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Cross-sector Alliances for Corporate Social Responsibility Partner Heterogeneity Moderates Environmental Strategy Outcomes

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Abstract This article provides a new mechanism in understanding how partner heterogeneity moderates an alliance's ability to advance corporate social responsibility goals. I identified the antecedents for firms to select a more diverse set of partners and explored whether more diverse alliances (especially cross-sector alliances) may facilitate partners to achieve more proactive environmental outcomes. I employ 146 environmental alliances formed in the U.S. between 1990 and 2009 to test the assertions. Results suggest that firms with innovative orientation and alliance experiences tend to choose a more diverse set of partners (especially cross-sector partners); and such partner heterogeneity in turn moderates an alliance's environmental outcomes—compared to inter-firm alliances, cross-sector alliances are more likely to facilitate partners to pursue more proactive environmental strategies.

Keywords Resource-based view · Partner heterogeneity · Cross-sector alliances · Cross-industry alliances · Same-industry alliances · Environmental strategy · Corporate social responsibility

Introduction

Strategic alliances are short- or long-term voluntary collaborations between organizations, involving exchange, sharing or co-development of products, technologies and services to pursue a common set of goals or to meet a critical business need (Gulati 1998). In today's complex business world, firms increasingly collaborate with other firms to control for turbulence and complexity within the surrounding environment (Gray and Wood 1991) while undertaking joint innovations (Grant and Baden-Fuller 2004) to enhance their capabilities (Cyr 1999). These benefits have motivated businesses to engage in over 20,000 strategic alliances worldwide between 2000 and 2002 (Martin 2002). Worldwide evidence demonstrates that the use of strategic alliances has been growing for several decades, with an approximate annual growth rate of 25 % (Baka 2011). It is anticipated that this phenomenon will continue to accelerate as the dramatic economic and technological changes in the global economy escalate.

Related to the natural environment, corporations are increasingly using strategic alliances to address complex social and environmental issues, like climate change, because of the grand scale and uncertainty embedded in these issues. These issues lack a simple or certain solution, and addressing them is often beyond the capabilities of any individual business (Selsky and Parker 2005; Lin 2012). As such, it is critical to foster collaborations among diverse partners in combining complementary capabilities to explore innovative solutions. For instance, Pollution probe, a Canadian charitable environmental organization, has aligned with the Canadian Automobile Association to increase the fuel efficiency of vehicles and has partnered with Toronto Hydro to jointly market electric vehicles. Such alliances that address complex social environmental problems differ from other types of strategic alliances because these alliances may mobilize varied resources and involve diverse partners (e.g., government and universities) with an attempt to achieve more complex environmental, social, and political goals.

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While firms are increasingly aligning with other firms, universities, government, and non-governmental organizations (NGOs) to advance corporate social responsibility (CSR), the extant alliance literature tend to assess the technical or economic aspects of partner heterogeneity in the inter-firm relationship setting (e.g., Sakakibara 1997), while cross-sector partnerships for CSR have largely been ignored (Rondinelli and London 2003). Although an increasing number of studies have focused on the role of cross-sector partnerships in advancing CSR and social innovation goals (Selsky and Parker 2005; Bryson et al. 2006; Le Ber and Branzei 2010, 2011), they have predominantly been conceptual evaluations or qualitative case study papers, and their reported results of the performance of these cross-sector partnerships varied. As such, the literature lacks robust empirical study to assess the environmental performance of these cross-sector partnerships.

To fill this literature gap, I employ large number data set to examine the environmental performance of strategic alliances associated with varied partner structure, which was ranged from homogeneous partners (same-industry partners) to heterogeneous partners (cross-industry and -sector partners). I further examine what kind of factors may influence a firm's decision to align with more heterogeneous (cross-industry and -sector) partners. In addressing these question, I apply the resource-based view of the firm (RBV) to examine the antecedents for firms to collaborate with institutional distant heterogeneous (cross-industry and -sector) partners. I argue that firms with innovative orientation and alliance experiences tend to choose a more diverse set of partners to access complementary resources and conduct organizational learning. The access and development of tacit knowledge in a heterogeneous partnership may help firms develop socially complex and imitable capacities for firms to strengthen competitive positions and pursue more proactive environmental strategies. Therefore, firms' alignment with more heterogeneous partners (especially cross-sector partners) may enhance their ability to achieve more proactive CSR goals. To test my arguments, I examined 146 U.S.-based environmental alliances formed between 1990 and 2009.

Theory and Hypotheses

This study aims to provide a new mechanism in identifying what factors motivate firms to align with more heterogeneous partners and whether such partner heterogeneity moderates an alliance's ability to achieve more proactive environmental outcome. To analyze these associations, I develop a two-stage research framework (see Fig. 1) for both theoretical hypothesis development and empirical testing.

