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Three essays on power issues in buyer-supplier relationships, sustainable supply chain management, and their synergy

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Three essays on power issues in buyer-supplier relationships, sustainable supply chain management, and their synergy

by

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A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Business and Technology (Supply Chain Management)

Program of Study Committee:
Frank Montabon, Major Professor
Jennifer Blackhurst
Songxi Chen
Scott Grawe
Sachin Modi

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

Ames, Iowa

2018

DEDICATION

This dissertation is dedicated to my beloved grandparents, who brought me up with their love.

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ACKNOWLEDGMENTS

I would like to thank my husband, who has always been patient, understanding, and considerate. My grandma, my parents, and my brother have also been very supportive of my doctoral studies. I am greatly indebted to all of them.

I want to thank my committee chair, Dr. Frank Montabon, who recruited me more than five years ago. He has been a very helpful and patient advisor. He always encourages me, especially when I am down. He helped me a lot in the last five years, without which I would not have completed my doctoral studies. I also want to thank my dissertation committee members, Dr. Jennifer Blackhurst, Dr. Scott Grawe, Dr. Sachin Modi, Dr. Songxi Chen, and Dr. Lily Wang. They have all been very helpful and responsive.

In addition, I would also like to thank my friends, fellow Ph.D. students, and the department faculty and staff for making my time in the Ivy College of Business at Iowa State University an unforgettable experience.

ABSTRACT

This dissertation follows the three-essay models and features two important topics in supply chain management, power dynamics in buyer-supplier relationships and sustainable supply chain management. The first paper is a conceptual paper on power imbalance in buyer-supplier relationships, which provides some theoretical refinement. The second paper is on the role of culture in environmental management. The third paper examines the synergy between the two and investigates the role of power in sustainable supply chain management and how power moderates the role of sustainable engagement in buyer-supplier dyads that are embedded in bigger supply networks.

CHAPTER 1.   INTRODUCTION

During my six years of working in industry, I had always been bewildered by one question: why are my customers so demanding? They always had many requests, some of which were reasonable, and others were simply condescending and outrageous. I thought of two reasons to dispel my confusions. First, they are the customers and they think they deserve whatever they want; second, they are larger companies compared to my employers and they know my employers' dread of losing their businesses. Another issue that caught my attention is the issue of sustainable development and businesses' role in it. My second employer is in the perfume and flavor business. Residents close to the plant where I worked kept complaining about the strong and weird smell that came out of the plant. Government officials would then get involved and urge my employer to take better measures for waste reduction and disposal. During my work there, I also occasionally needed to deal with formula changes (bill of material changes) for perfume oils because of industrial regulations of such organizations as IFRA (International Fragrance Association). In that company, there is a department called HSE (Health, Safety and Environment) which deals with all sorts of environmental concerns and educates employees about the importance of sustainable development.

This dissertation thus features the two important topics: power issues in buyer-supplier relationships and sustainable supply chain management. The first two papers deal with each topic separately and the third one connects the two topics and examines how power affect some mechanisms in sustainable supply chain management.

A conversation on dynamics in buyer-supplier relationships (BSR) would not be thorough if power issues are not discussed. This is probably the reason why the power

phenomenon has been a recurring theme in supply chain management (SCM) studies. Previous research has mainly focused on the consequences of power usage in buyer-supplier relationships—power usage is generally considered an obstacle to effective BSRs and negatively related to BSR quality and supply chain performance (Doney & Cannon, 1997; Maloni & Benton, 2000). However, the question of why a certain company is in a position to exercise power and manipulate its partner is largely understudied in the literature. As a matter of fact, power imbalance in a BSR is the fundamental issue that makes the less powerful party more susceptible to power usage. Power imbalance is a critical property of BSRs. At a particular point in time, power usage might not be manifest. Different from power usage, power imbalance is the difference between the amount of power that two parties each have and it can be measured anytime. A BSR that features high power imbalance implies more potential threats to the less powerful party since it can be forced by its powerful partner to do things that it doesn't want to do otherwise. Thus it is interesting to investigate what actually predicts power imbalance in a BSR. Applying the social stratification theory from sociology, an equivalent composite measure of companies, "translated" from socioeconomic status (SES), is developed to facilitate theorizing. It is proposed that the more disparate a buyer and its supplier are from each other in terms of SES, the higher the power imbalance in the BSR in question. Other contingent factors are also taken into account. A complete theory of power is built and detailed propositions are proposed for empirical testing.

Sustainable supply chain management is another recurring theme in SCM studies. The depletion of natural resources and pollution caused by industrialization concerns all of society. Businesses in particular need to be responsible for the natural environment in which

they operate (Carter & Easton, 2011). As companies start sourcing globally or expand businesses to global markets, monitoring their environmental impact and achieving their environmental performance targets becomes more complicated and challenging. On the one hand, governmental regulations tend to be different from country to country and cultural differences mean different levels of concerns for the natural environment (Husted, 2005); as such, companies might need to adopt different environmental management practices in different countries. On the other, implementing a similar environmental management practice in different cultures can lead to different levels of performance given that national culture can affect the implementation of environmental management practices. Therefore, it is worthwhile and meaningful to examine how national culture would affect the adoption of environmental management practices (i.e., whether a certain cultural trait is associated with the adoption of more or fewer environmental management practices) and how effectively those practices can be implemented in different cultures (i.e., whether a certain cultural trait is related to more or less effective implementation of EMPs). Using multiple data sources (the GMRG 5th round survey, Hofstede cultural dimensions, and WorldBank), the second paper empirically approaches these research questions and hierarchical linear modeling results show that several cultural dimensions are significantly related to EMP adoption levels and the effective implementation of different types of EMPs.

Joining the two themes together leads to a unique and increasingly important topic, power in sustainable supply chain management. Firms engage with their supply chain partners in various ways in SSCM. Previous research mainly studied how the depth of engagement (monitoring or collaboration) affects the focal firm's environmental performance. The third paper shifts attention to the sustainable outcomes of suppliers in

dyadic relationships. It aims to understand dyadic relationships as part of larger industrial networks because of structural embeddedness of supply chain members and interdependency in supply chain relationships. Interaction of dyads with their immediate and non-immediate supply chain partners is considered and the impact of the breadth of environmental engagement in extended supply chains is one focus of the study. Using a novel data set comprised of 1122 dyads, this research found support for the critical role of the breadth of engagement in SSCM. Power's influence is also incorporated into the theoretical framework. It is found that large and powerful companies play more important roles in SSCM.

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CHAPTER 2.   ANTECEDENTS AND CONSEQUENCES OF POWER IMBALANCE IN SUPPLY NETWORKS: A CONCEPTUAL FRAMEWORK

Abstract

Studies on power in the supply chain literature typically focus on the influences of power in supply networks. Many papers were actually studying power usage while they claimed they were studying power. This paper draws a definite distinction between power as a phenomenon that exists in business and power usage as overt actions by power holders. A third concept, power imbalance, which can encourage power usage and is a more fundamental issue in supply networks, constitutes the main focus of this paper. Specifically, antecedents of power imbalance are explored from a social stratification perspective given that power is originally a social concept. A new composite measure for firms, socioeconomic status (SES), is proposed from the new theoretical lens. With an integrated overview of the literature, a conceptual framework is built. The framework reveals that (1) socioeconomic status disparity between supply chain partners will portend power imbalance in the relationship; (2) the association between socioeconomic status disparity and power imbalance can be moderated by the power holder's relationship orientation; (3) power imbalance creates greater risks and challenges for the weaker party and enables the more powerful party to exercise power; and (4) the power holder may refrain from power usage if a long-term relationship orientation is valued. This paper also argues that mediated power usage is the only way to use power and non-mediated power usage is an oxymoron. Some proposals for theoretical refinement are discussed. This paper represents one of the first attempts to shift attentions from power usage to power imbalance and builds a complete theory of power with an exposition of the pertinent conceptual background from multiple theoretical lenses.

Introduction

Power is a concept that originated from social and political sciences (Bierstedt, 1950; Dahl, 1957; Emerson, 1962). It is recognized as a universal phenomenon in human societies and in all social relationships (Bierstedt, 1950). Power is a ubiquitous phenomenon in the business world as well. Business researchers have long realized the importance of power and started to study power in channel relationships in early 1970s (e.g., El-Ansary & Stern, 1972; Hunt & Nevin, 1974; Wilkinson, 1974). In the supply chain management field, power is typically studied in buyer-supplier relationships (hereafter abbreviated as BSRs). Researchers have focused on the effects of power on BSR quality and supply chain performance (e.g., Maloni & Benton, 2000; Benton & Maloni, 2005; Zhao, Huo, Flynn, & Yeung, 2008). It has been found that power usage generally negates cooperation, commitment, and trust in BSRs (Kumar, 1996; Doney & Cannon, 1997; Kumar, Scheer, & Steenkamp, 1998; Maloni & Benton, 2000) and is negatively related to supplier satisfaction (Benton & Maloni, 2005) and supply chain performance (Maloni & Benton, 2000; Handley & Benton, 2012b). Less attention has been paid to the fundamental cause of power usage—power imbalance.

In a BSR, the buyer and its supplier don't necessarily have the same amount of power, which causes a power imbalance between them. The party who has more power is able to exercise power and influence decisions of the weaker party. A rather extreme case could be found in a relationship where a monopolist supplier has much more power than its buyer, where the buyer will have to comply with the monopolist supplier's many terms and conditions, some of which could be unfair. The huge power imbalance between the buyer and its supplier in this example makes it possible for the supplier to impose terms on the buyer;

whereas in a case where two parties in a BSR have similar levels of power, it might not be easy for one party to ask the other for whatever it wants. Therefore, power imbalance makes power usage easier and more effective.

However, it is not accurate to argue that wherever there is power imbalance, there is power usage. There are factors that can deter power usage. For instance, the strategic importance of the outsourced service to the buyer and the buyer's switching difficulties are both negatively correlated to buyer power usage (Handley & Benton, 2012b). Despite the close association between power imbalance and power usage, the concept of power imbalance has not been examined by many researchers. While previous research on the effects of power usage advanced knowledge of power in supply networks, a closer look at how power imbalance is formed in a relationship and how it affects power usage is much needed at this point.

In order to understand the perplexing dynamics of power imbalance, we turn to the sociology literature as power is originally a social concept (Bierstedt, 1950. Drawing on the theory of stratification (Blau & Duncan, 1967; Pandey, 1983; Scott, 1996) and the concept of socioeconomic status (Mueller & Parcel, 1981; Nam & Powers, 1983; Campbell, Marsden, & Hurlbert, 1986), we explore how socioeconomic status disparity between a buyer and its supplier can cause power imbalance. We also make use of the literature on power in sociology and marketing. Through these theoretical lenses, we develop a theoretical framework from which propositions about the antecedents and consequences of power imbalance are generated. The contributions of this paper and the managerial implications of these propositions are also discussed.

Literature Review

In this section, we first review the literature on power, power usage and power imbalance to make a distinction between the three concepts. We then focus on the sociology literature to explore the relationship between a firm's socioeconomic status and its relative power in a buyer-supplier dyad. Following that, we look for clues in the marketing literature to facilitate our understanding of how firms' relationship orientation can affect power structures and power usage in BSRs. A complete conceptual framework is built after the review.

Power, Power Usage and Power Imbalance

Power has long been the focus of study in such fields as political science, sociology, management, marketing, and supply chain management. Definitions of power thus abound in the literature. One of the earliest versions by the German sociologist and philosopher Max Weber conceptualized power as the chance of a man or of a number of men to realize their own will in a communal action even against the resistance of others who are participating in the action (Gerth & Mills, 1962). Robert Dahl, a political theorist, thought of power as a relation among people or groups and defined power as the ability of one individual or group to get another unit to do something that it would not otherwise have done (Dahl, 1957). In his seminal work on power which developed a theory of power relations, Richard M. Emerson, the distinguished sociologist, recognized power as potential influence and defined power as the amount of resistance on the part of one actor which can be potentially overcome by another (Emerson, 1962). El-Ansary and Stern (1972) applied Dahl's definition to distribution channels by operationally defining power as the ability of a channel member to control the decision variables in the marketing strategy of another member. Supply chain management scholars adopted similar definitions that were used in marketing studies (Zhao

et al., 2008). Though the wordings of these definitions are not all the same, understanding of the concept seems to be consistent in those fields and they all imply two important characteristics of power.

First, power is latent. Power is an ability to cause someone to do something that they would not have done otherwise (Gaski, 1984). It signifies potential influence which is not necessarily realized (French & Raven, 1959; Emerson, 1962). To say that one has power is one thing, but to say one has wielded power is different. Power can be regarded as the predisposition or prior ability which makes the application of power possible (Bierstedt, 1950), but power in itself is different from power usage. This point can be more easily driven home by considering that a firm can have power without using it (Frazier, 1983; Gaski & Nevin, 1985). The power of an actor, whether individual or collective, is measured by the chance that they have of realizing their will (Scott, 1996). So power is not necessarily evident, active, or visible.

Second, power is relative. For power to be a meaningful concept, there should be at least two parties and a relation between them (Dahl, 1957). A firm can only know how much power it possesses when a specific relationship is referred to, for example, with a certain supplier or client. Tech behemoth Apple Inc. is certainly more powerful compared with many of its suppliers, but its power in one dyad is not necessarily the same as that in another. A firm's absolute power is thus unknown unless a relationship is specified and its power is different in different BSRs. Emerson (1962) illustrated this point by stating that saying that "X has power" is vacant, unless we specify "over whom."

From these two characteristics of power, we can infer that power itself is neither harmful nor helpful. It is not the mere possession of power that may pose a threat to a

relationship; rather, it is power usage that can leave the weaker party unhappy. Power is latent while power usage is manifest. As Emerson (1962) pointed out, power exists only as a potential to be occasionally employed by the participants. Power is thus not visible but power usage is. Power is actualized through power usage.

Another concept that is derived from power is power imbalance or power asymmetry (we will use the term power imbalance for this paper). Dahl (1957) developed a statement of power comparability, which is the relative degree of power held by two or more persons or groups. He maintained that if two actors are power comparable, they can be ranked according to the amount of power they each possess. It can be inferred from the definition of power that as long as there is a relationship between two actors, the two are power comparable. As a result, we can know how much relative power each party has in a certain relationship. Emerson (1962) defined power advantage as Pab (i.e., Power of A over B), minus Pba, which can be a power disadvantage if the value is negative. Intuitively, whenever the amount of power possessed by two parties in a relationship is different, there is power imbalance in the relationship. Power imbalance, caused by the unequal distribution of power between partners in a relationship, represents a situation or status. Unlike power, it is an attribute specific to relations.

Power imbalance does not necessarily portend conflict in supply chain relationships, but it does create greater risks and challenges for the weaker party (Nyaga, Lynch, Marshall, & Ambrose, 2013). This is due to the fact that an unbalanced relation is unstable and it encourages the use of power (Emerson, 1962). Power imbalance in a buyer-supplier dyad thus significantly shapes inter-firm relationships and inter-firm governance (Xiao, Xie, & Hu,

2013). Table 1 summarizes the differences between power, power imbalance, and power usage.

In spite of the importance of power imbalance in buyer-supplier relationships, only a few papers have mentioned the linkage between power imbalance and power usage (e.g., Anderson & Weitz, 1989; Brown, Lusch, & Nicholson, 1995). Even less attention has been directed to the antecedents of power imbalance. This paper will thus fill the gap and aim to understand the nature, antecedents, and effects of power imbalance in supply chain relationships, to further our understanding of the power phenomenon in BSRs.

Table 1 *Comparisons of power, power usage and power imbalance*

Concepts	Definition	Unit of Study	Relativity	Visibility
power	potential ability of exerting influence over another party	individual	relative	latent
power imbalance	situation where parties in a relationship have different levels of power	relation	absolute	N/A
power usage	application of power	individual	N/A	manifest

Power as Studied in the Supply Chain Management (SCM) Literature

In the SCM literature, there are plentiful studies on power. Many of them empirically examined the effects of power usage on BSR quality and supply chain performance. See Table 2 for a list of some example studies.

Table 2 *Examples of Power Studies in SCM*

Title	Authors	Year published	Power-related key construct
Power influences in the supply chain	Maloni and Benton	2000	Power usage
The influence of power driven buyer/seller relationships on supply chain satisfaction	Benton and Maloni	2005	Power usage
The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain	Zhao, Huo, Flynn, and Yeung	2008	Power usage
The effects of trust and coercive power on supplier integration	Yeung, Selen, Zhang, and Huo	2009	Coercive power usage
Mediated power and outsourcing relationships	Handley, and Benton	2012	Mediated power usage
The influence of exchange hazards and power on opportunism in outsourcing relationships	Handley, and Benton	2012	Power usage
Power asymmetry, adaptation and collaboration in dyadic relationships involving a powerful partner	Nyaga, Lynch, Marshall, and Ambrose	2013	Power usage

Note that except Nyaga et al. (2013) all these papers use the word power in the titles, instead of power usage. But a close examination of the measurements these studies use to measure power reflects the fact that most if not all of these studies were actually measuring *power usage*, rather than *power*. For example, in Maloni and Benton (2000), the following items were used to measure reward power and coercive power.

Reward Power

XXX offers incentives when we were initially reluctant to cooperate with a new program.

We feel that by going along with BBB, we will be favored on other occasions.

XXX offers rewards so that we will go along with their wishes.

Coercive Power

If we do not do as asked, we will not receive very good treatment from XXX.

If we do not agree to their suggestions, XXX could make things difficult for us.

XXX makes it clear that failing to comply with their requests will result in penalties against us.

In Zhao et al. (2008), similar items were adopted to measure reward power and coercive power.

Reward Power

REW1: If we did not do what as the major customer asked, we would not have received very good treatment from them.

REW2: We felt that by going along with the major customer, we would have been favored on some other occasions.

REW3: By going along with the major customer's requests, we avoided some of the problems other suppliers face.

REW4: Our major customer often rewarded us to get our company to go along with their wishes.

Coercive Power

COE1: The major customer's personnel would somehow get back at us if we did not do as they asked and they would have found out.

COE2: The major customer often hinted that they would take certain actions that would reduce our profits if we did not go along with their requests.

COE3: The major customer might have withdrawn certain needed services from us if we did not go along with them.

COE4: If our company did not agree to their suggestions, the major customer could have made things more difficult for us.

It can be seen that these questions generally ask the respondents whether their buyers have exercised reward or coercive power in their interactions. Therefore, to be accurate, it is the effects of different kinds of *power usage* that were examined in these studies rather than the effects of *power*. The reason why we make this distinction is that as we have demonstrated before, power and power usage are different concepts and should not be confused with each other. In the SCM literature, such a distinction is either not realized or researchers simply prefer using the two concepts interchangeably, which is potentially confusing given the differences between the two. In this paper, we will strictly follow the definitions of the two concepts.

Effects of Power Usage on Supply Chain Relationships

Though a firm's use of power may result in the partner's short-term compliance (Leet-Pellegrini & Rubin, 1974; Kasulis & Spekman, 1980; Handley & Benton, 2012b), power usage is generally considered an obstacle to the effective workings of BSRs and negatively related to BSR quality and supply chain performance. Power usage negates cooperation, commitment, and trust (Kumar, 1996; Doney & Cannon, 1997; Kumar et al., 1998). Maloni and Benton (2000) empirically showed that exploitation of the supply chain by the powerful party may lead to dissension and underperformance, thus hurting the power holder. Coercive power usage was found to maintain significant negative effects on supply

chain buyer–supplier relationships (Benton & Maloni, 2005) and have a negative impact on supplier commitment (Zhao et al., 2008). The use of mediated power, namely, reward power, coercive power and legal legitimate power (hereafter referred to as legal power), represents the competitive and negative use of power (Benton & Maloni, 2005) and establishes an adversarial environment in the buyer-supplier relationship. Buying firms' mediated power usage is associated with an increased risk of opportunistic behaviors by their service providers (Handley & Benton, 2012a). Yeung, Selen, Zhang, and Huo (2009) have found that though power has no direct effect on internal integration, it would manifest itself through the interaction with trust and as such, supply chains should build a climate of trust before relying on power usage. Nyaga et al. (2013) showed that exercise of coercive power and legal power has a strong negative effect on buyers' and suppliers' collaborative behavior in buyer-supplier relationships. These studies offer consistent evidence that power usage, especially mediated power usage, has a negative impact on the quality of inter-organizational relationships. But still there are firms who rely on heavy-handed use of power to coordinate supply chains (Handley & Benton, 2012b). In view of the negative effects of power usage, it is imperative that a better understanding of the antecedents of power imbalance and the deterrents to power usage be developed.

Thus far, we have reviewed the concepts of power, power usage and power imbalance. Comparisons are made and their measurements are reviewed as well. We were able to recognize the important role of power imbalance in encouraging power usage. Next, we move on to the sociology literature to explore the antecedents of power imbalance.

Theory of Stratification

The power phenomenon in a society is closely related to the phenomenon of social stratification (Scott, 1996), which, like power, is also an integral element of all human

organizations (Lenski, 1966). In sociology, researchers have long been studying social stratification to understand inequalities in the society. Different dimensions have been used to measure social stratification on different hierarchies. For individuals, people can be divided into different socioeconomic strata, based on occupation and income, wealth and social status, or derived power (Scott, 1996). Stratification thus speaks of the relative social position of individuals within a social group or geographic region. The intellectual origins of the multi-dimensional approach to stratification were usually traced to the work of Max Weber (Pandey, 1983). In his three-component theory of stratification, Weber argued that economic order alone is not adequate for an effective stratification approach. He maintained that power can take a variety of forms and a person's power can be shown in the social order through their status, in the economic order through their class, and in the political order through their party (Scott, 1996; Hurst, 1998). As the theory of stratification sheds light on the connection between power and social and economic orders and helps us understand what causes power differences in relationships, we will introduce this theory to the supply chain management field so that we can explore the association between power and social and economic orders in the context of buyer-supplier dyads. The concept of socioeconomic status (SES), which is a combination of social and economic orders, will thus be a key construct to investigate in this study.

Socioeconomic Status and Power

Few concepts are as central to sociology as SES (Bollen, Glanville, & Stecklov, 2001; Bradley & Corwyn, 2002). SES holds such a vital role in sociological studies because the study of social stratification can help researchers understand various social phenomena. SES is commonly conceptualized as the social standing or class of an individual or group (Lavaine, 2015). More specifically, it refers to "the position of individuals, families,

households, or other aggregates on one or more dimensions of stratification" (Bollen et al., 2001, p. 157). These dimensions could be income, education, occupation, wealth, prestige, or other aspects of standing that members of society deem salient (Bollen et al., 2001). Because SES variation is pertinent to many research issues, SES has been introduced to many disciplines, including psychology, medical studies, education studies, etc., even though there is no consensus among researchers from different fields about what dimensions should be included or whether some dimensions are more important than others (Mueller & Parcel, 1981; Bollen et al., 2001). At times, its measures differ from field to field (Mueller & Parcel, 1981). Nevertheless, SES is popular with researchers in different fields and shows good applicability and compatibility. Despite SES's versatility, at best we can tell SES has not been introduced to the field of supply chain management thus far.

