) have a significant consequence while the analysis showed at this time Scope 2 emissions (indirect emissions) are not a significant predictor variable.
- Six year Scope 1 and Scope 2 emissions have a negative correlation to six year stock price return.

- If a company increases their six year Scope 1 CO<sub>2</sub>e emissions, that company's stock price over six years will be reduced by 2/10<sup>ths</sup> of a percent for each ton of CO<sub>2</sub>e they emit.

#### Industry Regressions with Intensity Ratios, GHG Emissions Changes, and Qualitative Corporate Strategies Included

In every year tested, the new regression model adding additional sustainability variables was significant for at least two industries. Only the Technology industry did not have at least two years where the model was significant. In contrast, the Consumer industry had significance every year tested (and also had the largest sample size,  $n = 207$ ). The table below highlights the significance of the model by industry and year. If the model's  $p$ -value is significant, then at least one of the independent variables in the model must be significant as well. Focusing on the Consumer industry's reception to the model, the variables that were significant in the Consumer industry are evaluated next.

Table 14. The significance of the regression model for each industry and year (collated from results section).

| Industry        | Significance of the Model <sup>1</sup> |      |      |      |      | Total |
|-----------------|----------------------------------------|------|------|------|------|-------|
|                 | 2011                                   | 2012 | 2013 | 2014 | 2015 |       |
| Technology      |                                        |      | **   |      |      | 1     |
| Basic Materials | *                                      |      |      |      | **   | 2     |
| Communications  |                                        |      | ***  | *    |      | 2     |
| Energy          |                                        |      | ***  | *    |      | 2     |
| Financial       | ***                                    |      | **   | **   |      | 3     |
| Industrial      | **                                     |      |      | *    | *    | 3     |
| Utilities       | **                                     | *    |      |      | *    | 3     |
| Consumer        | ***                                    | ***  | ***  | **   | **   | 5     |
| Totals          | 5                                      | 2    | 5    | 5    | 4    |       |

<sup>1</sup>Note: \* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$

For each year in the Consumer industry, the following variables were significant ( $p < 0.05$ ):

- 2011: Scope 2/Revenue ( $B = 0.057^*$ ), Scope 2/Market Cap ( $B = -0.106^{***}$ )
- 2012: Scope 1/Revenue ( $B = -0.07^*$ ), Scope 1/Market Cap ( $B = 0.008^{***}$ ), Scope 2/Revenue ( $B = 0.093^{**}$ )
- 2013: Scope 1 Emissions ( $B = \text{tiny positive}^{**}$ ), Scope 1/Revenue ( $B = -0.098^{**}$ ), Scope 1/Net Income ( $B = 0.001^{***}$ ), Scope 1/Market Cap ( $B = -0.011^*$ )
- 2014: Scope 1 emissions ( $B = \text{tiny positive}^{***}$ ), Scope 1/Market Cap ( $B = -0.007^*$ ), Scope 1 Total Change ( $B = -0.028^*$ ), Scope 2 Total change ( $B = 0.002^*$ )
- 2015: Scope 2/Market Cap ( $B = 0.073^{**}$ ), Scope 2 emissions change ( $B = -0.072^{**}$ ), Manager Level = other, lower level departments ( $B = 31.243^*$ )

*Intensity ratio analysis example.* To properly evaluate the intensity ratios in a model, a hypothetical example was produced using the unstandardized  $B$  values instead of the standardized  $\beta$  (beta) reported in the results discussed in Chapter III.

Campbell's Soup Company's 2011 raw data were entered into the 2011 predictor model ( $\beta_0$  was not significant at  $p=0.637$ ) which is:

$$y = \left( \beta * \frac{S2}{Rev} \right) + \left( \beta * \frac{S2}{MC} \right)$$

The output for the sample data entered and predictor variables are shown in Table 15.

Table 15. Estimated returns using the 2011 consumer industry MLR model.

| 2011 Consumer Industry Model |         |            |         |         |
|------------------------------|---------|------------|---------|---------|
| Variable                     | 2011    | Estimated  |         |         |
| Scope 2                      | 382,084 | 200,000    | 300,000 | 400,000 |
| Revenue                      | 7,719   | 7,719      | 7,719   | 7,719   |
| Market Cap                   | 10,576  | 10,576     | 10,576  | 10,576  |
| Return (%)                   | -0.971  | -0.528     | -0.079  | -1.055  |
| Return =                     | $B *$   | $S2/Rev +$ | $B *$   | $S2/MC$ |
| -1.008                       | 0.057   | 49.499     | -0.106  | 36.127  |

The model predicted 2011 return at -1.008%, the actual 2011 return was -0.971%. The model was off by 0.037%, or a fraction of one percent. When running the predictor model for other amounts of Scope 2 emissions, the result is a negatively sloped line (Figure 17).

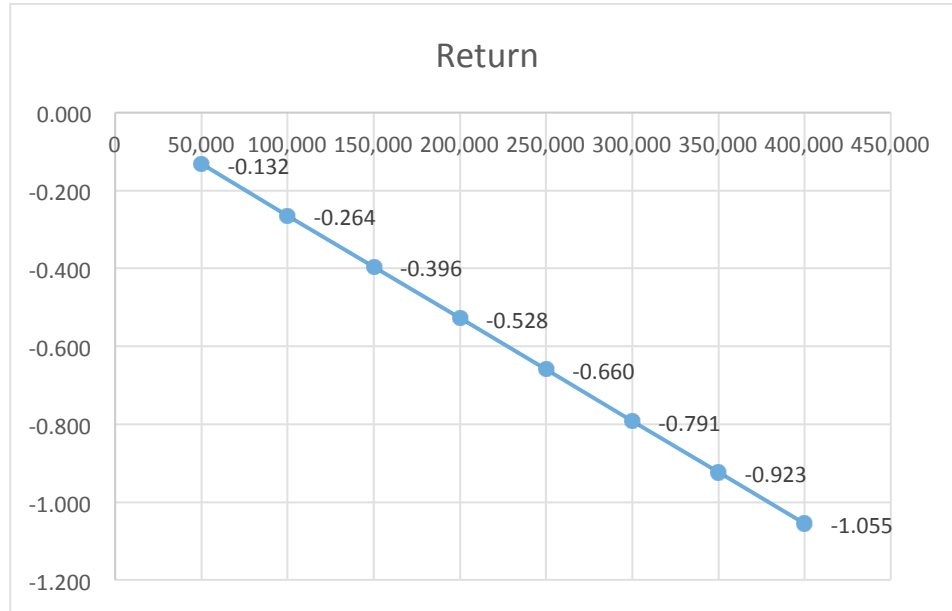


Figure 17. Estimated returns for 2011 with selected Scope 2 inputs.

The model displays evidence that increases in Scope 2 emissions negatively affect six year stock price returns, however, the effect is not a large one. Still, the hypothesis that reducing Scope 2 emissions will improve stock price performance is predicted by the model in one year as a small improvement in six year total stock price return. Scope 2 emissions were not significant predictors in all years.

*Significant predictor variables by industry.* Variable analysis can be accomplished to see which variables are significant in each year in attempt to find predictor variables consistent through a relevant time period, but is beyond the scope of this paper; this paper intended to see whether or not any of the independent variables would be significant, and looked for the significant variables in the most recent

year. Taking a quick look at the most recent data, in 2015 for the following industries, the following variables were significant:

1. Basic Materials: Scope 1 emissions ( $\beta = -0.358^*$ ); Scope 1 divided by net income ( $\beta = 0.344^*$ ); Scope 1 divided by market capitalization ( $\beta = 1.466^*$ ); Scope 2 divided by market cap ( $\beta = -1.303^{**}$ ).
2. Communications: Scope 2 total change ( $\beta = -0.760^*$ ).
3. Consumer: Scope 2 divided by market capitalization ( $\beta = -0.228^*$ ); Scope 2 prior year change ( $\beta = -0.184^{**}$ ).
4. Energy: Scope 2 divided by net income ( $\beta = 2.054^*$ ); having a board-level committee over no climate change responsibility ( $B = 84.282^*$ ); having other, low-level departments over no climate change responsibility ( $B = 103.459^*$ ).
5. Financial: Scope 1 emissions divided by net income ( $\beta = -2.714^{**}$ ); Scope 2 emissions divided by market capitalization ( $\beta = -0.947^*$ ).
6. Industrial: Scope 1 emissions divided by net income ( $\beta = -0.370^{**}$ ); Scope 1 total change ( $\beta = 0.174^*$ ).
7. Technology: None.
8. Utilities: Scope 1 divided by market capitalization ( $\beta = -1.056^{**}$ ); Using an ETS over those that do not ( $B = 26.916^*$ ).

This is an area for further research and outside the scope of this paper.

*Discussion on the results of the enhanced regression model.* The central results of the enhanced regression model are:

- Adding new variables and segregating the sample data by industry increased fit, strength, and the linearity of the original model.
- Different industries will need to use industry-specific sustainability predictor variables related to their specific business model. Analysis should first be done on the industry's operations to determine the correct independent variables to include in a regression, and is a topic for further academic research (the same variables were used in all of the industry models in this paper).
- The independent variables used were most significant to the Consumer industry.
- In 2011, 2013, and 2014 the enhanced regression model was more significant than in 2012 and 2015. Yearly regressions should include independent variable data that accounts for the economic atmosphere characteristics for the year in question.
- The strongest regression model was the 2013 Energy industry model ( $***p = <0.001$ ) that showed linearity and variability accounted for of  $R = 96\%$ ,  $R^2 = 93\%$ ,  $Adj. R^2 = 88\%$ . This is a very strong outcome and a model for further consideration (see Appendix 12).
- ETS usage had a substantial increase in six year stock prices for the Basic Materials industry in 2015 and 2011 ( $B = 22.264^*$ ,  $B = 22.378^{**}$ ) and the Utilities industry in 2015 and 2012 ( $B = 26.916^*$ ,  $B = 26.271^{**}$ ), and an

increase in six year stock prices in the Financial industry in 2012 and a decrease in 2011 ( $B = 11.963^*$ ,  $B = -13.526^{**}$ ).

- Climate change manager levels were near significant in the Utilities industry in 2015, having low level managers instead of no management increased six year stock price performance by 55.389% ( $B = 55.389$ ,  $p = 0.051$ ) when rounding the *Sig.* to 0.05.
- The change in prior year's emissions was not significant in the selected models; the implication of long-term effects on emissions changes (total six year changes) were identified as significant in a few of the models shows that sustainability is a long-term strategy.
- Intensity ratio analysis was tested and determined to be a significant predictor, however, ratios are generally used to compare benchmarks and forecast fundamentals. More research is necessary to identify their proper use in current or predicted uses.
- Manager incentives for climate change were not significant.

#### Top 100 vs. Bottom 100 Discussion

An analysis was done to employ a final assessment in order to validate the regressions in another manner. The entire population sample dataset was truncated by Scope 1 and Scope 2 emissions and the top and bottom portions summed to see if their returns substantiated the regression results. As expected, companies with less Scope 1 and Scope 2 emissions outperformed their peers with higher GHG outputs. The dominant themes from this enquiry are:

- The top emitters pollute much more than the bottom emitters.
- The proportion of the difference between the top and bottom emitters is much greater with Scope 1 emitters than it is with Scope 2 emitters.

## Conclusion

In conclusion, the main discovery of this paper is that GHG emissions are revealed to move stock prices negatively. This conclusion was statistically supported by all three separate hypotheses tested in this thesis. Strategy implementation (ETS use and manager responsibility for climate change initiatives) was shown to have larger impacts on stock prices than simply reducing GHG output, confirming the theory that sustainability is integrated and requires a long-term effort. Emissions trading schemes will be key players in corporate strategies in the near future due to regulations such as the Paris Agreement, scientific pressure from global warming studies, and the commodification of carbon as a tradable commodity on open carbon markets. A company can establish a competitive advantage by using an ETS to mitigate their GHG, carbon, and ESG risks. For example, buying carbon futures or selling carbon puts could mitigate a company's carbon risk. Examples as this can only occur once ESG concerns become an integral part of a corporate strategy – an event that is not an “if we should do this” question but a “when will it be implemented” statement.