Corporate Innovative Orientation Moderates Alliance Partner Heterogeneity

Alliance partner heterogeneity refers to the breath or diversity of the complementary capabilities held by different alliance participants. Sakakibara (1997) defined inter-firm alliance diversity by assessing how wide participation was from varied industries and concluded that cross-industry alliances are more diverse than same-industry alliances. Cross-sector alliances, involving two or more organizations with fundamentally different governance structures and missions (Rondinelli and London 2003), are more diverse than inter-firm alliances. Alliance partner heterogeneity thus varies along a continuum of diversity scale that ranges from same-industry partners, cross-industry partners to cross-sector partners (see Fig. 1).

One of the main motives for firms to get into diverse partnerships is to access heterogeneity resources from the diverse partners (Sakakibara 1997). Such a motive can be better characterized using resource-based view (RBV) lens. RBV focuses on the access or development of idiosyncratic resources and competencies that lead to competitive advantage (Barney 1991). Applied to strategic alliances, firms with innovative orientation tend to align with

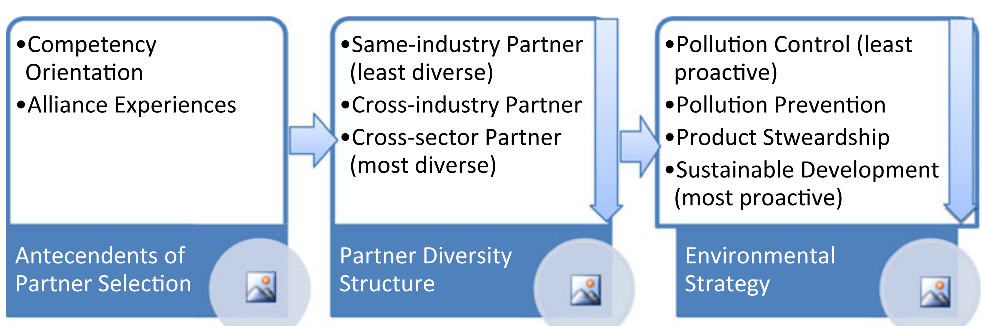

Fig. 1 Partner structure moderate alliances' environmental strategy outcomes

heterogeneous partners to combine idiosyncratic and complementary resources to develop valuable organizational competencies, especially tacit knowledge-related resources that can lead to competitive advantage (Gulati, 1995, 1999; Sakakibara 1997). In today's complex business world, "few firms have the breadth of knowledge required for innovation" (Randor 1991; Sakakibara 1997), and many competencies needed for innovation are organization-specific and embedded in organization's daily routine, thus aligning with partners who possess these competencies becomes the only alternative for firms to acquire such complementary resources (Barney 1991; Sakakibara 1997). To access to these core competencies, in most instances, firms need to align cross-industry or sector, since the locus of innovation frequently originates from outside the base industry (Kotabe and Swan 1995; Powell et al. 1996), and the "technology fusion" pooled by diverse partnership becomes increasingly important for innovation (Sakakibara 1997).

In some instances, the heterogeneity resources are from cross-sector partners, like NGOs, universities and governmental bodies. For instance, NGOs can be a source of external expertise and perspective for partnering firms. They can co-develop new competencies with firms, or educate partnering firms' customers and other stakeholders through their unique communication channel, thus endorsing firms' development of new markets related to environmental improvements. For instance, in 1989, the Environmental Defense Fund (an environmental NGO) collaborated with McDonald's in the USA to develop competencies on alternative packaging. This cross-sector partnership helped eliminate one million tons of packaging by redesigning or reducing material used in straws, napkins, sandwich packaging, cups, French fry containers, etc. Other cross-sector partners, such as a university or lab, also provide firms with innovative solutions to initiate radical change in the industry (Rothaermel and Deeds 2004). In industries in which know-how is critical, companies must be an expert at both in-house research and cooperative research with university scientists (Powell et al. 1996). Such collaborative R&D is helpful to "shorten research time as compared to the firms setting up their own research efforts from scratch" (Contractor and Lorange 1988; Sakakibara 1997, p. 146). Based on the above analysis, I suggest:

Hypothesis 1 Firms with innovation orientation tend to choose more diverse alliance partners.

Alliance Experiences Moderate Alliance Partner Heterogeneity

Forming an alliance with diverse partners is not easy. Focal firms need to go through considerable political, legal, and organizational hoops to reach out to their potential allies. The network of prior alliances helps firms access influential channels of information (Gulati 1995) and connect firms to key organizations across industry and sector borders. This network of prior alliances also develops firms' organizational and management capacities to align with a more diverse set of partners (Gulati 1999). Since diverse alliance partners (especially cross-sector organizations) have fundamentally different governance structures and missions (Rondinelli and London 2003), it is difficult to reach a consensus and build trust among diverse partners to join forces for common strategic goals. Focal firms need to develop specific "systems, procedures, and personnel" in managing such diverse and complex alliances (Gulati 1999, p. 402). As such, firms need to have enough prior alliance experiences so that they can accumulate their organizational and management capacities through the historical process of learning (Barney 1991). Resulting from its unique historical experience, firms' network resources may come about in a unique path-dependent process in which both the frequency of its past ties and also the identity of its partners are critical (Gulati 1995).The more prior alliance experiences firms possess, the more likely they may be able to access to diverse partners and develop the capacities to manage alliances with a more diverse set of partners.

