Three Essays on Firm Responses to Climate Change

by

Ta Kang Hsu

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Graduate Supervisory Committee:

Kevin Dooley, Chair
Elliot Rabinovich
Charles Corbett

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ABSTRACT

Evidence is mounting to address and reverse the effects of environmental neglect. Perhaps the greatest evidence for needing environmental stewardship originates from the ever-increasing extreme weather events ranging from the deadly wildfires scorching Greece and California to the extreme heatwaves in Japan. Scientists have concluded that the probability and severity for about two thirds of such extreme natural events that occurred between 2004 and 2018 is contributed by rising global temperatures.

Operations management literature regarding environmental issues have typically focused on the “win-win” approach with a multitude of papers investigating a link between sustainability and firm performance. This dissertation seeks to take a different approach by investigating firm responses to climate change. The first two essays explore firm emissions goals and the last essay investigates firm emissions performance.

The first essay identifies firm determinants of greenhouse gas (GHG) reduction targets. The essay leverages Behavioral Theory of the Firm (BTOF) and argues for two additional determinants, Data Stratification and Science-Based Targets, unique to GHG emissions. Utilizing system generalized method of moments on a dataset from Carbon Disclosure Project for years 2011-2017, the paper finds partial confirmation for BTOF and support for the two additional determinants of firm GHG emission goals.

The second essay is an exploratory study that seeks to understand factors for firm participation in the Science-Based Targets (SBT) initiative by combining both primary and secondary data analysis. The study is a working paper with primary data still needing to be completed. Secondary data analysis begins with a review of the literature which suggested four potential factors: ISO 14001 certification, Customer Engagement, Emission Credit Purchases, and presence of Absolute Emissions Targets. Preliminary

results using panel logistic regression suggest that Emissions Credit Purchases and Absolute Emissions Targets influence SBT participation.

The third essay seeks to understand whether stakeholder pressure drives firm GHG emissions reductions. This relies on Stakeholder Theory and classification schemes proposed in Management literature to divide stakeholders, based on their relationship with the firm, into three groups: primary, secondary, and public. Random effects estimation results provide evidence for primary and public stakeholder pressure impacting firm GHG emissions.

DEDICATION

I dedicate this work to my mother, Hsiu Lan Chih.

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I am grateful to all those with whom I have had the pleasure of working alongside to complete this project. I express my sincerest gratitude to my doctoral committee chair Dr. Kevin Dooley. They often say an advisor can break or make your PhD and Dr. Dooley has definitely made my PhD experience as one of the most positives in my life. His patience and support along the way has guided me to become a better researcher. I am also thankful to Dr. Elliot Rabinovich and Dr. Charles Corbett whose knowledge and insights have been an invaluable support.

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ESSAY 1: CORPORATE GREENHOUSE GAS EMISSIONS: SETTING GOALS FOR OPERATIONAL EFFICIENCY

Abstract

Firms regularly set goals for operational efficiency in order to affect improvement. Goals involving cost reduction, quality improvement, delivery improvement, accident reduction, and innovation have been discussed in the operations management literature. More recently, stakeholder interest has led firms to publicly set operational efficiency goals for their corporate greenhouse gas (GHG) emissions. As with other types of operational goals, we posit that firms are likely to set goals in accordance with behavioral theory through anchoring, social comparison, and attainment discrepancy. We also hypothesize that the adoption of GHG "Science-based Targets" provides firms a way to signal leadership in sustainable operations, and that complexity in measuring GHG emissions can lead to goal modification. We perform an econometric analysis on a panel data set of 496 firms from 2011 to 2017 from Carbon Disclosure Project reports. Results partially confirm behavioral theory but supports the inclusion of adopting Science-based Targets and GHG measurement complexity. This study contributes to literature in behavioral operations management and sustainable operations management.

Keywords: Operational Efficiency, Sustainability, Behavioral Operations, Dynamic Panel Analysis

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Introduction

Firms regularly set and track progress towards operational efficiency goals in order to affect improvement. Often such goals are determined by market or customer needs. For example, firms may set cost reduction goals in operations in order to meet target prices for particular products or services. Some goals are chosen to be aspirational. For example, an internal goal of “zero waste” or “no accidents” is meant to invoke a perfect end state that is never completely achievable. Other operational goals may result from comparison to competition, such as goals related to inventory turns or quality levels.

More recently, sustainability has gained increasing global attention. Firms that once operated on a domestic scale are now operating on a global level. As a result, firms are placing greater environmental pressures on the planet, especially involving greenhouse gas (GHG) emissions that lead to climate change and global warming (Hoffman et al. 2014). Corporate stakeholders are pressuring firms to develop strategies, policies, and practices that are aligned with firm and societal environmental goals (Klassen 1993). In line with the Paris Climate Agreement (PCA also commonly referred to as COP21), governments are enacting policies and regulations that guide nations on limiting the global rise in temperature to 2°C as compared to pre-industrial temperatures. Non-governmental organizations such as the Carbon Disclosure Project (CDP) collect and report GHG emissions data and goals to socially responsible investors. Retailers like Walmart (Walmart, 2017) take GHG emissions reduction performance into account in purchasing decisions. The culmination of these forces is transforming firm approaches to sustainable operations.

There are several reasons why it is worthy to consider GHG emissions as an issue of operational efficiency rather than as simply “air pollution”. First, GHG emissions largely come from energy production, and so inefficiencies and waste in operational processes will also lead to more GHG emissions (Dooley et al., 2019). Thus, quality or lean improvement activities in operations can impact environmental progress (Corbett and Klassen 2006). Second, since GHG emissions are linked to energy use, which is costly, emissions reductions may also lead to cost reductions. In fact, given the historical lack of attention to energy efficiency, this pathway may be the current “low hanging fruit” for cost reduction. Third, reducing GHG emissions through shifting from fossil fuel sources to renewable energy sources is ultimately a question of operations strategy, as it involves decisions about equipment, facilities, and suppliers. Finally, GHG emissions do not currently fall under any global or locally-consistent regulatory regime, thus emissions reductions are strategic operational choices, not issues of operational compliance.

Operational goals (a.k.a. aspirations) play an important role in organizational performance. Operational goals are used by managers to align operations with higher-level strategic goals (Fiegenbaum, Hart, and Schendel 1996). By connecting goal achievement to incentives, improved performance can be rewarded (Eisenhardt 1985) and tracked (Kaplan and Norton 1996). Research in organizational behavior has established that individual within firms, and thus firms themselves, follow regular patterns when setting organizational goals. For example, management scholars have used the Behavioral Theory of a Firm to study goal setting for financial performance (Mezias, Chen, and Murphy 2002; Lant 1992), company size (Greve 2008), research and development intensity (W.-R. Chen and Miller 2007), and acquisitions (Iyer and Miller 2008). Likewise, operations scholars have empirically observed these same

behavioral explanations for operational goal setting (White and Flores 1987; Bendoly, Donohue, and Schultz 2006; Linderman, Schroeder, and Choo 2006; Croson et al. 2013)

We posit that like other operational goal setting, goals for GHG emissions reduction can be partially explained by these behavioral heuristics. We hypothesize that firms will adjust GHG emissions reduction goals relative to an anchor goal; they will adjust their goals relative to competitors' goals; and they will adjust their goals relative to the degree of current goal attainment. GHG emissions though are different from other operational goals.

First, many operational goals are determined by customer or market requirements. GHG emissions goals are largely determined by external stakeholders. These stakeholders include financial investors, who also help shape financial goals, but also other stakeholders such as NGOs that don't typically influence operational decisions. Second, unlike most other operational goals, GHG emission goals are publicly announced, thus they must appear rational under external scrutiny. Third, "science-based targets" provide an external, achievable target that signifies leadership, thus GHG emissions goals can be used as part of a firm's signaling about their sustainable operations. Finally, measuring GHG emissions is much more complex than measuring cost, quality, or delivery performance.

For these reasons we hypothesize that the adoption of GHG "Science-based Targets" will lead to more aggressive reduction goals since it signals a leadership position, and that complexity in measuring GHG emissions can lead to goal modification. In order to test our hypotheses, we perform econometric analysis on a panel data set of 496 firms from 2011 to 2017 using CDP reports. Results confirm most of the hypotheses with anchoring having a positive impact and social comparison having a negative impact on goal formation. Further, adoption of GHG "Science-based Targets" is a signal of

leadership in sustainable operations, and the complexity in measuring GHG emissions leads to higher goals.

This study contributes to literature in behavioral operations management and sustainable operations management. As pointed out by operations and supply chain management scholars advocating for behavioral operations research (Bendoly, Donohue, and Schultz 2006; Croson et al. 2013), there is increased need to examine the psychological processes that underlie decision making behavior in operational systems. While behavioral processes have been confirmed in general organizational goal setting, this study is one of the first large scale empirical studies of operations goal setting, and the first to examine the drivers of a sustainability-related goal. In addition, our study highlights two ways in which GHG emission reduction goals are different from other goals. The presence of science-based targets (Krabbe et al. 2015) provides a leadership norm that also dictates the specific quantitative goals to adopt. The complexity in measuring GHG emissions leads firms to adjust their goals as well, something that cannot be seen with other dimensions of operational efficiency.

Literature Review

In this section we review literature relevant to our research question, i.e. how firms determine GHG emission reduction goals. We review operational goal setting, GHG emissions in an operational context, and behavioral explanations of goal setting. To conclude we assess current practice regarding environmental goals created by public and private entities.

Operational goals

Most firms have operational goals for performance in terms of cost reduction, quality improvement, delivery improvement, accident reduction, and innovation.

Determining goals for these operational dimensions often involves a need to meet a customer requirement. For example, in target costing (Kee 2010), an overall cost goal is determined for the overall products or its components, derived from market needs. The cost requirement may come directly from the customer, or it may reflect a comparison to competitor product or service prices. Cost reduction goals may also emerge from higher level corporate financial decisions. For example, corporate finances may call for a five percent reduction in costs, and individual operating processes may be expected to contribute to the overall goal. Because of the direct connection to the firm's financial state, investors may pay particular attention to cost reduction goals, and corporate boards of directors may demand such goals be made.

Service level agreements (Larson, 1998) are another example of customer-specified goals, where targets for system reliability and operability are established and part of contractual arrangements linking payment to performance. Product or service quality goals are often derived from downstream buyer requirements, including the end customer. Individual process quality goals may be derived from quality requirements at the system level. Likewise, goals related to improvements in production or service throughput time can be driven by the need to meet more stringent requirements for delivery.

Operational goals may also be chosen according to an aspirational norm. In quality, Crosby (1979) brought attention to Japanese manufacturers adopting "zero defect" programs. The goal served to suggest that zero defects was attainable, and that any less aspiration would bring customer dissatisfaction. As quality programs became more focused on process results, the concept of "six sigma" emerged (Shafer and Moeller, 2012). While six sigma programs encompassed numerous practices, the core

goal was to improve processes so that their natural range of variation was only half of the range of the design tolerances.

Internal operational goals may also be set as aspirations that may not be ever completely achievable, but nevertheless provide a rational goal to strive for. For example, firm safety programs will typically adopt a zero accidents goal and track how time has elapsed since the last accident. More recently, firms have adopted zero waste goals (Song, Li, and Zeng 2015) as a means to incentivize more recycling of materials at end of life. Practically, no one assumes actual zero waste is achievable – but "10% waste" is not an aspirational goal compared to "zero waste".

Environmental sustainability and OM

Firms are facing stakeholder pressure and are also becoming internally aware of the vulnerabilities, risks, and costs associated with regulatory and physical changes related to global climate change (Jira and Toffel 2013). In order to better deal with these realities, firms should extensively focus on their operations as the foundation of good environmental management is operations (Corbett and Klassen 2006). Beginning in the late 1980s, in part due to the rise of international companies outperforming their American counterparts, the focus shifted from low-cost production to quality, flexibility, short lead times and dependable delivery with concepts and philosophies of production management (computer integrated manufacturing, just in time, optimized production technology, total quality management, and lean management) taking center stage. The literature has seen these concepts of operations management as complementary to environmental sustainability and vice versa (Martínez-Jurado and Moyano-Fuentes 2014, Florida 1996; King and Lenox 2001).

Key concept and principles within OM, such as TQM, JIT, lean manufacturing etc. have direct linkages on a firm's environmental success as highlighted by the

similarity between standards such as ISO 9001 and ISO 14001. Corbett and Klassen (2006) argue a need to expand the horizon of TQM to include the natural environment and other stakeholders. They discuss and offer examples for the duality of TQM tools and principles, and their applicability to environmental improvements. For example, Romm (2014) notes how Toyota was able to reduce paint defects by a factor of 30 while simultaneously reducing energy consumption by 50% by installing variable-speed motor drives. Evidence from the U.S. furniture industry shows a link between greater investments in JIT systems and improved environmental performance (Klassen 2000). King and Lenox (2001b) find that lean manufacturing is correlated with greater waste prevention and lower emissions. Similarly, Rothenberg et al. (2001) found strong anecdotal evidence that lean manufacturing is associated with emissions reduction of volatile organic compounds. Other studies in OM that have investigated the impact of environmental sustainability on operations include the relationship between firm environmental orientation and its impact on investments in operational improvements (Power et al. 2015) as well as environmental technologies (Klassen and Whybark 1999a) and the impact on operational performance (Klassen and Whybark 1999b).

Despite the parallels of environmental sustainability and operations, a disconnect still seems to exist. While firms do recognize that environmental sustainability has implications on their competitive positions, they are uncertain about how best to implement environmental management practices (Montabon, Sroufe, and Narasimhan 2007a). Pagell and Gobeli (2009) find that operational managers have yet to embrace a environmental sustainability mindset, but environmental performance does impact operational performance. Further, when it comes to being more sustainable, large gaps can exist between top management and operational level decisions (Wheeler, Fabig,

and Boele 2002). These issues can be addressed by setting firm wide environmental sustainability goals.

Firm GHG Emissions Goals

Organizational goals play an important role in organizational performance (Smith, Locke, and Barry 1990). Goals are used by managers to communicate strategic goals (Fiegenbaum, Hart, and Schendel 1996), enhance performance (Eisenhardt 1985), and provide measures of success (Kaplan and Norton 1996). Setting specific and challenging microlevel organizational goals leads to superior individual task performance (Mento, Steel, and Karren 1987; Tubbs 1986), and setting specific and challenging macrolevel organizational goals improves corporate performance (Smith, Locke, and Barry 1990). In both cases, specific goals provide a means for superior performance evaluation, where outcomes can be easily compared against the initial goals that were set. Challenging goals induce motivation to achieve such goals.

Literature on the GHG emissions target setting process has mainly been investigated from a scientific point of view (Rietbergen, van Rheede, and Blok 2015). This literature includes papers that focus on the different options for formulating corporate GHG emission reduction or energy efficiency improvement targets (Margolick and Russell 2001; Rosenberg et al. 2012; Rietbergen and Blok 2010). The options include main target types such as absolute or volume targets, economic intensity targets, physical efficiency targets, and economic targets for GHG emission reduction targets. There are also so-called guidance papers that offer systematic outlines to establishing GHG emissions targets (WBCSD 2004). In general, these outlines have the following procedural steps: obtain senior management commitment, choose the target type, decide on the organizational boundary, chose a base year, develop baselines, define completion date, and decide on commitment length. Despite these procedural

steps, little attention has been paid to understanding how firms set its GHG emissions reduction targets.

There are a couple of empirical studies that attempt to understand the process. Margolick and Russell (2001) looked into the process of setting voluntary targets for energy efficiency or GHG emissions reduction of companies under the Business Environmental Leadership Council. The main conclusions were that the target-setting process followed more or less the step-by-step approach as suggested by the WBCSD/WRI (2004). Rietbergen and his co-authors (2015) investigated the GHG emission reduction target setting process of firms participating in the CO_2 Performance Ladder by utilizing an exploratory research design with data collected from interviews. They find that companies used both top-down and bottom-up approaches for establishing GHG emission reduction targets, and that most targets were not ambitious. Our study contributes to this niche area by attempting to identify the determinants for the aspirational level of GHG emission reduction targets.

Behavioral Theory of the Firm

The Behavioral Theory of the Firm (BTOF) has long assisted scholars in understanding the thought process of organizational decision makers. BTOF is a decision theory that is based on bounded rationality, problemistic search, a dominant coalition, standard operating procedures, and slack search (Cyert and March 1963a). Decision makers are boundedly rational, i.e. they lack perfect knowledge and must search for information in order to make a decision. This strays from the conventional theory of the firm which postulates that decision makers are purely rational-agents seeking the optimal decision.

The cognitive foundations of decision makers can be captured by three central themes: satisficing, search, and heuristics. Satisficing posits that decision makers do not

optimize, but rather settle on the first alternative they believe to be satisfactory. A decision maker will search amongst known alternatives (where not all choice options are known) and select the first option that they perceive to procure a satisfactory outcome. Choice options tend to be similar to those used before in similar situations, ensuring that a decision does not stray too far from status quo. Heuristics provide rules-of-thumb that make decision making easier, especially in contexts of high uncertainty. These heuristics are constructed from past experience and often substitute for more formal decision processes.

The theoretical foundation of our paper is form on the concept of aspirational level in BTOF (Argote and Greve 2007). In this theory, goals represent an aspirational level on a measurable organizational outcome. Decision makers chose an aspirational level based on "the organization's past goal, the organization's past performance, and the past performance of other 'comparable' organizations" (Cyert and March 1963a, 115). An aspirational level emerges as the weighted average based on these antecedents. An organization's past goal serves as an anchor for future goals. A firm's performance is considered a realized outcome which typically triggers problemistic search when performance falls below aspirational levels. Problemistic search is based on the notion that cognitive limitations force decision makers to focus on problematic areas. Due to the concepts of bounded rationality, decision makers follow rule-based behavior and maintain the status quo when performance rises above aspirational levels. Similar mechanisms apply to a firm's "comparable organizations". Performance that fall below aspirational levels of a comparison group trigger problemistic search for actions that produce outcomes that may surpass the aspirational level of a goal.

BTOF has been applied to many different fields ranging from population ecology to evolutionary economics and political science (Argote and Greve 2007). However,

these seems to be a lack of empirical studies that quantitatively test the case studies, theorizing, and simulations (Argote and Greve 2007), leading to a lack of robust empirical evidence on the antecedents of aspirations (Shinkle 2012). Our paper adds to the dearth of empirically tested BTOF stream by investigating sustainability goals with explicit measures of performance against those goals.

