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ABSTRACT

This article focuses on strategic alliances that strive for economic profit while contributing to environmental sustainability. These so-called environmental alliances operate on a spectrum between the goals of economic and environmental value. New environmental alliances signal in announcements to their external stakeholders where they position themselves on this spectrum of alliance goals in order to reduce information asymmetry and enhance their credibility. In this article, we predict the type of external signal that environmental alliances send by studying alliance processes and structures that embed the latent alliance goals. We built an original dataset by combining data on 389 environmental alliances from the SDC Platinum database for the period 2013-2017 and data on signals in 650 alliance announcements. Our findings show that announcements signaling on economic value are mainly used by environmental production and marketing joint ventures, thereby reducing the information asymmetry on their latent goal of economic value. Conversely, announcements signaling on environmental value are mainly used by environmental R&D contracts that focus on the latent goal of environmental value. Our article thus illustrates that alliances aim to enhance their credibility by achieving signal fit between external signals and latent alliance goals. Even though environmental alliances operate on a spectrum of economic and environmental value, we demonstrate that they prefer to avoid sending mixed messages and hence only signal on one of the alliance goals. Our article contributes to the literature on environmental alliances by applying signaling theory to explain these counterintuitive findings and to improve our understanding of how environmental alliances aim for credibility through their communication on their alliance goals.

Keywords: Signaling theory; environmental alliances; economic value; environmental value

1. Introduction

As a response to climate change, firms are expanding their collaborative efforts to develop, produce and sell more environmentally sustainable products and services (Wassmer et al., 2014), realizing that '*no one company can solve the "tragedy of the commons" by going it alone'* (Bhattacharya and Polman, 2017, p. 10). The corporate challenges of environmental sustainability have become so complex that effective solutions require inter-firm alliances (Ardito et al., 2019; Husted and de Sousa-Filho, 2017). These everyday experiences of alliances for environmental sustainability – referred to as environmental alliances - are mirrored by a recent surge in academic studies on the topic underlining the need for more collaboration to foster lasting change towards sustainability (Niesten and Jolink, 2019).

The literature characterizes environmental alliances as inter-firm alliances that combine a focus on economic and environmental value, with some environmental alliances emphasizing economic value and others emphasizing environmental value within the spectrum of the two intertwined alliance goals (e.g. Paquin et al., 2015; Niesten and Jolink, 2019). Environmental alliances '*create economic value by exploiting new market opportunities while simultaneously seeking to generate positive environmental impacts*' (Wassmer et al., 2014, p. 757). Since environmental alliances operate on a spectrum of economic and environmental value, they attract different types of stakeholders including investors, shareholders, regulators, NGOs, and consumers (Lin, 2012) with different preferences for an emphasis on either economic or environmental value (Bansal and Clelland, 2004). To ensure their credibility, environmental alliances have to communicate honestly to their stakeholders about where they position themselves on the spectrum of economic and environmental value (e.g. Connelly et al., 2011; Hawn and Ioannou, 2016). In other words, they have to communicate that they 'walk the talk' and thus reduce information asymmetry by revealing information on their alliance goals (e.g. Berrone et al., 2017, p. 366). Given the importance of credibility in a sustainability context, in particular for different types of performance such as market value and legitimacy (e.g. Berrone et al., 2017; Hawn and Ioannou, 2016), this article studies the communication by environmental alliances and their efforts to credibly reduce information asymmetry.

However, the literature on corporate communication about environmental sustainability has mainly focused on individual firms, addressing the relation between corporate environmental disclosure and credibility (Aerts and Cormier, 2009; Cormier and Magnan, 2015), between corporate communication and the credibility and legitimacy of firms (Berrone et al., 2017), and between environmental impression management and the legitimacy of firms (Bansal and Clelland, 2004; Bansal and Kistruck, 2006). Despite the recent surge in academic articles on environmental alliances, there is a lack of research on the communication by alliances that promote environmental sustainability. This article aims to fill this gap by studying the communication by environmental alliances, and in particular the external signals that environmental alliances send on their goals of economic and environmental value. To do this, we apply signaling theory to the study of communication by environmental alliances in order to better understand how these alliances credibly reduce information asymmetry regarding their focus on economic or environmental value.

At the core of signaling theory is the idea that signalers communicate on their unobservable, latent qualities to reduce information asymmetry (e.g. Connelly et al., 2011). Studies within signaling theory define signal fit as the extent to which a communication or a signal conveys the signaler's unobservable quality (Bianchi et al., 2019; Connelly et al., 2011, p. 53). Once signal fit is established it enhances the credibility of the signaler (Bianchi et al., 2019; Connelly et al., 2011). In our article, the unobservable qualities are the latent goals of the environmental alliances, and the signals are the communication about the alliances' focus on economic or environmental value. To study signal fit and thus the credible reduction in information asymmetry, we built an original dataset on 389 alliances that research, produce or market a renewable energy technology. Information on these alliances and their latent goals is taken from the Thomson Reuters SDC Platinum database for the period 2013-2017. This SDC data is combined with information on external signals in 650 press releases on alliance announcements collected via searches online and in Factiva.

Our article contributes to the literature on environmental alliances by explaining counterintuitive findings through the application of signaling theory. While the literature defines environmental alliances as having a combined focus on economic and environmental value, our findings show that they are more likely to communicate on only one of these goals and are less likely to send mixed messages. We find that environmental production and marketing joint ventures that emphasize the latent goal of economic value are more likely to exclusively signal on economic value. Environmental R&D contracts that emphasize the latent goal of environmental value are more likely to exclusively signal on environmental value. These counterintuitive findings can be explained by signaling theory. Environmental alliances are less likely to send mixed messages in which they communicate about a combined focus on economic and environmental value, because they aim for signal fit by only communicating on the latent goal that is the main focus of the environmental alliance. While aiming for signal fit, they reduce information asymmetry and enhance their credibility. The integration of signaling theory in research on environmental alliances thus helps us understand why the alliances communicate on only one of their goals: the alignment of external signals to latent alliance goals credibly reduces information asymmetry.

2. Theoretical background

In this section, we discuss the literature on alliances, environmental alliances and signaling theory. We combine insights from these research fields to develop our hypotheses that predict how environmental alliances communicate on their goals. Subsections 2.1 and 2.2 define environmental alliances and their goals of economic and environmental value. Since alliance goals are unobservable qualities, subsection 2.3 argues that we need to study observable alliance processes and structures that embed the latent alliance goals. Subsection 2.4 introduces signaling theory to show that environmental alliances communicate on their alliance goals to credibly reduce information asymmetry. Subsection 2.5 develops our hypotheses that test the application of signaling theory to environmental alliances, by predicting that an environmental alliance communicates on its alliance goal (economic or environmental value) that is embedded in its structure and process to credibly reduce information asymmetry.