H2 Firms' prior alliance experiences moderate firms' likelihood to align with more diverse partners.

Partner Heterogeneity Moderates Alliance's Environmental Outcomes

Typology of Environmental Strategy

Aragon-Correa (1998) classified the typologies of corporate postures regarding the natural environment along a continuum that ranges from reactive to proactive. Reactive environmental strategies adopt end-of-pipe pollution control technologies as the mechanistic and daily practice response to regulatory requirements and stakeholder pressures (Aragon-Correa and Sharma 2003; Buysse and Verbeke 2003). Such pollution control technologies include a multitude of biological and chemical systems used for treating water, barrier systems used for treating air, and disposal methods for waste (Henriques and Sadorsky 2005). Investments in end-of-pipe technologies have often been rated as a reactive strategy since they focus on cleaning up after problems occur, instead of changing the production process or resource base to avoid producing waste in the first place (Jones and Klassen 2001).

At the other end of the continuum there are at least three types of environmental strategies that range along a continuum of proactiveness—from pollution prevention, product stewardship, to sustainable development (Hart 1995). Pollution prevention strategy reduces pollution at the source before it is produced. It allows firms "to reduce, change, or prevent waste through better housekeeping, material substitution, recycling, or process innovation" (Hart 1995). Product stewardship strategy extends beyond an organization's operational boundaries to integrate external (stakeholder) perspectives into product design with the goal of minimizing the negative environmental burden throughout the products' life cycles—from raw material, through production processes, to product use, and disposal of spent products (Buysse and Verbeke 2003; Hart et al. 2003). Sustainable development, as the most proactive environmental strategy, "aims to minimize the environmental burden of firm growth through the development of clean technologies" (Buysse and Verbeke 2003, p. 455; Hart 1995). Clean technology "refers not to the incremental improvement associated with pollution prevention, but to innovations that leapfrog standard routines and knowledge" (Hart et al. 2003). The aforementioned environmental strategies fall along a proactive continuum scale that ranges from the reactive strategy (end-of-pipe or pollution control) to the most proactive environmental strategy (sustainable development) (see Fig. 1).

Hart (1995) identified an interconnectedness among the above four stages of environmental strategy, in that they are path-dependent and embedded. The path toward sustainability requires changes in business models, appropriate technologies, operation process, organizational forms, and performance objectives (Sharma and Henriques 2005). The facilitation of these changes necessitates resource accumulations, and requires significant investments in knowledge-based organizational systems and practices. In such instances, strategic alliances are important mechanisms to facilitate firms' effective utilization of resources to initiate changes along this path. However, strategic alliances formed for complex social and environmental issues have different partner structures. The varied resources and capacities contributed by different alliance partners may influence an alliance's ability to adopt more or less proactive environmental strategy along the sustainability path.

Alliance Partner Heterogeneity and Environmental Strategy Outcomes

From RBV perspective, firms aligning with diverse partners may better combine perspectives from diverse partners to stimulate organizational learning (Sakakibara 1997; Gulati 1999), especially exploration learning. Strategic alliances are essentially platforms for learning (Inkpen and Tsang 2007), which are either explorative or exploitative (Levinthal and March 1993). Exploration learning involves "search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation" (March 1991, p. 71). This process of resource accumulation through exploration learning becomes especially important when firms try to "enter a new business, to redefine their core industries, or when they respond to shifting industry boundaries" (Sakakibara 1997, p. 145). Applied to complex environmental issue context, the emerging environmental challenges associated with global sustainability may be catalysts for a new round of creative destruction that offers unprecedented business opportunities (Hart and Milstein 1999). In such instances, firms need to require and learn knowledge from firms outside their industry boundaries (Sakakibara 1997) so as to develop "next-generation competencies" (Hamel 1991; Sakakibara 1997, p. 145). By crossing traditional boundaries, partnerships between organizations from different sectors may foster new perspectives, thus developing new problem solving approaches.

