# Going Green in The Face of Political Threats:
# A Study of the Chicago Climate Exchange

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Abstract

The impact of corporate social responsibility initiatives on shareholder value is uncertain. Research points to both positive and negative market reaction to the announcement of a firm either being recognized for its social responsibility or voluntarily engaging in an activity that would presumably be perceived as such. In this study, I examine market reaction to a firm's decision to make a voluntary, yet legally binding and potentially costly commitment to reduce green house gas emissions by joining the now-defunct Chicago Climate Exchange. The Chicago Climate Exchange, as a field experiment, provides a unique opportunity to study the connection between corporate social responsibility and market valuation because the expected and actual costs of non-compliance are more observable, when compared against non legally binding initiatives. I find that the market reacts negatively to a firm's decision to join as evidenced by negative, although insignificant, cumulative abnormal returns and significant declines in trading volumes around the announcement date. Price reaction is negatively associated with a firm's price-to-book ratio in the year prior to joining the exchange and positively associated with the Kinder, Lydenberg, Domini Research & Analytics (KLD) rating of a firm's environmental strengths. Trading volume is positively associated with firm size, measured with market capitalization in the year prior to the announcement. Larger firms were less likely to make the commitment, whereas, firms in more highly concentrated industries and those with higher KLD rankings for community strengths were more likely to have joined the exchange.

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*"Yesterday you were too young, tomorrow you will be too old to regret all the things you've done"*

*-D. Pirner*

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## List of Abbreviations

CCX Chicago Climate Exchange

CFI Carbon Financial Instrument

CSR Corporate social responsibility

GHG Green house gas

HHI Herfindahl industry concentration index

IPCC Intergovernmental Panel on Climate Control

KLD Kinder, Lydenberg, Domini Research & Analytics

# 1. Introduction

In the face of environmental concerns, there is mounting pressure for firms to adopt more environmentally friendly business practices. Such practices comprise one aspect of corporate social responsibility (CSR). Of debate is whether CSR is in the best interests of shareholders. One side of the argument is that a conflict between management and shareholders arises due to management allocating resources towards improving the firm's social responsibility when these resources could be put towards projects with greater expectations of financial returns, and in doing so they are decreasing the value to the shareholders (Hillman & Keim, 2001; Thornburn & Vanden, 2008). The other side is that CSR can increase value to shareholders by improving public relations, demonstrating an ability to keep up with technological advancements or demonstrating a greater knowledge of the possible future government regulations (Kempf & Osthoff, 2007; Klassen & McLaughlin, 1996; Konar, 2001; Orlitzky, 2003).

Increasing concern over green house gas (GHG) emission, more specifically the problem of global warming, have appeared in the media, politics and in academia. Although debate continues over the existence of global warming, the magnitude of the problem and the impact that humans can have on it, the majority of academic studies find that GHG emissions and global warming are in fact very real problems that we are face (IPCC[1],: Schneider, 1989; Young, 1992). Governments and organizations are turning to regulation as a means to control the problem, the most notable being the introduction of the Kyoto Protocol in 1997. Under the Kyoto Protocol,

[1] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html

industrialized countries are required to reduce their aggregate GHG emissions 5.2% below their 1990 emissions levels before the protocol expires in 2012. However, not all industrialized countries are in agreement with the Kyoto Protocol objectives. The United States, which happens to be one of the largest emitters of GHGs (Matthews et al. 2007), failed to come to an agreement on an emissions reduction schedule and refused to sign the protocol, arguing that the opportunity costs of regulating GHG emissions to the U.S. economy are too high when weighed against the improvements to social welfare (Barker & Ekins, 2004). In response to the lack of regulation in the U.S. and the recognition of the severity of the problems related to GHG emissions, some firms and organizations have voluntarily begun reducing their emissions.

Politics looms large in the issues surrounding corporate social responsibility. It has been argued that the demise of the Chicago Climate Exchange in 2010 was the result of waning government endorsement and an unwillingness of the U.S. government to table legislation requiring a reduction of greenhouse gas emissions. This, in turn, implies that interest in the market, and more importantly, the value of corporate social responsibility itself, as it applies to pollution reduction, is driven by the threat of potentially costly political action. Investors do not value corporate social responsibility if it does not hurt to ignore it; they are not interested in placing bets on firms committing to good corporate social responsibility if threats are not imminent—*Don't bother unless you have to*. But despite its collapse, the Chicago Climate Exchange is a valuable field experiment from which we can explore the market's reaction to the firms that joined and committed to reducing emissions, and ask how these firms differ from those that did not join. The challenge is in operationalizing public and private political threats. The most direct measure I use in this study, although very noisy, is Sierra Club membership in the state in which each firm is headquartered. Others, such as ratings of environmental strengths and concerns as published by Kinder, Lydenberg, Domini Research & Analytics (KLD), are less direct, or even ambiguous, because these could measure firm attributes that are valued (or not) by consumers or employees as much as they can be signals that will attract unwanted political attention. Even less direct perhaps is firm size or industry concentration, normally thought of as purely "financial" variables but equally "political" in the sense that the big ones tend to attract more (unwanted) attention and therefore be more motivated to act in, what are perceived to be, socially acceptable ways.

With this caveat, I find that the market reacts negatively to a firm's decision to join the CCX as evidenced by negative, although insignificant, cumulative abnormal returns and significant declines in trading volumes around the announcement date. Price reaction is negatively associated with a firm's price-to-book ratio in the year prior to joining the exchange and positively associated with the KLD rating of a firm's environmental strengths. Trading volume is positively associated with firm size. Firms in more highly concentrated industries were more likely to have joined the exchange, as were those with higher KLD rankings for community strengths. Firm size is negatively associated with a firm's decision to join, that is, larger firms are less likely to join.

The paper is organized as follows: Section 2 reviews literature on CSR, influencing factors and market reaction. Section 3 discusses the issue of global warming and possible solutions. Section 4 reviews previous markets for emissions reduction. Section 5 outlines the Chicago Climate Exchange. Section 6 explores factors which might motivate a firm to become involved with CSR. Section 7 summarizes financial, industry and environmental statistics. Section 8 and 9 reports and interprets results. Section 10 summarizes and concludes the thesis, providing a discussion of possible future work.

## 2. Background

There has been debate over the impact that corporate socially responsibility (CSR) has on financial performance, with some studies finding that CSR leads to improvement in performance and others finding a negative impact. Renneboog et al. (2008) and Beurden et al. (2008) provide an extensive review of studies on CSR and their relation to firm performance; the main findings of their paper indicate that past work suggests reaction to CSRs are dependent on a variety of internal and external factors, with firm size, industry and R&D being the most reoccurring significant variables. Overall studies find a positive relationship between shareholder value and CSR investments. Using KLD data as a measure for CSR performance, Galema et al. (2008) find that on average firms with higher CSR ratings tend to outperform similar firms with lower CSR ratings. In a meta-analysis of 52 studies Orlitzky et al. (2003) find that there is a positive correlation between CSR performance and financial performance of the firm. Results also indicate that the relationship is bidirectional, meaning that in certain cases higher CSR leads to higher financial performance and at other times it is higher financial performance that leads to higher CSR. Kempf et al. (2007) find that using a strategy in which portfolios are built around firms that rate high on CSR, an investor can earn annual abnormal returns in the range of 8.7%. Although they find a positive relationship between CSR and financial performance they question whether the performance might be due to a temporary mispricing in the market and suggest this might be an area for future research. Levi and Newton (2011) explore the persistence of the increase in returns of firms that are recognized as being socially responsible firms. In their study *Newsweek's* "Green List" is used to identify firms with positive environmental responsibility ratings. They find that, although there is a positive increase in performance around the green listing announcement, the increase in returns appears to be temporary and is eventually corrected.

In some cases there is a negative relationship between CSR and financial performance. Fisher-Vanden and Thorburn (2008) explore market reactions to firms announcing voluntary corporate environmental initiatives, using Climate Leaders and Ceres as a measure for these initiatives. They find significantly negative abnormal returns for around the announcement date of a company taking on either initiative. Overall results indicate a negative correlation between these environmental initiatives and financial performance.

Unlike previous studies, this paper examines the performance and characteristics of firms that joined the Chicago Climate exchange, and thereby made a legally binding commitment to reduce emissions. Participation in the exchange mimicked the legal obligations that would be in place under government regulation and running of such a market. The following section outlines the subject of the need for reduction in GHG emissions and how the CCX responds to the issue.

# 3. Global Warming

Once the problem of global warming is understood, possible solutions to the problem based on three forms of government regulation are reviewed. A successful form of government regulation for sulphur dioxide emissions in the U.S. is discussed, suggesting that the possibility of using a similar method to reduce GHG emissions in the U.S. The section concludes with a discussion and outline of a voluntary cap and trade program for GHG emissions in U.S.

## 3.1 What is Global Warming?

Global warming can be described as an increase in the trend of average global near surface air and ocean temperatures. Sceptics argue that current warming trends are a natural phenomenon where the temperature of the earth fluctuates, going through periods of heating and then cooling. These heating and cooling periods are found to be real, and relate to changes in the sun's cycle. However, the problem in question is not whether the earth goes through natural periods of cooling and warming, but whether the current trend of increasing global temperatures is a result of changes in the sun's cycle or anomalies to the natural cycle. A report written by the Intergovernmental Panel on Climate Change (IPCC, 2007) finds that there has been an increase of 0.74°C in average global temperatures between 1906 and 2005. This heating trend was found to be relatively worse in the latter 50 years where the average increase was 0.13°C per decade, indicating that the problem is getting persistently worse. A study designed to explain the portion of global warming caused by natural solar cycles since 1610 finds that since 1860 only portions of the increase in average temperature can be explained by changes in the sun's cycle. Between 1610 and 1800, the changes in global temperatures can be explained by the natural solar cycle; however, between 1860 and 1990 the solar cycle can only account for half of the increase in global temperatures and for only one third of the warming since 1970 (Foukal, 1990). These findings suggest that although the earth is undergoing a natural increase in temperature, the changes that we have observed in the past 150 years are not fully explained by the natural cycle, and that anomalies are becoming more common. The problem that we are now faced with is understanding the causes of these temperature anomalies and whether or not they are a result of human involvement in the natural environment. Scientists explain the increase in green houses gases as being a result of growth in industrial activities since the 18th century (Schneider, 1989). The industrial revolution led to an increase in the release of green house gases into the atmosphere, continuing at an increasing rate into the 21st century. Green house gases are gases that are naturally found in the earth's atmosphere, which trap solar energy and therefore heat the earth. Without the presence of green house gases in the atmosphere the earth's average temperature would be 33°C lower then it is and would not be able to support life (Schneider, 1989). When an excess amount of green house gases are released into the atmosphere, the natural balance of necessary gases is disturbed, leading to the warming.

