Institutional and stakeholder effects on carbon mitigation strategies

Kanwalroop K. Dhanda
Professor
Jack Welch College of Management & Technology
Sacred Heart University
5151 Park Avenue
Fairfield, CT 06825
Email: dhandak@sacredheart.edu

Joseph Sarkis
Professor
Foisie Business School
Worcester Polytechnic Institute
100 Institute Road
Worcester, MA 01609-2280
Email: jsarkis@wpi.edu

HUMLOG Institute
Hanken School of Economics
Helsinki, Finland

Dileep G. Dhavale
Professor
Graduate School of Management
Clark University
950 Main Street
Worcester, MA 01610
Email: ddhavale@clark.edu

Abstract

The latest IPCC report foreshadows a far gloomier picture of climate change consequences than previously held by demonstrating how avoiding environmental damage requires transforming the world economy at a speed and scale that has “no documented historic precedent.” One of the options to address climate change is adoption of mitigation strategies to reduce carbon emissions on national, sectoral, and corporate levels. This research analyzes mitigation responses by organizations facing institutional and stakeholder pressures while dealing with the risk and opportunities presented by climate change. Our research indicates that different types of institutional pressures—coercive, normative, and mimetic—lead to different and, in certain situations, more active responses from companies. We find that coercive pressures are about equal or more effective than normative or mimetic pressures for adoption of mitigation strategies.

Keywords: Carbon Mitigation Strategies, Institutional Pressures, Stakeholder Pressures, Carbon Disclosure Project, Multinomial Logistical Regression Model

1: INTRODUCTION

The current epoch – the Anthropocene – began around 1780 and has witnessed a marked experience on Earth as well as its environment caused by human activities (Crutzen, 2006). The latest report from the United Nations Scientific Intergovernmental Panel on Climate Change (IPCC) reported if greenhouse gas (GHG) or carbon (CO_2) emissions continue at the present level, the atmosphere will increase by 2.7 degrees Fahrenheit (1.5° C) above pre-industrial levels by 2040. Indeed, climate change is one of the nine planetary boundaries that represents the most serious limits to humanity's survival (Steffen et. al., 2015).

The most dramatic discovery of the IPCC report is the planet has only12 years to avoid attaining the limit of 1.5° C increase and ultimately evade catastrophic environmental breakdown. In addition, it was found that the impact and costs of the temperature rise will be more significant than initially anticipated. Hence, the IPCC report calls for urgent and unprecedented changes to be implemented to avoid colossal damage on the environment (Taylor, et. al., 2018).

Soon after the IPCC report, an additional report was released by 13 United States federal agencies. The National Climate Assessment (NCA) report warns of the consequences of climate change for the United States, and outlines the crippling effects including the wildfires in California, crop failures in the Midwest, and a crumbling infrastructure in the South. The report estimates that climate change could slash up to a tenth of gross domestic product by 2100, which is more than double the losses of the Great Recession (Davenport and Pierre-Louis, 2018).

Therefore, given these critical global climate changes and warming implications, what can be done? The solutions range from policy decisions by government and regulators to actions at the business level to individual and consumer choices.

The strategies put forth in the NCA report are primarily regarding adaptation. However, the reality is both mitigation and adaptation strategies need to be pursued simultaneously in order to reach the estimates put forth by the IPCC report. Most emissions causing global climate change result from industrial activity and this has led to increased pressure on corporations and industrial sectors to mitigate emissions. Actions taken for mitigation of GHG emissions and disclosure of relevant information have become more commonplace (Depoers, et. al., 2016).

In order to curb global GHG emissions and achieve Paris Agreement targets (Taylor, et. al., 2018), companies must make efforts to reduce their own emissions, both direct and indirect. Carbon emissions are categorized into different groups or "scopes" by the commonly applied GHG Protocol. Scope 1 emissions are direct emissions from sources that are owned and controlled by a company and cover production of electricity, fuel consumption, or emissions from a company's vehicles. Scope 2 emissions are indirect emissions from consumption of purchased electricity, heat, or steam (GHG 2017). Scope 3 emissions— which are the most difficult to measure and control— are all other indirect emissions from sources not owned or controlled by the company, which include emissions from both suppliers and consumers (Carbon Trust, 2017). Unlike Scope 3, Scope 1 and 2 emissions are measurable and can be reduced by effective company effort. In this study, we focus on Scope 1 and Scope 2 emissions.

Environmental disclosures have become a common organizational practice. Indeed, sustainability reporting by corporations is on the rise and, in case of Europe and Japan, is accompanied by regulatory requirements and government encouragement (Kolk, 2003).

Furthermore, voluntary carbon disclosure is positively associated with firms' financial performance (Alsaifi, et. al., 2020). One such voluntary emission disclosure mechanism is the Carbon Disclosure Project (CDP), a non-profit organization that facilitates environmental disclosures from share-holder owned companies. Every year, CDP sends out a questionnaire and collects data from large firms across the globe and across different industrial sectors (CDP, 2017). In our study, we utilize the Climate Change Information Survey segments from the CDP in order to determine how organizations respond to various pressures— both institutional and stakeholder— in the adoption of various levels of carbon emissions mitigation strategies. We utilize the CDP database since it is considered to be the most comprehensive collection of self-reported environmental climate data, and is widely used in academic literature (Matsioff, Noonan, and O'Brien, 2012; Stanny and El, 2008; Kolk, Levy, and Pinsky, 2008).

Our research investigates the relationships between various emission abatement practices: such as reduction of GHG emissions, carbon trading against various institutional – categorized as coercive, normative, or mimetic – and stakeholder pressures including governmental and industrial stakeholders. We jointly utilize stakeholder theory and institutional theory as the theoretical foundation to frame and analyze corporate carbon reduction strategies and actions. Our study utilizes a Bayesian framework for statistical estimation in investigating these relationships.

Likewise, we provide novel insights into what institutional pressures cause organizational adoption and various mitigation strategies. The institutional-stakeholder pairing is likely to have varying—heterogeneous—results in adoption; these relationships are a major theoretical dimension we seek to investigate. We find strong evidence of heterogeneity of responses based on pairings which have implications for policy makers and organizations. These insights critically advance understanding of both the theory and practice of corporate efforts to manage emissions.

2: LITERATURE REVIEW

Stakeholders are defined as "any group or individual who can affect or is affected by the achievement of an organization's objectives" (Freeman, 1984). Companies produce externalities in their operations, those in turn have an impact on parties that are either internal or external to the organization. Because of the presence of these externalities – which are usually considered free goods to an organization – stakeholders attempt to influence companies to reduce their negative impacts and increase positive ones.

Stakeholders are categorized in various ways across different contexts (Henriques and Sadorsky, 1999); Buysse and Verbeke, 2003). For the purpose of this paper, the following three stakeholder groups are used: governmental and regulatory bodies; industry associations and non-governmental organizations (NGOs); and competitors of the company.

Stakeholder Pressures

Literature has documented the impact of stakeholder pressure on the adoption of environmental practices. Indeed, stakeholder pressure is stated to be a central factor (Gonzalez-Benito and Gonzalez-Benito, 2006), one that is supported by the connection between institutional theory and stakeholder pressure with dynamic capabilities (Sarkis, et al., 2010).