Hypotheses

We develop the theoretical framework for our paper by utilizing the mechanism of aspirational level setting of BTOF. From our literature review, Cyert and March (1963a, 162) identified three main antecedents to the formation of a firm's aspirational level as: "the organization's previous aspiration level, the organization's previous performance, and the previous performance of other comparable organizations." We begin by formulating our hypotheses from each of these antecedents and argue that additional variables are needed in order to explain the formation of GHG reduction goals.

The prior aspiration level

It is generally taken that decision makers in organizations are boundedly rational (Simon 1957). Wherein, decision makers are cognitively limited from knowing all possible information and alternatives to make an optimal choice. In situations where the decision and outcome become more ambiguous, it has been argued that decision makers rely on the use of simple decision heuristics to assist with economizing the amount of information processing needed to make decisions. Examples of these simple heuristics include incremental adjustment (Padgett 1980), trial and error (March and Shapira 1992), and anchoring and adjustment (Bromiley 1987; Kahneman and Tversky 1982; Tversky and Kahneman 1974)

Projects in sustainability typically have long time horizons, which inherently should make the decision/outcome link more uncertain and ambiguous. As such, decision makers would most likely rely on simple heuristics in determining GHG reduction goals (a.k.a. aspirational level). Cyert and March (1963a) argue that previous organizational aspiration level serves as an anchor for aspiration level in the current period. Decision makers would anchor on previous aspiration level as a starting point from which adjustments would be made. Furthermore, adjustments that are made will not typically be a full adjustment to the level of performance achieved in a single time period. Hence, if previous GHG reduction goals is relatively high, then GHG reduction goals in the current period will also quite likely be similarly as high. Conversely, if the goal is relatively low, then the goal in the current period will likely be just as low. This anchoring and adjustment behavior is found to be consistent in studies conducted in experiments (Glynn, Lant, and Mezias 1991) and classroom simulations (Lant 1992) where the level of prior aspiration level positively effects aspiration level in the current period, ie. the higher the previous aspiration level the higher aspiration level in the current period will be set. This leads us to our first hypothesis:

Hypothesis 1: Prior GHG reduction goals will have a positive association with current GHG reduction goals.

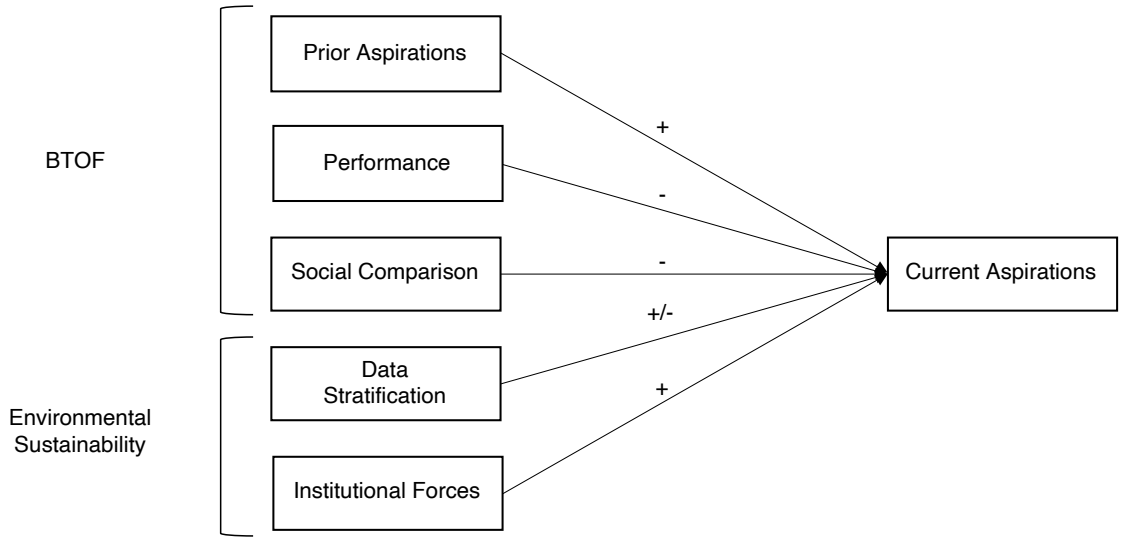


Figure 1. Framework for research design

The previous performance level

We believe that decision makers will update GHG reduction goals in the current period by using a simple decision rule based on previous performance (Cyert and March 1963a; March and Simon 1958). Previous performance offers a crucial piece of information from which decision makers adjust previous aspiration level to set current aspiration levels. Changes driven by deviations from aspirations are typically incremental, with both aspirations and actions changing in small steps (Padgett 1980). Incremental change is another example of decision simplification and has been shown in studies of anchoring and adjustment (Tversky and Kahneman 1974) and strategic decision making (Quinn 1980). Decision makers will compare the level of achievement between performance and the aspiration level, ie attainment discrepancy (Lewin et al. 1944). Positive attainment discrepancy reflects superior performance relative to aspiration levels, and negative attainment discrepancy represents underperformance.

Adjustments to previous aspiration levels is dependent on the direction of attainment discrepancy.

BTOF emphasizes that due to the cognitive limitations of decision makers, attention is sequentially allocated to find solutions to specific problematic areas, i.e. problemistic search (Cyert and March, 1962; Washburn and Bromiley, 2012). As such, we believe decision makers will not focus on adjusting GHG reduction goals if positive attainment discrepancy was achieved. Furthermore, outperforming aspiration levels has been linked to reduced risk taking (Bromiley, Miller, and Rau 2001) resulting in decision makers maintaining the status quo. Conversely, if negative attainment discrepancy has occurred, decision makers will focus on reducing the discrepancy between actual GHG emissions emitted and the GHG reduction goal. Moreover, underperforming aspiration level has been linked to increased risk taking in an attempt to overcome past performance deficiencies. (Cyert and March 1963a; Kahneman and Tversky 1979) Based on these arguments, we propose our second hypothesis:

Hypothesis 2a: If a firm has positive attainment discrepancy, GHG reduction goals in the current period will be equal to GHG reduction goals in the previous period.

Hypothesis 2b: If a firm has negative attainment discrepancy, GHG reduction goals in current period will be lower than GHG reduction goals in the previous period.

Social comparison

The two antecedents that have been discussed thus far have related to information pertaining to the focal firm. The last variable shifts the focus away from the focal firm to information regarding the environment. Social comparison theory suggests that information from a socially comparable group may affect the setting of aspiration levels (Bandura and Jourden 1991; Festinger 1954). Social comparison allows for firms to evaluate their own opinions, actions, performance, etc. by benchmarking against firms

in a similar comparable group. Differences and gaps that may occur could affect the setting of aspiration levels. For example, in the context of performance, information pertaining to a socially comparable group could impact the setting of aspiration because focal firms want to minimize the performance gap between itself and similar firms (Cyert and March 1963a; March and Simon 1958).

Following both Greve (1998) and Mezias (2002), we conceptualize social comparison as a difference variable between GHG emissions levels of the focal firm and a socially comparable group. The variable takes on a negative term if the focal firm has performed below comparable others and takes on a positive term if the focal firm has performed better than comparable others. If we assume that managers believe there is a positive aspiration-performance relationship, then underperformance as compared to comparable others will trigger a rise in GHG reduction targets. Presumably, performance will raise in accordance and thus minimize the performance gap between the focal firm and a socially comparable group. Conversely, focal firms that performed well as compared to others will likely adjust GHG reduction targets downwards. This will presumably lower performance, and once again, bring the focal firm's performance closer to that of comparable others. Based on this logic, we predict that the effect of social comparison will be negative.

Hypothesis 3: If a firm has better/worse performance than peers, GHG reduction goals in current period will be less/greater than GHG reduction goals in the previous period.

Data Stratification

Firm familiarity with various measurements is crucial to how effective firms measure and utilize those measurements in the decision-making process. Traditional measurements such as throughput, cycle time, and customer fill rate, etc have long established measurement methodologies which has successfully aided firms in the

decision-making process. Firms are in various stages of adopting GHG emissions measurements. Early adopters are more likely to be familiar with measurement techniques leading to understanding how best to use those measurements in the decision-making process. We posit that the contrary is applicable to late adopters.

In general, there are three principle life cycle approaches to accounting for emissions inventories: environmental input-output analysis (EIOA), process analysis (PA), and a hybrid environmental input-out life cycle assessment. EIOA is a top-down approach that uses national economic and environmental data to estimate emissions for various activities of industry sectors (Wright, Kemp, and Williams 2011). This estimation technique is less labor intensive than other methods because it requires no primary data collection. Despite the positives, EIOA does not account for emissions generated during delivery, use and end-of-life stages of products. When granular emissions are needed, firms tend to adopt the PA methodology, ie a bottom-up approach that analyzes emission associated with specific processes. PA tends to lead to greater accuracy than EIOA, but is more labor intensive, requiring more time and resources. Firms typically engage in a hybrid method, where PA is utilized to calculate emissions for specific processes and embedded within an EIOA.

While firms can easily jump into carbon emissions accounting by employing an EIOA method, the process for adopting PA require more resources and time. Converting such raw data to a standardized measure of emissions present challenges as well. This is one of the reasons why consulting firms such as PwC and Deloitte are actively developing new capabilities to help firms understand and integrate new carbon accounting requirements (Engels 2009). The degree of variation result in firms that are at different stages of carbon emissions accounting, leading us to assume that firms are continually improving and enhancing their data stratification techniques for accounting

for GHG in order to obtain more precise estimations of GHG emissions from specific activities and processes within a firm. Improvements in data stratification will provide additional information to assist decision makers in setting a GHG reduction goal. With more information on hand, decision makers will likely reassess current goals, and adjust accordingly based on what they believe to be satisfactory, which leads us to our fourth hypothesis:

Hypothesis 4: If a firm improves data stratification from one period to the next, GHG reduction goals in the current period will be adjusted.

Institutional forces

Perhaps the most distinct aspect that distinguishes sustainability aspiration levels, in particular GHG emission targets, from other corporate target goals (i.e., financial targets, growth targets, size targets, R&D targets) is the existence of institutional forces. Governments are enacting policies and regulations that adhere to the PCA's (a global agreement between 196 nations) goal of limiting the rise in global temperatures to 2°C compared to pre-industrial levels. It is generally believed that adhering to the 2°C threshold would prevent catastrophic floods, droughts, rising sea levels, and extreme weather events.

Despite such ambitious goals, emission reports indicate that the top Global 3500 companies, accounting for about one fifth of the world's carbon emissions, are falling short of achieving the 2°C goal (Moorhead and Nixon 2016). This is not surprising given the fact that in order to maintain the 2°C limit, emissions reductions have to amount to an almost 80-90% absolute reduction level as compared to 2010 emissions. However, it is quite surprising that these Global 3500 companies have increased their overall carbon emissions. Since 2011, companies carbon emissions have grown 3.9% instead of

decreasing by the required 5.6% (Moorhead and Nixon 2016). Within the Global 3500, 50 firms produce nearly half the emissions which equates about 10% of global emissions. Of these 50 firms, only 20% is achieving sustainable growth with most firms exceeding the allotted carbon emissions required to maintain a 2°C increase in global temperatures.

A core reason for such a phenomenon is that many companies have largely been flying blind (Gies 2017), resulting in inappropriately setting emission reduction targets. This is unsurprising not only because of the already difficult nature of measuring emissions, but also the added complexity of how each firm's actions contribute to achieving the 2°C threshold. Pedro Faria, technical director for the CDP, discussed how "there was no real consideration of what had to be done to achieve a world of 2°C (Gies 2017)."

As such, in 2014, the Science-Based Target initiative was launched by a partnership between CDP, WRI, WWF, and the UN Global Compact (Krabbe et al. 2015). Firms can respond to institutional forces by leveraging the SBT initiative to assure that their emissions goals are aligned with the 2°C limit. Analysts at the initiative used methodologies as outlined in Krabbe et al. (2015) to determine the world's carbon budget to limit global warming, and subsequently calculate a company's share based on reported current emissions. At the time of this writing, 470 firms have signed on to participant in the SBT initiative. While most of these firms already have ambitious long-term goals to be carbon neutral; firms such as Coca Cola, Tesco, and Sony have credited SBT in setting more ambitious short-term and mid-term reduction goals. In addition, we feel that with the current failings of carbon reduction efforts, companies will exhibit an increase in carbon reduction targets as they begin to align with the 2°C threshold. SBT goals are a form of an institutional norm that allows those adopting the

quantitative goal to claim leadership in sustainable operations. This leads us to our fifth hypothesis:

Hypothesis 5a: If a firm adopts the SBT initiative, GHG reduction goals in the current period will be greater than GHG reduction goals in the previous period.

Data and Methodology

Data and Sample

The data consists of firm responses to annual CDP questionnaires. CDP was founded in 2000. It works closely with institutional investors to encourage corporations to report on environmental issues, particularly carbon emissions and water usage. One of the key reasons for the success of CDP is due to its support of more than 800 institutional investors with a combined US$95 trillion in assets. Because of this partnership, the questionnaires that CDP hands out to firms usually enjoy high response rates. CDP data provides social investors with information on firms' risks associated with climate change and to inform managers about investors' concerns about climate change (Stanny and Ely 2008). In academia, data from CDP has also been used in studies across many disciplines. Some examples include looking at the effects of voluntary climate change disclosure on firm performance (Lee, Park, and Klassen 2015), the impact of a CEOs educational degree on environmental disclosure (Lewis, Walls, and Dowell 2014), and identifying differences between numbers reported in corporate reports and CDP reports. (Depoers, Jeanjean, and Jerome 2016).

Our data is an unbalanced panel from 2011 to 2017, containing 11,191 observations of GHG emissions reduction targets spanning over 2,041 firms. While CDP was founded in 2000, data collected on emissions target prior to 2011 did not include a specified criterion "percentage in scope" which we utilized to prepare the data. The

“percentage in scope” criteria indicates the percentage of emissions that a target covers. The data contains specific region and/or project level emission data reflected by a much lower “percentage in scope”. Since our study focuses on firm level emissions targets, we include targets that only have 100 percent emissions captured by the “percentage in scope.”

GHG emissions are typically broken down to three different types: Scope 1, Scope 2, and Scope 3. Scope 1 refers to all GHG emissions that are directly emitted from sources that are owned or controlled by the firm. Scope 2 refers to indirect emissions that result from consumption of purchased electricity, heat or steam. Scope 3 is all other direct GHG emissions from sources that are not owned or controlled by the firm. A firm could have multiple GHG reduction targets in any given year. These reduction targets range from overall combined Scope 1 and Scope 2 (i.e. direct) emissions reduction targets to targets that are related to projects at specific sites or subsidiaries. Some firms also include Scope 3 (i.e. supply-chain) emissions reduction targets. Since our study is focused on firm level operational improvements, we limit our sample to only the broader combined Scope 1 and Scope 2 emissions reduction targets that have at least 2 years of data. Furthermore, the number of firms that actually have emissions reduction targets are quite limited. This reason alone dramatically reduces our sample size from 11,191 observations with 2,041 firms to 1,542 observations and 496 remaining firms.

Measures

Table 1 summarizes our dependent and independent variables of interest.

Table 1	**List of Variables Used in the Model**
Variable	Description
$GHGgoals_{i,t}$	Dependent variable, defined as GHG emissions per CO_2 equivalent for firm *i* in year *t*. Positive/negative value represent lower/higher aspirations, respectively
$lag\ GHGgoals_{i.t}$	Lagged expression of $GHGgoals_{i.t}$
$lag\ GHGperf_{i.t}$	Sustainability performance as measured by attainment discrepancy ($GHGgoals_{i.t} - GHGperf_{i.t}$) for firm *i* in time period *t-1*
$lag\ GHGcomp_{i.t}$	Performance of a socially comparable group as measured by $(GHGperf_{i,t} - GHGperf_{sc,t})$ for firm *i* in time period *t-1*
$lag\ DataStratify_{i.t}$	Changes in data stratification for firm *i* in time period *t-1*
$lag\ SBT_{i.t}$	Adopted and established science based targets for firm *i* in time period *t-1*

Dependent Variables

GHG reduction goals. The main dependent variable are targets for reductions in GHG emissions. Data from CDP includes targets that are either Scope 1, 2, 3, or a combination of the three. These targets are then divided between absolute aspirational targets or intensity aspirational targets. Recall that Scope 1 refers to all GHG emissions that are directly emitted from sources that are owned or controlled by the firm. Scope 2 refers to indirect emissions that result from consumption of purchased electricity, heat or steam. Scope 3 is all other direct GHG emissions from sources that are not owned or controlled by the firm. Examples of scope 3 emissions include: extraction and production of purchased materials and fuels and transport related activities.

The difference between absolute emissions and intensity emissions is that absolute emissions measures the total amount of emissions emitted whereas intensity is normalized by either total revenue or number of full time employees. Our dependent variable is developed by using the absolute GHG reductions targets that firms set for Scope 1 and Scope 2. We convert targets that span multiple years into yearly targets by

allocating equal weighted targets to each year. For example, if a firm sets a 20% reduction in GHG emissions over a 5-year period, our dependent variable will show 4% yearly reduction targets. The reduction percentages are then applied to baseline emissions to determine the actual absolute GHG emission target, where lower absolute GHG emissions targets refer to higher aspirational levels, and vice versa. Our study does not include Scope 3 emissions targets since we are only focused on focal firm operational improvements.

Independent Variables

Prior GHG reduction goals. This independent variable is measured by lagging our dependent variable by one period.

GHG emission (performance) levels. Following the same reasons as aspirational levels, sustainability performance measures for Scope 1 and 2 will be included in the sample. Attainment discrepancy is then calculated by subtracting emission goals from actual emissions (Mezias, Chen, and Murphy 2002). Due to our measurement of aspiration as an actual GHG emissions target number, a negative difference here represents positive attainment discrepancy. To account for whether firms outperform or underperform, we institute an indicator variable of 0 or 1, with 1 indicating firms that have underperformed its emissions goals.

GHG emissions - Social Comparison. Here, we define a socially comparable group as any firm within the same industry group as the focal firm. We calculate a firm's emissions performance relative to comparable others by differencing the firm's own emissions with the industry emission. We then categorize social performance with an indicator variable of 0 or 1, with 1 indicating firms that have underperformed its industry peers.