### 3.2 Green House Gases

As the GHGs absorb infrared radiation, not allowing it to exit the earth's atmosphere, the temperature of the earth is maintained at the level required to sustain life. The main GHGs present in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, ozone and chlorofluorocarbons (CFCs). Global industrial activity since the middle of the eighteenth century has led to a substantial increase in the amount of GHGs present in the atmosphere. Although an excessive amount of any of these GHGs gases can have a harmful effect on the environment, it has been the increase in carbon dioxide released since the industrial revolution that has come to the forefront of environmental concern in the past few years. The increase comes from the burning of fossil fuels such as coal and oil. Schneider (1989) and Chen et al. (1986) suggested that there is reason for concern over the amount of pollution caused by human activity. It is not only the increase of 25% of the amount of CO2 present in the atmosphere that is of great concern but also the increasing exponential trend of the presence which indicates that the problem is worsening.

As humans require more space for roadways, factories, agricultural land and cities, they are required to cut and clear naturally occurring forests; this process is known as deforestation. Deforestation further compounds the problems associated with post industrial revolution pollution by further disturbing the natural equilibrium of $CO_2$ in the atmosphere. Plants, more specifically trees in forests, act as filters for excess $CO_2$ through a process known as photosynthesis. As plants grow, $CO_2$ is transformed into carbon (C) in the plant's tissues and oxygen ($O_2$) is released into the atmosphere. As forests are cut down, fewer trees are left available for this filtering process and therefore more $CO_2$ is found in the atmosphere.

### 3.3 The Need For a Reduction in $CO_2$ Emissions

Since the effects that green house gases have on global warming tend to be lagged it is difficult to determine the specific impact that a GHG has on global warming at the time it is emitted, therefore making it difficult to determine the reduction required for improvement (Nordhaus, 1991). The current opinion is that reducing emissions to the levels in 1990 would allow for the curbing of the global warming without having a large impact on economic prosperity. The objective of reducing GHG emissions to the 1990 level was adopted by the

United Nations Framework Convention on Climate Change (UNFCC[2]) and put into effect in the framework of the Kyoto Protocol. The Kyoto Protocol was adopted in 1997 and came into effect in early 2005. Its main objective was to have all countries cooperate to reduce global GHG emissions with more emphasis put on emissions reduction by industrialized countries. The protocol established a legally binding cap for the amount of GHG which a participating country can emit in a given year. Flexibility was given to participants as to the methods in which they would meet their objectives. Three flexibility mechanisms were introduced in order to assist participants: clean development, emissions trading, and joint implementation. The clean development mechanism allows industrialized countries to invest in cleaner practices in developing countries as a substitute for reduction in their own country. Emissions trading allows countries to trade pollution rights between each other so that a country which has surpassed its required reduction can trade the rights to another country that is having difficulty meeting their objective. Finally, joint implementation allows for industrialized countries to invest in cleaner practices in other industrialized countries in other to offset their excess emissions. The frame work for the Protocol was designed to address the issue of aggregate global pollution and not as a means to target specific countries. However in order for the protocol to be effective in the aggregate, it is important that the industrial countries with the highest emission rates participate. The United States declined to participate over fears of economic consequences. It is very difficult to reach the objective of significantly reducing global emissions with the U.S. not participating in the Kyoto Protocol. The importance of U.S. involvement in reducing global GHG emissions has lead to mounting political pressures from both within and outside the U.S. for them to become committed to some form of emissions reduction plan.

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[2] http://unfccc.int/2860.php

### 3.4 Possible Approaches to $CO_2$ Emission Reduction

Fear of economic consequences are said to be the main reason for the U.S. not participating in the Kyoto Protocol. However with the proper policy in place, a government can successfully reduce emissions without having a harmful effect on the economy. There are generally three policies considered when dealing with pollution reduction and the economy: Regulation of a firm's pollution output (command and control), a pollution tax (Pigouvian tax), and a cap and trade system (Stavins,1998). Under a command and control, governments are able to restrict the amount of pollution firms emit by either requiring them to practice cleaner methods of production or by reducing output. Although this approach can be effective in reducing individual firm's emissions it can have negative effects on the economy. Controlling the amount that a firm can pollute will either increase costs to the firm, as they are now required to invest in cleaner practices, or require the firm to decrease output in order to meet the standard. In either case the end result will be an increase of the price of the goods in the market, decreasing social welfare. Under a Pigouvian tax, firms are taxed on the amount of pollution they emit. Although this technique holds firms accountable for their emissions it does not address the need for a reduction in aggregate emissions. If a firm found that it was more profitable to increase production and in turn increase emissions, paying a high rate of tax, rather than reduce emissions and pay less tax, then we might actually see an increase in emissions. The cost of the tax to the firm has potential to eventually be passed on to the consumer therefore resulting in higher prices in the market and not really holding firm's accountable for their emissions. A pollution tax is more of a revenue generating technique for the government then a method in which to reduce emissions, since firms may simply see it as paying for the right to pollute and may even result in increased emissions. Under a cap and trade system, firms are designated emission allowances based on a certain bench mark. Allowances can either be used to account for the firm's own emissions or can be sold to other firms in order to meet objectives. The cap and trade system is designed to address the problem of aggregate pollution by capping emissions for the entire market and then dividing it amongst firms. Under cap and trade, firms are able to apply the method they feel the most economical in order to achieve their target. Firms that feel the best method is to invest in cleaner practices and reduce emission amounts can do so. In fact a firm that is able to reduce emissions beyond their target can sell their excess allowances to firms in need. A firm that is unable to meet the reduction requirement can purchase allowances in the market rather than pay the penalty for exceeding the target amount. The cap and trade system addresses the problem of a need for aggregate reduction in emissions, while allowing firms the right to choose the most efficient method in meeting their requirement and therefore having minimal impact on the economy. The cap and trade system has proven to be fairly successful on several different occasions, including various climate exchange markets that have emerged throughout Europe in response to the Kyoto Protocol (Sandor et al. 2001) as well as an sulphur dioxide cap and trade market that proved to be very effective in reducing $SO_2$ emissions in the U.S. as a response to the Clean Air Act Amendment of the 1990's.

This thesis examines how a voluntary GHG reduction program in the U.S., such as the Chicago Climate Exchange, can work to mitigate mounting pressures on firms to reduce their amounts of GHG emissions. As global warming and it's relation to GHG emissions becomes a more prevalent concern, firms under various forms of political threats related to the issue might be motivated to voluntary make a commitment to reduce emissions by joining a reductions market.

# 4 Reductions Markets

## 4.1 Market for Sulphur Dioxide Reduction

In 1852 a chemist named Robert Angus Smith released research discussing the impact that the industrial revolution was already having on the natural environment (Senanayake et al., 2005; Clark et al., 2001). His work at this time was focused on the effect that the increase in the release of sulphur dioxide ($SO_2$) and nitrogen dioxide($NO_2$) into the atmosphere would have on air quality. He suggested that the release of these gases into the atmosphere would lead to an increase in the pH levels of rain and ultimately have a negative impact on the environment. Although Smith had made this discovery during the industrial revolution, it wasn't until over 100 years later that the problem really began to be investigated in detail by scientists. In the late 1960's concern began to grow over the impact that this pollution was having on the environment. It was around this time that the term acid rain was presented to describe the phenomenon. Heavy polluting countries began to develop possible solutions to the problem of acid rain. One solution involved creating high rising smoke stacks which would allow for the $SO_2$ to be dispersed into the air and spread out over a wider area. Since $SO_2$ is a relatively heavier gas when using short stacks, the gas remains in the area in which it was released, thus having a greater impact on the immediate surroundings. Although the solution of higher stacks would work in keeping heavy polluting cities relatively cleaner, it was having a harmful effect on surrounding areas. The U.S. government found that it was necessary to take action on the issue of acid rain. The solution involved requiring a reduction in $SO_2$ emissions and not simply permitting pollution to be dispersed over a larger area. In 1990 the U.S. government introduced a reform to the Clean Air

Act of the 1970s by developing a system of emissions trading in which polluters would be required to cap and reduce their $SO_2$ emissions. The Clean Air Act Amendment[3] of 1990 introduced the Acid Rain Program (Title IV) which consisted of a two phase program which focused on the reduction of $SO_2$ emissions by major power plants. Phase I would begin in 1995 and continue through until the end of 1999. Phase I participants consisted mainly of large power plants, in which allowances were based on previous emissions rates requiring a relative reduction in each year. Phase II expanded participation to all power plants with a significant level of output. Caps and reductions for Phase II were structured similar to Phase I.

The idea behind the market was to internalize the cost of $SO_2$ emissions to the firm by holding them accountable for their level of emissions, where as previously the costs of the emissions were external to the firm and came in the form of acid rain, ultimately being paid by the societies it affected. The decision on how the reduction target would be met was left up to the firm itself. If a firm felt that it would be more cost effective to install newer technologies in order to meet their reduction objective then they could do so and could possibly even profit from reducing emissions beyond the requirement. Firms that were able to make a reduction in $SO_2$ emissions below their cap would be left with excess allowances which could either be sold in the market or banked for future use. It must be noted that although firms could bank and use allowances from the previous year, they could not use allowances from future years to meet the requirements of the current year. Firms that were unable to meet the required cap in a certain year had the option to either use allowances which they have banked from previous years or purchase the needed allowances from firms with an excess. Failure to meet the required cap by

[3] http://www.epa.gov/air/caa/title1.html

reducing emissions, using banked allowances or purchasing allowances, would result in a penalty to the firm in the form of a fine[4]. The penalty for failing to make the required reductions does not excuse a firm's excess emissions but rather, in addition to a fine, the firm is required to make additional future reductions as compensation. The cap and trade system for $SO_2$ emissions was found to be effective in addressing both environmental and economic concerns. By capping the aggregate amount of emissions in the market and allowing firms to trade emissions rights, total $SO_2$ emissions in the U.S. are reduced and not simply that of a few firms. In addition, the fact that firms were given the freedom to make the decision on how to go about meeting the required emission reduction, rather than having a method imposed through regulation, made it possible for the firm to make the decision which they deemed to be the most cost effective, resulting in minimal economic impact.

