Climate change mitigation and internationalization: The competitiveness of multinational corporations

Author:

Subrata Chakrabarty; Liang(Lucas) Wang;

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Climate Change Mitigation and Internationalization: The Competitiveness of Multinational Corporations

By
Subrata Chakrabarty
Liang Wang

In recent years, the debate about climate change and the competitiveness of multinational corporations (MNCs) has increased. Decision makers in MNCs often face ambiguities on how their business competitiveness could be impacted by their actions to mitigate climate change. By combining knowledge from the field of climatology with the management literature, this study suggests that climate change mitigation can enhance an MNC's competitiveness. We test the hypotheses using longitudinal panel data on US MNCs from 2001 to 2009. We find that MNCs that implement climate change mitigation are likely to see significant increase in sales effectiveness and product leadership but no significant increase in return on equity. Further, the positive influence of mitigation on sales effectiveness and product leadership is found to be more strongly positive when the MNC's internationalization

Correspondence to: Subrata Chakrabarty, University of Nebraska—Lincoln, Department of Management, College of Business Administration, Lincoln, NE 68588-0491, +1-402-472-3915 (phone), chakrabarty@gmail.com.

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is high. Hence, mitigation efforts positively impact at least two dimensions of competitiveness—sales effectiveness and product leadership, particularly when internationalization is high.

Introduction

Climate change has become a concern globally. The observable effects of climate change include various abnormalities such as extreme weather events, shrinking glaciers, vanishing arctic ice, rising sea levels, droughts and famine, and extinction of species, among others (J. Bare, 2011; J. C. Bare & Gloria, 2008). Many see it as a wakeup call—an opportunity to correct our ways and become more responsible toward our planet. The challenges of climate change have imposed immense pressure on decision makers in both governments and corporations. Nongovernmental organizations (NGOs), social activists, and various advocacy groups are exhorting decision makers in governments and corporations to recognize the dangers of climate change. Institutional regulations and laws related to the impact of business operations on the natural environment are becoming more stringent.

Multinational corporations (MNCs) often bear the brunt of these social and regulatory pressures because of their deep embeddedness and widespread presence in the global economy. However, managers at MNCs are often unconvinced about the feasibility of attempts to mitigate the destructive effects that their business operations have on our planet's climate (M. E. Porter & Kramer, 2011). Some managers seem convinced that "the combination of environmentally and competitively sound improvements is very difficult to implement" (Klassen & Whybark, 1999, p. 599) and that "the more environment friendly they become, the more the effort will erode their competitiveness" (Nidumolu, Prahalad, & Rangaswami, 2009, p. 57).

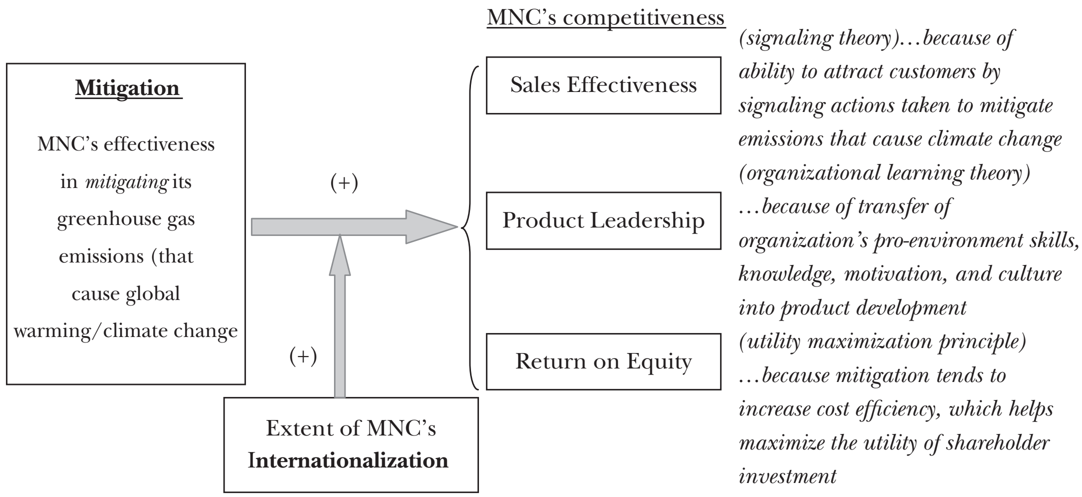
Institutional regulations and laws related to the impact of business operations on the natural environment are becoming more stringent.

We argue that MNCs can achieve convergence between two strategic goals: (1) mitigating their impact on the climate and (2) enhancing competitiveness. Climate change mitigation refers to the actions undertaken for the reduction of emissions of greenhouse gases (GHGs) and for the enhancement of sinks that absorb GHGs (Intergovernmental Panel on Climate Change [IPCC], 1990). Six types of GHGs are currently monitored under the Kyoto Protocol, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Among those GHGs, carbon dioxide (CO_2) is normally conceived as the major contributor to the abnormal levels of climate change in recent decades (World Business Council for Sustainable Development [WBCSD] & World Resources Institute [WRI], 2004). Mitigation refers to the reduction of the GHG emissions at the source (Hart, 1997), thereby lowering their impact on our planet's climate. Mitigation represents an undertaking to alleviate anthropogenic interference in the natural climate system of planet earth (Solomon et al., 2007).

This article makes three importance contributions to the literature. First, the study deepens the understanding of a specific type of environmental problem (i.e., climate change) that MNC activities might be associated with, thus extending the environmental management literature. Second, we theorize and empirically test three primary mechanisms through which the competitiveness can be harvested from mitigation: market signaling, organizational learning, and cost efficiency. Third, we argue that the level of internationalization constitutes an important contextual factor. It amplifies the influence of mitigation on the three competitiveness dimensions. Overall, this paper provides theoretical implications for several research domains: environmental management, strategic management, and international business.

The theoretical framework of this study is illustrated in Figure 1. MNC competitiveness is a multidimensional concept that includes sales effectiveness, product leadership, and return on equity (ROE). The selection of these multiple dimensions is informed by prior literature.

FIGURE 1 Theoretical Framework



Strategy literature has long argued that corporations must improve their performance on multiple dimensions if they want to survive and prosper (Kaplan & Norton, 1992). Similarly, organizational theory suggests that corporations seek to achieve multiple goals, among which sales effectiveness, product leadership, and shareholder returns hold prominent positions (Cyert & March, 1963). The three competitiveness dimensions, therefore, are chosen to indicate MNCs' competitiveness in a more comprehensive manner.