This research has shown that different industries will require different sustainability strategies. In the regressions, significant predictor variables changed from year-to-year and industry-to-industry. Corporate sustainability focuses must then be adaptive and change in accordance to both the economic and industry's situation at present. A long-term sustainability strategy should include provisions for unforeseen

changes and be unconstrained from adapting to ESG-related market conditions. Mother Nature can be unpredictable, and knowing unpredictability is a quality of the environment, is then predicting that unpredictable quality.

## Appendix 1

### 2015: Basic Materials Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Basic Ma (Selected) | B INDUSTRY ~= Basic Ma (Unselected) |          |                   |                            | B INDUSTRY = Basic Ma (Selected) | B INDUSTRY ~= Basic Ma (Unselected) |
| 1     | .679 <sup>a</sup>                | .                                   | .461     | .302              | 28.69644329                | 2.358                            | 2.001                               |

a. Predictors: (Constant), ETS\_data=Yes, S2\_NI\_2015, Incentive\_data=Yes, S2 2015 Chg, S1 Tot Chg, S1\_MC\_2015, S1 2015 Chg, MgrLvl\_data=Other, lower level departments, S2 2015, S1\_NI\_2015, S1 2015, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_REV\_2015, S1\_REV\_2015, S2 Tot Chg, S2\_MC\_2015

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Basic Ma.

c. Dependent Variable: Ret 2015

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 38086.318      | 16 | 2380.395    | 2.891 | .002 <sup>c</sup> |
|       | Residual   | 44468.236      | 54 | 823.486     |       |                   |
|       | Total      | 82554.554      | 70 |             |       |                   |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Basic Ma

c. Predictors: (Constant), ETS\_data=Yes, S2\_NI\_2015, Incentive\_data=Yes, S2 2015 Chg, S1 Tot Chg, S1\_MC\_2015, S1 2015 Chg, MgrLvl\_data=Other, lower level departments, S2 2015, S1\_NI\_2015, S1 2015, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_REV\_2015, S1\_REV\_2015, S2 Tot Chg, S2\_MC\_2015

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -17.992                     | 9.911      |                           | -1.815 | .075 |
|       | S1 2015                                                                                                   | -5.328E-7                   | .000       | -.358                     | -2.197 | .032 |
|       | S1_REV_2015                                                                                               | -.022                       | .012       | -.538                     | -1.841 | .071 |
|       | S1_NI_2015                                                                                                | .000                        | .000       | .344                      | 2.247  | .029 |
|       | S1_MC_2015                                                                                                | .005                        | .002       | 1.466                     | 2.460  | .017 |
|       | S2 2015                                                                                                   | 2.071E-7                    | .000       | .027                      | .171   | .864 |
|       | S2_REV_2015                                                                                               | -.002                       | .016       | -.018                     | -.101  | .920 |
|       | S2_NI_2015                                                                                                | -.001                       | .000       | -.233                     | -1.946 | .057 |
|       | S2_MC_2015                                                                                                | -.013                       | .005       | -1.303                    | -2.738 | .008 |
|       | S1 2015 Chg                                                                                               | -.210                       | .243       | -.110                     | -.865  | .391 |
|       | S2 2015 Chg                                                                                               | -.025                       | .131       | -.023                     | -.190  | .850 |
|       | S1 Tot Chg                                                                                                | -.002                       | .012       | -.050                     | -.198  | .844 |
|       | S2 Tot Chg                                                                                                | .009                        | .025       | .099                      | .356   | .723 |
|       | MgrLvl_data=Other, lower level departments                                                                | 12.357                      | 16.121     | .084                      | .767   | .447 |
|       | Incentive_data=Yes                                                                                        | 1.287                       | 8.401      | .017                      | .153   | .879 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 10.523                      | 12.336     | .116                      | .853   | .397 |
|       | ETS_data=Yes                                                                                              | 22.264                      | 9.174      | .326                      | 2.427  | .019 |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Basic Ma

## Appendix 2

### 2015: Consumer Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Consumer (Selected) | B INDUSTRY ~= Consumer (Unselected) |          |                   |                            | B INDUSTRY = Consumer (Selected) | B INDUSTRY ~= Consumer (Unselected) |
| 1     | .403 <sup>a</sup>                | .176                                | .163     | .087              | 24.26781138                | 2.087                            | 1.997                               |

a. Predictors: (Constant), ETS\_data=Yes, S1\_REV\_2015, MgrLvl\_data=Other, lower level departments, S2\_NI\_2015, S2 Tot Chg, S2 2015 Chg, S1 2015 Chg, S2\_REV\_2015, S2 2015, Incentive\_data=Yes, S1\_NI\_2015, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_MC\_2015, S1 Tot Chg, MgrLvl\_data=Board committee or other executive body, S1 2015, S1\_MC\_2015

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Consumer.

c. Dependent Variable: Ret 2015

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 21607.102      | 17  | 1271.006    | 2.158 | .007 <sup>c</sup> |
|       | Residual   | 111307.141     | 189 | 588.927     |       |                   |
|       | Total      | 132914.243     | 206 |             |       |                   |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Consumer

c. Predictors: (Constant), ETS\_data=Yes, S1\_REV\_2015, MgrLvl\_data=Other, lower level departments, S2\_NI\_2015, S2 Tot Chg, S2 2015 Chg, S1 2015 Chg, S2\_REV\_2015, S2 2015, Incentive\_data=Yes, S1\_NI\_2015, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_MC\_2015, S1 Tot Chg, MgrLvl\_data=Board committee or other executive body, S1 2015, S1\_MC\_2015

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -12.216                     | 13.147     |                           | -.929  | .354 |
|       | S1 2015                                                                                                   | -3.219E-6                   | .000       | -.369                     | -1.742 | .083 |
|       | S1_REV_2015                                                                                               | .048                        | .032       | .338                      | 1.485  | .139 |
|       | S1_NI_2015                                                                                                | 4.399E-5                    | .000       | .078                      | .263   | .793 |
|       | S1_MC_2015                                                                                                | -.002                       | .008       | -.067                     | -.210  | .834 |
|       | S2 2015                                                                                                   | -7.298E-7                   | .000       | -.039                     | -.437  | .663 |
|       | S2_REV_2015                                                                                               | -.013                       | .025       | -.046                     | -.514  | .608 |
|       | S2_NI_2015                                                                                                | .000                        | .001       | -.054                     | -.698  | .486 |
|       | S2_MC_2015                                                                                                | -.073                       | .030       | -.228                     | -2.416 | .017 |
|       | S1 2015 Chg                                                                                               | -.004                       | .005       | -.063                     | -.843  | .401 |
|       | S2 2015 Chg                                                                                               | -.072                       | .027       | -.184                     | -2.697 | .008 |
|       | S1 Tot Chg                                                                                                | .000                        | .014       | .003                      | .032   | .975 |
|       | S2 Tot Chg                                                                                                | .000                        | .001       | -.033                     | -.326  | .745 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 23.094                      | 13.227     | .302                      | 1.746  | .082 |
|       | MgrLvl_data=Other, lower level departments                                                                | 31.243                      | 14.192     | .380                      | 2.201  | .029 |
|       | Incentive_data=Yes                                                                                        | -.809                       | 3.885      | -.015                     | -.208  | .835 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -4.388                      | 5.898      | -.058                     | -.744  | .458 |
|       | ETS_data=Yes                                                                                              | 5.514                       | 4.030      | .102                      | 1.368  | .173 |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Consumer

## Appendix 3

### 2015: Industrial Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Industri (Selected) | B INDUSTRY ~= Industri (Unselected) |          |                   |                            | B INDUSTRY = Industri (Selected) | B INDUSTRY ~= Industri (Unselected) |
| 1     | .443 <sup>a</sup>                | .096                                | .196     | .091              | 26.61592176                | 2.245                            | 2.086                               |

a. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2015, S1\_NI\_2015, S2 2015 Chg, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S1 2015 Chg, Incentive\_data=Yes, S1\_REV\_2015, S2 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 2015, S1 2015, S2\_NI\_2015, S1\_MC\_2015, S2\_REV\_2015, MgrLvl\_data=Board committee or other executive body

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Industri.

c. Dependent Variable: Ret 2015

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 22456.191      | 17  | 1320.952    | 1.865 | .027 <sup>c</sup> |
|       | Residual   | 92092.948      | 130 | 708.407     |       |                   |
|       | Total      | 114549.139     | 147 |             |       |                   |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Industri

c. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2015, S1\_NI\_2015, S2 2015 Chg, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S1 2015 Chg, Incentive\_data=Yes, S1\_REV\_2015, S2 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 2015, S1 2015, S2\_NI\_2015, S1\_MC\_2015, S2\_REV\_2015, MgrLvl\_data=Board committee or other executive body

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -12.835                     | 15.458     |                           | -.830  | .408 |
|       | S1 2015                                                                                                   | 7.119E-7                    | .000       | .190                      | 1.403  | .163 |
|       | S1_REV_2015                                                                                               | .002                        | .003       | .108                      | .694   | .489 |
|       | S1_NI_2015                                                                                                | .000                        | .000       | -.370                     | -2.867 | .005 |
|       | S1_MC_2015                                                                                                | -.004                       | .003       | -.191                     | -1.327 | .187 |
|       | S2 2015                                                                                                   | -1.131E-6                   | .000       | -.032                     | -.290  | .772 |
|       | S2_REV_2015                                                                                               | .010                        | .040       | .041                      | .257   | .798 |
|       | S2_NI_2015                                                                                                | .000                        | .001       | .094                      | .666   | .506 |
|       | S2_MC_2015                                                                                                | -.011                       | .008       | -.150                     | -1.310 | .192 |
|       | S1 2015 Chg                                                                                               | .021                        | .063       | .027                      | .334   | .739 |
|       | S2 2015 Chg                                                                                               | .030                        | .077       | .033                      | .390   | .697 |
|       | S1 Tot Chg                                                                                                | .014                        | .007       | .174                      | 2.012  | .046 |
|       | S2 Tot Chg                                                                                                | -.039                       | .024       | -.151                     | -1.635 | .104 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 7.148                       | 16.056     | .084                      | .445   | .657 |
|       | MgrLvl_data=Other, lower level departments                                                                | 21.494                      | 17.406     | .233                      | 1.235  | .219 |
|       | Incentive_data=Yes                                                                                        | -1.690                      | 4.992      | -.029                     | -.339  | .735 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 1.708                       | 6.105      | .025                      | .280   | .780 |
|       | ETS_data=Yes                                                                                              | 4.820                       | 5.745      | .080                      | .839   | .403 |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Industri

## Appendix 4

### 2015: Utilities Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Utilitie (Selected) | B INDUSTRY ~ Utilitie (Unselected) |          |                   |                            | B INDUSTRY = Utilitie (Selected) | B INDUSTRY ~ Utilitie (Unselected) |
| 1     | .804 <sup>a</sup>                | .157                               | .646     | .444              | 20.77962529                | 1.755                            | 2.025                              |

a. Predictors: (Constant), ETS\_data=Yes, S2\_REV\_2015, MgrLvl\_data=Board committee or other executive body, S2 2015 Chg, S2\_NI\_2015, S1 Tot Chg, S1\_MC\_2015, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 Tot Chg, S2 2015, Incentive\_data=Yes, MgrLvl\_data=Other, lower level departments, S1 2015, S1\_REV\_2015, S2\_MC\_2015, S1 2015 Chg

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Utilitie.

c. Dependent Variable: Ret 2015

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 22100.304      | 16 | 1381.269    | 3.199 | .003 <sup>c</sup> |
|       | Residual   | 12090.199      | 28 | 431.793     |       |                   |
|       | Total      | 34190.503      | 44 |             |       |                   |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Utilitie

c. Predictors: (Constant), ETS\_data=Yes, S2\_REV\_2015, MgrLvl\_data=Board committee or other executive body, S2 2015 Chg, S2\_NI\_2015, S1 Tot Chg, S1\_MC\_2015, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 Tot Chg, S2 2015, Incentive\_data=Yes, MgrLvl\_data=Other, lower level departments, S1 2015, S1\_REV\_2015, S2\_MC\_2015, S1 2015 Chg