2.1. Environmental alliances

The literature on environmental inter-firm alliances finds its origins in a diversity of fields, such as business, management, industrial ecology, and environmental studies (Niesten and Jolink, 2019; Wassmer et al., 2014). It includes research on environmental alliances in different empirical settings, with a strong claim in renewable energy technologies, and extending into alternative fuel vehicles, sustainable fashion, organic food and waste management (e.g. Ardito et al., 2019; Aschemann-Witzel et al., 2017; Chkanikova, 2016; Li et al., 2014; Post et al., 2015). A few focus areas can be distinguished in this dispersed literature, including the study of alliance motivations and thus the reasons for firms to enter into environmental alliances (Lin, 2012; Lin and Darnall, 2015), and the effects of environmental alliances on environmental, innovative and financial performance (Ardito et al., 2019; Ashraf et al., 2014; Husted and de Sousa-Filho, 2017; Dangelico and Pontrandolfo, 2015). The studies converge on the notion that environmental alliances are not only aimed at creating economic value but also at creating environmental value (e.g. Wassmer et al., 2014), or in other words, they operate on a spectrum combining economic and environmental value (Chen et al., 2017; Paquin et al., 2015). Environmental alliances are voluntary cooperative agreements between firms aimed at the development, manufacture, and/or distribution of green and sustainable products or services in which partners exchange, share, or co-develop environmental resources, knowledge or technologies, to create economic and environmental value (Niesten and Jolink, 2019; Stadtler and Lin, 2017; Wassmer et al., 2014).

2.2. Latent goals of environmental alliances: Economic and environmental value

Economic value has been defined as 'the net rent earning capacity of an asset or resource, tangible or intangible' (Madhok and Tallman, 1998, p. 326). In a strategic alliance, economic value is a 'supernormal profit jointly generated in an exchange relationship that cannot be generated by either firm in isolation and can only be created through the joint idiosyncratic contributions of the specific alliance partners' (Dyer and Singh, 1998, p. 662). Environmental value has been defined as 'value that is created at local, regional, national, and international levels that results in a positive effect on the environment due to benefits to air, water, land, and biodiversity' (Meyskens and Carsrud, 2013, p. 74). In an environmental alliance, the concept of environmental value represents those contributions by alliances that impact the environment in a positive manner. Examples of collaborative initiatives that lead to environmental value are reforestation programs, carbon emission neutralization programs, investments in preservation and environmental education, and a maximized use of renewables (e.g. Eidelwein et al*.,* 2018; Paquin et al., 2018). Economic and environmental value also differ in how they are created and how they can be appropriated: economic value is internal (to the alliance) value, created and appropriated by the alliance partners, whereas environmental value is external (to the alliance) value, created for stakeholders outside the boundaries of the alliance comprising benefits to air, water, land, and biodiversity (e.g. Lepak et al., 2007; Volschenk et al., 2016).

The alliance goals of economic and environmental value are unobservable to outsiders and can therefore be described as the latent qualities of environmental alliances (Basco, 2017; Dellaert et al., 2018). Given the 'unobservable nature of goals', and also that 'they cannot be observed directly in real life', 'the study of business goals has to deal with unobservable constructs' (Basco, 2017, p. 30). In order to deal with the unobservable nature of goals, we will follow the line of reasoning in the strategy literature that latent, unobservable alliance goals are embedded in observable alliance processes and structures (Chandler, 1962; Yin and Zajac, 2004). On the basis of Chandler's seminal work on the strategy/structure fit, Yin and Zajac

(2004) show that firms align governance structures to strategy with the latter characterized as the degree of complexity of goals. In this article, we rely on this strategy literature and argue that latent alliance goals are embedded in observable structures and processes. This argument is important in our study, because stakeholders need to be able to decide on the credibility of environmental alliances. In order for stakeholders to determine whether environmental alliances have *credibly* reduced information asymmetry, they need to observe the alliances' communication on their latent goals *and* determine if the communication is in line with the alliance processes or structures in which the latent goals are embedded.

2.3. Goals embedded in processes and structures of environmental alliances

In discussions on strategic alliance types, several authors have argued that one of the most common distinctions in alliance processes is between production, marketing and R&D alliances (Contractor and Lorange, 1988; Oxley, 1997; Oxley and Sampson, 2004; Phene and Tallman, 2012). Simultaneously, the most common typology of alliance structures distinguishes between equity alliances and nonequity alliances (e.g. Das and Teng, 2000; Gulati, 1995; Oxley and Sampson, 2004). This paper extends the area of application of these well-known typologies of alliance processes and structures to environmental alliances, i.e. alliances that are not only focused on economic value but that aim for environmental value as well. In terms of the processes of environmental alliances, we therefore distinguish environmental production and marketing alliances from environmental R&D alliances (Sadovnikova and Pujari, 2017). In terms of the structures of environmental alliances, we distinguish joint ventures in which equity is shared from contractual agreements in which no equity is shared (Garcia-Canal et al., 2008).

To understand how these processes and structures embed the alliance goals of economic and environmental value, we adopt a comparative approach. Since 'comparative economic organization never examines organization forms separately but always in relation to alternatives' (Williamson, 1991, p. 269), 'only differences rather than absolute magnitudes need to be determined' (Williamson, 1998, p. 48). Adopting a comparative approach, we argue that environmental production and marketing alliances governed by joint ventures combine economic and environmental value but are more inclined to focus on economic value. In comparison, environmental R&D alliances governed by contractual agreements combine economic and environmental value but are more inclined to focus on environmental value.

2.3.1. Processes of environmental alliances: Economic versus environmental value

Alliances that produce or market an environmental technology engage in exploitation, which is in essence 'the refinement and extension of existing competences, technologies, and paradigms. Its returns are positive, proximate, and predictable' (March, 1991, p. 85). These alliances yield economic benefits that are likely to accrue in the short term (e.g. Ji and Darnall, 2018). The production and marketing of environmental technologies, such as renewable energy, are often impacted by external institutions, such as government policies, rules and regulations. These policies include subsidies, tradeable certificates, tax breaks and other economic incentives that are implemented to financially stimulate the production and marketing of renewable energy (e.g. Doblinger et al., 2019), thereby contributing to a focus on economic value by environmental production and marketing alliances. In contrast, environmental R&D alliances engage in exploration of environmental technologies, which is in essence the 'experimentation with new alternatives. Its returns are uncertain, distant, and often negative' (March, 1991, p. 85). Since 'returns of green innovations are more uncertain' (e.g. Ardito et al., 2019, p. 185), we argue that environmental R&D alliances are less inclined to focus on economic value when compared to environmental production and marketing alliances.

Moreover, environmental R&D alliances are characterized by double externalities (e.g. Rennings, 2000; De Marchi, 2012), which means that they create two types of external value. First, the development of new environmental technologies creates environmental value for stakeholders outside of the alliance (i.e. benefits to air, water, land and biodiversity). Second, knowledge of the new environmental technologies spills over to other firms, who can then use these technologies to create additional environmental value (Ning and Wang, 2018). This means that environmental R&D alliances focus more on environmental value when compared to environmental production and marketing alliances. The latter create environmental value through their production and marketing of environmental technologies but are not characterized by double externalities and therefore do not create the additional environmental value due to spill-over effects.