In the business world, there are some emergent or purposeful categorizations of companies that serve to establish or reinforce corporate differences in relative economic worth. For instance, the FORBES Global 2000 is "a comprehensive list of the world's largest, most powerful public companies, as measured by revenues, profits, assets and market value", each of which are given equal weight (Chen, 2015, para. 2). Companies are ranked by total revenues for their respective fiscal years for the Fortune 500 lists (Global 500, 2015). Such categorizations only emphasize the economic dimension though they use different metrics. Similar rankings of the social worth of these companies are not readily available. But the creation of social values and the need to understand firms' social values are topics that currently receive great attention (Hess, Rogovsky, & Dunfee, 2002; Selsky & Parker, 2005; Felício, Gonçalves, & Gonçalves, 2013). A composite measure such as SES will thus qualify as a more promising measure than those single-dimension measures.

SCM scholars have also realized that asymmetrical distribution of power among partners in supply chain relationships is attributable to firms' differences in size, expertise, dependence, contract structure, etc. (Nyaga et al., 2013). This coincides with Max Weber's point that power is rooted in economic and social relations, from which we can arrive at the conclusion that SES as an aggregate measure of individual or group's capabilities and resources is an antecedent of power. Difference in the SES of partners causes difference in amount of power they each possess. Therefore, difference in SES between supply chain partners will portend power imbalance in the buyer-supplier dyad.

Relationship Orientation and Power

Relationship orientation is related to firms' decisions on the types of partnering they want to accomplish with their supply chain partners. Some supply chain relationships are strategic and some are merely transactional (Mentzer, Min, & Zacharia, 2000). With strategic partners, firms usually have a long-term relationship orientation. In such relationships, firms aim to achieve long-term strategic goals and gain competitive advantage by forming strategic alliance with their partners. Long-term orientation is "the culture of viewing time holistically, valuing both the past and the future rather than deeming actions important only for their effects in the short term" (Bearden, Money, & Nevins, 2006, p. 457). Literature on buyer-supplier relationships has consistently noted that more strategic inter-organizational relationships are characterized by increased commitment and a longer-term relationship orientation (Handley & Benton, 2012b). A firm with a long-term orientation towards their relationship with a specific partner will value cooperation for future benefit, rather than exploit the relationship for short-term benefits. A firm with a short-term relationship orientation relies on the efficiencies of market exchanges to maximize their gains in a transaction (Ganesan, 1994). Dependence, trust, commitment and transaction-specific

investment have been considered antecedents of relationship orientation (Ganesan, 1994; Mentzer et al., 2000; Cannon, Doney, Mullen, & Petersen, 2010).

When a firm has a long-term relationship orientation for a specific partner, it is more dependent on the partner and expects the relationship in question to last longer. More relationship-specific investments are usually made and more importance is assigned to the partner. The power positions of the two will be different compared to when the focal firm does not have a long-term relationship orientation. This can be explained by the power dependence relations proposed by Emerson (1962), which has been followed by marketing researchers when studying channel relationships (e.g., El-Ansary, 1975; Brown, Lusch, & Muehling, 1983; Frazier, 1983). It has been posited that one firm's power over its partner derives from the partner's dependence on the firm (Emerson, 1962; El-Ansary and Stern, 1972, Frazier, 1983). Specifically, suppose the focal firm is the power holder and has more power over the partner, if the focal firm is dependent on the partner and has a long-term orientation, the relative power its partner holds will increase. The power imbalance will hence be smaller. Relationship orientation moderates the association between SES disparity and power imbalance.

In spite of the presence of power imbalance in a buyer-supplier dyad, power usage can be deterred to some extent. This is why power imbalance can sometimes exist but is unobservable. That is to say, even though one party has more power than its partner in the relationship, it might not use the surplus power to manipulate its partner's decisions or actions. Power can exist without being exercised (Gaski & Nevin, 1985). As both practitioners and researchers began to acknowledge the role of collaboration in organizational success, long-term relationships based on trust and cooperation became more

favored than arms-length adversarial relationships (Hoyt & Huq, 2000). Closer long-term relationships between buyers and suppliers have had positive effects on performance in a number of areas (Helper & Sako, 1995). Therefore, some firms choose to treat their partners equally and strive to maintain long-term relationships with key partners. Some of these partners might be at a power disadvantage compared with the focal firm. But they won't necessarily be influenced by the focal firm since the focal firm will refrain from wielding power over the weak partners so that an environment of trust and commitment is established. Therefore, firms' long-term orientation will deter power usage. Relationship orientation thus has a direct effect on power usage. Specifically, the power holder's long-term relationship orientation can deter its power usage.

Taken altogether, we complete our theoretical framework below (Figure 1).
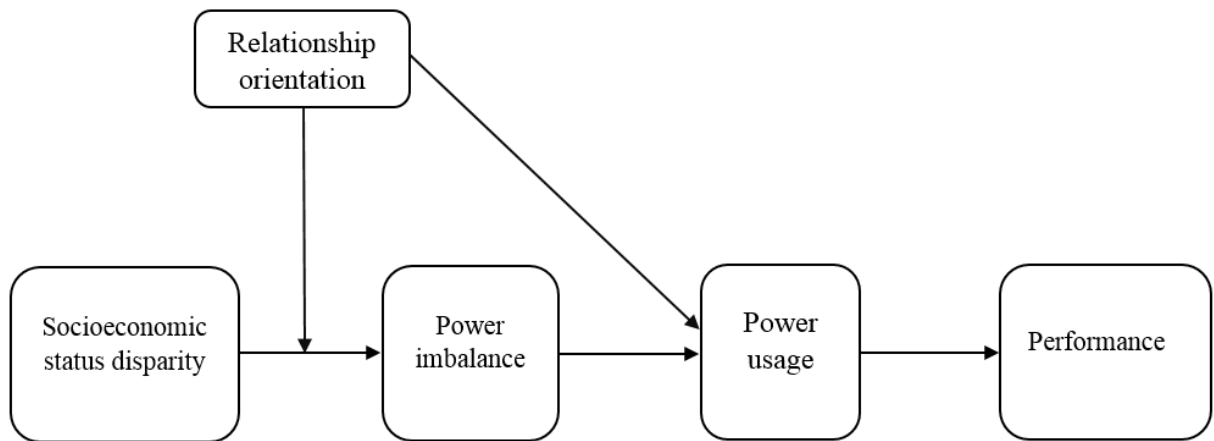
Figure 1 *Theoretical framework*

Proposition Generation

With an exposition of the pertinent conceptual background, we have built a theoretical framework. In this section, we develop propositions from the framework. We first present the SES measure for firms. Following that we visualize the association between SES

disparity and power imbalance with two continua, which are used to show different BSR scenarios. One proposition is proposed for each scenario. A separate proposition is developed for the effects of power usage on supply chain performance.

Firm SES

Socioeconomic status (SES), the key concept that comes into play here, is an aggregate concept comprised of both resource-based (i.e., material and social resources) and prestige-based (individual's rank or status) indicators of socioeconomic position and can be measured across societal levels (individual and group) and at different periods in time (Krieger, Williams, & Moss, 1997). SES is a powerful construct that is related to many social phenomena and can help explain them. It is commonly implicated in sociological studies as predictors of inequalities in health, both physical and mental (e.g., Smith, 1998; Goodman, 1999, Bollen et al., 2001, Jean-Christophe & Kuate-Defo, 2005), education (Sewell & Shah, 1967; Bradley & Corwyn, 2002) and marital or relationship stability (Tzeng, 1992; Jalovaara, 2003).

Firms can be measured in terms of both social value and economic value. Combining the two dimensions, we can get the SES measure for firms (see table 3 for the proposed measure of firm SES.) Economic measures have generally received more attention than social measures and there are many established economic or financial measures of firms such as revenue, profit margin, cost of goods sold, assets, return on sales, return on assets, return on equity, etc. But firms are also organic parts of the society. In fact, firms' social role goes above and beyond meeting legal requirements, complying with ethical standards, creating jobs and paying taxes (Strandberg, 2014). Firms have been increasingly under pressure from both customers and stakeholders to incorporate the triple-bottom line of social, environmental and economic responsibility considerations into operations and supply chain

management strategies (Tate, Ellram, & Kirchoff, 2010). Therefore, this paper takes into consideration the social measures and combine them with the economic measures and form a composite measure for firms' SES, which will be linked to power based on the social stratification theory.

Table 3. *Proposed Measure of SES for Firms*

	ECONOMIC	SOCIAL	
SES of an individual	Income	Education	Occupation
SES of a company	company size, market share, annual sales, profitability	years of experience, third party accreditations and certifications	product or service quality, customer service level, reputation (brand image & brand recognition)

The Two Continua

The current literature on power and the theory of social stratification provides theoretical basis for the link between socioeconomic status disparity and power imbalance—since socioeconomic status can predict individual or an organization's power position, socioeconomic status disparity will portend power difference between the two parties in a relationship, namely power imbalance. Next, we will use two continua (SES disparity continuum and power imbalance continuum, see Figure 2) to facilitate our development of propositions.

Suppose *b* is the buyer in a buyer-supplier relationship and *s* is the supplier. *b*'s SES is denoted as SES_b and that of *s* is SES_s. *b*'s power is P_b and *s*'s power is P_s. Therefore, SES disparity between the two is $SES_b - SES_s$, and power imbalance is $P_b - P_s$.

Note that both SES disparity and power imbalance can be negative. We can denote different values in the two continua. The values at the ends of the continua represent situations where SES differences are extremely large or there is insurmountable power imbalance. The two continua function as parallel coordinates.
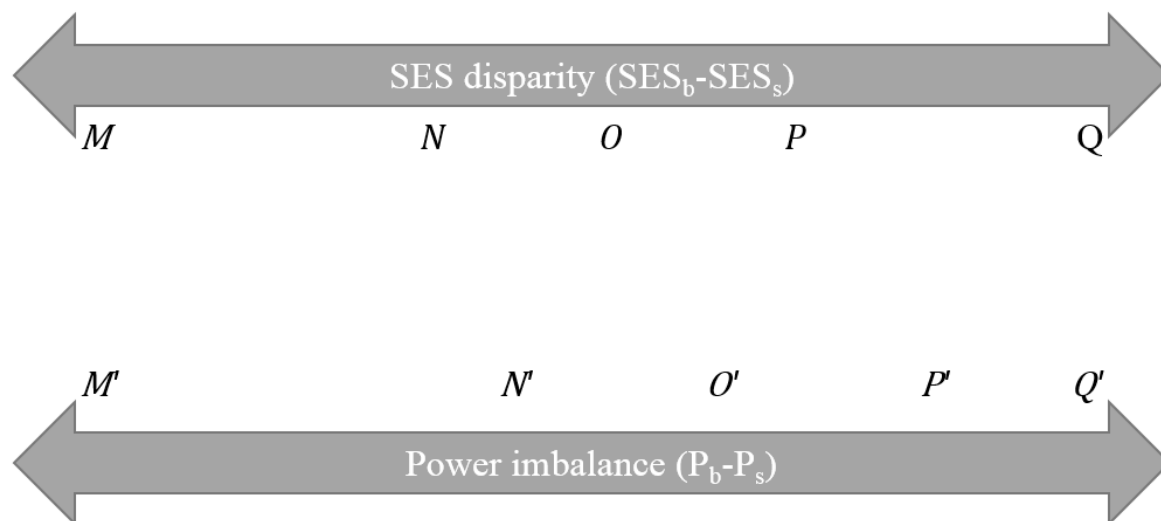
Figure 2 *The two continua*

Point M of the SES Disparity Continuum. For SES, point *M* corresponds to an extreme case where the supplier's socioeconomic status is much higher than that of the buyer. That could happen when the buying firm is a very small firm and the supplier is in a monopoly or oligopoly market where it is the only seller or one of the few sellers of a certain kind of product or service. The firm dominates the industry and controls a large market share in the industry, thereby gaining the ability to set price. Aside from price, the supplier also has control regarding other policies, for example, inventory policy, order size, distribution policies, etc. The buyer has to accept these policies since it has no alternative or very few alternatives. Even when there are a few alternatives, they are no better because these few

firms control the whole market. In this situation, the power imbalance between the two is insurmountable. As a result, the supplier might rely on heavy use of power to control the behaviors of its buyer. So point M at the left end of the SES disparity continuum corresponds to point M' at the left end of the power imbalance continuum where the supplier has much more power than the buyer. Relationship orientation will not have a strong influence on their power relative positions since the gap between the two is huge. But the supplier's relationship orientation can still affect its power usage. So we propose the following.

> ***Proposition 1.*** When $SES_b << SES_s$, namely supplier's SES is much higher than that of the buyer, the supplier will be much more powerful than the buyer. Supplier's relationship orientation will have a weak moderating effect. Supplier's long-term relationship orientation will reduce its power usage.

From Point M to N. As we move from M toward the right side, SES difference becomes smaller. For a certain segment on the continuum, the supplier still has a substantially higher SES than the buyer. This could apply to any market structure as long as the supplier enjoys a substantially higher socioeconomic status than the buyer in question. We illustrate such a point at N. From point M to N, the supplier has more power than the buyer because of its higher SES. This positive association between SES disparity and power imbalance is moderated by supplier's relationship orientation. The supplier might also use power to make the buyer yield to its requests depending on its relationship orientation. We will discuss N's corresponding point on the power imbalance continuum later. For this range, we have the proposition below.

> ***Proposition 2.*** When $SES_b < SES_s$, namely supplier's SES is substantially higher than that of the buyer, the supplier will be more powerful than the buyer. Relationship

orientation of the supplier will have a moderating effect on the link. Supplier's long-term relationship orientation will deter its power usage.

From Point N to O. Moving from point N to O, the midpoint, before the value of $SES_b - SES_s$ approaches zero, the supplier is in a slightly higher socioeconomic position. But it's difficult to tell whether the supplier will have more power in the relationship or not, especially when their SESs are very similar. Relationship orientation becomes more important here. The buying firm in question might be an important one (the business volume that the buyer trades with the supplier takes up a big proportion of the supplier's total business) and thus the supplier values its relationship with the buying firm. The supplier's long-term relationship orientation will therefore reduce the power imbalance between them. It will also suppress the supplier's urge to wield power. On the contrary, if the buyer is not an important client to the supplier, the supplier may care less about how long this relationship can last. Power imbalance is as determined by SES disparity. Since SES disparity is small here, power imbalance will also be less noticeable. There may not be a lot of power usage involved in this case since both parties' power positions are similar. Relationship orientation will play a more important role for this range compared with the previous two scenarios.

Proposition 3. When SES_b is a bit lower than SES_s, the two parties' power positions will be similar if they both have the same relationship orientation. Supplier's relationship orientation will have a strong moderating effect on the relationship between SES disparity and power imbalance. Each firm's long-term relationship orientation will reduce their power usage.

At Point O. We use the example of point O to describe why N' and O' are offset to the right on the Power Imbalance Continuum relative to their corresponding points on the

SES Disparity Continuum. At the midpoint O, the supplier and the buyer have the same SES. They should have similar amount of power, but they will not because of the nature of buyer-supplier relationships. Buyers purchase from suppliers and are the customers. Because of the long-held belief in the importance of customer satisfaction and customer loyalty, which is considered an important source of competitive advantage (Woodruff, 1997), firms tend to try their best to please their customers. Organizations are thus dependent upon their customers. Without customers the organization would not exist. In the US, the customer is king (Wahhab, 2012) and in Japan, the customer is God (Orr, 1995). Because it is important that customers' needs be met and customers be pleased and satisfied, customers can take advantage of firms' commitment to them. Naturally, when two firms are equal or very close in SES and they are equally important to each other, the buyer will still have more power because the customer is granted the privilege to ask for more. This actually corresponds to legitimate power as described by French and Raven (1959). Legitimate power is defined by them as the kind of power that stems from internalized values in the supplier which dictates that the buyer has a legitimate right to influence the supplier and that the supplier has an obligation to accept this influence. Therefore, at point O, where SES disparity is zero, there will still be a power imbalance favoring the buyer. That means when SES disparity is zero, there is still a power imbalance because of the buyer's legitimate power. In a similar way, N' and P' are to the right of point N and P.

> ***Proposition 4.*** When $SES_b =/\approx SES_s$ and they have the same long-term orientation,
> buyer will be more powerful because of its legitimate power. Both parties'
> relationship orientation will have strong moderating effects. Their long-term
> relationship orientation will reduce their power usage.

From Point O to P. Starting from point *O* and moving on to the right to point *P*, the buyer starts to outrank the supplier in SES but the difference is not big. The buyer will have more power than the supplier. But still the amount of power they each have is moderated by their relationship orientation. If the buyer has a long-term orientation, the power imbalance between them will be smaller. If the buyer has a short-term orientation, the power imbalance will be bigger than as determined by SES disparity. If both have the same relationship orientation, power imbalance will be as determined by SES disparity and not big. Buyer's long-term relationship orientation can deter its power usage. On the Power Imbalance Continuum, *P′* is the point that corresponds to *P*.

> *Proposition 5.* When SES_b is a bit higher than SES_s, the buyer will have more power if they both have the same relationship orientation. Buyer's relationship orientation will have a strong moderating effect on the relationship between SES disparity and power imbalance. Buyer's long-term relationship orientation will reduce its power usage.

From Point P to Q. From point *P* until somewhere near the end point *Q*, the buyer is a more influential company and substantially bigger. In such relationships, the buyer will have more power than the supplier. Buyer's relationship orientation will not have a significant impact on the power imbalance between the two. Buyer can use power to make the supplier accommodate its needs depending on its relationship orientation.

> *Proposition 6.* When $SES_b > SES_s$, namely buyer's SES is substantially higher than that of the supplier, the buyer will be more powerful. Long-term orientation of the buyer will have a moderating effect. Buyer's long-term relationship orientation will deter its power usage.

At Point Q. At point *Q*, the buyer has a much higher SES than the supplier. This could happen in the case of monopsony where there is one single buyer and many sellers. It may be the case that with regard to the percent of business that each side represents to the other the seller is a tiny part of the buyer's total spend whereas the buyer represents a large portion of the seller's revenues. This will give the buyer much more power. In this scenario, no matter whether the buyer has long-term orientation or not, it has much more power over the supplier. But long-term orientation can reduce the buyer's tendency to use power.

> *Proposition 7.* When $SES_b >> SES_s$, namely buyer's socioeconomic status is much higher than that of the supplier, the buyer will be much more powerful than the buyer.
>
> *Proposition 8.* Buyer's relationship orientation will have a weak moderating effect. Buyer's long-term relationship orientation will reduce its power usage.

Mediated Power Usage

Previous papers have attempted to simplify power research by categorizing the different power bases (French & Raven 1959) into dichotomies such as coercive/non-coercive and mediated/non-mediated (Maloni & Benton, 2000). We use the mediated/non-mediated dichotomy because its symmetry lends parsimony. Each side of the dichotomy has three bases—mediated power bases include coercive, reward and legal power and non-mediated power bases are expert, referent and legitimate power (Johnson, Sakano, Cote & Onzo, 1993).

We only include mediated power usage in our model because non-mediated power usage is an oxymoron. The sources of power identified by French and Raven (1959) assumed that power comes from perceptions, which have analogs in execution or use. Reward,

coercive, or legal power can be easily transformed to usage. For instance, reward power is based on focal firm's perception that the partner has the ability to confer rewards; if the partner does confer rewards in their interaction as the focal firm perceived, then the partner engages in reward power usage. Coercive and legal power have similar transformations. But for the other three types of power, it is difficult to transform them into power usage. For example, referent power is based on one firm's identification with the partner. Because the focal firm values its identification with the partner, the partner has referent power. The focal firm's perception makes the partner more powerful but we cannot say that if focal firm values its identification with the partner, the partner has *used* referent power. Instead, referent power is actually used as coercive, reward or legal power. It is the same case with legitimate or expert power. So power holders can have power from non-mediated sources but when the power is used, it is used in a mediated way. Non-mediated power bases do not require the power holder's overt action but they stem from the weaker party's perceptions about its partner and the relationship.

Thus we posit that power can only be used in the form of reward power, coercive power or legal power. These three types have been categorized as meditated power because the use of these three kinds of power represent influence efforts that are deliberately engaged (or threatened) by the power holder to guide its partner's response (Maloni & Benton, 2000). Mediated power usage forces one's partner to agree to some requests not out of their own will. Previous research has shown that one side exercising power has negative effects on their BSR partner (Kumar, 1996; Doney & Cannon, 1997; Kumar, Scheer, & Steenkamp, 1998; Maloni & Benton, 2000). Along this line of reasoning, it can be argued that although through mediated power usage short-term gains can be maximized, mediated power usage is

harmful to relationships because it diminishes trust and commitment in the relationship and hurts the party who has been forced to do things that it will not do otherwise. The eighth proposition of our study summarizes these statements.

Proposition 9. Mediated power usage will be detrimental to BSRs and hurt supply chain performance in the long run.

Discussion

In this paper we concentrate our attention on the antecedents of power imbalance by introducing the concept of SES into power research and applying the theory of stratification. We distinguish power, power imbalance, and power usage from each other and maintain that they are different concepts in essence and should be used with caution. We connect the SES Disparity Continuum with the Power Imbalance Continuum in hopes that their link can be presented as manifest propositions. Inclusion of the construct of relationship orientation makes these relationships more precise. We make it clear how scholars transfer the typology of French and Raven (1959) into measures of power usage and why non-mediated power usage is an oxymoron. Some proposals for theoretical refinement for the construct of non-mediated power usage are presented. We also emphasized the negative influence of mediated power usage to complete our set of propositions. Thus, this paper builds a complete power theory by revealing the connections between the various power concepts and highlighting the antecedents and consequences of power imbalance.

The propositions generated from the conceptual framework provide guidelines for buyers and suppliers. The managerial implications are multi-fold. First, when buyers are looking for suppliers, they likely hope to have more power over their suppliers so that they can influence the suppliers' decisions and easily get the suppliers' compliance. They may think the power advantage is beneficial to them. From our propositions, we can see that if

buyers want to be more powerful in their relationships with suppliers, they should work with suppliers that are as good as them or a little bit better than them in terms of SES. In other words, they should avoid suppliers who are significantly higher than them in SES. But the reality is sometimes a buying firm has to choose from more powerful suppliers, which might not be satisfactory. But the situation can be changed if the buyer's business volume with the supplier takes up a significant proportion of the supplier's total sales volume. The supplier will thus be more dependent on the buyer and have a long-term relationship orientation. The long-term orientation will deter the supplier's power usage. Firms should be aware of these intricacies of power dynamics and look for suppliers that are appropriate for them in terms of SES in the long run.

Second, from the suppliers' perspective things are somewhat different. Selling products or services to companies that are more influential than themselves seems beneficial as associations with these big and powerful companies can make their products or services more appealing and help themselves grow bigger and be more competitive. Some suppliers may be willing to cope with the power imbalance considering their long-term development goals. They often boast of being a supplier of a certain company and refer to such relationships when advertising for themselves. So suppliers need to balance this desire against the possible negative effects of an SES mismatch.

Third, buyers' legitimate power in the buyer-supplier dyad also makes buyers more powerful even though a supplier might have higher SES. This helps us understand that there might be more combinations of strong buyer and weak supplier than other kinds of combinations.

Last but not least, both buyers and suppliers should adopt proper influence strategies and refrain from heavy mediated power usage. Though firms can gain from power usage in the short run, their partners will suffer and in the long-run the relationship quality will decrease and the supply chain performance will be affected. There are different influence tactics power holders can draw upon, aside from wielding power to force weaker partner to give way to them. But it seems some firms are believers in mediated power usage and they want to reap as much as they can from relationships (Handley & Benton, 2012b). Another reason could be that they want the weaker partners to accommodate their needs as soon as possible. Such firms should be aware of the negative effects of power usage, and had better be more patient when dealing with weaker partners and show more respect to them.