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -39.890                     | 15.795     |                           | -2.526 | .017 |
|       | S1 2015                                                                                                   | 1.784E-7                    | .000       | .157                      | .672   | .507 |
|       | S1_REV_2015                                                                                               | .005                        | .002       | .476                      | 1.955  | .061 |
|       | S1_MC_2015                                                                                                | -.005                       | .002       | -1.056                    | -3.410 | .002 |
|       | S2 2015                                                                                                   | 2.469E-6                    | .000       | .143                      | .736   | .468 |
|       | S2_REV_2015                                                                                               | .025                        | .056       | .074                      | .438   | .664 |
|       | S2_NI_2015                                                                                                | -1.498E-5                   | .000       | -.213                     | -1.430 | .164 |
|       | S2_MC_2015                                                                                                | -.017                       | .043       | -.104                     | -.407  | .687 |
|       | S1 2015 Chg                                                                                               | -.130                       | .115       | -.302                     | -1.129 | .269 |
|       | S2 2015 Chg                                                                                               | -.114                       | .069       | -.226                     | -1.650 | .110 |
|       | S1 Tot Chg                                                                                                | .000                        | .006       | .003                      | .018   | .986 |
|       | S2 Tot Chg                                                                                                | -7.803E-5                   | .000       | -.055                     | -.262  | .796 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 14.618                      | 17.244     | .180                      | .848   | .404 |
|       | MgrLvl_data=Other, lower level departments                                                                | 55.389                      | 27.111     | .501                      | 2.043  | .051 |
|       | Incentive_data=Yes                                                                                        | -5.018                      | 9.010      | -.090                     | -.557  | .582 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 16.664                      | 14.883     | .151                      | 1.120  | .272 |
|       | ETS_data=Yes                                                                                              | 26.916                      | 10.720     | .485                      | 2.511  | .018 |

a. Dependent Variable: Ret 2015

b. Selecting only cases for which B INDUSTRY = Utilitie

## Appendix 5

### 2014: Communications Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    |                                    | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic |       |
|-------|----------------------------------|------------------------------------|------------------------------------|-------------------|----------------------------|-------------------------|-------|
|       | B INDUSTRY = Communic (Selected) | B INDUSTRY ≈ Communic (Unselected) | B INDUSTRY ≈ Communic (Unselected) |                   |                            |                         |       |
|       |                                  |                                    |                                    |                   |                            |                         |       |
| 1     | .815 <sup>a</sup>                | .                                  | .664                               | .393              | 16.97809296                | 1.676                   | 1.900 |

a. Predictors: (Constant), ETS\_data=Yes, S1 2014 Chg, S2 2014, S1\_REV\_2014, MgrLvl\_data=Board committee or other executive body, Incentive\_data=Yes, S2 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_NI\_2014, S2 2014 Chg, S2\_REV\_2014, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S1\_MC\_2014, S1\_NI\_2014, S1 2014, S2\_MC\_2014

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Communic.

c. Dependent Variable: Ret 2014

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 11980.972      | 17 | 704.763     | 2.445 | .027 <sup>c</sup> |
|       | Residual   | 6053.368       | 21 | 288.256     |       |                   |
|       | Total      | 18034.340      | 38 |             |       |                   |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Communic

c. Predictors: (Constant), ETS\_data=Yes, S1 2014 Chg, S2 2014, S1\_REV\_2014, MgrLvl\_data=Board committee or other executive body, Incentive\_data=Yes, S2 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_NI\_2014, S2 2014 Chg, S2\_REV\_2014, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S1\_MC\_2014, S1\_NI\_2014, S1 2014, S2\_MC\_2014

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 13.166                      | 17.254     |                           | .763   | .454 |
|       | S1 2014                                                                                                   | 6.629E-5                    | .000       | .761                      | 1.824  | .082 |
|       | S1_REV_2014                                                                                               | -1.955                      | 1.136      | -.857                     | -1.720 | .100 |
|       | S1_NI_2014                                                                                                | .018                        | .059       | .133                      | .307   | .762 |
|       | S1_MC_2014                                                                                                | 2.391                       | 2.699      | .491                      | .886   | .386 |
|       | S2 2014                                                                                                   | -6.902E-6                   | .000       | -.500                     | -1.327 | .199 |
|       | S2_REV_2014                                                                                               | .664                        | .375       | .791                      | 1.773  | .091 |
|       | S2_NI_2014                                                                                                | -.010                       | .018       | -.325                     | -.558  | .583 |
|       | S2_MC_2014                                                                                                | -.841                       | .674       | -.791                     | -1.248 | .226 |
|       | S1 2014 Chg                                                                                               | -.158                       | .162       | -.259                     | -.976  | .340 |
|       | S2 2014 Chg                                                                                               | -.029                       | .137       | -.037                     | -.210  | .836 |
|       | S1 Tot Chg                                                                                                | -.011                       | .030       | -.119                     | -.350  | .730 |
|       | S2 Tot Chg                                                                                                | -.012                       | .018       | -.124                     | -.695  | .495 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -18.680                     | 18.409     | -.290                     | -1.015 | .322 |
|       | MgrLvl_data=Other, lower level departments                                                                | -20.502                     | 21.217     | -.289                     | -.966  | .345 |
|       | Incentive_data=Yes                                                                                        | 4.262                       | 6.725      | .099                      | .634   | .533 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 11.673                      | 8.256      | .237                      | 1.414  | .172 |
|       | ETS_data=Yes                                                                                              | -6.977                      | 11.024     | -.108                     | -.633  | .534 |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Communic

## Appendix 6

### 2014: Consumer Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Consumer (Selected) | B INDUSTRY ~= Consumer (Unselected) |          |                   |                            | B INDUSTRY = Consumer (Selected) | B INDUSTRY ~= Consumer (Unselected) |
| 1     | .407 <sup>a</sup>                | .                                   | .165     | .090              | 24.81413934                | 1.902                            | 1.998                               |

a. Predictors: (Constant), ETS\_data=Yes, S1\_MC\_2014, S2 2014 Chg, S2\_REV\_2014, S2 Tot Chg, MgrLvl\_data=Other, lower level departments, S1\_NI\_2014, S2 2014, S1 2014 Chg, Incentive\_data=Yes, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_MC\_2014, S2\_NI\_2014, S1 Tot Chg, S1\_REV\_2014, S1 2014, MgrLvl\_data=Board committee or other executive body

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Consumer.

c. Dependent Variable: Ret 2014

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 23044.093      | 17  | 1355.535    | 2.201 | .005 <sup>c</sup> |
|       | Residual   | 116375.146     | 189 | 615.742     |       |                   |
|       | Total      | 139419.239     | 206 |             |       |                   |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Consumer

c. Predictors: (Constant), ETS\_data=Yes, S1\_MC\_2014, S2 2014 Chg, S2\_REV\_2014, S2 Tot Chg, MgrLvl\_data=Other, lower level departments, S1\_NI\_2014, S2 2014, S1 2014 Chg, Incentive\_data=Yes, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_MC\_2014, S2\_NI\_2014, S1 Tot Chg, S1\_REV\_2014, S1 2014, MgrLvl\_data=Board committee or other executive body

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 18.672                      | 13.196     |                           | 1.415  | .159 |
|       | S1 2014                                                                                                   | 1.965E-6                    | .000       | .219                      | 1.442  | .151 |
|       | S1_REV_2014                                                                                               | .033                        | .023       | .213                      | 1.444  | .150 |
|       | S1_NI_2014                                                                                                | .000                        | .000       | -.091                     | -.955  | .341 |
|       | S1_MC_2014                                                                                                | -.007                       | .003       | -.232                     | -2.063 | .040 |
|       | S2 2014                                                                                                   | -7.696E-7                   | .000       | -.039                     | -.480  | .632 |
|       | S2_REV_2014                                                                                               | .046                        | .029       | .135                      | 1.607  | .110 |
|       | S2_NI_2014                                                                                                | .000                        | .000       | .110                      | 1.125  | .262 |
|       | S2_MC_2014                                                                                                | -.030                       | .038       | -.075                     | -.797  | .426 |
|       | S1 2014 Chg                                                                                               | .013                        | .018       | .050                      | .708   | .480 |
|       | S2 2014 Chg                                                                                               | -.005                       | .041       | -.010                     | -.133  | .894 |
|       | S1 Tot Chg                                                                                                | -.028                       | .013       | -.214                     | -2.126 | .035 |
|       | S2 Tot Chg                                                                                                | .002                        | .001       | .244                      | 2.481  | .014 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -7.691                      | 13.271     | -.098                     | -.579  | .563 |
|       | MgrLvl_data=Other, lower level departments                                                                | 3.051                       | 14.044     | .036                      | .217   | .828 |
|       | Incentive_data=Yes                                                                                        | -6.083                      | 3.950      | -.114                     | -1.540 | .125 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -6.303                      | 5.892      | -.082                     | -1.070 | .286 |
|       | ETS_data=Yes                                                                                              | -5.599                      | 4.128      | -.101                     | -1.356 | .177 |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Consumer

## Appendix 7

### 2014: Energy Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                              |                                  | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic        |                                  |
|-------|--------------------------------|----------------------------------|----------|-------------------|----------------------------|--------------------------------|----------------------------------|
|       | B INDUSTRY = Energy (Selected) | B INDUSTRY ~ Energy (Unselected) |          |                   |                            | B INDUSTRY = Energy (Selected) | B INDUSTRY ~ Energy (Unselected) |
| 1     | .769 <sup>a</sup>              | .                                | .591     | .323              | 20.88032033                | 2.129                          | 2.022                            |

a. Predictors: (Constant), ETS\_data=Yes, S2 2014 Chg, S2\_REV\_2014, S1 Tot Chg, S1\_MC\_2014, S1\_NI\_2014, MgrLvl\_data=Other, lower level departments, S1 2014, Incentive\_data=Yes, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1\_REV\_2014, S1 2014 Chg, MgrLvl\_data=Board committee or other executive body, S2\_MC\_2014, S2 2014, S2 Tot Chg, S2\_NI\_2014

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Energy.

c. Dependent Variable: Ret 2014

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 16362.556      | 17 | 962.503     | 2.208 | .033 <sup>c</sup> |
|       | Residual   | 11335.682      | 26 | 435.988     |       |                   |
|       | Total      | 27698.239      | 43 |             |       |                   |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Energy

c. Predictors: (Constant), ETS\_data=Yes, S2 2014 Chg, S2\_REV\_2014, S1 Tot Chg, S1\_MC\_2014, S1\_NI\_2014, MgrLvl\_data=Other, lower level departments, S1 2014, Incentive\_data=Yes, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1\_REV\_2014, S1 2014 Chg, MgrLvl\_data=Board committee or other executive body, S2\_MC\_2014, S2 2014, S2 Tot Chg, S2\_NI\_2014

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -37.069                     | 27.436     |                           | -1.351 | .188 |
|       | S1 2014                                                                                                   | -3.710E-7                   | .000       | -.397                     | -.871  | .392 |
|       | S1_REV_2014                                                                                               | .003                        | .011       | .072                      | .296   | .770 |
|       | S1_NI_2014                                                                                                | -.001                       | .001       | -.712                     | -.702  | .489 |
|       | S1_MC_2014                                                                                                | -.007                       | .005       | -.424                     | -1.314 | .200 |
|       | S2 2014                                                                                                   | 5.347E-6                    | .000       | .632                      | 1.409  | .171 |
|       | S2_REV_2014                                                                                               | -.099                       | .092       | -.375                     | -1.068 | .296 |
|       | S2_NI_2014                                                                                                | .007                        | .009       | .832                      | .876   | .389 |
|       | S2_MC_2014                                                                                                | .061                        | .182       | .114                      | .336   | .740 |
|       | S1 2014 Chg                                                                                               | -.182                       | .179       | -.220                     | -1.018 | .318 |
|       | S2 2014 Chg                                                                                               | -.230                       | .105       | -.479                     | -2.180 | .039 |
|       | S1 Tot Chg                                                                                                | .000                        | .000       | .355                      | 2.475  | .020 |
|       | S2 Tot Chg                                                                                                | .024                        | .021       | .417                      | 1.165  | .255 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 35.789                      | 27.197     | .410                      | 1.316  | .200 |
|       | MgrLvl_data=Other, lower level departments                                                                | 44.177                      | 32.641     | .444                      | 1.353  | .188 |
|       | Incentive_data=Yes                                                                                        | -4.603                      | 9.253      | -.089                     | -.498  | .623 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -21.701                     | 10.935     | -.385                     | -1.985 | .058 |
|       | ETS_data=Yes                                                                                              | -14.572                     | 10.318     | -.289                     | -1.412 | .170 |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Energy