2.3.2. Structures of environmental alliances: Economic versus environmental value

Joint ventures are legally described as common venturing for profit under common control with each partner participating in profits and losses (Hale, 1956). They involve the formation of new and separate business entities (Niesten and Jolink, 2018), and are 'evaluated primarily as stand-alone entities seeking to maximize their own performance' (Anderson, 1990, p. 23). Joint ventures are tightly coupled forms of organizing in which the parent companies are linked together by formal structures (e.g. a joint venture board of directors) and joint ownership (Dacin et al., 2007; Klijn et al., 2019; Lin and Darnall, 2015), which facilitates the allocation of profits and benefits among the partners (Garcia-Canal et al., 2008; Lin, 2012; Lin and Darnall, 2015). They allow partners to readily share in value creation and offer them income stability (Lin and Darnall, 2015). In contrast, contractual agreements do not share equity between the partners. They are legally-binding agreements between alliance partners which specify their rights and duties (Hagedoorn and Hesen, 2007). They are loosely coupled forms of organizing which involve less structure, control and coordination (Dacin et al., 2007). They provide greater flexibility to the alliance partners, including the ease of relationship termination (Dacin et al., 2007). They facilitate the alliance's continual redefinition as new ideas evolve and set the stage for innovation (Lin and Darnall, 2015). The flexibility of contractual agreements allows partners to pursue proactive environmental improvements, and contracts are therefore ‘associated with more proactive environmental strategies’ (Lin, 2012, p. 342; Lin and Darnall, 2015).

In a comparative approach, a major difference between joint ventures and contracts is that joint ventures offer more safeguards against opportunistic behavior than contractual agreements (Oxley, 1997; Jolink and Niesten, 2016; Niesten and Jolink, 2018). They have been described as more protective governance structures (Oxley and Sampson, 2004) due to their administrative controls and incentive alignment via equity and profit sharing among partners (Oxley, 1997). Joint ventures are therefore more effective at appropriating economic value, while contractual agreements allow for spill-overs and thus the transfer of environmental technologies to other firms and society at large. This means that joint ventures are more inclined to a focus on economic value in comparison to contractual agreements; in this comparison the latter are more inclined to focus on environmental value.

2.4. Signaling theory: Reducing information asymmetry on latent qualities

Adopting a comparative approach, we have argued that environmental production and marketing joint ventures are more inclined to focus on economic value, whereas environmental R&D contracts are more inclined to focus on environmental value in the spectrum of alliance goals. However, we know very little about communication by these environmental alliances, and whether their claims to stakeholders are in line with their alliance goals, hindering our understanding of their credibility. This is in sharp contrast to the large number of studies on communication by individual firms on environmental sustainability (Aerts and Cormier, 2009; Bansal and Clelland, 2004; Bansal and Kistruck, 2006; Berrone et al., 2017; Cormier and Magnan, 2015). In order to study the communication by environmental alliances and whether they credibly reduce information asymmetry, we apply signaling theory.

Signaling theory was introduced in the 1970s to address asymmetric information among economic actors. Several authors have demonstrated that actors reduce information asymmetry by revealing information through 'signals' (e.g. Spence, 1973). Over the years the essential elements of signaling theory have largely remained the same, identifying a *signaler,* a *signal* and a *receiver* of the signal, and the intent to reduce information asymmetry between the signaler and the receiver through the signal (Connelly et al., 2011).

The *signaler* could be a person, a firm or a composite group of either, but it can also be, for instance, a product or a business model (Bojovic et al., 2018). The essential element is that this person, firm or product holds information which is exclusive to the signaler. In Connelly et al.'s (2011) terminology we have opted for the environmental alliance to be the signaler transmitting the information. The information is then revealed through *signals*. Signals can take any form although signaling theory specifies two characteristics of signals: signal observability and signal cost (Connelly et al., 2011; Spence, 1973). The first characteristic refers to the extent to which *receivers* are able to identify the signal. By sending press releases announcing the formation of new environmental alliances, signalers aim for signal observability. The second characteristic of efficacious signals refers to the extent to which receivers are able to evaluate signals in terms of costs (e.g. alliance formation costs involve costs of partner search, negotiation and contracting, or in the case of joint ventures the costs of equity contributions). Signals that are observable and costly constitute strong signals and contribute to the credibility of the signalers (Berrone et al., 2017; Park and Mezias, 2005; Truong and Pinkse, 2019). These signals intend to resolve information asymmetry about a latent or unobservable quality (Van Veen and Wittek, 2016), where quality is defined as the 'underlying, unobservable ability of the signaler to fulfil the needs or demands of an outsider observing the signal' (Connelly et al., 2011, p. 43). A signal is thus an 'announcement that conveys a firm's intentions and abilities' (Bojovic et al., 2018; Truong and Pinkse, 2019, p. 288). Studies within signaling theory define signal fit as the extent to which a communication or a signal conveys the signaler's unobservable quality (Bianchi et al., 2019; Connelly et al., 2011, p. 53). The credibility of a signaler reflects the extent to which a signaler is honest, such that the signal corresponds with actual quality (e.g. Berrone et al., 2017).

In this article, we rely on signaling theory to argue that the credibility of an alliance is enhanced when the alliance achieves signal fit and thus reduces information asymmetry by signaling on latent or unobservable qualities. Announcements of a new environmental alliance contain signals that reveal the unobservable ability of the alliance to emphasize economic or environmental value as the goal of the environmental alliance.

2.5. Hypotheses

We develop our hypotheses by combining insights from signaling theory and the literature on strategic and environmental alliances. We predict that environmental production and marketing alliances governed by joint ventures are more likely to signal on economic value to achieve signal fit and credibly reduce information asymmetry (Hypothesis 1). These signals intend to reveal the latent quality, i.e. that production and marketing joint ventures have the ability to emphasize economic value. We compare signaling on economic value to two types of base categories: no signal on value and a mixed signal, with the first referring to announcements without a reference to value, and the latter referring to signaling on economic and environmental value at the same time without emphasizing either one or the other. Hypotheses 1a and 1b thus predict that environmental production and marketing joint ventures prefer to signal on economic value over sending no signal on value at all or sending a mixed signal that combines economic and environmental value. Using these two base categories allows us to test the argument that alliances aim for signal fit and send signals to credibly reduce information asymmetry on their latent goal.

Hypothesis 1a. Environmental production or marketing alliances, governed by joint ventures, are more likely to signal on economic value, compared to not signaling on value.

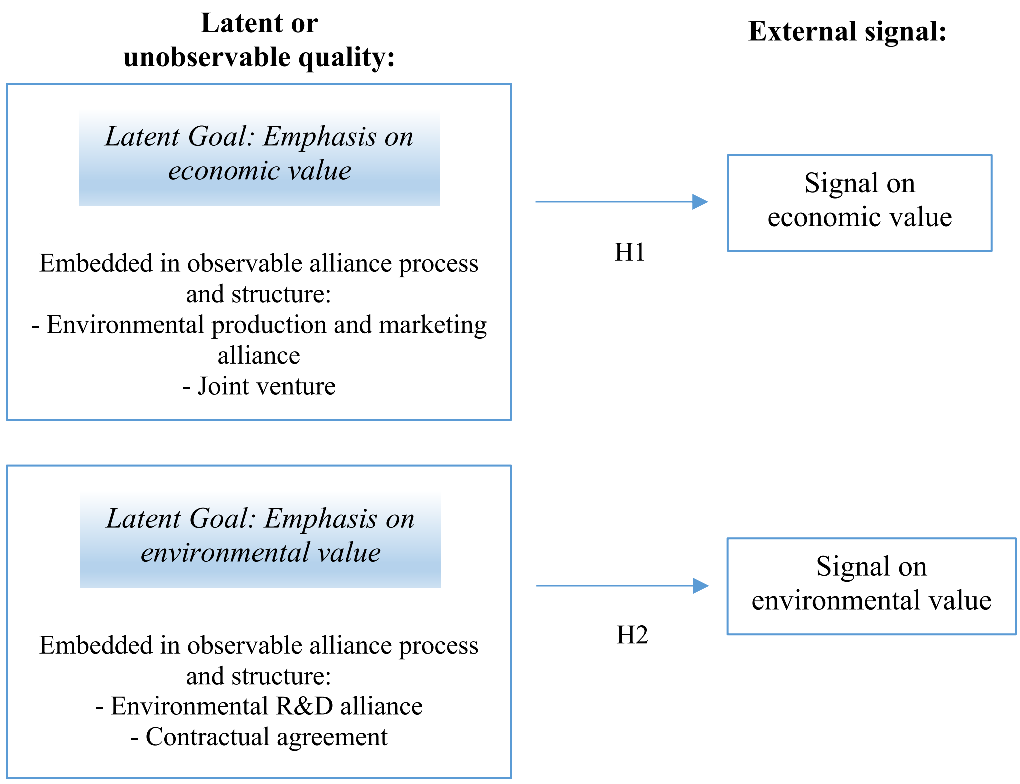
Hypothesis 1b. Environmental production or marketing alliances, governed by joint ventures, are more likely to signal on economic value, compared to sending a mixed signal.