Stavins (1998) examined the effectiveness of the U.S. $SO_2$ allowance trading market as a method in which emissions can be reduced while having minimal impact on firm value. He argues that the market based approach to reducing $SO_2$emissions can be far more cost effective to firms when compared against the more commonly used command-and-control method. The trend in using command-and-control methods is found to be rooted in a political framework rather than one of economics, leading legislators to often overlook the possibility of an allowance market as means to reduce emission rates. At the time when Stavins wrote his paper, the $SO_2$ allowance-trading market had only been fully binding for 3 years, and he cautioned on drawing concrete conclusion on results from such a short time period. However, that preliminary analysis indicates that $SO_2$ allowance-trading market was successful in meeting $SO_2$ reduction in

[4] 2004 fine rates were $2,727 per ton of $SO_2$ above the required reduction.

a cost effective manner. Stavins attributes the success of the $SO_2$ allowance-trading market to a variety of factors: the political support of the Bush administration, the design of the market as a method to reduce emissions and not simply reallocate them, the design process that set the emission reductions objectives and then deliberated on the cost effective methods in which to achieve them, and the fact that $SO_2$ emissions were previously unregulated allowed for the market to come in effect and operate freely without any additional constraints. The allowance-trading program for $SO_2$ emissions was successful at meeting required emissions reduction targets, while keeping reduction costs significantly lower than more traditionally used environmental regulations (Kanwalroop, 1999).

### 4.2 Market for Carbon Dioxide Reduction

The lack of commitment by the U.S. government to participate in GHG emission reduction initiatives has resulted in growing demand for some form of GHG emissions regulation. In response to this growing demand various programs have developed throughout the U.S. in which firms can participate on a voluntary basis and work towards developing more environmentally friendly business practices. One notable program is the Chicago Climate Exchange (CCX). The CCX is the only climate exchange market in North America that had markets for all six of the major GHGs, with $CO_2$ being its main one. The structure of the CCX is very similar to that of the earlier market for $SO_2$ reduction and $CO_2$ markets found in Europe. Participating members of the CCX commit to reducing their GHG emissions scheduled on a predetermined baseline. Emissions rights that are traded on the CCX are called Carbon Financial Instruments (CFIs) and can be traded amongst members. Members who surpass their required reduction have the option of either banking their CFIs or selling them to members who are unable to meet their required reduction. The CCX is composed of three parts main parts: the CCX registry, the trading platform, and the clearing and settlement platform. What is unique about the CCX is that it operates in a country without any formal regulation of $CO_2$ emissions, making it a voluntary market. But, although the market is voluntary all commitments are legally binding, which simulates a situation in which the firm would be legally bound to reduction requirements if legislation were introduced.

## 5. The Chicago Climate Exchange (CCX)

The Chicago Climate Exchange (CCX) began in 2000 with a series of grants from the Joyce Foundation to the Kellogg Graduate School of Management at Northwestern University. The grants were established in order to provide Professor Richard Sandor with the necessary funding to examine and design a possible cap and trade market for green house gas emissions in the United States. The objective of the project was to address the lack of government regulation towards the growing problems related GHG emissions in the United States though the development of a voluntary cap and trade market for GHG emissions. The design process began in 2001 and continued through 2002. Trading began in 2003 with 13 initial members on an annual emissions reduction schedule. Membership grew quickly and eventually topped 400. All members were subject to emissions verification by the Financial Industry Regulatory Authority, Inc. (FINRA) formally the North American Securities Dealers, Inc. (NASD) and were legally required to meet their reduction commitment. Members met their required emissions reduction by either reducing current emissions to the required level or purchased carbon financial instruments (CFIs) in the market place. The following is a summary of the CCX registry, the CCX trading platform, the dynamics of the CFIs and the various membership categories.

The CCX registry was an online registry designed to facilitate the management of member's accounts. Each member had a registry account in which they could manage their GHG emissions inventories, manage their CFIs, search and review trades and allowances, review member statements and view member only information. In order to track all transaction on the CCX each GHG allowance was given a specific serial number on the registry account, this was used primarily to track transaction and prevent double counting of emission offsets.

The Carbon Financial Instrument is what was traded on the CCX. The CFI contract was equivalent to 100 metric tons of $CO_2$, which can be in the form of carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluocarbons (PFCs) and sulphur hexafluoride ($SF_6$). Conversions of non-$CO_2$ GHGs follow the standards established by the IPCC in order to obtain the $CO_2$ equivalent. Each firm was designated a certain level of emissions allowances in the form of CFIs. The CFI could be banked towards future years of compliance; however, members could not use future year CFIs to comply with an earlier year. CFIs were traded on the CCX's electronic trading platform, in which offers to buy, sell and accept took place. All trades were provided with price transparency, anonymity, and were guaranteed through CCX's clearing and settlement. The CFI contracts exchanged between CCX registry account holders occurred on the same day and were generally delivered on a FIFO basis, where settlement occurred on the next business day for banking purposes. Short selling by registry account members was not permitted; however the CCX had implemented lending facilities in order to provide professional traders with the possibility to accommodate short selling strategies.

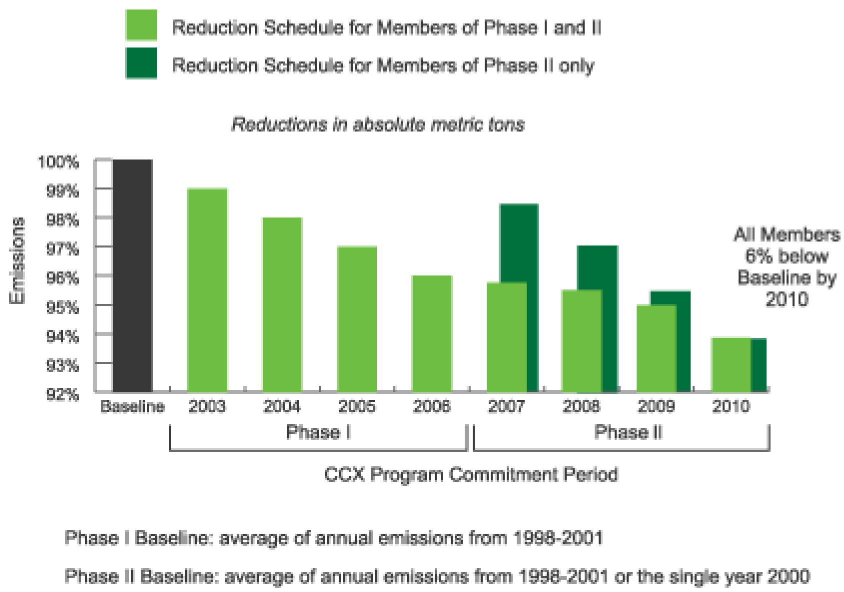
## 5.1 Membership Categories

The CCX was composed of several different types of membership categories, each of which played a different role. These included public corporations, private corporations, universities, states, municipalities and a variety of other organizations. All membership categories are outlined in the following pages, with emphasis put on the legal requirements of the member and how these requirements are satisfied.

*Registry Members*

Members were firms and other entities that had direct GHG emissions and made a legally binding commitment with the CCX to reduce emissions based on a predetermined reduction schedule. The reduction schedule is as shown below, with phase lengths lasting four years. Members were committed for the length of the phase in which they join and can either commit for another phase or withdraw from the CCX program once the phase in which they are currently participating in expires.

Figure 1. CCX Reduction Schedule[5]




Phase I Baseline was based on the average annual emissions from 1998 – 2001. Phase II Baseline was based on the average annual emissions from 1998 – 2001 or the single year 2000. Members make legally binding commitment to reduce emissions following this baseline. Members who fail to meet their reductions are required to purchase CFIs in the markets in order to offset excess emissions.

*Registry Participant Members*

Registry Participant Members were members with direct GHG emissions who had yet to make a commitment to reducing emissions in a specific year, but had agreed to undergo verification of their current GHG emission quantities. Registry Participant Members established a CCX registry account and submitted a minimum of one year worth of complete emissions data, which was then independently verified by FINRA. Future years of GHG emissions were then

[5] Source: www.chicagoclimatex.com

verified and recorded on the online registry account. Although Registry Participant Members did not participate in the reduction commitment and market for CFIs as Members do, by establishing a registry account they facilitated the process of becoming a Member if the decision was made and the independent verification by FINRA allows them to better respond to future government regulation.

*Associate Members*

Associate members consisted of entities with negligible direct emissions however did have relevant indirect emissions in the form of business energy consumption and relative travel emissions. Associate Members made a legally binding commitment to reduce or offset all of their indirect emissions from the year they join through 2010. Indirect emissions could be offset through the purchase and retirement of CFIs in the CCX market place. In order to entirely offset annual emissions, an Associate Members had to purchase the necessary quantity of CFIs associated with the emissions levels and then retire them for each given year. Associate Members were required to submit annual indirect emissions reports to the CCX to be verified by FINRA. In terms of the CCX market, Associate Members acted as a demand side economic agent through their required purchase of CFIs in order to offset annual emissions.

*Offset Providers & Offset Aggregators*

The Offset Providers membership category consisted of owners of offset projects which sequestered, destroyed or reduced GHG emissions, whereas the Offset Aggregators members acted as agents between smaller offset project owners and the CCX. Offset Aggregators did so by grouping together small projects and presenting them as a larger single offset project and were therefore subject to the same rules and regulations as offset providers. These projects address issues related to deforestation as mentioned in section 3.2. Offset Projects were rewarded with the issuing of CFIs which could be traded on the CCX market and were awarded on a retroactive basis to the year in which the project took place. In order to maintain consistency and integrity of project compensation, all projects were rewarded on a predetermined scale and were weighted appropriately to the size of the offset project. Guidelines for qualifying sequestering, destruction and reduction projects are clearly outlined by the CCX and follow those established by IPCC in 2007. In order for an offset project to qualify the offset provider or aggregator had to first qualify as a CCX member, any offset member with an annual emissions rate greater than 10,000 metric tons of $CO_2$ equivalent had to also register as a CCX Member and were subject to the emissions reduction schedule as previously outlined. This requirement ensured that an offset provider did not benefit from an offset project while continuing with high levels of emissions elsewhere. In order to avoid possible double counting of offset projects, the CCX made a list of all Offset Projects associated with it publicly available and verified other registries for possible double counting before approving the project. Offset Providers and Offset Aggregators acted as supply side agents in terms of the CCX market, bringing new CFIs to the marketplace once a project has been reviewed and approved.

*Liquidity Providers*

The Liquidity Providers joined the CCX with the intent of trading CFIs for financial gain and did not make a reductions requirement commitment. Types of Liquidity Providers that joined the CCX included market makers, commodity trading advisors, proprietary trading groups, hedge funds and local traders. Since Liquidity Providers were not required to make any reduction commitment and joined the CCX simply for trading purposes their economic implications are rather limited in terms of this study.