The argument concerning the influence of climate change mitigation on sales effectiveness is based on signaling theory—the insight that mitigation efforts by MNCs are positive signals that appeal to consumers (McWilliams & Siegel, 2000). The argument concerning the influence of climate change mitigation on product leadership is based on organizational learning theory—through a cross-functional learning process, climate change mitigation will lead to comprehensive improvements of products so that corporations can gain product leadership over their competitors (Cohen & Levinthal, 1990; Grant, 1996a). The argument concerning the influence of climate change mitigation on ROE is based on the utility maximization principle—the cost efficiencies induced by pro-environmental initiatives would help maximize the utility of shareholder investment (King & Lenox, 2001). Beyond the direct influence of climate change mitigation on MNC competitiveness, the level of MNCs' internationalization can be an important contextual factor. In particular, the associations between mitigation and the three competitiveness dimensions are argued to be more positive when an MNC's internationalization is high. Fundamentally, the present study sheds light on whether and how firms can enhance their competitiveness through climate change mitigation.

Theory and Hypotheses

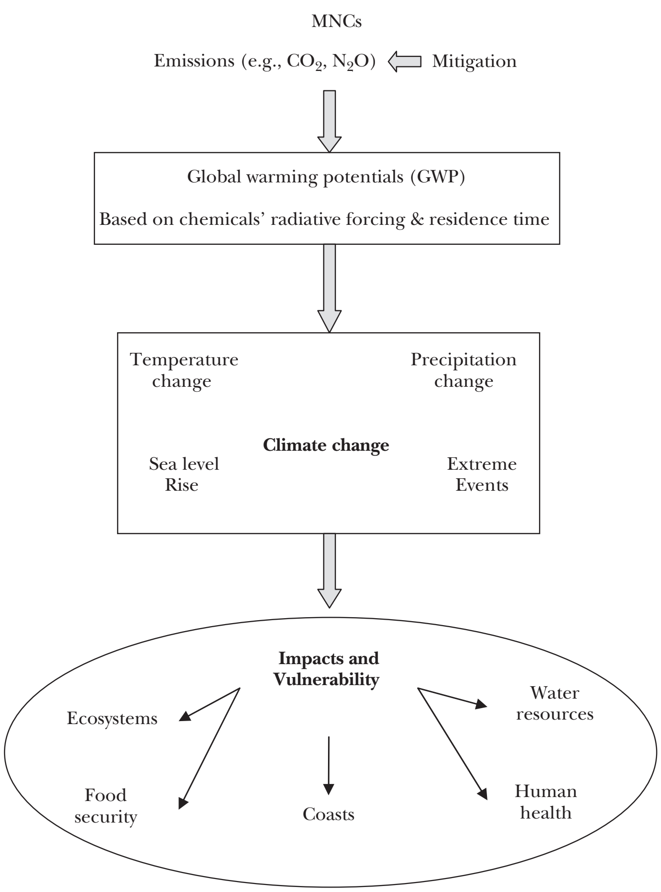
Global Climate Change

Before theorizing on the relationship between climate change mitigation and MNC competitiveness, we provide information on the key phenomenon—global climate change and its impact on the natural and human systems. Global climate change refers to "the potential change in the earth's climate caused by the buildup of chemicals (i.e., GHGs) that trap heat from the reflected sunlight, which would have otherwise passed out of the earth's atmosphere" (J. Bare, Norris, Pennington, & McKone, 2003, p. 56). Figure 2 depicts the chain of potential effects of this phenomenon (Bare et al., 2003).

The principal GHGs that result from human activities are CO_2, CH_4, N_2O, and fluorinated gases. Table 1 contains information with respect to the emission sources of these gases. After the GHGs are emitted into the atmosphere, the projected marginal damage (i.e., global warming potential [GWP]) of these gases is a function of the chemical's radiative forcing (i.e., potency of electromagnetic radiation) and residence time (the time it remains in the atmosphere) (J. Bare, 2011).

The two mechanisms that play a role in determining the extent of atmospheric concentration of GHGs are sources and sinks. On the one hand, *sources* of GHGs—from human activities and natural systems—contribute to increases in their concentration. Excessive release of GHGs from the sources results in an imbalance or

FIGURE 2 MNCs Emission and the Chain Impacts of Climate Change



destabilization in the optimal concentration of GHGs. On the other hand, *sinks*—like oceans and land vegetation—absorb the emitted GHGs. Sinks, if increased proportionately to the increase in sources, can help restore balance in the atmospheric concentration of GHGs. During the past few centuries, however, the sources have increased significantly, mostly due to the increased combustion of fossil fuels by humans, whereas the sinks have decreased through processes such as deforestation. The report from the Intergovernmental Panel on Climate Change (IPCC, 2001b) shows that since preindustrial times, atmospheric concentrations of CO_2, CH_4, and N_2O have increased by over 30 percent, 145 percent, and 15 percent, respectively. Further, the average global temperature has increased at a rate of 0.13°C per decade between 1956 and 2005, almost twice that for the 100 years from 1906 to 2005 (Pachauri & Reisinger, 2007).

Both natural and human systems are vulnerable to changes in global temperature and precipitation. To date, some of the adverse impacts resulting from climate change have been more evident. Detailed information regarding various impacts is summarized in Table 2. Mounting evidence suggests that the consequences of climate change are so severe that immediate and effective measures need to be undertaken to cut the emissions of GHGs before the damages become irreversible (J. Bare, 2011; J. C. Bare & Gloria, 2008; IPCC, 2001a; Pachauri & Reisinger, 2007).

Both natural and human systems are vulnerable to changes in global temperature and precipitation.

TABLE 1 Principal Greenhouse Gases Due to Human Activities

Greenhouse Gases	Emission Sources
Carbon dioxide (CO_2)	Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.
Methane (CH_4)	Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and from the decay of organic waste in municipal solid waste landfills.
Nitrous oxide (N_2O)	Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
Fluorinated gases	Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as "high global warming potential" gases.

Source: EPA, 2008a, 2008b.