We also predict that environmental R&D alliances governed by contractual agreements are more likely to signal on environmental value to achieve signal fit and credibly reduce information asymmetry (Hypothesis 2). These signals intend to reveal the latent quality, i.e. that environmental R&D contracts have the ability to emphasize environmental value. Here we also use the two base categories of no signal on value and a mixed signal to test the assumption that alliances intend to reduce information asymmetry on their latent goal. Hypotheses 2a and 2b thus predict that R&D contracts prefer to signal on environmental value over sending no signal on value or sending a mixed signal that combines economic and environmental value. Figure 1 summarizes the conceptual framework of this article on the alignment of signals and latent qualities.

Hypothesis 2a. Environmental R&D alliances, governed by contractual agreements, are more likely to signal on environmental value, compared to not signaling on value.

Hypothesis 2b. Environmental R&D alliances, governed by contractual agreements, are more likely to signal on environmental value, compared to sending a mixed signal.

Fig. 1. Conceptual framework on signal fit: Alignment of signals and latent qualities



3. Methods

3.1. Sample and data collection

We choose the empirical context of environmental alliances for several reasons, mainly revolving around the potential for studying credibility through the reduction of information asymmetry in a sustainability context. First, environmental alliances have latent, unobservable goals (i.e. emphasis on economic or environmental value) that are embedded in observable processes (i.e. production, marketing or R&D alliances) and structures (i.e. joint ventures or contracts), enabling us to collect data on the independent variable. Second, environmental alliances communicate on their formation in press releases. These alliance announcements are strong and observable signals that convey commitment on the part of the alliance partners (Park and Mezias, 2005). Third, the nature of environmental alliances allows us to distinguish between different types of signals: a signal on economic value, a signal on environmental value, no signal on value, and a mixed signal communicating on both types of value. The presence of these different types of signals enables us to collect data on the dependent variable and thus to test our hypotheses that rely on signaling theory and the argument that signalers aim for signal fit to credibly reduce information asymmetry.

Our sample of environmental alliances is extracted from the Thomson One SDC Platinum database and contains renewable energy alliances between firms that were formed between 2013 and 2017. We choose to collect data on renewable energy alliances to ensure that alliance partners consider environmental value as one of the unequivocal goals of the alliance, aligning our data with the definition of environmental alliances (i.e. alliances that impact the environment in a positive manner). In addition, as argued by Post et al. (2015, p. 424) in a study on renewable energy alliances, '*restricting the sample to a single industry helps reduce the noisy distraction of industry variation in alliance formation and environmental considerations*.' We read the entire SDC database for the years 2013-2017 to select alliances that research, produce or market renewable energy. We identified 8 categories of renewable energy: biomass, geothermal, hydro, hydrogen, solar, tidal, wind and renewable energy (Rogge and Schleich, 2018). The final category 'renewable energy' includes alliances that combine different types of renewable energy, most often alliances that research, produce or market solar and wind energy.

A well-known classification of environmental technologies is the International Patent Classification (IPC) Green Inventory, which includes an 'alternative energy production' class (Albino et al., 2014). In addition to renewable energy technologies, this IPC class also includes low carbon technologies that use non-renewable energy (e.g. integrated gasification combined cycle, harnessing energy from manmade waste such as chemical or industrial waste, see Albino et al. 2014 for an extensive discussion on the IPC and the 'alternative energy production' subclasses). Since we focus on renewable energy, our selection is a subset of this class.

We only included alliances between firms and excluded alliances with not-for-profit partners and partners in which a state is a majority shareholder (e.g. government agencies, municipalities) to ensure that alliance partners consider economic value as a goal of the alliance. We used information of the partner and its parent company to determine the ownership structure of the partner. We only included alliances labelled as pending, completed/signed or letters of intent, and excluded those labelled as rumors. This selection process resulted in 389 inter-firm renewable energy alliances. Our focus on inter-firm renewable energy alliances thus enables us to collect data on alliances operating on a spectrum of environmental and economic value, ensuring the theoretical suitability of the empirical setting.

The SDC database contains information on the name, industry and country of the alliance and its partners, but also contains an activity description and a deal text of the alliance. We combined information in this database with an extensive search for information in alliance announcements. Following earlier work on environmental impression management by Bansal and Clelland (2004), we searched for press releases online and in the Factiva database. We included alliance announcements that were released by the alliance partners and are published on the websites of the partners as well as press releases of news agencies, as far as they contained statements on the alliance that were made by the alliance partners themselves. This selection was made to only include data sources with information formulated by the environmental alliance and its partners and thus reflecting the alliance's signaling activity. We continued collecting press releases on an alliance formation until they contained no new information; on average, we have more than one press release per alliance. In total, we analyzed information in 650 press releases.

3.2. Dependent variable and multinomial logit models

Our dependent variable on the external signal contains four categories: a signal on economic value, a signal on environmental value, no signal on value and a mixed signal. To identify the signal on economic value, we coded statements in the press releases that referred to financial benefits resulting from the new environmental alliance, including statements on feed-in-tariffs, energy tenders, tax equity, power purchase agreements with state-owned utilities, support from local councils, and renewable energy production targets set by policy makers. Our coding thus reflects the benefits resulting from a regulatory system favorable to renewable energy and is in line with previous research that has identified subsidies as credible signals (Chen et al., 2018; Bianchi et al., 2019). To identify the signal on environmental value, we coded statements in the press releases that referred to the alliance's contribution to environmental sustainability. Examples of these statements include aims to reduce CO_2 emissions, references to fight climate change, provide sustainable solutions, stimulate a transition to sustainability, promote sustainable progress and a sustainable society, and testimonials indicating the adoption of a long-term approach to sustainability. Appendices 1 and 2 offer several examples of the coding of these signals. Previous research has also used alliance announcements as data that contains signals impacting the perceptions of stakeholders (e.g. Koh and Venkatraman, 1991; Park and Mezias, 2005).

We estimate four multinomial logit models, including a model with control variables and a full model in which the signals on economic and environmental value are compared to the base category of sending no signals on value, and a model with control variables and a full model in which the signals on economic and environmental value are compared to the base category of sending mixed signals (i.e. referring to both economic and environmental value).