Organizational learning in the diverse partnership setting can also stimulate higher-order organizational learning, which involves the development of different interpretations of new and existing information (Sharma and Vredenburg 1998). Heterogeneous partners bring new values and perceptions into the alliances, which may cause participating firms to become more positive and forward-thinking. This may lead to changing business paradigms and fundamental shifts in business philosophy (Sharma and Vredenburg 1998), which may help develop a "shared vision" in the organization (Hart 1995). "Shared vision" is critical for the adoption of more proactive environmental strategies as all functional units (including management, R&D, production, and marketing) must be mobilized and committed if a firm is to implement a policy of using clean technologies (Russo and Fouts 1997). The above analyses suggest how heterogeneous partners may help firms develop explorative and higher-order learning to develop radically improved innovations which substitute existing technology, and they do so in a way that mitigates complex environmental issues (Kemp 1994). Based on the above analysis, I suggest:

Hypothesis 3 Heterogeneous cross-industry and -sector partners are more likely to associate firms with more proactive environmental strategies.

Methods

Data

The data used in this study were gathered from four databases: (1) I incorporated environmental alliance data for 1991–2009 from the Securities Data Corporation (SDC) database (a division of Thomson Financial). The SDC database focuses on publicly announced inter-firm alliances (including joint ventures). While coverage is incomplete, since firms are not required to report alliance activities, the database is among the most comprehensive sources of information on alliances. It is also one of the only sources available for large-scale empirical studies on alliance activity (Sampson 2007). To increase the reliability of the SDC data, I selected data from 1991 onwards, since SDC coverage of alliances is more comprehensive after 1990 (Sampson 2007). (2) I collected firm patent data from the U.S. Patent and Trademark Office database. This database provides full text and citation access to information in the reference, business, medical, and legal disciplines. (3) I used Compustat database to collect firms' financial attributes. (4) I used KLD Research & Analytics database to collect data on firms' environmental performance prior to current alliance participation. KLD is a commonly used measure of corporate social performance (Graves and Waddock 1994; Sharfman 1996). This rating scheme has been tested for construct validity against other measures of corporate social performance by Sharfman (1996), who found it to be one of the best measures of corporate social performance available to date.

The combination of these four databases derives a total of 146 observations for the period of 1991–2007, which involved the participation of 74 manufacturing and utility firms (SIC codes 20-49) in 146 alliances. I excluded observations from service and other industries to increase data comparability. A firm's participation in a specific alliance is the subject of this study. The individual alliance was not selected as the unit of analysis since the focus of the study was to identify firms' decision to align with different partners in pursuing strategic alliance goals.

Statistical Models

My conceptual model consists of two components: (i) and (ii). The first component (i) is an alliance partner choice equation, $Pi = \gamma + \beta 3 \;\; Mi + \beta 4 Vi + \mu 2$. It relates the probability of firms' choices of same-industry partners, cross-industry partners or cross-sector partners (*Pi*) to firms' motivations to align with diverse partners (competency orientation and alliance experiences) (*Mi*), a vector *Vi* representing other factors that influence firms' alliance partner choices, and unobserved factors $\mu 2$. The second empirical component (ii) is an environmental strategy choice equation, $Y1 = \alpha + \beta 1 \;\; Pi + \beta 2 Wi + \mu 1$, which predicts the proactiveness of firms' environmental strategies (*Y*) to the probability of firms' choices of different partners (*Pi*). In my model, P1, P2, and P3 specifically represent the probability for firms to choose same-industry, cross-industry and -sector partners. $\beta 1$ represents the inverse mills ratio of P1, P2, and P3 after first stage logit model. The vector *Wi* captures observed exogenous firm/alliance-specific control variables, and $\mu 1$ represents unobserved factors. Some of the variables included in *Wi* may also be included in *Vi*; the unobserved variables $\mu 1$ and $\mu 2$ are likely to be correlated (Greene 2000) because of a selection bias associated with the firm-level decision to participate in the strategic alliance. If unaddressed, selection bias produces erroneous coefficient estimates in the ordinary least square (OLS) analysis (Maddala 1986).

There are a number of different statistical techniques that have been developed to address selection bias. In this study, I modified Heckman regression model and applied a two stage technique combining multinomial logit model (first stage) and OLS regression models (second stage) to control for self-selection bias in the evaluation of voluntary social behavior (Greene 2000; Maddala 1986). The general strategy of the two stage model is to estimate the probability of selection based on exogenous factors, and this estimated probability of selection computed in stage 1 (Eq. i) can be used as the independent variable in stage 2 (Eq. ii) (Greene 2000).

Variables and Measurements

Independent Variable: Innovative Orientation

Firms' innovative orientation was measured by patents. The use of U.S. patents as a reliable measure of firms' innovativeness is widely accepted in the literature (Hagedoorn and Schakenraad 1994; Sampson 2007). Patents "are strongly correlated with the introduction of new products, invention counts, and non-patentable innovations" (Sampson 2007, p. 370). Therefore, firms' innovative orientation to participate in strategic alliances was assessed by "patent intensity"—the total number of assigned U.S. patents (1 year prior to firms' participation of environmental alliance) against "firms' average sales/turnovers."