Furthermore, stakeholder groups influence corporate behavior and coerce companies to introduce environment-related initiatives (Madsen and Ulhøi (2001). Motivations behind beneficial corporate environmental practices result from variations in perceived stakeholder pressures. For example, Vanpoucke (2016) studied green supply chain practices, stakeholder support, and recognition whereas Simpson and Sroufe (2014) observed this phenomenon in ISO 14000 standards adoption.

The responses differ depending on the institutional pressure-stakeholder pressure pairing. Firms with a greater regulatory-coercive stakeholder focus are linked to better use of reportable practices, such as end-of-pipe pollution reduction whereas firms with greater normative stakeholder events are linked to an increase use of embedded practices, such as pollution prevention policies (Simpson and Sroufe, 2014).

In terms of stakeholders' influence, it seems that internal stakeholders have the greatest impact followed by economic pressures, environmental regulations, and external stakeholders, respectively (Ramanathan et. al., 2014). Stakeholder pressures can also be effective in development of pro-environmental attitudes and, in turn, can help offset some of the negative effects of environmental re-activism (Liston-Heyes, 2016). A recent study states stakeholders can guide organizations to address barriers in the adoption of low carbon practices (Jabbour, et. al. 2020).

In this research, we consider a categorization of stakeholders most suitable for emission abatement scenarios used in the CDP data. The stakeholders are classified as: 1) government/regulatory bodies; 2) industry associations, NGOs; and 3) company competitors.

Institutional Theory

We rely on institutional theory to identify the type of pressures exerted by different classes of stakeholders: an institutional-stakeholder pressure pairing. Delmas and Toffel (2004) state that stakeholders—such as governments, regulators, customers, competitors, and industry associations—impose different types of pressures. These pressures are recognized as coercive, normative, and mimetic pressures – collectively called institutional isomorphic pressures – on firms.

Research by Zhu and Sarkis (2007) indicates that both market (normative) and regulatory (coercive) pressures influence organizations to improve their environmental performance whereas research by Marshall et. al. (2005) states that managerial norms, existing regulations and competitive pressures – all isomorphic pressures, constitute strong drivers of proactive environmental behavior. Recent research by Chithambo et. al. (2020) also shows that stakeholder pressure in the form of regulatory, mimetic and shareholder pressure positively influenced emisions disclosure.

In the context of this paper, we use the term coercive pressures to refer to rules and regulations that a firm must adhere to under the force of law. Normative pressure results from norms or standards expected to be followed by firms belonging to an industry association or an organization that sets the technical, financial, or ethical standards for a particular industry. Typically, the adherence to norms or standards is voluntary for firms. Mimetic pressure is experienced by a firm when it tries to match competitor records and activities on emission abatement as a business strategy, so it may be perceived by its stakeholders and consumers as a socially responsible and conscientious business entity. Mimetic pressure is similar to a normative pressure; compliance and observance are voluntary. Given that normative and mimetic pressures are difficult to parse, we classify the institutional pressures simply as coercive and noncoercive.

In this paper, we demonstrate how various institutional pressures produce different emission abatement responses from firms. This phenomenon of disparate responses has been observed in other environmentally related scenarios such as stakeholder groups (Murillo-Luna et. al., 2008) and coercive pressures (Masocha and Fatoki, 2018). In fact, firms with more proactive profiles differ from less environmentally committed firms in their perceptions of the relative importance of different stakeholders in influencing their environmental practices (Henriques and Sadorsky 1999).

3: THEORETICAL DEVELOPMENT AND RESEARCH HYPOTHESES

Ultimately, the main research question of this paper is: *how do organizations respond to various stakeholder-institutional pressure pairings when adopting carbon emissions mitigation strategies?* In addition to the primary research question, we also consider two other important factors that affect a firm's strategy for combating emissions. A firm must consider the risks and opportunities it faces from operational, financial, and business perspectives due to climate change in order to take appropriate actions. Secondly, it may need to actively engage in shaping of public policy and public opinion, so they remain conducive to the firm's business. Discussion on these two aspects are outlined below.

The following responses of a firm are considered in our research: 1) Take no action, ignore the threat of climate change, and engage in a "business as usual" approach— the most passive strategy; 2) Get involved in reduction of emissions efforts throughout the operations and in supply chain by using improved technology, equipment, and processes; 3) Purchase or sell carbon credits where such a market is available in order to offset emissions towards the final goal of carbon neutrality; or 4) Pursue the most pro-active strategy by doing both— implement emissions reductions within the company and trade carbon offsets to further reduce emissions.

The model is schematically summarized in Figure 1.

FIGURE 1 ABOUT HERE

Climate Risks, Opportunities Identification, and Mitigation Strategies

Companies are evaluating their climate change risks and seeking opportunities arising from climate change. In order to do so, companies need to identify, manage, and report climate risks (Kouloukoui et. al., 2018). Some other companies might recognize competitive advantages of new business opportunities arising from climate change (Agrawala et. al., 2011). Yet, other companies develop sets of corporate indices that measure the level of climate change corporate commitment, climate change risk management integration and strategies for adoption (Eleftheriadis and Anagnostopoulou 2017). Indeed, recent research states that firms with high commitment to climate change action garner positive reputation, better credit rating, reduced agency and information asymmetry thus yielding easier access to long-term debt markets (Lemma, et. al., 2021).

Environmental regulation is of value not only to the environment, but also to tackling climate change and protecting society (Gemmel et. al., 2013). In order to make the case for risk-based regulation in Europe, Dahlstorm (2003) analyzes the linkage between environmental management systems and company performance. Regardless, it is imperative for policy makers to understand motivation behind corporate environmentalism, since the effectiveness of governmental environmental polices depends on corporate response (Lyons and Maxwell, 1999).

Based on these arguments, we conjecture the positive relationship between the identification of climate change risks as well as opportunities with the emission mitigation strategies. Our discussion leads to the following two hypotheses:

Hypothesis (H1). *A company which has identified potential regulatory-based climate change risks to its business operation has a stronger link to its emission mitigation strategies compared to companies which have identified only non-regulatory risks.*

Hypothesis (H2). *A company which has identified potential regulatory-based climate change opportunities to its business operation has a stronger link to its emission mitigation strategies compared to companies which have identified only non-regulatory climate change opportunities.*

Our analysis recognizes four mitigation strategies: taking no action, reduction of emissions, trading of carbon credits, or engaging in both reduction of emissions and carbon trading strategies. It is clear that reducing emissions or trading carbon credits are better mitigation strategies than being passive; engaging in both simultaneously is the best strategy. However, it is difficult to distinguish a better mitigation strategy between reduction of emissions and trading of carbon credits. It is arguable that reduction is a better strategy given its proactive nature—alternatively, trading requires better planning and sound analysis of emissions. If a company is acting as a seller of credits, then it likely achieved the desired reduction of emissions. Since it is difficult to identify a superior mitigation strategy between the two without a case-by-case analysis with additional firm-specific data, this paper presumes they are equally proactive.

Public Policy Activities and Mitigation Strategies

Institutional investors can encourage companies to address climate change risks and take advantage of opportunities presented by these risks (Mercure, 2019). One approach is to utilize shareholder influence to encourage companies to be more proactive. Indeed, there is increasing investor activity in this regard (Fang et al., 2019). Models of shareholder activism, termed as 'shareholder democracy,' based on responsible ownership are also being created to address social and environmental issues (O' Rourke, 2003). The alternative approach is to explicitly factor climate change risks and opportunities into 'mainstream' investment analysis processes (Pfeifer and Sullivan, 2008).

