
Climate Change Strategies and Firm Performance: An Empirical Investigation of the Natural Resource- Based View of the Firm

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Abstract

There is widespread consensus that human activity has had a significant impact on global climatic patterns which will have important consequences for much of society. Although there has been much research on the relationship between corporate environmental performance and corporate financial performance, empirical testing of the association between proactive corporate climate-change strategies and financial (or accounting) performance is still in its infancy. Based on the logic embodied in the Natural Resource-Based View (NRBV) of the firm, firms that successfully implement strategies to lessen their effect on climate change should outperform competitors who are less proactive in such efforts. This study uses a matched-pair design to empirically demonstrate that firms with proactive climate change strategies achieved significantly higher levels of accounting performance than competitors that were less proactive, thus providing additional support for the NRBV.

Introduction

To satiate the needs of capital market stakeholders, firm managers are compelled to identify, formulate, and implement strategies aimed at achieving sustainable competitive advantage (SCA) and superior profitability. Unfortunately, traditional corporate strategies used in market-based economies have negatively impacted the natural environment in ways that threaten the ecosystems supporting mankind's existence. The multiplicity of problems resulting from climate change and the requisite measures needed to decrease (or stabilize) the atmospheric levels of carbon dioxide and other greenhouse gases has become one of the most widely discussed environmental issues among journalists, politicians, environmentalists, academics, businesses, and other stakeholders.

Indeed, the consequences of global climate change, such as rising sea levels due to melting glaciers, the spread of non-native pathogens, drought in some areas and greater flooding in others, are well documented (IPCC, 2007; McKibbin &

Wilcoxon, 2002); and the United States' abstinence from the Kyoto Protocol will not protect it from the environmental and economic consequences of global climate change. If atmospheric carbon dioxide doubles by 2050, it will cost the U.S. an estimated \$68 billion annually and the annual global cost will be approximately \$304 billion (Hoffman, 2005).

Although there has been much research examining the association between corporate environmental performance and organizational outcomes (e.g., Bansal & Hunter, 2003; Margolis & Walsh, 2003; Orlitzky, Schmidt, & Rynes, 2003; Russo & Fouts; 1997; Sharma & Vredenburg, 1998), there are no published empirical studies that specifically examine whether firms pursuing proactive climate change strategies financially outperform competitors that are less proactive. To-date, the extant literature has focused on firm motivations for pursuing climate change strategies (Levy & Kolk, 2002; Kolk & Pinske, 2004, 2005, 2007b; Okereke, 2007; Porter & Reinhart, 2007), corporate political lobbying strategies regarding climate change (Kolk & Pinkse, 2007a), and the degree to which global firms voluntarily commit to reducing their impact on climate change (Stanwick & Stanwick, 2006). The purpose of this study is to examine the relationship between proactive climate change strategies and accounting performance.

In this paper, we describe how highly proactive firms typically engage in three broad climate-change initiatives aimed at reducing carbon dioxide and other greenhouse gas emissions: (1) by developing energy substitutes for oil and coal, such as wind and solar power, (2) by developing renewable energy sources (e.g., hydrogen and other fuel cells), and (3) by working collaboratively with firms, governments, Non-Governmental Organizations (NGOs), and other stakeholders toward large-scale climate-change solutions. We then show how these three climate-change initiatives are consistent with the logic embodied in the NRBV, a unique perspective of SCA based on the inter-relationship between the firm and the natural environment (Hart, 1995). It builds on the strengths of the RBV but addresses a deficiency inherent in RBV and many other management theories — that constraints imposed by the earth's natural environment will impact a firm's resource-based advantage in the long run.

As such, the theoretical section of the paper begins with an overview of the RBV, including its assumptions, prescriptions, and summary of RBV studies, followed by an overview of the NRBV and Hart's (1995) original framework (founder of the NRBV). We use the logic embodied in Hart's framework in identifying three strategic capability-based climate-change strategies that can be a source of SCA in a way that reduces carbon dioxide and other greenhouse gas emissions. The linkages

between the proactive climate change initiatives, the three strategic capability-based climate-change strategies, and the source of SCA provide the foundation for the “NRBV Framework for Proactive Climate Change Organizations,” shown in Table I. The remainder of the paper describes the methodology of the study, the empirical results, the implications and limitations of the empirical findings, and possible avenues for future research.

Climate Change Initiatives

Carbon Emissions and Greenhouse Gases: Fossil Fuels

Climate changes have, in large part, been linked to the global economy's heavy reliance on oil as an energy source. As a cheaper alternative energy source to oil, coal is vast and can last for generations (EIA, 2006). However, coal-fired power plants release substantial amounts of carbon dioxide into the atmosphere (DOE & EPA, 2000) which conflicts with growing regulatory and societal pressure on countries and corporations to reduce their carbon dioxide emissions. Even the United States, which is not a signatory to the Kyoto Protocol, is facing increasing regulatory pressure to address climate change. In 2007, the U.S. Supreme Court ruled that, “greenhouse gases fit well within the Clean Air Act's capacious definition of air pollutant” (Greenhouse, 2007), thus, paving the way for a carbon constrained future. In short, it is becoming increasingly unlikely that global firms will be able to escape regulatory mandates to reduce their emissions of greenhouse gases.