TABLE 2 Adverse Impacts of Climate Change on Natural and Human Systems

Impact on …	Extent of Impact
Water	Excess water availability in moist tropics and high latitudes
	Decreasing water availability and increasing drought in midlatitudes and semiarid low latitudes
	Hundreds of millions of people exposed to increased water stress
Ecosystems	Species at increasing risk of extinction around the globe
	Increased coral bleaching and mortality
	Increasing species range shifts and wildfire risk
	Ecosystem changes due to weakening of the meridional overturning circulation
Food	Complex, localized negative impacts on small holders, subsistence farmers and fishers
	Tendencies for cereal productivity to decrease in low latitudes
	Tendencies for some cereal productivity to increase at mid-to high latitudes
Coasts	Increased damage from floods and storms
	Increased lost in global coastal wetlands
	Millions more people could experience coastal flooding each year
Health	Increasing burden from malnutrition, diarrheal, cardiorespiratory and infectious diseases
	Increased morbidity and mortality from heat waves, floods, and droughts
	Changed distribution of some disease vectors
	Substantial burden on health services

Source: Pachauri & Reisinger, 2007.

In the business domain, MNCs have been accused of being major contributors to various environmental problems as a result of their worldwide operations (Christmann, 2004; Christmann & Taylor, 2001; Strike, Gao, & Bansal, 2006). The reduction and eventual elimination of GHG emissions is becoming a prominent issue for MNCs. As Nidumolu et al. (2009) observed, the quest for social and environmental sustainability has transformed the landscape of global competition. Managers are increasingly reevaluating the impact of their business activities on the climate system and, more importantly, finding ways to mitigate the impact (Bowen, 2011; Reid & Toffel, 2009).

In the middle of such dramatic transformation, it is critical to understand whether and how MNCs can gain competitiveness from the effort to mitigate climate change emissions. In the following section, we extend this line of inquiry by elaborating on the relationship between climate change mitigation and three competitiveness dimensions.

Signaling Theory: Climate Change Mitigation and Sales Effectiveness

Originating from seminal studies in economics (Akerlof, 1970; Spence, 1974; Stiglitz, 2002), signaling theory is concerned with the reduction of information asymmetry between senders and receivers (Spence, 2002). According to signaling theory, firms can gain differentiation advantages if their efforts to please relevant stakeholders are readily perceivable. Based on signaling theory, we argue that sales effectiveness can increase as a result of effective climate change mitigation.

Sales effectiveness is an indicator of the ability to attract customers and is usually a result of effective market signaling, that is, effective advertising, marketing, and sales programs (Boubakri & Cosset, 1998; Guthrie, 2001). Climate change mitigation would be a positive signal to environmentally conscious consumers (Aguilera, Rupp, Williams, & Ganapathi, 2007; Brammer & Pavelin, 2006; McWilliams & Siegel, 2000). When corporations demonstrate a genuine concern for climate change issues via improvements in operations like abating and sequestering GHGs, corporate reputation and market legitimacy will be improved (Brammer & Pavelin, 2006). Consequently, consumers are inclined to prefer products from emission-efficient corporations and therefore reward environment-friendliness. Hence, the positive signals arising from climate change mitigation provide MNCs means to differentiate their products, gain social approval, and thereby increase sales.

Hypothesis 1a: *Climate change mitigation of MNCs positively influences sales effectiveness.*

MNCs with a higher level of internationalization may gain a larger improvement in sales effectiveness due to climate change mitigation. Their relatively high visibility makes signals of being emission efficient more far-reaching and salient, thus drawing appreciation from a wider range of consumers. MNCs attract more attention—both positive and negative—and face stringent scrutiny from stakeholders such as the news media, NGOs, and local government agencies (Chakrabarty & Wang, 2012; Teegen, Doh, & Vachani, 2004). Any success in preventing climate change emissions tends to receive widespread publicity (Aguilera et al., 2007; Reid & Toffel, 2009; Zaheer, 1995). Efforts toward climate change mitigation thus provide a greater improvement in the brand image and reputation of an MNC with a greater level of internationalization. Thus, internationalization would amplify the influence of climate change mitigation on sales effectiveness.

Hypothesis 1b: *The extent of MNC internationalization modifies the influence of climate change mitigation on sales effectiveness, such that the influence is more strongly positive when internationalization is high.*

Organizational Learning Theory: Climate Change Mitigation and Product Leadership

The organizational learning literature suggests that learning is an important intraorganizational dynamic that allows an organization to use and act on information across its various functions and to achieve knowledge integration (Grant, 1996a, 1996b). Cross-functional learning enhances internal information flow, cultivates a shared understanding and consistency in product development, and improves the utilization of organizational resources by consolidating resources and skills from distinct functions (Whitten, Chakrabarty, & Wakefield, 2010; Zaheer, 1995). Given these insights, we postulate that the MNCs that are more effective in climate change mitigation can also develop product leadership—via mechanisms of organizational learning. We define a firm's product leadership as the strengths of the firm's products that make it an industry leader in terms of quality, social, community, and innovation aspects (Hart, 1997; Nidumolu et al., 2009). The organizational learning process in MNCs would transfer the innovative skills, knowledge, and capabilities that were learned from the internal implementation of climate change mitigation into the domain of product development for their external customers (Hart, 1997; Nidumolu et al., 2009; Surroca, Tribó, & Waddock, 2010).

Contrary to the practice of simply installing treatment or disposal devices at the end of the production process, climate change mitigation requires MNCs to invest in new, cleaner technologies, to perform process refinement, and, more importantly, to go through a process of organizational learning (Hart, 1997; Russo & Fouts, 1997). In addition, mitigation tends to enhance an MNC's relational capital (e.g., relationship with local government or NGOs) and reputation (useful to attract more funds and talents), which in turn fuels the MNC's organizational learning process (Surroca et al., 2010). Such superior capabilities and learning from their own mitigation efforts enable MNCs to develop better products for external customers (McWilliams & Siegel, 2000, 2001).

Contrary to the practice of simply installing treatment or disposal devices at the end of the production process, climate change mitigation requires MNCs to invest in new, cleaner technologies, to perform process refinement, and, more importantly, to go through a process of organizational learning.

Furthermore, an internal corporate culture that is sensitive to the emission level of GHGs could engender a holistic perspective in managers and employees such that their attention goes beyond the mere economic paybacks and extends to environmental and social issues as well (Aguilera et al., 2007; Chakrabarty & Whitten, 2011). As environmental and social responsibilities get imprinted on organizational culture, this promotes organizational commitments and learning as well as cross-functional knowledge integration that lends support to sustainable initiatives (Russo & Fouts, 1997; Surroca et al., 2010). Consequently, organizational learning—enabled by the mitigation strategies and promoted by the diffusion of pro-environment culture—promotes the development of leading edge products by emission-efficient MNCs.