Data Stratification. We define Data Stratification by capturing a firm's ability to break down GHG emissions into various subgroups such as region, business division, facility, GHG type and activity. The intuition is that granularity of GHG emissions represents a firm's maturity for measuring GHG. For example, GHG type. There are several gases that contribute to GHG emissions. These include: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), and other fluorinated gases (Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride) (US EPA 2015). Breaking down the combined GHG emissions by these various gases is complicated, and we assume that firms who can do so have better data stratification techniques to estimate and allocate GHG emissions.

In order to determine whether firms improve data stratification, we first account for the number of breakdowns that a firm provides in each subgroup (ie. if a firm lists 5 different countries in its region breakdown, we count it as 5). We then calculate how complete the breakdown within each subgroup is. For instance, some firms list 5 different countries but only have emissions data for 4 of those 5 countries. In such a case, our measure of completeness is 80%. Next, we compute data stratification for each subgroup by multiplying the number of breakdowns with the percentage complete.

The change in data stratification is then computed by comparing stratified data for each subgroup between time t and $t-1$. If the percentage change between the two time periods in any subgroup is greater than 15%, we consider that a change in data stratification.

Science based targets. Science based targets is a fairly new initiative, where companies have signed on to establish GHG emissions targets driven by institutional forces. The data we obtained from the SBT website include 470 firms that are either committed or have already established science-based targets. The variable for SBT is

an indicator variable with 1 indicating the year when the firm adopts and establishes a SBT, and 0 otherwise.

We use figure 2 to demonstrate how our data is mapped into these variables. Aspirations for Wal-Mart Stores Inc. in 2017 is 19,675,821 metric tons of carbon dioxide equivalent (CO_2e). We first compute percentage target reduction for 2017 by distributing the percentage target reduction over the target period (1.8%). We then account for which year the goal is in by comparing current year and base year (year 2). We then multiply both figures and subtract from one to arrive at the required aspirational level for 2017 (96.4%). This figure is then multiplied by base year GHG emissions to determine the actual GHG emissions target for 2017 (19,675,821 metric tons CO_2e). Attainment discrepancy for 2017 is then calculated by combining Scope 1 and Scope 2 emissions (21,700,845 metric tons CO_2e) and differencing aspirational emissions (19,675,821 metric tons CO_2e), which is

Figure 2. Sample data for Wal-Mart in 2017

account_id	project_year	account_name	Scope	% in scope	% target	base year	base yr GHG	target year	Scope 1 GHG	Scope 2 GHG
20402	2017	Wal-Mart Store	Scope 1+2 (ma	100	18	2015	20410603	2025	6650232	15050613
			Other: Scope 3	100		2015		2030		

BTOF

Country	Scope 1 GHG	GHG Type	Scope 1 GHG	Country	Scope 2 GHG	Activity	Scope 2 GHG
Argentina	210746	CH4	1255	Argentina	90947	Retail Formats	11619920
Brazil	434323	N2O	2764	Brazil	137531	Wholesale & M	1494583
Canada	182335	HFCs	2886899	Canada	144919	Discount Form	506729
Chile	203529	CO2	3164807	Chile	161595	Convenience F	1527
China	261902			China	946247	Non Store Forn	1024066
Costa Rica	10614			Costa Rica	6081		
El Salvador	7583			El Salvador	11350		
Guatemala	7603			Guatemala	20902		
Honduras	12274			Honduras	13477		
India	10040			India	19271		
Japan	65692			Japan	323913		
Mexico	666761			Mexico	1029532		
Nicaragua	7943			Nicaragua	9147		
Puerto Rico	48501			United Kingdom	446985		
United Kingdom	218806			United States o	11135598		
United States o	4293156			Africa	470364		
Africa	56924			Bangladesh	153		
				Indonesia	14		
				Pakistan	29		
				Vietnam	14		
				Puerto Rico	82756		

Data Stratification

Status	Date committed
Targets Set	Nov 2016

Science-based targets

2,025,023 metric tons CO_2e. Since actual emissions for 2017 is higher than the emissions target, Wal-mart has negative attainment discrepancy which we code as 0 in

our data. Social comparison is computed by calculating the average emission for firms in the same industry as Wal-mart (excluding Wal-mart). We then compare emissions for the industry and Wal-mart. Data Stratification for Wal-mart in 2017 for country breakdown would be 17 (100%*17 different countries). We compare this figure for data stratification for country breakdown in 2016 (not shown in figure), which is also 17. In this scenario, Wal-mart had no change in data stratification for country breakdown in 2017. We repeat this process for each subgroup (ie, GHG type, activity etc.). If any subgroup has a change of greater than 15%, we would code it as a change in data stratification. Lastly, Science-based targets for Wal-mart would take on a value of 1 in 2016.

Control Variables

Firm size. We include a firm's total assets to account for possible effects of a firm's size.

Year dummies. When dealing with panel data, the inclusion of year dummies is crucial in accounting for aggregate trends.

Table 2	**Descriptive statistics**									
	Mean	**S.D.**	**Min**	**Max**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
(1) GHGgoals	1.27E+06	4.11E+06	0	3.34E+07	1					
(2) GHGperf	0.394	0.489	0	1	-0.09	1				
(3) GHGcomp	0.143	0.35	0	1	0.37	0.22	1			
(4) DataStratify	0.415	0.493	0	1	-0.02	-0.05	-0.02	1		
(5) SBT	0.055	0.228	0	1	0.04	-0.16	-0.08	-0.02	1	
(6) Assets total (ln)	11.6	3.162	5.377	19.895	0.09	-0.04	0.24	-0.03	-0.03	1

Note. Attainment, Social Comp, Change in measure, and SBT are indicator variables.

A table of descriptive statistics and corresponding correlation matrix is presented in table 2. The table suggests no major collinearity problems in our data.

Econometric Model

We begin our model with Cyert and March's (Cyert and March 1963a; Mezias, Chen, and Murphy 2002) organizational adaptation model, where current aspirations is a summation of previous aspirations, performance (measured by attainment discrepancy),

and social performance. We then include our variables of interest Data Stratification and Science Based Targets, as well as our control variables and a constant, resulting in the following econometric model:

$$GHGgoals_{i,t} = \beta_1 GHGgoals_{i,t-1} + \beta_2 GHGperf_{i,t-1} + \beta_3 GHGcomp_{i,t-1} + \beta_4 DataStratify_{i,t-1} + \beta_5 SBT_{i,t-1} + \gamma controls_{i,t} + \epsilon_{i,t}$$

Variables of the model is as defined in the previous section and summarized in Table 1. The error term $\epsilon_{i,t}$ captures idiosyncratic shocks. Since we included a lagged dependent variable in our model as per the Aspirational Adaptation Model our model is considered a dynamic panel model. Panel estimation techniques such as fixed effects or random effects are not appropriate since the lagged dependent variable is correlated with the fixed effects in the error term giving rise to what is known as dynamic panel bias (Nickell 1981). Estimation techniques that takes this into consideration includes Kiviet's (1995) suggestion for running a least squares dummy variables then manually correcting for the standard errors, Arellano and Bond's (1991) difference GMM, and Arellano and Bover (1995)/Blundell and Bond's (1998) system GMM method. Following recent dynamic panel studies (Lam, Yeung, and Cheng 2016; Chizema et al. 2015; Suarez, Cusumano, and Kahl 2013), we employ generalized method of moments (GMM) estimation to test our hypothesis. We specifically adopted the System GMM estimator as it offers several important advantages for our research.

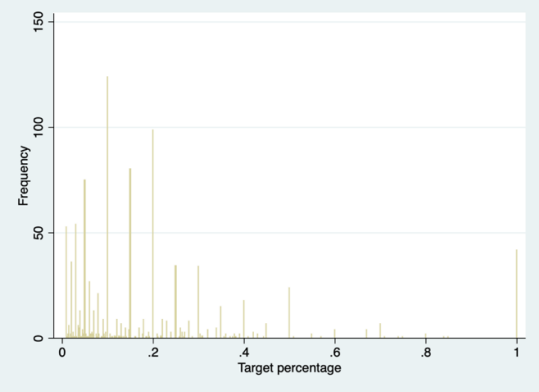
First, Flannery and Hankins (2013) extensively compare different dynamic panel estimation techniques and suggest that the System GMM estimator appears to be one of "the most robust methodologies for unbalanced panels with endogenous variables" (p.13). The estimation technique addresses dynamic panel bias directly by instrumenting lagged dependent variables with variables that are uncorrelated with the fixed effects in the error term. It can also reduce omitted variable bias by instrumenting additional

variables (outside of the lagged dependent variable) that are not strictly exogenous. Although conventional instrumental variables are preferred, it is difficult to obtain such strictly exogenous instruments as pointed out in prior studies (Bardhan, Krishnan, and Lin 2013; Wintoki, Linck, and Netter 2012). To account for this, system GMM constructs instruments internally through the transformation of existing variables, eg. our study utilizes both differenced lagged variables and lagged differenced variables as instruments. Lastly, unlike Kiviet's (1995) estimation suggestion that is only robust for balanced panels, System GMM is suitable for data that have unbalanced panels with small T and large N (eg. our data).

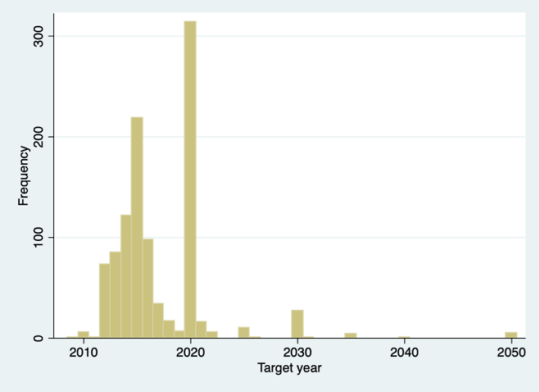
One drawback for utilizing System GMM, relative to other techniques such as Fixed Effects or Difference GMM, is that transformation of data does not expunge unobservable fixed effects. However, although the endogenous variables are correlated with the fixed effects in the error term by construction, it is assumed that the correlation is constant over time (ie, time-invariant) (Arellano and Bover 1995; Blundell and Bond 1998). This is a reasonable assumption for data that have relatively short time periods such as ours with a maximum of seven years from 2011 to 2017 (Lam, Yeung, and Cheng 2016; Wintoki, Linck, and Netter 2012). Furthermore, system GMM allows the researcher to instrument potential endogenous variables. However, one must be keen to not instrument too many variables, or it could lead to instruments overfitting the data resulting in biased estimates (Roodman 2006). We estimate our model treating the antecedents of BTOF ($\boxed{GHGgoals, GHGperf, GHGcomp}$) as potentially endogenous and our remaining independent variables ($\boxed{OpMaturity, SBT}$) and control variables ($\boxed{size\ and\ year\ dummies}$) as strictly exogenous. Lastly, we address our small sample size issue by requesting both a small-sample correction to the covariance matrix and a forward orthogonal transformation of variables.

Results

We first include graphs to show a tendency for target years and absolute percentage reductions to take on “convenient” numbers, giving credence to decision makers relying on simple heuristics in attempting to reduce the complex nature surrounding environmental goals. Graph 1 shows frequency for GHG emission reduction targets, with spikes appearing in 5% intervals. Graph 2 also shows similarities in decision makers relying on “convenient” numbers. We see spikes in years 2015, 2020, 2025, and 2030. There are also a few long-term goals targeted for 2035, 2040, and 2050.



Graph 1. Frequency plot of target percentage.



Graph 2. Frequency plot of target year

Recall that we are trying to determine what influences a firms GHG emissions reduction targets. The foundation of our theoretical model begins with BTOF’s aspirational adaption model. We further include two additional variables of interest, data stratification and science-based targets, as we believe that the original aspirational model does not ably explain how emissions goals are determined. We provide our estimation results using the Arellano and Bond system GMM method in table 3 following

the outlined logic flow. First, estimation results with a model containing only the control variables are reported, followed by including BTOF's aspirational adaptation model, then iteratively adding our additional two variables of interest. The inclusion of too many instruments could lead to overfitting the data and bias our estimates. Given that, we follow Roodman's (2006) recommendation of providing estimations with reduced instruments.

Table 3	**System GMM results**					
Dependent Variable: GHGGoals	GMM estimations				Sensitivity Analysis	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
lag GHGgoals		0.907***	0.913***	0.913***	0.909***	0.893***
		(0.0222)	(0.0221)	(0.0222)	(0.0188)	(0.0277)
lag GHGperf		156856.7	130285.5	127121.7	66491.6	49022.9
		(147707.3)	(157774.0)	(157250.4)	(79654.1)	(94016.0)
lag GHGcomp		198904.7*	161227.3^	158468.1^	162483.5^	195583.5
		(93180.4)	(88875.5)	(89079.7)	(91752.0)	(128290.7)
lag DataStratify			-101966.6^	-104689.7^	-109557.3^	-110996.0^
			(58227.7)	(59166.1)	(61382.5)	(62231.9)
lag SBT				-131447.8*	-133951.7*	-151135.0*
				(62114.4)	(60057.8)	(66677.7)
Assets total (ln)	130647.7**	8622.0	5800.6	5889.6	5375.4	5208.6
	(44870.7)	(7188.6)	(6847.9)	(6862.4)	(6272.9)	(7407.7)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	1048	549	488	488	488	488
Number of Groups	463	283	249	249	249	249
Number of Instruments	7	42	42	43	34	25
F-statistic	4.95***	676.08***	842.11***	790.60***	685.24***	446.05***
(degrees of freedom)	(8, 463)	(11, 283)	(12, 249)	(13, 249)	(13, 249)	(13, 249)
Hansen Test Statistic	N/A	30.39	27.62	28.36	17.49	7.99
Arellano and Bond AR(2)	0.90	0.88	0.89	0.9	0.9	0.87

Note. Standard errors are in parenthesis, except where noted

^Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level

Model 1 indicates larger firms have higher absolute GHG emissions targets than smaller firms. The results make intuitive sense as larger terms tend to emit more emissions than smaller firms. The coefficient of 130647.7 is positive and significant indicating that doubling the size of a firm is associated with a firm's actual GHG emissions targets that is about 1,306 percentage points higher.

Results for Model 2 show that two antecedents of BTOF are significant and positive. As indicated in our hypothesis, prior GHG reduction goals do indeed have a positive effect on goals in the current period. The coefficient of 0.907 suggests that a

percentage point increase in prior goals increases current reduction goals by nine tenths of a percentage point. Curiously, we find that our variable for attainment discrepancy is not significant. We expected the sign for our social comparable group to be negative. (Recall that our values for aspirational targets is actual GHG emissions, where a positive increase reflects lower GHG emissions goals, and vice versa) However, results show that the coefficient is positive and significant, indicating that firms who underperform in the prior period as compared to a socially comparable group will decrease their absolute GHG emissions goals in the current period by 198,904 metric ton CO_2 equivalent.

Model 4 and model 5 indicate that our hypothesized additional variables, which could impact GHG emissions reduction targets, are negative and significant. The coefficient for change in data stratification ranges from negative 101,966 to negative 104,689 between the two models supporting hypothesis 4. We had not hypothesized the direction of change that data stratification would exhibit, and our results show that firms who are becoming more sophisticated at measuring GHG emissions will increase their GHG emissions goals in the current period by 101,966 to 104,689 metric ton CO_2 equivalent. Lastly, we confirm that firms who participate in the SBT initiative will exhibit better GHG emissions goals. Our coefficient of negative 131,447 metric ton CO_2 equivalent is significant indicating that firms who participate in the SBT initiative will commit to an additional reduction of 131,447 metric ton CO_2 equivalent of emissions.

We conducted two tests to verify the suitability of applying System GMM in our research. We use the Hansen test (1982) to check for overidentifying restrictions in our model. Our Hansen test statistic of 28.36 (p=0.551) suggests that our instruments appear to be exogenous and appropriate. The second test is to check autocorrelation in the idiosyncratic disturbances. Our test for second-order autocorrelation in differences (AR2) is statistically insignificant (p > 0.05) suggesting no serial correlation in the idiosyncratic disturbances (Roodman 2006). The results of these two tests suggests that there is no evidence that our System GMM models are misspecified.

Models 5 and 6 follow the procedure outlined by Roodman (2006) to test the sensitivity of our GMM estimation by reducing the number of instruments in our estimation to observe possible changes in parameter significance. As seen in the table, the sign and significance for our variables remain fairly consistent as the number of instruments decreases, which further supports the use of GMM estimation. The variable for social comparison in model 6 remains fairly consistent as well.

We check to see if there are significant changes in our change in data stratification and SBT variables by replacing the use of indicator variables for our attainment discrepancy and social

Table 4. Results w/o indicator variables

Dependent variable: GHGgoals	Model 7
lag GHGgoals	0.897***
	(0.0484)
lag GHGperf	-0.0115
	(0.0198)
lag GHGcomp	0.00318
	(0.0166)
lag DataStratify	-110568.2^
	(62878.1)
lag SBT	-165162.3*
	(73158.3)
Assets total (ln)	12744.7
	(10457.0)
Year dummies	Yes
Number of Observations	481
Number of Groups	246
Number of Instruments	43
F-statistic	282.57***
(degrees of freedom)	(13, 246)
Hansen Test Statistic	28.57
Arellano and Bond AR(2)	0.91

Note. Standard errors are in parenthesis, except where noted

^Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level

comparison variables with actual emissions values. Table 4 reports the results of this model. We see that the sign and significance for the coefficients of those variables as well as prior aspirations are quite similar to our main model. Coefficient results for attainment discrepancy and social comparison are not significant owing to the fact that we are no longer looking at direct impacts of outperformance/underperformance. In addition, we run a fixed effects and normal OLS regression and find that the coefficient of our lagged variable estimated via system GMM lies within both estimations (Roodman 2006; Suarez, Cusumano, and Kahl 2013). Lastly, we check for sensitivity to our threshold in computing change in data stratification. We find that if the threshold is set to values above 15%, it is found to be statistically significant (we went up to 30% in our analysis). However, if the threshold is set to values under 15%, the variable is not significant. These thresholds represents decision maker's cognitive standpoint, where certain levels need to be reached to "fight or flight."

Post-hoc results

Following the results of estimating our main model, we attempt to investigate why attainment discrepancy was not significant in impacting GHG emission goals. We believe part of this has to do with a manager's limited attention, and that there could be a certain threshold where performance falls below aspirations before firms seek solutions to the problem. This notion particularly pertains to GHG emissions goals because most goals are set over long-time horizons and underperformance for a given year may not trigger problemistic search. However, if performance for a given year falls below a certain threshold then managers may be more inclined to review possible solutions.