Renewable Energy and Fossil Fuel Substitutes

Firms are beginning to identify profitable market opportunities for developing technologies that assist organizations in transitioning from oil and coal to alternative energy sources. Recent revenue projections from wind and solar power are expected to increase by a factor of five or six in the next several years and hydrogen fuel cells, which emit no greenhouse gases, are expected to increase by a factor of 15 from 2004 to 2014. In less than a decade, the estimated market value for these three energy sources is expected to reach \$100 billion (Makower, Pernick, & Wilder, 2005). The point is that market opportunities and not just regulatory pressures will motivate firms to find innovative ways to profit from these new energy-based market opportunities.

Another substitute for oil and coal is natural gas, and although it is a fossil fuel, it emits only half as much carbon dioxide as coal (EPA, 2006a) and one third less carbon dioxide than oil (EPA, 2006b). While these emissions are still greater

than that generated by solar and wind power, natural gas can serve as a transitional fuel (Greene, Hopson, & Li, 2006) from a high greenhouse-gas economy to a low greenhouse-gas economy. Additionally, the world's natural gas reserves are vast and expected to last over 60 years (EIA, 2006). Thus, regulatory pressure for firms to reduce their carbon dioxide emissions coupled with the vast geophysical availability of natural gas provides firms with a viable, lower-greenhouse gas energy substitute for oil and coal. This presents opportunities for profit-driven entities to develop and market proactive gas-based energy solutions that reduce carbon dioxide and other greenhouse gases.

Solutions-Based Coalitions

Corporate efforts to reduce carbon dioxide and other greenhouse gases by adopting more environmentally efficient technology, shifting from oil and coal to 'cleaner' energy sources such as solar power, making transitional shifts in energy sources from coal or oil to natural gas, and developing next generation power sources such as hydrogen fuel cells are commendable. However, such efforts will not be sufficient to negate the increasing rate of carbon dioxide emissions and resultant increase in global temperatures. What is needed is the collective effort of individuals, corporations, and nations working in concert to address this problem (Hendry, 2006; Starik & Rands, 1995).

The Intergovernmental Panel on Climate Change notes that a "portfolio or mix of strategies that includes mitigation, adaptation, technological development (to enhance both adaptation and mitigation) and research" across multiple constituencies will be invaluable in decreasing the risks of climate change posed to humankind (IPCC, 2007, p. 20). Corporations must be highly proactive in such collaborative efforts because of the large amounts of carbon dioxide, greenhouse gases, and other toxins they emit into the Earth's atmosphere (Lovins, Lovins, & Hawken, 2007). Indeed, a multitude of management scholars propound that corporations must change their current business practices in ways that sustain the planet's natural resources and interconnected ecological systems (Gladwin, Kennelly, & Krause, 1995; Hart, 1995; Porter & Reinhardt, 2007; Shrivastava, 1995; Starik & Rands, 1995). Such cutting edge practices include large-scale collaboration with various constituencies (governments, NGOs, other firms, and other key stakeholders) in identifying ways to preserve planet's biosphere.

Literature Review

NRBV is an extension of the RBV but focuses on identifying strategic resources and capabilities that are sources of both competitive and environmental sustainability. As such, we first describe the RBV, including its assumptions and prescriptions, as well as a summary of empirical tests of the RBV. Then we discuss NRBV, its application to climate change strategies, and the hypothesis tested in the current research.

Resource-Based View of the Firm

According to RBV, resources are the main determinant of firm performance, based on the logic that firms are unique bundles of valuable resources that, over time, become relatively immobile (Barney, 1991). Barney defines resources as “all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable a firm to conceive of and implement strategies that improve its efficiency and effectiveness” (p 101). Barney includes capabilities in the definition of resources; however, single resources (e.g., patents on environmental technologies, corporate reputation) and sets of resources used to perform integrated tasks, labeled capabilities (e.g., environmentally-friendly manufacturing systems and organizational processes), can be sources of SCA (Amit & Schoemaker, 1993; Collis & Montgomery, 1995).

Strategic assets and distinctive competencies are single resources and capabilities, respectively, that are simultaneously valuable, rare, difficult or costly to imitate, and nonsubstitutable (Barney, 1991, 2001; Peteraf, 1993). Strategic assets and distinctive competencies are valuable when they can be leveraged to exploit market opportunities or can thwart competitive threats. Resources & capabilities (R&Cs) that are valuable and rare can be sources of SCA, unless competitors possess them or develop strategically equivalent substitutes (Barney & McEwing, 1996).

Resource and capability based advantages are short-lived if competitors can imitate them at a reasonable cost. Four impediments to competitor imitation are causal ambiguity, social complexity, unique historical conditions, and path dependency (Barney, 1991, 2001; Dierickx & Cool, 1989). Such advantages are causally ambiguous when competitors cannot determine how resources (e.g., environmentally-conscious corporate culture) and/or capabilities (e.g., environmental control systems and processes) create the firm's SCA. Socially complex resources, such as the inter-firm relationships among firm managers, NGOs, and environmentally-

oriented suppliers, are inimitable because they are based on the unique personalities and value systems of parties involved in the inter-firm relationships. Unique historical conditions are contexts (time, location, etc.) that determine the relative importance of a resource or capability. Path dependent resources, such as a strong environmentally-oriented corporate reputation, accumulate through stocks of strategic investments (e.g., contiguous inventions in green technology, eco-branding, philanthropic investments to improve the planet's ecosystems) over time that competitors cannot quickly replicate. Acquiring the rights to path dependent resources (e.g., patented internally-developed cutting-edge green technologies) can be expensive, making it costly for the acquiring firm to reap superior financial returns. Firms develop strategic assets and distinctive competencies by possessing the insight to identify critical environmental resources and capabilities *ex ante* and then limit competition for such resources and capabilities by erecting impediments to imitation (Peteraf, 1993).