The paper has theoretical contributions. First, it distinguishes among the concepts of power, power imbalance and power usage. Researchers have been using these concepts interchangeably and did not pay much attention to their differences. But these three concepts are different and there are relationships among them. The term power usage is often confused with power or types of power. This paper draws a distinction between them and argues that power can be only exercised as mediated power. Building on these distinctions, the relationship between power imbalance and power usage is examined. High power imbalance tends to encourage power usage.

Second, an important yet understudied antecedent of power imbalance, SES disparity, is proposed. SCM researchers focus more on the effects of power usage and have not tried to understand the fundamental causes of power imbalance. This paper incorporates theory from sociology and look at the phenomenon from a different lens. SES disparity between supply chain partners portents power imbalance in the relationship, which will further cause

potential power usage. The important role of relationship orientation comes into play in both these associations. Relationship orientation moderates the association between SES disparity and power imbalance. It can also predict power usage together with power imbalance. The framework is completed by including the effect of mediated power usage on supply chain performance. Future work can be done test these relationships with empirical data and see whether there are exceptions to these relationships.

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CHAPTER 3. THE IMPACT OF NATIONAL CULTURE ON CORPORATE ADOPTION OF ENVIRONMENTAL MANAGEMENT PRACTICES AND THEIR EFFECTIVENESS

Abstract

National culture matters in business as it affects managerial attitudes, values, behaviors, and efficacy in organizations. It contributes to our understanding of environmental management issues as well. Previous studies investigating the link between national culture and environmental performance had mixed findings as they overlooked the intervening mechanism between the two—firm environmental management practice (EMP) adoption. This paper considers the missing link, lays out a complete theoretical framework, and empirically tests the effects of national culture on firm EMP adoption and EMP effectiveness. The analysis uses data collected during the 5th round of the Global Manufacturing Research Group (GMRG) survey, Hofstede cultural dimensions, and World Bank Database. Hierarchical linear models (HLMs) estimated using the Bayesian Markov chain Monte Carlo (MCMC) approach are employed to examine the cross-level relationships in the framework. The study finds out that certain cultural traits are significantly related to corporate EMP adoption and how effectively EMPs are implemented after adoption. The study provides meanings insights into the role of national culture in the context of environmental management.

Keywords: sustainability; environmental *management; national culture; archival data; hierarchical linear modeling; Bayesian statistics*

1. Introduction

Globalization is a double-edged sword that has been credited with improving standards of living (Fuller & Geide-Stevenson, 2003; Lawrence, Rodrik, & Whalley, 1996; Park, Russell, & Lee, 2007), but also has been blamed for environmental degradation (Figge, Oebels, & Offermans, 2017). Questions like whether globalization and environmental sustainability can co-exist bewilder environmentalists and researchers (Grossman and Krueger, 1995). Globalization also poses new challenges to environmental management because of national cultural differences (McLaughlin and Fitzsimmons, 1996). The well-known examples of Nike and Apple (Guthrie, 2012) can be seen as a clash of national cultures with regard to how they view sustainability.

National culture has been established as one of the determinants of location decisions for multinational corporations (MNCs) as explained by Jones and Teegen (2001). Cultural shock may be experienced by an MNC who enters a new country where the indigenous culture is different from that of the MNC's home country. Concern for environmental issues by government policy makers, industrial associations, and consumers varies across countries as national culture shapes their environmental attitudes and values and influences how they desire natural resources to be utilized (Husted, 2005; Park et al., 2007). This causes differences by country in the rate sustainability is adopted. For example, the diffusion of ISO 14000 has shown significant variation by country (Vastag, Corbett, & Kirsch, 2004).

While the importance of the relationship between national culture and environment management is appreciated by researchers, our understanding of how these two dynamics interact remains weak (Wu, Ellram, & Schuchard, 2014). As sustainability is becoming a factor in valuation (Koller and Bailey, 2017), companies are more active than ever in pursuing sustainability to align with values and engage stakeholders (Song, Zheng, & Wang,

2016; Bové, D'Herde, & Swartz, 2017). It is thus time for companies to understand the substantial impact of national culture on environmental management so that they can better achieve their environmental goals.

In the extant literature, the findings with regard to the associations between national cultural dimensions and sustainability performance are often equivocal. For instance, power distance is reported to have negative (Husted 2005; Park *et al.* 2007), positive (Ho, Wang, & Vitell, 2012), and non-significant (Hackert, Krumwiede, Tokle, & Vokurka, 2012) associations with firm sustainability performance. These equivocal findings in the literature likely indicate the presence of an important intervening mechanism that these studies have failed to take into account. National culture as a deep-rooted country-level force will assert itself in green decision making to influence the level of corporate environmental investments (Rungtusanatham, Forza, Koka, Salvador, & Nie, 2005; Wiengarten, Fynes, & de Búrca, 2011). The current study thus proposes that national culture does not influence firm environmental performance directly; instead, *the level of corporate EMP adoption* is a missing link that mediates between national culture and environmental performance.

As Jung, Su, Baeza, and Hong (2008) noted, as a multinational corporation implements a new innovation campaign at its worldwide operations, varying degrees of success will be reported because of the effect of national culture. Azadegan, Kach, Golara, & Mousavi (2017) also mentioned that implementation of world-class managerial practices is influenced by national context, of which national culture is an important component. National culture is therefore not only related to the decision to adopt EMPs, but also the implementation of EMPs. There is a large body of literature that studies organizational management practices and their effectiveness in different cultures (e.g., Jaeger, 1986;

Newman and Nollen, 1996; Flynn and Saladin, 2006; Kull and Wacker, 2010; Kull, Yan, Liu, & Wacker, 2014). These studies provide consistent evidence that national culture affects not only organizational management practices adoption but also how effectively they are implemented in different cultures. Surprisingly, the impact of national culture on firm EMP effectiveness is still unknown in the literature. This paper thus sets out to answer the research question of how national culture is related to firm environmental management, in terms of EMP adoption and EMP effectiveness.

Methodologically, since the national cultural dimension measures are at a different level (country level) than the measures of firm EMP adoption and environmental performance (firm level), multilevel analysis should be performed to examine such cross-level relationships. Surprisingly, none of the current studies on the relationship between national culture and firm sustainability has used this more appropriate technique. This study will adopt a multilevel approach to address its research question. Specifically, Bayesian MCMC estimation methods will be used to estimate the multilevel models.

This study will make multiple contributions to the literature. First, it bridges the gap between national culture and corporate environmental performance by introducing the intervening mechanism—firm EMP adoption. Second, it furthers our understanding of the bearing of national culture on organizational effectiveness by investigating the role of national culture in a new context. Third, the appropriate statistical method adopted distinguishes this paper from earlier work on the role of national culture in environmental management.

2. Literature Review and Hypotheses Development

2.1. The Hofstede National Culture Framework

Culture is typically viewed as an organization's or society's values, beliefs, and ideology (DiMaggio, 1997; Montabon, Pagell, & Wu, 2016). Socio-cultural obligations, norms and values play a significant role in people's livelihood strategies (Wu & Pullman, 2015) and national culture affects managerial attitudes, values, behaviors, and efficacy in organizations (Newman & Nollen, 1996). Consequently, the relationship between national culture and the functioning of social organizations has been a recurring theme in the business research. Hofstede's cultural dimensions (Hofstede, 1980, 1983a, 1983b, 1984a, 1984b, 2001) are the most commonly used framework in these studies. Hofstede (1980), in the seminal work on national culture, identified four major dimensions along which cultural values could be analyzed: power distance, uncertainty avoidance, individualism/collectivism and masculinity/femininity. Two more dimensions were added to the original framework around 2010: long-term orientation/short-term orientation and indulgence/restraint (Minkov & Hofstede, 2011).

There are criticisms of the Hofstede cultural data (e.g., Osland and Bird, 2000). Nevertheless, Hofstede's framework does a good job capturing national cultural differences while focusing on universals of each culture that connect society. The framework is simple and concise to use, which is one of the reasons why it has gained acceptance as a paradigm for explaining the impact of national culture on various research topics. The Hofstede cultural dimensions framework has been found to be highly robust (Murphy, 1999) and has largely been confirmed and validated in replications and extensions of the study (Flynn and Saladin, 2006; Hofstede, 2001; Søndergaard, 1994; Hoppe, 1990). The use of the Hofstede dimensions for this study makes its results comparable to previous studies.

Most if not all of the studies that have examined the bearing of national culture on environmental management using Hofstede's cultural dimensions included only the first four cultural dimensions (power distance, individualism, uncertainty avoidance, and masculinity) but not long-term orientation or indulgence. One exception to this is Hackert *et al.* (2012), which included long-term orientation but not indulgence. Our study uses Hofstede's framework to dimensionalize culture given its wide acceptance and applications. All of the six dimensions will be incorporated to enable a thorough investigation of the role of national culture in the context of environmental management.

2.2. National Culture and Management Practice Effectiveness

Both practitioners and academics have long recognized the impact of national culture on organizational management practices. There is abundant literature that suggests national culture as a factor influencing the effectiveness of management practices. For example, Newman and Nollen (1996) found that work unit financial performance is higher when management practices in the work unit are congruent with the national culture; Flynn and Saladin (2006) found that there are many interactions between dimensions of national culture and the Baldrige Award quality management practices; Kull and Wacker (2010) examined quality management effectiveness in different national cultures and found that specific cultural dimensions are statistically related to quality management effectiveness; and Kull *et al.* (2014) examined the effectiveness of lean manufacturing practices in plants from different countries and they found that lean manufacturing is most effective in countries that have certain cultural traits. What is missing in the literature is the research on the impact of national culture on EMP effectiveness.

2.3. National Culture and Sustainable Management

Though the impact of national culture on management practice effectiveness has not been explored in the context of sustainable management, there are some studies that have investigated the relationship between national culture and environmental performance. A review of the literature reveals that generally two types of relations have been examined. The first type, which accounts for most of the studies, is interested in the bearing of national culture on firm or country level environmental or social performance (see Figure 1). These studies posited a direct effect of national culture on sustainability performance and explored the statistical relationship between the two. National culture was modeled as a cultural antecedent to environmental sustainability (*e.g.*, Calza *et al.*, 2016; Ho *et al.*, 2012; Husted, 2005; Ringov & Zollo, 2007). Different results have been generated by these studies (*c.f.* Calza *et al.*, 2016), likely due to the effect of confounding variables. One possibility is that national culture does not have a direct effect on environmental performance and there is an intervening mechanism that is missing.

Strategic decisions of executives are affected by profiles of national culture (Franke, Hofstede, & Bond, 1991). Specifically, their ability to adopt and implement environmental programs and standards depends upon the national culture they are in (Husted, 2005). The environmental policies of a country are also significantly influenced by culture (Vogel & Kun, 1987) and government regulations in turn affect firm decisions with respect to the adoption of EMPs (Carter & Carter, 1998; González-Benito & González-Benito, 2006a; Zhu, Sarkis, & Lai, 2013). Consequently, EMP adoption is associated with national culture. This is the second type of relationship that is examined in the literature.
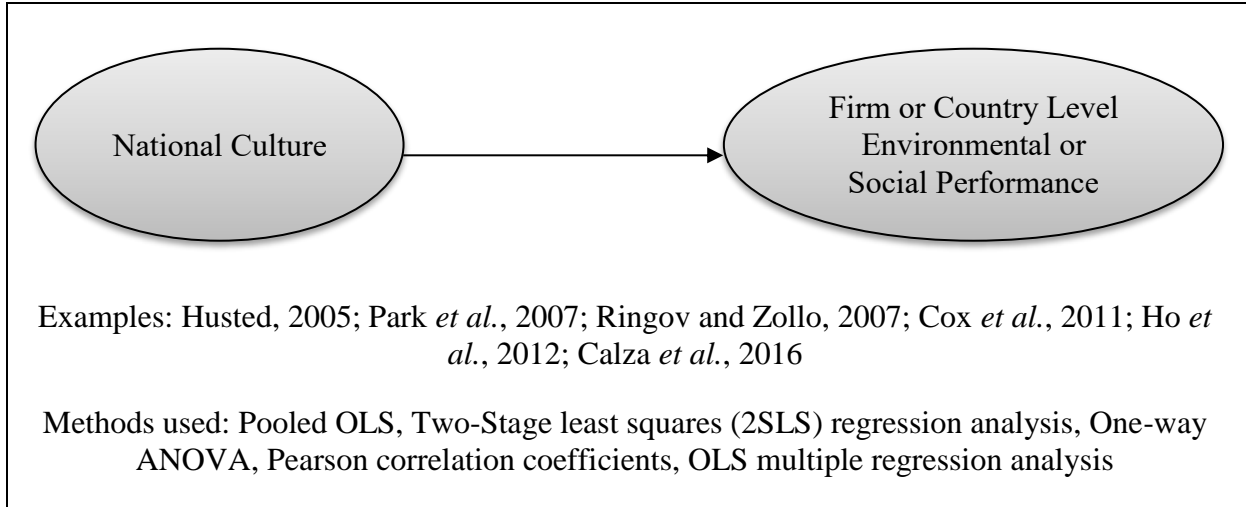
Figure 1 *National culture and environmental performance studies*

Hackert *et al.* (2012) and Vachon (2010) fall into the second category and they examined the association between national culture and firm environmental practices or investments. Vachon (2010) assessed the linkage between national culture and corporate sustainable development practices in 55 countries and the results suggested that two of Hofstede's national culture dimensions (individualism and uncertainty avoidance) are linked to a higher degree of sustainable practices by corporations. Hackert *et al.* (2012) found that individualism, uncertainty avoidance, and long-term orientation are correlated with firm investments in corporate social responsibility activities. These findings support our supposition about the association between national culture and firm adoption of EMPs.
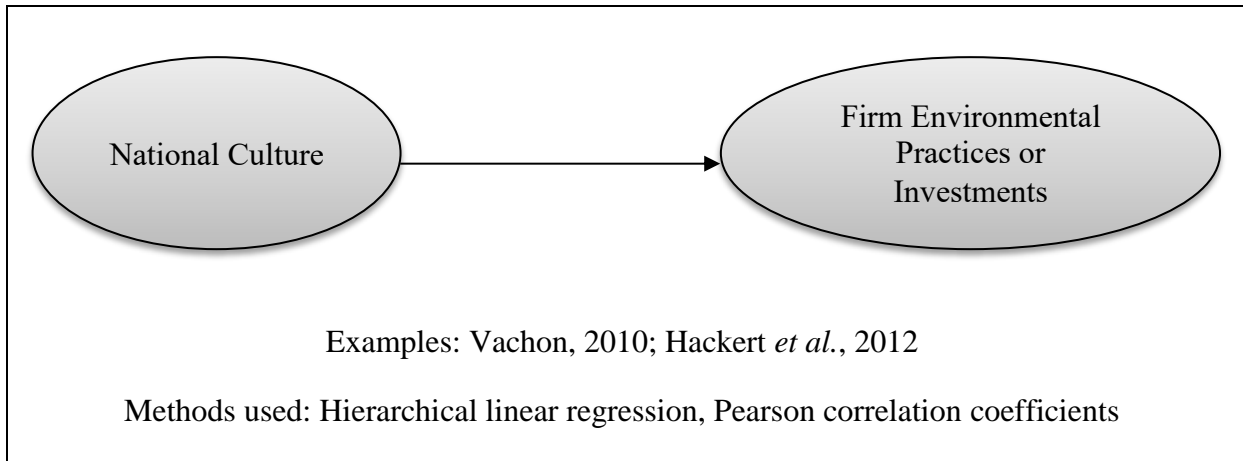
Figure 2 *National culture and environmental practices/investments studies*

Building on previous studies, this paper lays out a model including all of the three variables (national culture, firm EMP adoption, and firm environmental performance), with firm EMP adoption bridging the gap between national culture and firm environmental performance. The theoretical model is shown in Figure 3. The dotted line separates the two levels of measurements. National culture is a country-level measure while the other two are firm-level measures. National cultural dimensions affect not only the adoption of EMPs by firms in different countries but also how effectively the adopted EMPs are implemented.
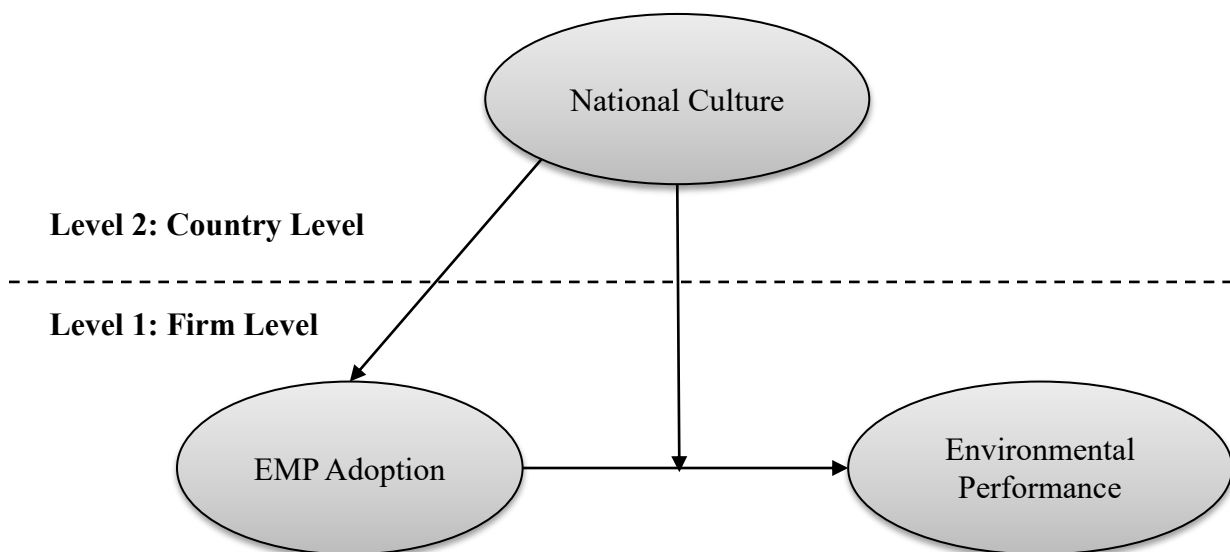
Figure 3 *Theoretical framework*

2.4. Hypotheses Development

As discussed in the introduction, previous research on the issue of national culture's relationship to environmental issues has resulted in inconsistent findings. This makes creating a research model and developing hypotheses challenging especially as previous papers have specified hypotheses that have been opposed to each other (*c.f.* Calza *et al.*, 2016). Despite that, this paper draws upon the literature on the drivers of EMP adoption. Previous research has used stakeholder theory (Freeman, 2010) to argue that stakeholder pressure is a key driver (Caprar & Neville, 2012; Dubey, Gunasekaran, Childe, Papadopoulos, Hazen, Giannakis, & Roubaud, 2017; González-Benito & González-Benito, 2006a; Sarkis, Gonzalez-Torre, & Adenso-Diaz, 2010; Seles, de Sousa Jabbour, Jabbour, & Dangelico, 2016; Zhu *et al.*, 2013). The literature also indicates that environmental values and attitudes of individuals are affected by national culture (Lynch, 1993; Onel & Mukherjee, 2014). Therefore, this paper argues that national culture affects environmental attitudes of stakeholders such as consumers, government policy makers, and industrial associations, which create different levels of pressure in different cultural contexts and cause firms to adopt fewer or more EMPs. With that, two sets of hypotheses are developed below. One set concerns the effect of national culture on firm EMP adoption. The other set is on the association between national culture and EMP effectiveness. The former has an "a" in their hypothesis label and the latter has "b".

2.4.1. Power Distance

Power distance refers to "the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally" (Hofstede, 1980). A high degree of power distance indicates that hierarchy is clearly established and executed in the culture, where superiors and subordinates are not

equal and subordinates may be unlikely to approach and contradict their bosses directly (Hofstede, 2001). A low degree of power distance can be expected in an egalitarian culture where people question authority and strive to distribute power more evenly. A culture characterized by high power distance features more focus on internal politics and less on real problem-solving (Husted, 2005). Such a culture is also found more tolerant of unethical practices (Cohen, Pant, & Sharp, 1996). Katz, Swanson, and Nelson (2001) argued that high power distance implies less concern about the natural environment since the respect for authority embedded in high-power-distance cultures can possibly result in less capacity for debate and weaker business responses to environmental problems. Stakeholders and governmental/industrial regulations in a high-power-distance culture thus care less about the natural environment (Tata & Prasad, 2015). Companies would face fewer pressures and implement fewer EMPs. Along this line of argument, the first hypotheses is offered:

H1a: Ceteris paribus, firms in high-power-distance countries adopt fewer environmental management practices (EMPs).

In high-power-distance countries, subordinates are more dependent on their superiors and tend to defer to their bosses, whom they expect to be respectable and autocratic (Hofstede, 1984a, 1984b). The previous hypothesis argued that firms in high-power-distance countries are less likely to adopt EMPS. However, given the autocracy associated with greater power distance, it can be argued that *if* EMPs are adopted in such a context, superiors at the firm will expect that the EMPs are as effective as possible and since employees in this context are more deferential, they will comply to please their superiors. Therefore, we hypothesize that companies in high-power-distance cultures who adopt EMPs will be able to implement the practices more effectively.

H1b: EMPs will be more effective in firms in high-power-distance countries.

2.4.2. Individualism/Collectivism

The individualism/collectivism dimension refers to the extent to which people in a society are integrated into groups (Hofstede, 1980). In an individualistic culture, people are oriented towards acting as individuals and value personal interests more than shared group interests. While in a collectivistic culture, the society is characterized by tightly-integrated relationships which are viewed as taking precedence over individual tasks (Hofstede, 1984a, 1984b). Managing the natural environment for sustainable development is a collective enterprise in which benefits to the collective should outweigh costs of the few (Tata & Prasad, 2015). People in a collectivistic culture place interests of the collective first, so they are more likely to concern themselves with protecting the natural environment. Therefore, firms in collectivistic cultures will face more pressures from stakeholders and from government or industrial regulations. Conversely, individualistic cultures emphasize self-interest. People in individualistic cultures will demonstrate less of a concern about the broader impacts of businesses on the environment. Consequently, companies in individualistic countries receive less pressure from key stakeholders and macro-level sources and are thus are less motivated to implement sustainable practices. Therefore, companies in an individualist culture will care less about environmental problems and implement fewer EMPs.

H2a: Ceteris paribus, firms in high-individualism countries adopt fewer environmental management practices (EMPs).

The individualism/collectivism dimension affects EMP effectiveness as well. Collectivistic groups are more responsive to shared goals and group members tend to work closely together to achieve the goals (Hofstede, 1984b). Collectivistic cultures are more

likely to emphasize cooperation among group members as the basis for success in competition with other groups, whether at the level of the family, business, or nation (Leake & Black, 2005). Members of successful groups take pride in what the groups have accomplished. Therefore, more emphasis on cooperation, collaboration, goal sharing, and employee involvement will be evident in companies in collectivistic cultures, whereas employees in individualistic cultures work to satisfy personal interests and strive for individual successes (Chen, Chen, & Meindl, 1998; Kim, Triandis, Kâğitçibaşi, Choi, & Yoon, 1994). In consequence, EMPs will be better implemented and more effective in firms in collectivistic cultures.

H2b: EMPs will be more effective in firms in low-individualism countries.