Independent Variable: Alliance Experiences

Gulati (1999) argued that an important basis for alliance formation is learning from prior experiences, which may help firms develop the capacity to manage a more complex type of alliance partners (e.g., cross-sector partners). Using SDC data, prior alliance experience, often used as a proxy for a firm's alliance capability, was measured (1) by counting firms' years of alliances experiences prior to their current alliance participation, and (2) by taking a count of firms' prior environmental alliances.

Dependent Variable (First Stage): Partner Heterogeneity

The first stage-dependent variable, alliance partner heterogeneity index, was measured by assigning three scales to cross-sector, cross-industry, and same-industry alliances specifically. Since cross-sector partners are fundamentally different from industry partners, cross-sector alliances are considered to be more diverse than inter-firm alliances. As such, I coded the breadth of alliance participation as "3" if alliance partners were across different sectors (involving NGOs, universities, labs, government, etc.), as "2" when partners were from different industries, and as "1" if the alliance partners were from one single industry. Since "partner heterogeneity" is a three-scale categorical variable, I applied multinomial logit model for first stage model analysis.

Dependent Variable (Second Stage): Environmental Strategy

I measured alliances' environmental performance through examining the type of environmental strategy that firms adopted during alliance participation. I developed this measurement through modifying Hart (1995)'s environmental strategy framework. The "deal synopsis" element in SDC database contains a qualitative explanation of each firm's activities during their alliance participation. I applied content analysis to assess these data and categorized firms' environmental strategies into four categories: A firm's environmental alliance strategy was coded "1" (pollution control strategy) when I came across such key words as "waste to energy," "water and wastewater treatment services" and "environmental clean-up." These activities address pollution after it occurs. Environmental strategies were coded "2" (pollution prevention strategy) when I came across such key words as "enhanced energy efficiency," "reduce," "reuse," "recycling," "source reduction," etc. These activities reduce pollution generation at the source before it is produced. Environmental strategies were coded "3" (product stewardship strategy) when I came across such key words as "life cycle analysis," "supply chain involvement," and "smart design in reversing supply chain." This strategy integrates the external stakeholder and supply chain into product design to minimize environmental burdens. Environmental strategies were coded "4" (sustainable development through development of clean technology) when I came across such key words as "explore alternative fuel/material," "clean technology," and "renewable energy." The renewable energy includes solar, wind, biomass, geo-thermal, fuel cell vehicle, hydrogen-based energy, etc. This strategy strives to develop new products or services that challenge existing practices and produce "zero" emission. To address potential bias related to personal judgment in content coding, another colleague also independently coded the environmental strategy variable, and his coding rate matched mine in 93.8 % of all cases indicating a sufficient inter-reliability rate (Cohen 1960).

The environmental strategy measure falls on an ordinal scale from 1 to 4. In considering how to model this variable statistically, I treated it as a continuous variable as it is statistically more powerful when treating ordinal variables as continuous to reveal relationships that otherwise may be overlooked (Pasta 2009).

Control Variables

Firm level control variables were compiled 1 year prior to the firm's participation in strategic alliances. The 1 year lag is due to the time interval that is needed to translate financial and other conditions into actual alliance decision making. Most firm-level controls were derived from the Compustat database. I looked at firm size, performance, solvency, risk propensity, and firm diversification as key indicators of a firm's resource base attribute that can be critical in its decisions to select diverse alliance partners. (1) Size indicates a firm's financial and managerial resource endowment, as well as its level of economies of scale and scope (Gulati 1999). I expect larger firms may have more scrutiny pressures from stakeholders. They tend to work with same-industry partners to manage reputation and image. Size was measured as the logarithm of firms' sale prior to firms' participation of the current alliances. (2) Prior financial performance was measured as return on assets (ROA). (3) Solvency was measured by the total amount of five-year average debt divided by the firm's current equity. (4) Firm diversification—Firms aiming for diversification are more likely to conduct R&D to explore new business niches and adopt more proactive environmental strategies. I followed many scholars to apply "entropy", which is to modify Shannon (1948)'s diversity index to assess the structural diversity in firms' degree of diversification. (5) Organizational risk is important to strategic management, since income variation can have negative consequences (Palmer and Wiseman 1999) for firm's decision to select alliance partners and to adopt more proactive environmental strategies. Following past risk research (Palmer and Wiseman 1999), I use variance in return on asset (firms' income stream uncertainties) to measure firms' organizational risks.

In addition, I controlled for firms' environmental performance compiled 1 year prior to firms' participation in the current alliances from KLD database. Johnson and Greening (1999) categorized KLD into two conceptually distinct dimensions: (1) a community, women, minorities, and employee relations dimension and (2) a product quality and environment dimension. This last dimension relates to product and service quality and to a firm's stance toward the natural environment. Therefore I used the ratings from the last dimension 1 year prior to firms' participation of environmental alliance as the proxy of firms' past environmental performance. These ratings include environmental concern ratings ("regulatory problems" and "hazardous waste"), environmental strength ratings ("clean technology", "recycling", "pollution prevention", and "beneficial products or services element"), product concern rating ("product safety"), and product strength rating ("R&D innovation").