Further research finds that soft policy measures — such as raising awareness and information disclosure has minimal influence on investment decisions, rather, hard policy measures like regulation and market-based incentives led to climate change being systematically factored into investment analysis (Pfeifer and Sullivan, 2008; Sinclair, 2019). Using this argument, we infer a stronger relationship between corporate engagement in public policy activities aimed at climate change and emission mitigation strategies. Our discussion leads to the following hypothesis:

Hypothesis (H3). *If a company is engaged in influencing public policy concerning climate change, then it is more likely to adopt emission mitigation practices.*

Governmental-Institutional Pressures and Mitigation Activity

Policy makers need to understand motivations behind corporate environmentalism, since the effectiveness of governmental environmental polices depends on corporate response (Lyons and Maxwell, 1999). In addition, regulators ought to give companies time and flexibility to learn and experiment. Even though management may respond initially by attempting to preserve the status quo, over time, this behavior causes an organization to gradually evolve (King, 2000).

Shareholder activism—due to regulatory threats—delivers a message to firms to adopt practices that are consistent with broader social movements and emergent regulatory practices (Reid and Toffel, 2009). These findings illustrate that both activist groups and governments can spur changes in organizational practices.

Institutional pressures— governmental pressures in particular—motivate firms to implement environmental management practices. As such, institutional pressures can trigger innovation especially in those firms that pollute more than their industry peers (Berrone et. al., 2013). Both regulatory and normative pressures are positively related to firm propensity to implement environmental management practices (Wang and Zhao, 2017). Additional complexities and contingencies appear in other studies as well. For example, top management support moderates relationships between institutional pressure and corporate environmental responsiveness (Colewell and Joshi, 2011). Furthermore, coercive pressures—due to their mandatory nature—cause greater adoption of environmental practices (Berrone et. al., 2013; Zhu et. al., 2016).

Based on these arguments, we conjecture the positive relationship between government, industry, or competitor pressures in addition to the emission mitigation strategies; but also, notion that the response is heterogeneous. Our discussion leads to the following hypothesis:

Hypothesis (H4a). *Pressure from different groups of stakeholders results in distinct proactive approaches to emission mitigation activities of a company.*

Hypothesis (H4b). *Coercive pressure results in stronger mitigation response compared to normative or mimetic pressures.*

Dependent Variable

The CDP's Climate Change Information Request survey contains 15 broad questions, ranging from governance and strategy to amount of Scope 1 and Scope 2 emissions. Within each broad question, there are many sub-questions. We selected the questions that pertained directly to our research. In 2016, the data is available for about 2,800 companies. We were able to obtain the complete sets of data for 2,502 companies for questions used in this research. Most of the data are in categorical (nominal) form.

To determine the category or level of the dependent variable, we examined whether the company is involved in reduction of emissions or emissions trading schemes by deriving the data from questions CC3.1 and CC13.1 of the CDP survey.

After combining the responses to the above two questions, four mutually exclusive nominal levels of the dependent variable are determined: if a company is neither involved in reductions of emissions nor in trading of carbon credits, then it is level 1 or $m = 1$; if the company is involved in reduction of emissions only, $m = 2$; trading of credits only, $m = 3$; if the company is involved in both reduction and trading, $m = 4$.

Independent Variables

The following four independent variables are used for hypotheses examination.

1) Variable $\beta_{g,m}$: CDP question, CC5.1. Have you identified any inherent climate change risks that have the potential to generate a substantive change in your business operations, revenue, or expenditure?

   Response coded: *Risk driven by changes in physical climate parameters or changes in other climate related developments g=1, Risk driven by regulation g= 2.* This variable has 2 nominal levels[1].

2) Variable $\gamma_{h,m}$: CDP question, CC6.1. Have you identified any inherent climate change opportunities that have the potential to generate a substantive change in your business operations, revenue, or expenditure?

   Responses coded: *opportunities in changes in physical climate parameters or changes in other climate related developments h=1, Opportunities in regulations h=2.*

3) Variable $\delta_{i,m}$: CDP question, CC8.6a. “Relevant standard” used for verification/assurance undertaken for your Scope 1 emissions.

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[1] By coding the variable levels as 1, 2..., instead of 0, 1,.., the coded variable level matches its subscript, for example $\beta_{1,3}$ indicates level of the independent variable is 1 and that of the dependent variable is 3. Hence $\beta_{1,3}$ represents effect of a situation where a company has not identified climate change risk driven by regulation and is involved in carbon credit trading. First subscript of any independent (as well as control variable) refers to the level of that variable and the second subscript refers to the level of the dependent variable.

Response coded: *No response i= 1, Industry, NGO, company i= 2, Government i= 3, Other i=4.*

4) Variable $\epsilon_{j,k}$: CDP question CC2.3. Do you engage in activities that could either directly or indirectly influence public policy on climate change through any of the following? Direct engagement with policy makers, trade associations, direct engagement with policy makers, funding research organizations, or any other entity.

Response coded: *No engagement* j=1, *Engaged* j= 2.

Control Variables

It may be argued that the geographical location of a firm plays a significant role in determining the type and severity of institutional pressures—for example, Europe vs Africa. To note, we have included geographical region as a control variable. The five regions used in the model are: 1) Asia, Australia, New Zealand; 2) Africa; 3) Europe; 4) North America; and 5) South America.

Some industries such as utilities are prone to high emissions when compared to the service sector. Hence, we use industry type as a control variable. Firms are categorized into four industries using their core business operations: Service, Manufacturing, Utilities, and Transportation.

We intended to include the size of a company, measured by its total sales or total assets, as a control variable to eliminate likely decrease in emissions per unit due to scale of operations; however, CDP does not collect such data. In our attempt to obtain the data on total sales or total assets, we faced challenges of annual financial reports in different languages, with diverse accounting systems, year endings, and issues of conversion of the reported monetary unit into one common currency. Furthermore, annual reports were not available for all 2,502 companies in our sample. Hence, the control variables are denoted by:

1) Control variable $\theta_{k,m}$: CDP industry group data

   Response coded: *Service* $k = 1$, *Manufacturing* $k = 2$, *Utilities* $k = 3$, *Transportation* $k = 4$.

2) Control variable Region $\kappa_{l,m}$: CDP country data

   Response coded: *Asia*, *Australia*, *New Zealand* $l = 1$, *Africa* $l = 2$, *Europe* $l = 3$, *North America* $l = 4$, *South America* $l = 5$.