Hypothesis 2a: *Climate change mitigation of MNCs positively influences product leadership.*

When internationalization is high, the influence of climate change mitigation on product leadership is likely to be more strongly positive. At least two mechanisms contribute to this moderating effect. First, a higher level of internationalization facilitates MNCs cultivating a greater sensitivity to environmental and social needs (Chakrabarty & Wang, 2012; Christmann, 2004; Strike et al., 2006). MNCs become aware of sustainability issues in foreign markets through exposure to international consumers, technological evolutions, NGOs, and international governmental organizations (IGOs) (Frost & Zhou, 2005; Gupta & Govindarajan, 2000). Some foreign markets enforce stringent environmental and social standards (also known as *green barriers*), which function as thresholds for initial entry and as a requirement for continued business operations (Christmann, 2004; Christmann & Taylor, 2001). As MNCs rely more heavily on foreign markets (i.e., higher internationalization), the necessity to comply with stringent emission regulations and consumer expectations encourages MNCs to learn more from climate change mitigation and effectively apply the knowledge, capabilities, and skills to their products (Strike et al., 2006).

Second, MNCs' subunits and headquarters compose a network that helps distribute superior capabilities and pro-environment values to a wider area. Ghoshal and Bartlett (1990) conceptualized MNCs as an intra-organizational network in which information, technology, and people flow across units. Through the exchanges and interactions among networked units, the pro-environment knowledge and values learned from climate change mitigation can disseminate rapidly across functions and subsidiaries (Chakrabarty & Wang, 2012; Nidumolu et al., 2009). The collaboration among network units leads to the development of knowledge/skill-sharing capabilities and thus serves as a resource for gaining product leadership (Hart, 1997). Hence, internationalization amplifies the influence of climate change mitigation on product leadership.

Hypothesis 2b: *The extent of MNC internationalization modifies the influence of climate change mitigation on product leadership, such that the influence is more strongly positive when internationalization is high.*

Utility Maximization Principle: Climate Change Mitigation and Return on Equity

Investment theory in the finance literature suggests a utility maximization principle, which states that an investment opportunity is attractive when the investment can deliver a positive equity increase (Arditti, 1967; Modigliani & Merton, 1958). The investment meets this criterion when its present value exceeds its cost. Therefore, utility maximization encompasses an evaluation process—on the costs and possible returns of certain investments—and steers investors to select optimal investments.

Corporations seek investments from shareholders in order to run their businesses. The amount by which a corporation is financed through common and preferred shares is known as shareholder equity (corporation's total assets minus debt liabilities). We argue that the cost efficiencies induced by pro-environmental initiatives would help maximize the utility of shareholder investment. Corporations have to incur costs to mitigate climate change—such as for the purchase of new technologies to detect, analyze, and minimize the release of CO_2 (Nidumolu et al., 2009). We contend that the potential gains from mitigation would ultimately offset the costs of mitigation and, therefore, help maximize the utility of investment that shareholders have made in the corporations.

Generation of GHGs is an indication of operational inefficiency. Greenhouse emissions can lead to significant cost disadvantages, such as compliance costs, penalties, carbon taxes, control costs, disrepute among stakeholders, and excessive energy consumption (Corbett & Klassen, 2006; Hart, 1997; Klassen & Whybark, 1999; M. Porter & van der Linde, 1995). Corporations, in order to mitigate the release of various GHGs, would necessarily have to improve the efficiency of their production operations. This improved operational efficiency would not only help outperform competitors, but would also help meet environmental regulations and avoid penalties, and therefore contribute to financial returns (King & Lenox, 2001; Nidumolu et al., 2009; Surroca et al., 2010). For instance, improving energy efficiency not only reduces GHG emissions into the atmosphere, but also reduces energy costs for MNCs, which is good for the bottom line. Some carbon-trading programs (e.g., Chicago Climate Exchange) also allow emission-efficient corporations to trade the carbon that they do not emit. Hence, we argue that MNCs that manage to release a lower quantity of greenhouse emissions are likely to be rewarded with a higher return on shareholder equity.

Hypothesis 3a: *Climate change mitigation of MNCs is positively associated with return on equity.*

When internationalization is high, the influence of climate change mitigation on return on equity is likely to be more strongly positive. Highly internationalized MNCs are faced with more complex and heterogeneous stakeholder expectations (Chakrabarty, 2009; Chakrabarty & Wang, 2012; Zardkoohi, Bierman, Panina, & Chakrabarty, 2011). For instance, there might be great variation in the carbon tax rates and emission quotas across countries (e.g., the signatories versus the nonsignatories of the Kyoto Protocol). MNCs with a higher level of internationalization, through the effective abatement of GHGs, will please a larger group of stakeholders, enjoy higher economies of scale, and optimize a wider global supply chain (Nidumolu et al., 2009). In sum, the marginal benefits of climate change mitigation would be more salient to highly internationalized MNCs.

Hypothesis 3b: *The extent of MNC internationalization modifies the influence of climate change mitigation on return on equity, such that the influence is more strongly positive when internationalization is high.*

Methods

Sample and Procedure

A longitudinal panel data set was created by merging five databases. The Toxic Release Inventory (TRI) database from the US Environmental Protection Agency (EPA) contains firm-level longitudinal data on toxic chemical releases and waste management activities reported annually by corporations that manufacture, process, or use toxic chemicals above certain specified amounts. The database of the Tool for the Reduction and Assessment of Chemical and other environmental Impacts (TRACI) from the EPA (J. Bare, 2011; J. C. Bare & Gloria, 2008) was used to weigh the extent to which the toxic chemical releases reported in the TRI database could lead to climate change. The Kinder, Lydenberg, and Domini (KLD) database provides ratings that have been extensively used in corporate social responsibility research (McWilliams & Siegel, 2000; Surroca et al., 2010). Compustat Fundamentals and Compustat Segments databases are reputable and popular sources of financial data.

Consistent with the purpose of this study, the sample consists of US MNCs whose emissions of GHGs cause climate change. The geographic segments file in the Compustat Segments database is used to identify corporations that are MNCs. Consistent with the literature, a firm is considered to be an MNC in a given year if it reports data for one or more nondomestic segments and has foreign sales greater than zero in that year (Chakrabarty & Wang, 2012).