I also controlled for two industry attributes: (1) industry complexity/concentration is measured by the amount of heterogeneity present in a firm's industry environment. I measured industry concentration by dividing the combined sales of the four largest firms in Compustat (ranked by sales) within each industry by the total sales of that industry (Palmer and Wiseman, 1999); (2) industry sector—industry differences are controlled using five industry dummies: light manufacturing SIC 20-27, chemical and refining SIC 28-29, heavy manufacturing SIC 33, 36, and 38, and utilities and communication SIC 48-49.

Finally, I controlled alliance level attributes: (1) alliance size was measured by the number of participants in the alliance, (2) alliance relation was measured by calculating the frequency that the alliance partners have previously aligned with their current partners; and (3) total alliance agreements was measured by the total number of alliance agreements firms signed during alliance participation. Since firms may symbolically announce the forming of environmental alliance without actually conducting any activities, I created this control variable to measure to what extent the alliance partners make substantiate efforts toward environmental improvements.

Results

Table 1 reports the means, standard deviations, maximum, and minimum for all variables, except industry dummies and prior environmental performance attributes used in the study.

In conducting data analysis, an extensive sensitivity analysis was conducted to ensure the robustness of these results. For instance, I obtained size measure using total sales, total assets, and employees. I obtained similar results when switching from one measure to the other. To test for multicollinearity, I checked the correlation matrix and variance inflation factors (VIFs) of the regression models. None of the VIF's is greater than 3.03, suggesting that my results are not affected by harmful multicollinearity (for which Kennedy 1998, cites a benchmark VIF of 10).

Strategic alliances in my sample normally are composed of 2–3 participants. The only exception is ten firms' participation in a large alliance with 16 participants from 12 different industries. I then created a dummy variable to control for these ten observations. All models were run with and without these ten observations to observe the variances. Through this sensitive analysis, I decided to exclude the ten observations from this study.

Table 2 presents the results of the multinomial logit model statistics analysis testing the hypotheses 1 and 2—to identify the specific factors that shape firms' decision to align with diverse partners.

Results support both hypothesis 1, that firms with innovative orientation ($\beta = 4.98$, $p = 0.02$) are more likely to align with cross-sector partners, and hypothesis 2, that firms with more years of alliance experience tend to choose cross-sector partners ($\beta = 0.15, p = 0.10$), whereas firms with fewer years of alliance experience tend to choose same-industry partners ($\beta = -0.19$, $p = 0.007$). Alliance experience is also measured with the number of prior environmental alliances. This measurement also produces similar results, that firms with more accumulated prior environmental alliances are less likely to choose same-industry partners ($\beta = -2.8$, $p = 0.01$). I controlled for alliance size, partner relation, firm size, solvency, organizational risk taking propensity, firm diversification, prior financial performance, prior environmental performance, industry complexity (concentration) and industry in the model. The results show that larger firms tend to work

Table 1 Description analysis

	Mean	SE	Minimal	Maximal		Mean	SE	Minimal	Maximal
Environmental strategy	2.32	0.99	1	4	Organizational risk	0.002	0.004	6.31e-06	0.03
Partner Diversity	1.81	0.68	1	3	Debt/equity	1.69	3.12	−4.39	28.37
Patent/sale	0.14	0.22	0	1.58	Industry concentration	0.72	0.22	0.15	1
Alliance experiences-year	6.81	4.86	0	21.8	Entropy	0.88	0.65	0	2.42
Alliance experiences-# of alliances	0.44	0.40	0	1.15	# of Alliance agreements signed	1.38	0.95	0	4
Firm size	4.05	0.76	1.56	5.26	Alliance size	3.38	3.56	2	16
ROA	0.07	0.03	−0.12	0.20	Prior relation	0.61	1.69	0	10.92