Empirical tests of RBV seem to demonstrate that it is a valid theory of SCA. Corporate-level RBV studies indicate that resources impact diversification decisions in ways that improve firm performance (e.g., Farjoun, 1994; Harrison, Hitt, Hoskisson, & Ireland, 2001), that portfolio resource-relatedness positively impacts corporate performance (e.g., Robins & Weirsem, 1995), and that R&Cs influence corporate-level strategic alliance decisions (e.g., Eisenhardt & Schoonhoven, 1996). Business-level RBV studies show that a firm's resources and capabilities influence foreign investment decisions (e.g., Collis, 1991), that resource coordination, learning capabilities, and dynamic capabilities are positively associated with firm performance (e.g., Schroeder, Bates, & Junttila, 2002), that resource management impacts first mover advantages (Henderson & Cockburn, 1994; Zott, 2003), that firms reconfigure and upgrade their resources and capabilities over time as firms interact with their competitive environments (e.g., Sharma & Vredenburg, 1998), that industry-specific competencies serve as isolating mechanisms in sustaining a firm's competitive advantage (e.g., Brush & Artz, 1999), that environmental contexts impact the competitive value of a resource (e.g., Miller & Shamsie, 1996), that firm characteristics are better predictors of firm performance than industry characteristics (e.g., Barney & Arkan, 2001), that constructive work relationships and social capital positively impact firm competitiveness (Hitt, Bierman, Shimizu, & Kochhar, 2001), and that information technology and related competencies positively impact firm performance (Zhu & Kraemer, 2002; Zhu, 2004). In short, these and other empirical RBV studies seem to support RBV's main prescription and underlying assumptions.

Natural Resource-Based View of the Firm

As the earth's natural capital diminishes and the earth's ecosystems change in ways that negatively affect society, firms need to examine the natural resources they use and how they use them for their own continued viability. Otherwise, valuable and unique environmental resources and ecological services, most lacking strategically equivalent substitutes, will become scarcer. As firms recognize the constraints imposed by the natural environment, environmental sustainability will become an important part of the strategic management process in sustaining their resource-based advantage(s).

NRBV builds on RBV logic in describing how firms gain a SCA in ways that sustain the earth's natural resources and ecosystems, from which these natural resources are so delicately intertwined. Hart (1995) proposed three interconnected NRBV strategic capabilities that firms can develop to achieve that objective: pollution prevention, product stewardship, and sustainable development. Unfortunately, limited empirical research on NRBV has been occasioned and, to our knowledge, no NRBV-based studies have been conducted that assess whether firm's proactively pursuing climate change strategies outperform firms that are less proactive.

While not directly testing NRBV, some studies have examined the association between corporate environmental initiatives and organizational performance. Orlitzky, Schmidt, and Rynes (2003) performed a meta-analysis of 52 studies linking corporate social responsibility and environmental responsibility with organizational outcomes. Unfortunately, the findings were mixed, with some studies showing significant positive associations and others showing either significant negative associations or no significant associations. Russo and Fouts (1997) discovered that a positive environmental-financial performance relationship was strengthened by industry growth; however, the change in explained performance variance was minimal. Al-Tuwaijri, Christensen, and Hughes (2004) found that firms with smaller levels of toxic emissions and effluents from manufacturing facilities were more likely to have higher levels of economic performance. Similarly, Kassinis and Vafeas (2006) analyzed the association between toxic discharge at manufacturing plants and community stakeholder pressure. They concluded that cleaner manufacturing facilities were more likely to be found in communities with greater financial and political power, which could be an indication that 'creating a shared vision' of a more sustainable future is possible but it should not be limited to only the wealthier sections of society. In short, these studies provide some evi-

dence that a positive association between corporate environmental initiatives and organizational performance may exist.

Empirical research explicitly based on the NRBV has yielded similar results. Based on case studies of three oil companies, Hastings (1999) concluded that increasing social pressures caused all three firms to modify their operations to be more environmentally oriented and that those changes may have created a competitive advantage over competing firms that did not embrace such environmental initiatives. Chan's (2005) NRBV-based empirical examination of foreign enterprises in China that manufacture clothing and electronics suggests that such enterprises can increase their financial performance through proactive environmental strategies. Similarly, Menguc and Ozanne (2003) found that Australian manufacturing firms that demonstrated a simultaneous commitment to entrepreneurship, corporate social responsibility, and the natural environment experienced higher levels of after-tax profit and market share; however, sales growth was negatively correlated.

Overall, the empirical evidence seems to indicate that a positive association exists between environmental performance and firm performance with some exceptions. Unfortunately, these studies do not specifically address the linkage between proactive climate change strategies and firm performance. As such, the current research empirically tested the hypothesis that firms with proactive climate change strategies will have higher levels of accounting performance than comparable firms with less proactive climate change strategies. This hypothesis is theoretically grounded in the NRBV, the topic of the next section.