*Exchange Participants*

Exchange Providers were entities that joined the CCX with the intentions of purchasing CFIs and permanently retiring them. They included businesses, organizations and individuals who wished to offset emissions for an event or activity and did so by purchasing the relevant amount of CFIs and permanently retiring them. The Exchange Providers were subject to enrolment fees and annual dues for each year in which they maintain their registry account. CFIs could be purchased at any time at the prevailing market price. In an economic context, Exchange Providers can be viewed as demand side agents where once an event or activity takes place the Exchange Providers return to the market to purchase CFIs and retire them, thus reducing the overall amount of CFIs in the market place.

## 5.2 Non-Compliance Costs

The failure to meet a required target reduction could be fairly costly to a firm. Costs varied between the magnitude of which the target was missed and the CFI prices, which the firm was required to purchase to make up the difference. The following outlines a hypothetical example in which a firm is unable to meet target reductions. American Electric Power (AEP) is used in this example providing actual baseline and target reductions. We explore situations where AEP hypothetically missed targets by 10%, 25%, and 50% and provide total costs of purchasing CFIs at the yearly low, median, high prices.

AEP Baseline : 154,621,848[6] Tons of $CO_2$

Table 1. AEP Reduction Schedule 2003-2010

| Year | Reduction Requirement | Target Tons of $CO_2$ |
|---|---|---|
| 2003 | 1.00% | 153,075,630 |
| 2004 | 2.00% | 151,529,412 |
| 2005 | 3.00% | 149,983,193 |
| 2006 | 4.00% | 148,436,975 |
| 2007 | 4.25% | 148,050,420 |
| 2008 | 4.50% | 147,663,866 |
| 2009 | 5.00% | 146,890,756 |
| 2010 | 6.00% | 145,344,538 |

American Electric Power's actual $CO_2$ emission reduction requirements as outlined by the CCX reduction Schedule.

Table 2. CFI Prices[7]

| Year | Low | Median | High |
|---|---|---|---|
| 2003 | $0.98 | $0.98 | $1.00 |
| 2004 | $0.73 | $0.96 | $1.80 |
| 2005 | $1.16 | $1.77 | $3.24 |
| 2006 | $1.50 | $4.00 | $4.85 |
| 2007 | $1.70 | $3.50 | $4.15 |
| 2008 | $1.10 | $3.90 | $7.40 |
| 2009 | $0.10 | $0.73 | $2.35 |
| 2010 | $0.05 | $0.10 | $0.15 |

Actual CFI prices for the period between 2003 - 2010

[6] Source: www.aep.com/environmental/reports

[7] Source: www.chicagoclimatex.com

Table 3.1. Non-Compliance Costs: Missing Target By 10%

| | Tons of $CO_2$ | Required CFIs | Non-Compliance Cost Low | Median | High |
|---|---|---|---|---|---|
| 2003 | 15,307,563 | 153,076 | $150,014.12 | $150,014.12 | $153,075.63 |
| 2004 | 15,152,941 | 151,529 | $110,616.47 | $145,468.24 | $272,752.94 |
| 2005 | 14,998,319 | 149,983 | $173,980.50 | $265,470.25 | $485,945.55 |
| 2006 | 14,843,697 | 148,437 | $222,655.46 | $593,747.90 | $719,919.33 |
| 2007 | 14,805,042 | 148,050 | $251,685.71 | $518,176.47 | $614,409.24 |
| 2008 | 14,766,386 | 147,664 | $162,430.25 | $575,889.08 | $1,092,712.61 |
| 2009 | 14,689,075 | 146,891 | $14,689.08 | $106,495.80 | $345,193.28 |
| 2010 | 14,534,453 | 145,345 | $7,267.23 | $14,534.45 | $21,801.68 |

Hypothetical non-compliance costs where AEP was 10% above their reduction targets. Tons of $CO_2$ represents the amount of emissions in which they exceed the target. Required CFIs are the numberof CFIs which must be purchased in order to offset the excess emissions. Non-compliance costs are the total costs of the required CFIs, based on prices outlined in table 2.

Table 3.2. Non-Compliance Costs: Missing Target By 25%

| | Tons of $CO_2$ | Required CFIs | Non-Compliance Cost Low | Median | High |
|---|---|---|---|---|---|
| 2003 | 38,268,907 | 382,689 | $375,035.29 | $375,035.29 | $382,689.08 |
| 2004 | 37,882,352 | 378,824 | $276,541.18 | $363,670.59 | $681,882.35 |
| 2005 | 37,495,798 | 374,958 | $434,951.26 | $663,675.63 | $1,214,863.87 |
| 2006 | 37,109,243 | 371,092 | $556,638.66 | $1,484,369.75 | $1,799,798.32 |
| 2007 | 37,012,605 | 370,126 | $629,214.29 | $1,295,441.18 | $1,536,023.11 |
| 2008 | 36,915,966 | 369,160 | $406,075.63 | $1,439,722.69 | $2,731,781.51 |
| 2009 | 36,722,689 | 367,227 | $36,722.69 | $266,239.50 | $862,983.19 |
| 2010 | 36,336,134 | 363,361 | $18,168.07 | $36,336.13 | $54,504.20 |

Hypothetical non-compliance costs where AEP was 25% above their reduction targets.

Table 3.3. Non-Compliance Costs: Missing Target By 50%

| | Tons of $CO_2$ | Required CFIs | Non-Compliance Cost Low | Median | High |
|---|---|---|---|---|---|
| 2003 | 79,000,000 | 790,000 | $774,200.00 | $774,200.00 | $790,000.00 |
| 2004 | 73,500,000 | 735,000 | $536,550.00 | $705,600.00 | $1,323,000.00 |
| 2005 | 73,232,480 | 732,325 | $849,496.77 | $1,296,214.90 | $2,372,732.35 |
| 2006 | 71,261,043 | 712,610 | $1,068,915.66 | $2,850,441.75 | $3,456,160.62 |
| 2007 | 78,150,000 | 781,500 | $1,328,550.00 | $2,735,250.00 | $3,243,225.00 |
| 2008 | 74,084,000 | 740,840 | $814,924.00 | $2,889,276.00 | $5,482,216.00 |
| 2009 | 64,857,350 | 648,573 | $64,857.35 | $470,215.79 | $1,524,147.72 |
| 2010 | 67,000,000 | 670,000 | $33,500.00 | $67,000.00 | $100,500.00 |

Hypothetical non-compliance costs where AEP was 50% above their reduction targets.

This example demonstrates that the cost of failing to meet a required reduction could be fairly high. Costs fluctuate significantly with the magnitude of missing the target and the CFI price. Here we see that missing the reduction target by 50% when the CFI prices are high could have costs AEP $5.5million in 2008. Unlike initiatives which are not legally binding, CCX firms face uncertainty as to costs. The legally binding nature, as well as the potential high cost of non-compliance, of the CCX demonstrates that firms who decide to join are making a more definitive statement about their commitment to emission reductions.

**5.3 The End of The CCX**

In November 2010 the Chicago Climate Exchange announced that they would closing down. Lack of government regulation on issues related to GHG emissions has been cited as one of the main reasons for the collapse of the CCX. Yang (2006) argues that, although the cap and trade system used by the CCX is an effective way to control emission rates, without proper government regulation these types of markets will have a hard time being entirely effective. In his book, Prof. Sandor outlines the collapse of the CCX and it's relation to the unwillingness of the U.S. government to introduce proper legislation on the matter. Professor Sandor draws a link between fluctuations in CFI price and political endorsement of the CCX, with CFI prices reaching a record high of $7.40 in 2008 after endorsements by Democratic candidates Hilary Clinton and Barack Obama, as well as Senator John McCain. As political interest and support of the CCX began to fade the prices of CFIs began to drop, reaching a record low of $0.05 per CFI in 2010. Dr Sandor recognizes that the collapse of the CCX does not indicate that the market was a complete failure. Rather, the experience presented that a fully functioning cap and trade market in which GHG emission rights can be traded is possible. With participation of over 400 members and support from some powerful politicians the CCX demonstrated that there is interested in such a cap and trade market.

# 6. Why Corporate Social Responsibility?

Kitzmueller and Shimshack (2012) outline factors that might motivate a firm to ostensibly become more socially responsible, including market and politic avenues. For the purpose of this study greater attention will be given to the politics avenue and how it relates to the decision to participate in the CCX. The following outlines the markets and politics avenues discussed by Kitmueller and Shimshack, and provides their relationship to CSR.

## 6.1 Market Determinants of Corporate Social Responsibility

Both labour and product markets may motivate firms. Labour markets are considered to influence a firm's decision to undertake CSR investments through the desire to align the employer's interests with those of their employees. By aligning the interests of both parties, employees are better able to identify with the organization in which they work and by doing so increase their satisfaction within the organization. In a study comparing workers of non-profit organizations with workers of for-profit organizations it is found that workers have a preference for social good and will often trade wages in turn for higher social good (Preston 1989). Higher levels of CSR activity by the organization will result in the willingness of workers to accept a higher wage differential, indicating that workers gain utility from social good through CSR. Besley and Ghatak (2005) find that higher worker utility derived from the employer being involved with social good will often result in greater worker motivation. This relationship between CSR and worker motivation allows firms to screen for more highly motivated workers through CSR (Brekke and Nyborg, 2008). Furthermore, Davis, Whitman and Zald (2008) suggest that higher worker satisfaction through the use of CSR might be a method in which firms can discourage possible unionization attempts.

In addition to the labour markets benefits, firms with higher CSR ratings can gain from increased demand of CSR produced goods in the market place. Baron (2008) finds that management can align their incentives with demands for social responsible goods and thus increase their profitability. In competitive markets CSR firms are able to benefit from increased utility to consumers of CSR produced goods by separating from non-CSR firms. In the case where government regulation requires firms to meet a certain level of compliance higher quality firms will distinguish themselves with over compliance, where the lower quality firm will find it difficult to meet the required compliance levels (Besley and Ghatak, 2007). This separation will allow for consumers to more easily distinguish between the two different qualities of firms.

### 6.2 Political Threats As a Determinant of Corporate Social Responsibility

Kitzmueller and Shimshack (2012) distinguish between public and private threats. Public political threats consist of threats brought on by government intervention, either through legislation or regulation. Private political threats come from activists or non government organizations. Private politic, threats are brought on by boycotts, lawsuits and demonstrations. The effectiveness of private political threats in obtaining a response from the firm depends on a variety factors. Baron (2002) outlines a theoretical framework for the effectiveness of boycotts, the private politic agents that introduce them and the firms that are targeted. The main arguments suggest that the effectiveness of boycotts depends on the reputation or strength of the activist, the characteristics of the target firm (industry concentration, brand value, reputation etc.) and the legitimacy or urgency of the boycott issue (Eesley & Lenox 2006). The private political threats derive from the concerns of citizens on a certain social issue, and the boycott can be seen as a mechanism in which these concerns are brought to the attention of the target firms (Eesley & Lenox 2006, Baron 2009). Baron (2002) also argues that potential target firms need not wait until a private political threat is in place and a proactive approach by potential target can actually be favourable to the firm in terms of opinions of the general public.