2.4.3. Masculinity/Femininity

The masculinity/femininity dimension refers to the extent of focus on "material success" as opposed to a concern with the "quality of life" (Hofstede, 1997). A masculine culture features more focus on competitiveness, individual achievement, assertiveness, power, and material success; on the contrary, a feminine culture values nurturance, helpfulness, cooperation, caring, modesty and quality of life (Hofstede, 1980; Tata & Prasad, 2015). Hofstede posits that masculinity creates "a preference for economic growth over environmental conservation" (Hofstede, 2001). Companies in high-masculinity countries will thus prioritize economic development and environmental protection is of less interest to them. Their stakeholders will have the same focus as they do. They will hence face fewer pressures from government and industrial regulations. Feminine cultures are different in that they are more likely to value the importance of environmental conservation initiatives which can benefit the whole society (Tata & Prasad, 2015). Companies in high-femininity cultures

will thus face more pressures from both internal and external sources than their counterparts in high-masculinity cultures. They tend to adopt more EMPs to improve quality of life.

H3a: Ceteris paribus, firms in high-masculinity countries adopt fewer environmental management practices (EMPs).

When it comes to implementation, a national culture that is high in femininity places a high value on good working relationships with direct superiors and there is better cooperation among individuals (Hofstede, 1980, 2001). In contrast, in a high-masculinity culture, there is less appreciation for cooperative behavior (Ho *et al.*, 2012). Successful EMP implementation calls for cooperation and consensus (Hunton-Clarke, Wehrmeyer, Clift, Mckeown, & King, 2002; Wu, Melnyk, & Calantone, 2008), which is more prevalent in feminine cultures. Further, in high-masculinity cultures, companies are more interested in the pursuit of material goals and they may direct more resources to the implementation of other projects or systems that directly contribute to better economic performance (Husted, 2005). Given those reasons, EMPs will be better implemented in more feminine cultures.

H3b: EMPs will be more effective in firms in in low-masculinity countries.

2.4.4. Uncertainty Avoidance

Uncertainty avoidance measures the degree to which people within a culture are made uncomfortable by situations they perceive to be unstructured, unclear or unpredictable (Hofstede, 1980, 2001). A country that scores high on uncertainty avoidance opts for stiff codes of behavior, guidelines, regulations, and laws to reduce or manage uncertainty and ambiguity (Hofstede, 1984a). Conversely, a low uncertainty avoidance culture is less afraid of unknown future and does not rely as heavily on rule-oriented mechanisms for uncertainty mitigation (Hofstede, 1997). Members in such cultures are more willing to take risks (Hofstede, 1984b) and this risk taking is highly correlated with unethical actions (Rallapalli,

Vitell, Wiebe, & Barnes, 1994), which include neglecting environmental impacts of corporate operations. On the contrary, firms in high uncertainty avoidance cultures will be more responsive to address their environmental impacts and minimize potential risks. The following hypothesis is thus proposed.

H4a: Ceteris paribus, firms in high uncertainty avoidance countries adopt more environmental management practices (EMPs).

High uncertainty avoidance can be helpful for implementation (Nakata & Sivakumar, 1996). Members in high uncertainty avoidance cultures seek orderliness, consistency, structure, and formalized procedures (Triandis, 1989). They emphasize controls and planning for future uncertainty, which helps ensure that the intertwined details of EMPs are reviewed and considered, which will subsequently be beneficial to the successful implementation of EMPs. Consistent planning and monitoring also reduce the possibility of errors during implementation processes. So a high uncertainty avoidance culture is conducive to the effective implementation of EMPs.

H4b: EMPs will be more effective in firms in high uncertainty avoidance countries.

2.4.5. Long-term/Short-term Orientation

This dimension measures the time orientation of a society and infers a tendency to emphasize the future or the present (or the past) in values and attitudes (Hofstede, 1980). A short-term oriented culture will honor traditions and steadfastness and the focus is on the past and present, while a long-term oriented culture views adaptation as a necessity and focuses on long-term strategies and goals. Sustainable development and environment preservation concerns envisioning a desirable future state where there are enough planetary resources for use by future generations; sustainability is long-term oriented by nature (Tata & Prasad, 2015). Further, EMPs may be seen as having longer payoff periods (Conrad, 2003).

Therefore, companies in long-term oriented cultures are more future-oriented and more likely to adopt EMPs and improve their environmental performance. The stakeholders will also appreciate the importance of sustainable operations and urge companies to be more environmentally responsible. On the contrary, firms in short-term oriented cultures are slow in change and adoption of EMPs as they are more interested in immediate economic returns (Tata & Prasad, 2015).

H5a: Ceteris paribus, firms in long-term oriented countries adopt more environmental management practices (EMPs).

A reason for companies to adopt EMPs is for their operations to leave a smaller impact on the natural environment and sustain finite natural resources necessary to provide for the needs of future generations on the planet. This goal is well aligned with the mindset of companies in long-term oriented cultures and this alignment is conducive to the effective implementation of EMPs. Companies in short-term oriented cultures are less willing to undertake changes that do not pay off in the short run. EMPs thus will be more effectively implemented in companies in long-term oriented cultures. In other words, since EMPs tend to have longer payback periods (Conrad, 2003), firms in long-term oriented cultures can be expected to have the patience to implement EMPs so as to extract maximum value over the long term.

H5b: EMPs will be more effective in firms in long-term oriented countries.

2.4.6. Indulgence/Restraint

The indulgence-restraint dimension is the most recently proposed dimension in Hofstede's model of national culture (Hofstede, Hofstede, & Minkov, 2010) and due to its relative newness, it has not been used in SCM research much. It measures whether or not simple joys are fulfilled and refers to the degree to which people emphasize pleasure as

opposed to duty (Hofstede *et al.*, 2010). An indulgent culture is one that allows relatively free gratification of basic and natural human desires related to enjoying life and having fun (Minkov & Hofstede, 2010). Its counterpart is a culture in which gratification of basic and natural needs is controlled and strict social norms are in place. A high-indulgence culture will value freedom in choice of personal behaviors. In a low-indulgence (*i.e.*, restrained) culture, people tend to endorse the work ethic, emphasizing the importance of responsibility in a social or working environment (Zhou, Jin, Fang, & Vogel, 2015). For them, personal freedom and pleasure can be sacrificed for responsibility. Therefore, companies in low-indulgence cultures will be more willing to sacrifice their personal interests and be more responsible for the natural environment, so will their stakeholders and governments. These companies will be more willing to embrace EMPs.

H6a: Ceteris paribus, firms in low-indulgence countries adopt more environmental management practices (EMPs).

In an indulgent culture, employees are freer to express their own concerns and satisfy their own desires. More supervision is supposedly needed for good implementation of new policies in such a culture as employees do not like to stick to rigid rules. While in a restraint culture, employees are more disciplined (voluntarily or reluctantly) and think work and responsibility are more important than other things, especially individual desires (Hofstede, 2010). As such, EMP implementation will be easier in companies in restrained cultures. EMPs will thus be more effective in such companies.

H6b: EMPs will be more effective in firms in low-indulgence countries.

3. Methodology

3.1. Data

This study uses three sources of data. The first is the Hofstede cultural dimensions data, available at https://geert-hofstede.com/national-culture.html. The second is the fifth round survey data collected by the Global Manufacturing Research Group (GMRG), which will be described below. We also used data from World Bank Database.

The GMRG is a multinational community of researchers studying the improvement of manufacturing practices worldwide and consists of leading academic researchers from over 20 countries who developed a validated survey instrument that is administered to manufacturing plant managers and directors in multiple countries. The respondents were encouraged to seek input from other functions if needed. As a result, for each plant up to six respondents were involved in filling in the questionnaire. The questionnaire is translated into the native languages of respective countries from the English original with the goal of ensuring equivalency of meaning, validity, and reliability of the survey. The questionnaire is also revised periodically to keep the content of the questions in line with developing issues of interest to the operations management research community. After administration of the survey in various countries, the data are pooled, validated, and re-distributed to the participating members of the group. This study uses a subset of the data collected in the fifth round of the survey. More information is available at http://gmrg.org/. As Durach and Wiengarten (2017) detail, the GMRG process includes checks for non-response bias.

The dataset started with 765 firms. Those with missing data (79 firms) were removed. The responses were further reviewed and unengaged responses were removed, which led to a sample of 629 firms from 10 countries. Table 1 briefly summarizes these firms by size as measured by number of employees in the plant. Researchers using the GMRG data are at the

mercy of the GMRG data collectors with regards to which countries are represented in the final data set. In other words, though having data from Country X might be useful for theoretical reasons, if no GMRG researcher collected data there, it is simply not available. The countries included in this study represent a wide array of economic development, national cultures, and geographic diversity. Thus, we believe this makes the results generalizable.

Table 1 *Sample demographics*

Country	N	Percentage	No. of plant employees			
			<=50	50-100	100-500	>500
Australia	50	7.9%	22	13	9	6
China	64	10.2%	0	1	19	44
Croatia	106	16.9%	73	17	14	2
Hungary	28	4.5%	1	7	17	3
India	55	8.7%	0	1	35	19
Ireland	27	4.3%	3	7	16	1
Korea	62	9.9%	31	9	13	9
Poland	62	9.9%	36	17	7	2
US	102	16.2%	17	24	38	23
Vietnam	73	11.6%	4	23	41	5
Total	**629**					

3.2. Measurement Assessment

The GMRG data includes measures for internal monitoring, supplier monitoring, and environmental management systems (EMS). They represent the three types of EMP adoption. Further, a measure of firm environmental performance is included. Table 2 gives the wording for each item. The scales have also been validated in previous rounds and as such were expected to show high reliability and validity.

Reliability is tested based on Cronbach's alpha value. All of the coefficients of reliability measures for the constructs exceeded the threshold value of 0.70, which is desirable (Nunnally, 1978). All of the Cronbach's alphas for the four latent variables are

significant at α=0.05. The results (Table 2) suggest high internal consistency of measurement indicators and, hence, the reliability of each construct is established. Convergent validity can be assessed from the measurement model by checking if each indicator's estimated loading on its posited underlying construct is significant (Anderson & Gerbing, 1988). Table 2 summarizes the standardized loadings and p-values. All items load significantly on the hypothesized constructs and it provides evidence of convergent validity. Discriminant validity is assessed by examining if the average variance extracted by the items of a construct is greater than the average shared variance (square of the correlations in the off-diagonals) between two constructs (Fornell & Larcker, 1981). All constructs pass this test, supporting discriminant validity. Overall, the measurement model has a good model fit.

Common method bias arises from having a single respondent, a common measurement context, or the characteristics of the measures themselves (*e.g.*, perceptual measures) (Podasakoff, MacKenzie, Lee, & Podsakoff, 2003). It can inflate relationships among variables as it induces correlations that would not otherwise exist or be weaker in real settings. Though three sources of data are used, all firm-level measures come from the GMRG dataset and for that a check of common method bias is warranted. The GMRG questionnaire has been designed to minimize such bias by guaranteeing response anonymity and confidentiality. This is a practice commonly used by researchers to reduce common method bias (Podasakoff *et al.*, 2003). Following the statistical remedies suggested by Podsakoff and Organ (1986) and Podasakoff *et al.* (2003), Harman's one-factor test (Harman, 1976) was conducted. An exploratory factor analysis was performed for all items and it was found that no single factor can account for a majority of the variance. The concerns of common method bias are thus alleviated.

Table 2 *Measurement assessment*

Construct	Items	Mean	S.D.	Standardized Loading	Cronbach's Alpha
During the past two years, to what extent did you engage in the following activities? (1=Not at all, 4=Some extent, 7=Great extent)					
Internal Monitoring	We actively monitored energy usage in our facilities	5.18	1.44	0.736	0.85
	We actively monitored water usage in our facilities	4.97	1.58	0.791	
	We actively monitored waste re-usage at our facilities	4.78	1.69	0.692	
	We actively monitored carbon usage at our facilities	4.11	1.88	0.693	
During the past two years, to what extent did you engage in the following activities? (1=Not at all, 4=Some extent, 7=Great extent)					
Supplier Monitoring	We provided major suppliers with written environmental requirements and monitored these	3.83	1.80	0.885	0.943
	We sent environmental questionnaires to major suppliers in order to monitor their compliance	3.51	1.84	0.917	
	We monitored major suppliers commitment to environmental improvement goals	3.68	1.80	0.918	
	We conducted environmental audits of major suppliers' operations	3.43	1.87	0.874	
Compared to the leaders in your industry in environmental management, to what extent does your plant engage in the following activities within your facility? (1=Far less, 4=About the same, 7=About the same)					
Environmental Management Systems	We systematically control the environmental impact of our products and processes	4.69	1.50	0.866	0.96
	We implement a systematic approach to setting environmental targets	4.64	1.53	0.950	
	We implement a systematic approach to achieving environmental targets	4.59	1.55	0.947	
	We implement a systematic approach to demonstrating that environmental targets have been met	4.57	1.53	0.958	
During the past two years, please indicate the extent to which your plant has performed from an environmental perspective: (1=Not at all, 4=Some extent, 7=Great extent)					
Environmental Performance	We have reduced energy use in our facilities	4.72	1.47	0.862	0.907
	We have reduced water use in our facilities	4.53	1.58	0.866	
	We have reduced waste at our facilities	4.75	1.47	0.833	
	We have reduced emissions at of our facilities	4.40	1.65	0.851	
Model Goodness of Fit Statistics: Chi-square=399.948, Chi-square/df=4.255, NFI=0.959, RFI=0.948, IFI=0.969, TLI=0.960, RMSEA=0.072.					
Note: All items significant at p< .001 level.					

GMRG undertakes efforts to reduce social desirability bias, which refers to the tendency of study participants to provide answers that they believe will be viewed favorably by the researcher (Crowne & Marlowe, 1960). In order to solicit candid responses from respondents, the GMRG questionnaire ensures confidentiality and anonymity for respondents and their employers; further, respondents are asked to answer questions in terms of the activities of the plant in general rather than the actions of themselves as individuals. This type of questioning has been shown to be effective in lowering social desirability bias (Armacost, Hosseini, Morris, & Rehbein, 1991; Rudelius & Buchholz, 1979).

3.3. Control Variables

Large companies have more resources to allocate to environmental management (González-Benito & González-Benito, 2006b; Melnyk, Sroufe, & Calantone, 2003); they are also under greater scrutiny from consumers, regulators, investors and other stakeholders (Freedman & Jaggi, 2010; Hall, 2000). It is thus intuitive that larger companies tend to adopt more EMPs and there is also empirical evidence in the literature that supports the significant role of firm size in environmental management. For instance, Arora and Cason (1996) found a positive and significant relationship between firm size and participation in voluntary environmental programs, and King and Lenox (2001) observed that the adoption the ISO14001 standard is positively related to production facility size. Given the important role of firm size in environmental management, we include it as a control variable and it is measured by number of employees.

The other control variable that we include is GDP per capita as a proxy for economic development. Differences in national wealth can possibly account for differences in EMP adoption and environmental performance of firms in different countries (Azadegan et al., 2017). Wealthier countries also have more and better resources to enable better

implementation of EMPs (Ho et al., 2012; Husted, 2005; Inglehart, 1990). Previous research also found that the level of environmental concern and knowledge of people in a certain country is correlated with the country's wealth (Diekmann & Franzen, 1999; Husted, 2005) and that citizens in wealthier nations express greater concerns for the natural environment and demand higher environmental quality of life (Franzen, 2003). GDP per capita of 2014 is used in order to match the collection timeframe of the GMRG fifth round. GDP per capita data is from the World Bank Database (World Bank, 2017).

3.4. Data Analysis

In our dataset, the variables are measured at two different levels. HLM is thus employed for our analysis. HLM can resolve the various problems inherent in traditional regression methods of dealing with cross-level relationships, such as aggregation and disaggregation bias, misestimated precision, and unit of analysis problems (Bryk & Raudenbush, 1992; Hofmann, 1997; Raudenbush & Bryk, 2002; Woltman, Feldstain, MacKay, & Rocchi, 2012). HLM also accounts for differing sample sizes within clusters that otherwise would lead to biased results (Raudenbush & Bryk, 2002). With HLM, one can readily test hypotheses between different levels of analysis and partition explained variances from each level.

Random-intercept Models. There are two sets of hypotheses to test in this study and two independent sets of HLM analysis are performed. To test the relationship between Hofstede cultural dimensions and firm adoption of EMPs, random-intercept models (Geiser, 2012; Raudenbush & Bryk, 2002) are estimated for each type of firm EMP adoption: internal monitoring, supplier monitoring, and EMS. A typical two-level random-intercept model can be expressed as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_1 X_{ij} + r_{ij}$,
Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01} W_j + u_{0j}$,

where r_{ij} represents a random error and u_{0j} is a random effect of the jth cluster. In this model, the level-1 intercept β_{0j} is modeled as a function of the level-2 covariate, *W*. The motivation of this model is the question if the level-1 intercept varies across groups or clusters and can be predicted by the level-2 covariate. Note that the two equations are not estimated one after another but simultaneously as one whole model as follows:

$Y_{ij} = \gamma_{00} + \gamma_{01} W_j + \beta_1 X_{ij} + u_{0j} + r_{ij}$.

Writing a whole HLM model in several parts is makes equations clearer and avoids very long equations. The random-intercept model for internal monitoring (*INTM*) is shown below for illustration purposes.

Level 1 (firm level):
$$INTM_{ij} = B_{0j} + B_1 Size_{ij} + R_{ij} \tag{1}$$
Level 2 (country level):
$$B_{0j} = \Gamma_{00} + \sum_{k=1}^{6} \Gamma_{0k} * C_{kj} + \Gamma_{07} * GDP_j + U_{0j} \tag{2}$$

$INTM_{ij}$ represents internal monitoring score of the ith firm in country j. C_{kj} is the kth cultural dimension score (C_1 for power distance, C_2 for individualism, C_3 for masculinity, C_4 for uncertainty avoidance, C_5 for long-term orientation and C_6 for indulgence) of country j. In this two-level model, firm size is the predictor variable at the first level. At the second level, the six cultural dimensions and GDP per capita are modeled as covariates, which will predict the intercept of the level-1 model (B_{0j}). In total, three such models are evaluated for the three types of firm EMP adoption. All variables have been standardized to facilitate the interpretation of intercepts and coefficients.

When the number of higher-level units, i.e., countries in our paper, is small, the estimation of parameters using likelihood-based methods, such as maximum likelihood (ML)

or restricted maximum likelihood (REML), may contain bias which can affect inferences (McNeish & Stapleton, 2016). To avoid the potential estimation bias associated with likelihood-based methods when the number of higher-level units is small, we employed Bayesian MCMC estimation methods as a remedy (Gilks, Richardson & Spiegelhalter, 1995). Recent research, such as Austin (2010), Browne and Draper (2006), and Stegmueller (2013), has provided evidence that Bayesian estimates can achieve unbiased estimates with lower numbers of clusters and perform better than likelihood methods even when fewer than ten clusters are present. Different from frequentist inference, Bayesian analysis assumes that all parameters are random variables rather than fixed values, and inferences of the parameters are based on their estimated posterior distributions (Gelman, 2006). A posterior mean estimate and a credible interval are often used in Bayesian analysis, corresponding to a point estimate and a confidence interval for a parameter in frequentist inference. To specify prior distributions for the parameters, we used diffuse priors similar to the ones used in Stegmueller (2013). To estimate the posterior distributions of interest, we adopted MCMC methods. For a parameter, its Bayesian estimates were calculated from a chain run for 13,000 iterations, of which the first 3,000 iterations were discarded and the remaining 10,000 iterations were thinned by a factor of 10. Model selection is often used to remove irrelevant variables and test hypotheses in HLM. In this paper, we use a backward elimination approach. A backward elimination procedure is commonly adopted for model selection in the literature. To determine whether a certain variable or parameter should be removed without a statistically significant loss of fit, we used the deviance information criteria (DIC) (Spiegelhalter et al., 2002) for a measure of model fit. Similar to Akaike information criterion (AIC), a smaller DIC value indicates a better fit. For each elimination step, the

current model is compared with several reduced "leave-one-out" models. A "leave-one-out"

model is a model where one variable in the current model is removed. If more than one

"leave-one-out" models are better than the current model, the best "leave-one-out" model is

the one with the smallest DIC and the elimination procedure proceeds with current model

updated by the best "leave-one-out" model; otherwise, the current model is preferred and the

elimination procedure terminates.

Random-slope Models. The second set of hypotheses, which concerns how Hofstede

cultural dimensions affect EMP effectiveness is tested with random-slope models (also

known as random-coefficients models). In random-slope models, not only does the level-1

intercepts vary with level-2 covariates but also with the level-1 slopes. The starting model is

shown below.

Level 1 (firm level):
$$EP_{ij} = \beta_{0j} + \beta_{1j}\,INTM_{ij} + \beta_{2j}\,SUPM_{ij} + \beta_{3j}\,EMS_{ij} + \beta_4\,Size_{ij} + r_{ij} \tag{3}$$
Level 2 (country level):
$$\beta_{0j} = \gamma_{00} + \gamma_{01}C_{1j} + \gamma_{02}C_{2j} + \gamma_{03}C_{3j} + \gamma_{04}C_{4j} + \gamma_{05}C_{5j} + \gamma_{06}C_{6j} + \gamma_{07}GDP_j + u_{0j} \tag{4}$$
$$\beta_{1j} = \gamma_{10} + \gamma_{11}C_{1j} + \gamma_{12}C_{2j} + \gamma_{13}C_{3j} + \gamma_{14}C_{4j} + \gamma_{15}C_{5j} + \gamma_{16}C_{6j} + \gamma_{17}GDP_j + u_{1j} \tag{5}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21}C_{1j} + \gamma_{22}C_{2j} + \gamma_{23}C_{3j} + \gamma_{24}C_{4j} + \gamma_{25}C_{5j} + \gamma_{26}C_{6j} + \gamma_{27}GDP_j + u_{2j} \tag{6}$$
$$\beta_{3j} = \gamma_{30} + \gamma_{31}C_{1j} + \gamma_{32}C_{2j} + \gamma_{33}C_{3j} + \gamma_{34}C_{4j} + \gamma_{35}C_{5j} + \gamma_{36}C_{6j} + \gamma_{37}GDP_j + u_{3j} \tag{7}$$

In this two-level model, firm environmental performance is predicted by four

variables, internal monitoring, supplier monitoring, EMS and firm size. Firm size is a control

variable. The effects of internal monitoring, supplier monitoring, and EMS, denoted by β_{1j},

β_{2j}, and β_{3j}, will be allowed to vary from country to country and can be predicted by

national cultural dimensions (*C₁-C₆*) and economic development level (*GDP* for GDP per

capita). Recall that similar to our comments on the random-intercept models, in model fitting

and analysis for the random-slope model, equation (3) to equation (7) are combined as a

whole model. Similarly, we used Bayesian MCMC estimation methods for the estimation

and inference of parameters. Again all variables are standardized and the backward

elimination procedure is adopted.

We refer the above random-slope model as "full model". To eliminate unimportant

variables, we propose the following backward elimination procedure based on DIC.

1. Remove the intercept γ_{00} of Equation (4). Since all variables have been standardized, the

intercept turns out to be zero and can be removed. This is also supported by the results from

DIC.

2. Remove level-1 variables one by one until no other level-1 variables can be further

removed.

3. Remove level-2 variables one by one until no other level-2 variables can be further

removed.

4. Remove the remaining statistically insignificant parameter(s) step by step until no

parameters can be further eliminated.

Table 3 below partially shows the details of the backward elimination procedure.