Table 2 Multinomial logit model predicting firms' choices of diverse partners

Explanatory variables	Same industry partner	Cross-sector partner
Drivers for partner selection		
Competency-patent/sale	−0.64(1.23)	4.98 (2.23)**
Alliance experiences-# of years	−0.19 (0.07)***	0.15 (0.09)*
Alliance experiences-# of environmental alliances participated	−2.80(1.12)**	1.89 (1.89)
Control variables		
Debt equity	−0.27(0.10)***	−0.19 (0.19)
Firm size (log sale)	1.33 (0.68)**	0.52 (0.81)
ROA	7.74 (10.24)	−13.59(24.52)
Firm diversification	0.17(0.64)	−0.81 (0.92)
Industry concentration	−0.35(1.37)	0.51 (2.41)
Organizational risk	60.57(75.93)	30.84 (84.49)
Previous environmental performance		
Clean energy	−1.27 (1.20)	2.58 (1.31)**
Beneficial service	1.41 (1.09)	−37.45 (2.49)***
Pollution prevention	−0.91(0.72)	−1.63 (1.13)
Recycling	2.57 (0.86)***	−1.06(1.40)
R&D innovation	1.74 (1.25)	−1.45(3.04)
Regulatory problems	1.15 (0.74)	−0.54 (0.96)
Hazardous waste	−0.32 (0.79)	−1.42 (1.56)
Product safety	0.22 (0.79)	−0.57 (0.85)
Industry dummy:		
Heavy industry (SIC33, 36, 38)	−1.28 (1.36)	−1.21 (1.71)
Chemical refining (SIC2829)	−1.36 (0.94)	−0.13 (1.48)
Light industry (SIC 20–27)	−1.96 (1.35)	−34.80 (1.72)***
Electricity (SIC40)	−0.95(1.26)	−1.52 (1.99)
Alliance level control		
Alliance size-# of partners	−0.86 (0.31)***	0.47(0.29)
Repeated alliance partner	1.17 (0.28)***	0.15(0.57)
Constant	−1.66 (3.19)	−3.73 (3.70)
Model significance	$P = 0.0000$	
R^2	0.3395	
Observations	135	

*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.10$

Cross-industry partner = 2 is the base outcome

with same-industry partners to minimize their scrutiny pressures ($\beta = 1.33$, $p = 0.05$). Firms' prior environmental performance results show that firms making incremental improvements like recycling tend to align with same-industry partners ($\beta = 2.56$, $p = 0.003$), where firms making radical improvements, like clean energy, tend to align with cross-sector partners like universities, labs and governments ($\beta = 2.58$, $p = 0.048$). And firms that have prior alliance relation with current partners have a tendency to work with same-industry partners to repeatedly refine their routines and enhance efficiency ($\beta = 1.17$, $p = 0.000$).

In this analysis, I applied the two stage model manually. Right after running the first stage multinomial logit regression model, I created variables for the predicted probabilities of each outcome (same-industry, cross-industry, and cross-industry). I then used these probabilities to create three mills ratio terms according to formulas given by Dubin and McFadden (1984). I then plug in these three mills ratio terms in my second stage ordinal regression model. Table 3 presents the results of this regression model. Results support hypothesis 3, that cross-sector partnership tends to be associated with more proactive environmental strategies ($\beta = 0.005$, $p = 0.07$), whereas same-industry partnership tends to be associated with less proactive environmental strategies ($\beta = -0.04$, $p = 0.09$).

I controlled for total alliance agreements signed, firm size, solvency, organizational risk taking propensity, firm diversification, prior financial performance, industry complexity (concentration), and industry in the model. The results show that firms with good financial performance

Table 3 Predicting the environmental performance of varied partner structure

	Dependent variable: environmental strategy proactive scale
Variable of interest	
P1-Probability in aligning with same-industry partner	−0.04 (0.02)*
P2-Probability in aligning with cross-industry partner	−0.004 (0.2)
P3-Probability in aligning with cross-sector partner	0.005 (0.003)*
Control variables	
Total agreements signed in alliance	0.17 (0.08)**
Industry concentration	−1.11(0.38)***
Firm diversification	0.21 (0.14)
ROA	−5.70 (3.43)*
Firm size (log sale)	0.07 (0.13)
Debt/equity	0.01 (0.01)
Organizational risk	−4.86 (22.34)
Heavy manufacturing	−0.11 (0.34)
Chemical refining	0.30(0.31)
Light manufacturing	1.23 (0.51)**
Utility & communication	−0.02 (0.26)
Constant	2.48 (0.76)***
Model significance	$p = 0.0000$
R^2	0.2743
Observations	135

*** $p \leq 0.01$; ** $p \leq 0.05$; * $p \leq 0.10$

(measured by return on assets) are less likely to adopt more proactive environmental strategies ($\beta = -5.7$, $p = 0.10$). It suggests that companies adopting more proactive environmental strategies tend to have a larger initial investment; therefore, they may have lower returns on assets at the beginning. Firms from a more complex industry environment are more likely to adopt more proactive environmental strategies ($\beta = -1.11$, $p = 0.004$). They may seek radical environmental improvements as opportunities to develop new business niches, thus enhancing their competitive position in the industry. Results from the total alliance agreements signed suggest that firms who make more substantiate efforts in the alliances tend to produce more proactive strategy outcomes ($\beta = 0.16$, $p = 0.000$).

Discussion

In this study, I investigated the relationship between partner heterogeneity and alliances' environmental performance, and explored the antecedents that drive firms to align with more diverse partners. In hypothesis 3, I predicted that more diverse partner structure may associate firms with more proactive environmental outcomes. The significant results help explain why cross-sector alliances are developing around the world in an attempt to solve complex environmental and social issues.