The merged panel data set narrows down to a sample size of 264 firm-years (includes 43 corporations, with each firm having at least 2 years of data). The sample covers the period of 2001 through 2009. Due to missing data, sample size is a bit lower for two dependent variables: sales efficiency (259 firm-years—includes 43 firms, with each firm having at least 2 years of data) and product leadership (180 firm-years—includes 31 corporations, with each firm having at least 2 years of data). Table 3 provides the sample characteristics, with the various types of climate change causing chemicals released to the air by the MNCs listed in the footnote.

Measures of Dependent Variables

Sales Effectiveness

Sales effectiveness is measured as the ratio of an MNC's net sales (revenues or turnover) to its number of employees in a given year (Boubakri & Cosset, 1998; Guthrie, 2001; Samuelson & Nordhaus, 1989). Data for this variable are obtained from Compustat Fundamentals.

Product Leadership

An MNC's product leadership is measured as the KLD rating for the MNC, in respect to the MNC having achieved exceptionally high product strengths that make it an industry leader in terms of quality, social, community, and innovation aspects. The product leadership rating is based on: (1) quality strength—quality is well-developed and recognized as exceptional in the US industry; (2) social strength—products have notable social benefits that are highly unusual or unique for their industry; (3) community strength—provision of products or services

MNCs with a higher level of internationalization, through the effective abatement of GHGs, will please a larger group of stakeholders, enjoy higher economies of scale, and optimize a wider global supply chain. In sum, the marginal benefits of climate change mitigation would be more salient to highly internationalized MNCs.

TABLE 3 Sample Characteristics: US MNCs That Reported Climate Change Emissions

Characteristics of MNCs (Sampling Period: 2001–2009)		
Characteristic, average annual numbers per firm	Mean	
Climate change causing emissions, in millions of pounds of CO_2 equivalent*	20.17	
Total assets, in millions of dollars	20,661.89	
Employees, in thousands	26.73	
Revenues (net sales), in millions of dollars	21,323.01	
Net income, in millions of dollars	1,822.38	
R&D, in millions of dollars	523.63	
Total stockholder's equity, in millions of dollars	8,682.28	
Number of years as a publicly listed firm	29.57	
Number of countries (domestic + foreign) where goods are sold	3.43	
Frequency Distribution by Primary Industry		
Major Industry Group	Firm-Years	Corporations
Manufacturing—Paper and Allied Products (26xx)	24	3
Manufacturing—Chemicals and Allied Products (28xx)	68	13
Manufacturing—Petroleum Refining and Related Industries (29xx)	32	4
Manufacturing—Plastic Products (30xx)	21	4
Manufacturing—Primary Metal Industries (33xx)	22	4
Manufacturing—Industrial and Commercial Machinery (35xx)	16	2
Manufacturing—Transportation Equipment (37xx)	14	3
Manufacturing—Laboratory, Optical, and Medical Related Items (38xx)	50	7
Manufacturing—Musical Instruments (39xx)	5	1
Electric and Sanitary Services (49xx)	12	2
All other industry groups	0	0
Total Sample Size	264	43

All dollar values are adjusted for inflation with 2000 as base year. Sample size is 264 firm-years (includes 43 corporations, with each firm having at least 2 years of data). Data covers the period of 2001 through 2009.

*The chemical substances (i.e., greenhouse gases, whose release to air contributes to global warming) emitted by MNEs in this study's sample, along with their CO_2 equivalents, are as follows. *1,1,1-Trichloroethane* (146 lbs CO_2 equivalent/lb substance), *Carbon Tetrachloride* (1,400 lbs CO_2 equivalent/lb substance), *CFC-11* (4,750 lbs CO_2 equivalent/lb substance), *CFC-113* (6,130 lbs CO_2 equivalent/lb substance), *CFC-114* (10,000 lbs CO_2 equivalent/lb substance), *CFC-115* (7,370 lbs CO_2 equivalent/lb substance), *CFC-12* (10,900 lbs CO_2 equivalent/lb substance), *CFC-13* (14,400 lbs CO_2 equivalent/lb substance), *Halon 1301* (7,140 lbs CO_2 equivalent/lb substance), *HCFC-123* (77 lbs CO_2 equivalent/lb substance), *HCFC-124* (609 lbs CO_2 equivalent/lb substance), *HCFC-141B* (725 lbs CO_2 equivalent/lb substance), *HCFC-142B* (2,310 lbs CO_2 equivalent/lb substance), *HCFC-22* (1,810 lbs CO_2 equivalent/lb substance), *Methyl Bromide* (5 lbs CO_2 equivalent/lb substance), *Methyl Chloride* (13 lbs CO_2 equivalent/lb substance), and *Methylenechloride* (8.7 lbs CO_2 equivalent/lb substance).

for the economically disadvantaged; and (4) innovative strength—bringing notably innovative products to market.

Return on Equity

Return on equity (ROE) is an indicator of the extent to which an MNC generates high returns relative to shareholder equity. The numerator is an MNC's net income, which is the annual income or loss reported by an MNC on its income statement after subtracting expenses and losses from all revenues and gains. The denominator is stockholder's equity equivalent to the total assets minus total liabilities. Compustat Fundamentals database provides data for this variable.

Measures of Independent Variables

Data for calculating the moderator variable *internationalization* are obtained from the Compustat Segments database. Data for calculating the control variables *firm size* and *R&D* are obtained from the Compustat Fundamentals database, and data for calculating the control variable *recycling* are obtained from the TRI database.

Mitigation

Pollution prevention is typically measured as the difference between a predicted and actual pollution level (Berrone & Gomez-Mejia, 2009; King & Lenox, 2001). The TRI database contains data on (1) pounds of various chemicals released by a facility in a given year and (2) the production ratios. The production ratio indicates the extent of increase (or decrease), compared to the previous year, in the production process that makes use of the toxic chemical. For example, a production ratio of 1.2 would indicate that production associated with the use of the toxic chemical has increased by 20 percent. Conversely, a production ratio of 0.7 would indicate that production associated with the use of the toxic chemical has decreased by about 30 percent.