Table 5	**Results w/ attainment threshold**		
Dependent Variable: GHGgoals	GMM estimations		
	Model 8	Model 9	Model 10
lag GHGgoals	0.906***	0.905***	0.907***
	(0.0207)	(0.0203)	(0.0210)
lag GHGperf	381691.5^	435080.5^	400729.2
	(218803.2)	(241147.8)	(246783.2)
lag GHGcomp	206684.0^	169685.0	182147.2^
	(112900.0)	(102913.2)	(107013.3)
lag DataStratify	-112054.5^	-111988.8^	-110381.6^
	(63290.4)	(63349.5)	(62518.3)
lag SBT	-180349.0*	-193380.6^	-193643.1^
	(91314.6)	(102545.3)	(98693.8)
Assets total (ln)	6773.2	8124.3	7647.8
	(7740.9)	(8112.2)	(7966.7)
Year dummies	Yes	Yes	Yes
Number of Observations	488	488	488
Number of Groups	249	249	249
Number of Instruments	43	43	43
F-statistic	473.85***	438.60***	487.33***
(degrees of freedom)	(13, 249)	(13, 249)	(13, 249)
Hansen Test Statistic	24.64	24.50	25.17
Arellano and Bond AR(2)	0.92	0.93	0.94

Note. Standard errors are in parenthesis, except where noted

^Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level

We follow this logic process and run our GMM estimation by iteratively increasing thresholds for our indicator variable of attainment discrepancy (our main model does not have a threshold). Our initial threshold is set at 1% and we iteratively run our estimation by increasing a percentage point. Results for the threshold set at 11%, 12% and 13% is presented in model 8, model 9, and model 10, respectively, of table 5. In model 8, we see that if performance falls below 11% of emission goals, firms will reduce their emissions goals by roughly 380,000 metric ton CO_2 equivalent. If we increase the threshold to 12%, we see that firms will further reduce their emissions goals by about 53,000 metric ton CO_2 equivalent. This makes intuitive sense as the more performance falls below goals, firms will further reduce their GHG emissions goals. Here, the social comp variable barely misses the significance level (p-value 0.100). We include in model

10 a threshold that is set at 13%. We see here that our attainment discrepancy variable misses the significance (p-value 0.106) indicating that there is a threshold between 11% and 13% where performance below goals will impact GHG emission targets in the current period. While not presented in table 5, we also check to see if there would be any impact for positive attainment discrepancy. We find that outperformance leads to no change in current aspirational levels.

Discussion

Corporate social responsibility has undoubtedly become an important topic in the business environment. Pressures from governments, NGOs, and various stakeholders have driven firms to act. Our paper exclusively focuses on the environmental aspect of CSR. Operations scholars who study sustainability believe that sustainability and OM are intertwined. In fact, key concept and principles within OM, such as TQM, JIT, lean manufacturing etc. have direct linkages on a firm's environmental success as highlighted by the similarity between standards such as ISO 9001 and ISO 14001. Despite the parallels of environmental sustainability and operations, a disconnect still seems to exist. Pagell and Gobeli (2009) find that operational managers have yet to embrace a environmental sustainability mindset, but environmental performance does impact operational performance. Further, when it comes to being more sustainable, large gaps can exist between top management and operational level decisions (Wheeler, Fabig, and Boele 2002). These issues can be addressed by setting firm wide environmental sustainability goals. Target-setting in general, play a crucial role in performance assessment in many other fields such as health, transport, and safety (Van Herten and Gunning-Schepers 2000).

The theoretical foundation of our paper is the aspirational adaptation model of BTOF. However, we find that there may be caveats to the aspirational model. Only two,

prior aspirations and social comparison, of the three antecedents of the model are significant. We think that a plausible reason for this is owed to the long-time horizons in environmental goals (our sample contains more than 65% of GHG emission reduction targets that have lengths of 5 or more years). This could influence manager's attention to minor deviations of yearly performances, where only large deviations trigger action. Our additional results show that this may be the case as prior attainment discrepancy is significant between the 11-13% range.

In addition, we believe that the aspirational adaption model does not fully explain how firms establish GHG reduction targets. Our two additional variables, change in data stratification and inclusion in the Science-based targets initiative, shows some empirical evidence that this could be the case. These two variables typically are not considered in traditional corporate goals (i.e. financial targets, growth targets, size targets).

Firm adoption and familiarity of methodologies for measuring GHG emissions are in its infancy stages resulting in firms that are at different stages of accounting for carbon emissions. This leads us to assume that firms are continually improving and enhancing their measurement techniques in order to obtain more precise estimations of GHG emissions from specific activities and processes. Environmental sustainability is also governed by a 2°C threshold, where all environmental sustainability actions are aimed at staying below this threshold. The science-based targets initiative assists with firms establishing reduction goals that are aligned with the 2°C threshold. These issues do not arise in other types of corporate goals due to the long lineage of standardized measurements and the absence of a global target.

Our results show that prior GHG reduction goals do indeed have a positive impact on goals in the current period. Curiously, we find that the direction of social comparison was opposite than what we expected. Our belief is that many firms could

initially be setting GHG emissions reduction targets that are too ambitious. Firms in the early stages of emission reduction goal setting are entering uncharted areas and are typically “flying blind” (Gies 2017) where the easiest course of action might be to mimic their competitors. We imagine that competitors in this scenario would usually be industry leaders that have had years of experience and knowledge in setting emissions reductions targets. These industry leaders probably also leverage reduction targets as a source of competitive advantage, which leads to more ambitious reduction targets. Thus, late-movers that mimic these industry leaders would find themselves ill-equipped to achieve those goals, leading to adjusting to a more realistic GHG emissions goal.

Change in data stratification seems to have a positive impact on GHG emissions reduction targets. Managers may believe that the resources utilized in improving measurement techniques could also improve implementation and execution of environmental projects. This would lead to a more emboldened goal for reducing additional emissions. Our robustness check indicates that if we set a threshold of under 15%, the change in data stratification variable is not significant. This makes intuitive sense as improvements in measurement capabilities need to reach a certain level before it can make an impact on decision making. It is not surprising that inclusion in the Science-based target initiative would have a positive impact on reduction targets. Most GHG emissions reductions target are not quite aligned with the 2°C threshold. Even companies that have already ambitious long-term reduction targets credit SBT in setting more ambitious short-term and mid-term reduction goals.

Conclusion

As pointed out by operations and supply chain management scholars advocating for behavioral operations research (Bendoly, Donohue, and Schultz 2006; Croson et al. 2013), there is increased need to examine the psychological processes that underlie

decision making behavior in operational systems. While behavioral processes have been confirmed in general organizational goal setting, our study is one of the first large scale empirical studies of operations goal setting, and the first to examine the drivers of a sustainability-related goal. In addition, our study highlights two ways in which GHG emission reduction goals are different from other goals. The presence of science-based targets (Krabbe et al. 2015) provides a leadership norm that also dictates the specific quantitative goals to adopt. The complexity in measuring GHG emissions leads firms to adjust their goals as well, something that cannot be seen with other dimensions of operational efficiency.

Our study also contributes to the BTOF literature stream. First, with the exception of a handful of papers (Lant 1992; Mezias, Chen, and Murphy 2002), empirical research in this domain has mostly used proxy measures for aspirational levels (Washburn and Bromiley 2012). Our work utilizes direct measures of GHG emission reduction targets and suggests evidence that a portion of the aspirational level adaption process exists in an environmental sustainability context. Our empirical results suggest that BTOF may not fully explain firm goals that have long-time horizons, and that there may exist some threshold in attainment discrepancy before managers shift their attention to the problem. While prior research has mostly focused on profitability goals such as ROA, ROE, or Tobin's Q, our work contributes to the nascent stream of literature that focuses on non-financial goals.

We believe our findings have important practical implications for managers. Managers who are serious about reducing their overall GHG emissions can strategically invest resources in improving measurement techniques. This provides additional information to managers in determining appropriate reduction targets as well as allowing managers a better understanding of the overall GHG emissions climate at their firms.

Our results also empirically support anecdotal evidence that firms such as Coca Cola, Tesco, and Sony have credited SBT in setting more ambitious short-term and mid-term reduction goals. Managers can leverage this information and strategically maneuver to participate in the SBT initiative.

Our results should be taken with some limitations. The nature of our data required us to focus on the broader firm level aspiration for both Scope 1 and Scope 2 emissions reduction targets. We did not consider targets for individual projects/sites as well as Scope 3 emissions reduction targets. As a result, our conclusions may not apply to all types of GHG emissions reduction goals. A direct consequence of focusing only on Scope 1 and Scope 2 emission reduction goals is our limited sample size, which could lead to potentially biased estimations. We adjusted our GMM estimation technique to account for this by having the standard errors reported as t-statistics, limiting the estimation to a one-step estimation, and utilized orthogonal deviations (Roodman 2006). We also triangulated the magnitude and direction of the coefficients in our model with other estimation techniques.

This limitation directly leads us to our first implication for future research. We believe that results will be more robust with additional years of data. Moreover, as firms begin to become more sophisticated in accounting for carbon, individual project specific data may become publicly available and reliability of Scope 3 emissions could improve. Such trends would allow future research to ascertain whether the aspirational adaption model applies to all types of GHG emissions reduction targets.

A second implication for future research is that there needs to be further investigation into the underlying mechanisms of social comparison. We reasoned that due to managers tendencies of wanting to minimize performance gaps with comparable organizations, GHG emissions goals will become more ambitious during times of

underperformance. However, our results show the opposite. Further investigation would be needed to determine whether the underlying mechanisms follow our reasoning for whether late-movers mimic first-movers or something entirely different.

Lastly, our hypotheses and results only pertain to GHG emissions reduction goals. The determinants of other sustainability goals may operate in a different manner. Most firms initially focus their sustainability activities, including GHG emissions reduction, on their own operations. Other sustainability risks such as water usage or deforestation tend to be location-specific and embedded in the supply chain, so goal-setting may not be strictly in the hands of a single firm, but rather the result of a collective goal setting by relevant stakeholders. As such, future research can investigate the determinants of how firms set their other sustainability goals.

ESSAY 2: SCIENCE-BASED TARGETS: A CONSUMER ORIENTED OPERATIONAL VOLUNTARY PROGRAM

Abstract

Adoption of a resilience-based target has been slow despite continued growth in institutional pressures. The purpose of this paper is an exploratory study that offers potential insights into the drivers and antecedents for firm adoption of resilience-based targets, in particular, the participation in the Science-based Targets (SBT) initiative. The approach is to combine both primary and secondary data analysis. Preliminary data analysis has been completed with four potential factors for SBT adoption emerging from literature: ISO 14001, Customer Engagement, Emissions Credit Purchase, and Absolute Emissions Targets. Results using logistic panel regression with data from SBT, ISO, CDP, and Compustat for 2015-2017 shows evidence that Emissions Credit Purchases and Absolute Emissions Targets as potential drivers for SBT adoption. Primary data gathering and analysis will still need to be conducted in order to finish this essay.

Keywords: Voluntary programs, environmental sustainability, content analysis

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Introduction

Environmental sustainability issues seem to be more mainstream. This is in large part attributable to the sudden emergence and ferocity of the negative consequences from climate change. Weather events that were traditionally seen as rare occurrences have started to become the norm. Summers are consistently getting warmer with new highs set annually. Winters continue to exhibit increasing amounts of snowstorms and blizzards. The increasing likelihood and severity of these events are beginning to disrupt our way of life.

Voluntary programs have long been seen as an important policy tool for both government and nongovernment actors looking to improve environmental and regulatory performance. They benefit governmental actors by reducing their reliance on command and control regulations, which have often elicited negative corporate reactions (Potoski and Prakash 2005). More importantly, they give nongovernmental actors the ability to take part in inducing organizational level change (Prakash and Potoski 2012).

Perhaps the two most studied voluntary programs in operations management literature is ISO 9000 and ISO 14000 certifications. Operations researchers have long been interested in the antecedents of adopting ISO Certifications (Anderson, Daly, and Johnson 1999; Naveh and Marcus 2005; Corbett and Kirsch 2001; Vastag 2004; Castka and Balzarova 2008), their impact on financial performance (Zhu and Sarkis 2004a; Montabon, Sroufe, and Narasimhan 2007b), and the efficacy of those standards (Anderson, Daly, and Johnson 1999; King and Lenox 2001b). Our study contributes to the literature stream that focuses on drivers for adopting voluntary programs.

In particular, we are interested in identifying antecedents for firm participation in the Science-Based Targets initiative (SBT). The SBT initiative is a voluntary program that was launched through a partnership between the Carbon Disclosure Project, World

Resources Institute, World Wildlife Fund, and the United Nations Global Compact (Krabbe et al. 2015). Its purpose is to help firms align their firm emissions goals with global emissions goals. There is general consensus among the scientific community that global rises in temperatures need to be limited to 2°C as compared to pre-industrial levels. Analysts at SBT use methodologies as outlined in Krabbe et al. (2015) to determine the world's carbon budget to limit global warming, and subsequently calculate a company's share based on reported current emissions. The resulting goals are then aligned with the generally agreed upon 2°C limit. SBT is a unique voluntary program that holds distinctive differences from the ISO class of certifications typically studied in our discipline. It parallels the class of ISO certifications in that it relates directly with operations management, where operational improvements are correlated with environmental performance. SBT is distinct in that it is more consumer focused.

Literature Review

Voluntary governance

Firm legitimacy is largely influenced by institutional forces. Government regulations represents the most common form where policy makers invoke governmental authority to permit, prescribe, or prohibit private actors' behavior. This command and control approach represent a traditional style of governmental regulation where policy makers prescribe legally binding performance standards, monitor compliance with those standards, and penalize those found out of compliance.

Command and control regulations for environmental issues performed relative well in the early 1970s and 1980s (Cole and Grossman 2018) where focus was set on a small number of large violators. Examples of such successful regulation included major legislations such as the Clean Air Act and the Clean Water Act. It soon became clear

that the initial success of the command and control approach could not be replicated as parties on both sides started to face shortfalls. Policy makers began to face diminishing returns with increased demands on resources, capacity and expertise. Budget shortfalls further compounded the legitimacy and efficacy of command and control regulation. For example, between 1996 and 1998, less than 1% of 122,226 large regulated facilities in the United States were inspected for all three pollution media (Potoski and Prakash 2005). Business started to voice their concerns of high compliance costs and the rigidity of pollution regulations (Prakash and Potoski 2012) with some firms citing regulation as their reason for seeking “pollution havens” in the developing world (Antweiler, Copeland, and Taylor 2001).

Voluntary programs have been seen as a response to command and controls’ shortfalls. These programs theoretically incentivize participation by offering nontrivial but indirect benefits as trade-offs for incurring specific private costs. For instance, participation in voluntary programs legitimize a firm’s environmental stewardship. The assumption is that external stakeholders may reward these firms with good will, regulatory relief, higher market shares, customer loyalty, and higher product prices (Gunningham, Kagan, and Thornton 2004; Lundgren 2003). Voluntary programs also enjoy the benefit of allowing nongovernmental actors an avenue to influence firm environmental stewardship. For these reasons, voluntary programs are imperative instruments of environmental policy and governance across the world.

Perhaps the most well studied voluntary programs in operations management literature is the International Standards Organization certifications. Operations researchers have long been interested in the antecedents of adopting ISO Certifications (Anderson, Daly, and Johnson 1999; Naveh and Marcus 2005; Corbett and Kirsch 2001; Vastag 2004; Castka and Balzarova 2008), their impact on financial performance (Zhu

and Sarkis 2004a; Montabon, Sroufe, and Narasimhan 2007b), and the efficacy of those standards (Anderson, Daly, and Johnson 1999; King and Lenox 2001b). Our study falls into the literature stream that focuses on drivers for adopting voluntary programs. In particular, we are interested in the antecedents for firm participation in the Science-based targets initiative.

Environmental targets

Environmental goal setting falls into two distinct categories: organization centric and resilience-based environmental targets (Haffar and Searcy 2018). The prevailing approach to corporate sustainability focuses on an organization-centric notion of sustainability (Milne and Gray 2013), where firms assume incremental company improvements in environmental performance will contribute to wider planetary-level improvements. If viewed in isolation, these incremental improvements may be interpreted as sustainability gains. If the view is broadened to a systems-level perspective, these gains may actually mask unsustainable ecological performance (Dahlmann, Branicki, and Brammer 2019). For example, a firm could be experiencing 5% annual reductions in emissions and view that as a positive step towards a sustainable future. However, if the company were to compare their emissions with planetary thresholds, it may find that 5% reductions fall well short of their expected improvements.

Resilience-based environmental targets begin at the systems-perspective. It determines a maximum planetary threshold forming a “global goal”. The consensus is to limit the rise in global temperatures 2°C compared to pre-industrial levels (Paris Climate Agreement). Resilience-based environmental targets appropriate this threshold to determine a maximum “ceiling” for individual firm level emissions. Assessing

performance is then based on this system level threshold rather than incremental improvements towards a vaguely “more sustainable” state.

Recent studies have found that many companies today are still organization-centric with goals that fall well below planetary thresholds (Maartensson and Westerberg 2016; Ihlen and Roper 2014; Milne and Gray 2013). Fortunately, there seems to be growing external stakeholder pressure to adopt resilience-based sustainability initiatives. Examples include nongovernmental actors such as the Global Reporting Initiative’s inclusion of the notion of “sustainability context” as a key principle in the reporting guidelines, the Carbon Disclosure Project’s call for science-based target setting in corporate reports, and a joint NGO (CDP, World Resources Institute, World Wildlife Fund, and UN Global Compact) Science-Based Targets Initiative. As such, firms are finding increasing incentives to align their environmental performance to planetary thresholds. First, adopting a resiliency-based approach confers a sense of legitimacy and signals to key stakeholders a company’s commitment to societal-level sustainable development. Consumers may reward firms with price premiums (M. A. Delmas and Grant 2014), investors could enhance access to capital markets (Miralles-Quiros, Miralles-Quiros, and Arraiano 2017), and firms could be better equipped to effectively anticipate and adapt to disruptive risk from climate change (Bertels and Dobson 2017).

In our review, the Science-based targets initiative appears to be the only widely accepted voluntary program for resiliency-based targets. We believe that SBT is a unique voluntary program that holds distinctive differences from the ISO class of certifications typically studied in our discipline. It parallels the class of ISO certifications in that it relates directly with operations management, where operational improvements are correlated with environmental performance. SBT is distinct in that it is more consumer focused. Our paper leverages this distinction to provide insights into why firms

participate in operational related voluntary programs that have a stronger influence in the B2C market.