Theoretical Development and Hypothesis

The three interconnected strategies (pollution prevention, product stewardship, and sustainable development) that Hart (1995) proposed in his NRBV framework can be applied to different types of environmental issues, including climate change. The requisite strategic capabilities and resources will vary depending on the environmental initiative inherent in a particular strategy. Table 1 adapted Hart's (1995) framework in identifying the requisite strategic capabilities and resources needed for firms to proactively pursue climate change initiatives that can simultaneously achieve business and environmental sustainability. The following subsections detail the NRBV Climate Change Framework.

Table 1
NRBV Framework for Proactive Climate Change Organizations

Proactive Climate Change Initiatives	NRBV Strategic Capabilities	Key Resources	Basis for SCA	KLD Selection Criteria*
Reduce Carbon Emissions & Other Greenhouse Gases	Pollution Prevention	Continuous Improvement	Lower Costs	• Clean Technology & Efficiency
Renewable Energy Sources & Stakeholder Participation	Product Stewardship	Stakeholder Integration	Preempt Competitors	• Renewable Energy
Solutions-based Coalitions	Sustainable Development	Shared Vision	Future Position	• Future Fuels • Climate Leader

Adapted from Hart (1995).

*From the KLD Global Climate Change 100 Index Methodology.

Pollution Prevention Strategic Capabilities

Pollution prevention strategic capabilities help firms become more operationally efficient using modified TQM principles to minimize emissions, effluents, and waste through existing pollution control equipment, material substitution, recycling, incremental process innovations, developing and deploying climate-friendly production technology, reducing compliance and liability costs, and redesigning value-chain activities to reduce pollution (Hart, 1995; Kolk & Pinske, 2004, 2005, 2007a, 2007b; Porter & Reinhardt, 2007). Low-cost advantages accrued from strategies based on pollution prevention strategic capabilities can be sustainable for several reasons. First, the firm's value chain can be reconfigured in unique, valuable ways beyond the requirements of ISO 14001 certification standards in effectuating activities within and across functions to further reduce waste, emissions of greenhouse gases, and other toxins (Orsata, 2006). That, coupled with the complex vertical linkages with environmentally-conscious suppliers, customers and strategic alliance partners, would make this complex, biospheric-oriented value chain configuration difficult, if not impossible, for competitors to imitate (Porter & Reinhardt, 2007). Second, internally developed low-emissions-based production equipment and systems are patentable, helping to protect them from imitation by competitors. Third, learning curve advantages accrued through climate-based value chain reconfigurations, through the development of environmentally-based production systems and processes, and through other climate-change initiatives cumulate in path dependent

ways over time under unique historical conditions, making it difficult and/or costly for new entrants to easily or quickly replicate. Fourth, being proactive in lessening the inefficient use of natural resources and in reducing or eliminating harmful emissions into the Earth's biosphere will help the firm avoid fines, liability costs, and other penalties levied by environmental regulatory bodies. Last, an environmentally-based, cost-conscious corporate culture coupled with incentive systems that reward innovative environmental efficiencies promote continuous climate change efforts throughout the organization, helping to sustain the firm's environmentally-oriented cost-based advantage over competitors.

Product Stewardship Strategic Capabilities

Product stewardship strategic capabilities help the firm gain a SCA in ways that preserve the biosphere by soliciting the participation of firm stakeholders in developing "green" products (Hart, 1995). In addition to seeking input on product specifications, firms gather information from stakeholders that can be used in developing systems, processes, procedures, and controls in producing "green" products and environmental innovations that reduce or eliminate emissions of carbon dioxide and other greenhouse gases (Kolk & Pinske 2004, 2005; Orsata, 2006). Firms employ a variety of analytic methods, such as Life Cycle Analysis and greenhouse emission tracking tools, to determine their carbon footprint as a starting point in identifying ways to reduce the amount of nonrenewable resources incorporated in their products, to utilize resources less detrimental to the atmosphere, to replenish the environment with renewable natural resources that lessen existing damage to the biosphere, to eliminate the use of toxic materials, and to recycle or reuse product parts at the end of the product's natural life, so that the firm can systematically track and manage its carbon emissions (Esty, 2007; Slater, 2007).

Because markets for climate-friendly products are still in their infancy, a firm can gain a competitive advantages in the following ways: (1) by being the first to enter viable "green" product market segments, (2) by designing green products that meet the specifications of environmentally-conscious customers, (3) by involving customers and other constituencies in designing "green" products and the requisite systems and production processes to minimize the impact on the biosphere (Aragon-Correa & Sharma, 2003), (4) by differentiating the firm's products as being climate-friendly through eco-branding based strategic marketing efforts (Esty, 2007; Hart, 1995; Orsata, 2006), (5) by gaining exclusive access to requisite climate-friendly supplies and working with suppliers to be climate conscious in designing and