With the backward elimination procedure, unimportant variables are removed and a

final model is selected (shown below from Equation 8 to 12). In this model, power distance

(C_1), masculinity (C_3), Uncertainty Avoidance (C_4), and GDP per capita (*GDP*) are the four

second-level variables that remain. This model is estimated to evaluate the moderating

effects of power distance (C_1), Uncertainty Avoidance (C_4), and GDP per capita. Detailed

results are offered in the next section.

Level 1 (firm level):

$$EP_{ij} = \beta_{0j} + \beta_{1j}(INTM_{ij}) + \beta_{2j}(SUPM_{ij}) + \beta_{3j}(EMS_{ij}) + r_{ij} \quad (8)$$

Level 2 (country level):

$$\beta_{0j} = \gamma_{01}C_{1j} + \gamma_{03}C_{3j} + \gamma_{04}C_{4j} \tag{9}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{17}GDP_j \tag{10}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}C_{1j} + \gamma_{23}C_{3j} + \gamma_{24}C_{4j} + \gamma_{27}GDP_j \tag{11}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}C_{1j} + \gamma_{33}C_{3j} + \gamma_{34}C_{4j} + \gamma_{37}GDP_j \tag{12}$$

Table 3 *Backwards elimination procedure*

Model	Parameter(s) Removed	DIC
Full model		1513.330
Remove intercept of Equation (4)	γ_{00}	1512.324
Remove size	γ_{40} to γ_{47}	1497.992
Remove C_6	γ_{06}, γ_{16}, γ_{26}, γ_{36}	1493.294
Remove C_5	γ_{05}, γ_{15}, γ_{25}, γ_{35}	1490.861
Remove C_2	γ_{02}, γ_{12}, γ_{22}, γ_{32}	1488.317
Remove INTM*C_1	γ_{11}	1486.762
Remove INTM*C_4	γ_{14}	1484.944
Remove INTM*C_3	γ_{13}	1484.180

Aside from backward elimination process, two other models are estimated. The first

one is a simple linear regression model with the firm size only. This model, referred to as

Model 0, is estimated to test the effect of firm size on firm environmental performance. The

second model is a multiple regression model with effects of EMP adoption added to Model 0

to test EMP adoption's effect on environmental performance. This model is called Model 1.

Model 0, Model 1, and the Final Model are all nested models.

4. Results

4.1. Random-intercept Models

The first set of analyses (with "a" in their hypothesis labels) is performed to test the relationship between national cultural dimensions and firm EMP adoption levels. The results are presented in Table 4. Following the backward-fitting approach, dimensions that are removed during the process are noted with an "n.s." designation. Two of the three EMPs (internal monitoring and EMS) are significantly related to power distance, but not in the direction hypothesized, so H1a is not supported. An illustration of the relationship between internal monitoring and power distance is exemplified in Figure 4. Only one EMP is significantly related to individualism, i.e., supplier monitoring. However, this is opposite to what we hypothesized. H2a is thus not supported. For masculinity, it is positively related to internal monitoring and negatively related to supplier monitoring. So H3a is supported for supplier monitoring but not internal monitoring. Uncertainty avoidance, long-term orientation, and indulgence are all negatively related to supplier monitoring and EMS. No support was found for H4a and H5a. H6a is supported. For the two control variables, firm size is not significantly related to internal monitoring and EMS, but positively related to supplier monitoring. This indicates that small companies can have the same level of internal monitoring and EMS as large ones, while large companies seem to be monitoring suppliers' environmental performance more closely. GDP per capita is positively related to supplier monitoring and EMS, but is not related to internal monitoring. This means that more economically developed countries tend to have more supplier monitoring activities and higher levels of EMS.
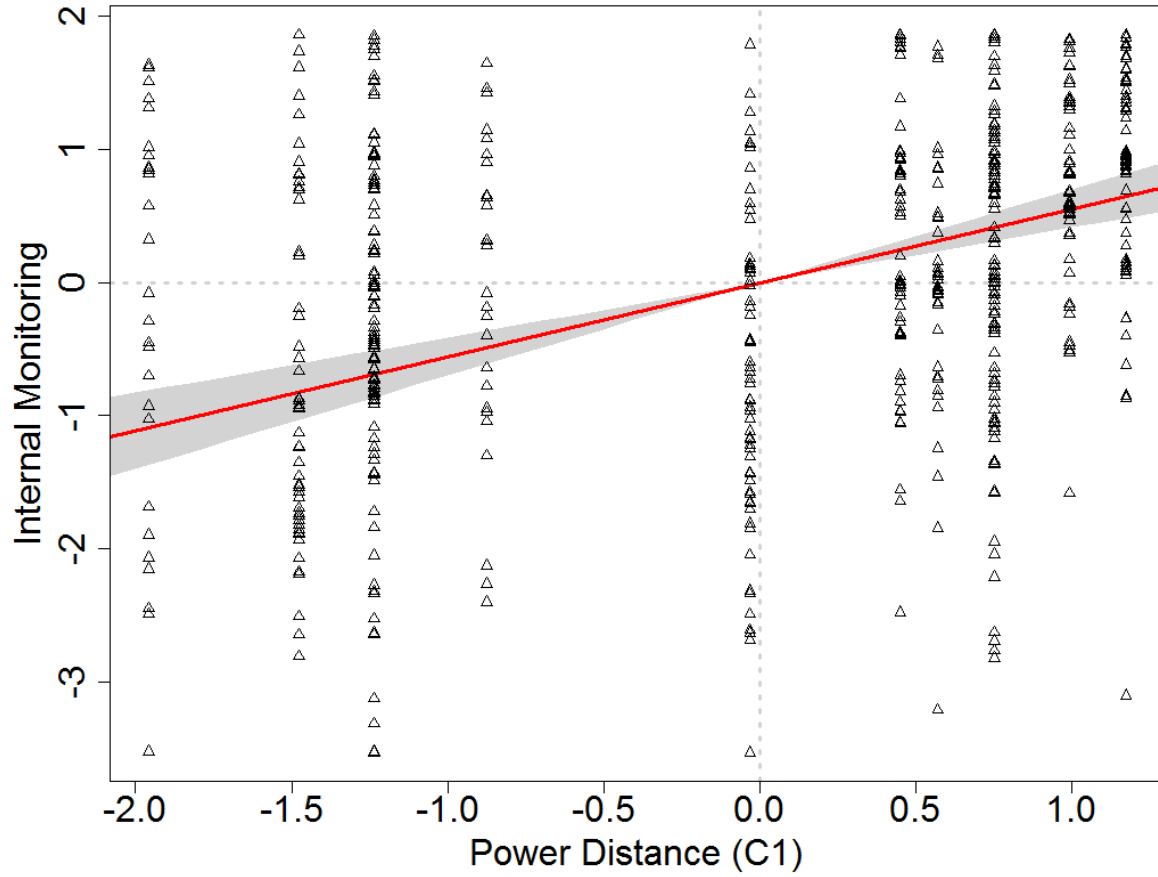
Figure 4 *The relationship between internal monitoring and power distance*

Table 4 *Results of random-intercept models*

Hypothesis Tested		1a	2a	3a	4a	5a	6a
EMP	Cultural Dimension	Power Distance	Individualism	Masculinity	Uncertainty Avoidance	Long-term Orientation	Indulgence
Internal Monitoring	Posterior mean	0.555***		0.265***			
	95% Lower bound	0.413	n.s.	0.149	n.s.	n.s.	n.s.
	95% Upper bound	0.699		0.396			
Supplier Monitoring	Posterior mean		0.771*	-0.505**	-1.034***	-1.062***	-4.382***
	95% Lower bound	n.s.	0.172	-0.803	-1.312	-1.506	-5.399
	95% Upper bound		1.292	-0.221	-0.762	-0.685	-3.389
EMS	Posterior mean	0.474*			-0.343**	-0.554**	-1.521**
	95% Lower bound	0.116	n.s.	n.s.	-0.580	-0.864	-2.406
	95% Upper bound	0.830			-0.130	-0.194	-0.618
Note: *** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$.							

4.2. Random-slope Models

To test the second set of hypotheses (with "b" in their hypothesis labels) on the

effects of national cultural dimensions on the effectiveness of EMPs, random-slope models

are adopted. Two more nested models are estimated (Model 0 and Model 1). Detailed results

are presented in Table 5.

Table 5 *Results of random-slope models*

Variable	Parameters	Model 0 95% CI	Model 1 95% CI	Final Model 95% CI
Firm size	γ_{40}	0.150** (0.058, 0.024)	n.s.	
Internal Monitoring	γ_{10}		0.471*** (0.401, 0.543)	0.411*** (0.321, 0.485)
Supplier Monitoring	γ_{20}		0.122*** (0.071, 0.179)	0.110* (0.040, 0.189)
EMS	γ_{30}		0.180*** (0.097, 0.252)	0.165** (0.070, 0.260)
Power Distance	γ_{01}			n.s.
Masculinity	γ_{03}			n.s.
Uncertainty Avoidance	γ_{04}			n.s.
Internal Monitoring *GDP per Capita	γ_{17}			0.112** (0.028, 0.198)
Supplier Monitoring *Power Distance	γ_{21}			-0.305** (-0.477, -0.115)
Supplier Monitoring *Masculinity	γ_{23}			-0.114* (-0.205, -0.035)
Supplier Monitoring* Uncertainty Avoidance	γ_{24}			n.s.
Supplier Monitoring *GDP per Capita	γ_{27}			-0.321** (-0.494, -0.148)
EMS*Power Distance	γ_{31}			0.444** (0.222, 0.692)
EMS*Masculinity	γ_{33}			0.127* (0.031, 0.229)
EMS* Uncertainty Avoidance	γ_{34}			n.s.
EMS*GDP per Capita	γ_{37}			0.395** (0.184, 0.619)
DIC		1992.718	1535.441	1484.180
Note: *** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$;				

In Model 0, only size is modeled to predict firm environmental performance. It is

found that size is positively related to environmental performance, suggesting that large firms

tend to have better environmental performance. In Model 1, where the fixed effects of firm

EMP adoption are added, the firm size effect becomes insignificant. The three types of EMPs (internal monitoring, supplier monitoring, and EMS) all have significant positive effects on firm environmental performance. Internal monitoring has the strongest impact (γ_{10}=0.471), and supplier monitoring (γ_{20}=0.122) and EMS (γ_{30}=0.180) are also related. This finding empirically attests to the positive association between firm EMP adoption and environmental performance, just as the other studies have found (*e.g.*, Klassen & Whybark, 1999; Montabon, Sroufe, & Narasimhan, 2007; Paulraj & de Jong, 2011; Tang, Lai, & Cheng, 2016; Geng, Mansouri, & Aktas, 2017). The random-slope analysis with the backward elimination procedure using Bayesian MCMC estimation methods helps identify the significant cultural dimensions that affect EMP effectiveness and tests hypotheses 1b, 2b, 3b, 4b, 5b and 6b. Results from the Final Model reveal that EMP implementation is indeed different across cultures—power distance and masculinity are the two cultural dimensions that have significant impacts on EMP effectiveness. The other four Hofstede cultural dimensions—individualism, uncertainty avoidance, long-term orientation, and indulgence, are not significantly related to EMP effectiveness. GDP per capita, a proxy for economic development, also significantly affects EMP effectiveness. More detailed interpretation of these effects is presented below.

4.2.1. Internal Monitoring Effectiveness

Internal monitoring has a significant positive effect on environmental performance. This direct effect (β_{1j}) turns out to be contingent on economic development level, but none of the cultural dimensions. Therefore, hypotheses 1b, 2b, 3b, 4b, 5b, and 6b are not supported for internal monitoring effectiveness. Internal monitoring effectiveness (β_{1j}) increases with economic development level, indicating that internal monitoring is more effective in more

developed countries. Figure 5 shows the relationship between economic development level and internal monitoring effectiveness ($\beta_{1j} = \gamma_{10} + \gamma_{17}GDP_j$). It is noteworthy that internal monitoring almost always has a positive impact on firm environmental performance. In our sample, in every culture, internal monitoring has a positive impact.
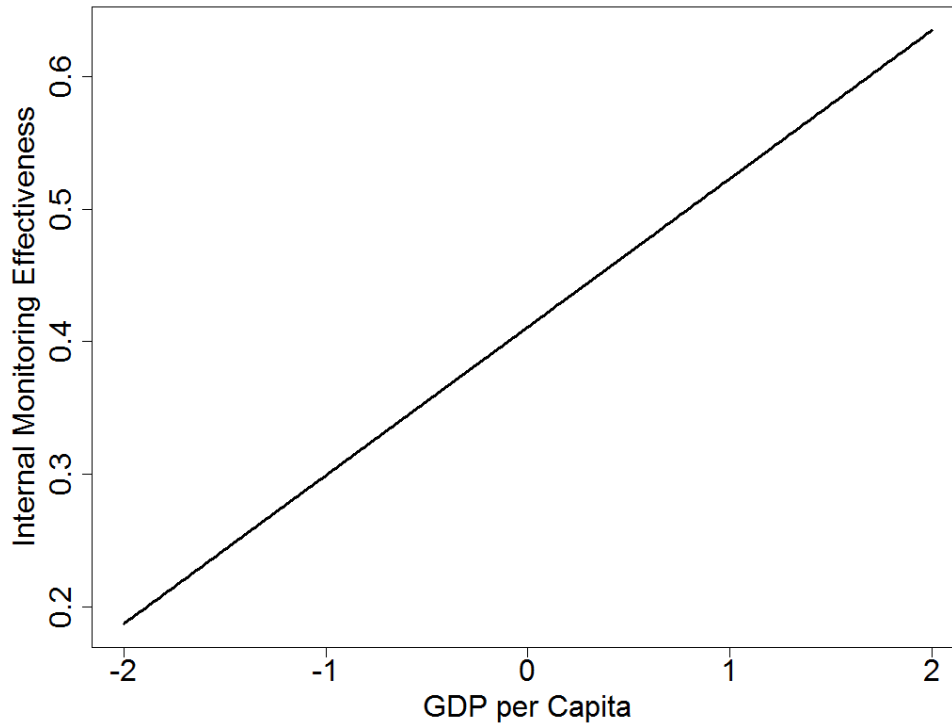
Figure 5 *Relationship of GDP per capita to internal monitoring effectiveness*

4.2.2. Supplier Monitoring Effectiveness

Supplier monitoring effectiveness (β_{2j}) is related to two cultural dimensions (power distance and masculinity) and national economic development level. γ_{20} (0.116) is the value of supplier monitoring effectiveness when power distance, masculinity, and GDP per capita are all at the average levels of the ten countries in the sample. All three variables are negatively related to supplier monitoring effectiveness, suggesting supplier monitoring efforts lead to better environmental performance when a firm is in a country featuring low power distance, low masculinity, and low economic development level. Thus H3b is

supported for supplier monitoring effectiveness but not H1b, H2b, H4b, H5b or H6b. Details

of the relationships ($\beta_{2j} = \gamma_{20} + \gamma_{21}C_{1j} + \gamma_{23}C_{3j} + \gamma_{27}GDP_j$) are pictured in Figure 6. It is

worth noticing that because the three level-2 predictors are all negatively related to supplier

monitoring effectiveness, supplier monitoring can have a negative effect as these level-2

predictors increase. As indicated by the magnitudes of γ_{21}, γ_{23} and γ_{27}, masculinity has a

smaller effect on supplier monitoring effectiveness than power distance and national

economic development level.
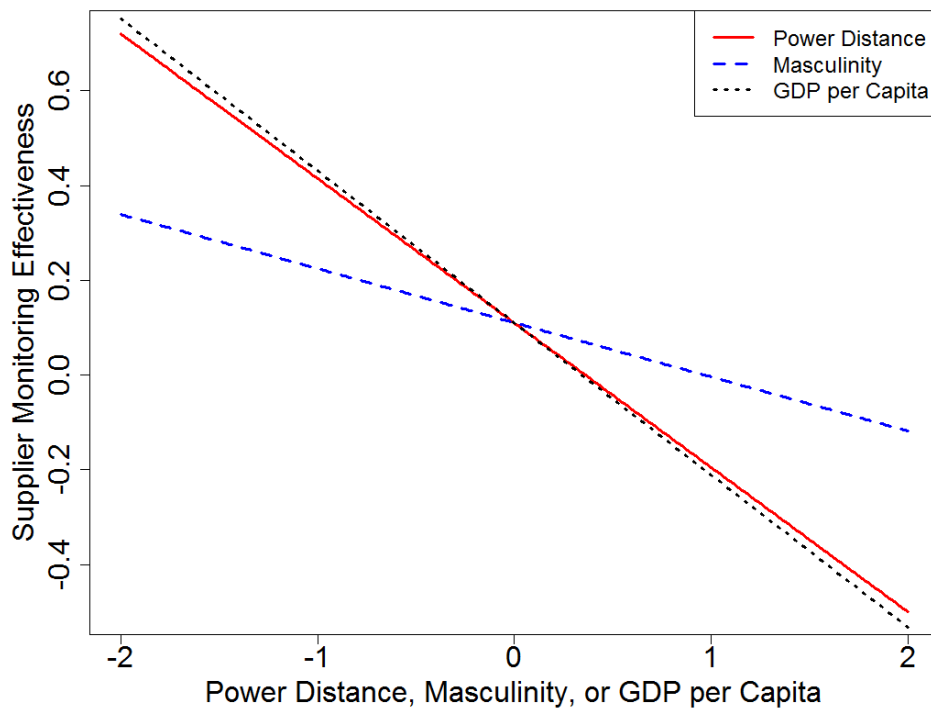
Figure 6 *Relationship of* power distance*, masculinity and GDP per capita to supplier monitoring effectiveness*

4.2.3. EMS Effectiveness

The direct effect of EMS on firm environmental performance is represented by β_{3j},

which becomes γ_{30} when power distance, masculinity, and GDP per capita are all at the

average levels of the ten countries (see Equation 13). Power distance, masculinity, and

national economic development level are all positively related to EMS effectiveness. Stated differently, EMS is more effective in firms that are in a country that features high power distance, high masculinity and high GDP per capita. By comparing the magnitudes of γ_{31} (0.440), γ_{33} (0.142) and γ_{37} (0.376), it can be concluded that power distance and national economic development level have stronger effects than masculinity. For EMS, H1b is supported, but not H2b, H3b, H4b, H5b or H6b. Figure 7 shows the relationship between EMS effectiveness and the three level-2 variables ($\beta_{3j} = \gamma_{30} + \gamma_{31}C_{1j} + \gamma_{33}C_{3j} + \gamma_{37}GDP_j$).
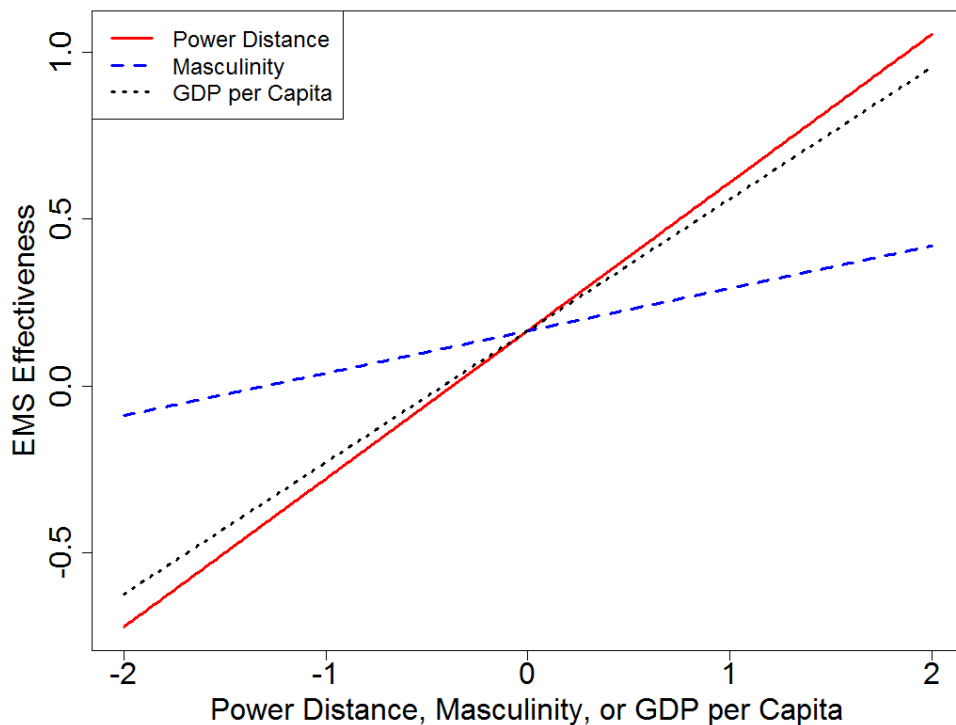

Figure 7 *relationship of power distance, masculinity and gdp per capita to ems effectiveness*

5. Discussion

This study investigates two related issues. The first is the effect of national culture on firm EMP adoption. Previous research used linear regression models or Pearson correlation coefficients and showed that national culture does affect firm environmental management

initiatives and that EMP adoption level is different in different cultures (Hackert *et al.*, 2012; Husted, 2005). EMP adoption represents the missing link between national culture and environmental performance that the extant literature on the relationship between national culture and environmental performance has overlooked, which may explain the previous equivocal findings regarding this relationship. Employing a more appropriate statistical method—HLM and Bayesian MCMC estimation methods, we found that all cultural traits can have an influence on firm EMP adoption.

The second issue is how national culture affects EMP effectiveness as the implementation of policies and practices is influenced by national culture (Husted, 2005). This paper argues specifically that the implementation of EMPs is affected by national culture and empirically tests it. To the best of our knowledge, the effects of national culture on EMP effectiveness have not been examined in the extant literature. A better understanding of cultural impact may allow environmental degradation to be minimized in the process of economic growth and globalization. HLM analysis shows that the effects of EMPs on firm environmental performance are contingent on two cultural traits (power distance and masculinity) and national economic development level. Below we describe the theoretical and managerial implications of our findings.

5.1. Theoretical Implications

5.1.1. National Culture and Firm EMP Adoption

With the first set of hypotheses this study aims to test the relationship of national cultural dimensions to firm EMP adoption. It is believed that national culture affects firm adoption of management practices (Denison & Mishra, 1995; Husted, 2005; Rungtusanatham et al., 2005). Using random-intercept models, this study found that all cultural dimensions are associated with firm EMP adoption.

Specifically, power distance is positively related to internal monitoring and EMS; individualism is positively related to supplier monitoring; masculinity is positively related to internal monitoring but negatively related to supplier monitoring; uncertainty avoidance, long-term orientation, and indulgence are all negatively related to supplier monitoring and EMS.

In countries with high power distance, where people accept the hierarchical orders in which everybody has a place and power is unequally distributed, companies are more engaged in internal monitoring and EMS. This is opposite to what was hypothesized. In our dataset, China, India, and Vietnam are high in power distance and are all developing countries that have contributed greatly to the world's industrial output in the past decade. Rising pollution follows the industrialization of developing countries (Simpson, 2012). Severe pollution problems, more stringent governmental regulations, and increasing consumer awareness may pressure firms in developing countries to put more efforts into environmental management. Given their initially low environmental engagement and poor performance, we see a greater increase in EMP adoption in developing countries compared with their counterparts in developed countries; firms in developing countries appear to be able to reap the low-hanging fruits. Our finding is consistent with what some previous studies have found. For example, Lo, Fryxell, & Tang (2010) have found in their study that increased vibrancy in green civic engagement has been seen in developing countries; Schoenherr (2012) suggested that recent emphasis on environmental initiatives has been greatest among plants located in emerging economies, compared to their counterparts in industrialized and developed nations. Power distance is not related to supplier monitoring level though.