3.3. Independent variable

The independent variable contains three categories: an environmental production and marketing alliance governed by a joint venture; an environmental R&D alliance governed by a contract; and a base category. The base category includes production and marketing alliances governed by contracts, and R&D alliances governed by joint ventures, and thus contains alliances without a consistent alliance goal of either economic or environmental value.

To determine whether an alliance is an environmental production and marketing alliance or an environmental R&D alliance, we used information from the SDC database, such as the deal texts and activity descriptions, and information in press releases. An alliance is coded as an environmental production and marketing alliance when the SDC deal text or press release refers to producing, assembling, constructing or manufacturing; operating a plant; or commercializing, exploiting, buying, purchasing, sourcing, supplying or selling of a renewable energy product, technology or service by alliance partners. An alliance is coded as an environmental R&D alliance when the SDC deal text or press release refers to the collaborative or joint innovation, creation, development, exploration or improvement of a renewable energy product, technology or service, or explicitly to R&D alliances in the field of renewable energy. Occasionally, the deal texts indicate that an alliance is involved in more than one stage of the value chain. To reduce the number of categories for this variable, we only code the first stage of the value chain, with R&D preceding production and marketing (Niesten and Jolink, 2018).

The SDC database and press releases also provide information on the governance structures of the alliances, distinguishing between joint ventures and contracts. We combined this data on structures with data on the processes to create the three categories of the independent variable. Data on R&D, production and marketing alliances, and data on joint ventures and contracts (also from the SDC database) have been used in previous research to construct variables (Jolink and Niesten, 2016; Niesten and Jolink, 2018; Oxley 1997; Oxley and Sampson, 2004).

3.4. Control variables

A first control variable is the type of renewable energy technology of the alliance, which is coded using the SDC database and checked in the press releases (see Table 1). Following Reiche and Bechberger (2004), we argue that signaling may differ for each type of renewable energy, depending on existing regulation for the renewable energy technology and on the novelty of the technology. When a renewable energy technology receives regulatory support, the alliance may be more likely to signal on economic value. When a renewable energy technology is in the early stages of development, the alliance may be more likely to signal on environmental value.

As established by research in international business, international partnerships increase customer pressures on firms to behave environmentally responsible, and international alliances are therefore more likely to signal that they surpass local environmental responsibility requirements (Christmann and Taylor, 2001; Dacin et al., 2007). We therefore expect that international alliances are more likely to signal on environmental value when compared to national alliances. This variable is a binary variable using information from the SDC database and establishes whether the alliance partners are from a different country.

A third control variable deals with the ownership of the alliance partners, i.e. whether one or both of the partners is a public or a private firm. We expect that alliances of public firms are more likely to signal, because of their greater visibility and pressure from stakeholders (Clark and Perrault Crawford, 2012; Yang et al., 2018). This binary variable is measured at the holding level of the partners, using the SDC database and websites of the alliance partners.

A fourth control variable establishes whether one or both of the partners were already engaged in renewable energy before forming the new alliance, as evidenced by the reference to renewable energy in the SDC long business description and/or the SIC codes 3674 (includes companies that produce solar cells) and 499A (all types of renewable energy). We expect that a presence in the renewable energy industry creates an awareness of regulatory support and leads alliances to signal on economic value.

We include a control variable on the environmental performance of the alliance nation. We anticipate that alliances operating in countries with a strong environmental performance are more likely to send signals that assure their stakeholders they promote environmental sustainability (Aerts and Cormier, 2009; Cormier and Magnan, 2015). We have used the environmental performance index of the alliance nation for the year of the alliance announcement. The environmental performance index is generated by the Yale Center for Environmental Law & Policy and The Center for International Earth Science Information Network (CIESIN) at Columbia University's Earth Institute, in collaboration with the World Economic Forum (WEF).

We also include a control variable on the competitiveness of the alliance nation. We expect that alliances operating in countries with an increasing competitiveness are less likely to signal on environmental value, as intensified market competition will focus partners' attention on reducing costs and generating profits, and away from contributing to environmental sustainability (Duanmu et al., 2018). We have computed the increase or decrease in competitiveness according to the Global Competitiveness Index (GCI) of the World Economic Forum, based on the GCI of the alliance nation in the year of the alliance announcement compared to the same GCI eight years earlier.

To control for unobserved heterogeneity during the study period (2013-2017), we include a control variable reflecting the year of the alliance (e.g., Reuer and Lahiri, 2014).

Table 1. Descriptive statistics

Variables	Measurement scale	Frequency	Data source
Dependent variable:			
External signal	Nominal	Signal on economic value: 134 Signal on environmental value: 68 Base category: mixed signal: 49 Base category: no signal: 138	Press releases
Independent variable:			
Substantive action: Alliance process & structure	Nominal	Environmental production and marketing JV: 235 Environmental R&D contract: 36 Base category: environmental production and marketing contract & environmental R&D JV: 118	SDC and press releases
Control variables:			
Type of renewable energy technology	Nominal	Biomass: 33 Geothermal: 11 Hydro: 8 Hydrogen: 8 Renewable energy: 41 Solar: 217 Tidal: 5 Wind: 66	SDC and press releases

International alliance	Binary	Partners in different countries: 253 Partners in same country: 136	SDC
Ownership of alliance partners	Binary	One of the partners is a public firm: 301 All partners are private firms: 88	SDC and websites of alliance partners
Partner in renewable energy	Binary	Yes: 269 No: 120	SDC
Environmental performance of alliance nation	Continuous	Mean: 67.191 (s.d.: 14.480) Min: 29.56 Max: 90.68	YCELP
Competitiveness of alliance nation	Continuous	Mean: 2.920 (s.d.: 5.902) Min: -9.6 Max: 23.6	WEF
Year of alliance	Nominal	2013: 79 2014: 78 2015: 58 2016: 75 2017: 99	SDC

Table 2. Association and correlation coefficients (Cramer's V, Spearman, and Pearson)

	External signal	**Substantive action: alliance process and structure**	**Type of renewable energy technology**	**International alliance**	**Ownership of alliance partners**	**Partner in renewable energy**	**Environmental performance of alliance nation**	**Competitiveness of alliance nation**	**Year of alliance**
External signal	1.000								
Substantive action: alliance process and structure	0.3557****	1.000							
Type of renewable energy technology	0.1448	0.1069	1.000						
International alliance	0.1169	0.0131	0.1816**	1.000					
Ownership of alliance partners	0.1099	0.0841	0.1536	0.0485	1.000				
Partner in renewable energy	0.0989	0.0427	0.3190****	-0.1173**	0.1045**	1.000			
Environmental performance of alliance nation	-0.0157	-0.0973*	0.0570	0.0757	-0.0865*	-0.0824	1.000		
Competitiveness of alliance nation	-0.1125**	0.0205	0.0541	-0.0194	0.0261	0.0905*	-0.4122****	1.000	
Year of alliance	0.1294*	0.2313****	0.1506*	0.1035	0.0581	0.1175	0.0112	0.2251****	1.000
* Significant at 0.1 level; ** significant at 0.05 level; *** significant at 0.01 level; **** significant at 0.001 level (based on LR Chi^2 for Cramer's V)									

4. Analysis of results

Table 1 reports the descriptive statistics of the variables and Table 2 the association and correlation coefficients. Table 3 shows the results of the multinomial logit models. In Hypothesis 1, we proposed that in order to achieve signal fit and credibly reduce information asymmetry, environmental production and marketing alliances governed by joint ventures are more likely to signal on economic value. The results in Table 3 illustrate that Hypotheses 1a and 1b are supported (0.998, $p < 0.01$ with base is no signal on value; 1.167, $p < 0.05$ with base is mixed signal). After converting the coefficients into odds ratios, we conclude that environmental production and marketing joint ventures are 2.712 times more likely to signal on economic value than to not signal on value. They are also 3.213 times more likely to signal on economic value than to send mixed messages by signaling on both environmental and economic value.