4: RESEARCH METHODOLOGY

Model Specification

To test the four hypotheses, we estimate the parameters of the following logistic regression model. It is an analysis of variance- type model, all variables used in the model are nominal variables. Such models are also known as base-line category logit models (Agresti, 2007). The additive model is represented by:

$$ln\left(\frac{P(g,h,i,j,k,l,m)}{P(1,1,1,1,1,1,1)}\right) = \propto_m + \beta_{g,m} + \gamma_{h,m} + \delta_{i,m} + \epsilon_{j,k} + \theta_{k,m} + \kappa_{l,m}$$

where:

$$g = 1,2;\;\; h = 1,2;\;\; i = 1\; to\; 4;\;\; j = 1,2;\;\; k = 1\; to\; 4;\; l = 1\; to\; 5;\; m = 1\; to\; 4;$$

The left-hand side of the regression equation is a natural log of the odds. Unlike conventional linear regression, the left-hand side is not the dependent variable itself. Probability $P(g, h, i, j, k, l, m)$ is the probability of an event where independent variables β, γ, δ and ε are at levels g, h, i, and j respectively. Similarly, the control variables θ and κ take levels k and l. The dependent variable is at level m. The probability in the denominator is the reference event when all variables including dependent variable are at level 1. Level 1 for each variable is defined in the above paragraph, for example, level 1 for ε is response "no". Variables at level 1 are the baseline. Occurrences of all other events are compared to the occurrence of the baseline event; any convenient level may be chosen as a baseline.

The above additive model may be easily changed into a multiplicative one by raising each side of the equation to the power of the base of natural logarithms.

The multiplicative form is:

$$\frac{P(g,h,i,j,k,l,m)}{P(1,1,1,1,1,1,1)} = e^{\alpha_m} e^{\beta_{g,m}} e^{\gamma_{h,m}} e^{\delta_{i,m}} e^{\varepsilon_{j,m}} e^{\theta_{k,m}} e^{\kappa_{l,m}}$$

Often, it is easier to work with the odds, as in the above equation, rather than log of odds in the additive form. In most logistic regression models, the dependent variable is dichotomous: yes or no, success or failure, etc. In our case—given the dependent variable has four levels—a multinomial distribution is used. The paper uses Bayesian estimation techniques for estimating the regression parameters.

Prior Distributions

The logistic regression expression contains the following parameter vectors that need to be estimated: $\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\delta}, \boldsymbol{\varepsilon}, \boldsymbol{\theta}$, and $\boldsymbol{\kappa}$. When a Bayes framework is used for estimation purposes, the estimates should be based on collected data – the sampling distribution – alone, and the prior distribution should not add any information to estimation of the parameters. This is achieved using "vague" or non-informative priors (Congdon 2007, Lunn et al. 2013). The non-informative prior used in our model is an almost flat, very high variance, normal distribution with mean 0. A normal distribution is used so that the regression parameters can have any value on the real line, and high variance (100,000 in our case) allows a range of values on either side of the mean as likely values, while adding very little, if any, prior information. Thus, the priors for all parameters are:

$$\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\delta}, \boldsymbol{\varepsilon}, \boldsymbol{\theta}, \boldsymbol{\kappa} \sim \text{Normal}(0, 100000)$$

Sampling Distributions

The data collected are in the form of number of occurrences for each combination of levels of independent and control variables. We now provide a brief description of how the parameters of a logistic regression are developed from multinomial sampling distributions. Let $X_{g,h,i,j,k,l,m}$ indicate the number of occurrences when variables $\beta, \gamma, \delta, \varepsilon, \theta$, and κ are at levels g, h, i, j, k, l respectively, and the dependent variable is at level *m*. For a combination of independent and control variables, we first obtain the total number of occurrences for that combination:

$$n_{g,h,i,j,k,l} = \sum_{m=1}^{4} X_{g,h,i,j,k,l,m}$$

The multinomial sampling distribution to be fitted for the combination now can be obtained as:

$$X_{g,h,i,j,k,l,m=1,2,3,4} \sim Multinomial(\pi_{g,h,i,j,k,l,m=1,2,3,4}, n_{g,h,i,j,k,l})$$

where $\pi_{g,h,i,j,k,l,m=1,2,3,4}$ are the probabilities of dependent variable achieving levels *m=1, 2,3* or *4* for the given combination. The sampling distribution is connected to the logistic regression expression through the following linking functions:

$$\pi_{g,h,i,j,k,l,m} = \frac{(P_{g,h,i,j,k,l,m}/P_{1,1,1,1,1,1,1})}{\sum_{m=1}^{4}(P_{g,h,i,j,k,l,m}/P_{1,1,1,1,1,1,1})}$$

$$ln(\frac{P(g,h,i,j,k,l,m)}{P(1,1,1,1,1,1,1)}) = \propto_m + \beta_{g,m} + \gamma_{h,m} + \delta_{i,m} + \epsilon_{j,k} + \theta_{k,m} + \kappa_{l,m}$$

Posterior Distributions

The posterior distribution of the parameters of the logistic regression can be expressed as follows: Let us define $\varphi_{g,h,i,j,k,l,m} = ln(P_{g,h,i,j,k,l,m}/P_{1,1,1,1,1,1,1})$ to simplify writing of the following expression.

$$f(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\delta}, \boldsymbol{\varepsilon}, \boldsymbol{\theta}, \boldsymbol{\kappa} | \boldsymbol{\varphi}) \propto \quad f_{Multinomial}(\boldsymbol{\varphi} | \boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\delta}, \boldsymbol{\varepsilon}, \boldsymbol{\theta}, \boldsymbol{\kappa}) \times f_{Normal}(\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}, \boldsymbol{\delta}, \boldsymbol{\varepsilon}, \boldsymbol{\theta}, \boldsymbol{\kappa})$$

Until about 1990, any complex Bayesian model such as one developed in this paper were outside the reach of further analysis under a Bayesian framework. Gelfand and Smith (1990) showed that it is possible to obtain marginal posterior distributions without deriving the pdf. These distributions are obtained by holding all parameters except one constant. The Gibbs sampler algorithm is used for this purpose, which falls under the general category of Markov Chain Monte Carlo (MCMC) simulation methods (Lunn et al. 2013, Congdon 2007, Hoff 2009).

Gibbs Sampler

A concise treatment of underlying theory and description of the steps involved in the Gibbs sampler algorithm can be found in Hoff (2009). We use WinBugs software to run the Gibbs Sampler (Lunn et. al., 2000)[2]. Each setup was run to obtain 1,000,000 realizations. The first 4,000 realizations were discarded to remove transient results and to obtain a steady state. After that point, every 30th realization was included in the sample. This selection process was adopted to eliminate the effect of autocorrelation in samples. Thus, there were 33,200 usable data points to form each posterior distribution.

Bayesian Estimator Results

The top row of Figure 2 provides an example of pdfs of posterior distributions of the two effects: $\beta_{2,4}$ and $\delta_{4,2}$. The means of the distributions are 1.62 and 0.29, respectively as listed in Table 1, which shows posterior distribution means of all effects. We will discuss the interpretation of the effects later; at this juncture, we are interested in validity of the values. In frequentist statistics, the validity is judged by the significance level or p value. In the Bayesian framework, the pdf distribution of the possible values provides us a robust basis to make that

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[2] WinBUGS software is available for free: http://www.mrc-bsu.cam.ac.uk/software/bugs

judgment. For example, from the pdf it can be determined that the effect $\beta_{2,4}$ will always have a positive sign since the entire pdf is located above 0. This fact is depicted in the bottom left graph in Figure 2. It shows the area above 0 of the posterior distribution of $\beta_{2,4}$, (indicated by P), is 1. This is similar to testing the null hypothesis: $\beta_{2,4} = 0$; the null can be rejected with 100% confidence since all values of $\beta_{2,4}$ fall above 0.