Public political threats also derive from concerns of citizens. However, in the case of the public political threats it is through government intervention through forms of regulation and legislation that the concerns are brought to the attention of the firms. When considering the political landscape of the U.S. we can consider Republican and Democrat states as a framework for the different demands of their citizens. In a study on the relationship between political orientation and social issues in the U.S., Leiserowitz et al. (2011) find that citizens who associated themselves with democrat political party tend to be more concerned with social issues related to environmental issues, such as global warming, when compared with citizens who associate themselves with republican parties. In fact, there is found to be a negative correlation between conservative politics (republican) and support for CSR (Liston-Heyes and Creton, 2007). The findings related to political orientation of citizens and the relative support of CSR support from political parties might suggest that firms who are located in democratic states might face greater public political threats then  those in republican states.

In this study, I examine whether implicit political threats motivated companies to join the Chicago Climate Exchange, and whether the stock market's reaction around the time a company announced its joining is associated with such threats. Sierra Club Membership and KLD Rankings are used as proxies for political threats. Sierra Club is a highly influential grassroots organization originating in the U.S. and currently contains over 1.4 million members in the U.S. alone. The organization is a community of activists who seek to increase welfare through social responsibility initiatives. Initiatives include lobbying governments, boycotts, educating on social issue, as well as many others. KLD Rankings provide a look at which firms might be more likely to face some form of political threat. It is possible to make the assumption that a firm with higher rankings for community and environmental strengths would be less likely to face political threats than a firm with lower strength rankings. In addition, we could assume that firms with higher ranking for community and environmental concerns would be more likely to face political threats as societies would be more demanding of CSR improvements.

## 7. Data and Sample Selection

The following section outlines the criteria used in creating a CCX sample and a comparison sample. It also includes a summary of financial, industry and environmental characteristics of both samples. The sample of CCX firms is composed of companies which were listed as members on the CCX, are publicly traded, and for which an exact announcement date for their intentions to join the CCX was identifiable through searches on Factiva and Lexis-Nexis. There are 34 CCX members that meet these criteria a. A comparison sample is composed of firms which are listed on the S&P500 Composite Index and share the same 4-digit SIC code as the CCX firms. Comparison sample data is matched to the announcement year of the respective CCX firm. The comparison sample consists of 75 firms.

### 7.1 Financial and Industry Summary Statistics

Table 1 presents financial and industry characteristics of both CCX sample and comparison sample firms, where All Firms represents CCX and Matching samples combined. Sales, Market Value of Equity and Price to Book data are all collected from Compustat, with Year -1 and Year 0 signifying the year prior to the announcement and the year of the announcement respectively. The Herfindahl index represents industry concentration and is calculated as $HHI_j = \sum_{n} \left(\frac{s_{i,j}}{\sum_{n} s_{i,j}}\right)^2$, where $s$ is the total sales of firm $i$ in the announcement year and $n$ is total number of firms for industry $j$.

Table 4. Summary of Financial and Industry Characteristics of Sample Firms

| | All Firms (n=109) | CCX (n=34) | Comparison (n=75) |
|---|---|---|---|
| Sales Year -1 ($ million) | | | |
| Mean | 13,124.18 | 20,487.56 | 9,786.12 |
| Median | 7,221.8 | 7,727 | 6,899 |
| Sales Year 0 ($ million) | | | |
| Mean | 13,865.21 | 21,481.75 | 10,412.37 |
| Median | 7,676 | 8,534.5 | 7,546 |
| Price to Book Year -1 | | | |
| Mean | 2.691493 | 2.920031 | 2.587889 |
| Median | 1.940 | 1.813 | 2.013 |
| Price to Book Yr-0 | | | |
| Mean | 3.10002 | 3.373304 | 2.976132 |
| Median | 2.073 | 2.201 | 2.036 |
| Market Cap Yr-1 ($ million) | | | |
| Mean | 19,717.02 | 25,709.84 | 16,963.56 |
| Median | 9,025.411 | 8,013.75 | 9,567.335 |
| Market Cap Yr-0 ($ million) | | | |
| Mean | 20,408.37 | 28,780.4 | 16,561.76 |
| Median | 9,689.29 | 8,770.07 | 9,689.29 |
| HHI | | | |
| Mean | 0.093552 | 0.189446 | 0.049493 |
| Median | 0.028976 | 0.09473 | 0.028976 |

CCX represents the 34 firm sample that have joined the CCX, comparison represents the 75 firm comparison sample, all firms represents both samples combined. HHI represents Herfindahl industry concentration index.

Mean sales for the CCX firms are double that of the comparison sample for both year prior and year of, with medians still being significantly higher for both years. Price to book ratios are higher for the CCX firms, for both year of and year prior, when compared against the comparison sample. The higher price to book ratios suggests that CCX firms have greater growth potential in relation to the comparison firms. Mean market cap is much larger for CCX firms in relation to the comparison sample, indicating that on average CCX firms are larger. However, median market caps for both years are smaller for the CCX firms, suggesting that there is a greater variety of firm sizes for the CCX firms versus comparison firms. The CCX firm sample contains some very large companies which are driving the mean results. The Herfindahl index means suggest that the CCX firms come from moderately concentrated industries, where the non-CCX firms tend to come from fairly un-concentrated industries. The HHI median for CCX firms is much smaller than the mean (median = 0.09473vs. mean =0.189446), suggesting that that there are some firms from highly concentrated industries in the sample and then others from fairly un-concentrated industries.

Table 4's overall results suggest that on average the CCX firms tend to be much larger, have greater growth potential and come from more highly concentrated industries than the non-CCX firms.

### 7.2 Environmental Summary Statistics

Environmental performance data is collected from the Kinder, Lydenberg, Domini Research & Analytics (KLD) database. KLD provides binary coding for firm's strengths and weaknesses on a variety of social issues, with 1 indicating if the strength or weakness is present and 0 indicating its absence. Table 5 presents the KLD ratings for strengths and concerns on

Environmental, Corporate Governance and Community issues for the announcement year. This table also provides the ratio of Sierra club membership per 1000 population of the state in which the firm is headquartered during the announcement year.

Table 5. Summary of Environmental Characteristics of Sample Firms

| | All Firms (n=109) | CCX (n= 34) | Matching (n=75) |
|---|---|---|---|
| KLD No. of Environmental Concerns | | | |
| Mean | 1.439252 | 1.46875 | 1.426667 |
| Median | 1 | 1 | 1 |
| KLD Environmental Concerns Regulatory Problems | | | |
| Mean | 0.364486 | 0.4375 | 0.333333 |
| Median | 0 | 0 | 0 |
| KLD Environmental Concerns Substantial Emissions | | | |
| Mean | 0.392523 | 0.4375 | 0.373333 |
| Median | 0 | 0 | 0 |
| KLD No. of Environmental Strengths | | | |
| Mean | 0.691589 | 0.90625 | 0.6 |
| Median | 0 | 1 | 0 |
| KLD Environmental Strengths Pollution Prevention | | | |
| Mean | 0.093458 | 0.1875 | 0.053333 |
| Median | 0 | 0 | 0 |
| KLD No. of Corporate Governance Concerns | | | |
| Mean | 0.682243 | 0.6875 | 0.68 |
| Median | 1 | 1 | 1 |
| KLD No. of Corporate Governance Strengths | | | |
| Mean | 0.364486 | 0.40625 | 0.346667 |
| Median | 0 | 0 | 0 |
| KLD No. of Community Concerns | | | |
| Mean | 0.336449 | 0.40625 | 0.306667 |
| Median | 0 | 0 | 0 |
| KLD No. of Community Strengths | | | |
| Mean | 0.457944 | 0.59375 | 0.4 |
| Median | 0 | 0 | 0 |
| Sierra Club Membership per 1000 HQ State Pop. | | | |
| Mean | 2.377064 | 2.101494 | 2.501989 |
| Median | 1.831058 | 1.7665 | 1.858412 |

CCX represents the 34 firm sample that have joined the CCX, comparison represents the 75 firm comparison sample, all firms represents both samples combined. KLD rankings are provided by Kinder, Lydenberg, Domini Research & Analytics. KLD stats are based on the year of announcement.

KLD ratings rank CCX firms as having slightly higher environmental concerns then the non-CCX firms, with means for both regulatory problems and substantial emissions being higher for the CCX sample. However, CCX firms also out do the comparison firms in number of environmental strengths present (0.9 vs. 0.6), with high ratings in the area of pollution prevention. Both the CCX and comparison samples perform similarly in areas of corporate governance concerns, as well as corporate governance strengths. CCX firms face slightly higher community concerns than their counterparts, but adjust for this with an even higher performance in the area of community strengths. Sierra club membership per 1000 HQ state population means and medians indicate that the comparison sample firms are headquartered in states with a higher membership participation rate than CCX firms. This finding suggests that the comparison sample of non-CCX firms might face greater political threats related to environmental and community concerns then their CCX counterparts

## 8. Event Study

### 8.1 Abnormal Returns

In order to estimate market reaction to the announcement of a firm joining the CCX, abnormal returns are calculated for several event windows around the announcement date. Exact announcement dates are confirmed through searches on Factiva and Lexis-Nexis. Returns are collected from the Center for Research in Security Prices (CRSP) database. Cumulative Abnormal Returns (CARs) are calculated for firm $i$ as $CAR_i = {}_{t=a}^{t=b} \frac{1+r_{i,t}}{1+r_{m,t}} - 1$, where $t$ is the day relative to the announcement day ($t = 0$), $r_i$ is firm $i$'s return and $r_m$ is the market return. Table 6 uses S&P Composite index as the market return.[8]

Table 6. Cumulative Abnormal Returns Around Announcement Date

| Window | No. of days | CARs > 0 | Mean | p-value | Median | p-value |
|---|---|---|---|---|---|---|
| Day -60 to -6 | 55 | 9 | 0.0468 | 0.1750 | 0.0432 | 0.0402** |
| Day -5 to 5 | 11 | 14 | 0.0211 | 0.0824* | 0.0118 | 0.1043 |
| Day -4 | 1 | 15 | 0.0064 | 0.1885 | 0.0003 | 0.4417 |
| Day -3 | 1 | 18 | -0.0030 | 0.3604 | -0.0016 | 0.6567 |
| Day -2 | 1 | 20 | 0.0022 | 0.4236 | -0.0012 | 0.9455 |
| Day -1 | 1 | 19 | 0.0003 | 0.9014 | -0.0011 | 0.8241 |
| Day 0 | 1 | 13 | 0.0035 | 0.2055 | 0.0029 | 0.2120 |
| Day 1 | 1 | 15 | -0.0001 | 0.9815 | 0.0036 | 0.5843 |
| Day -5 to 1 | 7 | 12 | 0.0108 | 0.2033 | 0.0083 | 0.1824 |
| Day -1 to 1 | 3 | 12 | 0.0050 | 0.5337 | 0.0051 | 0.2739 |
| Day 2 to 10 | 9 | 21 | -0.0018 | 0.8101 | -0.0116 | 0.4316 |
| Day 11 to 60 | 50 | 19 | -0.0398 | 0.2344 | -0.0192 | 0.3214 |

Cumulative Abnormal Returns (CARs) are calculated for firm $i$ as $CAR_i = \prod_{t=a}^{t=b} \frac{1+r_{i,t}}{1+r_{m,t}} - 1$, where $t$ is the day relative to the announcement day ($t = 0$), $r_i$ is firm $i$'s return and $r_m$ is the market return. S&P Composite index is used as market return. ** and * indicate significance at the 5% and 10% level, respectively, using t-test for means and Wilcoxin signed-ranks for medians.