Accordingly, to calculate our mitigation measure, we estimate the likely GHG emissions corresponding to the production ratio and contrast this estimate with the actual emissions. The steps are as follows: First, the amount of each chemical released to the air by an MNC is weighted by its CO_2 equivalent (which indicates the extent to which it is a GHG that causes climate change). The weighing factors for various chemicals are available in the TRACI database for climate change. Second, the amount of emissions (in pounds of CO_2 equivalent) are multiplied by their corresponding production ratios to arrive at the estimated emissions, and aggregated across chemicals and facilities to the firm level. Finally, the estimated emissions (in pounds of CO_2 equivalent) for a year are compared against the actual emissions (in pounds of CO_2 equivalent) for that year. The formula is as follows:

$$\text{Mitigation}_{i,y} = \text{Predicted}_{i,y} - \text{Actual}_{i,y}, \text{ where}$$

$$\text{Predicted}_{i,y} = \Sigma_j \Sigma_c \left(E_{j,c,y-1} \times W_c \times PR_{j,c,y}\right)$$

$$\text{Actual}_{i,y} = \Sigma_j \Sigma_c \left(E_{j,c,y} \times W_c\right)$$

where $E_{j,c,y-1}$ and $E_{j,c,y}$ are the onsite emissions of chemical c to air by facility j of firm i in years y–1 and y respectively. W_c is the weighting factor (which converts it to CO_2 equivalent) corresponding to chemical c. $PR_{j,c,y}$ is the production ratio reported for year y corresponding to production process in facility j in which the chemical c is used. A positive value of mitigation indicates the effectiveness of mitigation given that actual GHG emissions ($\text{Actual}_{i,y}$) is lower than the predicted level ($\text{Predicted}_{i,y}$). Conversely, a negative value is evidence of deterioration of mitigation efforts as actual is higher than the predicted.

Internationalization

Internationalization is measured as the ratio of foreign sales to total sales (Carpenter, Pollock, & Leary, 2003; Wiersema & Bowen, 2008). It indicates the extent to which an MNC's business comes from foreign versus domestic markets. Results of hypothesis tests are found to be very similar when this variable is alternatively measured as the ratio of foreign sales to domestic sales.

Firm Size

Firm size is included as a control. Larger MNCs are likely to have a greater influence among the community and other stakeholders. Hence, we control for size, measured as *ln*(total assets), where total assets is in millions of dollars.

R&D

Research and development (R&D) intensity, the ratio of R&D expenses to the total assets, is included as a control because there is variation across MNCs on the emphasis placed on innovation.

Recycling

Recycling includes a variety of methods, including solvent recovery and metals recovery. This variable is included as a control because MNCs that are ineffective in mitigating (preventing) the generation and release of GHGs from their production processes tend to invest in recycling processes. This variable is calculated as a ratio in which the numerator is the aggregate end-of-pipe production-related waste (in pounds) that is converted by the onsite and offsite recycling processes to recycled material, and the denominator is the total end-of-pipe production related waste generated (in pounds).

Firm, Year, and Industry Dummies

The regressions used are two-way fixed-effect regressions, which automatically generate and include (n–1) dummy variables for n corporations and (t–1) dummy variables for t years. By using each firm and each year as its own control, the regression controls for all stable characteristics of the corporations and years and uses only within-firm and within-year variation to estimate the regression coefficients. Further, to control for industry effects, industry dummies are included.

Results

Table 4 provides the correlations of the variables. We use two-way fixed-effect regressions to test the hypotheses, the results of which are presented in Table 5. For the regressions, all the variables were standardized (including centering with mean set to zero) to avoid multicollinearity problems and to obtain standardized parameter estimates.

TABLE 4 Correlations: Variables About US MNEs That Reported Climate Change Emissions

	Mean	S.D.	N	1	2	3	4	5	6	8
1) Sales Effectiveness	0.53	0.68	259	1.00						
2) Product Leadership	0.10	0.31	180	–0.14	1.00					
3) Return on Equity	0.13	0.37	264	0.10	0.09	1.00				
4) Firm Size	8.18	2.10	264	0.50	0.14	0.10	1.00			
5) R&D	0.03	0.03	264	–0.26	0.31	0.05	0.21	1.00		
6) Recycling	0.28	0.35	264	–0.24	–0.11	–0.05	–0.10	0.02	1.00	
8) Mitigation	–3.48	22.19	264	0.02	0.06	0.05	–0.07	–0.07	–0.04	1.00
9) Internationalization	0.40	0.28	264	0.19	–0.10	0.03	0.37	0.36	0.02	–0.02

Sample size is 264 firm-years (includes 43 corporations, with each firm having at least 2 years of data). Due to missing data, sample size is lower for two variables: sales efficiency (259 firm-years; includes 43 corporations, with each firm having at least 2 years of data) and product leadership (180 firm-years; includes 31 corporations, with each firm having at least 2 years of data). Data covers the period of 2001 through 2009. All dollar values are adjusted for inflation with 2000 as base year. Dependent variables are lagged ahead of independent variables by 1 year to indicate the direction of influence. Hence, independent variables cover the period 2001–2008 and dependent variables cover the period 2002–2009.

Note: Basic correlations fail to take into account the longitudinal/panel nature of data, and can therefore be misleading. Hence, the literature suggests using fixed-effect regressions, rather than correlations, to test hypotheses.

All the independent variables were lagged behind the dependent variable by one year, to indicate the longitudinal direction of the effects being tested. Hence, the independent variables covered the period 2001–2008 and the dependent variables covered the period 2002–2009. Figure 3 provides the plots of the interaction effects of internationalization (the moderator variable is continuous, but only lines representing high and low values of the moderator are plotted for ease of visualization).

Consistent with Hypothesis 1a, mitigation has a significantly positive influence on sales effectiveness (β = 0.04 with $p < 0.05$ in model A2). Further, consistent with Hypothesis 1b, internationalization amplifies the influence of mitigation on sales effectiveness (β = 0.05 with $p <$ 0.01 in model A4). As shown in the interaction plot in Figure 3a, the influence of mitigation on sales effectiveness is strongly positive and significant when internationalization is high (simple slope = 0.002, $p = 0.002$) but becomes weak and nonsignificant when internationalization is low (simple slope = –0.001, $p = 0.274$). That is, sales effectiveness is more sensitive to mitigation efforts when an MNC's internationalization is higher rather than lower.