FIGURE 2 ABOUT HERE

TABLE 1 ABOUT HERE

In case of the effect $\delta_{4,2}$, however, it can be positive about 68% of the time and negative the rest or 32% of the time (as shown on bottom right graph in Figure 2, also in Table 1). In this case, it is difficult to attach any specific direction to this effect. We could say that this is not a valid effect and may ignore it—or make the statement that the effect has a positive impact 68% of the time and let the decision maker determine if this positivity of the effect is an acceptable notion in the scenario under consideration.

The cutoff point to determine whether an effect has an acceptable positive or negative impact is subjective. For example, one decision maker may use cutoff points of 90% and 10% probabilities for the effects to be valid. The probabilities in Table 1 are measured for the effects being positive. Hence, a 90% probability cutoff for positive coefficients would mean a 10% cutoff for negative coefficients. With these cutoff values, the valid effects are those with probabilities less than 10% or greater than 90%. Thus, $\gamma_{2,4}$ and $\delta_{4,2}$ are not valid effects since their probabilities do not fall in either tails of this range.

5. ANALYSIS OF RESULTS AND HYPOTHESES ASSESSMENTS

Climate change risk is captured by Hypothesis 1 and the independent variable beta ($\beta_{g,m}$) has information about identified risk. Its level, denoted by the first subscript, indicates type of risk to a company's operations, revenues, and expenditures due to government regulations concerning climate change. If such regulatory risks are present, then *g= 2*, otherwise *g=1*. The second subscript *m* of every independent variable denotes the level of the dependent variable, to— emphasize— they are: *m=1* indicates no mitigation action taken by a company, *m=2*: reduction of emissions, *m=3*: trading of carbon credits, *m=4*: both reduction and trading.

Table 2 excerpted from Table 1 shows that all the $\beta_{g,m}$ at level *g=2* are positive ($\beta_{2,2} = 0.55, \beta_{2,3} = 2.19, \beta_{2,4} = 1.62$). These results indicate that identification of risk due to government regulations, a form of coercive pressure, results in higher level of emissions abatement activities compared to risk resulting from non-regulatory, climate-related developments (level 1 beta coefficients: $\beta_{1,m=2,3,or\,4}$). The highest number, $\beta_{2,3}$ =2.19, has second subscript 3, which indicates organizations that identify greater regulatory risk are likely to also adopt a more proactive trading strategy.

TABLE 2 ABOUT HERE

For example, odds for emissions reduction ($\beta_{2,2}$) rise by $e^{0.55} = 1.73$ under regulatory risk pressure compared to non-regulatory risks. Odds that a company will do carbon trading ($\beta_{2,3}$) increase by 8.94, and that it will do both, ($\beta_{2,4}$), go up by 5.05 under coercive pressure compared to noncoercive pressure. Since all these results are valid effects at the 90% cutoff, we would state that it supports the above hypothesis in that identification of risks due to government regulations encourages companies to act with an emissions abatement strategy.

In hypothesis H2, we consider the response in company abatement actions based on whether or not they have identified climate change opportunities. Independent variable $\gamma_{h,m}$ separates this effect where h *=2* if opportunities resulting from government regulations are identified, *h=1* otherwise. Table 3 , also excerpted from Table 1, shows the $\gamma_{h,m}$ coefficients, one of the coefficients has a negative sign.

TABLE 3 ABOUT HERE

Furthermore, Table 1 shows that effect $\gamma_{2,4}$ is not valid at the 90% cutoff. The effect $\gamma_{2,4}$ has a positive sign 79% of the time and a negative sign the rest. Since this result does not provide enough assurance about its sign or rather its direction of impact, we consider it invalid and are unable to draw any conclusions from this result.

The effect $\gamma_{2,2} = 0.61,$ however, is valid and has a positive sign indicating that when climate change opportunities in operations result from regulatory pressure opportunities, these organizations are likely to work on reducing their emissions. The odds of doing so go up by a factor of 1.84 when compared to a non-regulatory pressure opportunity resulting from climate change. This result is promising in helping to adopt GHG reduction; in this case regulatory policies that provide opportunities for organizations should be pursued.

The effect $\gamma_{2,3}$ has a mean of -1.10. The negative sign indicates that this effect contradicts our hypothesis. When government regulation present opportunities to get involved in carbon trading activities the companies are less likely to do so, the odds are reduced by $e^{-1.10}$ = 0.3329, about a third. Companies are less likely to be involved in carbon trading when opportunities present themselves from regulatory-based opportunities. In this case the incentives or costs associated with trading may not be worthwhile and companies shy away from trading and go towards reduction and technological investments in response.

Public policy activities are captured by Hypothesis 3 and the independent variable $\varepsilon_{j,m}$ represents whether a company is involved in influencing public policy that impacts climate change; $j = 1$ means a company is not involved, whereas $j = 2$ points to its involvement in such activities.

Table 4 shows the values of $\epsilon_{j,k}$ coefficients. The positive values of the $\epsilon_{j,k}$ coefficients at *j=2* support our hypothesis stating when a company is involved in public policy activities it is also active in emissions abatement activities. Odds that such a company is involved in both reduction and trading are the highest when compared to no action at all, followed by trading and then reduction of emissions. Thus, in this case, it is likely that companies will make a concerted effort on all aspects with greater policy making involvement. It seems that these companies may be setting the stage for all in their industry to adopt these practices. A conjecture here is that these companies have taken the initiative to set policy because they have adopted these practices and are hoping to avoid or preempt a free-rider situation (Nordhaus, 2015).

TABLE 4 ABOUT HERE

External shareholder pressure is captured by Hypothesis H4a. The variable $\delta_{i,m}$ consolidates the information about the pressures from various company stakeholders on a company; $i = 1$ refers to no response (or no pressure) on companies, $i = 2$ refers to pressures from industry associations, non-governmental agencies and other companies, this may be considered normative or mimetic pressure. Pressure from government through laws and regulations may be considered a coercive pressure and is coded as $i = 3$. In addition, “other” pressures on a company to improve its abatement policies are coded as $i = 4$.

Tables 5A-5C are taken from Table 1. For table 5A, with *i* held constant at 2, the results state that industry (normative, mimetic*)* pressures increase the likelihood of reduction and trading compared to no action in terms of abatement. From table 5B, with *i=3*, the results indicate that government standards for verification and assurance increase the likelihood of reduction and trading compared to no action. Lastly, from table 5C, with *i=4,* the results show that "other" relevant standards-pressures increase the likelihood of reduction or trading compared to no action.

TABLE 5 ABOUT HERE

There is an alternative perspective for evaluating these results by transposing the tables and focusing on the mitigation strategies (denoted by subscript *m*) as shown in Table 6. Table 6A—where *m* is held constant at 2—indicates that the reduction strategy is achieved most effectively through normative or coercive standards with values of 2.66 and 2.65, respectively. Table 6B shows that the carbon trading strategy (*m=3*) is best achieved when coercive pressures exist. Table 6C indicates that joint reduction and trading strategies (*m=4*) are most influenced by coercive pressures as well.

TABLE 6 ABOUT HERE

From Table 1, we note that all effects in tables 5 and 6 except $\delta_{4,2}$ are valid at a 90% cutoff. Since the "other" pressure category, $i = 4$, includes many different types of local, regional standards and decrees, they varied from company to company; thus we consider them a mix of normative and mimetic pressures. First, we note that all $\delta_{2,m}$ and $\delta_{3,m}$ for *m=1 to 4* are non-negative indicating that either type of pressure increases the odds that a company will take some emissions mitigation action compared to do nothing. This supports the hypothesis that government and industry pressures have positive impact on emissions mitigation effort.