producing critical supplies (Correa, 2007), (6) by becoming the standard “green” product for climate-conscious customers, (7) by minimizing the price premiums in producing products through learning-curve effects, through reconfiguring key value-chain activities, and through rigorous Life Cycle Analysis (Porter & Reinhardt, 2007), (8) by developing a reputation for being proactive in climate change initiatives through the participation of environmentally-conscious stakeholders (e.g., customers, government regulators, environmentalists) in designing and producing climate-friendly products (Kolk & Pinske, 2004, 2005; Murray & Montanari, 1986), (9) by developing alternative power sources (e.g., wind, solar, hydrogen cells) and developing technologies that increase the efficiency of fossil fuels, and (10) by continuously scanning the environment for potential changes in the demands of environmental constituents, so that firm can make the requisite changes *ex ante* (Schwart, 2007). Indeed, with the growing awareness of customers, industry analysts, fund managers, environmental NGOs, government agencies, and other regulator bodies about the impact of climate change on our planet and whether companies are being proactive in developing climate-friendly products and services, senior managers are becoming highly conscious of the impact on corporate reputation and resultant firm profitability of producing products that meet or exceed the environmental concerns of such constituencies (Esty, 2007; Roosevelt & Llewellyn, 2007). Moreover, savvy stakeholders are more capable of determining the validity of environmental claims, which can negatively impact the corporate reputation of firms engaging in greenwashing (Schendler, 2007).

Product stewardship strategic capabilities can be difficult for competitors to replicate, and thus be a source of SCA, because: (1) “green” market opportunities can occur in unique times and contexts, (2) the unique personalities of the multiple constituencies involved in developing the climate-friendly products are socially complex (Barney, 1991), (3) the firm can shape environmental product standards through its proactive involvement with various government agencies (Hoffman, 2007), (4) the firm can patent new climate-friendly products and the production methods used to bring them to fruition, (5) the link between the firm’s performance and its unique climate-friendly value-chain is causally ambiguous to competitors, as highly innovative firm managers, employees, and various stakeholders work collaboratively to identify new ways to reengineer the firm’s value chain activities in an effort to further reduce its carbon footprint (Porter & Reinhardt, 2007), (6) the dynamic capabilities underlying the development of new climate-friendly products accrue over time, and thus can not be easily imitated by competitors, and (7) a corporate reputation for being environmentally responsible

to the planet's biosphere develops over long periods of time, and thus cannot be quickly replicated.

Sustainable Development Strategic Capabilities

Sustainable development strategic capabilities constitute the highest level of environmental responsibility, where the firm's overall strategy is driven by a "strong sense of social-environmental purpose," (Hart, 1995: 1002) calling for other firms (even competitors), governments (international, national, state, and local levels), environmentalists, academics, and others to work toward solving our global climate change problems. Because such firms recognize the magnitude of the problems in the biosphere and their own internal limitations, they proactively organize research and technology consortiums to draw on the collective resources, skills, knowledge, and insights among multiple participants in deriving broad-based climate change solutions (Kolk & Pinske, 2007b). Firms that harness these potent strategic capabilities are highly proactive (1) in assisting countries where they operate in addressing environmental problems associated with greenhouse gas emissions, (2) in working with government officials toward stricter policies on air standards, and (3) in providing support to regions impacted by natural disasters (Kolk & Pinske, 2004, 2005; Kolk & Pinske, 2007a; Schwart, 2007). In essence, these multinational leaders take a long-term view about the future state of the planet in which they operate and the role they play in promoting societal well-being.

Internally, CEOs committed to sustainable development based strategies instill a shared sense of environmental responsibility among employees through oral and written communication, employee training programs, and posting mission statements throughout the company articulating the firm's environmental commitment (Way & Rendlen, 2007; Waddock, 2006). The top management team crafts an organizational culture and administrative context that promotes employee innovation and participation in identifying ways to restructure the firm and the industry to more effectively address climate change issues and, in the process, potentially change the competitive rules of the game (Porter & Reinhardt, 2007).

The intensive internal and collaborative effort to produce environmentally-friendly products encompasses the philosophies underlying both pollution prevention and product stewardship strategies. As such, the drivers of SCA associated with pollution prevention strategies and product stewardship strategies are embedded in sustainable development strategies (Hart, 1995). Moreover, the strategic capabilities underlying a sustainable development strategy strengthens a firm's strategic compet-

itiveness in four additional ways. First, as the firm becomes recognized as a leader in working to solve the planet's climate change problems, its reputation may help the firm attract and retain highly talented employees that share similar values and convictions about corporate environmental responsibility (Murray & Montanari, 1986; Waddock, 2006). Second, the leading-edge competencies and insights on business and environmental sustainability gained from working collaboratively with multiple constituencies is a socially-complex and partly tacit in nature, making it difficult for competitors to easily replicate (Reed & DeFillippi, 1990). Third, the relationships developed in these collaborative efforts may give the firm exclusive access to critical suppliers of finite natural resources, provide access to countries that allow few if any foreign competitors, help the firm increase its market share of "green" customers, and allow the firm to gain the political acumen needed to be at the forefront in crafting new environmental legislation (Hoffman, 2007; Porter & Van der Linde, 1995). Because relationships develop over time and are based on the unique personalities of the constituencies involved, these relationship-based advantages would be difficult to replicate, lack strategically equivalent substitutes (Barney, 1991), and thus be a source of SCA. Last, the learning curve effects of internally-developed "green" technologies; the collaborate knowledge among consortium (and other partnership) members over time; a keen understanding of the language and issues associated with cap-and-trade programs, renewable energy credits, carbon-based emissions permits, renewable energy credits, verified emissions reductions, certified emissions reductions, emissions reduction units, European Union allowances, the myriad of climate-related bills, and the various national and international climate-related treaties and laws that can impact a multinational enterprise are complex and path dependent in nature, based on unique historical conditions across continents, and causally ambiguous to organizations seeking to replicate the leader's sustainable development strategy and resultant competitive strength (Hoffman, 2007).