In Hypothesis 2, we proposed that in order to achieve signal fit and credibly reduce information asymmetry, environmental R&D alliances governed by contractual agreements are more likely to signal on environmental value. The results in Table 3 illustrate that Hypotheses 2a and 2b are supported (1.929, $p < 0.001$ with base is no signal on value; 1.309, $p < 0.05$ with base is mixed signal). After converting the coefficients into odds ratios, we conclude that environmental R&D contracts are 6.884 times more likely to signal on environmental value than to not signal on value. They are also 3.701 times more likely to signal on environmental value than to send mixed messages by signaling on both environmental and economic value.

While the main results of our multinomial logit models offer a comparison between environmental production and marketing joint ventures and environmental R&D contracts, as introduced in the theory section, the multinomial analysis also allows us to include other comparisons. The base category of the independent variable includes production and marketing alliances governed by contracts and R&D alliances governed by joint ventures, and thus consists of environmental alliances of which the latent quality is not clearly focused on either economic or environmental value. Considering this base category, our findings illustrate that environmental alliances that embed economic value in both their processes and structures are more likely to signal on economic value. In addition, alliances that embed environmental value in both their processes and structures are more likely to signal on environmental value. This additional interpretation of our findings, using the base category of the independent variable, offers additional support for our argument that alliances avoid sending mixed messages: they communicate to achieve signal fit and reduce information asymmetry on their latent alliance goal.

In terms of the control variables, we find some significant relations. In line with our expectations, we observe that partners with experience in the renewable energy industry are more likely to signal on economic value, compared to not signaling on value. In addition, alliances operating in countries with an increasing competitiveness are less likely to signal on environmental value, compared to not signaling on value.

Table 3. Results of multinomial logit models

Variables	**Model with CVs** Coefficients (robust SEs) / p-values **DV: Signal Economic Value** (base: NO signal)	**Full Model** Coefficients (robust SEs) / p-values **DV: Signal Economic Value** (base: NO signal)	**Model with CVs** Coefficients (robust SEs) / p-values **DV: Signal Economic Value** (base: MIXED signal)	**Full Model** Coefficients (robust SEs) / p-values **DV: Signal Economic Value** (base: MIXED signals)
Environmental production and marketing JV		0.998 (0.308) / 0.001		1.167 (0.453) / 0.010
Environmental R&D contract		-15.999 (0.587) / 0.000		-16.62 (0.755) / 0.000
Type of renewable energy technology				
- Biomass	-0.114 (0.635) / 0.858	-0.005 (0.653) / 0.994	-0.390 (0.735) / 0.595	-0.234 (0.767) / 0.760
- Geothermal	-0.760 (0.783) / 0.332	-0.744 (0.788) / 0.345	-0.124 (1.011) / 0.902	-0.164 (0.963) / 0.865
- Hydro	-0.007 (0.975) / 0.994	0.177 (1.020) / 0.862	0.124 (1.079) / 0.909	0.326 (1.128) / 0.772
- Hydrogen	-14.064 (0.662) / 0.000	-15.480 (0.769) / 0.000	-14.102 (0.909) / 0.000	-15.517 (0.854) / 0.000
- Solar	-0.154 (0.427) / 0.719	0.044 (0.439) / 0.921	1.136 (0.530) / 0.032	1.371 (0.557) / 0.014
- Tidal	0.821 (1.277) / 0.520	1.475 (0.830) / 0.076	14.100 (0.757) / 0.000	16.937 (1.594) / 0.000
- Wind	-0.242 (0.512) / 0.636	-0.123 (0.522) / 0.814	0.326 (0.621) / 0.599	0.445 (0.661) / 0.501
International alliance	0.167 (0.277) / 0.547	0.186 (0.284) / 0.513	0.788 (0.379) / 0.037	0.817 (0.389) / 0.035
Ownership of alliance partners	-0.381 (0.294) / 0.196	-0.304 (0.304) / 0.318	-0.547 (0.446) / 0.220	-0.437 (0.468) / 0.351
Partner in renewable energy	0.485 (0.292) / 0.097	0.518 (0.298) / 0.083	0.009 (0.400) / 0.982	0.037 (0.418) / 0.930
Environmental performance of alliance nation	-0.006 (0.011) / 0.593	0.001 (0.011) / 0.924	0.031 (0.013) / 0.020	0.040 (0.014) / 0.005
Competitiveness of alliance nation	-0.043 (0.025) / 0.084	-0.041 (0.025) / 0.103	0.058 (0.037) / 0.123	0.063 (0.039) / 0.100

Year of alliance - 2014 - 2015 - 2016 - 2017	 -0.872 (0.431) / 0.043 -0.474 (0.424) / 0.263 -0.379 (0.410) / 0.355 0.016 (0.392) / 0.968	 -0.827 (0.426) / 0.052 -0.610 (0.433) / 0.159 -0.217 (0.427) / 0.612 0.402 (0.412) / 0.329	 0.805 (0.646) / 0.213 0.208 (0.643) / 0.746 -0.878 (0.541) / 0.104 0.123 (0.450) / 0.805	 0.854 (0.664) / 0.198 0.043 (0.654) / 0.948 -0.681 (0.579) / 0.239 0.597 (0.551) / 0.279
	Model with CVs Coefficients (robust SEs) / p-values **DV: Signal Environmental Value** (base: NO signal)	**Full Model** Coefficients (robust SEs) / p-values **DV: Signal Environmental Value** (base: NO signal)	**Model with CVs** Coefficients (robust SEs) / p-values **DV: Signal Environmental Value** (base: MIXED signals)	**Full Model** Coefficients (robust SEs) / p-values **DV: Signal Environmental Value** (base: MIXED signals)
Environmental production and marketing JV Environmental R&D contract		-1.292 (0.413) / 0.002 1.929 (0.519) / 0.000		-1.122 (0.522) / 0.031 1.309 (0.644) / 0.042
Type of renewable energy technology - Biomass - Geothermal - Hydro - Hydrogen - Solar - Tidal - Wind	 0.704 (0.737) / 0.340 -0.993 (1.219) / 0.415 -13.733 (1.079) / 0.000 0.544 (1.090) / 0.618 -0.556 (0.571) / 0.330 1.115 (1.432) / 0.436 -0.023 (0.625) / 0.970	 0.487 (0.749) / 0.515 -0.833 (1.560) / 0.593 -15.670 (1.134) / 0.000 0.504 (0.993) / 0.611 -0.805 (0.606) / 0.184 -0.185 (2.341) / 0.937 -0.065 (0.670) / 0.923	 0.427 (0.812) / 0.599 -0.356 (1.395) / 0.798 -13.602 (0.975) / 0.000 0.506 (1.150) / 0.660 0.733 (0.629) / 0.244 14.393 (0.946) / 0.000 0.545 (0.696) / 0.433	 0.258 (0.805) / 0.748 -0.253 (1.769) / 0.886 -15.522 (1.014) / 0.000 0.468 (1.131) / 0.679 0.523 (0.641) / 0.415 15.277 (1.264) / 0.000 0.502 (0.717) / 0.484
International alliance	-0.648 (0.332) / 0.051	-0.876 (0.370) / 0.018	-0.027 (0.411) / 0.948	0.244 (0.440) / 0.579
Ownership of alliance partners	0.419 (0.418) / 0.317	0.290 (0.445) / 0.514	0.253 (0.543) / 0.642	0.157 (0.540) / 0.771
Partner in renewable energy	0.165 (0.357) / 0.644	-0.133 (0.383) / 0.728	-0.332 (0.455) / 0.494	-0.614 (0.464) / 0.186
Environmental performance of alliance nation	-0.003 (0.014) / 0.845	-0.014 (0.016) / 0.383	0.034 (0.016) / 0.036	0.025 (0.017) / 0.139
Competitiveness of alliance nation	-0.082 (0.031) / 0.009	-0.094 (0.039) / 0.017	0.019 (0.042) / 0.651	0.010 (0.047) / 0.825
Year of alliance - 2014	 0.334 (0.490) / 0.495	 0.534 (0.598) / 0.372	 2.011 (0.702) / 0.004	 2.214 (0.825) / 0.007