Our data also suggests that coercive pressures are about equal or more effective than normative or mimetic pressures. This finding can be verified by comparing normative and mimetic effect, $\delta_{2,m}$, to its corresponding coercive effect $\delta_{3,m}$. We note that $\delta_{2,2} = 2.66$ and $\delta_{3,2} = 2.65$ are just about equal, but $\delta_{3,3} = 5.44 > \delta_{2,3} = 2.09$ and $\delta_{3,4} = 6.52 > \delta_{2,4} = 4.62$.

Another way to express the stronger influence of coercive pressures compared to normative or mimetic pressures is based on increased odds when coercive pressure is applied. The odds that a company gets involved in trading under coercive pressure go up by $e^{5.44-2.09} = 28.5$ when compared to normative and mimetic pressure. Similarly, the odds increase by $e^{6.52-4.62} = 6.69$ that a company will do both reduction and trading under coercive pressure compared to normative or mimetic pressure. Thus, both hypotheses 4a and 4b are supported by these results.

One interesting effect is $\partial_{4,4} = -252.10$. It indicates the use of "other" standards for verification of scope 1 emissions when both reduction and trading mitigation measures are used is a very rare event. The odds are essentially 0 of this event taking place.

6: RESEARCH AND PRACTICAL IMPLICATIONS

In this paper, we investigated relationships between various emission mitigation strategies such as greenhouse gas emissions reductions or carbon trading against a backdrop of various institutional and stakeholder pressures. Both stakeholder pressures and institutional pressures are documented in the literature (Gonzales-Benito and Gonzales-Benito, 2006; Berrone et. al., 2012; Daddi, et. al, 2018). Hence, both stakeholder and institutional theoretical lenses were considered in evaluating these relationships. Using data from the CDP, a Bayesian framework was used for statistical estimation in analyzing these relationships.

Our results show that institutional pressures do cause organizational adoption of various mitigation strategies. However, institutional-stakeholder pairing seems to indicate heterogenous results in adoption. Specifically, our results demonstrate how organizations who identify greater regulatory risk are likely to adopt more proactive trading strategies (from H1). In addition, when climate change opportunities are identified, companies are likely to engage in emissions reduction strategies (H2). Companies that are engaged in influencing public policy concerning climate change are more likely to adopt emissions mitigation strategies (H3). Overall, our results state that various stakeholder pressures lead to distinct emissions mitigation responses (H4a).

There are practical managerial implications and theoretical research implications that derive from these results. We provide an overview of the most pertinent implications.

6.1 Theoretical and Research Implications

It has been noted that though companies view climate change as a material issue for their businesses, the actual climate risk management strategies implemented do not differ from the usual process of managing risks (Wienhofer and Busch, 2013). Hence, whether companies manage climate risks separately from regular risks or not, the results should hold under both scenarios.

Moreover, the presence of public policy measures also impacts company response to climate change. One aspect is focused on how institutional investors and shareholders can encourage companies to be proactive and address climate change. Though soft policy measures are important, it is the hard policy measures that actually drive climate change being factored into investment analysis. These arguments, captured in Hypotheses 3, were supported by the results indicating that companies involved in public policy activities aim to mitigate emissions and engage in carbon trading.

Two different approaches are proposed by Urwin (2008): a top-down approach that takes set policies and implements these into action on ground, and bottoms-up approach that takes the input of local actors in shaping policy implementation. This research concludes that both approaches are needed to offer perspectives on climate policy integration. Hypothesis 3 did not separate a top-down approach from a bottoms-up approach; however, it is significant to emphasize the role of public policy in corporate response to climate change.

Institutional pressures and governmental pressures also serve to encourage companies to adopt and implement environmental management practices. Coercive pressures also cause greater adoption of environmental practices due to their mandatory nature. These arguments, captured in Hypotheses H4a and H4b, are supported by the results that find government and industry pressures have positive impact on emission mitigation efforts. The results also found that coercive pressures are about equal or more effective that the normative or mimetic pressures.

It is evident that institutional and stakeholder pressure pairings will have varying influences of organizational strategic initiative adoption. Thus, not only is it the type of pressure, but specifically who is pressuring plays a very distinctive role that may address heterogenous, or contingent responses. The level of adoption, from reactive to proactive, is also going to be dependent on the level and pairing of pressures. Going beyond compliance—although compliance from a carbon emissions perspective is not necessarily a regulatory reaction, but rather more of a normative reaction—and being more reactive for what may be considered essentially voluntary measures is also dependent on the type of institutional and stakeholder pressure.

Interestingly, a fascinating counter-intuitive finding in our study is that greater government pressures may result in companies shying away from trading. Companies may not wish to take the chance of not meeting their caps by trading; where trading may involve buying credits from a market and potentially giving their competitors greater economic benefits. Many cap-and-trade markets are targeted to specific industries with competitors in the same industry having to cooperate or shift resources to each other. It may be that rather than directing funds to other companies in the same industries, companies would—in response to these pressures—focus on adopting innovations and technologies to reduce their emissions.

Additionally, mixed results in this study provide evidence of relationship complexity between institutional and stakeholder pressures-antecedents, and adoption of various carbon mitigation practices. Heterogeneity in pressures across and within industries, as well as geographical and regulatory regimes, contributes to these complex patterns. This study provides some perspective on potential nuances in adoption of practices.

Theoretically, the interactions of stakeholders and the type of pressures they exhibit needs more careful investigation. Sometimes it is the messenger and sometimes it is the message that needs careful evaluation. This nuance needs further careful evaluation in institutional and stakeholder theoretical perspectives.

6.2 Practical and Managerial Implications

Our first practical implication is that organizations need to identify, manage, and report climate risks. Indeed, there are competitive advantages for doing so due mainly to new business opportunities. Furthermore, companies can also develop indices or metrics that can be used to assess their own performance. These arguments were supported by results indicating that identification of risks encourages companies to respond with emission abatement strategies.

Environmental regulation is also a key driver to tackle climate change. While environmental regulations encourage innovation in environmental regulations, these regulations have also been linked to competitiveness and company performance. These arguments are supported by the results that conclude when regulatory pressure opportunities exist, companies were more likely to reduce their emissions.

Both policy makers and organizations can learn from these findings. Our research finds that coercive pressure results in stronger mitigation response compared to normative or mimetic pressures (H4b). Since we investigate various emission mitigation strategies, we conclude that the reduction of emissions strategy alone is most effectively accomplished through normative or coercive standards. The trading of emission permits strategy is best achieved when coercive pressures exist. Lastly, the joint strategy of emissions reductions and trading is most influenced by coercive pressures. The stakeholder that typically has the strongest coercive pressures—including penalties, fines, and even organizational dissolution—is the government and its regulators. Depending on the type of mitigation practices that policy makers wish to have organizations adopt, various tools and measures may be used. Voluntary regulatory policy may not be the best approach in many of these situations, even cap-and-trade market mechanisms have a coercive aspect to them with fines associated with going over the cap. The level of coercive pressure, a nuance not captured in our study, may also play a role where fines and penalties can induce greater practices.