Individualism is found to be positively related to supplier monitoring but non-related to internal monitoring or EMS. This is similar to what some previous research has found (*e.g.*, Husted, 2005; Peng, Dashdeleg, and Chih, 2012; Scholtens and Dam, 2007; and Vachon, 2010). A nation with a high degree of individualism is one where ties between individuals are loose and group cohesiveness does not matter as much. Its members confer a particular importance to free and voluntary association as well as to individual initiative (Husted, 2005; Vachon, 2010). Such characteristics might be less tolerant of environmental malpractices. Although managing the natural environment for sustainable development is a collective cause, because of collectivistic cultures' emphasis on group cohesiveness, there will be less challenge of the status quo. In more masculine countries where more value is placed on material success and competition, more internal monitoring practices and less supplier monitoring can be expected while we hypothesized that the association between masculinity and EMP adoption is negative. Internal monitoring is concerned with improving the focal firm's own environmental performance and the benefits can be easily discerned. While monitoring supplier's environmental performance is beneficial to the supply chain in question in the long run, its benefits can be overlooked and not appreciated by buying firms. Previous research has found that supplier monitoring does not have a significant impact on focal firm environmental performance (Tachizawa, Gimenez and Sierra, 2015). This might be the reason why masculine cultures are associated with more internal monitoring but not supplier monitoring. Vachon (2010) did not find any significant association between masculinity and environmental management, neither did Hackert *et al*. (2012).

The link between uncertainty avoidance and two of the three EMPs (supplier monitoring and EMS) is negative. This is the same as what Vachon (2012) has found, while a

few other studies found that the link between uncertainty avoidance and corporate social sustainability performance is positive, such as, Ho *et al.*, 2012 and Peng *et al.*, 2012. When a nation is more uncertainty avoiding, it opts for stiff codes of behavior and guidelines to dispel ambiguity and uncertainty. The benefits of environmental stewardship could be unknown and unappreciated especially when firms and nations place more emphasis on economic development. Supplier monitoring and EMS have a smaller positive impact on environmental performance. The opportunity cost associated with these two EMPs thus can be deemed high. This could be the reason why uncertainty avoidance is negatively related to supplier monitoring and EMS.

Long-term orientation is one of the two newly-added cultural dimensions. We hypothesized that it is positively associated with firm EMP adoption. Nonetheless, this study found that the relationship is found to be negative for supplier monitoring and EMS. More future oriented cultures tend to be associated with lower levels of supplier monitoring and EMS. The explanation for this can be the smaller impact of these two EMPs on environmental performance. Managers might think that in the long run, the efforts might not pay off for these two EMPs. Hackert et al. (2012) found that investments in pollution prevention were positively correlated with long-term orientation. Their results were based on the fourth round of the GMRG data, collected in 2006-2007.

A higher level of supplier monitoring and EMS is also associated with low-indulgence cultures, which emphasize responsibility in social and work contexts. A culture with such an emphasis on responsibility may encourage firms to adopt more EMPs. This finding supports our hypothesis and it is both original and new in that none of the previous studies have included the sixth dimension of the Hofstede framework. It indicates that overall

more restrained culture is more environmentally friendly and more EMPs tend to be adopted in companies in those cultures. We are not able to compare our results with others on this index given ours is the first to include this dimension.

5.1.2. National Culture and EMP Effectiveness

Our second set of hypotheses is concerned with the relationship of national culture to EMP effectiveness. We first examined the impact of EMPs on firm environmental performance. All the three types of EMPs are found to be positively related to firm environmental performance. Internal monitoring shows the highest effect among the three, while supplier monitoring and EMS are also associated with better environmental performance. It has also been found that firm size accounts for a very small portion of variance in firm environmental performance. So large firms do tend to have better environmental performance. As it turns out, EMP effectiveness is related to national culture—the same level of EMP adoption can lead to different levels of improvement in environmental performance in different cultures.

For different EMPs, cultural dimensions have different moderating effects. Specifically, internal monitoring effectiveness is not contingent on any cultural dimensions, which implies that internal monitoring works equally well in different cultures and internal monitoring can significantly improve environmental performance in any culture. Internal monitoring does seem to be more effective in more economically developed countries.

Supplier monitoring is associated with better focal firm environmental performance and its effectiveness is related to two cultural dimensions. Specifically, power distance and masculinity both negatively influence supplier monitoring effectiveness, *i.e.*, supplier monitoring is more effective in low-power-distance and low-masculinity countries. It is also negatively related to economic development level. Supplier monitoring can have a negative

impact on environmental performance when one or more of the contingent factors (power distance, masculinity, and GDP per capita) are high in magnitude. This could explain why previous studies have found that supplier monitoring has no positive effect on focal firm environmental performance (Gimenez, Sierra, & Rodon, 2012; Simpson, Power, & Samson, 2007; Tachizawa *et al.*, 2015). The empirical finding of this paper provides new insights into the role of supplier monitoring in environmental management.

EMS also has a moderate positive effect on firm environmental performance. But EMS may be implemented differently in different cultures and their effectiveness can thus differ across countries. Specifically, this study found that power distance and masculinity both positively moderate the relationship between EMS and environmental performance. EMS is more effective for firms that are in high power-distance and high-masculinity countries. So one can speculate that if a firm views EMS as a means of increasing its competitiveness in the marketplace, once this decision is made, the employees will not only go along with it but also strive to make sure the EMS is as effective as possible. EMS effectiveness is also positively related to national economic development level, which means that EMS is seen more effective in more affluent countries.

EMS effectiveness is different from supplier monitoring effectiveness in that it is positively related to the three contingent factors (two cultural dimensions and GDP per capita) while supplier monitoring is negatively related to all three. It can be inferred that if a firm scores high on supplier monitoring effectiveness, it will score low on EMS effectiveness. To further explore this idea, the relationship between the two is depicted in a graph (Figure 8). The pattern is surprising as there is no reason to expect it; further, the literature does not seem to have investigated it. These results indicate a trade-off between

supplier monitoring and EMS effectiveness, which would imply that firms can do one or the other very well or both just moderately well. One explanation for this could be that firms have limited resources to implement both supplier monitoring and EMS. This implies that they should focus on one of them and they cannot do very well in both.
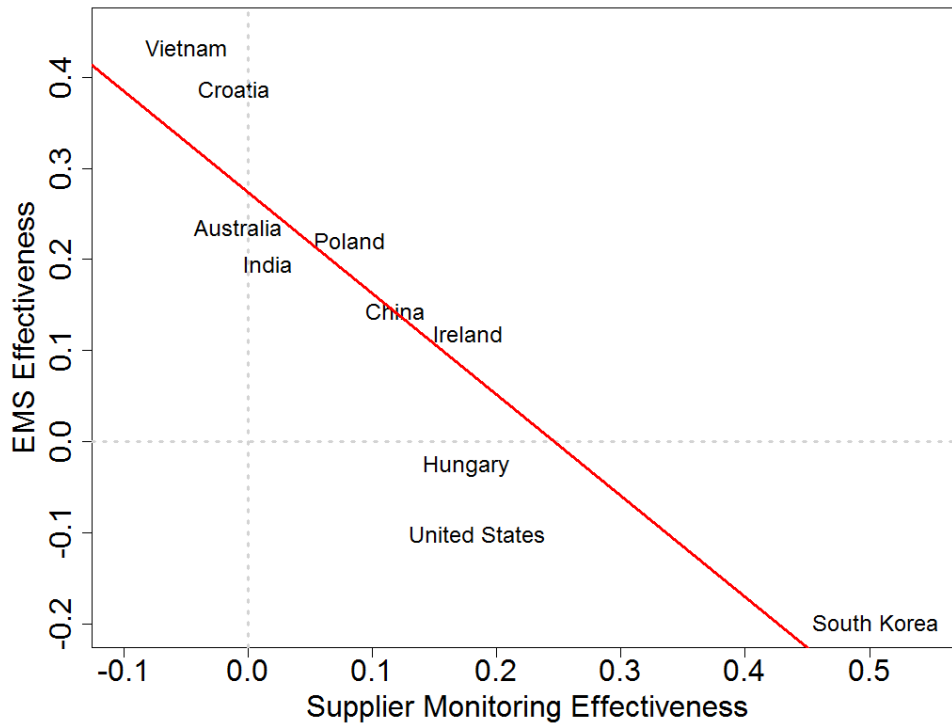
Figure 8 *Supplier* monitoring *effectiveness and ems effectiveness*

5.2. Managerial Implications

As environmental pollution and global warming start to worry governments, investors, and customers, companies are under great pressure to adopt more green management practices to improve their environmental performance. Many MNCs have facilities in different countries and they implement similar environmental management practices in their subsidiaries in hopes of achieving similar environmental performance. Even more companies have supply chain partners that are overseas and they monitor supplier environmental performance by checking whether they have certain EMPs in place. They

might feel assured when they know their international suppliers have adopted enough EMPs. Based on the results of this study, executives and purchasing managers need to take into account cultural elements that affect firm EMP adoption and EMP effectiveness.

Internal monitoring is monitoring energy usage, water usage/re-usage, and carbon usage at the company's own facilities. As suggested by this study, companies in high-power-distance and high-masculinity cultures are more active in internal monitoring. It implies that motivating subsidiaries or suppliers to implement internal monitoring in such cultures may be easier. For opposite cultures, managers need to know that more efforts are warranted to induce a similar level of EMP adoption. Such implications may affect decisions regarding facility location and supplier selection. Internal monitoring is found to be most effective in improving firm environmental performance. Different from supplier monitoring and EMS, internal monitoring works equally effectively in all cultures. This suggests that companies who are eager to improve their environmental performance should start from monitoring their own energy usage, water usage, waste recycling, carbon usage, etc. This is corroborated by the idea of getting your own house in order before asking your supply network to do the same (Arlbjorn, Wong, & Seerup, 2006; Wong, Boon-Itt, & Wong, 2011). Nevertheless, internal monitoring effectiveness does vary with economic development level. Internal monitoring leads to better environmental performance in more developed countries. This finding is consistent with that of Husted (2005), who found that higher "social and institutional capability of a country for environmental sustainability" is associated with higher economic development level.

Supplier monitoring concerns requesting supplier environmental compliance and monitoring suppliers' commitment to environmental improvement goals. Its adoption is

associated with all national cultural dimensions except power distance. Supplier monitoring is more prevalent in more individualistic cultures. It is negatively related to all the other four dimensions (masculinity, uncertainty avoidance, long-term orientation, and indulgence). However, it tends to be more effective in low-power-distance and low-masculinity cultures. Tachizawa *et al.* (2015) found that supplier monitoring alone is not sufficient in improving focal firm environmental performance and it only has an indirect relationship through supplier collaboration. A few other studies found that supplier monitoring is not significantly related to buying firm environmental performance (Gimenez, et al., 2012; Simpson et al., 2007). Firms should be careful when they aspire to improve their environmental performance through monitoring suppliers' EMP adoption and performance. They might need to work more closely with suppliers and provide more resources to suppliers rather than simply monitoring their performance. They should also be aware of the cultural impact on supplier monitoring effectiveness.

EMS is concerned about systematically monitoring and controlling the environmental impact of products and processes. Companies in high-power-distance, low-uncertainty-avoidance, short-term oriented, and low-indulgence cultures are more open to take a systematic approach to environmental management. With respect to EMS effectiveness, it is more effective in firms in high-power-distance and high-masculinity cultures. As such, a systematic approach toward environmental management leads to more improvement in environmental performance in countries like China, Hungary, India, and Poland. Managers when making decisions related to offshoring or global sourcing can keep an eye on the cultural differences and understand how they can cause differences in EMP effectiveness.

6. Conclusion, Limitations and Future Research

This study contributes to the current literature by providing meaningful insights into the role of national culture in environmental management issues. The increasing importance of sustainable supply chain management and the unstoppable trend of globalization make it urgent for companies, investors, and policy makers to understand the impact of cultural differences on environmental management issues. As revealed by this study, national culture does create a difference in adoption of environmental management practices and the effective implementation of these practices. Certain cultural dimensions are statistically strongly related to these environmental management issues. Nevertheless, this study has some limitations.

First, the questionnaire asks how the responding firms are doing in the past two years with respect to EMP adoption and environmental performance. To some extent, the respondents are comparing their performance to what did two years ago. So the measures for EMP adoption and environmental performance are not absolute measures. Future research can use a different data source, where absolute measures are available, to test the model and see whether the results will still hold.

Cross-sectional data is used for this study while it might take a longer time for some EMPs to take effect. For example, supplier monitoring might have a time lag effect. Supplier monitoring will help suppliers improve their environmental performance first and then the supply chain partners can benefit from working with them. This might be the reason why supplier monitoring is not as effective as the other two EMPs. Future research can use longitudinal data to verify whether this conjecture is true.

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CHAPTER 4. ENGAGEMENT AND POWER IN SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Abstract

Firms engage with their supply chain partners in various ways in sustainable supply chain management (SSCM). Previous research mainly studied how the depth of engagement (monitoring or collaboration) affects the focal firm's environmental performance. This study shifts attention to the sustainable outcomes of suppliers in dyadic relationships. It aims to understand dyadic relationships as part of larger industrial networks because of structural embeddedness of supply chain members and interdependency in supply chain relationships. Interaction of dyads with their immediate and non-immediate supply chain partners is considered and the impact of the breadth of environmental engagement in extended supply chains is one focus of the study. Using a novel data set comprised of 1122 dyads, this research found support for the critical role of the breadth of engagement in SSCM. Power's influence is also incorporated into the theoretical framework. It is found that large and powerful companies play more important roles in SSCM.

Keywords: sustainable supply chain management; environmental engagement; power; linear mixed models; dyadic data

Introduction

The diffusion of environmental management techniques via the supply chain is a very important factor that influences the improvement of industrial environmental performance (Lloyd, 1994). Results from the most recent Carbon Disclosure Project (CDP) data show that

"greenhouse gas emissions within the supply chain are often at least four times greater than those from direct operations" (CDP, 2017). There is thus great potential for companies to make their supply chains cleaner. Engaging supply chain partners in sustainable supply chain management is essential to achieving this goal.

Greater collaboration among the members of a supply chain can foster the development of improved environmental systems through both technological innovation and better resource management (Handfield, Walton, Seeger, & Melnyk, 1997; Geffen & Rothenberg, 2000), which can reduce the overall environmental impact across one or more segments of the supply chain. Companies should not consider their own manufacturing operations in isolation; instead it is necessary to incorporate those of others along the supply chain (Klassen & Vachon, 2003). Involving upstream suppliers in environmental management has been a common practice. The role of large buying firms in passing on practices to their suppliers has been considered a key in the development of environmental management (Lamming & Hampson, 1996). While many suppliers might not be under environmental pressure themselves, they are often faced with considerable pressure from their customers (Hall, 2000). As such, they are urged to be more environmentally concerned. With that, the suppliers can also engage with their suppliers to make sure their suppliers are not introducing any potential environmental risks to the supply chain.

While it is common to engage with suppliers in environmental management, downstream customers also play an important role in sustainable business models and customer engagement proves to be another viable approach to successful environmental management (Kiron, Kruschwitz, Reeves, & Goh, 2013). As a significant proportion of their environmental footprint is in product use, some organizations have adopted the idea of

product stewardship, with an assessment of the life-cycle impact of their products (McIntyre, Smith, Henham, & Pretlove, 1998) and assurance of their proper use by customers (Snir, 2001). While such initiatives might not reduce direct greenhouse gas (GHG) emissions of manufacturing firms, it does help cut product life-cycle emissions, thus benefiting other supply chain partners and the supply chain in question.

The connectivity amongst the actors that make up a supply network is critical to sustainable supply chain management (SSCM). Analyzing SSCM phenomena requires a focus on coordination of activities amongst multiple supply chain actors (Meqdadi, Johnsen, & Johnsen, 2018). While previous research recognizes the need for inter-organizational collaboration in sustainability endeavors (Carter & Rogers, 2008; Klassen & Vachon, 2003; Saunders, Kleiner, McCoy, Lingard, Mills, Blismas, & Wakefield, 2015), most if not all extant research focuses on single organizations or dyadic relationships and very few have examined the extended supply chain that is composed of more than two supply chain nodes (Miemczyk, Johnsen, & Macquet, 2012). This paper aims to examine the role of engagement among supply chain partners in environmental stewardship. Specifically, the interaction of a dyad with its immediate or non-immediate partners is considered. Environmental performance of Tier 1 (T1) suppliers of influential buying firms is targeted as our focus as they tend to be neglected and there are greater potentials for these firms to excel in environmental sustainability.

A novel data set with data from the Carbon Disclosure Project in 2017, buyer-supplier relationships as documented in Mergent Horizon, and corporate data from Compustat is used to enable the empirical analysis. First, the impact of a T1 supplier's engagement with its direct suppliers and customers and other supply chain partners on its environmental

performance is investigated. Second, as a buying firm can have multiple suppliers, the buying firm's impact on its suppliers is examined to see how buying firms may be able to influence their suppliers. The buying firm's overall engagement with its supply chain partners and its power are considered. Each buyer has one or more suppliers and some suppliers serve more than one buying firms, leading to the issue of non-independence of responses. To solve this problem, linear mixed models (Jiang, 2007) are adopted to examine the relationships in the framework. Since likelihood-based methods often rely on the assumption of normality of the random effects and errors, a Bayesian approach using Markov chain Monte Carlo (MCMC) methods (Gelman, Carlin, Stern, Dunson, Vehtari, & Rubin, 2013) is employed, which does not impose distributional assumptions.

This paper contributes to the extant literature in the following ways. First, it highlights the important role of suppliers in dyadic relationships in SSCM while most if not all extant literature focuses on buying firms' environmental management. It supplements the current SSCM literature and provides a complete view of the role of engagement in SSCM. Second, it incorporates the extended supply chains of dyadic relationships by examining how engagement with partners of extended supply chains can have an impact on the performance of the suppliers in those dyads. It looks at the breadth of environmental engagement rather than the depth of engagement. Third, the influence of power held by supply chain actors is considered since sustainability requires firms to exercise control, for example through monitoring. A novel non-perceptual measure of power is used in this study. It opens up the possibility of new measures of the power concept.

Literature Review

This study is built on four streams of literature as reviewed below.

Collaboration in Sustainable Supply Chain Management

Manufacturing firms cannot be managed from an isolated perspective; interactions with upstream and downstream supply chain members are necessary in effective supply chain management (Davis, 1993). This holds true for not only core operations in supply chains, but also peripheral and non-core areas, such as environmental sustainability (Vachon & Klassen, 2006).

The discussion of collaboration in SSCM begins with the broader construct of supply chain integration (SCI). SCI is the degree to which an organization strategically collaborates with its supply chain partners and manages key intra- and inter-organizational processes to achieve effective and efficient flows of products, services, information, money, and decisions in the supply chain, with the ultimate goal of providing maximum value to its customers (Bowersox, Closs, & Stank, 1999; Frohlich & Westbrook, 2001; Naylor, Naim, & Berry, 1999). This includes information sharing and coordination between supply chain partners at the operational, tactical, and strategic levels (Stevens, 1989). With SCI, supply chain members manage the supply chain in question as a system. Benefits arise from doing so, as opposed to individually optimizing fragmented subsystems (Watts and Hahn, 1993; Watts, Kim, & Hahn, 1995; Vickery, Jayaram, Droge, & Calantone, 2003).

SCI in sustainability relates to SSCM, which can be defined as "the strategic, transparent integration and achievement of an organization's social, environmental and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its suppliers [and customers]" (Carter & Rogers, 2008; p. 368). SSCM must be viewed as managing sustainability-related activities of two or more transacting organizations. Inter-organizational collaboration thus becomes key in SSCM. The interconnectedness of supply

chain relationships also warrants a more holistic approach to SSCM (Meqdadi et al., 2018).

Benefits of collaboration in environmental management includes increased participation of

supply chain partners, alignment of goals, emergence of creative solutions, more efficient

utilization of resources, reduction in time to achieve environmental goals, enhanced

environmental innovation, greening of production processes, etc. (Poncelet, 2001; Fadeeva,

2004; Rao, 2004; Verghese & Lewis, 2007). It also strengthens the relational ties between

supply chain partners.

No prior research of which this study is aware has examined the collaboration of a

dyadic relationship with its upstream suppliers and downstream customers (Figure 1). A

dyadic relationship, as interconnected and embedded within wider industrial networks, is

connected with its upstream suppliers and downstream customers. Within a dyadic

relationship, the buyer and supplier interact with each other. The dyad inevitably engages

with the upstream suppliers and downstream customers when it comes to environmental
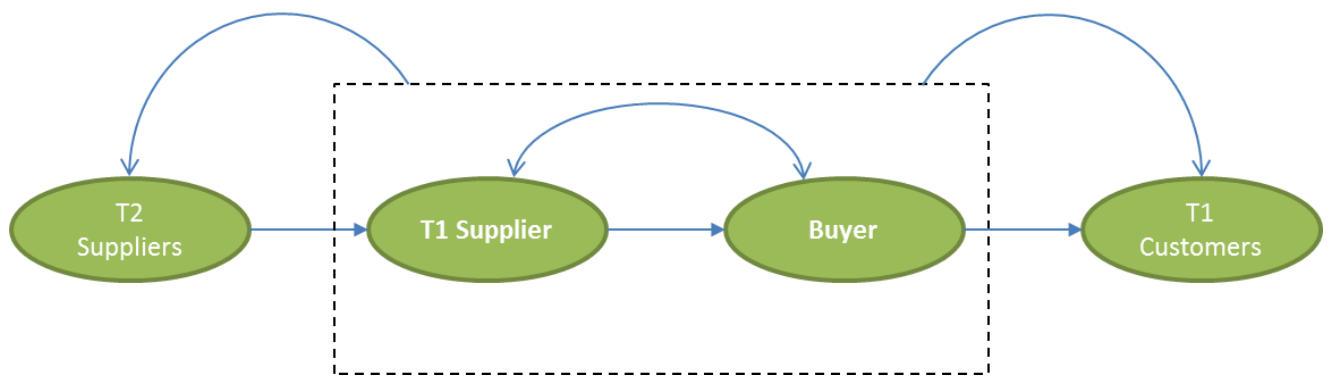
initiatives.

Figure 1 *Extended supply networks*

Different approaches can be adopted to manage or influence the environment-related

activities in other organizations in the supply chain. Essentially, an organization can choose

to get directly involved and invest its own resources to improve the environmental practices

of supply chain members. Alternatively, it can also use arms-length, market mechanisms to influence other organizations' practices (Vachon & Klassen, 2006). There are quite a few studies on different types of collaboration with supply chain partners, especially suppliers (e.g., Klassen & Vachon, 2003; Vachon & Klassen, 2006; Tachizawa, Gimenez, & Sierra, 2015). For instance, ways of engaging suppliers in environmental management include supplier environmental evaluation or monitoring, and supplier environmental collaboration (Klassen & Vachon, 2003). While these studies focus on the depth of engagement between supply chain partners, supplier collaboration being a deeper type of collaboration compared with supplier monitoring, the current study focuses on the breadth of engagement with an extended supply network.