In sum, given that pollution prevention strategic capabilities, product stewardship strategic capabilities, and sustainable development strategic capabilities can be combined in whole or in part to create firm-level climate change strategies capable of capturing a competitive advantage, firms that are more proactive in implementing climate change strategies should outperform firms that are less proactive, as articulated in Hypothesis 1.

Hypothesis 1: Firms with proactive climate change strategies will have higher levels of accounting performance than comparable firms with less proactive climate change strategies.

Methodology

The sample in the current research came from the KLD Global Climate Change 100 Index, consisting of 100 global publicly-traded firms well recognized for being proactive in pursuing climate change strategies. The index includes firms from 14 different countries, most of which are headquartered in North America, Western Europe, or Japan, and classified into nearly a dozen industries. Since the index was created in July 2005, 16 of the original companies have been removed, thus leaving 84 firms for analysis.

Based on their industry experience and information they gathered from company web-sites, regulatory filings, trade associations, professional journals, non-governmental organizations, corporate officers, and from various experts, KLD analysts identify companies engaged in one of three themes: (1) developing, generating, and consuming renewable energy, such as wind and solar energy (2) firms whose policies or products reduce the demand for fossil fuels through efficiency improvements, and (3) firms that are proactive leaders in 'future fuels,' such as hydrogen fuel cells, biofuels, and natural gas production and distribution. As shown in Table 1, these three themes are consistent with the three climate change strategies described in the previous section.

Since the purpose of the current research was to determine if firms with recognized proactive climate change strategies had higher levels of accounting performance than comparable firms with less recognized proactive climate change strategies, we used the pairwise-comparison method to determine if the accounting-based returns of the proactive firms were significantly greater than those of the less proactive firms. This technique has been performed in other studies of firms that differed in terms of other key environmental strategies (i.e., Bansal & Hunter, 2003). Accounting performance data on the KLD firms and their matched pairs were taken from the 2005 & 2006 "Forbes 2000 Index" ("2000" refers to the number of firms in the index, not the year of the data) so that we could evaluate differences in performance between the pairs across a two-year period. Forbes Index also provided various firm data (such as assets, sales, profits, and market value, as well as their country of origin and main industry in which the firm competes) that proved useful in the pairing process.

We attempted to pair the remaining 84 firms from the 2005 KLD Global Climate Change 100 Index (GC100) with firms that were similar based on their country of origin, industry, and size (based on reported assets for 2005). The first step was to eliminate KLD sample firms that did not appear on both the 2005 and

2006 Forbes Index, the source from which the comparison firms would be selected. This resulted in the number of sample firms being reduced from 84 to 45 firms. We then compared the remaining 45 KLD sample firms with firms on the Forbes Index to find comparable firms based on country of origin, industry, and size. We could not identify comparable firms (headquartered in the same country, operating in the same industry, and of similar size) for 14 of the 45 KLD firms, thus reducing the number of pairwise comparisons to 31. Statistical and graphical analysis of the 31 pairs identified one outlier, resulting in 30 pairwise comparisons to test the hypothesis. Of the remaining 30 pairs, the mean size (in terms of 2005 assets) of the proactive climate change strategy firms is \$32.2 billion and the matched pairs mean is \$30.3 billion. Inferential testing using SPSS showed there was no statistically-significant difference in the size of KLD firms versus their matched pairs. In fact, the paired samples correlation (in terms of 2005 assets) between the KLD firms and their matched pairs is .98, which is significant at $p < .001$. Hence, the experimental design was effective in matching the firms in terms of their country of origin, industry, and size.

To test whether firms with greater emphasis on climate change would have higher levels of accounting performance than comparable firms with less emphasis on climate change, we tested the difference in accounting performance across the 30 pairs of firms using three performance metrics: Return on assets (ROA), return on sales (ROS), and total asset turnover (TAT = Total Revenue/Total Assets). ROA and ROS are common measures of accounting-based profitability while TAT measures the efficiency of asset utilization (Pugh, Jahera, & Oswald, 2005). We measured ROA, ROS, and TAT using a two-year average (2005-2006) based on the Forbes Index data.

Results

The descriptive statistics and correlations appear in Table 2. Notice that the mean ROA, ROS, and TAT of the KLD firms are greater than those of the paired comparison firms. Specifically, the proactive climate change firms earned an ROA 93% greater than their matched pairs (5.8% vs. 3.0%), an ROS 59% greater than their matched pairs (8.6% vs. 5.4%), and a TAT 18% greater than their matched pairs (72.4% vs. 61.6%), thus providing preliminary evidence supporting our hypothesis. Some of the performance variables are correlated; however, this does not violate the assumptions underlying the pairwise comparison method (Hair, Anderson, Tatham, & Black, 1995).