For alliance literature, I develop a mechanism in explaining why cross-sector partners (e.g., universities, labs, governments, NGOs) are more likely to associate firms with more proactive environmental outcomes. By crossing traditional sectoral boundaries, partnerships between organizations from different sectors may foster new perspectives and develop new problem solving approaches that provide numerous organizational and societal benefits. My results confirm Hart (1995)'s assertion that a sustainable-development strategy extends beyond the firm to "include collaboration among the public and private organizations needed to bring about substantial technological change" (p. 1004).

Previous research in alliance heterogeneity (Sakakibara 1997) suggested a positive association between cross-industry partner structure and firms' technical or business performance. However, in my study, the association between cross-industry partners and proactive environmental strategy is not significantly supported. It suggests that cross-industry alliances may have different performance in the conventional business setting and complex environmental issue setting. The results also suggest that same-industry partner structure is less likely to be associated with more environmental strategies. The different environmental strategy outcomes associated the same-industry, cross-industry and -sector partner structure reveal a graduation pattern that more diverse partner structure may be associated with more proactive environmental outcomes. The findings further underscore the specific roles that cross-sector partners play in advancing corporate social responsibility goals.

In further evaluating this potential, I explored the factors that may motivate firms to select more diverse (e.g., cross-sector) partners. In hypothesis 1, I applied RBV lens to explain how firms' innovative orientation may drive them to pursue more diverse alliance partners to combine their complementary competencies to develop more radical solutions. The support for this hypothesis suggests that RBV offers one basis to understand why some firms seek more diverse partnerships (especially cross-sector alliances) to activate social environmental goals. Using RBV, I also drew a connection between partner heterogeneity and the type of organizational learning firms conduct in environmental alliances, and argued that more diverse partnerships tend to conduct exploration learning and higher-order learning to change mindset and shift knowledge base towards more proactive environmental strategy adoption.

My research findings have important policy and managerial implications. Many policymakers and NGOs are endorsing (and even developing) cross-sector alliances to advance their environmental protection goals. Since homogeneous alliances may be associated with less proactive environmental strategies, they may be less likely to lead to meaningful environmental outcomes than would cross-sector alliances that target competence development and organizational learning. As such, policymakers and NGOs may achieve stronger environmental outcomes by going beyond simply pushing environmental change among the regulated community, and instead, should align themselves with businesses to foster stronger learning and innovation opportunities that lead to more ambitious environmental outcomes. Firms are increasingly adopting alliance strategies for both economic and political reasons. It is critical for them to choose the right alliance partners, since constituents may judge firms by their alliance associations. By knowing what types of alliance partners are more proactive in associating firms for more meaningful environmental improvements, firms can have a more informed selection of appropriate alliances that can preempt regulations, signal environmental stance, or explore new market opportunities.

Lastly, my results support hypothesis 2 that firms' alliance experiences may moderate firms' choices of more diverse partners. The supporting of this result adds a time dimension into my model, which suggests that firms' partner selection is dynamic, and firms' prior alliance experiences may help firms develop the capacities to manage a more diverse partnership.

It is also important to acknowledge that my data is U.S.-centric, which limits the generalizability of my study results. To my knowledge, this is the first empirical study employing large data set examining the environmental performance of diverse (especially cross-sector) alliances. My study results have merits, and I hope more empirical studies can be conducted with data from other countries to cross-check research findings.

Conclusion

My study provides a new mechanism in understanding the performance of cross-sector alliances in advancing CSR goals. I identified the driving factors for firms to select a more diverse set of partners and explored whether such partner heterogeneity may influence the alliances' abilities to achieve more proactive environmental outcomes. This research contributes to the discussion of cross-sector alliances and environmental improvements by highlighting the proactive environmental strategy outcomes associated with cross-sector partners. Though an increasing number of studies explaining how cross-sector alliances address the social and environmental good in many more subtle ways (Selsky and Parker 2010), my research provided the timely empirical support of the environmental outcomes of these cross-sector partnerships.

There are also other key contributions of this research. First, I revisited the construct of alliance partner heterogeneity. Sakakibara (1997) suggested the use of industry heterogeneity of firms as a possible measure of capability heterogeneity. I developed this diversity index to include cross-sector partners. The test results confirm my assertion that cross-sector partners tend to be associated with more proactive environmental outcomes, whereas same-industry partners have confirmed the opposite. My study also developed the construct in measuring alliances' environmental performance. Previous researchers recognized that KLD data have many limitations in measuring corporate social responsibility (CSR) (Sharfman 1996). Specifically, KLD "net scores" have already been criticized for bringing together incommensurate counts of strengths and weaknesses (Strike et al. 2006). I answered the call from Strike et al. (2006) and improved CSR measurement by developing the environmental strategy typology index, which has four proactive scales that include pollution control, pollution prevention, product stewardship, and sustainable development. This environmental strategy typology index captures the immediate, direct environmental impacts in a shorter time window, which provides a more accurate metric to measure the environmental performance of strategic alliances.

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