Hypothesis Development

Complementary programs

As we discussed in our literature review, SBT parallels other voluntary programs that have been extensively studied in operations management literature. We begin development of our first hypothesis by drawing from insights and findings of drivers for ISO 14000/14001 certification.

The literature has seen concepts of operations management as complementary to environmental sustainability and vice versa (Martínez-Jurado and Moyano-Fuentes 2014, Florida 1996; King and Lenox 2001). King and Lenox (2001b) find that lean manufacturing is correlated with greater waste prevention and lower emissions. Similarly, Rothenberg et al. (2001) found strong anecdotal evidence that lean manufacturing is associated with emissions reduction of volatile organic compounds. Authors that have investigated the drivers for ISO 14000 certification have systematically used this line of reasoning to explain why ISO 9000 is highly correlated with ISO 14000 certifications (King and Lenox 2001b; Corbett and Kirsch 2001; Vastag 2004). Further the positive externalities associated with voluntary programs are shared between ISO certifications and SBT as well. Inclusion in either conveys a signal to various stakeholders a commitment to that specific voluntary program's objectives. The similarities between ISO 14000 certification and SBT leads us to our first hypothesis

Hypothesis 1: ISO 14000 certification is positively associated with participation in the Science-Based Targets Initiative

Engagement with customer

We briefly discussed earlier that SBT is a more consumer oriented that compared with other operations grounded voluntary programs. We first consider the case of ISO 14001 adoption. Potoski and Prakash (2005) conducted semi structured interviews with government officials and facility environmental managers and found that only one of the managers noted ISO 14001 certification as a signal to consumers. Respondents would cite increased awareness among suppliers, vendors, and even government regulators but were skeptical that ISO 14001 was recognized by consumers.

SBT adds additional insight into voluntary programs in OM literature that previous studies were not able to explore. The focus on the green movement has been more consumer oriented than ever before. This is due to a confluence of factors, including increased information availability to consumers and the ushering of a new generation of consumers. This generation of consumers are very different from previous generations. They are the first to be a computer-literate general, but more importantly they are concerned with environmentalism (Tully and Schonfeld 1994). We see businesses adapting to this changing tide with significant investments in green marketing (Lu, Bock, and Mathew 2013). This suggests that firms would consider joining SBT as a signal of environmental stewardship to millennial stakeholders. Naturally, firms who are currently actively engaging with their consumers would benefit more from joining SBT than compared to firms who are not actively engaging with their consumers, leading us to our second hypothesis:

Hypothesis 2: Engagement with consumer is positively associated with participation in the Science-Based Targets Initiative

Carbon "Cap and Trade" system

In reviewing carbon policy options to reduce Greenhouse Gas Emissions, discussions have leaned towards either carbon taxes or government subsidies (Chameides and Oppenheimer 2007). Carbon taxes could work if taxes are high enough so that energy prices from carbon-free sources are competitive with carbon-intensive sources. Subsidies could help in developing low carbon technologies. Chameides and Oppenheimer (2007) argue that a market-based "cap and trade" system that offer the same benefits as carbon taxes and subsidies while also enjoying distinct advantages.

Cap and trade schemes align closely with resilience-based emissions. In a cap and trade scheme, governments would place a maximum cap on the total emissions for a specific region eg. U.S. government establishing cap in the U.S. They would then allocate emission allowances to each firm dictating how much emissions that firm can emit during the year. If a firm's actual emission is lower than the allocated amount, the firm can sell their allowances on the open market. Conversely, if a firm's actual emission is higher than their allocated amount, the firm would need to purchase allowances from the open market. It is often argued that because this market-based scheme is agnostic to the location and type of CO_2 emitted, it can cover multiple industries and sectors. It then follows that investments would be funneled to the most cost-efficient emissions reduction technologies. Along with adequate enforcement, a cap and trade scheme can achieve the goal of overall emissions reduction, adequately addressing resilience-based emissions.

Despite these advantages, individual firms can leverage cap and trade systems as a form of customer engagement. Cap and trade systems offer firms the ability to generate or purchase carbon credit (EU ETS 2016). These credits can be generated through investing in specific projects in developing nations where investments costs are

lower. Generated credits can either be used to reduce a firm's own emissions or sold to other firms. These credits have multiple purposes including compliance and voluntary offsetting ("Data - CDP" 2020). Firms who want to enhance its green image, increase customer engagement, and improve sales can purchase these credits for voluntary offsetting purposes. For example, consider a firm that had two choices to improve emission reductions. The first option is to invest in improving standard operating procedures, increase efficiency, and find innovative solutions to offset carbon emissions. The second option is to purchase carbon credits. We posit that firms who purchase carbon credits for voluntary offsetting purposes are mostly interested in a cheaper alternative to improving its green image. In line with improving a firm's green image and customer engagement, these firms will also more likely participate in SBT leading to our third hypothesis:

Hypothesis 3: Purchase of carbon credits is positively associated with participation in the Science-Based Targets Initiative

Corporate Greenhouse Gas Emissions Targets

Our literature review covered two categories for environmental goal setting: organization centric and resilience-based (Haffar and Searcy 2018). Firms that have set environmental reduction targets typically fall under organizational centric based goal setting (Maartensson and Westerberg 2016; Ihlen and Roper 2014; Milne and Gray 2013). These organizational centric based goals follow how firms are reporting their emissions figures. In general, there are two types of methods for how firms report their emissions figures: absolute emissions and intensity emissions. Absolute emission figures report the total emissions that a firm is emitting. Intensity emission figures report total emissions that are normalized by annual revenue, number of employees, etc. Firms utilize intensity emission figures as a means to diminish the impact of growth. For

instance, it's likely for total emissions of a manufacturing firm to increase if it decides to open an additional plant to increase its production capacity. However, a firm can utilize intensity emission figures to normalize the increase in absolute emissions. This could lead to intensity emissions that are unchanged from prior to opening a new plant, or in some cases, show a decrease in intensity emissions.

The two different methods for how firms report their emissions figure naturally led to two different types of organization centric based emissions reduction targets: absolute emissions targets and intensity emissions targets. These targets have three components: 1. A baseline that establishes a year and emissions from which reductions are to be made, 2. The target year, and 3. A reductions amount. An absolute emissions target will then set a goal based on total firm emissions whereas an intensity emissions target will normalize that goal based on annual revenue, number of employees, etc. An example of an absolute emissions target is Timberland setting a 50% emissions reduction goal by 2011 as compared to 2006 emissions. An example of an intensity emission is Target setting 20% emissions per million dollars of sales by 2015 as compared to 2007.

We posit that of the two types of organization centric emissions reduction targets, absolute emissions reduction targets are more closely aligned with resilience-based reduction targets. The purpose of a resilience-based emission reduction target is to reduce the total emissions within the entire system. This is similar to an absolute target where firms strive to improve processes, increase utilization, and find innovative solutions as a means to reduce its overall emission levels. Intensity targets could exhibit that same type of corporate response, but at lower levels of effort. Furthermore, an intensity target may not result in reducing a firm's overall emissions level. Let's consider the intensity target from the Target example in the preceding paragraph. If Target grew

its sales faster than its emission levels, then Target would be making progress towards its intensity target. As such, absolute emission targets are more closely aligned with resilience-based emission targets. Since SBT is a voluntary program for resilience-based targets, we posit that firms who set absolute emissions targets are more likely to adopt SBT leading us to our fourth hypothesis:

Hypothesis 4: Absolute emissions reduction targets are positively associated with participation in the Science-Based Targets Initiative

Data and Methodology

Data and Sample

The data for this paper comes from four sources: SBT, ISO, CDP, and Compustat. SBT provides data on when firms have committed to and established science-based targets initiative. ISO publishes annual data for ISO 14000 certifications at the country level. CDP ("Data - CDP" 2020) contains data of whether firms have engaged with their customers, participation in trading schemes, as well as whether firms have established emissions targets. Computstat holds firm financial data including total assets and net income.

Table 1 provides a summary of our data. In total, we have 2,603 observations for 1,422 companies spanning years 2015-2017. Our indicator variables are shown as counts rather than mean and standard deviation. Since, SBT is a relatively new initiative, the number of firms that have actually participated (within our research time period) is low. Other indicator variables, customer engagement and absolute emissions target have about 30% more no's than yes's. ISO is for each country with an average of 10,390 ISO 14001 certifications. The average emissions credit purchase is 187,000 CO_2e metric

tonnes. Lastly, the table indicates that our variables are not highly correlated amongst each other.

Table 1. Descriptive Statistics

	Count								
	0-No	**1-Yes**	**Min**	**Max**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(1) SBT	2563	40	0	1	1				
(2) CustEngage	1508	1095	0	1	-0.07	1			
(3) AbsTarget	1450	1153	0	1	0.05	-0.18	1		
	Mean	**SD**							
(4) ISO	10390	11447	0	137000	-0.02	0.02	0.12	1	
(5) ETSPurch	187000	2750000	0	95000000	0.05	-0.05	-0.01	0	1

Measures

Dependent Variables

Participation in Science-Based Targets. The main dependent variable is a binary variable indicating whether firms are participating in SBT. SBT provides data on when firms commit and establish SBT. For our paper, we count only firms that have committed and established their targets as participating in SBT. Thus, our dependent variable is a 0 or 1, with 1 indicating the year a firm started to participate in SBT and 0 otherwise.

Independent Variables

ISO 14001 certification. Here we proxy firm ISO 14001 certification with the number of ISO 14001 certification of in the country for where firms are headquartered. We match firm headquarter countries with that of ISO database. The ISO 14001 certification is then the count for the number of certifications within that country.

Customer engagement. CDP provides categorial data on whether firms engage with various elements of the value chain on GHG emissions and climate change strategies. The data includes engagement with customers, suppliers, other partners in the value chain, or various combinations of the three. Customer engagement then contains any combination that includes “customer”, leading to an indicator variable of 0 or 1, with 1 representing firms that do engage with their customers and 0 otherwise.

Credit Purchases. Firms can participate in different governmental trading schemes, including the European Union Emissions Trading Scheme, California GHG Cap and Trade Program, Tokyo Cap and Trade program, etc. We include all types of trading schemes for this variable and it represents the total amount of CO_2e metric tonnes purchased by a firm.

Absolute Target. The data for firm emissions targets is categorical. Firm emissions targets could either be absolute targets, intensity targets, or a combination of the two. Absolute Targets then contains any combination that includes “absolute targets”, leading to an indicator variable of 0 or 1, with 1 representing firms having absolute targets and 0 otherwise.

Control Variables

Return on Assets. We include a firm’s return on assets to control for possible effects of firm slack resources.

Region. Regulations and policies differ between regions as well. General consensus is that the European Union is at the forefront of addressing climate change with stricter regulations than other parts of the world. Our data represents firms operating in 5 distinct regions: EU, North America, Asia, Australia, and Others (Mostly Brazil and South Africa)

Industry. Literature has shown that greenhouse gas emissions vary greatly between different industries. Industries that are heavy on manufacturing would intuitively exhibit much larger greenhouse gas emissions. As such, industry is included as a control variable. We classify industry based on a firm’s GIC industry code.

Year dummies. When dealing with panel data, the inclusion of year dummies is crucial in accounting for aggregate trends.

Econometric Model

Our model begins with parallels to prior OM literature where adoption of ISO 14001 was influenced by ISO 9000 certification. We parallel that notion in our model and hypothesized that SBT adoption is influenced by ISO 14001 certification. We then included engagement with customers due to the voluntary nature of SBT. Our remaining variables related more with firm level emissions, including how much emissions allowances firms purchased, as well as whether firms had existing absolute emissions targets. The model also includes the following control variables: return on assets, sector and year dummies. This leads us to the following model:

$$SBT_{i,t} = \beta_1 ISO_{i,t} + \beta_2 CustEngage_{i,t} + \beta_3 ETSPurch_{i,t} + \beta_4 AbsTarget_{i,t} + \gamma controls_{i,t} + \epsilon_{i,t}$$

Variables of the model is as defined in the previous section and summarized in Table 1. The error term $\epsilon_{i,t}$ captures idiosyncratic shocks. We estimate our model using a random-effects logistics regression for the following reasons. The binary nature of our dependent variable requires us to make assumptions of the error term to better capture the probability distribution leading to the use of the logistics regression. We are then interested in the overall impact of our independent variables on SBT adoption rather than each firm which points us towards a population average estimation.

Preliminary Results

Recall that we are interested in factors that impact firm adoption of joining SBT. We hypothesized that there could be four possible factors: ISO certification, customer engagement, emission credit purchases, and absolute emission targets. We provide our preliminary estimation results using a random-effects logistic regression method in Table 2. First, estimation results with a model containing only control variables are reported. We then provide estimation results for our main model.

Model 1 presents results for control variables. We included industry as well as year dummies in our estimation, but do not provide the results here for space concerns. Our results show that return on assets have no significant impact on whether firms adopt SBT. We find that region plays an important role in firms joining SBT, with firms that operate in the European Union having much higher rates that other regions.

Table 2. Panel Logit Estimations

	Model 1	Model 2		Model 3	Model 4
	PA	PA	Odds Ratio	RE	RE
Dependent Var: SBT					
Variables of Interest					
ISO (H1)		-0.0000183	1.000		-0.0000187
		(0.0000240)			(0.0000209)
Customer Engage (H2)		0.618	1.855		0.623^
		(0.402)			(0.376)
ETSPurch (H3)		0.0559*	1.057		0.0560***
		(0.0231)			(0.0136)
AbsTarget (H4)		0.907*	2.477		0.890*
		(0.415)			(0.396)
Control Variables					
Return on Assets	1.138	0.446	1.562	1.156	0.458
	(3.358)	(3.313)		(2.315)	(2.203)
Region					
EU	1.519*	1.465^	4.328	1.487*	1.463*
	(0.762)	(0.788)		(0.750)	(0.687)
Asia	1.214	1.338	3.811	1.207	1.349^
	(0.843)	(0.908)		(1.026)	(0.775)
Australia	0.705	0.616	1.852	0.708	0.639
	(1.293)	(1.315)		(1.419)	(1.362)
Industry	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Constant	-3.851**	-4.713***	0.009	-3.791*	-4.753***
	(1.240)	(1.333)		(1.694)	(1.329)
Number of Observations	1143	1143	1143	1143	1143

Note. Standard errors are in parenthesis, except where noted

^Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level

Model 2 summarizes the results as our main model. Here, we don't find support for either ISO certification or Customer Engagement. We find support for emissions allowance purchases (H3 $p<0.05$) with an odds ratio of 1.057. This translates to a 1.057

increase in the odds of adopting SBT for each million metric tonne of CO_2e credits purchased. Firms who have absolute targets (H4 $p<0.05$) increased their odds ratio by 2.477. Thus, firms who have absolute emission targets have a 2.477 times rise in the odds of adopting SBT. We include models 3 and 4 to show random-effects estimates. As expected, we find that the coefficients and significance levels are very similar to that Models 1 and 2.

Next Steps

This essay is currently still in the preliminary stages. The strategy of this essay was to identify potential factors and insights into why firms participate in the Science-Based Targets initiative. Our approach was two-fold. We first identify and hypothesize theoretical reasonings for joining SBT. We then conduct interview/surveys which could provide additional understanding into factors outside of our theoretical understanding for why firms may consider joining SBT. All these data points will then be used in a logit model to see if certain factors do indeed influence firm adoption of SBT.

As it currently stands, the preliminary analysis presented in this paper has explored a few factors through literature that could influence SBT adoption. The next steps of this project would be to design questions for an interview/survey and identify potentially other sources of factors that could influence firm adoption.

ESSAY 3: STAKEHOLDER PRESSURE AND FIRM ENVIRONMENTAL PERFORMANCE

Abstract

Firms are facing increasing pressure by stakeholders to engage in more sustainable activities. Particular focus is on the need for firms to reduce their greenhouse gas (GHG) emissions, which are contributing to accelerated global climate change. This paper seeks to identify whether various stakeholder pressures, perceived as opportunities or threats by managers, impact firm GHG emissions. We use stakeholder theory to propose how pressures from primary, secondary, and public stakeholders lead to actions that reduce emissions. We perform econometric analysis on a panel data set of 2388 observations from 2011 to 2017 from Carbon Disclosure Project reports. Results show that public stakeholder pressures have the largest impact on reducing firm GHG emissions, and there is partial support that primary stakeholder pressures reduce firm GHG emissions as well. We find that reduction of GHG emissions is more significant when the firm is responding to perceived threats versus perceived opportunities. This study contributes to literature by proposing and empirically testing how pressure from different stakeholder groups has differential impact in a firm's operations strategy.

Keywords: Sustainability, Stakeholder Theory, Greenhouse Gas emissions, Panel data analysis

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Introduction

Sustainability has gained increasing global attention. Firms that once operated on a domestic scale are now operating on a global level. As a result, firms are placing greater environmental pressures on the planet (EPA). Perhaps the greatest evidence for the need of environmental stewardship originates from the ever-mounting extreme weather events such as the deadly wildfires scorching Greece and California, extreme droughts in Cape Town, South Africa, and a deadly heat wave in Japan occurring mere days after a flooding that killed 150 people (Rainey 2018). Scientists have concluded that rising global temperatures have increased the probability and severity for about two thirds of the extreme natural events that occurred between 2004 and 2018 (Schiermeier 2018).

Because of events like these, key stakeholders are pressuring firms to develop strategies, policies, and practices that align with an organization's environmental goals (Klassen 1993). OM scholars have long relied on stakeholder theory to explain the nuances of firm participation in social enhancing and environmentally sustainable practices (Sarkis, Gonzalez-Torre, and Adenso-Diaz 2010) that improve corporate social performance (C.-M. Chen and Delmas 2011; Jacobs, Kraude, and Narayanan 2016; Sila 2018). Literature has also explored the link between stakeholder pressures and firm transparency (Liesen et al. 2015; Depoers, Jeanjean, and Jerome 2016) as well as adoption of climate change mitigation strategies (Sprengel and Busch 2011; Cadez, Czerny, and Letmathe 2019). The general consensus is that stakeholders are becoming increasingly concerned about social and environmental issues resulting in greater pressure on the firm to act. Despite the abundance of environmental sustainability studies that utilize stakeholder theory, there seems to be a paucity of research that

investigates whether stakeholder pressures lead to improved firm environmental performance.