- 2015 - 2016 - 2017	-0.780 (0.640) / 0.212 0.337 (0.557) / 0.545 0.882 (0.510) / 0.084	-0.651 (0.798) / 0.414 0.138 (0.634) / 0.828 0.445 (0.578) / 0.441	-0.118 (0.779) / 0.880 -0.162 (0.631) / 0.798 0.989 (0.582) / 0.089	0.002 (0.895) / 0.998 -0.327 (0.714) / 0.647 0.640 (0.683) / 0.348
Model fit n = 389	Prob < Chi^2 = 0.000 Pseudo R^2 = 0.0792	Prob < Chi^2 = 0.000 Pseudo R^2 = 0.1748	Prob < Chi^2 = 0.000 Pseudo R^2 = 0.0792	Prob < Chi^2 = 0.000 Pseudo R^2 = 0.1748

4.1. Robustness and endogeneity

We estimated the four multinomial logit models with robust standard errors to provide a conservative test of our hypotheses (Niesten and Jolink, 2018). We also checked for multicollinearity of the independent and control variables. The variance inflation factor (VIF) is never higher than 1.24, with a mean VIF of 1.11, which indicates that there are no problems with multicollinearity between the independent and control variables (Kutner et al., 2005, p. 409). Endogeneity problems may occur due to simultaneity (Soytas et al., 2019), which refers to feedback loops between the independent and dependent variables (Soytas et al., 2019; Truong and Pinkse, 2019). It has also been described as a problem of dual causality (Jean et al., 2015). In the research design of our study, we address simultaneity by studying variables that are determined at different points in time (Blossfeld and Rohwer, 1997, p. 360; Jean et al., 2015, p. 492). In line with signaling theory and its signaling timeline, we analyze attributes of signalers (at t=0) and the relation with the signal sent to receivers (at t=1) (Connelly et al., 2011, p. 44). We also follow the example of Hawn and Ioannou (2016) by measuring prior substantive actions (i.e. alliance processes and structures) and their effect on subsequent external signals.

5. Discussion

This article has studied strategic alliances that strive for economic profit while contributing to environmental sustainability. Since the study of environmental inter-firm alliances is a relatively recent field (Wassmer et al., 2014), there is substantial room for making contributions to this literature, but also for suggesting future research directions.

5.1. Theoretical contributions

Our article contributes to the literature on environmental alliances in several ways. First, we argue that observations on the processes and structures of environmental alliances can provide insights into the alliances' emphasis on either economic or environmental value within the confines of the spectrum of the two latent alliance goals. In a comparative approach, we argue that environmental production and marketing joint ventures are more inclined to focus on economic value, whereas environmental R&D contracts are more inclined to focus on environmental value. Our study on environmental alliances is based on established typologies on alliance processes and structures from the strategic alliance literature, such as those that distinguish between equity and non-equity alliances (e.g. Das and Teng, 2000; Gulati, 1995; Oxley and Sampson, 2004). Since we use these typologies in a study on environmental alliances, we extend the typologies' area of application to alliances that do not only focus on economic value but also aim for environmental value.

Second, we contribute to research on communication on environmental sustainability. Although an extensive amount of research exists on individual firms' communication on environmental sustainability (e.g. Aerts and Cormier, 2009; Bansal and Clelland, 2004), there is a lack of research on communication by environmental alliances. The application of signaling theory to the study of environmental alliances enables us to show that these alliances signal on their latent alliance goals to credibly reduce information asymmetry. We show that environmental production and marketing joint ventures are more likely to signal on economic value, whereas environmental R&D contracts are more likely to signal on environmental value. These alliances thus align their signals with their processes and structures to credibly reveal information about their latent alliance goals. Stakeholders allocate a greater credibility to environmental alliances that honestly communicate about their alliance goals, and thus that achieve a fit between their signals on latent alliance goals and the observable alliance processes and structures that embed these goals. The study of signals by environmental alliances is important, because it improves our understanding of how these alliances enhance their credibility through signaling (Bansal and Kistrick, 2006; Berrone et al., 2017; Hawn and Ioannou, 2016). Previous research has shown that credibility is a key determinant of performance in a sustainability context (Berrone et al., 2017; Hawn and Ioannou, 2016).

Third, by applying signaling theory, we can explain counterintuitive findings in the study of goals of environmental alliances. Although environmental alliances combine a focus on economic and environmental value, in their communication they emphasize only one of these alliance goals. We show that environmental production and marketing joint ventures prefer to signal on economic value over not communicating on value at all or sending mixed signals consisting of messages on both types of value. Similar findings have emerged for the environmental R&D contracts that favor signals on environmental value over not communicating on value at all or sending mixed signals. The integration of signaling theory in research on environmental alliances thus helps us understand why the alliances communicate on only one of their goals: the alignment of external signals to latent alliance goals credibly reduces information asymmetry.

5.2. Limitations and future research

This article relies on an extensive body of literature on signaling, alliance announcements and the credibility of environmental actions (Bansal and Clelland, 2004; Berrone et al., 2017; Park and Mezias, 2005) to support our claim that signal fit regarding economic and environmental value matters to stakeholders. Future research may follow this up by studying what type of stakeholders respond to signals on economic value and environmental value. This research will improve our understanding of how information asymmetry is reduced for the different types of stakeholders. This recommendation for future research is in line with earlier suggestions by Connelly et al. (2011, p 60), who have argued that management research on signaling has focused to a large extent on shareholders as receivers of signals. Studies on signaling in a sustainability context should in particular consider a broader set of stakeholders, such as communities, policymakers, NGOs, and customers. This future research can be informed by recent findings from Bianchi et al. (2019, p. 5) who distinguish between academic and corporate actors as receivers of signals, and who argue that 'corporates are primarily concerned with the commercial exploitation of the technological outcomes of the collaboration'.