Further, consistent with Hypothesis 2a, mitigation has a significantly positive influence on product leadership (β = 0.23 with $p < 0.001$ in model B2). Moreover, consistent with Hypothesis 2b, internationalization amplifies the influence of mitigation on product leadership (β = 0.22 with $p < 0.01$ in model B4). As shown in the interaction plot in Figure 3b, the influence of mitigation on product leadership is strongly positive and significant when internationalization is high (simple slope = 0.007, $p < 0.001$), but becomes weak and nonsignificant when internationalization is low (simple slope = –0.001, p = 0.547). That is, product leadership is more sensitive to mitigation efforts when an MNC's internationalization is higher rather than lower.

However, inconsistent with Hypothesis 3a, the influence of mitigation on return on equity is not significant (β = 0.04 with $p > 0.10$ in model C2). Further, inconsistent with Hypothesis 3b, internationalization does not amplify the influence of mitigation on return on equity (β = –0.07 with $p > 0.10$ in model C4). Hence, whereas sales effectiveness and product leadership were influenced by mitigation and its interaction with internationalization, return on equity was not.

Discussion

Decision makers in MNCs tend to find themselves in a perplexing situation—they are unsure if actions undertaken to help tackle global climate change would contribute to their business competitiveness. This study sets out to explore the relationship between climate change mitigation and competitiveness of MNCs. In general, our findings establish that the mitigation strategies can consolidate a source of competitiveness. By proactively seeking strategies to reduce their climate change impact, MNCs might not see a notable increase in return on equity. However, they can capitalize on significant improvements on the other two competitiveness dimensions—product leadership and sales effectiveness.

TABLE 5 Regressions: Influence of Mitigation on MNC Competitiveness, and Its Moderation by Internationalization

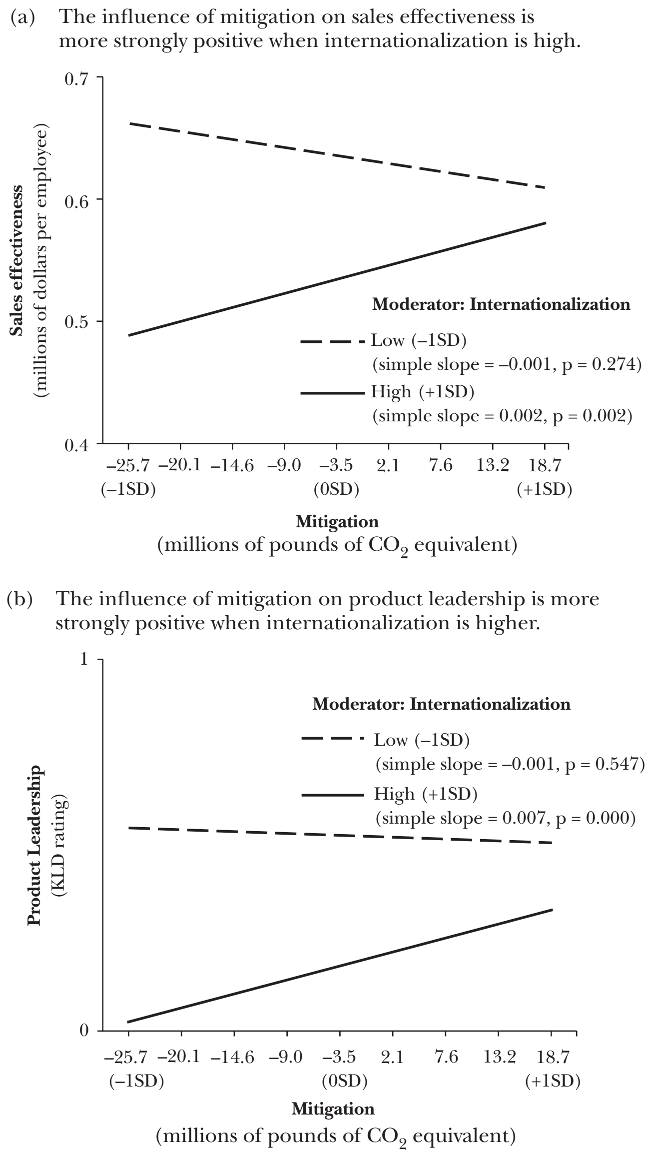
	Firm's Sales Effectiveness (year y + 1) as Dependent Variable Standardized Parameter Estimates β					Firm's Product Leadership (year y + 1) as Dependent Variable Standardized Parameter Estimates β					Firm's Return on Equity (year y + 1) as Dependent Variable Standardized Parameter Estimates β				
	A1	A2	A3	A4	Support	B1	B2	B3	B4	Support	C1	C2	C3	C4	Support
Controls (year y):															
Firm, Industry, & Year Dummies	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	
Firm Size	0.17	0.16	0.18	0.17		−1.21***	−1.27***	−1.20***	−1.15***		−1.90***	−1.91***	−1.95***	−1.94***	
R&D	0.02	0.01	0.01	0.00		0.31*	0.25*	0.22†	0.17		0.07	0.07	0.08	0.08	
Recycling	−0.02	−0.01	−0.02	−0.02		−0.01	−0.00	−0.03	−0.02		−0.17	−0.16	−0.14	−0.14	
Predictor (year y)															
Mitigation		0.04*	0.04*	0.02	Yes		0.23***	0.24***	0.21***	Yes		0.04	0.04	0.07	No
Moderator (year y)															
Internationalization			−0.08	−0.07				−0.46**	−0.47**				0.16	0.15	
Interaction															
Mitigation x Internationalization				0.05**	Yes				0.22**	Yes				−0.07	No
R^2 F Value *p* Value	0.9456 40.43 < 0.001	0.9466 41.03 < 0.001	0.9471 39.46 < 0.001	0.9487 40.40 < 0.001		0.7686 10.72 < 0.001	0.8062 13.31 < 0.001	0.8181 13.10 < 0.001	0.8295 14.05 < 0.001		0.2360 1.26 0.136	0.2373 1.24 0.150	0.2389 1.25 0.146	0.2422 1.25 0.147	
ΔR^2 Wald ChiSq *p* Value		0.0010 3.95 0.046	0.0005 1.63 0.202	0.0016 6.57 0.010			0.0376 26.82 < 0.001	0.0119 8.96 0.003	0.0114 9.08 0.003			0.0013 0.35 0.557	0.0016 0.45 0.502	0.0033 0.89 0.346	

*** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$, † $p \leq 0.10$ (conservative two-tailed tests).

Sample size is 264 firm-years (includes 43 corporations, with each firm having at least 2 years of data). Due to missing data, sample size is lower for regressions with dependent variable as sales efficiency (259 firm-years; includes 43 corporations, with each firm having at least 2 years of data) and with dependent variable as product leadership (180 firm-years; includes 31 corporations, with each firm having at least 2 years of data). Data covers the period of 2001 through 2009. Dependent variables are lagged ahead of independent variables by 1 year to indicate the direction of influence. Hence, independent variables cover the period 2001–2008 and dependent variables cover the period 2002–2009.