Supplier Engagement and Customer Engagement in Environmental Management

Buyer-supplier partnerships have evolved from short-term joint product development projects to an often lasting integration of suppliers into intricate aspects of a buying firm's operations (Foerstl, Azadegan, Leppelt, & Hartmann, 2015). Such a trend in deeper collaborative relationships is also seen in sustainability efforts. Companies in a supply chain coordinate resources and efforts to jointly manage environmental management processes to achieve their sustainability objectives. Collaboration with suppliers is viewed as a critical component of creating sustainable supply chains (Pagell & Wu, 2009). Walton, Handfield, and Melnyk (1998) noted that companies are compelled to include suppliers if they want truly environmentally-friendly practices for purchasing and materials management, which is tantamount to greening the supply chain.

Supplier engagement in environmental management is the involvement of supplying organizations in achieving sustainability goals. It is characterized by coordination, collaboration and information sharing between supply chain members. As a key means of

achieving boundary-spanning moves towards common goal setting and assessment of operations against performance standards, the idea of supplier engagement is based on the prevailing view that deeper and closer partnerships with the longest possible part of the supply chain are critical to the success of SSCM (Tidy, Wang, & Hall, 2016). Supplier engagement is also essential to sustainability diffusion, which refers to the process by which sustainability initiatives or practices spread to, and are adopted by, supply network actors from one tier to the next (Meqdadi et al., 2018).

The current literature on supplier engagement focuses on how focal buying firms can achieve better environmental performance through engaging their immediate suppliers (e.g., Vachon & Klassen, 2008; Tidy et al., 2016). It is not known how such initiatives affect T1 suppliers' environmental management, both in terms of performance and practices adoption. T1 suppliers that promote their capabilities as sustainability gatekeepers for the upstream supply chain demonstrate dependability to their customers (Foerstl et al., 2016). T1 suppliers involved in sustainability endeavors of their buying firms can further engage with their upstream suppliers, i.e., the T2 suppliers of the focal buying firms. As collaboration in SSCM is critical, supplier collaboration should not just be seen with a fragmented supply chain. T1 suppliers, influenced by their buyers, can diffuse environmental management practices to their upstream suppliers, thus resulting a cleaner supply chain and mitigating any risks that comes from Tier 2 (T2) suppliers, who are farther from the "point of sale", where the effects of consumer and other stakeholder pressures are directly felt (Green, Morton, & New, 1996).

Suppliers need to understand the sustainability priorities of customers and stakeholders to derive the effective focus and depth of further upstream engagement with their direct suppliers (Foerstl, et al., 2015). In order to meet the ever-increasing customer

expectations in environmental management, a supplying firm can reach out proactively to their customers and be involved in the customers' sustainability initiatives. Consumer and business customer preferences for low carbon products are cited as opportunities to increase sales and create competitive advantage by the majority of suppliers (CDP, 2017).

While the important role of collaboration with suppliers has been widely accepted in the literature, the effect of customer engagement on sustainable outcomes is unclear. As firms look beyond the boundary of their own operations and consider the complete scope of supply chain management to address environmental issues, the customer cannot be neglected. The scant research on customer environmental engagement and the importance of customer engagement thus presents an opportunity for our work to test its impact.

In the SCI literature, customer integration, as one approach to SCI, has been found to be the most important type of integration in influencing competitive performance (Stank, Keller, & Closs, 2001; Zhao, Huo, Flynn, & Yeung, 2008). It derives from coordination with critical SC customers (Bowersox et al., 1999). Similar to supplier engagement, customer integration encompasses activities in information sharing, coordination, and synchronization of processes. Companies can engage with their key customers by aligning sustainability strategy with theirs. Transparency and trust is key to building joint strategic sustainability approaches. To foster a lasting trustworthy partnership, companies can invite their customers to plant visits to carry out their audits and process reviews. Product stewardship is a popular environmental management strategy, with an assessment of the life-cycle impact of their products (McIntyre, Smith, Henham, & Pretlove, 1998) and assurance of their proper use by customers (Snir, 2001).

Suppliers' Role in SSCM

Mounting pressure from stakeholders forces companies to be more sustainable. Suppliers perceive the need to incorporate sustainability efforts into their business practices differently than their downstream customers, as more regulatory pressures and end-consumer scrutiny occur in the downstream part of the supply chain (Lo, 2013). Compared with their buying firms, suppliers are farther from the "point of sale" and product brands, where more pressures from end consumers are felt (Green et al., 1996). Suppliers are thus less motivated to pursue sustainability initiatives than their customers (Gonzalez-Benito & Gonzalez-Benito, 2006). Some critics suggest that suppliers of raw materials and components hide their deficient sustainability practices behind their customers' trademarks with which consumers identify (Foerstl et al., 2015; Rivera-Camino, 2007). Supplier firms are usually smaller in size, revenue, and financial capabilities than their customers, so engaging in sustainability endeavors can be more challenging for suppliers and imply fewer immediate benefits (Chiu & Sharfman, 2011; Siegel, 2009). This results in suppliers being less proactive than their downstream customers in the adoption of sustainability-related practices (Foerstl et al., 2015). If their components are visible in the end product, they are probably capable of influencing their customers' sustainability performance and will be incentivized by the buying firms to be more sustainable in their operations. Large buying firms are often in the limelight and catch more attention with their suppliers behind the scenes most of the time. This is consistent with the greater focus on buying firms' environmental management seen in the academic literature. Large buying firms often have to account for the malpractices of their suppliers and sometimes their suppliers' suppliers (Touboulic, Chicksand, & Walker, 2014). There is more room for improvement for supplying firms. To understand the antecedents of suppliers' environmental management performance, this work targets

suppliers of large firms as the focus of study and examines how suppliers are affected by their own collaboration efforts with their immediate supply chain partners and also their buying firms' approaches to environmental management.

Power Effect in SSCM

The previous literature has put a strong emphasis on collaboration between supply chain partners to facilitate sustainability initiatives (Seuring & Müller, 2008; Touboulic et al., 2014). In different collaborative initiatives, firms deal with their supply chain partners. For example, buying firms might request their suppliers to adopt a certain green practice or invite them to participate in the design of a greener product to meet end consumers' needs. Whatever the collaboration might be concerned about, power dynamics come into play in collaborations in SSCM.

Conceptually, buyer power usage should result in favorable outcomes for buying firms. However, in the long term, it is not beneficial to the whole supply chain. The role that power plays in supply chain management is often perceived as being negative (Nair, Narasimhan, & Bendoly, 2011). For example, it has been found that power usage generally negates cooperation, commitment, and trust in buyer-supplier relationships (Kumar, 1996; Doney & Cannon, 1997; Kumar, Scheer, & Steenkamp, 1998; Maloni & Benton, 2000) and is negatively related to supplier satisfaction (Benton & Maloni, 2005) and supply chain performance (Maloni & Benton, 2000; Handley & Benton, 2012). Close ties to large buying firms are thus considered a mixed blessing, especially for small suppliers (Barringer, 1997).

In SSCM, power might play a different role. With a case study, Touboulic et al. (2014) developed propositions that highlight the positive role that power can play. For example, buyer dominance is positively associated with supplier compliance and the adoption and implementation of SSCM. Another piece of qualitative research by Meqdadi et

al. (2018) indicates that both coercive and non-coercive power impact suppliers' engagement in sustainability initiatives and its wider diffusion in supply networks, with coercive power facilitating diffusion to immediate suppliers and non-coercive (reward and expert) power leading to sustainability diffusion beyond the dyadic level into wider supply networks. Built on the previous research on power impact in SSCM, this empirical study incorporates the impact of power by investigating the power of not just the buying firm but also that of suppliers.

Hypothesis Development

Based on the previous section's review of relevant literature, we develop four hypotheses.

Suppliers' Engagement in SSCM

In a dyadic relationship between a buying and a supplying firm, the buying firm usually is the initiator of collaborative activities or programs in SSCM. They can involve their suppliers by monitoring their environmental performance, which focuses more on the environmental management outcomes of suppliers (e.g., compliance with existing regulations or ISO standards). They can also start joint planning sessions with regards to environmental management with key suppliers or provide training opportunities to them in which they focus more on the process through which more environmentally-sound operations might be achieved (Vachon & Klassen, 2006). Suppliers as standalone organizations have their own suppliers as well. When they are involved in their buying firms' environmental initiatives, they might feel the need to engage their own suppliers. High compliance of the activities conducted by their upstream sub-suppliers is critical to their operations.

Aside from suppliers' engagement with their upstream suppliers, other collaborative ventures by suppliers are also viable. They can engage with their other customers. Suppliers'

engagement with customers can be reactive or proactive. Either way, the supply chain in question should benefit from the collaborative efforts. For example, Klassen and Vachon (2003) found that environmental collaboration with customers is associated with higher investment in pollution prevention. Collaboration with customers on environmental issues can also create a synergy that fosters improvement across the broader supply chain network extending from supplier to customer (Vachon & Klassen, 2008). Within a rich collaborative context, suppliers and customers plan together the reduction of environmental impact from production processes and products. Management must extend their efforts to improve environmental practices across their supply chain. The breadth of a supplier's engagement in a supply chain affects its environmental performance. Along this line of reasoning and following the "collaborative paradigm" in supply chain management (Chen & Paulraj, 2004), the following hypothesis is proposed.

H1. A supplier's environmental performance is positively associated with its engagement with its supply chain partners.

Buying firms' Engagement in SSCM

Suppliers are influenced by their buying firms in either short-term interactions or long-term adaptations. They are incentivized by buyers to adopt environmental management practices and improve their environmental performance. The environmental outcomes of a buyer and its supplier in a dyad are easily tied together as there are many exchanges and transactions between them. As recipients of environmental collaborative initiatives or training opportunities, suppliers benefit from their buying firms' advancement and achievement in environmental management by learning from their buying firms' practices. That is how environmental management practices can be diffused through the supply chain (Meqdadi et al., 2018). As buying firms collaborate with more of its supply chain partners as

they deem necessary, the environmental performance of the buying firms improves. Consequently, supplying firms' environmental performance can be positively affected. A buying firm's environmental performance is affected by that of its suppliers (Preuss, 2001; Paulraj, 2011). As the buyer and supplier are tied together in the transaction, such impact should not be one-way, from supplier to buyer only. Instead, in a dyad, the supplier's environmental outcomes are related to the buying firm's engagement efforts as well.

H2. A supplier's environmental performance is positively associated with its buyer's engagement with its supply chain partners.

The Moderating Role of Power

Unlike small companies, large companies are usually under greater scrutiny from consumers, regulators, investors and other stakeholders (Freedman & Jaggi, 2010; Hall, 2000). As such, they need to be more concerned with their environmental impacts. Large companies also have more resources at hand to address sustainability issues (Zhu, Sarkis, Lai, & Geng, 2008) and are more powerful in supply chain relationships and can more effectively influence their supply chain partners' decisions. Research has found that companies' coercive and non-coercive power both impact their suppliers' engagement in sustainability initiatives and their wider diffusion in supply networks (Meqdadi et al., 2018). Such a result should still hold when companies' engagement with their customers and non-immediate partners is concerned. On the one hand, because of large companies' expert power and referent power, their supply chain partners are more willing to collaborate with them. On the other hand, large companies can impose solutions to their supply chain partners by exercising reward power or coercive power. Therefore, larger and more powerful suppliers should be able to reap better results from their engagement with supply chain partners.

H3. A supplier's power positively moderates the linkage between its engagement in SSCM and the environmental outcomes.

Buying firms' power also merits scrutiny in the same context. Buyer power represents a resource to force supplier compliance with sustainability requirements (Hall, 2000; Preuss, 2001; Ireland & Webb, 2007). As buying firms have more power, they can possibly drive the sustainability agenda on dependent supply chain partners and better ensure compliance (Touboulic et al., 2014). With the same level of engagement, they are able to garner more benefits than their counterparts in similar relationships who have less power. Consequently, they can more effectively influence their suppliers' environmental performance through engaging with their supply chain partners.

H4. A buying firm's power positively moderates the linkage between its engagement in SSCM and its supplier's environmental outcomes.

Methodology

Sample and Data Sources

Hypotheses are tested using data collected by the Carbon Disclosure Project (CDP), which is a UK-based not-for-profit charity that runs the global disclosure system for investors, companies, cities, states, and regions to manage their environmental impacts (Carbon Disclosure Project, 2018). CDP gathers data from companies at the request of stakeholders. Specifically, CDP has two kinds of members, investor signatories and supply chain members. CDP sends questionnaires to companies on behalf of their investor signatories and supply chain members to request them to disclose information about dealing with climate risk. Most data used in this research is from CDP's Supply Chain Program, which deals with their supply chain members' suppliers. The Supply Chain Program involves about 100 multinational corporations (buying firms) that are interested in learning their key

suppliers' vulnerabilities to global climate change, strategies to address these vulnerabilities, and green-house gas emission levels. Each buying firm typically selected a subset of their suppliers that represented a significant portion of its spending and provided CDP with contact information of these suppliers. CDP surveyed these suppliers on behalf of the buying firms using their online questionnaire system. The questionnaire is designed to help companies assess climate change risks and opportunities embedded in their supply chain. It helps buying firms understand more about their suppliers' sustainability initiatives. Most if not all of the buying companies also answered the questionnaire themselves as their investors or customers are also members of CDP. It is worth noting that companies either requested by their customers or investors are not obliged to respond to the questionnaire.

Responders are reminded that information in the CDP response is shared with CDP's investor signatories, whether the response is made available to the public or not, and are advised to provide information that is as complete, accurate and reflective of the company's current situation as possible.

The most recent data collected by CDP in year 2017 are used for this study. As of March 2017, CDP had 97 supply chain members. 70 public companies were initially included who have responded to CDP's questionnaire about climate change. To protect the proprietary information of their supply chain members, CDP is not able to provide the supplier lists of the 70 companies. Instead, data from Mergent Horizon about each buying firm's supplier base information was gathered. Mergent Horizon is a research database that provides supply chain information about competitors, suppliers and customers for approximately 6,200 public companies (NYSE, NASDAQ, and AMEX companies). For each one of the 70 companies from CDP, the supplier list was downloaded and a master supplier

list was created. I then went to the CDP response file and attempted to find out for each supplier whether it has responded to CDP's climate change questionnaire. I started with 7133 suppliers in the master list, 3147 of which are unique companies since many suppliers are serving multiple buying firms. In the CDP response file, there are responses from 4238 companies. The matching process was mostly manual because company names used in Mergent Horizon and CDP are different for most companies. The matching process was as follows.

1. Using supplier company name, I matched the two files, one being the master supplier list that has all the 70 buyers and their respective suppliers, the other being the CDP response file. "Vlookup" function in Excel is used.

2. Supplier lists downloaded from Mergent Horizon have ticker information for publicly traded companies. In the CDP file, there are also tickers for most public companies. Based on a ticker match, I was able to match a number of companies. However, companies traded in different stock exchanges can have same tickers. A manual process thus follows this step to eliminate mismatches.

3. For the remaining suppliers, an Excel function on whether a certain range contains a text is used. A certain company named "ABC Corp." in one file might be named "ABC Corporation" in the other. For every remaining supplier in the master supplier list, such a search is performed to see whether the "account_name" column in the CDP file contains its name. All spaces and punctuation marks are eliminated first. For every CDP company that has not been matched, such a search is also performed to see whether its name is contained in the "Supplier" column of the master supplier list.

4. The Excel add-in "fuzzy lookup" is used last to look for possible matches for all remaining companies. A cut-off value of 85% similarity is used. All pairs that are 85% or more similar are manually compared.

In the end, 586 unique suppliers were found to have responded to CDP's questionnaire. After these suppliers were identified, their Compustat information was retrieved using two databases, North American Daily and Global Daily. 552 companies can be found in Capitals IQ. All those companies whose information cannot be found were dropped from the sample. In total, there are 1370 dyads, representing 66 buying firms and 552 suppliers.

Variables Description

Supplier engagement. There are several questions on supplier engagement in CDP 2017 Questionnaire (see Figure 2 for an excerpt from CDP 2017 Questionnaire). Question CC14.4 asks first of all whether a company engages with its suppliers. If the answer to this part is positive, the respondent will be directed to questions about the details of engagement activities (type of engagement, number of suppliers, % of total spend, and impact of engagement). Based on CDP's scoring methodology for questions CC14.4 and CC14.4b, a numerical score is calculated for each company. The score varies from 0 to 10, with 0 meaning no engagement, and 10 meaning a high level of engagement. Those companies who did not answer CC14.4 and CC14.4b were removed, resulting in 1122 dyads (65 buying firms and 441 supplying firms). Table 1 shows more details about the buyers and the numbers of their suppliers.

CC14.4 Do you engage with any of the elements of your value chain on GHG emissions and climate change strategies? (Tick all that apply)

- [ ] Yes, our suppliers
- [ ] Yes, other partners in the value chain
- [ ] Yes, our customers
- [ ] No, we do not engage

If "Yes, our customers" or "Yes, other partners in the value chain" is ticked:
    CC14.4a Please give details of methods of engagement, your strategy for prioritizing engagements and measures of success

If "Yes, our suppliers" is ticked
    CC14.4b To give a sense of scale of this engagement, please give the number of suppliers with whom you are engaging and the proportion of your total spend that they represent **(CDP 2016 CC14.4b and CC14.4c, amended)**

Type of engagement	Number of suppliers	% of total spend (direct and indirect)	Impact of engagement

If "No, we do not engage" is ticked:
    CC14.4c Please explain why you do not engage with any elements of your value chain on GHG emissions and climate change strategies, and any plans you have to develop an engagement strategy in the future **(CDP 2016 CC14.4d)**

Figure 2 *Questions CC14.4 and CC14.4b from CDP 2017 Questionnaire*

Table 1. *Buyers and suppliers count*

Buyer	No. of Suppliers
Abbott Laboratories	10
Accenture	4
Ajinomoto Co.Inc.	3
Amdocs Ltd	10
AT&T Inc.	27
Banco Bradesco S/A	3
Bank of America	9
Barclays	13
BMW AG	49
Braskem S/A	15
Bridgestone Corporation	4
Bristol-Myers Squibb	13
BT Group	12
Cisco Systems, Inc.	14
CNH Industrial NV	11
Colgate Palmolive Company	8
CSX Corporation	1
Dell Technologies	11
Deutsche Telekom AG	17
Diageo Plc	7
Eaton Corporation	3
ENAGAS	2
Endesa	3
Fiat Chrysler Automobiles NV	37
Ford Motor Company	56
Gas Natural SDG SA	5
General Motors Company	60
Hewlett Packard Enterprise Company	9
Honda Motor Company	35

Table 1 continued

HP Inc	53
Imperial Brands	2
Intel Corporation	41
Itaú Unibanco Holding S.A.	10
Johnson & Johnson	19
Juniper Networks, Inc.	3
KAO Corporation	3
Kellogg Company	8
Klabin S/A	2
Koninklijke Philips NV	20
L'Oréal	12
McDonald's Corporation	16
Microsoft Corporation	26
National Grid plc	10
Nestlé	24
Nissan Motor Co., Ltd.	38
Nokia Group	15
Northrop Grumman Corp	6
Novartis	24
PepsiCo, Inc.	26
Philip Morris International	6
Royal Bank of Canada	1
Sky Plc	13
SSE	7
Stanley Black & Decker, Inc.	1
Swisscom	7
Symrise Ag	1
TD Bank Group	2
The Coca-Cola Company	29
Toyota Motor Corporation	53
Unilever Plc	25
Vodafone Group	18
Volkswagen AG	59
W.W. Grainger, Inc.	2
Wal Mart de Mexico	19
Wal-Mart Stores, Inc.	70
Grand Total	1122

Customer engagement. A binary variable is used to measure customer engagement

based on responses to question CC14.4.

Engagement with other supply chain partners. To better capture the breadth of

collaboration in SSCM, this binary variable is used based on responses to question CC14.4.

Power. This paper uses a simplified yet novel non-perceptual measure of power to capture

the power effect in SSCM. Firm revenue provides a good summary measure for valuation

purposes and conveys new information to the market (Chandra & Ro, 2008). We use revenue

information extracted from Compustat. One-year lagged data are used for buyer revenue and supplier revenue.

Environmental performance. Environmental issues can be extremely specific to environmental, geographical, social and business contexts in which they occur. Therefore direct or indirect GHG emissions cannot be used directly to gauge corporate environmental performance for two reasons. First, different companies adopt different methods to calculate carbon emissions and the accuracy can vary from one company to another. The second reason relates to the complexities of carbon benchmarking. Companies are embedded in bigger supply networks that are inherently complex. Industries, geographical locations, and product types all impact carbon benchmarking. For the purpose of this study, we use the CDP score as reported by CDP. The score provides a snapshot of how each company compares with other companies in terms of environmental stewardship performance. Responding companies are assessed across four levels which represent the steps a company moves through as it progresses towards environmental stewardship. The scoring of CDP's questionnaires is conducted by accredited scoring partners trained by CDP. CDP's internal scoring team coordinate and collate all scores and run data quality checks and quality assurance processes to ensure that scoring standards are aligned between samples and scoring partners. The scoring methodology is a means to assess the responder's progress towards environmental stewardship as communicated through the company's CDP response. The criteria for scoring the levels are distributed throughout the questionnaire. There are 9 levels (A, A-, B, B-, C, C-, D, D-, and F). More details are available in the "CDP 2017 climate change scoring methodology" (https://b8f65cb373b1b7b15feb-

c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/guidance_docs/pdfs/000/000

/509/original/CDP-climate-change-scoring-methodology.pdf)**.**

　　　Control variables. Both buyer-supplier relationships and environmental management

tend to be influenced by industry norms and trends (Reid & Toffel, 2009). Industry types of

all buyers and supplier are thus modeled as control variables to capture any potential industry

effect. Standard Industrial Classification (SIC) codes of each company is used for type. The

descriptive statistics of all variables are shown in Table 2 and Table 3.

Table 2 *Descriptive statistics of numerical variables*

Variable Name	Min	Q1	Median	Q3	Max
Supplier's supplier engagement score	0	0	6	10	10
Buyer's supplier engagement score	1.5	9.75	10	10	10
Supplier's revenue	-0.128	-0.128	-0.127	-0.124	14.139
Buyer's revenue	-0.349	-0.342	-0.334	-0.315	3.947

Table 3 *Descriptive statistics of binary variables*

Variable Name	Yes	No
Supplier's customer engagement status	64.8%	35.2%
Buyer's customer engagement status	78.0%	22.0%
Supplier's other engagement status	30.0%	70.0%
Buyer's other engagement status	56.9%	43.1%
Note: There are 1122 dyad with suppliers from 168 SICs and buyers from 37 SICs		

Data Analysis and Results

　　　Linear mixed models are an extension of simple linear models to allow both fixed and

random effects and are particularly appropriate when there is non-independence in the data.

Linear mixed models can be used to analyze data that are non-independent,

multilevel/hierarchical, longitudinal, or correlated (Jiang, 2007). In the data set, suppliers that

sell to the same buying firm are not independent. There are also some suppliers that serve

more than one buying firm. So linear mixed models are appropriate to use for the data

analysis. I next present the models and explain the notations.