Our analysis of external signals is restricted to announcements on the formation of new environmental alliances. Although alliance announcements are a representative signal, it cannot be excluded that other types of signals are also relevant to reduce information asymmetry during the lifespan of the environmental alliance. This dynamic perspective on the development of environmental alliances seems a fruitful avenue for future research that can contribute to both signaling theory and research on the dynamics of alliances (Reuer et al., 2016). More generally, Connelly et al. (2011, p. 56) have argued for incorporating longer periods into signaling theory and proposed that future research should study when and how often firms should signal.

In our article, we adopt the well-known distinction of alliance processes into exploration and exploitation, and the well-known distinction of alliance structures into joint ventures and contractual agreements (Oxley and Sampson, 2004; Parmigiani and Rivera-Santos, 2011). Even though these alliance processes and structures have been extensively researched in the literature on strategic alliances, more empirical research is needed on the processes and structures of environmental alliances. While the literature on strategic alliances has been extended into more complex processes in which exploration and exploitation are combined to study the ambidexterity of alliances (Parmigiani and Rivera-Santos, 2011), very few studies have applied these insights to environmental alliances (e.g. Russo and Vurro, 2010). A recent literature review on environmental alliances illustrates that there are very few studies focusing on the governance of these alliances through an analysis of equity versus non-equity structures (Lin, 2012; Lin and Darnall, 2015; Niesten and Jolink, 2019). The relative novelty of the study of environmental alliances opens up a number of avenues for future research, including empirical research on the ambidexterity and governance of environmental alliances. In addition, the analysis of environmental alliances as dyads could be extended to firms' portfolios of environmental alliances, which would allow for studying the effects of these portfolios on firms' environmental performance. The study of environmental alliances could also explore other typologies of alliances, such as those that distinguish between vertical and horizontal alliances (e.g. Rahman and Korn, 2010) and between strategic and tactical alliances (e.g. Van Gils and Zwart, 2004).

5.3. Managerial implications

This research is relevant for managers who have entered into a new environmental alliance and who wish to communicate about their alliance to stakeholders. We know from previous research that credibility of signalers is enhanced when they align their signals with their latent qualities (e.g. Connelly et al., 2011). This alignment does not only enhance the credibility of the signal and the signaler, but also improves the market value of firms (Hawn and Ioannou, 2016). The implications of this research are that signal fit can be achieved by communicating about the latent goal of the environmental alliance, and that this goal is embedded in the alliance process and governance structure. Joint ventures that are created to produce and sell renewable energy with the aim of capturing value should signal on economic value. Alliance partners that set out to jointly develop a technological solution for an environmental deficit to address environmental demands of stakeholders should signal on environmental value. Alliance partners are thus advised to communicate about the goal of their environmental alliance, and signal on either economic value or environmental value to credibly reduce information asymmetry and avoid sending mixed messages.

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APPENDIX A. Examples of Coding Signal on Economic Value

Type of financial benefits mentioned in signal	**Quotes from alliance announcements illustrating signals**
Feed-in-tariff	"*According to Meralco, the joint venture will avail of the* ***feed-in-tariff (FIT)*** *scheme mandated by the Renewable Energy Act of 2008 where the rate is guaranteed by the government for 20 years at P5.9 per kilowatt hour.*"
Tender	"*MISSB and HCSB shall procure a company limited by shares known as Bonanza Partners Sdn Bhd (BPSB) pursuant to the laws of Malaysia to pursue and engage in the following businesses: 1. To form a Joint Venture in order to submit* ***tenders*** *to the Government of Malaysia for the 100 MW Photovoltaic Solar Farm; 2. Should the tender be granted to BPSB, the JV Company is to build a photovoltaic solar farm on 300 acres at the district of Bachok, Kelantan.*"
Tax equity	"*The joint venture further expands APUC's presence in the renewable energy space. The total project cost is expected to be approximately U.S. $303 million. Non-recourse project financing will be arranged by the joint venture including approximately U.S. $151 million of* ***tax equity***."
Power purchase agreement	"*Greenbriar Capital Corp. and Alterra Power Corp. are pleased to announce they have entered into a partnership, AG Solar One, which intends to develop 100 MW of solar generation capacity in Puerto Rico under a Master Renewable* ***Power Purchase and Operating Agreement*** *with the Puerto Rico Electric Power Authority.*"
Council	"*Windlab will partner with the Eurus Energy Holdings Corporation in a 50/50 joint venture to build the Kennedy Energy Park plant.*" "*Mr Price (Windlab CEO) said community support was critical to the success of the Kennedy Energy Park plan." "Mr Greg Jones (mayor of the region), said* ***the council was backing the project****. 'The Council is very supportive of renewable energy initiatives and we are keen to continue to work with Windlab and Eurus to see this project built in the Shire of Flinders,' he said.*"
Renewable energy production targets	"*The Taiwanese offshore wind market is developing rapidly and the Taiwanese government's renewable energy policy aims to achieve a status of "non-nuclear homeland" by the end of 2025. The goal is to install 3 GW of offshore wind capacity by 2025. Century Wind Power Co. and Sif want to contribute jointly to this ambitious* ***target***."

APPENDIX B. Examples of Coding Signal on Environmental Value

Contribution to environmental sustainability mentioned in signal	**Quotes from alliance announcements illustrating signals**
Reducing CO_2 emissions	*"BWSC and PensionDanmark have joined forces to build, operate and own a brand new biomass power plant in Lincolnshire, in the east of England. They have committed to the investment of a total of GBP 160m via the BWSC PCL joint venture established by the two parties. The plant is expected to produce enough energy to cover the total consumption of 70,000 households and will result in an annual* ***CO_2 emissions reduction*** *of approx. 300,000 tonnes."*
Fighting climate change	*"CLP's growing investments in renewable energy underlines our determination to reduce greenhouse gas emissions and help* ***tackle climate change****. With the Veltoor solar project, we are now one of the largest renewable energy producers in India with operational and committed capacity of around 1100 MW across wind and solar. We believe that Suzlon can leverage their project execution capabilities to deliver the Veltoor solar project successfully."*
Providing sustainable solutions	*"SustainCo Inc., through its wholly owned Clean Energy Developments group, is pleased to announce that it has entered into an agreement with Cennatek Bioanalytical Services Inc. to provide a loan instrument of up to $500,000 towards the development of its brand of BioLiNE® biomass projects." "This investment is our first step to becoming a vertically integrated leader in the* ***full stage development of sustainable solutions****. We believe that partnering with Cennatek, a group that shares our vision for sustainable development, creates a strong partnership for the long term development of biomass facilities."*
Stimulating a transition to sustainability	*"This milestone points to our belief that commerce can be* ***fundamentally more sustainable*** *than it is today – and that eBay Inc. can be a* ***leader in that transition****. We look forward to continuing in our pursuit of contracting REG (Recovered Energy Generation) power and to reach, and possibly surpass, our goal to source at least eight percent of our energy from cleaner sources by 2015, said Dean Nelson, vice president, global foundation services at eBay Inc."*
Contributing to a sustainable society	"Tokyo Gas and Shizen Energy are continuing to support the growth of the renewable energy market and the ***realization of a sustainable society in the future***."
Adopting a long-term approach to sustainability	"Canadian Solar Australia is constructing 7 commercial rooftop PV systems, total 3.6 MW for IKEA in three Australian states." "We have a ***long-term approach to sustainability***. Globally, our ambition is to switch to renewable energy and become energy independent by 2020. We're well on the way. A project of this size is a considerable undertaking" said Richard Wilson, Sustainability Manager of IKEA Australia."