## Appendix 8

### 2014: Financial Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Financia (Selected) | B INDUSTRY ≠ Financia (Unselected) |          |                   |                            | B INDUSTRY = Financia (Selected) | B INDUSTRY ≠ Financia (Unselected) |
| 1     | .519 <sup>a</sup>                | .112                               | .269     | .157              | 15.85296913                | 2.019                            | 2.000                              |

a. Predictors: (Constant), ETS\_data=Yes, S1\_NI\_2014, S1 2014 Chg, S1 Tot Chg, S2 Tot Chg, MgrLvl\_data=Other, lower level departments, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., Incentive\_data=Yes, S2 2014 Chg, S2 2014, S2\_REV\_2014, MgrLvl\_data=Board committee or other executive body, S2\_MC\_2014, S1 2014, S1\_MC\_2014, S1\_REV\_2014, S2\_NI\_2014

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Financia.

c. Dependent Variable: Ret 2014

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 10273.203      | 17  | 604.306     | 2.405 | .003 <sup>c</sup> |
|       | Residual   | 27896.146      | 111 | 251.317     |       |                   |
|       | Total      | 38169.349      | 128 |             |       |                   |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Financia

c. Predictors: (Constant), ETS\_data=Yes, S1\_NI\_2014, S1 2014 Chg, S1 Tot Chg, S2 Tot Chg, MgrLvl\_data=Other, lower level departments, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., Incentive\_data=Yes, S2 2014 Chg, S2 2014, S2\_REV\_2014, MgrLvl\_data=Board committee or other executive body, S2\_MC\_2014, S1 2014, S1\_MC\_2014, S1\_REV\_2014, S2\_NI\_2014

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -1.957                      | 5.203      |                           | -.376  | .708 |
|       | S1 2014                                                                                                   | .000                        | .000       | -.821                     | -2.156 | .033 |
|       | S1_REV_2014                                                                                               | .589                        | .520       | .709                      | 1.133  | .260 |
|       | S1_NI_2014                                                                                                | .116                        | .080       | 1.300                     | 1.451  | .150 |
|       | S1_MC_2014                                                                                                | -2.504                      | 1.319      | -1.384                    | -1.899 | .060 |
|       | S2 2014                                                                                                   | 1.511E-5                    | .000       | .224                      | 1.754  | .082 |
|       | S2_REV_2014                                                                                               | .078                        | .077       | .214                      | 1.022  | .309 |
|       | S2_NI_2014                                                                                                | .013                        | .035       | .251                      | .357   | .722 |
|       | S2_MC_2014                                                                                                | -.347                       | .509       | -.432                     | -.681  | .497 |
|       | S1 2014 Chg                                                                                               | .002                        | .004       | .054                      | .614   | .541 |
|       | S2 2014 Chg                                                                                               | -.090                       | .053       | -.158                     | -1.693 | .093 |
|       | S1 Tot Chg                                                                                                | 3.139E-5                    | .000       | .113                      | 1.321  | .189 |
|       | S2 Tot Chg                                                                                                | .003                        | .011       | .031                      | .299   | .766 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 4.977                       | 5.789      | .113                      | .860   | .392 |
|       | MgrLvl_data=Other, lower level departments                                                                | 6.539                       | 7.255      | .106                      | .901   | .369 |
|       | Incentive_data=Yes                                                                                        | 2.393                       | 3.190      | .070                      | .750   | .455 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -2.207                      | 3.765      | -.053                     | -.586  | .559 |
|       | ETS_data=Yes                                                                                              | -10.949                     | 4.833      | -.215                     | -2.266 | .025 |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Financia

## Appendix 9

### 2014: Industrial Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Industri (Selected) | B INDUSTRY ~= Industri (Unselected) |          |                   |                            | B INDUSTRY = Industri (Selected) | B INDUSTRY ~= Industri (Unselected) |
| 1     | .428 <sup>a</sup>                | .004                                | .183     | .076              | 20.09059357                | 1.965                            | 2.053                               |

a. Predictors: (Constant), ETS\_data=Yes, S1\_REV\_2014, S2 2014 Chg, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S1\_NI\_2014, Incentive\_data=Yes, S2\_MC\_2014, S2 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 2014, S1 2014 Chg, S2\_NI\_2014, S1 2014, S2\_REV\_2014, S1\_MC\_2014, MgrLvl\_data=Board committee or other executive body

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Industri.

c. Dependent Variable: Ret 2014

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 11737.017      | 17  | 690.413     | 1.711 | .048 <sup>c</sup> |
|       | Residual   | 52472.153      | 130 | 403.632     |       |                   |
|       | Total      | 64209.170      | 147 |             |       |                   |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Industri

c. Predictors: (Constant), ETS\_data=Yes, S1\_REV\_2014, S2 2014 Chg, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S1\_NI\_2014, Incentive\_data=Yes, S2\_MC\_2014, S2 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 2014, S1 2014 Chg, S2\_NI\_2014, S1 2014, S2\_REV\_2014, S1\_MC\_2014, MgrLvl\_data=Board committee or other executive body

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -16.561                     | 11.932     |                           | -1.388 | .168 |
|       | S1 2014                                                                                                   | -1.653E-7                   | .000       | -.058                     | -.423  | .673 |
|       | S1_REV_2014                                                                                               | .005                        | .003       | .270                      | 1.694  | .093 |
|       | S1_NI_2014                                                                                                | -2.455E-5                   | .000       | -.035                     | -.279  | .781 |
|       | S1_MC_2014                                                                                                | -.003                       | .003       | -.219                     | -1.228 | .222 |
|       | S2 2014                                                                                                   | 5.394E-6                    | .000       | .238                      | 1.997  | .048 |
|       | S2_REV_2014                                                                                               | -.007                       | .030       | -.036                     | -.242  | .809 |
|       | S2_NI_2014                                                                                                | 3.555E-5                    | .000       | .012                      | .116   | .908 |
|       | S2_MC_2014                                                                                                | -.013                       | .010       | -.165                     | -1.338 | .183 |
|       | S1 2014 Chg                                                                                               | .004                        | .048       | .009                      | .089   | .929 |
|       | S2 2014 Chg                                                                                               | -.028                       | .022       | -.112                     | -1.284 | .201 |
|       | S1 Tot Chg                                                                                                | .000                        | .006       | .007                      | .068   | .946 |
|       | S2 Tot Chg                                                                                                | -.016                       | .017       | -.083                     | -.958  | .340 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 15.730                      | 12.510     | .247                      | 1.257  | .211 |
|       | MgrLvl_data=Other, lower level departments                                                                | 24.445                      | 13.471     | .354                      | 1.815  | .072 |
|       | Incentive_data=Yes                                                                                        | 3.490                       | 3.730      | .081                      | .936   | .351 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -3.821                      | 4.616      | -.074                     | -.828  | .409 |
|       | ETS_data=Yes                                                                                              | -10.925                     | 4.322      | -.241                     | -2.528 | .013 |

a. Dependent Variable: Ret 2014

b. Selecting only cases for which B INDUSTRY = Industri

## Appendix 10

### 2013: Communications Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Communic (Selected) | B INDUSTRY ~ Communic (Unselected) |          |                   |                            | B INDUSTRY = Communic (Selected) | B INDUSTRY ~ Communic (Unselected) |
|       |                                  |                                    |          |                   |                            |                                  |                                    |
| 1     | .887 <sup>a</sup>                | .                                  | .787     | .615              | 28.01058451                | 2.562                            | 2.064                              |

a. Predictors: (Constant), ETS\_data=Yes, S2 2013, S1 Tot Chg, S1\_MC\_2013, Incentive\_data=Yes, MgrLvl\_data=Board committee or other executive body, S1 2013 Chg, S2\_NI\_2013, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 Tot Chg, S2 2013 Chg, S1\_NI\_2013, S1\_REV\_2013, MgrLvl\_data=Other, lower level departments, S1 2013, S2\_REV\_2013, S2\_MC\_2013

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Communic.

c. Dependent Variable: Ret 2013

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 60863.670      | 17 | 3580.216    | 4.563 | .001 <sup>c</sup> |
|       | Residual   | 16476.450      | 21 | 784.593     |       |                   |
|       | Total      | 77340.120      | 38 |             |       |                   |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Communic

c. Predictors: (Constant), ETS\_data=Yes, S2 2013, S1 Tot Chg, S1\_MC\_2013, Incentive\_data=Yes, MgrLvl\_data=Board committee or other executive body, S1 2013 Chg, S2\_NI\_2013, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 Tot Chg, S2 2013 Chg, S1\_NI\_2013, S1\_REV\_2013, MgrLvl\_data=Other, lower level departments, S1 2013, S2\_REV\_2013, S2\_MC\_2013

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 11.959                      | 28.561     |                           | .419   | .680 |
|       | S1_2013                                                                                                   | .000                        | .000       | .722                      | 1.939  | .066 |
|       | S1_REV_2013                                                                                               | 1.270                       | 1.779      | .243                      | .714   | .483 |
|       | S1_NI_2013                                                                                                | -.918                       | .246       | -1.676                    | -3.732 | .001 |
|       | S1_MC_2013                                                                                                | 3.609                       | 4.246      | .320                      | .850   | .405 |
|       | S2_2013                                                                                                   | -1.913E-5                   | .000       | -.659                     | -1.968 | .062 |
|       | S2_REV_2013                                                                                               | -.791                       | .514       | -.651                     | -1.541 | .138 |
|       | S2_NI_2013                                                                                                | .109                        | .058       | 1.137                     | 1.880  | .074 |
|       | S2_MC_2013                                                                                                | .493                        | 1.171      | .222                      | .421   | .678 |
|       | S1_2013_Chg                                                                                               | .090                        | .128       | .084                      | .701   | .491 |
|       | S2_2013_Chg                                                                                               | -.248                       | .217       | -.216                     | -1.144 | .266 |
|       | S1_Tot_Chg                                                                                                | -.084                       | .030       | -.459                     | -2.833 | .010 |
|       | S2_Tot_Chg                                                                                                | .013                        | .033       | .062                      | .395   | .697 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 38.784                      | 30.285     | .291                      | 1.281  | .214 |
|       | MgrLvl_data=Other, lower level departments                                                                | 29.288                      | 36.866     | .200                      | .794   | .436 |
|       | Incentive_data=Yes                                                                                        | -1.643                      | 11.483     | -.018                     | -.143  | .888 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -14.917                     | 13.182     | -.146                     | -1.132 | .271 |
|       | ETS_data=Yes                                                                                              | -.478                       | 19.075     | -.004                     | -.025  | .980 |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Communic

## Appendix 11

### 2013: Consumer Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Consumer (Selected) | B INDUSTRY ≠ Consumer (Unselected) |          |                   |                            | B INDUSTRY = Consumer (Selected) | B INDUSTRY ≠ Consumer (Unselected) |
| 1     | .599 <sup>a</sup>                | .100                               | .359     | .302              | 34.08866038                | 2.133                            | 2.014                              |

a. Predictors: (Constant), ETS\_data=Yes, S1\_MC\_2013, S2\_REV\_2013, MgrLvl\_data=Other, lower level departments, S2 2013 Chg, S2 Tot Chg, S1 2013 Chg, S2\_NI\_2013, Incentive\_data=Yes, S2 2013, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1\_NI\_2013, S2\_MC\_2013, S1\_REV\_2013, S1 Tot Chg, S1 2013, MgrLvl\_data=Board committee or other executive body

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Consumer.