Our paper fills this research gap by identifying how pressures from different stakeholder groups will create differential impact on a firm's future environmental performance. We adopt an existing classification scheme within the strategic management literature that classifies stakeholders as *primary* or *secondary* (Clarkson 1995). Primary stakeholders are parties with formal relationships with the firm, including shareholders, employees, suppliers, customers and public agencies. Secondary stakeholders do not engage in formal transactions with the firm and include groups such as the media and special interest groups. We adapt this by splitting the category of primary stakeholders into two subgroups: primary and public stakeholders, with the latter representing government. This yields three distinct stakeholder groups, *primary, public,* and *secondary*.

Primary stakeholders apply direct pressures to firms in addressing climate change issues. For example, shareholders can vote to require firms to engage in proactive environmental management which has been shown to reduce the risks and liabilities associated with climate change and improvement shareholder wealth (F. L. Reinhardt 1999; Goldstein and Wiest 2007). Employees, suppliers, and customers all have the choice to associate or dissociate themselves with firms that have positive or negative environmental reputations.

Public stakeholder pressures manifest through the enactment of policy and regulations that require firms to address climate change issues. Examples include carbon taxes, cap and trade schemes, air pollution limits, etc. Violation of these policies generally include penalties and fines. In some extreme cases, firms might face criminal

charges, where individual defendants get incarcerated. The recent Volkswagen emission scandal highlights the possibility for such extreme cases.

Lastly, secondary stakeholders pressure firms by providing information to the general population. Positive information such as participation in various NGO (non-governmental organization) environmental initiatives and increased firm transparency can improve and reinforce a firm's environmental reputation. Negative information such as excessive pollution, inadequate waste disposal, and corporate scandals can harm a firm's reputation.

The pressures from these three stakeholder groups are not only compelling firms to become internally aware of the vulnerabilities, risks, and costs associated with the regulatory and physical threats related to global climate change (Jira and Toffel 2013), but are also inherently different in how they are influencing firms. In order to address these pressures, managers play a key role in determining appropriate organizational responses. Managers are tasked with determining how much engagement a firm should engage for different stakeholder group pressures. Furthermore, managerial perception and interpretation of environmental changes driven by these pressures influence the success of organizational responses and actions. Managers tend to interpret and internally categorize environmental changes as either opportunities or threats (Dutton and Jackson 1987; Jackson and Dutton 1988).

This paper addresses the above issues by investigating whether pressures perceived as opportunities or threats from three stakeholder groups impact a firm's environmental performance as measured by greenhouse gas (GHG) emissions. We also explore whether different stakeholder group pressures could impact GHG emissions differently. GHG emissions is chosen as it is a direct byproduct of a firm's operations and

offers a good gauge in measuring improvements in operations and logistics efficiency and waste reduction. To our knowledge this is the first empirical piece that considers the impact from multiple stakeholder group pressures, and to consider how action may differ between pressures perceived as opportunities or threats. Our results raise awareness in the biases that managers may possess that could affect their decision making.

Literature Review

Corporate Greenhouse Gas Emissions

Corporate Social Responsibility encompasses both social responsibility and environmental sustainability. Within the realm of environmental sustainability, the issues encompass a wide range of topics including forestry, protection of the ozone layer, climate change, water, energy and natural resources, biodiversity, and so forth. Our study specifically focuses on GHG emissions as there is growing scientific evidence that the likelihood and severity of extreme natural events, which cause substantial economic consequences, can be attributed to GHG emissions (Luo, Lan, and Tang 2012; Prado-Lorenzo et al. 2009; Schiermeier 2018). Corporations play a big part in emitting GHG emissions. Globally, *direct* emissions from corporations account for 21% of total emissions in 2017. In the United States alone, corporate *direct* and *indirect* emissions account for a combined 29% of emissions making it the largest emitting economic sector in 2017 (EPA).

Stakeholders acknowledge the corporate role in reducing carbon and are pressuring firms to address and reduce their share of GHG emissions. Public stakeholders put pressure on firms to reduce GHG emissions through regulation and treaties such as the Kyoto Protocol and the Paris Climate Agreement (Sprengel and

Busch 2011). The mere mention of possible emissions reduction regulations puts pressures on companies to act. For example, the airline industry planned voluntary environmental agreements when their inclusion in the European Union Emissions Trading Scheme began to be debated (Busch and Hoffmann 2007).

Primary stakeholders such as institutional investors are also putting pressure on firms by demanding data on companies' emissions and related reduction strategies (Funk 2003) as they have been found to influence a firm's creditworthiness as part of its financial performance (Weber, Scholz, and Michalik 2010). Institutional investor pressure on firm environmental performance has been steadily growing as reflected by the 35 institutional investors in 2003 supporting the Carbon Disclosure Project to 385 institutional investors in 2008 (CDP). Similarly, the Dow Jones Sustainability Index enjoyed the growth of investment volume from USD 1 billion in 2000 to USD 6 billion in 2007 (INDEXES 2008).

OM scholars have long argued that in order to better deal with the realities of global climate change, firms should extensively focus on their operations (Corbett and Klassen 2006). For example, the majority of GHG emissions attributed to the process of manufacturing a product comes from energy used by the production equipment (Williams et al. 2012). There are three methods to reduce GHG emissions related to its energy usage. First, the process can use equipment that is more energy efficient. Second, productivity of the process could be improved yielding more output for less input. Lastly, alternative sources of energy that generate GHG emissions could be utilized such as natural gas. It can be seen that process improvements aimed at increasing productivity or efficiency will often lead to increased energy efficiency and thus lower GHG emissions (Corbett and Klassen 2006; Curkovic et al. 2000)

Operations Strategy and Stakeholder Pressure

Operations strategies such as just in time, optimized production technology, total quality management, and lean management are often seen as complementary to environmental sustainability and vice versa (Martínez-Jurado and Moyano-Fuentes 2014, Florida 1996; King and Lenox 2001). Focusing on any of the above-mentioned operations strategy can also simultaneously address stakeholder pressures.

Firms that are focused on total quality management can invest and develop green products which has been shown to improve product quality (Dangelico and Pujari 2010). Doing so can lead to increased shareholder wealth while also addressing pressures to be "greener". Similarly, Romm (2014) notes that Toyota was able to reduce paint defects by a factor of 30 while simultaneously addressing stakeholder pressures by reducing energy consumption by 50% through installing variable-speed motor drives.

Firms that are associated with cost-leadership strategies can utilize the efficient use of resources and improve waste generation prevention (Orsato 2006). Improving waste generation prevention can satiate stakeholder pressures from customers, NGOs, and the government. Stakeholder pressures can also be addressed by focusing on lean manufacturing. King and Lenox (2001b) find that lean manufacturing is correlated with greater waste prevention and lower emissions. Similarly, Rothenberg et al. (2001) found strong anecdotal evidence that lean manufacturing is associated with emissions reduction of volatile organic compounds

Most importantly, firms that strive to be differentiators can engage in environmental sustainability development which has been linked to enhancing innovation and creating new practices (Klassen and Vereecke 2012). Simple enhancements in practices such as investing in in JIT systems has been shown to improve environmental

performance (Klassen 2000). Innovative solutions can also address stakeholder pressures such as regulatory requirements for lower emissions cars, institutional investor pressures for better environmental performance, and NGO pressures for transparency.

Stakeholder Theory

Stakeholder theory emphasizes firm relationships with their stakeholders, including customers, employees, communities, etc., and the management and balancing of those relationships while creating and trading value (Parmar et al. 2010). Numerous authors have explored and expanded on the concept of a stakeholder from its original definition of "any group or individual who can affect or is affected by the achievement of an organization's objectives" (Freeman 1984, 46). Within the strategic stakeholder literature, stakeholders are classified into two different groups: primary or secondary, depending on their relationship with the firm (Goodpaster 1991; Frooman 1999). Primary stakeholders include parties with formal relationships with the firm, including employees, suppliers, customers and public agencies. Secondary stakeholders do not engage in formal transactions with the firm and include groups such as the media and special interest groups (Clarkson 1995). Public stakeholders such as governments are considered a separate group within the primary stakeholder classification.

This paper modifies and adopts the stakeholder classification scheme as the foundation for our research design. We consider public stakeholders as a unique group outside of the primary stakeholder group. We do so because of two reasons. First, there is a literature stream that has explored the impact of governmental policies and regulation on GHG emissions (Drummond 2010; Burtraw, Fraas, and Richardson 2011; Kuo, Hong, and Lin 2016). Second, there exists international agreements such as the

Paris Climate Agreement and the Sustainable Developmental Goals that oversee actions regarding climate change. As such, we believe that governmental regulation and policies have much larger impacts on firm environmental performance as opposed to other forms of firm performance. We take this into account by expanding Clarkson's (1995) *primary* and *secondary* stakeholder group to include a third, *public* stakeholders.

OM literature has long relied on stakeholder theory to explain the nuances of firm participation in social enhancing and environmentally sustainable practices (Sarkis, Gonzalez-Torre, and Adenso-Diaz 2010) that improve corporate social performance (C.-M. Chen and Delmas 2011; Jacobs, Kraude, and Narayanan 2016; Sila 2018). Stakeholder relations has also been one of the key discussions in sustainable supply chain literature. Seuring and Müller (2008) suggest that pressures and incentives set by primary and secondary stakeholders are the starting point in influencing firms to engage in sustainability.

Literature on primary stakeholder pressure influencing firm environmental performance range from investigating institutional investors to eco-conscious consumers. Institutional investors' appetite for sustainable investing has pressured firms to improve their environmental performance. Firms that are environmentally responsible have been shown to be better positioned to attract capital (A. Chatterji and Levine 2006). Conversely, institutional investors can also punish firms for not being environmentally responsible. For example, TIAA-CREF, the largest U.S. retirement fund, sold 50 million shares of Coca-Cola stock in response to KLD Research & Analytics dropping Coca-Cola Co. from its Broad Market Social Index in July 2006 due to concerns relating to labor and environmental practices (A. K. Chatterji, Levine, and Toffel 2009). Customer pressures on environmental performance, both supply chain partners and downstream

consumers, have also been explored. Supply Chain Partners are said to be pressuring firms to develop socially responsible purchasing practices and implement green initiative programs (Atasu, Guide Jr, and Van Wassenhove 2008; Carter 2004; Seuring and Müller 2008; Bowen et al. 2001). Likewise, Loureiro and Lotade (2005) show consumer pressures by exploring how consumers are willing to pay higher premiums for fair trade and shade grown coffee labels.

Scholars have also examined how secondary stakeholder pressures influence firm environmental practices. NGOs, in particular, have been compelling firms to enhance transparency through public disclosures. Lewis et al (2014) identified how different CEO characteristics influenced firm's likelihood to voluntarily disclose environmental information. Similarly, Luo et al. (2012) identified economic pressures, GHG intensive sectors, and large companies impacted firm propensity to participate in the Carbon Disclosure Project. Scholars have also investigated how special interest groups such as KLD Research & Analytics and the Sustainable Asset Management Group provide transparency about past and likely future environmental performance (A. K. Chatterji, Levine, and Toffel 2009; M. Delmas and Blass 2010). These rating agencies are claimed to drive institutional investments and therefore indirectly impact firm environmental practices.

Lastly, the literature has extensively explored the impact of public stakeholders on firm environmental performance. At the State level, Drummond (2010) showed that State-level climate actions reduced GHG emissions by about one half metric ton per person per year, representing 2-3% of the average American's total GHG emissions. Burtraw et al. (2011) explored how the Clean Air Act could plausibly achieve 10 percent reductions in GHG emissions from 2005 to 2020 at moderate costs. Lastly, on a global

level, Luo et al. (2016) found that given appropriate levels of carbon taxes, public stakeholders can induce firms to alter its production processes to achieve emissions reductions. Other studies have also propagated the positive impacts of a carbon tax on carbon emissions (Gupta 2016; Allan et al. 2014; Meng, Siriwardana, and McNeill 2013).

The above literature review showcases numerous studies that have investigated how various stakeholder pressures influence firm environmental practices. Despite the abundance of these studies, there seems to be a paucity of papers that investigates impacts from multiple stakeholder groups in aggregation and its impact on firm environmental performance. One of the main challenges result from the abundance of multiple stakeholder groups and the increased complexity of determining which group has higher saliency (Matos and Silvestre 2013; Gago and Antolin 2004).

Managerial Perception

Stakeholder Saliency

A large part of literature on stakeholder theory has sought to systematically address the question of which stakeholders deserve or require management attention (Mitchell, Agle, and Wood 1997). Approaches to the relationship between management and stakeholders have largely focused on exchange transactions, power dependencies, legitimacy claims, or other claims (Donaldson and Preston 1995; Mitchell, Agle, and Wood 1997; Cummings and Doh 2000). We utilize Mitchell et al's (1997) typology for identifying stakeholder saliency and how manager prioritize stakeholder relationships. The typology is based on three attributes: the stakeholder's *power* to influence the firm, the *legitimacy* of the stakeholder's relationship to influence the firm, and the *urgency* of the stakeholder's claim on the firm. We adopt Mitchell et al's (1997) definition of these attributes but will not explicitly define them in our paper (Please refer to their paper if

interested). The classification scheme and typology are utilized to hypothesize each stakeholder group's impact on firm environmental performance.

The model proposed by Mitchell et al. (1997) has been widely used in environmental literature (Huang et al. 2015; Murillo-Luna, Garcés-Ayerbe, and Rivera-Torres 2008; Eesley and Lenox 2006; Gago and Antolin 2004; Buysse and Verbeke 2003; Harvey and Schaefer 2001; Agle, Mitchell, and Sonnenfeld 1999). Agle et al. (1999) investigated an attribute-saliency-corporate performance model and found that the three attributes (power, legitimacy, and urgency) proposed in Mitchell et al. (1997) influences stakeholder saliency. Eesley and Lenox (2006) explored how saliency for secondary stakeholders elicited positive firm responses. They found that greater relative power to target firms and requests that are legitimate in the eyes of the public are more likely to lead to positive firm responses. Huang et al. (2015)studied how salience of different stakeholder groups influenced reverse logistics implementation. Their results show that salience for government agencies, suppliers and customers are positively associated with reverse logistics implementation.

Task Environment

Environmental uncertainty has long played a role in organizational responses and actions. In OM literature, environmental uncertainty has been linked with manufacturing strategy (Swamidass and Newell 1987) with a focus on manufacturing flexibility (Pagell and Krause 1999; Vokurka and O'Leary-Kelly 2000; Wong, Boon-itt, and Wong 2011). However, managerial perception and interpretation of changes in the environment significantly influence successful organizational responses and actions (Daft and Weick 1984; Hambrick and Mason 1984; Chattopadhyay, Glick, and Huber 2001). Managerial perception is at the core of Teece's (1997; 2007) Dynamic

Capabilities framework, which is built on the capability of sensing (and shaping) opportunities and threats. He stresses the importance of sensing as only then can firms seize opportunities and manage threats effectively.

Our paper focuses not on the foundations of managerial perception, but on how those perceptions drive organizational action. Literature has shown that these perceptions guide managerial decisions which seem to influence organizational action (Hambrick and Mason 1984; Starbuck and Milliken 1988; Chattopadhyay, Glick, and Huber 2001). Managers tend to interpret and internally categorize environmental changes as either opportunities or threats (Dutton and Jackson 1987; Jackson and Dutton 1988). For the purposes of our paper, Sharma (2000) argues that the threat-opportunity categorization is particularly relevant for firm environmental strategies.

Empirical studies have shown that threats are relatively more influential than opportunities in driving organizational actions. Chattopadhyay's (2001) empirical study of the link between manager perception of threats and opportunities and subsequent organizational action, they find that perceived threats do appear to influence the direction of organizational outcomes. Similarly, Saebi et al (2017) found that companies were more likely to adapt their business model under perceived threats than opportunities. Our study contributes to this literature stream by exploring whether perceived threats and opportunities from the various stakeholder pressures impact environmental performance.

Hypothesis Development

We first give a broad overview of managerial interpretation of the environment, and how opportunities and threats may induce different levels of organizational action. This notion uniformly applies to various pressures coming from our three different

stakeholder groups: Primary, Public, and Secondary. We then hypothesize how opportunities and threats within each stakeholder group could drive environmental performance. Lastly, we discuss the saliency of stakeholder groups to firm managers by utilizing Mitchell et al. (1997) stakeholder identification and salience framework and hypothesize its subsequent impact on environmental performance.

Managerial perception and environmental performance

Within the propositions below regarding how different stakeholder groups effect GHG emissions reduction, we distinguish stakeholder issues that are perceived as threats versus those perceived as opportunities. Managers perception and interpretation of environmental changes influences organization action (Chattopadhyay, Glick, and Huber 2001), and these changes are often categorized as either opportunities and threats. An opportunity implies a positive situation in which the firm has a fair amount of control and a gain is likely. A threat implies a negative situation in which the firm has relatively little control and a loss is likely (Dutton and Jackson 1987). In the context of this paper, we also assume that managers will categorize information from stakeholders as either opportunities or threats.

The Behavior Theory of the Firm (BTOF) (Cyert and March 1963b) suggests that due to the cognitive limitations of decision makers, attention is sequentially allocated to finding solutions to specific problematic areas, i.e. problemistic search (Cyert and March, 1962; Washburn and Bromiley, 2012). As such, managers find themselves responding to issues they describe as “problems” more often than to issues they describe as “opportunities” (Nutt 1984). Furthermore, research has shown that people generally value loss prevention over gain (Kahneman and Tversky 1979). Given that, we assume that perceived opportunities related to environmental sustainability are not potential

problems and will not trigger problemistic search. Conversely, managers will respond to perceived threats, sequentially allocating their attention, firm resources, and subsequent organizational actions to finding potential solutions. This notion is uniformly utilized in our hypothesis development of how primary, secondary, and public stakeholder could impact firm environmental performance.

Primary stakeholder pressures

Environmental performance can promote or strain a company's reputation and affect various primary stakeholders (shareholders, employees, consumers, suppliers, etc.) associated with the firm. Environmental performance has been positively linked with financial performance (Klassen and McLaughlin 1996; King and Lenox 2001a; Zhu and Sarkis 2004b; Montabon, Sroufe, and Narasimhan 2007a). Furthermore, proactive environmental management reduces the risks and liabilities associated with climate change, which also adds to shareholder value (F. L. Reinhardt 1999; Goldstein and Wiest 2007). If environmental practices are not managed correctly, shareholders could suffer monetary losses if companies are found liable for environmental damages such as the BP oil spill (Heflin and Wallace 2017) or lose market value due to poor environmental practices in the media (Jacobs, Singhal, and Subramanian 2010). The perception of such increased risk exposure can result in shareholders and potential investors demanding higher risk premiums (Henriques and Sadorsky 1996). Shareholders can also voice their discontent by refusing to provide additional capital or withdraw capital altogether.