Table 2
Correlations and Descriptive Statistics

Variable	Mean	S.D.	1	2	3	4	5
1 KLD ROA	.058	.042					
2 MP ROA	.030	.031	.44**				
3 KLD ROS	.086	.058	.71**	.25†			
4 MP ROS	.054	.052	.26†	.80**	.13		
5 KLD TAT	.724	.344	.37*	.12	-.23	-.05	
6 MP TAT	.616	.311	.26†	.18	-.07	-.28†	.65**

MP = Matched Pairs (for pairwise comparisons)

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$

Table 3 summarizes the pairwise comparisons between the KLD firms and their matched counterparts. As shown, the mean difference in accounting performance (KLD performance – Matched Pairs) is statistically significant across all three paired sample tests. Specifically, the mean ROA for the KLD firms exceeds the mean ROA for their matched pairs by 0.028, which is significant at $p < 0.001$; the mean ROS for the KLD firms exceeds the mean ROS for their matched pairs by 0.032, which is significant at $p < 0.05$; and the mean TAT for the KLD firms exceeds the mean TAT for their matched pairs by 0.108, which is significant at $p < 0.05$. These results support Hypothesis 1.

Discussion and Conclusions

The empirical results support the hypothesis that firms with greater emphasis on climate change have higher financial returns than comparable firms with less emphasis on climate change. Specifically, the KLD firms outperformed their matched counterparts across all three performance metrics, which included measures of both firm efficiency and firm effectiveness. This has important implications for theorists, empiricists, and practitioners.

For theorists, Hart's (1995) seminal work informs us that firms with pollution prevention strategic capabilities attempt to gain a cost-based SCA by continuous efforts to control and prevent carbon emissions and other GHGs (greenhouse gases) using improved technologies and reconfiguring value chain activities to reduce direct and indirect GHG emissions. Firms with product stewardship strategic capabilities seek to gain first mover advantages in the use of renewable energy sources and by working closely with customers, suppliers, and other stakeholders

Table 3
Pairwise Comparisons

Paired Samples Tests

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pairing: KLD ROA - MP ROA	.0277033	.0398106	.0072684	.0128378	.0425689	3.811	29	.001

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pairing: KLD ROS - MP ROS	.0315333	.0727040	.0132739	.0043852	.0586815	2.376	29	.024

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pairing: KLD TAT - MP TAT	.1077833	.2749002	.0501897	.0051339	.2104327	2.148	29	.040

MP = Matched Pairs (for paired comparisons)

in the vertical value chain in developing products sought after by climate conscious customers. Pollution prevention strategies and product stewardship strategies are consistent with contemporary thinking that understanding and measuring the firm's carbon exposure, taking steps to reduce the firm's carbon footprint, and identifying opportunities to leverage the firm's climate-friendly products is essential in being competitive in an increasingly environmentally-conscious society (Esty & Winston, 2009; Hoffman & Woody, 2008).

Sustainable development-oriented firms possess pollution prevention strategic capabilities and product stewardship strategic capabilities but go further in their climate change efforts by working with other climate change leaders, government officials, legislative bodies, research consortiums, and other constituencies in solving the problems caused by climate change. Climate change leaders can reap competitive advantages (1) by attracting highly talented employees that share similar convictions about the environmental (Murray & Montanari, 1986; Waddock, 2006), (2) by developing unique socially-complex competencies on business and environmental sustainability through collaborative work with high-level constituencies, (3) by providing them access to finite natural resources and to market segments in countries that allow few if any foreign competitors, and (4) and by providing the firm with the political acumen needed to be at the forefront in crafting new environmental legislation (Hoffman, 2007; Porter & Van der Linde, 1995). This is also consistent with contemporary thinking that visionary leaders who have become highly recognized for their concern with the impact of climate change on the planet take steps to influence the policy-development process on climate change issues (Esty & Winston, 2009; Hoffman & Woody, 2008; Lovins, et al., 2007). Ultimately, sustainable development oriented firms want to be part of the policy-development process for climate change so that they know what climate change issues are being addressed and what political venues (e.g., international, national, state levels) will provide the greatest impact (Hoffman & Woody, 2008; Porter & Kramer, 2006). Clearly, setting the rules rather than having the rules set for you will (1) help to assure that your vision of requisite climate change goals and objectives become part of government policy and (2) provide you (and thus the firm) with first mover advantages from the ex ante knowledge from participation in the policy setting process.

For empiricists, NRBV is still in its developmental stages of empirical testing, and thus one contribution of this study is that it adds further support to the validity of NRBV. Moreover, to our knowledge, there are no published NRBV-based studies that empirically examine whether firms with proactive climate change strategies have higher levels of financial (and/or accounting) performance than com-

parable firms with less proactive climate change strategies. And finally, this study contributes to the literature by testing the hypothesis using 30 pairs of firms from seven countries on three separate continents spanning 12 industries. In other words, the results were statistically significant across all three performance metrics using a global, multi-industry paired sample of comparable firms. However, because of the limitations discussed in the next section, readers should interpret these results with some degree of caution.

Firm executives seem to be recognizing the important linkage between environmental sustainability and business sustainability by their climate change initiatives. For example, from a pollution prevention standpoint, Caterpillar has been using Six Sigma teams to improve heating and lighting efficiencies throughout its global operations to reduce its carbon intensity 36 percent per dollar of revenue in 2006 and 38 percent reduction in 2007, and now plans to reduce its absolute GHG emissions by 3 percent by 2015 (ClimateBiz, October 10, 2008). Walmart is reconfiguring its value chain activities in transportation and logistics and leveraging new technologies to reap cost efficiencies that reduce its GHG emissions in ways that are difficult for competitors to replicate (Porter & Reinhardt, 2007). Masisa, a forestry and wood-manufacturing company in Chile, has taken important steps to reduce carbon emissions and other greenhouse gases by planting rapid-growth trees that capture GHG from the atmosphere, by burning biomass (saw dust and wood chips) to generate much of its energy, using combustion gases from boilers and thermal plants as fuel, and reducing the distance between equipment and work areas to reduce fuel costs (Correa, 2007).