CCX firms outperform the market in the days leading up to the event date. More specifically, the 55 day window between day – 60 to -6 shows a mean CAR of 0.0468 and a median of 0.0432, indicating that in the months leading up to the announcement of the firm joining the CCX the firms are outperforming the S&P Composite Index. Performance slows down as we approach the announcement day, with individual day CAR means and medians approaching 0 around the announcement and for the event window -5 to 1 we find a mean of 0.0108 (median =0.0083). CCX firms underperform the market index in the days preceding the

[8] Additional results supporting table 6 are available in the appendix. Table A2 Provides CARs using value weighted portfolio including all distributions as market index. Table A3 Provides CARs using equally weighted portfolio including all distributions as market index.

announcement. Event window Day 2 to 10 demonstrates a mean CAR of -0.0018 (median -0.0116) and window Day 11 to 60 a mean of -0.0398 (median= -0.0192), indicating that the announcement of the firm joining the CCX is associated with an underperformance of the CCX firms relative to the S&P Composite Index in the following months. This finding suggests that investors have a negative view of a firm's decision to make voluntary and legally binding commitment to reduce greenhouse gas emissions by joining the CCX.

Table 7 presents and ranks individual three day $CARs_{-1,1}$ for the 34 CCX companies. $CARs_{-1,1}$ are ranked from most negative to most positive. These CARs are used as dependent variables for regressions in Table 10.

Table 7. Individual $CARs_{-1,1}$ Ranked by Most Negative To Most Positive

| Company Name | Ticker | Year | $CAR_{-1,1}$ |
|---|---|---|---|
| STMicroelectronics | STM | 2003 | -0.1016 |
| Avista Corporation | AVA | 2007 | -0.0635 |
| Boise Inc. | BZ | 2008 | -0.0464 |
| Abbott | ABT | 2008 | -0.0455 |
| Motorola, Inc. | MOT | 2003 | -0.0422 |
| Safeway, Inc. | SWY | 2006 | -0.0364 |
| PSEG | PEG | 2009 | -0.0271 |
| Neenah Paper Incorporated | NP | 2007 | -0.0220 |
| DuPont | DD | 2003 | -0.0101 |
| Ford Motor Company | F | 2003 | -0.0032 |
| Knoll Inc. | KNL | 2006 | -0.0023 |
| green mountain power | GMP | 2004 | -0.0005 |
| Duquesne Light Company | DQE | 2006 | 0.0023 |
| Jim Walter Resources Inc. | WLT | 2007 | 0.0041 |
| Temple-Inland Inc | TIN | 2003 | 0.0042 |
| Eastman Kodak Company | EK | 2007 | 0.0044 |
| Baxter International Inc. | BAX | 2003 | 0.0050 |
| Central Vermont Public Service | CV | 2005 | 0.0051 |
| Waste Management Inc. | WM | 2003 | 0.0109 |
| Puget Sound Energy | PSD | 2007 | 0.0129 |
| IBM | IBM | 2003 | 0.0144 |
| United Technologies Corporation | UTX | 2004 | 0.0171 |
| DTE Energy Inc. | DTE | 2007 | 0.0182 |
| Interface, Inc. | IFSIA | 2004 | 0.0186 |
| TECO Energy, Inc. | TE | 2004 | 0.0191 |
| Bank of America Corporation | BAC | 2007 | 0.0199 |
| International Paper | IP | 2003 | 0.0299 |
| MeadWestvaco Corp. | MWV | 2003 | 0.0316 |
| NRG Power Marketing | NRG | 2007 | 0.0382 |
| Smithfield Foods, Inc. | SFD | 2007 | 0.0410 |
| Intel Corporation | INTC | 2007 | 0.0490 |
| Monsanto Company | MON | 2007 | 0.0520 |
| American Electric Power | AEP | 2003 | 0.0789 |
| Domtar Corporation | UFS | 2008 | 0.0954 |

Individual $CARs_{-1,1}$ for the 34 CCX firms. $CARs_{-1,1}$ are ranked from most negative to most positive. Year is the announcement year.

### 8.2 Abnormal Trading Volumes

In addition to the event study abnormal trading volumes for the CCX firms are computed around the announcement date. Event window trading volumes are compared against average trading volumes for a period of 55 days between day -60 to -6 relative to Day 0 being the announcement date. Abnormal trading volumes are computed as the log of the ratio between individual firm's average trading volume over the event window and the average trading volume between day -60 to -6. That is, abnormal trading volume for firm $i$ is computed as: $\Delta V_{i,}\ t_a, t_b$ = $Ln\ \frac{V_i(t_a, t_b)}{V_i(-60,-6)}$ for event window day $a$ to $b$.

Table 8. Abnormal Trading Volume Around Announcement Date

| Window | No. of days | Mean $\Delta V$ | p-value | Median $\Delta V$ | p-value |
|---|---|---|---|---|---|
| Day -5 to 5 | 11 | 0.0573 | 0.2203 | 0.0650 | 0.1462 |
| Day -4 | 1 | 0.0003 | 0.9970 | -0.0297 | 0.9319 |
| Day -3 | 1 | 0.0180 | 0.8328 | 0.0201 | 0.8241 |
| Day -2 | 1 | -0.1208 | 0.1278 | -0.0803 | 0.1043 |
| Day -1 | 1 | -0.0436 | 0.5964 | -0.0980 | 0.7976 |
| Day 0 | 1 | -0.1423 | 0.0655* | -0.1351 | 0.0493** |
| Day 1 | 1 | -0.0215 | 0.7956 | 0.0451 | 0.9183 |
| Day -5 to 1 | 7 | 0.0303 | 0.5477 | 0.0233 | 0.6080 |
| Day -1 to 1 | 3 | -0.0256 | 0.6729 | -0.0258 | 0.6080 |
| Day 2 to 10 | 9 | 0.0691 | 0.2766 | 0.0650 | 0.3740 |
| Day 11 to 60 | 50 | 0.0639 | 0.2045 | 0.0787 | 0.2520 |

Abnormal trading volumes ($\Delta V_{i,}$) are calculated for firm $i$ as $\Delta V_{i,}\ t_a, t_b\ {}_i = Ln\ \frac{V_i(t_a, t_b)}{V_i(-60,-6)}$ , for event window day $a$ to $b$. ** and * indicate significance at the 5% and 10% level, respectively, using t-test for means and Wilcoxin signed-ranks for medians.

Abnormal volume results indicate an increase in trading during the days leading up to the announcement date and a decrease in volume beginning on day -2 and continuing until Day 1, with the largest, and only significant, decrease found on day 0 with Mean $\Delta V$ = -0.1423 (Median $\Delta V$ = -0.1351). The largest increase in trading volume occurs in the days following the announcement, with event windows day 2 to 10 and day 11 to 60 demonstrating high means and medians for $\Delta V$. The fluctuations in abnormal volumes reconfirm the finding in the CAR results, that investors have a negative reaction to the announcement of a firm's decision to join the CCX.

Table 9 presents and ranks individual $\Delta Vs_{-1,1}$ for the 34 CCX companies. $\Delta Vs_{-1,1}$ are ranked from most negative to most positive. These abnormal volumes are used as dependent variables for regressions in Table 11.

Table 9. Individual $\Delta Vs_{-1,1}$ Ranked by Most Negative To Most Positive

| Company Name | Ticker | Year | $\Delta V_{-1,1}$ |
|---|---|---|---|
| Boise Inc. | BZ | 2008 | -0.7964 |
| Jim Walter Resources Inc. | WLT | 2007 | -0.7019 |
| TECO Energy, Inc. | TE | 2004 | -0.4524 |
| Puget Sound Energy | PSD | 2007 | -0.4357 |
| Duquesne Light Company | DQE | 2006 | -0.4149 |
| Temple-Inland Inc | TIN | 2003 | -0.3856 |
| Ford Motor Company | F | 2003 | -0.3476 |
| Central Vermont Public Service | CV | 2005 | -0.2667 |
| Baxter International Inc. | BAX | 2003 | -0.2556 |
| green mountain power | GMP | 2004 | -0.2369 |
| Motorola, Inc. | MOT | 2003 | -0.1777 |
| Interface, Inc. | IFSIA | 2004 | -0.1041 |
| Waste Management Inc. | WM | 2003 | -0.0991 |
| Smithfield Foods, Inc. | SFD | 2007 | -0.0753 |
| Monsanto Company | MON | 2007 | -0.0690 |
| Abbott | ABT | 2008 | -0.0635 |
| NRG Power Marketing | NRG | 2007 | -0.0435 |
| American Electric Power | AEP | 2003 | -0.0081 |
| Safeway, Inc. | SWY | 2006 | -0.0048 |
| Domtar Corporation | UFS | 2008 | 0.0072 |
| IBM | IBM | 2003 | 0.0228 |
| MeadWestvaco Corp. | MWV | 2003 | 0.0508 |
| Eastman Kodak Company | EK | 2007 | 0.0761 |
| International Paper | IP | 2003 | 0.1223 |
| PSEG | PEG | 2009 | 0.1925 |
| United Technologies Corporation | UTX | 2004 | 0.2187 |
| DTE Energy Inc. | DTE | 2007 | 0.2416 |
| Neenah Paper Incorporated | NP | 2007 | 0.2720 |
| DuPont | DD | 2003 | 0.2937 |
| STMicroelectronics | STM | 2003 | 0.3170 |
| Knoll Inc. | KNL | 2006 | 0.3729 |
| Intel Corporation | INTC | 2007 | 0.3897 |
| Avista Corporation | AVA | 2007 | 0.6435 |
| Bank of America Corporation | BAC | 2007 | 0.8479 |

Individual $\Delta V_{i-1,1}$ for the 34 CCX firms. $\Delta V_{-1,1}$ are ranked from most negative to most positive. Year is the announcement year.