c. Dependent Variable: Ret 2013

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 123115.221     | 17  | 7242.072    | 6.232 | .000 <sup>c</sup> |
|       | Residual   | 219624.949     | 189 | 1162.037    |       |                   |
|       | Total      | 342740.170     | 206 |             |       |                   |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Consumer

c. Predictors: (Constant), ETS\_data=Yes, S1\_MC\_2013, S2\_REV\_2013, MgrLvl\_data=Other, lower level departments, S2 2013 Chg, S2 Tot Chg, S1 2013 Chg, S2\_NI\_2013, Incentive\_data=Yes, S2 2013, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1\_NI\_2013, S2\_MC\_2013, S1\_REV\_2013, S1 Tot Chg, S1 2013, MgrLvl\_data=Board committee or other executive body

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 53.315                      | 21.111     |                           | 2.525  | .012 |
|       | S1 2013                                                                                                   | 5.562E-6                    | .000       | .402                      | 2.644  | .009 |
|       | S1_REV_2013                                                                                               | -.098                       | .033       | -.402                     | -2.957 | .003 |
|       | S1_NI_2013                                                                                                | .001                        | .000       | .656                      | 8.502  | .000 |
|       | S1_MC_2013                                                                                                | -.011                       | .005       | -.226                     | -2.037 | .043 |
|       | S2 2013                                                                                                   | -3.247E-6                   | .000       | -.108                     | -1.506 | .134 |
|       | S2_REV_2013                                                                                               | .007                        | .036       | .013                      | .184   | .854 |
|       | S2_NI_2013                                                                                                | .000                        | .001       | .020                      | .294   | .769 |
|       | S2_MC_2013                                                                                                | -.049                       | .042       | -.096                     | -1.165 | .246 |
|       | S1 2013 Chg                                                                                               | -.153                       | .081       | -.130                     | -1.905 | .058 |
|       | S2 2013 Chg                                                                                               | -.021                       | .036       | -.039                     | -.578  | .564 |
|       | S1 Tot Chg                                                                                                | .004                        | .020       | .018                      | .186   | .852 |
|       | S2 Tot Chg                                                                                                | -.001                       | .001       | -.098                     | -1.040 | .300 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -16.030                     | 21.014     | -.131                     | -.763  | .447 |
|       | MgrLvl_data=Other, lower level departments                                                                | -13.286                     | 21.929     | -.101                     | -.606  | .545 |
|       | Incentive_data=Yes                                                                                        | -4.486                      | 5.415      | -.053                     | -.828  | .409 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 7.241                       | 8.191      | .060                      | .884   | .378 |
|       | ETS_data=Yes                                                                                              | 2.656                       | 5.768      | .031                      | .460   | .646 |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Consumer

## Appendix 12

### 2013: Energy Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                              |                                   | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic        |                                   |
|-------|--------------------------------|-----------------------------------|----------|-------------------|----------------------------|--------------------------------|-----------------------------------|
|       | B INDUSTRY = Energy (Selected) | B INDUSTRY ~= Energy (Unselected) |          |                   |                            | B INDUSTRY = Energy (Selected) | B INDUSTRY ~= Energy (Unselected) |
| 1     | .962 <sup>a</sup>              | .016                              | .925     | .876              | 22.92139428                | 1.772                          | 1.987                             |

a. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2013, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S2 Tot Chg, S1\_NI\_2013, S2 2013 Chg, S1 2013, S1 2013 Chg, S1\_REV\_2013, Incentive\_data=Yes, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., MgrLvl\_data=Board committee or other executive body, S2\_REV\_2013, S2 2013, S2\_NI\_2013, S1\_MC\_2013

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Energy.

c. Dependent Variable: Ret 2013

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F      | Sig.              |
|-------|------------|----------------|----|-------------|--------|-------------------|
| 1     | Regression | 168457.078     | 17 | 9909.240    | 18.861 | .000 <sup>c</sup> |
|       | Residual   | 13660.148      | 26 | 525.390     |        |                   |
|       | Total      | 182117.226     | 43 |             |        |                   |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Energy

c. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2013, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, S2 Tot Chg, S1\_NI\_2013, S2 2013 Chg, S1 2013, S1 2013 Chg, S1\_REV\_2013, Incentive\_data=Yes, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., MgrLvl\_data=Board committee or other executive body, S2\_REV\_2013, S2 2013, S2\_NI\_2013, S1\_MC\_2013

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -28.195                     | 26.536     |                           | -1.063 | .298 |
|       | S1 2013                                                                                                   | -7.221E-7                   | .000       | -.303                     | -1.710 | .099 |
|       | S1_REV_2013                                                                                               | -.003                       | .013       | -.028                     | -.234  | .817 |
|       | S1_NI_2013                                                                                                | .004                        | .001       | .955                      | 6.056  | .000 |
|       | S1_MC_2013                                                                                                | -.008                       | .037       | -.042                     | -.206  | .839 |
|       | S2 2013                                                                                                   | 7.703E-6                    | .000       | .355                      | 1.974  | .059 |
|       | S2_REV_2013                                                                                               | .079                        | .087       | .173                      | .906   | .373 |
|       | S2_NI_2013                                                                                                | -.013                       | .001       | -1.634                    | -9.593 | .000 |
|       | S2_MC_2013                                                                                                | -.285                       | .308       | -.234                     | -.923  | .364 |
|       | S1 2013 Chg                                                                                               | .178                        | .169       | .084                      | 1.054  | .302 |
|       | S2 2013 Chg                                                                                               | -.156                       | .136       | -.082                     | -1.148 | .262 |
|       | S1 Tot Chg                                                                                                | .000                        | .000       | .031                      | .515   | .611 |
|       | S2 Tot Chg                                                                                                | .021                        | .010       | .142                      | 2.197  | .037 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 39.654                      | 27.235     | .177                      | 1.456  | .157 |
|       | MgrLvl_data=Other, lower level departments                                                                | 47.550                      | 30.531     | .186                      | 1.557  | .131 |
|       | Incentive_data=Yes                                                                                        | 1.140                       | 10.682     | .009                      | .107   | .916 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -14.029                     | 11.866     | -.097                     | -1.182 | .248 |
|       | ETS_data=Yes                                                                                              | -.660                       | 11.751     | -.005                     | -.056  | .956 |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Energy

## Appendix 13

### 2013: Financial Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Financia (Selected) | B INDUSTRY ≠ Financia (Unselected) |          |                   |                            | B INDUSTRY = Financia (Selected) | B INDUSTRY ≠ Financia (Unselected) |
| 1     | .506 <sup>a</sup>                | .                                  | .256     | .142              | 29.59609254                | 2.190                            | 2.073                              |

a. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2013, S2 2013 Chg, S1 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1 2013, MgrLvl\_data=Other, lower level departments, Incentive\_data=Yes, S2\_NI\_2013, S2 2013, MgrLvl\_data=Board committee or other executive body, S2 Tot Chg, S2\_REV\_2013, S1 2013 Chg, S1\_REV\_2013, S1\_NI\_2013, S1\_MC\_2013

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Financia.

c. Dependent Variable: Ret 2013

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 33425.268      | 17  | 1966.192    | 2.245 | .006 <sup>c</sup> |
|       | Residual   | 97228.085      | 111 | 875.929     |       |                   |
|       | Total      | 130653.353     | 128 |             |       |                   |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Financia

c. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2013, S2 2013 Chg, S1 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1 2013, MgrLvl\_data=Other, lower level departments, Incentive\_data=Yes, S2\_NI\_2013, S2 2013, MgrLvl\_data=Board committee or other executive body, S2 Tot Chg, S2\_REV\_2013, S1 2013 Chg, S1\_REV\_2013, S1\_NI\_2013, S1\_MC\_2013

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 31.817                      | 9.409      |                           | 3.382  | .001 |
|       | S1 2013                                                                                                   | -8.320E-5                   | .000       | -.334                     | -.635  | .527 |
|       | S1_REV_2013                                                                                               | .524                        | 1.083      | .347                      | .484   | .629 |
|       | S1_NI_2013                                                                                                | -.109                       | .093       | -.763                     | -1.172 | .244 |
|       | S1_MC_2013                                                                                                | 4.477                       | 2.531      | 1.326                     | 1.769  | .080 |
|       | S2 2013                                                                                                   | 5.691E-6                    | .000       | .048                      | .352   | .725 |
|       | S2_REV_2013                                                                                               | -.176                       | .137       | -.293                     | -1.283 | .202 |
|       | S2_NI_2013                                                                                                | .004                        | .006       | .077                      | .679   | .498 |
|       | S2_MC_2013                                                                                                | -1.037                      | .539       | -.805                     | -1.922 | .057 |
|       | S1 2013 Chg                                                                                               | -.035                       | .027       | -.313                     | -1.306 | .194 |
|       | S2 2013 Chg                                                                                               | .114                        | .062       | .331                      | 1.835  | .069 |
|       | S1 Tot Chg                                                                                                | .000                        | .000       | .303                      | 1.429  | .156 |
|       | S2 Tot Chg                                                                                                | -.079                       | .027       | -.413                     | -2.917 | .004 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 11.607                      | 10.308     | .142                      | 1.126  | .263 |
|       | MgrLvl_data=Other, lower level departments                                                                | 13.780                      | 13.527     | .121                      | 1.019  | .311 |
|       | Incentive_data=Yes                                                                                        | -10.784                     | 6.033      | -.169                     | -1.788 | .077 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 1.144                       | 7.023      | .015                      | .163   | .871 |
|       | ETS_data=Yes                                                                                              | -1.414                      | 8.971      | -.015                     | -.158  | .875 |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Financia

## Appendix 14

### 2013: Technology Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Technolo (Selected) | B INDUSTRY ~ Technolo (Unselected) |          |                   |                            | B INDUSTRY = Technolo (Selected) | B INDUSTRY ~ Technolo (Unselected) |
| 1     | .745 <sup>a</sup>                | .034                               | .555     | .345              | 37.07009959                | 1.978                            | 2.162                              |

a. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2013, S1 Tot Chg, S1 2013 Chg, MgrLvl\_data=Board committee or other executive body, S1 2013, S2 2013 Chg, S1\_NI\_2013, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., Incentive\_data=Yes, S2 Tot Chg, S1\_REV\_2013, S2\_REV\_2013, S2 2013, S1\_MC\_2013, S2\_NI\_2013, MgrLvl\_data=Other, lower level departments

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Technolo.

c. Dependent Variable: Ret 2013

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 61683.225      | 17 | 3628.425    | 2.640 | .007 <sup>c</sup> |
|       | Residual   | 49470.922      | 36 | 1374.192    |       |                   |
|       | Total      | 111154.147     | 53 |             |       |                   |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Technolo

c. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2013, S1 Tot Chg, S1 2013 Chg, MgrLvl\_data=Board committee or other executive body, S1 2013, S2 2013 Chg, S1\_NI\_2013, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., Incentive\_data=Yes, S2 Tot Chg, S1\_REV\_2013, S2\_REV\_2013, S2 2013, S1\_MC\_2013, S2\_NI\_2013, MgrLvl\_data=Other, lower level departments