A company can tailor its emission mitigation strategies based on the type of stakeholder pressures it is subject to and, as the stakeholder or institutional pressures change, the company can shift emissions strategies—based on what others have done. It is assumed in this scenario that the actions or strategies of other companies are effective benchmarks and expectations of response to these pressures.

Moreover, another practical observation from our analysis is organizations will make a concerted effort to adopt all mitigation activities as they become more involved in policy making initiatives. These organizations may be early adopters of carbon mitigation practices. A conjecture we can make is that these organizations have taken the initiative to set policy to provide them with a competitive advantage. To be able to maintain this advantage, adopting carbon mitigation innovations early on gives them insights into efficient and effective carbon mitigation management. Yet, if regulatory policy does not require everyone in the industry to adopt some sort of practice, a free-rider situation arises. To make sure that this does not occur, lobbying for public policy will support their effort for others to invest in similar practices. Individual firms will contribute to a lobbying effort if it is in their own self-interest (Magee 2002). There are also subtleties in firm policy setting and lobbying on whether organizations are lobbying individually or in coalitions for setting carbon regulation, and could further result in different outcomes (Friedman and Heinle, 2020). Interesting managerial implications of this type of study would include the "losers paradox" where weaker industries receive more protection even when strong industries spend more resources on policy setting lobbying (Candel-Sanchez and Perote-Pena, 2018).

Additionally, organizations lobbying for public regulatory policy on climate change might be the culprits (Damania, 2001). This is the case where "dirtier" industries lobbied for fewer tariffs when their organizations were emitting greater amounts of CO_2 in other nations (Shapiro, 2020). There are also cases where organizations become involved in setting policy to circumvent expensive or arduous activities by helping to dilute regulatory action (Brulle, 2018). The political action can derive from both strong performing firms, or weak performing firms, although a recent study finds the lobbying process asymmetric in that clean firms find it more difficult to achieve their policy objectives—more stringent regulations—when dirty firms can more easily persuade weakened environmental regulations (Cai and Li, 2020).

For policy makers, our results indicate that both managers and organizations can expect greater regulatory policies in these areas. Also, managers will likely need to be very careful in their responses given the heterogeneity of the pressures and stakeholders involved in this environment. Organizations will need to develop the necessary systems and expertise to respond effectively to mitigation and adaptation strategies.

7: CONCLUSION AND FUTURE WORK

The Anthropocene epoch has resulted in some irreversible changes to Earth. We are in the depths of the most anthropogenically pernicious and global transformations to our Earth and environment—climate change and global warming. Climate change is occurring at a geologically rapid pace and is tied directly to industrial activities. Mitigation efforts—albeit at underwhelming levels—are occurring within industries. In this study, using the CDP database, we investigate how different stakeholder and institutional pressures play a role in the adoption—or lack of adoption—of various mitigation efforts including using carbon market trading schemes or adopting organizational reduction actions. These relationships were investigated using multinomial logistics methodologies that help us discover various relationships.

We did find a number of expected results where increases in coercive or normative pressures from different stakeholders meant greater adoption of carbon emission mitigation practices, whether separately or jointly. We also observed that coercive pressures played a more potent role than other pressures in greater adoption of practices.

Significantly enough, one counter-intuitive finding was observed in our results. Policy setting—which can be viewed as a regulatory pressure management practice or response—did not necessarily contribute to increased adoption, it actually had the opposite effect that deterred adoption. The nuances of why policy may have resulted in this negative correlation requires additional research. Two possible explanations exist in the literature to help explain this result. One explanation is the possibility of mixed regulatory messages that organizations who are performing well in adopting practices lobby for more stringent regulatory policies related to carbon mitigation. They may delay further adoption until free-rider possibilities are lessened. Alternatively, those organizations that are weak performing—and less likely to adopt—may be lobbying along with setting policy for weakened regulations, and do not wish to adopt expensive or extensive mitigation practices.

To add, we also support the literature on organizational responses to both institutional and stakeholder pressures. The interactions from these two types of pressures require further investigation since—for example—a mimetic pressure through voluntary governmental efforts may mean a very different type of corporate response than a mimetic pressure from industrial associations. We also did not consider how internal capabilities and resources play a role in adoption and this additional contextualization—based on resource-backed theories can also serve to help understand the responses to these pressures.

Even with some significant relationships identified in this investigation, our study faced some limitations. In terms of control variables, we would have liked to include organizational size, but the CDP data did not provide this information. We would have liked to include total sales or assets, although we faced challenges with collecting this information from annual reports of more than 2,000 companies, many who were not publicly traded.

The data granularity from the CDP did not allow for other types of forces and investigations. For example, government regulations may be based more on incentives for reduction or for investing in practices that would help reduce climate emissions. Government regulations giving tax break for renewable energy investments may have caused some firms to adopt some strategies, but these types of specificities were missing from the CDP data.

In summation, we observe that responses to mitigating the carbon emissions by organizations will depend on the pressures they face. Above all, type and origin of pressure each play roles. Even with these initial general results, more specific and emergent research questions remain that require further study and investigation.

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Figure 1: General Model – Level of Risks, Opportunities, Standards, and Public Policy Engagement Relationships to Emission Strategy Proactivity Level.