All variables are centered and standardized. Plot of the residuals against the predicted value did not indicate any evidence of heteroskedasticity problems. ΔR2 and corresponding Wald tests for models A2/B2/C2 are with respect to models A1/B1/C1, models A3/B3/C3 with respect to A2/B2/C2, and models A4/B4/C4 with respect to model A3/B3/C3. Maximum variance inflation factor (VIF) = 1.71, suggesting no evidence of multicollinearity problems among independent variables. Variables are winsorized at 0.5 and 99.5 percentiles to limit the role of potential outliers (results are similar without winsorizing). All dollar values are adjusted for inflation with 2000 as base year.

FIGURE 3 Interaction Plots



By proactively seeking strategies to reduce their climate change impact, MNCs might not see a notable increase in return on equity. However, they can capitalize on significant improvements on the other two competitiveness dimensions—product leadership and sales effectiveness.

Theoretical Implications

By focusing on a specific environmental issue (i.e., climate change), this article deepens the understanding of the influence of MNCs on the environment, thus contributing to the environmental management literature. The amount of research that investigates environmental issues in organizational settings is growing. A majority of the efforts are devoted to the discussion of the link between environmental performance and financial performance (King & Lenox, 2001; McWilliams & Siegel, 2000; Surroca et al., 2010). Also of note, most research in the environmental management literature has examined the aggregate environmental impact of corporations. Given that there are multiple interfaces between firm activities and the environment, the chemicals or substances emitted might cause a variety of environmental problems (J. Bare, 2011; J. C. Bare & Gloria, 2008) such as climate change, ozone depletion, smog formation, and so forth. Hence, the aggregate measure of environmental performance results in loss of information regarding specific environmental problems and, more seriously, leads to potentially fallacious conclusions. The present study exemplifies an effort to delve deeper by focusing on climate change rather than overall environmental performance.

Our results support the contention that MNCs enjoy an increase in sales effectiveness when they reduce their emission level of GHGs. In the environmental management literature, scholars have provided various answers to the question: "Why do corporations go green?" One line of argument is that superior environmental performance enhances product differentiation, thereby encouraging consumer purchases (McWilliams & Siegel, 2000, 2001). Our findings provide empirical evidence for this argument and highlight the importance of signaling mechanisms in converting mitigation efforts into greater sales.

In addition, we found that effective mitigation would help MNCs gain product leadership. It highlights that cross-functional learning and knowledge integration represents a critical engine for MNCs to reduce GHGs and gain product leadership (Cohen & Levinthal, 1990; Grant, 1996a). However, this cross-functional learning has not received sufficient attention in the environmental management literature. Research on the transfer of knowledge—especially about green initiatives—is relatively new, distinct, and underinvestigated. Given that the benefits of environmental programs can extend across organizational functions, we believe that there will be future research opportunities to integrate the organizational learning literature with the environmental management literature. There is substantial scope to extend recent research on how organizational factors play a role in the transfer of knowledge across organizational functions (Chakrabarty, in press; Chakrabarty & Bass, 21013a, 2013b).

Finally, we found that climate change mitigation exerts a positive but nonsignificant influence on the third competitiveness dimension—return on equity. The nonsignificance might be attributed to the possibility that the gains made from preventing emissions are offset by the costs of such effort. The nonsignificance also implies that the investment in mitigation does not bring financial loss to MNCs either.

Practical Implications

Deploying efforts and resources for mitigating climate change emissions can benefit MNCs in several ways. These findings ease the tension between the pursuits of climate change mitigation and corporate competitiveness (Porter & Kramer, 2011). The results of this study should encourage MNC managers to invest in climate change mitigation. Making the mitigation effort more salient and detectable to consumers is critical to propel sales. To achieve greater sales in consumer markets, MNC managers should send clear signals to the markets to demonstrate their concerns about global climate change. In addition, to develop product leadership, managers should emphasize learning and knowledge integration as well as remove the obstacles for the spread of the pro-environment values across organizational functions.

Conclusion

If MNCs, as major economic actors, can manage to mitigate their emission level of GHGs, the rate of climate change can be slowed. Effective mitigation provides benefits to the environment, society, and humanity. This belief is widely held and has been vigorously advocated for decades. However, there has been ambiguity on whether attempts to mitigate climate change can provide any direct benefit to MNCs (Chakrabarty & Wang, 2012; Wang, 2012).

In our results, the impact of MNCs' actions on climate change mitigation on return on equity was positive but statistically nonsignificant. This implies that while mitigation efforts might be falling short of significantly enhancing the return on equity of MNCs, the mitigation efforts do not bring financial loss to the MNCs either. Importantly, results suggest that MNCs' actions on climate change mitigation do have a positive and statistically significant impact on their sales effectiveness and product leadership. This is consistent with our argument that attempts to mitigate climate change can be of competitive value to MNCs if market signaling and organizational learning are effectively leveraged. Hence, mitigation efforts—apart from their obvious role in helping protect our planet's future—can be of direct benefit to MNCs.

Subrata Chakrabarty, PhD, is an assistant professor at the Department of Management, College of Business Administration, University of Nebraska–Lincoln, USA. His research centers on business strategy from a multistakeholder perspective. He investigates research questions on the ability of an organization to connect ethically and fruitfully with its various stakeholders (such as local communities, natural ecosystems, social activists, customers, suppliers, employees, leaders, shareholders, and creditors). His recent research extends the literature on (1) social entrepreneurship, corporate social responsibility, sustainability, and business ethics, and (2) international entrepreneurship and institutional voids. His research has been accepted at various journals and conferences. He received his PhD degree in strategic management from Mays Business School, Texas A&M University, USA.

Liang (Lucas) Wang is currently a PhD student at Richard Ivey School of Business, Western University (University of Western Ontario), Canada. His research interests are in the international strategies of multinational companies (MNCs) and social/environmental issues related to MNCs. He holds an MA in management from University of Nebraska–Lincoln, USA, and a BA in English literature from Jinan University, Guangzhou, China.

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