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 255.004                     | 262.086    |                           | .973   | .337 |
|       | S1 2013                                                                                                   | -6.256E-5                   | .000       | -.555                     | -1.070 | .292 |
|       | S1_REV_2013                                                                                               | .739                        | .818       | .490                      | .903   | .373 |
|       | S1_NI_2013                                                                                                | .004                        | .031       | .214                      | .136   | .892 |
|       | S1_MC_2013                                                                                                | .079                        | .886       | .051                      | .089   | .930 |
|       | S2 2013                                                                                                   | 2.539E-5                    | .000       | .517                      | 1.162  | .253 |
|       | S2_REV_2013                                                                                               | -.300                       | .321       | -.385                     | -.936  | .355 |
|       | S2_NI_2013                                                                                                | -.002                       | .017       | -.198                     | -.142  | .888 |
|       | S2_MC_2013                                                                                                | -.064                       | .351       | -.161                     | -.182  | .857 |
|       | S1 2013 Chg                                                                                               | -.022                       | .088       | -.033                     | -.251  | .803 |
|       | S2 2013 Chg                                                                                               | .294                        | .330       | .134                      | .891   | .379 |
|       | S1 Tot Chg                                                                                                | .081                        | .049       | .246                      | 1.649  | .108 |
|       | S2 Tot Chg                                                                                                | -.176                       | .104       | -.252                     | -1.689 | .100 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -223.886                    | 262.158    | -2.110                    | -.854  | .399 |
|       | MgrLvl_data=Other, lower level departments                                                                | -220.875                    | 262.400    | -2.024                    | -.842  | .405 |
|       | Incentive_data=Yes                                                                                        | 8.718                       | 15.163     | .089                      | .575   | .569 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -6.772                      | 20.342     | -.056                     | -.333  | .741 |
|       | ETS_data=Yes                                                                                              | -33.615                     | 18.173     | -.276                     | -1.850 | .073 |

a. Dependent Variable: Ret 2013

b. Selecting only cases for which B INDUSTRY = Technolo

## Appendix 15

### 2012: Consumer Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Consumer (Selected) | B INDUSTRY ≈ Consumer (Unselected) |          |                   |                            | B INDUSTRY = Consumer (Selected) | B INDUSTRY ≈ Consumer (Unselected) |
| 1     | .524 <sup>a</sup>                | .                                  | .275     | .209              | 26.07390767                | 1.723                            | 1.994                              |

a. Predictors: (Constant), ETS\_data=Yes, S2\_REV\_2012, MgrLvl\_data=Other, lower level departments, S2 Tot Chg, S1\_MC\_2012, S1 2012 Chg, S1\_NI\_2012, S2 2012, Incentive\_data=Yes, S2\_NI\_2012, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_MC\_2012, S1 2012, S1 Tot Chg, MgrLvl\_data=Board committee or other executive body, S1\_REV\_2012, S2 2012 Chg

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Consumer.

c. Dependent Variable: Ret 2012

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 48642.668      | 17  | 2861.333    | 4.209 | .000 <sup>c</sup> |
|       | Residual   | 128491.397     | 189 | 679.849     |       |                   |
|       | Total      | 177134.065     | 206 |             |       |                   |

a. Dependent Variable: Ret 2012

b. Selecting only cases for which B INDUSTRY = Consumer

c. Predictors: (Constant), ETS\_data=Yes, S2\_REV\_2012, MgrLvl\_data=Other, lower level departments, S2 Tot Chg, S1\_MC\_2012, S1 2012 Chg, S1\_NI\_2012, S2 2012, Incentive\_data=Yes, S2\_NI\_2012, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_MC\_2012, S1 2012, S1 Tot Chg, MgrLvl\_data=Board committee or other executive body, S1\_REV\_2012, S2 2012 Chg

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 29.236                      | 13.853     |                           | 2.110  | .036 |
|       | S1 2012                                                                                                   | 1.422E-6                    | .000       | .141                      | 1.038  | .301 |
|       | S1_REV_2012                                                                                               | -.070                       | .027       | -.405                     | -2.565 | .011 |
|       | S1_NI_2012                                                                                                | 5.516E-5                    | .000       | .054                      | .628   | .531 |
|       | S1_MC_2012                                                                                                | .008                        | .001       | .572                      | 5.922  | .000 |
|       | S2 2012                                                                                                   | -3.428E-6                   | .000       | -.147                     | -1.960 | .051 |
|       | S2_REV_2012                                                                                               | .093                        | .033       | .239                      | 2.848  | .005 |
|       | S2_NI_2012                                                                                                | -9.467E-5                   | .000       | -.087                     | -1.213 | .227 |
|       | S2_MC_2012                                                                                                | -.030                       | .033       | -.072                     | -.916  | .361 |
|       | S1 2012 Chg                                                                                               | .012                        | .009       | 2.792                     | 1.292  | .198 |
|       | S2 2012 Chg                                                                                               | -.009                       | .007       | -2.811                    | -1.301 | .195 |
|       | S1 Tot Chg                                                                                                | .012                        | .015       | .081                      | .832   | .406 |
|       | S2 Tot Chg                                                                                                | -.001                       | .001       | -.123                     | -1.354 | .177 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -8.673                      | 13.867     | -.098                     | -.625  | .532 |
|       | MgrLvl_data=Other, lower level departments                                                                | -8.751                      | 14.597     | -.092                     | -.600  | .550 |
|       | Incentive_data=Yes                                                                                        | 2.007                       | 4.211      | .033                      | .477   | .634 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 8.026                       | 6.310      | .092                      | 1.272  | .205 |
|       | ETS_data=Yes                                                                                              | 2.935                       | 4.363      | .047                      | .673   | .502 |

a. Dependent Variable: Ret 2012

b. Selecting only cases for which B INDUSTRY = Consumer

## Appendix 16

### 2012: Utilities Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Utilitie (Selected) | B INDUSTRY ~ Utilitie (Unselected) |          |                   |                            | B INDUSTRY = Utilitie (Selected) | B INDUSTRY ~ Utilitie (Unselected) |
| 1     | .759 <sup>a</sup>                | .                                  | .576     | .310              | 15.09987802                | 1.519                            | 2.000                              |

a. Predictors: (Constant), ETS\_data=Yes, S2\_REV\_2012, MgrLvl\_data=Other, lower level departments, S1\_REV\_2012, S1\_NI\_2012, S1 2012 Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 Tot Chg, S1 2012, Incentive\_data=Yes, S1 Tot Chg, S2\_NI\_2012, MgrLvl\_data=Board committee or other executive body, S2 2012 Chg, S2 2012, S1\_MC\_2012, S2\_MC\_2012

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Utilitie.

c. Dependent Variable: Ret 2012

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 8375.054       | 17 | 492.650     | 2.161 | .036 <sup>c</sup> |
|       | Residual   | 6156.171       | 27 | 228.006     |       |                   |
|       | Total      | 14531.225      | 44 |             |       |                   |

a. Dependent Variable: Ret 2012

b. Selecting only cases for which B INDUSTRY = Utilitie

c. Predictors: (Constant), ETS\_data=Yes, S2\_REV\_2012, MgrLvl\_data=Other, lower level departments, S1\_REV\_2012, S1\_NI\_2012, S1 2012 Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2 Tot Chg, S1 2012, Incentive\_data=Yes, S1 Tot Chg, S2\_NI\_2012, MgrLvl\_data=Board committee or other executive body, S2 2012 Chg, S2 2012, S1\_MC\_2012, S2\_MC\_2012

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -29.766                     | 10.603     |                           | -2.807 | .009 |
|       | S1 2012                                                                                                   | -4.371E-8                   | .000       | -.061                     | -.221  | .827 |
|       | S1_REV_2012                                                                                               | .007                        | .003       | 1.253                     | 2.297  | .030 |
|       | S1_NI_2012                                                                                                | .000                        | .000       | .829                      | 3.350  | .002 |
|       | S1_MC_2012                                                                                                | -.010                       | .005       | -1.223                    | -1.887 | .070 |
|       | S2 2012                                                                                                   | -1.782E-6                   | .000       | -.157                     | -.639  | .528 |
|       | S2_REV_2012                                                                                               | -.101                       | .067       | -.426                     | -1.513 | .142 |
|       | S2_NI_2012                                                                                                | .003                        | .010       | .504                      | .337   | .738 |
|       | S2_MC_2012                                                                                                | -.015                       | .161       | -.143                     | -.093  | .927 |
|       | S1 2012 Chg                                                                                               | -.086                       | .052       | -.267                     | -1.662 | .108 |
|       | S2 2012 Chg                                                                                               | .007                        | .003       | .560                      | 2.473  | .020 |
|       | S1 Tot Chg                                                                                                | .003                        | .004       | .120                      | .681   | .501 |
|       | S2 Tot Chg                                                                                                | .000                        | .000       | .162                      | .976   | .338 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 15.092                      | 10.873     | .286                      | 1.388  | .176 |
|       | MgrLvl_data=Other, lower level departments                                                                | -3.473                      | 14.120     | -.048                     | -.246  | .808 |
|       | Incentive_data=Yes                                                                                        | 5.544                       | 7.572      | .152                      | .732   | .470 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 19.579                      | 10.098     | .272                      | 1.939  | .063 |
|       | ETS_data=Yes                                                                                              | 26.271                      | 8.076      | .726                      | 3.253  | .003 |

a. Dependent Variable: Ret 2012

b. Selecting only cases for which B INDUSTRY = Utilitie

## Appendix 17

### 2011: Basic Materials Industry Regression Analysis

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Basic Ma (Selected) | B INDUSTRY ~ Basic Ma (Unselected) |          |                   |                            | B INDUSTRY = Basic Ma (Selected) | B INDUSTRY ~ Basic Ma (Unselected) |
| 1     | .601 <sup>a</sup>                | .                                  | .361     | .175              | 21.44205704                | 2.065                            | 2.013                              |

a. Predictors: (Constant), ETS\_data=Yes, S1\_REV\_2011, Incentive\_data=Yes, S1 Tot Chg, S2 2011 Chg, MgrLvl\_data=Other, lower level departments, S1 2011 Chg, S2 2011, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_NI\_2011, S2\_MC\_2011, S1 2011, S2\_REV\_2011, S1\_MC\_2011, S2 Tot Chg, S1\_NI\_2011

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Basic Ma.

c. Dependent Variable: Ret 2011

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 14286.989      | 16 | 892.937     | 1.942 | .036 <sup>c</sup> |
|       | Residual   | 25286.900      | 55 | 459.762     |       |                   |
|       | Total      | 39573.889      | 71 |             |       |                   |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Basic Ma

c. Predictors: (Constant), ETS\_data=Yes, S1\_REV\_2011, Incentive\_data=Yes, S1 Tot Chg, S2 2011 Chg, MgrLvl\_data=Other, lower level departments, S1 2011 Chg, S2 2011, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_NI\_2011, S2\_MC\_2011, S1 2011, S2\_REV\_2011, S1\_MC\_2011, S2 Tot Chg, S1\_NI\_2011

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -20.297                     | 7.711      |                           | -2.632 | .011 |
|       | S1 2011                                                                                                   | -2.055E-7                   | .000       | -.190                     | -.584  | .561 |
|       | S1_REV_2011                                                                                               | .016                        | .012       | .343                      | 1.317  | .193 |
|       | S1_NI_2011                                                                                                | -3.742E-5                   | .000       | -.340                     | -.279  | .781 |
|       | S1_MC_2011                                                                                                | -.004                       | .009       | -.258                     | -.424  | .673 |
|       | S2 2011                                                                                                   | -1.820E-8                   | .000       | -.004                     | -.022  | .983 |
|       | S2_REV_2011                                                                                               | -.006                       | .014       | -.088                     | -.407  | .685 |
|       | S2_NI_2011                                                                                                | 9.862E-5                    | .000       | .313                      | .278   | .782 |
|       | S2_MC_2011                                                                                                | -.032                       | .019       | -.462                     | -1.694 | .096 |
|       | S1 2011 Chg                                                                                               | -.002                       | .022       | -.015                     | -.102  | .919 |
|       | S2 2011 Chg                                                                                               | -.083                       | .083       | -.131                     | -1.005 | .319 |
|       | S1 Tot Chg                                                                                                | .002                        | .010       | .056                      | .192   | .848 |
|       | S2 Tot Chg                                                                                                | -.019                       | .020       | -.305                     | -.983  | .330 |
|       | MgrLvl_data=Other, lower level departments                                                                | 10.007                      | 12.068     | .098                      | .829   | .411 |
|       | Incentive_data=Yes                                                                                        | 2.727                       | 6.777      | .054                      | .402   | .689 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 22.378                      | 8.369      | .367                      | 2.674  | .010 |
|       | ETS_data=Yes                                                                                              | 10.832                      | 6.679      | .231                      | 1.622  | .111 |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Basic Ma

## Appendix 18

### 2011: Consumer Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Consumer (Selected) | B INDUSTRY ~= Consumer (Unselected) |          |                   |                            | B INDUSTRY = Consumer (Selected) | B INDUSTRY ~= Consumer (Unselected) |
| 1     | .527 <sup>a</sup>                | .                                   | .278     | .213              | 23.49791908                | 1.789                            | 2.001                               |

a. Predictors: (Constant), ETS\_data=Yes, S2\_NI\_2011, S1\_MC\_2011, MgrLvl\_data=Other, lower level departments, S2 Tot Chg, S2 2011, Incentive\_data=Yes, S2\_MC\_2011, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1\_REV\_2011, S1 Tot Chg, S1\_NI\_2011, S1 2011, MgrLvl\_data=Board committee or other executive body, S1 2011 Chg, S2\_REV\_2011, S2 2011 Chg