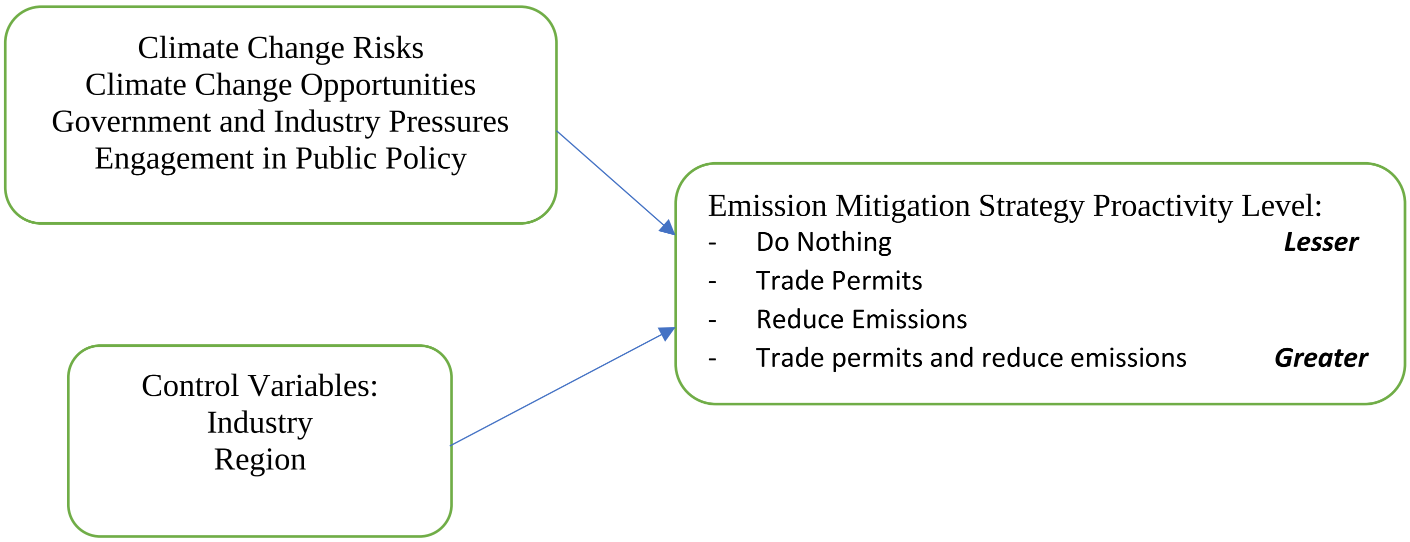

Figure 2. Posterior Distributions and Distributions of positivity of effect

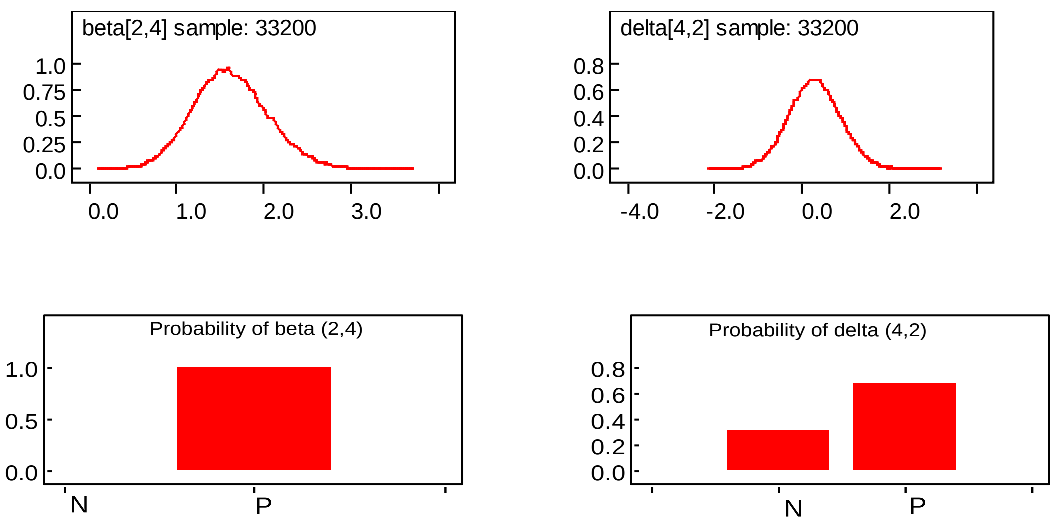

Table 1. Effect of the levels of the variables and probabilities of the positive sign

Level	Effect*	Probability**
alpha[1]	0.00	-
alpha[2]	-1.34	0.0000
alpha[3]	-8.45	0.0000
alpha[4]	-7.30	0.0000
beta[1,1]	0.00	-
beta[1,2]	0.00	-
beta[1,3]	0.00	-
beta[1,4]	0.00	-
beta[2,1]	0.00	-
beta[2,2]	0.55	0.9999
beta[2,3]	2.19	0.9954
beta[2,4]	1.62	1.0000

gamma[1,1]	0.00	-
gamma[1,2]	0.00	-
gamma[1,3]	0.00	-
gamma[1,4]	0.00	-
gamma[2,1]	0.00	-
gamma[2,2]	0.61	1.0000
gamma[2,3]	-1.10	0.0377
gamma[2,4]	0.28	0.7896

delta[1,1]	0.00	-
delta[1,2]	0.00	-
delta[1,3]	0.00	-
delta[1,4]	0.00	-
delta[2,1]	0.00	-
delta[2,2]	2.66	1.0000
delta[2,3]	2.09	0.9922
delta[2,4]	4.62	1.0000
delta[3,1]	0.00	-
delta[3,2]	2.65	0.9975
delta[3,3]	5.44	1.0000
delta[3,4]	6.52	1.0000
delta[4,1]	0.00	-
delta[4,2]	0.29	0.6846
delta[4,3]	2.17	0.9252
delta[4,4]	-252.10	0.0025

epsi[1,1]	0.00	-
epsi[1,2]	0.00	-
epsi[1,3]	0.00	-
epsi[1,4]	0.00	-
epsi[2,1]	0.00	-
epsi[2,2]	1.34	1.0000
epsi[2,3]	1.75	0.9986
epsi[2,4]	3.85	1.0000

* Level 1 of independent and dependent variable is reference level and are set at 0.00. Effects of other levels are measured from the reference level.
**Probability column indicates probability that the effect can be positive.

Table 2: Bayesian multinomial logistic coefficients for whether regulatory risk is identified and level of mitigation.

$\beta_{2,1}$	0.00
$\beta_{2,2}$	0.55
$\beta_{2,3}$	2.19
$\beta_{2,4}$	1.62

Table 3: Bayesian multinomial logistic coefficient for whether regulatory opportunity is identified and level of mitigation

$\boldsymbol{\gamma_{2,1}}$	0.00
$\boldsymbol{\gamma_{2,2}}$	0.61
$\boldsymbol{\gamma_{2,3}}$	-1.1
$\boldsymbol{\gamma_{2,4}}$	0.28

Table 4: Bayesian multinomial logistic coefficient results for whether a company is involved in setting climate change public policy and the level of mitigation

$\boldsymbol{\epsilon_{2,1}}$	0.00
$\boldsymbol{\epsilon_{2,2}}$	1.34
$\boldsymbol{\epsilon_{2,3}}$	1.75
$\boldsymbol{\epsilon_{2,4}}$	3.85

Table 5 Bayesian multinomial logistic coefficient results for various stakeholder pressure level

$\boldsymbol{\delta_{2,1}}$	0.00
$\boldsymbol{\delta_{2,2}}$	2.66
$\boldsymbol{\delta_{2,3}}$	2.09
$\boldsymbol{\delta_{2,4}}$	4.62

A

Normative & Mimetic Pressure
i held at 2

$\boldsymbol{\delta_{3,1}}$	0.00
$\boldsymbol{\delta_{3,2}}$	2.65
$\boldsymbol{\delta_{3,3}}$	5.44
$\boldsymbol{\delta_{3,4}}$	6.42

B

Governmental Pressure
i held at 3

$\boldsymbol{\delta_{4,1}}$	0.00
$\boldsymbol{\delta_{4,2}}$	0.29
$\boldsymbol{\delta_{4,3}}$	2.17
$\boldsymbol{\delta_{4,4}}$	-252

C

Other Pressure
i held at 4

Table 6 Bayesian multinomial logistic coefficient results for various level of GHG emissions mitigation strategy

$\boldsymbol{\delta_{1,2}}$	0.00
$\boldsymbol{\delta_{2,2}}$	2.66
$\boldsymbol{\delta_{3,2}}$	2.65
$\boldsymbol{\delta_{4,2}}$	0.29

A

Reduction of GHG
m held at 2

$\boldsymbol{\delta_{1,3}}$	0.00
$\boldsymbol{\delta_{2,3}}$	2.09
$\boldsymbol{\delta_{3,3}}$	5.44
$\boldsymbol{\delta_{4,3}}$	2.17

B

Carbon Trading
m held at 3

$\boldsymbol{\delta_{1,4}}$	0.00
$\boldsymbol{\delta_{2,4}}$	4.62
$\boldsymbol{\delta_{3,4}}$	6.42
$\boldsymbol{\delta_{4,4}}$	-252

C

Reduction and Trading both
m held at 4