# 9. Regressions

## 9.1 Determinants of Abnormal Returns

Table 10 examines the determinants of CARs around the event window Day -1 to 1, using three different OLS regressions. Dependent variables are the CARs for Day -1 to 1 for each of 34 firms. Independent variables: sales year -1, price to book Year -1, HHI, Sierra Club membership, KLD No. of environmental concerns, KLD No. of environmental strengths, KLD No. of community concerns, KLD No. of community strengths are as previously defined. Independent variable, stand deviation is the standard deviation of each individual firm's stock price for the period day -60 to -6 relative to the announcement date, CFI Price is the average CFI trading price in the 3-month period leading up to announcement date, Factiva Chicago Climate Exchange is number of search results using Factiva for "Chicago Climate Exchange" in the 3-Month period leading up to the announcement date. P-values are in parenthesis, * identifies significance at the 10% level.

Table 10. Cross-sectional Regressions on CARs Around Day -1 to 1

| | Regression 1 | Regression 2 | Regression 3 |
|---|---|---|---|
| Intercept | -0.0232504 | -0.039288 | -0.0060341 |
| | (0.663) | (0.412) | (0.882) |
| Log Market Value Year Prior ($ million) | 0.0029377 | 0.002947 | 0.0015465 |
| | (0.672) | (0.652) | (0.810) |
| Price to book Year -1 | -0.0111241 | -0.0108518 | -0.00977 |
| | (0.080*) | (0.075*) | (0.084*) |
| HHI | 0.0070555 | 0.0126574 | -0.0013222 |
| | (0.822) | (0.668) | (0.960) |
| Standard Deviation | 0.2216187 | 0.4715372 | |
| | (0.665) | (0.268) | |
| CFI Price | 0.0065817 | 0.0050716 | |
| | (0.385) | (0.367) | |
| Sierra Club Membership | -0.005429 | | |
| | (0.366) | | |
| Factiva Chicago Climate Exchange | -0.0000565 | | |
| | (0.825) | | |
| KLD No. of Environmental Concerns | 0.0019215 | 0.0030354 | 0.0022199 |
| | (0.782) | (0.648) | (0.733) |
| KLD No. of Environmental Strengths | 0.012828 | 0.0102512 | 0.012575 |
| | (0.106) | (0.150) | (0.069*) |
| KLD No. of Community Concerns | 0.0118473 | 0.0136958 | 0.0129931 |
| | (0.295) | (0.207) | (0.229) |
| KLD No. of Community Strengths | 0.0036676 | 0.0019231 | 0.0016864 |
| | (0.757) | (0.865) | (0.881) |
| Adjusted R-Squared | 0.0199 | 0.0704 | 0.0715 |

Coefficient estimates from OLS estimations on $CARs_{-1,1}$ for 34 CCX firms. HHI is the Herfindahl industry concentration index, standard deviation is the standard deviation in prices for days -60 to -6, CFI price is the average price of CFIs in the 3-month period leading up to the announcement, Factiva Chicago Climate Exchange is number of search results using Factiva for "Chicago Climate Exchange" in the 3-Month period leading up to the announcement date P-values are in parenthesis with * indicating significance at the 10% level.

Roughly 7% of the cross-sectional variations in $CAR_{-1,1}$ are explained by the variables in regression 3. The only variables found to be significant at the 10% significance level are Price to book Year -1 and KLD No. of Environmental Strengths. Price to book value in the year prior to the announcement had a negative impact on the $CAR_{-1,1}$, suggesting that perhaps investors might view joining the CCX as taking away from potential growth opportunities be allocating resources away from positive NPV projects towards emissions reductions projects. KLD rankings for both strengths and weaknesses have a positive impact on the abnormal returns, with KLD No. of Environmental Strengths having the most positive and only significant impact. Results for KLD No. of Environmental Strengths might indicate that investors view firm's which are already recognized as environmental leaders as being more likely to benefit from joining CCX. Results for table A4 in the appendix demonstrate similar results as table 7. Roughly 4% cross-sectional variations in $CAR_{-1,1}$ are explained by the variables in regression 3 in Table C. Price to book value in the year prior to the announcement had a negative impact on the $CAR_{-1,1}$ and was significant at the 5% level. Log market value year prior ($ million) was found to be significant at the 10% level and demonstrate a positive relationship with the dependent, indicating that larger firms experienced more positive abnormal returns around the announcement date.

### 9.2 Determinants of Abnormal Volumes

Table 11 replicates Table 10 using $\Delta Vs_{-1,1}$ as dependent in place of $CARs_{-1,1}$. All variables are as previously defined. P-values are in parenthesis, * identifies significance at the 10% level.

Table 11. Cross-sectional Regressions on Abnormal Volume Around Day -1 to 1

| | Regression 1 | Regression 2 | Regression 3 |
|---|---|---|---|
| Intercept | -0.9678109 | -0.0202132 | -1.029623 |
| | (0.107) | (0.355) | (0.882) |
| Log Market Value Year Prior ($ million) | 0.1087626 | 0.1347407 | 0.1379882 |
| | (0.160) | (0.076*) | (0.072*) |
| Price to book Year -1 | -0.0760412 | -0.091126 | -0.0539939 |
| | (0.262) | (0.177) | (0.397) |
| HHI | 0.3744896 | 0.256101 | 0.1077082 |
| | (0.281) | (0.442) | (0.721) |
| Standard Deviation | -4.043555 | -6.080925 | |
| | (0.471) | (0.206) | |
| CFI Price | -0.0047949 | 0.0722426 | |
| | (0.953) | (0.256) | |
| Sierra Club Membership | 0.0232409 | | |
| | (0.720) | | |
| Factiva Chicago Climate Exchange | 0.0040238 | | |
| | (0.159) | | |
| KLD No. of Environmental Concerns | -0.0604703 | -0.072176 | -0.0922253 |
| | (0.427) | (0.338) | (0.227) |
| KLD No. of Environmental Strengths | 0.0706989 | 0.0858033 | 0.0643071 |
| | (0.402) | (0.278) | (0.408) |
| KLD No. of Community Concerns | 0.0700089 | 0459515 | 0.0465735 |
| | (0.567) | (0.702) | (0.705) |
| KLD No. of Community Strengths | -0.0632321 | -0.0685199 | -0.0919568 |
| | (0.625) | (0.591) | (0.481) |
| Adjusted R-Squared | 0.1052 | 0.0981 | 0.0473 |

Coefficient estimates from OLS estimations on $\Delta V_{-1,1}$, for 34 CCX firms. HHI is the Herfindahl industry concentration index, standard deviation is the standard deviation in prices for days -60 to -6, CFI price is the average price of CFIs in the 3-month period leading up to the announcement, Factiva Chicago Climate Exchange is number of search results using Factiva for “Chicago Climate Exchange” in the 3-Month period leading up to the announcement date P-values are in parenthesis with * indicating significance at the 10% level.

Results indicate that roughly 10% of the cross-sectional variations in $\Delta V_{-1,1}$ are explained by the variables in regression 2. The only variable found to be significant is log of market value year prior ($ million), which is significant at the 10% level. The positive result indicates that larger firms experience an increase in trading volume around the announcement date. Results for table A5 in the appendix demonstrate similar results, with an adjusted r-squared of 0.1701 and results for market value year prior ($ million) showing positive and significant results.

### 9.3 Probit Regression

The following table reports probit estimation results for a firm's decision to join the CCX compared against that of the comparison sample of firms who did not join, exploring firm characteristics which influence the decision. The CCX Sample consists of 34 firms where the comparison sample includes 75 firms listed on the S&P Composite Index with same SIC code and years as the CCX sample, for total of 109 companies used in the regression . The dependent variable is coded as 1 for CCX sample firms and 0 for firms in the comparison sample. Independent variables are as previously defined. P-values are in parenthesis, ** and *** identify significance at the 5% level and 1% level respectively.

Table 12. Probit Regression on Decision to Join CCX

| | |
|---|---|
| Intercept | 2.400165<br>(0.064) |
| Log Market Value Year Prior ($ million) | -0.3832234<br>(0.014**) |
| Price to Book Year -1 | -0.0500651<br>(0.361) |
| HHI | 5.417945<br>(0.002***) |
| Sierra Club Membership | -0.1636549<br>(0.134) |
| KLD No. of Environmental Concerns | 0.0820295<br>(0.491) |
| KLD No. of Environmental Strengths | 0.246575<br>(0.158) |
| KLD No. of Community Concerns | 0.1723684<br>(0.579) |
| KLD No. of Community Strengths | 0.4228436<br>(0.046**) |
| Pseudo R-Squared | 0.2371 |

Coefficient estimates for probit regression on the probability that a firm joins the CCX. The sample consists 34 CCX firms and 75 comparison firms, coded as 1 and 0 respectively for the dependent variable. P-value are in parenthesis with ** and *** indicating significance at the 5% and 1% levels respectively.

Roughly 23.7% of the firms decision to join the CCX can be explained by the independent variables used in the probit regression. Estimate for log of market value in year prior are found to be significant and indicate that larger firms are less likely to join. Herfindahl index for industry concentration provides significant positive results, indicating that firms in highly concentrated industries are more likely to join. These two results could be an indication that it is the smaller firm in the highly concentrated industries that is making the decision to join to perhaps distinguish themselves from larger competitors. KLD ranking for number of community strengths provides significant and positive results, indicating that the presence of a community strength increases the probability of a firm joining the CCX.

## 10. Conclusion

Concerns over global warming and more specifically it's relation to GHG emissions continue to be a pressing issue that urgently needs to be addressed. The U.S. continues to be the leading culprit in the area of overall amounts of GHG emissions and at the same time continue to show little initiative towards finding a solution to the problem. Failure to join global initiative projects such as the Kyoto Protocol combined with the lack of national reduction initiatives within the U.S. leaves environmentally conscientious companies with no other option then to join a voluntary initiative program such as the CCX. However, these voluntary initiatives can prove to be costly to the companies that join them.