Companies with product stewardship strategic capabilities, such as Monsanto, recognized that shrinking amounts of land to grow crops for food and for alternative fuel in the face of population growth called for creative biotechnology. As such, Monsanto worked with its B2B stakeholders in developing genetically modified plant seeds of four crops (corn, soybeans, cotton, and canola) that contain genes that kill insects and tolerate weed-killing pesticides. Farmers pay a premium for Monsanto's seeds (versus traditional seeds) but can save twice that amount by reduced spending on chemical insecticides and herbicides and by growing substantially more crops, some of which are used to produce biodiesel fuel. As a result, Monsanto's net income has increased almost 44% from 2002 to 2007 (Hindo, 2007). Successful product stewardship oriented companies, such as Tesco, also understand the importance of demonstrating their ability to measure their carbon footprint, sharing such information with the stakeholders and the public at-large (via voluntary emissions reporting), and soliciting stakeholder input on requisite changes needed to preserve

and enhance their climate-friendly reputation and brand image in keeping and attracting customers (Hoffman & Woody, 2008; Esty, 2007). And finally, companies like Starbucks, FedEx, Kinko's, and Johnson & Johnson buy 5 to 10 percent of their energy from renewable energy sources as part of their efforts to reduce GHG emissions and become less dependent on energy from fossil fuels (Esty & Winston, 2009). In short, firms that develop product stewardship strategic capabilities engage stakeholders to find creative ways to produce desired products and services in ways that lessen GHG emissions, including the use of renewable energy resources.

Sustainable development oriented firms' overall strategy is driven by a strong sense of environmental purpose to work with other firms (even competitors), governments, environmentalists, academics, and others in solving our climate change problems (Hart, 1995). For example, Intel was one of the first companies to take the EPA's challenge to be part of its Project XL, asking Intel to be a leader in pollution prevention above and beyond legal requirements (Esty & Winston, 2009). Working closely with the EPA and other high-level constituencies, Intel developed stringent objectives and metrics to measure such objectives, which were reviewed regularly by the EPA. Intel's leadership won them state permits and quick environmental reviews needed for their expansion efforts. Some of the largest companies in the U.S. including Alcoa, Caterpillar, Duke Energy, DuPont, Dow, GE, PG&E, and Xerox formed a coalition called the U.S. Climate Action Partnership that went to Washington D.C. in 2007 to push for a federal cap on carbon emissions, showing that business leaders across various industries see the urgency of addressing the issues impacting climate change and are taking an active role in influencing government policy (Esty & Winston, 2009).

Limitations and avenues for future research

This study used a tight systematic methodology in pairing firms based on criteria such as country of origin, industry, and size, so that our analysis was based on highly comparable firms to enhance the validity of our empirical findings. Unfortunately, this limited our analysis to 30 pairwise comparisons. Other studies can follow similar methods using larger samples of paired firms to strengthen the generalizability of the results. Moreover, analyzing larger datasets using various multivariate techniques can produce more robust results than those produced by pairwise-comparisons. For instance, time-series analysis may prove useful in determining the linkage between the time it takes to implement proactive climate change strategies and resultant firm profitability.

KLD's methodology has won various awards, which enhances the validity of the data used in this study. Moreover, KLD's climate-based measurements match-up fairly well with the NRBV Framework of pollution prevention strategic capabilities (climate based efficiencies, climate-based efficient technologies), product stewardship strategic capabilities (use of renewable energy sources), and sustainable development strategic capabilities (identification of climate leaders and use of future fuels) developed in this manuscript. However, KDL does not identify which strategic capability (or capabilities) the firm is utilizing in its proactive climate change strategy in achieving superior profitability. Future research may attempt to flesh out performance impacts from pursuing different climate strategies. This will prove challenging as the strategies are interlinked such that sustainable development based firms theoretically possess pollution prevention strategic capabilities and product stewardship strategic capabilities as well. In that vein, other datasets using different statistical techniques may prove more effective in such empirical endeavors.

Finally, although the matched pairs were not on the KLD GC100 index, it does not necessarily mean that these firms are not pursuing any type of climate change strategy. Thus, we cannot measure the distance between the climate change emphasis between the KLD firms and their matched pairs. Thus, for purposes of this study, we made the assumption that firms selected for inclusion on the KLD GC100 Index were more proactive in their climate change initiatives than their paired counterparts that were not selected for inclusion on the KLD GC100 Index. Future research can explore other measures that tap into the exact distance in climate change initiatives between firms in testing NRBV. In conclusion, a plethora of opportunities for testing NRBV from a climate change perspective abound (beyond the ones noted above), including the impact of computer technologies and building designs (e.g., geothermal heating, solar panels, structural architecture) on the firm's environmental capabilities and resulting performance. What is clear is that many firms are expending a great deal of time, energy, and resources creating and implementing strategies to address global climate change, and this preliminary study will hopefully generate additional interest in an important topic facing all of society.

End Note

1. KLD has been recognized by third-party organizations for its social and environmental investment expertise. (www.tbli.org)

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