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Consumer.

c. Dependent Variable: Ret 2011

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 40160.812      | 17  | 2362.401    | 4.279 | .000 <sup>c</sup> |
|       | Residual   | 104356.766     | 189 | 552.152     |       |                   |
|       | Total      | 144517.578     | 206 |             |       |                   |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Consumer

c. Predictors: (Constant), ETS\_data=Yes, S2\_NI\_2011, S1\_MC\_2011, MgrLvl\_data=Other, lower level departments, S2 Tot Chg, S2 2011, Incentive\_data=Yes, S2\_MC\_2011, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1\_REV\_2011, S1 Tot Chg, S1\_NI\_2011, S1 2011, MgrLvl\_data=Board committee or other executive body, S1 2011 Chg, S2\_REV\_2011, S2 2011 Chg

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 6.061                       | 12.806     |                           | .473   | .637 |
|       | S1 2011                                                                                                   | -1.388E-6                   | .000       | -.149                     | -1.107 | .270 |
|       | S1_REV_2011                                                                                               | -.022                       | .023       | -.159                     | -.952  | .342 |
|       | S1_NI_2011                                                                                                | .001                        | .000       | .139                      | 1.291  | .198 |
|       | S1_MC_2011                                                                                                | -.001                       | .001       | -.054                     | -.438  | .662 |
|       | S2 2011                                                                                                   | 6.831E-7                    | .000       | .053                      | .629   | .530 |
|       | S2_REV_2011                                                                                               | .057                        | .028       | .511                      | 2.023  | .044 |
|       | S2_NI_2011                                                                                                | -1.400E-6                   | .000       | .000                      | -.005  | .996 |
|       | S2_MC_2011                                                                                                | -.106                       | .024       | -1.001                    | -4.353 | .000 |
|       | S1 2011 Chg                                                                                               | -.010                       | .023       | -1.261                    | -.419  | .675 |
|       | S2 2011 Chg                                                                                               | .004                        | .006       | 1.823                     | .595   | .553 |
|       | S1 Tot Chg                                                                                                | .011                        | .020       | .082                      | .544   | .587 |
|       | S2 Tot Chg                                                                                                | -.005                       | .006       | -.483                     | -.751  | .454 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -6.541                      | 12.864     | -.082                     | -.508  | .612 |
|       | MgrLvl_data=Other, lower level departments                                                                | 6.786                       | 13.282     | .079                      | .511   | .610 |
|       | Incentive_data=Yes                                                                                        | 4.768                       | 3.768      | .087                      | 1.265  | .207 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -8.327                      | 5.724      | -.106                     | -1.455 | .147 |
|       | ETS_data=Yes                                                                                              | .509                        | 3.896      | .009                      | .131   | .896 |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Consumer

## Appendix 19

### 2011: Financial Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Financia (Selected) | B INDUSTRY ≈ Financia (Unselected) |          |                   |                            | B INDUSTRY = Financia (Selected) | B INDUSTRY ≈ Financia (Unselected) |
| 1     | .582 <sup>a</sup>                | .255                               | .338     | .244              | 18.15899315                | 1.865                            | 1.489                              |

a. Predictors: (Constant), ETS\_data=Yes, S1 2011, S1 Tot Chg, S2 Tot Chg, S1 2011 Chg, MgrLvl\_data=Other, lower level departments, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., Incentive\_data=Yes, S2 2011, MgrLvl\_data=Board committee or other executive body, S2\_REV\_2011, S2\_NI\_2011, S2\_MC\_2011, S1\_REV\_2011, S1\_NI\_2011, S1\_MC\_2011

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Financia.

c. Dependent Variable: Ret 2011

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 18871.501      | 16  | 1179.469    | 3.577 | .000 <sup>c</sup> |
|       | Residual   | 36931.892      | 112 | 329.749     |       |                   |
|       | Total      | 55803.393      | 128 |             |       |                   |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Financia

c. Predictors: (Constant), ETS\_data=Yes, S1 2011, S1 Tot Chg, S2 Tot Chg, S1 2011 Chg, MgrLvl\_data=Other, lower level departments, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., Incentive\_data=Yes, S2 2011, MgrLvl\_data=Board committee or other executive body, S2\_REV\_2011, S2\_NI\_2011, S2\_MC\_2011, S1\_REV\_2011, S1\_NI\_2011, S1\_MC\_2011

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -13.240                     | 5.756      |                           | -2.300 | .023 |
|       | S1 2011                                                                                                   | -2.959E-5                   | .000       | -.217                     | -.311  | .756 |
|       | S1_REV_2011                                                                                               | 1.254                       | .433       | 2.975                     | 2.895  | .005 |
|       | S1_NI_2011                                                                                                | -.004                       | .029       | -.138                     | -.132  | .895 |
|       | S1_MC_2011                                                                                                | -1.522                      | .780       | -2.851                    | -1.953 | .053 |
|       | S2 2011                                                                                                   | -2.094E-6                   | .000       | -.030                     | -.213  | .832 |
|       | S2_REV_2011                                                                                               | .100                        | .072       | .498                      | 1.387  | .168 |
|       | S2_NI_2011                                                                                                | .008                        | .012       | .465                      | .650   | .517 |
|       | S2_MC_2011                                                                                                | -.411                       | .267       | -1.612                    | -1.541 | .126 |
|       | S1 2011 Chg                                                                                               | 4.026E-5                    | .000       | .968                      | 1.410  | .161 |
|       | S1 Tot Chg                                                                                                | 4.682E-5                    | .000       | .139                      | 1.728  | .087 |
|       | S2 Tot Chg                                                                                                | -.029                       | .010       | -.231                     | -2.797 | .006 |
|       | MgrLvl_data=Board committee or other executive body                                                       | -3.691                      | 6.321      | -.069                     | -.584  | .560 |
|       | MgrLvl_data=Other, lower level departments                                                                | 1.039                       | 7.903      | .014                      | .131   | .896 |
|       | Incentive_data=Yes                                                                                        | 4.617                       | 3.633      | .111                      | 1.271  | .206 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -.514                       | 4.303      | -.010                     | -.119  | .905 |
|       | ETS_data=Yes                                                                                              | -13.526                     | 5.312      | -.220                     | -2.546 | .012 |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Financia

## Appendix 20

### 2011: Industrial Industry Regression Analysis

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                    | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                    |
|-------|----------------------------------|------------------------------------|----------|-------------------|----------------------------|----------------------------------|------------------------------------|
|       | B INDUSTRY = Industri (Selected) | B INDUSTRY ~ Industri (Unselected) |          |                   |                            | B INDUSTRY = Industri (Selected) | B INDUSTRY ~ Industri (Unselected) |
| 1     | .489 <sup>a</sup>                | .                                  | .240     | .140              | 18.02081422                | 1.899                            | 1.988                              |

a. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2011, MgrLvl\_data=Other, lower level departments, S2 Tot Chg, S1\_NI\_2011, Incentive\_data=Yes, S1 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1 2011, S1 2011 Chg, S2\_NI\_2011, MgrLvl\_data=Board committee or other executive body, S1\_REV\_2011, S2 2011, S1\_MC\_2011, S2 2011 Chg, S2\_REV\_2011

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Industri.

c. Dependent Variable: Ret 2011

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df  | Mean Square | F     | Sig.              |
|-------|------------|----------------|-----|-------------|-------|-------------------|
| 1     | Regression | 13295.731      | 17  | 782.102     | 2.408 | .003 <sup>c</sup> |
|       | Residual   | 42217.467      | 130 | 324.750     |       |                   |
|       | Total      | 55513.198      | 147 |             |       |                   |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Industri

c. Predictors: (Constant), ETS\_data=Yes, S2\_MC\_2011, MgrLvl\_data=Other, lower level departments, S2 Tot Chg, S1\_NI\_2011, Incentive\_data=Yes, S1 Tot Chg, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S1 2011, S1 2011 Chg, S2\_NI\_2011, MgrLvl\_data=Board committee or other executive body, S1\_REV\_2011, S2 2011, S1\_MC\_2011, S2 2011 Chg, S2\_REV\_2011

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | -25.841                     | 10.466     |                           | -2.469 | .015 |
|       | S1 2011                                                                                                   | 1.453E-7                    | .000       | .083                      | .329   | .743 |
|       | S1_REV_2011                                                                                               | .007                        | .003       | .717                      | 2.147  | .034 |
|       | S1_NI_2011                                                                                                | .000                        | .000       | -.877                     | -2.907 | .004 |
|       | S1_MC_2011                                                                                                | -.006                       | .003       | -.755                     | -1.731 | .086 |
|       | S2 2011                                                                                                   | 2.684E-6                    | .000       | .249                      | 1.155  | .250 |
|       | S2_REV_2011                                                                                               | -.025                       | .031       | -.683                     | -.809  | .420 |
|       | S2_NI_2011                                                                                                | .002                        | .001       | .849                      | 2.005  | .047 |
|       | S2_MC_2011                                                                                                | -.020                       | .009       | -.560                     | -2.345 | .021 |
|       | S1 2011 Chg                                                                                               | -4.741E-5                   | .000       | -.106                     | -.337  | .736 |
|       | S2 2011 Chg                                                                                               | .002                        | .005       | .281                      | .436   | .664 |
|       | S1 Tot Chg                                                                                                | 7.922E-5                    | .005       | .001                      | .017   | .986 |
|       | S2 Tot Chg                                                                                                | -.043                       | .015       | -.242                     | -2.811 | .006 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 13.147                      | 10.856     | .222                      | 1.211  | .228 |
|       | MgrLvl_data=Other, lower level departments                                                                | 16.557                      | 11.706     | .258                      | 1.414  | .160 |
|       | Incentive_data=Yes                                                                                        | -.043                       | 3.343      | -.001                     | -.013  | .990 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | 2.792                       | 4.134      | .058                      | .675   | .501 |
|       | ETS_data=Yes                                                                                              | .915                        | 3.861      | .022                      | .237   | .813 |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Industri

## Appendix 21

### 2011: Utilities Industry Regression Analysis Output

**Model Summary<sup>b,c</sup>**

| Model | R                                |                                     | R Square | Adjusted R Square | Std. Error of the Estimate | Durbin-Watson Statistic          |                                     |
|-------|----------------------------------|-------------------------------------|----------|-------------------|----------------------------|----------------------------------|-------------------------------------|
|       | B INDUSTRY = Utilitie (Selected) | B INDUSTRY ~= Utilitie (Unselected) |          |                   |                            | B INDUSTRY = Utilitie (Selected) | B INDUSTRY ~= Utilitie (Unselected) |
| 1     | .771 <sup>a</sup>                | .                                   | .594     | .339              | 16.32080840                | 2.189                            | 2.002                               |

a. Predictors: (Constant), ETS\_data=Yes, MgrLvl\_data=Board committee or other executive body, S1 2011 Chg, S2\_NI\_2011, S1\_REV\_2011, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_REV\_2011, S2 2011 Chg, S1 2011, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, Incentive\_data=Yes, S2 2011, S1\_NI\_2011, S1\_MC\_2011, S2\_MC\_2011, S2 Tot Chg

b. Unless noted otherwise, statistics are based only on cases for which B INDUSTRY = Utilitie.