Let Y_i be the supplier CDP score of the i-th dyad, $i = 1, 2, \cdots, n$, and $n = 1122$. For each dyad, we denote the fixed effects associated with buyer covariates, X, and supplier covariates, Z, as $(X\beta)_i$ and $(Z\gamma)_i$, respectively. Specifically, we consider the following multiplicative interaction model for the fixed effects,

$$(X\beta)_i = \sum_{j=1}^{4} X_{ji}\beta_j + \sum_{j=1}^{3} X_{ji}X_{4i}\beta_{j4} ,$$

$$(Z\gamma)_i = \sum_{j=1}^{4} Z_{ji}\gamma_j + \sum_{j=1}^{3} Z_{ji}Z_{4i}\gamma_{j4} ,$$

where X_{1i} and Z_{1i} are supplier's and buyer's supplier engagement score of the i-th dyad respectively, X_{2i} and Z_{2i} are supplier's and buyer's customer engagement of the i-th dyad respectively, X_{3i} and Z_{3i} are supplier's and buyer's other engagement of the i-th dyad respectively, and X_{4i} and Z_{4i} are supplier's and buyer's revenue of the i-th dyad respectively.

Let $s(i)$ and $b(i)$ be the supplier and buyer SIC of the i-th dyad, respectively. Since we are not directly interested in the effects of supplier and buyer SIC and their SICs could be viewed as a sample of all SICs, I choose to model them by random effects. We proposed the following linear mixed effects model with multiplicative interactions,

$$Y_i = \alpha + (X\beta)_i + (Z\gamma)_i + u_{s(i)} + u_{b(i)} + e_i,$$

where $u_{s(i)}$ and $u_{b(i)}$ are random effects associated with supplier's SIC, $s(i)$, and buyer's SIC, $b(i)$, respectively, and e_i represents a random error associated with the i-th dyad. The variances of $u_{s(i)}$, $u_{b(i)}$, and e_i are denoted by σ_s^2, σ_b^2, and σ_e^2, respectively. We name the above model the full model.

Since likelihood-based methods often rely on the assumption of normality of the random effects and errors, we employed a Bayesian approach using Markov chain Monte Carlo (MCMC) methods (Gelman et al., 2013), which does not impose distributional assumptions. Different from traditional frequentist inference using likelihood-based

approaches, Bayesian inference treats all parameters as random variables rather than fixed values and inferences of parameters are based on their estimated posterior distributions. Corresponding to a point estimate and confidence interval for a parameter in frequentist inference, a posterior mean estimate and a credible interval are often used in Bayesian analysis. Prior distributions for parameters need to be specified in Bayesian analysis. We adopt the default diffuse priors used in the "MCMCglmm" package of the statistical software, R. The posterior distributions of interest were estimated using MCMC methods. For a parameter, its Bayesian estimates are calculated from a chain run for 13,000 iterations, of which the first 3,000 iterations are discarded and the remaining 10,000 iterations are thinned by a factor of 10.

The full model is fitted using MCMC method and the results showed that some effects are insignificant. To remove irrelevant variables and achieve a parsimonious model, I use an efficient model selection method, backward elimination. Insignificant variables or effects were removed step by step until a final model is achieved with no further variables or effects that can be eliminated. After the model selection procedure, the obtained model, called the final model, is

$$Y_i = \alpha + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{3i}\beta_3 + X_{4i}\beta_4 + Z_{1i}\gamma_1 + Z_{4i}\gamma_4 + Z_{1i}Z_{4i}\gamma_{14} + u_{s(i)} + e_i.$$

Tables 2 summaries the results from the final models. In a dyadic relationship, the breadth of a supplier's engagement in SSCM is positively related to its environmental stewardship performance. Engagement with every type of supply chain partners counts. Specifically, the supplier's engagement with its own suppliers has a positive association ($\beta = 0.198$; $p < 0.001$) with its performance. The supplier's engagement with its customers is also beneficial to improving its environmental performance ($\beta = 0.532$; $p < 0.001$). The supplier

can also engage with other supply chain partners other than its direct suppliers and customers. Such engagement also proves to be an effective kind of environmental initiative ($\beta = 0.441$; $p < 0.001$). The supplier's power does not seem to moderate the impact of its engagement with its supply chain partners on its environmental performance. But its power (revenue) is positively related to its environmental performance, meaning larger and more powerful companies do a better job in environmental management ($\beta = 0.180$; $p < 0.001$). Based on these, H1 is supported, while H2 is not.

The buyer's impact on the supplier is significant, but the impact is not as broad as the supplier's own engagement. Of the three types of engagement by the buyer, only engagement with suppliers (with a borderline p-value between 0.05 and 0.1) has an association with the supplier's environmental performance. The buyer's engagement with its customers or other supply chain partners besides its direct suppliers and customers does not have any significant impact on the supplier's environmental performance. The buyer's power (revenue) moderates the relationship between buyer's engagement with suppliers and supplier environmental performance. The moderation effect is shown in Figure 3. The association between buyer's supplier engagement efforts and supplier's environmental stewardship is contingent on the buyer's power (revenue). Specifically, when the buyer's power (revenue) is relatively low, its engagement with its suppliers can have a negative impact on the supplier's environmental performance. For example, in Figure 3, it is shown that for buyers whose power (revenue) is lower than the median of the 65 buyers in the dataset, the association is negative. While if a buyer's power (revenue) is at the third quartile (Q3) in the sample, the association is positive. Such a moderation effect of buyers' power (revenue) implies that large buying firms with more resources and power who engage their suppliers in SSCM can have a positive impact

on their suppliers' environmental performance, while for smaller buying firms, it does not do much good.

For the two hypotheses on buyer's engagement in SSCM, H3 is partially supported and H4 is supported. Industry effect of both buying firm and supplier is not significant, indicating the role of engagement in SSCM is not affected by industry types.

Table 4 *Inference results of linear mixed models with mcmc estimation*

|	Parameters	Posterior means with 95% CI
Fixed		
Intercept	α	0.197 (-3.688,3.711)
Supplier's supplier engagement score	β_1	0.198*** (0.175,0.219)
Supplier's customer engagement	β_2	0.532*** (0.366,0.734)
Supplier's other engagement	β_3	0.441*** (0.266,0.663)
Supplier's revenue	β_4	0.180*** (0.105,0.245)
Buyer's supplier engagement score	γ_1	0.359 · (0.006,0.744)
Buyer's revenue	γ_4	-11.259* (-22.870,-0.807)
Buyer's supplier engagement score * Buyer's revenue	γ_{14}	1.129* (0.083,2.290)
Random		
Supplier SIC	σ_b^2	1.108 (0.803,1.443)
Error	σ_e^2	1.270 (1.144,1.387)
Note: *** = p < 0.001; ** = p < 0.01; * = p < 0.05; · = p < 0.1		
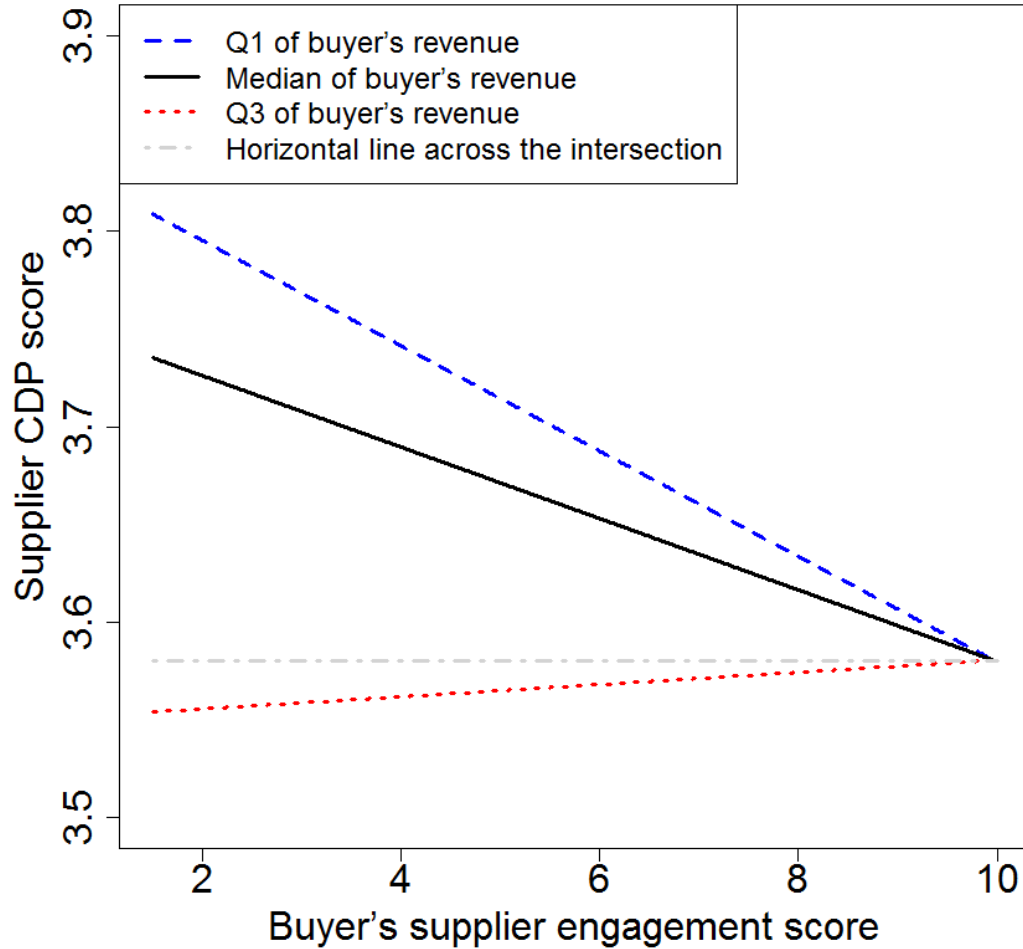
Figure 3 *Interaction figure of buyer power and buyer's supplier engagement*

Post Hoc Analysis

Since a buyer's engagement with its customers and other supply chain partners other than its T1 suppliers and customers does not seem to have a direct association with its supplier's environmental performance, a post hoc analysis conducted to see whether the buyer's engagement in SSCM has a mediating effect. Specifically, we examined whether the breadth of a buying firm's engagement in SSCM is positively related to the breadth of its supplier's engagement activities.

Supplier engagement. The Pearson correlation coefficient between buyer's supplier engagement score and supplier's supplier engagement score is -0.0497155 ($p = 0.09602$).

Customer engagement. Phi coefficient (mean square contingency coefficient) measures association for two binary variables. It was found buyer and supplier's customer engagement is not significantly related to each other ($\varphi = -0.01$). This implies that the two binary variables are not related to each other. Chi-square test of independence ($\chi^2 = 0.048268$, $df = 1$, $p = 0.8261$) is also performed and same results are generated.

Engagement with other supply chain partners. Phi coefficient is also calculated and it turns out to be very small. Chi-square test of independence ($\chi^2 = 0.0054088$, $df = 1$, $p = 0.9414$) shows that the two variables are independent of each other.

The post hoc analysis implies that the breadth of a buyer's engagement does not seem to affect that of the supplier's, nullifying the mediating effect of buyer's environmental engagement.

Discussion

Using a novel data set, this paper empirically tests the role of the breadth of environmental engagement and power in SSCM. Dyadic responses from buying and supplying firms are used and their relationships are mapped using supplier information from Mergent Horizon. A third database, Compustat, is used to gather information about all buying and supplying firms' power measure. In general, the results from the linear mixed models using Bayesian MCMC estimation methods support the critical roles of the breadth of engagement and firm power in SSCM. In particular, in a dyadic relationship, the supplier's own engagement with its supply chain partners has a positive impact on its own environmental performance. Engagement with its direct customers, suppliers, and other supply chain partners all contribute to its environmental performance. Large suppliers who have more resources and power tend to have better environmental outcomes. Suppliers are

closely connected to their buyers and buyers can involve suppliers in their SSCM initiatives. Suppliers' environmental performance is thus impacted by their buyers' engagement efforts. Specifically, buyers' engagement with its supply base has a significant impact on their suppliers' environmental performance. This impact is not as strong as that of suppliers' own environmental engagement. In the meanwhile, such an impact is moderated by the buying firms' power attributes. Large and more powerful buying firms' engagement with its supply base can have a positive impact on their suppliers' environmental performance. The impact can be negative when the buying firms are relatively small and have less power. It does not matter which industry a buyer or a supplier is from. All these findings are consistent across industries.

Theoretical Implications

Structural Embeddedness and the Three Dimensions of Engagement in SSCM

Buying companies rely more on their suppliers for design innovation ideas and they might request their suppliers to collaborate so that optimal design solutions can be achieved. Businesses operate in an environment where companies have become embedded in their supply networks. If structural embeddedness is not managed well and a supplier' performance falls short of certain requirements, then the performance of the buying firm may also suffer; fragmentation, misalignment among organizations, and local profit optimization in a supply chain might occur. Structural embeddedness of supply chain networks implies that a change induced by one actor in a dyadic relationship needs to be understood in the context of not only directly connected actors, but also indirectly connected actors (Choi & Kim, 2008; Meqdadi et al., 2018). It is thus necessary to address the importance of extended networks beyond the immediate dyadic relationships.

While the extant literature has done a good job studying the depth of supplier or customer collaboration in SSCM (supplier evaluation/supplier monitoring versus supplier collaboration) and their performance implications (e.g., Klassen & Vachon, 2003; Tachizawa et al., 2015), it fails to address how the breadth of environmental engagement in the supply chain affects supplying firms' environmental performance. In this work, by looking at the breadth of engagement, the interaction with the extended supply chain of 1122 dyadic relationships is considered. The empirical findings support the critical role that the breadth of engagement plays, which implies the need to address SSCM issues through a supply network approach. The diffusion of sustainability is in itself a process of change in supply networks through relationship interconnectedness (Tate, Ellram, & Gölgeci, 2013). As such, all those critical supply chain partners should be counted in SSCM.

This study also looks at different initiators of engagement initiatives (buyer or supplier). It matters who is proactive in an endeavor. Suppliers are generally less proactive than their customers in SSCM initiatives. This study found that suppliers benefit from their own engagement with all types of supply chain partners if resources permit. More of such environmental engagement might be initiated by suppliers themselves, especially engagement with their own suppliers. These findings support the doubt about the fair distribution of the benefits of collaborative ventures and the equal influence of the participating actors (Fadeeva, 2004).

Combining the findings of this study of those of previous studies on collaboration (also termed engagement or integration) in SSCM, the following framework for sustainable engagement is constructed (Figure 4). There are three dimensions of sustainable engagement (depth, breadth, and proactivity). Sustainable engagement can be measured along these three

dimensions. By joining these three dimensions together, the impact of sustainable
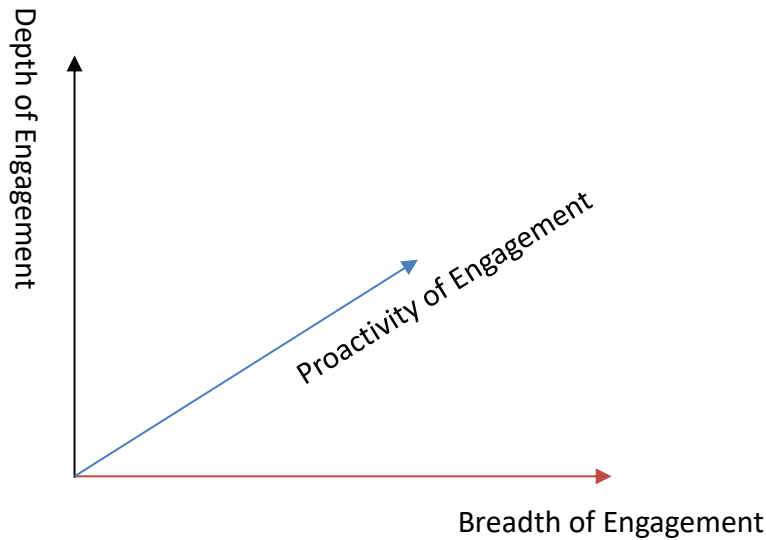
engagement can be better gauged.

Figure 4 *The three dimensions of sustainable engagement*

The effect of the buyer' environmental engagement on the supplier's environmental

performance is not as prevalent. Specifically, only buyer's engagement with its supply base

has some influence on the supplier's environmental performance. But this relationship is

contingent on the buying firm's power and resources. Post hoc analysis did not find any

association between buyer's engagement breadth and that of the supplier's in a given dyad.

These findings imply that the impact of a buyer's engagement efforts on its suppliers'

environmental performance is more nuanced than expected. This might be due to the fact that

the depth of engagement has not been taken into account.

The Role of Large Buying Firms in SSCM

Many business processes take place within a relationship atmosphere, described in

terms of power/dependence, cooperation, and closeness. Multinational corporations

occasionally have to assume responsibilities for the practices of their suppliers (Amaeshi, Osuji, & Nnodim, 2008). Sustainability thus presents a critical risk for companies that requires them to exercise control, for example through monitoring (Vachon & Klassen, 2006) rather than simply relying on collaboration and trust (Meqdadi et al., 2018). As such, power dynamics play a critical role in SSCM as well.

The ability of organizations to influence depends on the multiple factors, such as relative power of the actors and their ability to get their point across in supply networks (Ruzza, 1999). Previous research has highlighted the importance of power usage in SSCM. For example, Amaeshi et al., (2008) emphasized some possible sources of wielding positive moral influence along supply chains, such as the use of codes of conduct, corporate culture, personnel training and value reorientation. Other studies explore how different types of power can affect environmental endeavors. Some reported the drawbacks of using power-coercive power may result in "passivity" behavior and reduce cooperation (Fadeeva, 2004; Nyaga, Lynch, Marshall, & Ambrose, 2013). With an in-depth case study, Meqdadi et al. (2018) found that while the use of coercive power facilitates sustainability diffusion to immediate suppliers, the use of non-coercive (reward and expert) power leads to sustainability diffusion beyond the dyadic level into wider supply networks. Different from these studies, this paper takes a different view of power. Using a simple measure of revenue to capture the power of different firms, it found that large suppliers have better environmental performance and large buying firms can exercise a positive impact on their suppliers' environmental performance. For smaller companies, their engagement with their supply base did not seem to have any positive influence on their suppliers' performance. This view of power resembles to some extent non-coercive power. As large companies boast of

resource abundance and technological superiority, it is therefore easier for them to get their suppliers to cooperate. This is consistent with what some previous studies have found (e.g., Hall, 2000; Preuss, 2001; Ireland & Webb, 2007; Touboulic et al., 2014). They also might be able to involve suppliers in deeper collaborations rather than just through monitoring or evaluation. Pressure from a small buying firm might not drive lots of cooperation from its suppliers.

It is interesting to note that using such a novel non-perceptual measure of power, similar results have been found, supporting the role of large companies in SSCM. It opens up the possibility of new measures of the power concept, which has been measured by perceptual questions in most extant literature.

Managerial Implications

This study has multiple managerial implications. It has been shown that it takes every member's efforts to green the whole supply chain. Firms must cooperate with stakeholders both upstream and downstream in order to achieve success. Every bit of engagement counts, especially for the firm that starts the initiative. Aligning multiple firms with diverse objectives is complex. So a focal firm might engage with its suppliers serving its own self-interests. Thus the focal firm itself might be able to reap more gains out of the collaborative efforts.

The perceived cost of incentivizing supply chain partners to collaborate on sustainability issues might be high, the benefits will be tangible, based on the findings of this study. It can improve their own environmental performance. It will also contribute to the sustainability performance of their own products or services, which gives them a competitive edge over their competitors.

Monitoring suppliers can be part of a sustainable procurement strategy, but a complete strategy that includes a means to engage and support supplier improvement is needed. Firms need to understand the requirements of their supply chain partners in their network in order to motivate partners to engage and succeed long term (Savitz, 2013). Boundary spanning functions in firms play important roles in building strong relationships with supply chain partners so as to engage them in sustainability initiatives. By raising awareness of the positive aspects of collaboration in SSCM and understanding the role of large buying firms, it is possible to deliver tangible, meaningful results for the bottom line and the planet.

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CHAPTER 5.   GENERAL CONCLUSIONS AND FUTURE RESEARCH

General Conclusions

This dissertation features two interesting and important topics in the SCM field—power dynamics and sustainability. The two phenomena were first scrutinized separately and were joined together in the third paper.

There have been lots of studies on power in the SCM literature. Power as a social phenomenon has its roots in sociology. It first started to catch business researchers' attention in the early 1970s. Power was studied in the context of distribution channels and often times the suppliers have more power (auto manufacturer and their dealerships). When it was introduced to the SCM field, power usage became the focus. Specially, most if not all studies focus on the consequences of power usage. While these studies advance our knowledge of power dynamics in BSR, more needs to done to examine power's antecedents. The first paper highlights the important role of power imbalance in BSRs, introduced a novel composite measure for industrial firms (SES), and linked the two together based on the theory of social stratification. The study provides some theoretical refinements of the power theory and developed propositions for future research to test.

The second paper examines the diffusion of EMPs in different countries and the role of national culture in the process. With globalization and degradation of the natural environment, it is urgent to understand how the diffusion of EMPs is different in different cultures and how culture might affect the effectiveness of EMP implementation. Different from previous studies, the paper links national culture with EMP adoption first and then examines how national culture affects the implementation of EMPs. Such a framework is novel but based on extant literature. Using three different data sources, the study empirically confirms the important role of national

culture in environmental diffusion. The findings are compared with those of previous studies and implications were drawn.

The third paper merges the two important topics and investigates the role of engagement breadth in SSCM and how power can moderate relevant relationships. The collaborative paradigm is one the building blocks of this study. Supply chain embeddedness is incorporated to the effect that extended supply networks of dyadic relationships are considered. Different from previous studies, the study focuses on suppliers' environmental performance. Novel dyadic data is gathered from three data sources. In 1122 dyads, both buyers and suppliers' engagement with suppliers, customers, and non-immediate supplier chain partners was examined. Drawing upon the contributions of the first paper, a non-perceptual measure of power is used. The research found support for the critical role of the breadth of engagement in SSCM. It is found that large and powerful companies play more important roles in SSCM.

This dissertation makes several contributions. It develops a complete theory of power by investigating the fundamental issue of power imbalance in BSRs and its antecedents. This complements the extant literature which has mainly concentrated on the consequences of power issues. The second paper in this dissertation empirically attests to the significance of national culture in the context of environmental management. It not only shows that national culture affects the adoption of EMPs but also how the EMPs are implemented. The third paper joins the two important issues, incorporates some elements of the theoretical framework of the first paper, and empirically tests how the breadth of engagement in SSCM affect suppliers' environmental performance and how power of buyers and suppliers moderates those relationships. All three papers in this dissertation also have important managerial implications. They also lead to important future work to be done.

Future Research

Future research can be done to test the propositions developed in the first essay. Dyadic perceptual data might be collected to measure power imbalance, relational properties, and actual power usage. Non-perceptual measures on SES of firms can be collected from secondary data sources. By joining these data sets together, the propositions in the first study can be empirically tested. SES is an original and novel measure to be proposed for companies. I expect to see more applications of it in BSR studies.

The second and the third essay focus on environmental management, which is one dimension of sustainability. Future research can explore the role of national culture in social sustainability. Some work has been done by researchers on this topic, but the findings have been equivocal. The framework of culture affecting adoption and then implementation can be applied. Multilevel analysis should be employed to examine cross-level relationships.

The third study uses a novel non-perceptual measure of power. More non-perceptual dimensions can be included to measure firm power by adopting the SES measure proposed in the first essay. It will also be interesting to examine how power usage can affect the effectiveness of SSCM efforts since the question of power exploitation is complex and findings from general supply chain management research cannot be directly generalized to SSCM.

Future research can also extend to sustainable performance of supply chains since the ultimate goal is to improve sustainability performance of supply chains rather than a single node on the chain.