Employees can benefit greatly from eco-friendly firms. Delmas and Pekovic (2013) also found that firms who voluntarily adopted eco-friendly practices and standards have employees who are 16 percent more productive than the average.

Difficulties in obtaining and retaining intellectual capital can persist if firms are not environmentally oriented, especially if highly qualified employees find themselves having a strong preference for proactive environmental management (F. Reinhardt 1999). This also leads to positive externalities where firm successes in green competencies are dependent on the participation and involvement of their employees (Hart 1995; Ramus and Steger 2000).

Firms are also getting pressure through its supply chain. On the downstream end, changing consumer preferences coupled with the availability of information has significantly changed the way firms engage in attracting and retaining customers. Green consumerism could increase firm profits as these consumers are willing to pay a premium for eco-friendly products (Vandermerwe and Oliff 1990). These consumers can also negatively impact firm profits by boycotting products of companies that have a reputation for poor environmental management (Greeno 1992). On the upstream end, vendors are required to adhere to proactive green practices to improve their environmental performance (Lee and Klassen 2008; Zhu and Sarkis 2004a). Customers also require their suppliers to comply with all environmental regulations (M. A. Delmas and Montiel 2007) to ensure the reduction of environmental liabilities associated with final product development (Handfield et al. 2002). In summary, primary stakeholders are pressuring firms to improve their environmental performance.

Pressures from shareholders, supply chain partners, employees, customers, etc. can be interpreted by managers as either an opportunity or a threat. For example, consider the pressure of changing consumer behavior where consumers base their purchasing decisions on a firm's eco-status. Managers can interpret this as an opportunity and invest in green initiatives to leverage environmental efforts and drive

increases in sales. Conversely, managers can interpret this as a threat and invest in green initiatives as a means to stem potential losses. Applying the notion of problemistic search and how people generally value loss prevention over gain (Cyert and March 1963b; Kahneman and Tversky 1979), changing consumer behavior perceived as a threat will more likely induce organizational change compared to changing consumer behavior perceived as an opportunity. The same can be said about any primary stakeholder pressure, leading us to our first set of hypotheses:

Hypothesis 1a: Primary stakeholder pressures perceived as opportunities will lead to GHG emissions reductions

Hypothesis 1b: Primary stakeholder pressures perceived as threats will lead to greater GHG emissions reductions relative to primary stakeholder pressures perceived as opportunities

Secondary stakeholder pressures

Secondary stakeholders, including non-governmental agencies (NGOs), special interest groups, and the media have helped focus attention on social and environmental issues (Doh and Guay 2004). They are often times regarded as either a replacement or an extension of the role of government. Their involvement typically includes proposing, monitoring, and enforcing environmental initiatives and codes. NGOs can work with governments, corporations or even other NGOs.

NGOs have also been credited in establishing and proposing codes to be included in inter-governmental agreements. For example, the inclusion of environment and labor issues in the North American Free Trade Agreement was a response to environmental NGOs and trade unions (Doh and Guay 2004). Secondary stakeholders also work with firms to address climate change issues. For example, the International

Organization for Standardization established the ISO 14000 series as a voluntary set of standards intended to encourage firms to systematically address the environmental impacts of their operations. Lastly, secondary stakeholders also collaborate amongst themselves to establish environmental initiatives. For instance, the Science Based Targets initiative was jointly started between the Carbon Disclosure Project, UN Global Compact, World Resources Institute, and World Wildlife Fund to assist firms in the formation of environmental goals that align with international agreements. Science Based Targets have been shown to positively influence GHG emissions goals. The World Wildlife Fund is mostly attributed with recruiting several other NGOs to establish the Forest Stewardship Council (FSC) which provides accreditation and certification on whether wood products were harvested in a socially and environmentally sound manner. The FSC has been credited in convincing large multinational corporations to sell FSC-certified products. Similar to primary stakeholders, secondary stakeholders also pressure firms to improve their environmental performance.

Secondary stakeholder pressures can be interpreted as either an opportunity or a threat. Managers who perceive secondary stakeholder pressure as opportunities can incorporate NGOs (Johnson et al. 2018) into the strategy-making process. In doing so, firms can improve their social and environmental performance. This can result in competitive advantages derived from improved efficiency and performance, as well as reputation and good will. Managers who perceive secondary stakeholder pressures as threats can work with NGOs as a preventative measure for potential negative images or reputations. Utilizing the notion of problemistic search and how people generally value loss prevention over gain (Cyert and March 1963b; Kahneman and Tversky 1979), NGO pressure perceived as a threat will more likely induce organizational change compared

to NGO pressure perceived as an opportunity. Indeed, this is the presumption of most activist NGOs, who exert pressure through public shaming of firms (Hoffman 2008). The same can be said about any secondary stakeholder pressure, leading us to our second set of hypotheses:

Hypothesis 2a: Secondary stakeholder pressures perceived as opportunities will lead to GHG emissions reductions

Hypothesis 2b: Secondary stakeholder pressures perceived as threats will lead to greater GHG emissions reductions relative to secondary stakeholder pressures perceived as opportunities

Public stakeholder pressures

Public agencies play a unique role in the context of environmental sustainability. Governments are aware of the risks associated with climate change and have come together to pass the Paris Agreement in December 2015. It is one of the most important outcomes of international multilateral progress with member nations showing the willingness to cooperate and signaled a need for low-carbon transformation on a global scale (Zhang et al. 2017). The overarching goal of the Paris Agreement is to limit global rises in temperatures to 2°C compared to pre-industrial levels, as established by the Intergovernmental Panel on Climate Change. The consensus is that surpassing this limit will lead to an "urgent and potentially irreversible threat to human societies and the planet" (McBride 2017). Under the agreement, participating countries set targets known as Nationally Determined Contributions (NDCs). They are then to evaluate progress towards these NDCs and beginning in 2020 will submit updated carbon reduction plans every five years. Liu et al (2019) provides a summary of NDCs among different member countries. They show that Australia has committed to 26% absolute emissions reduction

by the year 2030, Europe has committed to a 40% reduction by 2030, India a 33% reduction by 2030, etc. These NDCs will be one of the main drivers for future climate change policies and regulations.

Building upon the conventional welfare economics literature under the “polluter should pay” principle (Palmer, Oates, and Portney 1995), public agencies typically resolve to applying coercive pressures (Zhu and Sarkis 2007). As a result, firms are subject to increased risks of noncompliance (Garrod 1997), facing threats from regulators levying legal action, penalties and fines (Sarkis, Gonzalez-Torre, and Adenso-Diaz 2010). Furthermore, noncompliance can also result in individual or class action lawsuits, which can negatively impact a firm’s public image and customer relations (Sarkis, Gonzalez-Torre, and Adenso-Diaz 2010). Firms will minimize non-compliance risks and the associated negative repercussions by improving environmental performance.

Managers can perceive public stakeholder pressures as either opportunities or threats. Regulatory pressures can be perceived as opportunities due to the differences in country specific regulations. Firms who adhere to more stringent regulations in one region of the world can utilize that conformity as an opportunity in another region is less stringent. For example, Ford, Honda, Volkswagen and BMW have publicly sided with California’s stringent auto emissions standards. The underlying belief is that cars manufactured under those standards can be sold anywhere else in the US. Conversely, firms can view regulations as potential threats as noncompliance can lead to negative repercussions such as fines and in some cases even revocation of conducting business in that region. This leads us to our third set of hypotheses:

Hypothesis 3a: Public stakeholder pressures perceived as opportunities will lead to GHG emissions reductions

Hypothesis 3b: Public stakeholder pressures perceived as threats will lead to greater GHG emissions reductions relative to public stakeholder pressures perceived as opportunities

Stakeholder salience

As noted earlier, stakeholder salience can largely be attributed to a group's power, legitimacy and urgency. Recall, the typology is based on three attributes: the stakeholder's *power* to influence the firm, the *legitimacy* of the stakeholder's relationship to influence the firm, and the *urgency* of the stakeholder's claim on the firm (Mitchell, Agle, and Wood 1997). Mitchell et al (1997) links saliency to the number of attributes a stakeholder group exhibits. In the context of environmental sustainability, we believe that Public stakeholders enjoy the most stakeholder saliency, while Primary and Secondary stakeholders' saliency are moderate. Our rank is based on the notion that Public stakeholders exhibit all three attributes. They have the power to enact regulations and policies. They exhibit legitimacy as their decisions and actions are made for the "social good". They display urgency as evidenced by the Paris Climate Agreement, and the notion that climate change requires immediate action. We argue that Primary stakeholders exhibit two (power and urgency) of the three attributes and lacks legitimacy. Primary stakeholders will on average base their decisions and actions on self-interest rather than for the "social good". Lastly, Secondary stakeholders also possess only two (legitimacy and urgency) of the three attributes. NGOs and special interest groups are established and exist specifically for the notion of societal good and the need for urgent action. However, they lack the means to enforce environmental

standards and regulation often times resorting to public shaming efforts to drive organizational response.

We believe that managers will tend to focus their attention and base a majority of decisions and actions on the most salient group. Their decisions should also be influenced by pressures from other groups. This results in a majority of environmentally sustainable organizational change being influenced by various policies and regulations put forth by Public Stakeholders. Additional environmentally sustainable initiatives will most likely be implemented to placate the pressures from both primary and secondary stakeholders. This leads us to the following set of hypotheses:

Hypothesis 4a: Public stakeholder pressures will have the greatest impact on firm GHG emissions reductions

Hypothesis 4b: Primary and Secondary stakeholder pressures will lower impact on firm GHG emissions reductions as compared to public stakeholder pressures

Science based targets

Environmental sustainability is in large part driven by institutional forces and a global agreement which states that climate change needs to stay within a 2°C threshold, as compared to the levels in the pre-industrial era, to reduce extreme weather events and irreversible environmental damage (Paris Climate Agreement). The Science-based targets initiative (SBT) is a joint partnership between CDP, World Resources Institute, World Wildlife Fund, and UN Global compact. Its purpose is to help firms discern exactly how much its environmental emissions contribute to the 2°C threshold and assist them in developing goals that align with the threshold.

In some sense, adoption of SBT acts as a signal to all three stakeholders. To primary stakeholders such as suppliers, workers, customers, and investors, SBT

signifies serious commitment to sustainability targets. To public stakeholders, it's the mechanism by which firms can help national and super-national goals. To secondary stakeholders, it is a simple way for (e.g.) media to determine how serious a firm is about sustainability.

Our argument for secondary stakeholder saliency included both legitimacy and urgency, but not power. We believe that SBT moderates secondary stakeholder pressure because it indirectly offers a good proxy for power, in terms of GHG emissions performance, for two reasons. First, SBT is a partnership between various NGOs and the UN Global Compact thus it is an extension of secondary stakeholders. Second, SBT helps firms establish GHG emissions reduction goals in line with the 2°C threshold which lead to more aspirational GHG emissions goals (Hsu and Dooley 2020). Goals have been shown to improve performance at both the micro and macro organizational levels (Mento, Steel, and Karren 1987; Tubbs 1986; Smith, Locke, and Barry 1990). As such, participation in SBT will lead to more ambitious GHG emission reduction goals resulting in more GHG emissions reductions, leading to the final hypothesis:

Hypothesis 5: Science-based targets will moderate Secondary stakeholder pressures' impact on GHG emissions reductions

Data and Methodology

Data and Sample

The data consists of firm responses to annual CDP questionnaires. CDP, founded in 2000, works closely with institutional investors to encourage corporations to report on environmental issues, particularly carbon emissions and water usage. One of the key factors of CDP's success is due the support of more than 800 institutional

investors with a combined US$95 trillion in assets. Because of this partnership, the questionnaires that CDP hands out to firms usually result in high response rates. CDP data provides social investors with information on firms' risks associated with climate change and informs managers about investors' concerns about climate change (Stanny and Ely 2008). In academia, data from CDP has also been used in studies across many disciplines. Some examples include looking at the effects of voluntary climate change disclosure on firm performance (Lee, Park, and Klassen 2015), assessing the impact of a CEOs educational degree on environmental disclosure (Lewis, Walls, and Dowell 2014), and identifying differences between numbers reported in corporate reports and CDP reports. (Depoers, Jeanjean, and Jerome 2016).

Our final sample is an unbalanced panel from 2011 to 2017 with 3,670 observations for 920 firms. The data contains information about the likelihood, time period, and magnitude of potential risks and opportunities. Information on likelihood ranges from unknown to virtually certain. Magnitude ranges from unknown to high, and time ranges from unknown to 10+ years. We filter out likelihoods that are unknown or unlikely and magnitudes that are unknown or low. Due to the limitations of the time period of our sample, we only include time periods that are between 1-6 years.

Measures

We summarize the operationalization of our variables in Table 1.

Dependent Variable

Environmental performance. Environmental performance is captured via firm GHG emissions. Under the WRI-WBCSD GHG Protocol (a standard in which to account for emissions), GHG emissions are classified via Scope 1, Scope 2, and Scope 3

emissions. Scope 1 refers to all GHG emissions that are directly emitted from sources that are owned or controlled by the firm. Scope 2 refers to indirect emissions that result

Table 1. Variable Definition

Construct	Variable	Description
Environmental performance	$\overline{env_performance_i}$	Dependent variable, defined as the percentage change in Scope 1 and Scope 2 emissions intensity (number of employees) for firm *i* in year *t*
Primary stakeholder pressure	$\overline{primary_{i.t}}$	Categorical variable that represents firm perception of Primary stakeholder pressure as neither an opportunity or threat (0), a threat (1) or an opportunity (2) for firm *i* in year *t*
Secondary stakeholder pressure	$\overline{secondary_{i.t}}$	Categorical variable that represents firm perception of Secondary stakeholder pressure as neither an opportunity or threat (0), a threat (1) or an opportunity (2) for firm *i* in year *t*
Public stakeholder pressure	$\overline{public_{i.t}}$	Categorical variable that represents firm perception of Public stakeholder pressure as neither an opportunity or threat (0), a threat (1) or an opportunity (2) for firm *i* in year *t*
Science based targets	$\overline{SBT_{i.t}}$	Indicator variable representing firm participation in SBT. A 1 represents participation for firm *i* in year *t*, and 0 otherwise

from consumption of purchased electricity, heat or steam. Scope 3 is all other direct GHG emissions from sources that are not owned or controlled by the firm. Examples of Scope 3 emissions include: extraction and production of purchased materials and fuels and transport related activities.

The measurements are reported as absolute emissions or intensity emissions. Absolute emissions capture the total amount of emissions as measured by CO_2 per metric ton. Intensity emissions are normalized to various measurements such as total revenue or number of full-time employees. To have better comparability of emissions over a number of years, we normalize absolute emissions by the number of employees.

We then capture the year-over-year percentage changes in intensity. Our study does not include Scope 3 emissions targets as we are focused on capturing the operational process improvements within a firm.

Independent Variables

Our sample includes managerial perception of opportunities and risks associated with climate change, including regulation, physical changes, and other climate-related developments. This data is included in CDP. CDP provides firms with a standard list of potential drivers for opportunities and risks associate with climate change. Firms then select and report drivers that could potentially impact them. We then look at the entire list of drivers that CDP provides and categorize those drivers as either pressures that could result from primary, secondary, or public stakeholders. The result is a list of pressures from each stakeholder group for each year in our panel. We then aggregate the number of opportunities and risks a firm perceives in a specific year. If more opportunities exist, we would code that firm as viewing pressures from a stakeholder group as an opportunity. If more threats are present, we could code that firm as perceiving pressures as a risk.

Perception of Primary stakeholder pressure. Examples of such drivers from CDP include “induced changes in natural resources” and “changing consumer trends.” Using the process we described in the preceding paragraph, perception of primary stakeholder pressures is then a *categorical* variable with 0 if a firm perceives neutral opportunities and risks, as 1 if a firm perceives pressures as a risk, and a 2 if a firm perceives pressures as an opportunity. We apply this logic to the Public and Secondary stakeholder groups as well.

Perception of Secondary stakeholder pressure. Opportunities and threats associated with Secondary stakeholder pressures result from drivers such as "Reputation" or "Increasing humanitarian demands". Following our codifying rocess, perception for secondary stakeholder pressure is then a categorical variable for with 0 representing no opportunities or threats, 1 representing a firm perceiving pressures as a risk, and a 2 representing a firm perceiving pressures as an opportunity.

Perception of Public stakeholder pressure. Our data include firm identification of opportunities and threats associated with regulation. Examples of the types of opportunities and risks are "air pollution limits", "carbon taxes", or "product efficiency regulations". We count these types of drivers as pressures from Public stakeholders. We employ the same explanation above and take a firm as perceiving opportunities from Public stakeholder pressures if more opportunities than risks exist, and vice versa. A categorical variable for Public stakeholder pressures is generated with 0 representing no opportunities or threats, 1 representing a firm perceiving pressures as a risk, and 2 representing a firm perceiving pressures as an opportunity.

Table 2 contains a subset of opportunities and risks in our dataset. Primary stakeholder pressures include opportunities and risks drivers associated with physical changes due to climate change as well as changing consumer behavior. We believe that these changes impact the firm itself or a primary stakeholder. For example, changes in natural resources pressure firms by adding uncertainty to raw materials and thus a firm's production flow as well as its downstream partners. When firms are unable to predict raw material flow, it leads to greater risks of overstocking/stockouts on the downstream end.