This thesis explores the market reaction to a firm's announcement of their decision to make a voluntary commitment to reduce GHG emissions, as well as the characteristics of firm who decide to make such a commitment. Overall results indicate that there is a negative market reaction to this announcement. These findings indicate that voluntary GHG initiative projects might conflict with investor's interests, suggesting that investors would prefer that resources not be allocated towards corporate social responsibility, such as GHG emissions reductions, when then can be allocated towards more profitable projects. The lack of shareholder interest in voluntary emission reductions programs might imply that the only way in which the problem of GHG emissions can be properly addressed is through the introduction of federal legislations. The use of a cap and trade system in conjunction with government regulation has proven to be successful in the past, such as in the case of $SO_2$ emission plans introduced by Clean Air Act Amendment in the 1990s. As the U.S. government continues to fail to react on the issue and is it appears the only truly viable solution to the problem is through the introduction of GHG emissions related legislation, perhaps there is greater need for public politics to take action and for the people of the United States to require their governments to hold firms accountable for their contributions to global warming.

The measures for political threats used in the study are recognized as being noisy. Sierra Club membership in the state in which each firm is headquartered, provides only a glimpse as to possible private political threats by activist citizens. Sierra Club is a grassroots organization covering many areas of social concern, making it difficult to link membership rates directly to political threats related to GHG emissions. Even more difficult to discern is the relationship of KLD statistics to political threats pertaining to GHG emissions, as the measure for KLD rating is somewhat ambiguous. Future research might explore the use of instrumental variables in order to define more distinct measures of political threats. Perhaps proxies for community involvement in social issues related to the environment might provide a clearer picture of what threats the firms are actually facing. Such proxies might include average age, areas of specialization or gasoline usage per capita for the communities in which the firms are part of. The challenge is in the operationalization of the public and private political threats, if future research were able to accomplish this we could gain a better understanding of which threats are influencing firm's decisions.

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# Appendix

Figure A1 shows historical CFI prices for the period 2003 to 2011. Figure 2 summarizes historical CFI by giving yearly averages for CFI prices.

Figure A1. Historical CFI Prices from 2003 to 2011


Table A1. Yearly Average CFI Prices

| Year | Average $/CFI |
|---|---|
| 2003 | $0.98 |
| 2004 | $1.07 |
| 2005 | $1.89 |
| 2006 | $3.59 |
| 2007 | $3.20 |
| 2008 | $3.75 |
| 2009 | $0.95 |
| 2010 | $0.09 |
| 2011 | $0.05 |

Table A2. CARs Using Value Weighted Portfolio Including All Distributions as Market Index

| Window | No. of days | CARs > 0 | Mean | p-value | Median | p-value |
|---|---|---|---|---|---|---|
| Day -60 to -6 | 55 | 11 | 0.0380 | 0.2620 | 0.0390 | 0.0842* |
| Day -5 to 5 | 11 | 14 | 0.0174 | 0.1469 | 0.0130 | 0.2058 |
| Day -4 | 1 | 17 | 0.0058 | 0.2265 | 0.0001 | 0.5611 |
| Day -3 | 1 | 18 | -0.0033 | 0.3078 | -0.0020 | 0.5270 |
| Day -2 | 1 | 19 | 0.0022 | 0.4123 | -0.0015 | 1.0000 |
| Day -1 | 1 | 20 | -0.0003 | 0.9031 | -0.0011 | 0.7068 |
| Day 0 | 1 | 12 | 0.0035 | 0.2058 | 0.0039 | 0.1714 |
| Day 1 | 1 | 15 | -0.0002 | 0.9434 | 0.0033 | 0.6443 |
| Day -5 to 1 | 7 | 13 | 0.0090 | 0.2907 | 0.0062 | 0.2381 |
| Day -1 to 1 | 3 | 12 | 0.0031 | 0.6274 | 0.0044 | 0.3649 |
| Day 2 to 10 | 9 | 23 | -0.0042 | 0.5809 | -0.0137 | 0.2814 |
| Day 11 to 60 | 50 | 20 | -0.0444 | 0.1829 | -0.0230 | 0.1880 |

Cumulative Abnormal Returns (CARs) are calculated for firm $i$ as $CAR_i = \prod_{t=a}^{t=b} \frac{1+r_{i,t}}{1+r_{m,t}} - 1$, where $t$ is the day relative to the announcement day ($t = 0$), $r_i$ is firm $i$'s return and $r_m$ is the market return. Value weighted portfolio including all distribution index provided by CRSP is used as market return. * indicates significance at the 10% level, using t-test for means and Wilcoxin signed-ranks for medians.

Table A3. CARs Using Equally Weighted Portfolio Including All Distributions as Market Index

| Window | No. of days | CARs > 0 | Mean | p-value | Median | p-value |
|---|---|---|---|---|---|---|
| Day -60 to -6 | 55 | 16 | 0.0000 | 0.9981 | 0.0186 | 0.9047 |
| Day -5 to 5 | 11 | 19 | 0.0008 | 0.9452 | -0.0061 | 0.6942 |
| Day -4 | 1 | 20 | 0.0036 | 0.4116 | -0.0009 | 0.9047 |
| Day -3 | 1 | 18 | -0.0048 | 0.1732 | -0.0034 | 0.2592 |
| Day -2 | 1 | 20 | 0.0006 | 0.8211 | -0.0025 | 0.7583 |
| Day -1 | 1 | 22 | -0.0033 | 0.2823 | -0.0049 | 0.2314 |
| Day 0 | 1 | 14 | 0.0028 | 0.3411 | 0.0046 | 0.3471 |
| Day 1 | 1 | 17 | -0.0016 | 0.6345 | 0.0006 | 0.9727 |
| Day -5 to 1 | 7 | 17 | -0.0006 | 0.9393 | -0.0005 | 0.9727 |
| Day -1 to 1 | 3 | 15 | -0.0019 | 0.7806 | 0.0044 | 1.0000 |
| Day 2 to 10 | 9 | 23 | -0.0109 | 0.1981 | -0.0169 | 0.1462 |
| Day 11 to 60 | 50 | 20 | -0.0437 | 0.2018 | -0.0314 | 0.2120 |

Cumulative Abnormal Returns (CARs) are calculated for firm $i$ as $CAR_i = \prod_{t=a}^{t=b} \frac{1+r_{i,t}}{1+r_{m,t}} - 1$, where $t$ is the day relative to the announcement day ($t = 0$), $r_i$ is firm $i$'s return and $r_m$ is the market return. Equally weighted portfolio including all distribution index provided by CRSP is used as market return. T-test for means and Wilcoxin signed-ranks for medians.

Table A4. Cross-sectional Regressions on CARs Around Day -1 to 1

| | Regression 1 | Regression 2 | Regression 3 |
|---|---|---|---|
| Intercept | -0.0695359 | -0.0795053 | -0.0470729 |
| | (0.130) | (0.055) | (0.134) |
| Log Market Value Year Prior ($ million) | 0.0107308 | 0.0102774 | 0.0092236 |
| | (0.032**) | (0.028**) | (0.039**) |
| Price to book Year -1 | -0.0120602 | -0.0117012 | -0.0112146 |
| | (0.060*) | (0.056*) | (0.049**) |
| HHI | 0.0185449 | 0.0231702 | 0.0120347 |
| | (0.549) | (0.425) | (0.633) |
| Standard Deviation | 0.3809311 | 0.5690181 | |
| | (0.444) | (0.175) | |
| CFI Price | 0.005996 | 0.0041861 | |
| | (0.432) | (0.456) | |
| Sierra Club Membership | -0.0042164 | | |
| | (0.478) | | |
| Factiva Chicago Climate Exchange | -0.0000782 | | |
| | (0.759) | | |
| KLD No. of Env. (Strengths – Concerns) | 0.0050992 | 0.0037093 | 0.0051957 |
| | (0.347) | (0.449) | (0.282) |
| KLD No. of Com. (Strengths – Concerns) | -0.0096466 | -0.0104338 | -0.0112567 |
| | (0.255) | (0.201) | (0.169) |
| Adjusted R-Squared | -0.0060 | 0.0538 | 0.0413 |
| | N=34 | N=34 | N=34 |

Coefficient estimates from OLS estimations on $CARs_{-1,1}$ for 34 CCX firms. HHI is the Herfindahl industry concentration index, standard deviation is the standard deviation in prices for days -60 to -6, CFI price is the average price of CFIs in the 3-month period leading up to the announcement, Factiva Chicago Climate Exchange is number of search results using Factiva for "Chicago Climate Exchange" in the 3-Month period leading up to the announcement date, KLD No. of Env. (Strengths – Concerns) and KLD No. of Com. (Strengths – Concerns) are composed of the difference between the strengths and concerns in each respective category. P-values are in parenthesis with * and ** indicating significance at the 10% and 5% level respectively.

TableA 5. Cross-sectional Regressions on Abnormal Volume Around Day -1 to 1

| | Regression 1 | Regression 2 | Regression 3 |
|---|---|---|---|
| Intercept | -0.9945885 | -1.037883 | -0.9232531 |
| | (0.039) | (0.021) | (0.010) |
| Log Market Value Year Prior ($ million) | 0.113153 | 0.1331758 | 0.1191567 |
| | (0.028**) | (0.009**) | (0.016**) |
| Price to book Year -1 | -0.0765148 | -0.0908339 | -0.0505823 |
| | (0.233) | (0.158) | (0.403) |
| HHI | 0.382249 | 0.2599412 | 0.0773263 |
| | (0.234) | (0.402) | (0.779) |
| Standard Deviation | -3.906499 | -5.825379 | |
| | (0.444) | (0.193) | |
| CFI Price | -0.0053302 | 0.0729911 | |
| | (0.945) | (0.228) | |
| Factiva Chicago Climate Exchange | 0.0040238 | | |
| | (0.134) | | |
| Sierra Club Membership | 0.0242553 | | |
| | (0.689) | | |
| KLD No. of Env. (Strengths – Concerns) | 0.0650237 | 0.076711 | 0.0773585 |
| | (0.245) | (0.149) | (0.148) |
| KLD No. of Com. (Strengths – Concerns) | -0.0710912 | -0.067599 | -0.0614109 |
| | (0.410) | (0.433) | (0.487) |
| Adjusted R-Squared | 0.1862 | 0.1701 | 0.1163 |
| | N=34 | N=34 | N=34 |

Coefficient estimates from OLS estimations on $\Delta V_{-1,1}$ , for 34 CCX firms. HHI is the Herfindahl industry concentration index, standard deviation is the standard deviation in prices for days -60 to -6, CFI price is the average price of CFIs in the 3-month period leading up to the announcement, Factiva Chicago Climate Exchange is number of search results using Factiva for "Chicago Climate Exchange" in the 3-Month period leading up to the announcement date, KLD No. of Env. (Strengths – Concerns) and KLD No. of Com. (Strengths – Concerns) are composed of the difference between the strengths and concerns in each respective category. P-values are in parenthesis with ** indicating significance at the 5% level.