c. Dependent Variable: Ret 2011

**ANOVA<sup>a,b</sup>**

| Model |            | Sum of Squares | df | Mean Square | F     | Sig.              |
|-------|------------|----------------|----|-------------|-------|-------------------|
| 1     | Regression | 10527.011      | 17 | 619.236     | 2.325 | .024 <sup>c</sup> |
|       | Residual   | 7191.957       | 27 | 266.369     |       |                   |
|       | Total      | 17718.969      | 44 |             |       |                   |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Utilitie

c. Predictors: (Constant), ETS\_data=Yes, MgrLvl\_data=Board committee or other executive body, S1 2011 Chg, S2\_NI\_2011, S1\_REV\_2011, ETS\_data=We don't currently, but anticipate participating in emissions trading within the next two years., S2\_REV\_2011, S2 2011 Chg, S1 2011, MgrLvl\_data=Other, lower level departments, S1 Tot Chg, Incentive\_data=Yes, S2 2011, S1\_NI\_2011, S1\_MC\_2011, S2\_MC\_2011, S2 Tot Chg

| Model |                                                                                                           | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|-------|-----------------------------------------------------------------------------------------------------------|-----------------------------|------------|---------------------------|--------|------|
|       |                                                                                                           | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                                                                                                | 3.539                       | 13.560     |                           | .261   | .796 |
|       | S1 2011                                                                                                   | -3.361E-7                   | .000       | -.425                     | -1.738 | .094 |
|       | S1_REV_2011                                                                                               | .002                        | .002       | .232                      | .884   | .385 |
|       | S1_NI_2011                                                                                                | -9.585E-5                   | .000       | -.270                     | -1.147 | .262 |
|       | S1_MC_2011                                                                                                | .001                        | .003       | .197                      | .599   | .554 |
|       | S2 2011                                                                                                   | 3.060E-6                    | .000       | .214                      | .841   | .407 |
|       | S2_REV_2011                                                                                               | .118                        | .084       | .301                      | 1.408  | .171 |
|       | S2_NI_2011                                                                                                | -.001                       | .002       | -.111                     | -.221  | .827 |
|       | S2_MC_2011                                                                                                | -.130                       | .071       | -.954                     | -1.836 | .077 |
|       | S1 2011 Chg                                                                                               | -.006                       | .035       | -.025                     | -.161  | .874 |
|       | S2 2011 Chg                                                                                               | .003                        | .002       | .854                      | 1.269  | .215 |
|       | S1 Tot Chg                                                                                                | .001                        | .005       | .033                      | .176   | .862 |
|       | S2 Tot Chg                                                                                                | -.001                       | .001       | -.819                     | -1.180 | .248 |
|       | MgrLvl_data=Board committee or other executive body                                                       | 7.307                       | 13.677     | .125                      | .534   | .598 |
|       | MgrLvl_data=Other, lower level departments                                                                | 4.051                       | 15.449     | .051                      | .262   | .795 |
|       | Incentive_data=Yes                                                                                        | 1.382                       | 7.748      | .034                      | .178   | .860 |
|       | ETS_data=We don't currently, but anticipate participating in emissions trading within the next two years. | -9.818                      | 11.172     | -.123                     | -.879  | .387 |
|       | ETS_data=Yes                                                                                              | -12.822                     | 6.876      | -.321                     | -1.865 | .073 |

a. Dependent Variable: Ret 2011

b. Selecting only cases for which B INDUSTRY = Utilitie

## Appendix 22



Figure 18. Price of carbon from 1/2010 until 7/2017. The price of carbon was \$19.03 in January of 2011, by December of 2011 it had dropped to \$9.92 (Investing.com, 2017). This drop in price would decrease the performance of financial companies investing in the market unless they were contrarian. In 2015, the price fluctuated from around 7.28 in January to 8.29 in December (Investing.com, 2017).

## References

- Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C., et al. (1995). Economic Growth, Carrying Capacity, and the Environment. *Science*, 268, 520-21.
- Bloomberg, M. (2017). *Trump won't stop Americans hitting the Paris climate targets. Here's how we do it*, Retrieved from theguardian.com:  
<https://www.theguardian.com/commentisfree/2017/aug/11/donald-trump-american-paris-climate-targets-michael-bloomberg>
- Boden, T., Marland, G., & Andres, R. (2017). National CO2 Emissions from Fossil-Fuel Burning, Cement Manufacture, and Gas Flaring: 1751-2014. *Carbon Dioxide Information Analysis Center*. Oak Ridge National Laboratory, U.S. Department of Energy.
- Bowen, H. (1953). *Social Responsibilities of the Businessman*. Harper, NY.
- Carbon Disclosure Project. (2015). *Guidance for companies reporting on climate change on behalf of investors & supply chain members 2015*. Retrieved from www.cdp.net:  
<https://www.cdp.net/en/guidance/guidance-for-companies>
- CDP. (2010-2016). *CDP proprietary questionnaire answer data* [Data file]. Retrieved from purchased data accessed through the Harvard University Library.
- CDP. (2017). About us. Retrieved from cdp.net: <https://www.cdp.net/en/info/about-us>. England.
- CEO's of 30 Major Corporations. (2017). *The B Team*. Retrieved from bteam.org:  
<http://bteam.org/announcements/30-major-ceos-call-on-trump-stay-in-paris/>
- Ceres. (2017). *US Fortune 500 Companies Public Support for the Paris Agreement*. Retrieved from Eenews.net: [https://www.eenews.net/assets/2017/05/26/document\\_daily\\_02.pdf](https://www.eenews.net/assets/2017/05/26/document_daily_02.pdf)
- Clemencon, R. (2016). The Two Sides of the Paris Climate Agreement. *The Journal of Environment & Development*, 25 (1), 3-24.
- Cohen, J. (1992). Quantitative Methods in Psychology: A Power Primer. *Psychological Bulletin*, 112, 155.
- Costanza, R., De Groot, R., Sutton, P., Van der Ploeg, S., Anderson, S. J., Kubiszewski, I., et al. (2014). Changes in the global value of ecosystems. *Global Environmental Change*, 26, 152-58.
- Eccles, R. G., Ioannou, I., & Serafeim, G. (2011). *The Impact of a Corporate Culture of Sustainability on Corporate Behavior and Performance*. Cambridge, MA: Harvard Business School.

- Evans, A., & Tzavara, D. (2012). Corporate social responsibility strategies in the light of the financial crisis: the case of Milan-based global companies. *European Journal of International Management*, 6, 154-174.
- Galbreath, J. (2010). Drivers of Corporate Social Responsibility: the Role of Formal Strategic Planning and Firm Culture. *British Journal of Management*, 21, 511-525.
- GRI. (2017). *About GRI*. Retrieved from [globalreporting.org](http://globalreporting.org):  
<https://www.globalreporting.org/information/about-gri/Pages/default.aspx>
- Hardin, G. (1968). The Tragedy of the Commons. *Science*, 162, 1243-1248.
- Henriques, I., & Sadorsky, P. (2008). Oil prices and the stock prices of alternative energy companies. *Energy Economics*, 30, 998-1010.
- Hertwich, E. G., & Peters, G. P. (2009). Carbon Footprint of Nations: A Global, Trade-Linked Analysis. *Environmental Science & Technology*, 43, 6414-6420.
- Intergovernmental Panel on Climate Change. (2014). *Climate Change 2014: Mitigation of Climate Change*. Retrieved from IPCC.ch: <https://www.ipcc.ch/report/ar5/wg3/>
- Intergovernmental Panel on Climate Change. (2014). GHG Emissions by Economic Sector. *Working Group III to the Fifth Assessment Report of the IPCC*.
- International Panel on Climate Change. (2007). *Climate Change 2007: the physical science basis*. Cambridge University Press.
- Investing.com. (2017). *Investing.com*. Retrieved from  
<https://www.investing.com/commodities/carbon-emissions-historical-data>
- ISO. (2010). Guidance on Social Responsibility. *ISO 2600:2010(E)*. Geneva.
- Kashmanian, R. M., Wells, R. P., & Keenan, C. (2011). Corporate Environmental Sustainability Strategy: Key Elements. *The Journal of Corporate Citizenship*, 44, 107-130.
- Kumar, S., Managi, S., & Matsuda, A. (2012). Stock prices of clean energy firms, oil and carbon markets: A vector autoregressive analysis. *Energy Economics*, 34, 215-226.
- Lloyd, W. F. (1832). *Two Checks on Population*. London: Oxford University.
- Lloyd, W. F. (1832). *Two Lectures on the Checks to Population*. London: S. Collingwood.
- Mann, M. E. (2014). Earth Will Cross the Climate Danger Threshold by 2036. *Scientific American*, 310, 78-81.

- Meyer, R. (2017). *The Atlantic*. Retrieved from <https://www.theatlantic.com/science/archive/2017/05/is-the-paris-accord-stronger-without-the-united-states/528456/>
- Moratis, L. (2016). Signaling Strategies for ISO 26000: a firm-level approach. *International Journal of Operations & Production Management*, 36, 512-531.
- NASA (2018). *Long-term warming trend continued in 2017: NASA, NOAA*. Retrieved from <https://climate.nasa.gov/news/long-term-warming-trend-continued-in-2017-nasa-noaa/>
- Natter, A. (2017). *Donald Trump Notifies UN of Paris Exit While Keeping Option to Return*. Retrieved from Time.com: <http://time.com/4888705/donald-trump-notifies-united-nations-paris-exit/>
- Nissim, D., & Penman, S. H. (2001). Ratio Analysis and Equity Valuation: From Research to Practice. *Review of Accounting Studies*, 6, 109-154.
- Nobel, C. (2017). *More Than 900 Examples Of How Climate Change Affects Business*. Retrieved from Forbes.com: <https://www.forbes.com/sites/hbsworkingknowledge/2017/03/15/more-than-900-examples-of-how-climate-change-affects-business/#746c940a5306>
- Oestreich, A. M., & Tsiakas, L. (2015). Carbon emissions and stock returns: Evidence from the EU Emissions Trading Scheme. *Journal of Banking & Finance*, 58, 294-308.
- Peloza, J. (2009). The Challenge of Measuring Financial Impacts From Investments in Corporate Social Performance. *Journal of Management*, 35, 1518-1541.
- Pertsova, C. C. (2008). *Ecological Economics Research Trends*. Hauppauge, NY: Nova Science Publishers.
- Pizer, W. A. (2002). Combining price and quantity controls to mitigate global climate change. *Journal of Public Economics*, 85, 409-434.
- Premier Oil. (2017). *Premier at a Glance*. Retrieved from Premier-Oil.com: <http://www.premier-oil.com/about/premier-at-a-glance>
- Rahdari, A. H., & Rostamy, A. A. (2015). Designing a general set of sustainability indicators at the corporate level. *Journal of Cleaner Production*, 108, 757-771.
- Rockström, J. W. (2009). Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Science*, 14, 32.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., & Ingo Fetzer, e. a. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347, 736.

- United Nations. (2015). The Paris Agreement. Paris, France. Retrieved May 30, 2017, from [https://treaties.un.org/Pages/CTCTitleSearch.aspx?clang=\\_en](https://treaties.un.org/Pages/CTCTitleSearch.aspx?clang=_en)
- United States Environmental Protection Agency. (2017). *Climate Change Indicators*. Retrieved from epa.gov: [https://19january2017snapshot.epa.gov/climate-indicators\\_.html](https://19january2017snapshot.epa.gov/climate-indicators_.html)
- Villar, J. C., Hidalgo, S. L., Carbolo, A. P., & Meijide, B. G. (2012). A New Perspective for Labeling the Carbon Footprint Against Climate Change. In B. R. Singh, *Global Warming - Impacts and Future Perspective*. InTech.
- Wara, M. W., & Victor, D. G. (2008). *A Realistic Policy on International Carbon Offsets*. Retrieved from Frush.free.fr: <http://frush.free.fr/Public/Economie%20du%20changement%20climatique/4%20-%20Victor%20and%20Wara%20offsets.pdf>
- World Commission on Environment and Development. (1987). *Our Common Future*. Oxford: Oxford University Press.
- World Economic Forum. (2016). *The Global Risks Report 2016, 11th Edition*. Retrieved from weforum.org: [http://www3.weforum.org/docs/GRR/WEF\\_GRR16.pdf](http://www3.weforum.org/docs/GRR/WEF_GRR16.pdf)
- World Resources Institute. (2004). *The Greenhouse Gas Protocol*. Retrieved from [www.wri.org](http://www.wri.org): <https://www.wri.org/publication/greenhouse-gas-protocol>
- Wundera, S., Engel, S., & Pagiola, S. (2008). Taking stock: A comparative analysis of payments for environmental services programs in developed and developing countries. *Ecological Economics*, 65, 834-852.