Table 2. Coding of Independent Variables

Opportunities	*Risks*
Primary stakeholder pressures	Primary stakeholder pressures
Change in mean (average) precipitation	Change in mean (average) precipitation
Change in mean (average) temperature	Change in mean (average) temperature
Change in precipitation extremes and droughts	Change in precipitation extremes and droughts
Change in precipitation pattern	Change in precipitation pattern
Change in temperature extremes	Change in temperature extremes
Induced changes in natural resources	Induced changes in natural resources
Other physical climate drivers	Other physical climate drivers
Other physical climate opportunities	Sea level rise
Snow and ice	Snow and ice
Changing consumer behavior	Tropical cyclones
Fluctuating socio-economic conditions	Tropical cyclones (hurricanes and typhoons)
Induced changes in human and cultural environment	Uncertainty of physical risks
	Changing consumer behavior
	Fluctuating socio-economic conditions
	Induced changes in human and cultural environment[1]
Secondary stakeholder pressures	Secondary stakeholder pressures
Increasing humanitarian demands	Increasing humanitarian demands
Other drivers	Other drivers
Reputation	Reputation
	Uncertainty in market signals
	Uncertainty in social drivers
Public stakeholder pressures	Public stakholder pressures
Air pollution limits	Air pollution limits
Cap and trade schemes	Cap and trade schemes
Carbon taxes	Carbon taxes
Fuel/energy taxes and regulations	Fuel/energy taxes and regulations

Therefore, this driver acts as a proxy for a couple of primary stakeholder pressures, including shareholders and multiple supply chain members, to improve a firm's GHG emissions.

Secondary stakeholder pressures include opportunities and risk drivers associated with increasing humanitarian demands, other drivers, and reputation. These pressures are most likely driven by NGOs, special interest groups, or the media. For example, a firm's reputation is often times driven by the information disseminated by Secondary stakeholders. A firm's reputation can improve much like how Starbucks enjoyed an increase in reputation after the media reported that it would ban plastic straws. Conversely, a firm's reputation can suffer similarly to how Apple's and Amazon's did when CDP listed them among other major companies that were refusing to disclose details of their carbon emissions. As such, Secondary stakeholders utilize a firm's environmental reputation to pressure them into addressing their GHG emissions.

Lastly, Public stakeholder pressure include drivers such as air pollution limits, taxes, and cap and trade schemes. These drivers are all decided by governmental agencies and pressure firms to address their GHG emissions. For example, firms will improve their carbon emissions to avoid carbon taxes or to adhere to air pollution limits. Given that, these drivers act as direct Public stakeholder pressures for firms to address their GHG emissions.

Science based targets. Science based targets is a fairly new initiative, where companies have agreed to establish GHG emissions targets driven by institutional forces. The data we obtained from the SBT website include 470 firms that are either committed or have already established science-based targets. The variable for SBT is an indicator variable, with 1 indicating the year (and subsequent years) of firm adopting and establishing SBT, and 0 otherwise.

Control Variables

Management Level. Since we are focused on managerial perception on opportunities and risks, we include the management level of a group or individual responsible for climate change as a control variable. Our data contains 4 distinct groups. An individual or group that directly responds to the board, a senior level manager, a manager, and no direct group or individual.

Incentives. Incentives for environmentally sustainable activities could also impact a firm's environmental performance. We include an indicator variable of 0 or 1 with 1 representing incentives were present.

Industry. Literature has shown that greenhouse gas emissions vary greatly between different industries. Industries that are heavy on manufacturing would intuitively exhibit much larger greenhouse gas emissions. As such, industry is included as a control variable. We classify industry based on a firm's GIC industry code.

Region. Regulations and policies differ between regions as well. General consensus is that the European Union is at the forefront of addressing climate change with stricter regulations than other parts of the world. Our data represents firms operating in 4 distinct regions: EU, North America, Asia, and Australia.

Year dummies. When dealing with panel data, the inclusion of year dummies is crucial in accounting for aggregate trends.

Table 3. Descriptive Statistics

	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)
(1) scope12intperc	0.026	0.359	-0.999	2.934	1				
(2) primary	0.658	0.828	0	2	0.02	1			
(3) secondary	0.407	0.747	0	2	0.02	0.29	1		
(4) public	0.451	0.688	0	2	-0.01	0.27	0.24	1	
(5) sbt	0.006	0.077	0	1	0.07	0.12	0.12	0.13	1

Note. Primary, secondary, public and SBT are factor variables.

A table of descriptive statistics and corresponding correlation matrix is presented in Table 3. The table suggests no major collinearity problems in our data.

Econometric Model

Our econometric model begins with various stakeholder pressures for firm environmental action. We then include our control variables, management level, and year dummies, resulting in the following econometric model:

$$env_performance_{i,t} = \beta_0 + \beta_1 primary_{i,t-1} + \beta_2 secondary_{i,t-1} + \beta_3 public_{i,t-1} + \beta_4 SBT_{i,t-1} + \beta_5 (SBT_{i,t-1} * secondary_{i,t-1}) + \gamma controls_{i,t} + \epsilon_{i,t}$$

Variables of the model is defined in the previous section and summarized in Table 1. The error term $\epsilon_{i,t}$ captures idiosyncratic shocks. Since we are dealing with an unbalanced panel, we apply a random-effects estimation.

Results

Recall that we are trying to determine firm environmental performance based on Primary, Secondary, and Public stakeholder pressures and whether firms perceive those pressures as opportunities or threats. We provide our estimation results using a random-effects method in Table 3. First, estimation results with a model containing only control variables are reported. We then provide estimation results for our main model without the moderating term and with the moderation included.

Model 1 presents results for control variables. We included industry as well as year dummies in our estimation, but do not provide the results here for space concerns. Our model suggests that lower level managers have a higher impact on emissions reductions than other groups, as much as about 17.5%. Curiously, we find that incentives do not play a factor. As expected, regions play a significant role in determining emissions reductions. What is surprising is firms in Australia have environmental performance of about 3% better than firms in the European Union.

Results for Model 2 show that stakeholder pressure does indeed have an impact on firm environmental performance. Firms perceiving opportunities from primary pressures increased its emissions by 3.62%. Both perceived opportunities and threats from Public stakeholder pressures improve emissions performance by 3.55% and 4.98%, respectively. Our results indicate that Secondary stakeholder pressures have no direct impact on firm environmental performance.

Results for including moderation effects between firms who participate in SBT and perceived opportunities and threats are shown in Model 3. We see that environmental performance (direction and magnitude) from other pressures are quite similar to Model 2. Results indicate that firms who are a part of the SBT initiative will, on average, exhibit increased emissions from perceived Secondary stakeholder threats. Firms will experience no changes in emissions performance when perceiving opportunities when they are in SBT.

For the purpose of comparison, Model 4 provides estimates for a fixed-effects regression.

Table 4. Panel Data Estimations

	Random Effects			Fixed Effects
	Model 1	Model 2	Model 3	Model 4
Variables of Interest				
Primary Pressure				
Perceived Threat		0.0186	0.0182	-0.0253
		(0.0188)	(0.0188)	(0.0297)
Perceived Opportunity		0.0362*	0.0361*	0.0340
		(0.0166)	(0.0166)	(0.0301)
Secondary Pressure				
Perceived Threat		-0.0190	-0.0210	-0.0658
		(0.0210)	(0.0210)	(0.0468)
Perceived Opportunity		0.0114	0.0108	-0.0467
		(0.0180)	(0.0180)	(0.0393)
Public Pressure				
Perceived Threat		-0.0498**	-0.0511**	-0.0687*
		(0.0157)	(0.0157)	(0.0288)
Perceived Opportunity		-0.0355*	-0.0362*	-0.0225
		(0.0179)	(0.0179)	(0.0294)
SBT		-0.138	-0.816***	-0.833***
		(0.155)	(0.0384)	(0.0442)
SBT#Secondary				
SBT#Perceived Threat			0.888***	0.766***
			(0.0538)	(0.0527)
SBT#Perceived Opp			0.816***	0.890***
			(0.0526)	(0.0751)
Control Variables				
Management Level				
None	-0.0129	-0.0207	-0.0209	0.251
	(0.135)	(0.132)	(0.132)	(0.259)
Other Manager	-0.175*	-0.181*	-0.182*	-0.314
	(0.0880)	(0.0880)	(0.0882)	(0.223)
Senior Manager	-0.0102	-0.0110	-0.0108	-0.0343
	(0.0315)	(0.0315)	(0.0315)	(0.0705)
Incentive	-0.0310	-0.0330	-0.0331	-0.0132
	(0.0237)	(0.0235)	(0.0235)	(0.0717)
Region				
EU	-0.0395	-0.0437^	-0.0448^	
	(0.0250)	(0.0253)	(0.0254)	
North America	0.0605	0.0668	0.0664	
	(0.121)	(0.124)	(0.124)	
Asia	-0.0240	-0.0276	-0.0272	
	(0.0275)	(0.0279)	(0.0280)	
Australia	-0.0693*	-0.0774*	-0.0783*	
	(0.0312)	(0.0326)	(0.0326)	
Industry	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Constant	0.0684	0.0761	0.0769	-0.182*
	(0.0494)	(0.0498)	(0.0498)	(0.0830)
Number of Observations	2388	2388	2388	2388

Note. Standard errors are in parenthesis, except where noted

^Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level

Table 5. Robustness Checks

	Random Effects	
	Model 5	Model 6
Variables of Interest		
Primary Pressure		
Neutral	-0.0198	
	(0.0205)	
Perceived Threat	0.0143	0.0107
	(0.0203)	(0.00902)
Perceived Opportunity	0.0314^	0.0130*
	(0.0182)	(0.00616)
Secondary Pressure		
Neutral	-0.00527	
	(0.0278)	
Perceived Threat	-0.0175	-0.0167
	(0.0214)	(0.0130)
Perceived Opportunity	0.0113	0.00626
	(0.0188)	(0.0136)
Public Pressure		
Neutral	-0.00873	
	(0.0261)	
Perceived Threat	-0.0496**	-0.0192**
	(0.0164)	(0.00713)
Perceived Opportunity	-0.0354^	-0.0167^
	(0.0182)	(0.00889)
SBT	-0.856*	0.851***
	(0.350)	(0.0507)
SBT#Secondary	0.328*	0.799***
	(0.132)	(0.0505)
Control Variables		
Management Level		
None	-0.0226	-0.0208
	(0.133)	(0.133)
Other Manager	-0.180*	-0.176*
	(0.0889)	(0.0878)
Senior Manager	-0.0110	-0.00831
	(0.0315)	(0.0314)
Incentive	-0.0313	-0.0336
	(0.0236)	(0.0237)
Region		
EU	-0.0455^	-0.0423^
	(0.0259)	(0.0250)
North America	0.0646	0.0551
	(0.125)	(0.115)
Asia	-0.0277	-0.0268
	(0.0284)	(0.0279)
Australia	-0.0799*	-0.0740*
	(0.0331)	(0.0323)
Industry	Yes	Yes
Year Dummies	Yes	Yes
Constant	0.0782	0.0740
	(0.0506)	(0.0508)
Number of Observations	2388	2388

Note. Standard errors are in parenthesis
^Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the

Robustness Check

Model Appropriateness

Since our paper is interested in the impact of various stakeholder pressures on different firms' environmental performance, a random-effects model is appropriate. Nevertheless, we utilize the Hausman tests (Greene 2003) to evaluate the appropriateness of specifying firm-level fixed-effects vs. random-effects models in our estimations. The Hausman tests confirmed that specification of firm-level random-effects were more suitable for analyzing our data. Furthermore, random-effects estimation is more consistent than fixed-effects estimation. Lastly, we check for serial correlation

amongst our error terms, and find that serial correlation is not present (Drukker 2003). Accordingly, we feel that estimation of our variables using a random-effects estimation method is most appropriate.

Variable Identification

Our result for the main model does not discern differences between neutral oriented firms and firms who did not perceive any threats or opportunities. Further, the variables are taken on a binary scale as we outlined in our variable operationalization section. We run additional estimation results presented in table 5 to highlight these issues. Estimation results for model 5 differentiate between neutral oriented firms who did not perceive any threats or opportunities. The results show coefficients to be fairly similar to our main model. Perceived opportunities from primary pressures are no longer significant at the 5% level but is still significant at the 10% level. Perceived opportunities from public pressures also falls marginally from the 5% level. Lastly, SBT continues to moderate perceived secondary pressures.

Model 6 utilizes total count of opportunities and threats from various stakeholder pressures. The results show that the pressures from various stakeholder pressures are fairly robust as compared to our main model with only perceived opportunities from public pressures falling into the 10% significance range. As expected, the coefficients are slightly different than our main model, but the direction of change remains consistent. We find that as firms perceive more opportunities from primary stakeholder pressures, environmental performance will become worse. Firms that perceive more opportunities and risks from public stakeholder pressures will result in better environmental performance. Further, SBT continues to moderate perceived secondary pressures.

Discussion

Climate change has become an important topic in the business environment. Pressures from governments, NGOs, and various stakeholders have driven firms to act. Our paper investigates how managerial interpretation of primary, secondary and public

stakeholder pressures affect a firm's GHG emissions. In particular, changes in GHG emissions is a good indication of changes in operations and logistics efficiency and waste reduction (Corbett and Klassen 2006; Rothenberg, Pil, and Maxwell 2001). We hypothesize that these stakeholder pressures impact firms differently depending on the firm's perception of whether the pressure is an opportunity or a threat (Chattopadhyay, Glick, and Huber 2001). Furthermore, our paper posits that stakeholder pressures are not equal in their likelihood of driving firm action.

Our results suggest that perception of opportunities and threats related to stakeholder pressures trigger organizational action. They further show that the amount of organizational action triggered varies between different stakeholder groups. Our data shows strongest support for Public stakeholder pressures. Managerial perception of whether public stakeholder pressures are opportunities or threats lead to improvements in a firm's environmental performance. Public stakeholder pressures also seem to have the largest amount of impact on a firm's emissions, which fully supports our fourth hypothesis. We only find partial support for our second hypothesis as only perceived threats from Primary stakeholders trigger improved environmental performance.

The dichotomous results of pressures perceived as opportunities or threats leads credence to the notion of problemistic search. Managers, who are bounded rationally, will allocate their limited attention and resources to problematic areas. This behavior is found in our results, as perceived threats systematically resulted in better emissions improvements than perceived opportunities. The logic of problemistic search can also be another reason for why results were only found for perceived Primary stakeholder threats and not opportunities.

Following the logic of Mitchell (1997), we discerned that manager salience for Primary and Secondary stakeholders were equal and both would trigger similar emission improvements. We conclude that only perceived Primary stakeholder threats triggered an environmental response. We believe that this is because stakeholders that possess power and urgency but lack legitimacy are considered “dangerous stakeholders” (Mitchell, Agle, and Wood 1997). This stakeholder group will typically resort to coercive actions to achieve their means. The possibility of severe negative consequences will force managers to address the demands for this group. Our results showed no meaningful environmental actions from Secondary stakeholder pressures. We believe that this is attributed to the group’s inherent lack of power. Mitchell (1997) classifies stakeholders who are both legitimate and urgent as “dependent stakeholders, [who] rely on other stakeholders for the power to carry out their will.” We feel that this logic is also reflected in our results, where primary and public stakeholders are carrying out the will of Secondary stakeholders.

Our results also support our last hypothesis. We found that firms participating in the Science Based Targets initiative will respond to Secondary stakeholder pressures. The Science Based Targets initiative is a collective of Secondary stakeholders with the intent of assisting firm establishments of targets that are in line with global goals. The establishment of goals drive corporate action and we believe is a form of Secondary stakeholder’s power. Specifically, we conject that these goals are an indirect method for Secondary stakeholders to pressure firms into taking corporate action. This leads us to believe that secondary stakeholders could be categorized into two different groups: those that are able to come up with environmental solutions to assist firms and those

that can't. Firms would more likely engage with those Secondary Stakeholders that are able to provide solutions, leading to changes in environmental performance.

Conclusion

This paper makes several contributions to existing research on how stakeholder pressure is impacting firm environmental performance. To the best of our knowledge, this paper is the first empirical piece that relies on secondary data to investigate multiple stakeholder groups.

Our findings suggest how different stakeholder groups should approach firms in addressing climate change. We find that public stakeholder pressures have the largest impact on firm improvements in environmental performance, regardless of whether firms perceive the pressure as an opportunity or threat. As such, we feel that it is a mistake for policymakers, such as the United States, to abandon and, in some cases, reverse its climate initiatives. These actions may only be beneficial to a firm's bottom line in the short term. As the negative effects of climate change begin to rise and the effects become irreversible, firms will unquestionably face unprecedented levels of consequences. In order to safeguard their futures, governments must play a role in addressing climate change. We see it as analogous to a parent safeguarding the livelihood of their children.

Our paper also suggests that primary stakeholders should frame their concerns and issues in a negative light. For example, primary stakeholders should depict the loss and consequence for certain issues rather than focus on a "win-win" scenario. Such framing and depictions would most likely be perceived as threats, which will then trigger problemistic search among managers.

The general act of NGOs and special interest groups publicly shaming companies have very little impact on firm environmental performance. Our argument highlights this groups lack of power to influence corporate actions. Further studies can determine whether mechanisms for corporate action from secondary stakeholders are indeed driven by a transference of power. Nevertheless, we found that special interest groups would be better suited in allocating their time and resources to designing programs and initiatives that indirectly trigger corporate action. Currently, the Science-based targets only directly involve greenhouse gas emissions. Other types of initiatives based the notion of goal setting could be developed around water usage or other sustainability related issues.

There are certain limitations to our results. We limited our definition for environmental performance to GHG emissions, in particular Scope 1 and Scope 2 emissions. This was done intentionally as we believe GHG emissions to be a byproduct of a firm's operations, which offers an alternative measure in gauging improvements in operational innovation and efficiency. Our conclusions may not be applicable to other types of environmental practices, such as water reduction, etc. As a result of the limitations of our data, we believe we only included a subset of the entire secondary stakeholder group. We assumed that our measurement for reputation represented special interest groups and the media, but more direct measurements could be used in future studies. Despite this shortfall, we speculate that our main results and conclusions would not differ much because this stakeholder group lacks the power to influence corporate action. Lastly, we were able to only utilize 6 years of panel data, limiting our results to a more short-term orientation.

This limitation directly leads us to our first implication for future research. We believe that results will be more robust with additional years of data. The variable of time could be introduced, and we can further investigate whether different stakeholder pressures manifest over longer periods. Further, including an accurate measure of pressures resulting from secondary stakeholders could provide additional insights to our model. As we mentioned earlier, we believe that our results would not change, but it would be interesting to see whether primary and public stakeholders mediate the pressures from secondary stakeholders.

Lastly, our hypotheses and results only pertain to environmental performance as measured by GHG emissions. Stakeholder pressures could have different impacts on other corporate social responsibility issues. In sustainability, water usage or deforestation is another concern for stakeholders. Future research can expand upon our framework and investigate how stakeholder pressures not only impacts GHG emissions, but other social responsibility dimensions such as water usage or employee welfare.

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