Received: 16 January 2022 | Revised: 27 April 2022 | Accepted: 11 May 2022

DOI: 10.1002/bse.3145

RESEARCH ARTICLE

Business Strategy and the Environment WILEY

The links between active cooperation and eco-innovation orientation of firms: A multi-analysis study

Ines Diez-Martinez | Angel Peiro-Signes | Marival Segarra-Oña

Management Department, Universitat Politècnica de València, Valencia, 46022

Correspondence
Ines Diez-Martinez, Management Department, Universitat Politècnica de València, Camino de Vera s/n, Valencia 46022, Spain.
Email: indiemar@alumni.upv.es

Abstract

The environmental orientation of companies is key for firms to gain a competitive advantage against peers. However, the high level of novelty and uncertainty involved with eco-innovations requires additional knowledge and capabilities that go beyond the firm and that can be achieved through cooperation. Thus, it is crucial to analyse how cooperation affects the elements that drive eco-innovation. This study tests the impact of cooperation on the environmental orientation of companies while innovating using structural equation modelling with partial least squares and multigroup analysis and a fuzzy-set qualitative comparative analysis for a sample of Spanish companies. Results suggest that companies that do not cooperate are less eco-innovation-oriented and show lower dependence on external information sources, although their impact on the orientation to product and process innovation is higher. This work leads to some theoretical conclusions and implications for researchers and practitioners.

KEYWORDS

cooperation, eco-innovation, environmental orientation, multigroup analysis (MGA), partial least squares (PLS), qualitative-comparative analysis (QCA)

1 | INTRODUCTION

In recent years, it has become apparent that our society is facing an environmental challenge as never before experienced (Burke et al., 2017; Kopnina & Shoreman-Ouimet, 2011). Consequently, environmentally related matters are playing a critical role in our socio-economic framework, increasing the demand for environmentally friendly firms (Gadenne et al., 2009; Peiró-Signes & Segarra-Oña, 2018) and greener products (Borin et al., 2013). To respond to these demands and the regulatory pressure, companies feel the necessity to include environmental aspects in their innovation strategy. In order to be able to do so, firms are forced to develop new knowledge and expertise. As described by González-Moreno et al. (2019), when cooperation is done effectively, and it involves deep, frequent and intense relationships with other third parties, these fluent connections and knowledge sharing are key to enhance eco-innovation, but cooperation may also have a negative effect when it is not done properly.

List of Abbreviations: AVE, average variance extracted; Bca, bias-corrected and accelerated; C, companies that cooperate with other companies while innovating; CR, composite reliability; DnC, companies that do not cooperate with other companies while innovating; EIS, external Information Sources; EO, environmental orientation; fsQCA, fuzzy-set qualitative comparative analysis; HTMT, heterotrait-monotrait ratio of correlations; MGA, multigroup analysis; PcO, process orientation; PdO, product orientation; PITEC, Spanish Technological Innovation Panel; pls, partial least squares; Q^2, Stone–Geisser's Q^2 Predictive relevance; QCA, qualitative comparative analysis; R^2, coefficient of determination; SEM, structural equation modelling; Tot, total sample; VIS, variance inflation factor; β, path coefficient.

This work aims to analyse the impact of cooperation in the environmental orientation of firms while innovating (eco-innovation orientation). We used a broad approach regardless of the firms' characteristics, such as the firm's size or the industry. Using a contrasted model (Peiró-Signes et al., 2013; Peiró-Signes & Segarra-Oña, 2018), we tested the differences in the relationships in the eco-innovation orientation model between companies that cooperate and those that do not cooperate. The study goes beyond previous research, complementing the analysis uncovering the role of cooperation in leading to high and low levels of firms' eco-innovation orientation, while at the same helping to understand the different paths to high levels of eco-innovation orientation. In this way, we address the following research questions: (1) How does cooperation for innovation affect the eco-innovation orientation of the firm? (2) Does cooperation affect the impact of the eco-innovation orientation drivers? (3) Is cooperation a condition for high levels of firms' eco-innovation orientation? To address these questions, we complemented structural equation modelling with partial least squares and multigroup analysis (PLS-MGA) with fuzzy-set qualitative comparative analysis (fsQCA). In particular, we studied a broad set of innovative Spanish companies from the Spanish Innovation Panel (PITEC), which monitors the innovative activities of Spanish companies.

This research consolidates and analyses empirical evidence related to the eco-innovation orientation of firms. The study makes two main contributions. First, we provide evidence of significant differences in the behavioural patterns between companies that cooperate and those that do not cooperate, attending to their environmental orientation and its drivers. Second, the study also tests for combinations of conditions or paths leading to high and low levels of environmental orientation and the role of cooperation in these paths. To our knowledge, there are no previous studies analysing the role of cooperation in the relation between the eco-innovation orientation and its drivers. Thus, the study addresses an important research gap.

This paper is structured as follows. In Section 2, we present the theoretical background and hypotheses associated with the proposed model. In Section 3, we describe the research methodology. In Section 4, we report the research results from the analysis and discussion. Finally, in Section 5, we present the conclusions, implications, and limitations of the study.

2 | BACKGROUND AND HYPOTHESIS

According to the Oslo Manual (OECD, 2005), a key reason why companies innovate is to improve the firm's performance. This can be achieved through increasing demand (product differentiation, new products, or processes), which thus can represent a source of market advantage or through reducing costs by implementing more efficient (productivity-enhancing) eco-innovation processes. Additionally, firms' environmental orientation and green innovation positively contribute to creating a competitive advantage and an increase in productivity (Adams et al., 2012; Chen et al., 2006; OECD, 2013).

Eco-innovation, sustainable innovation, green innovation or environmental innovation has been used to represent a multidimensional concept (Rennings, 2000). Eco-innovation may be defined as proposed by Kemp and Pearson (2007) as 'the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resource use (including energy use) compared to relevant alternatives' (Kemp & Pearson, 2007). The study of this concept has been very extensive, from its dimensions and types to its drivers and barriers. For example, as discussed by Fernández et al. (2021), drivers for eco-innovation may vary depending on whether the company is situated in a developed or in a developing country. Eco-innovation may also be influenced by different factors depending on the industry or firms' characteristics such as managerial environmental awareness, technological capabilities, human capabilities and/or firms' organizational capabilities.

Overall, among the factors motivating firms to implement eco-innovation, in the literature, we can find internal and external triggers. From the internal perspective, many studies refer to the internal characteristics of the firm or the resources and competences within the companies. The organizational capabilities (Horbach, 2008; Kesidou & Demirel, 2012), their technological capabilities (Horbach, 2008; Kammerer, 2009; Rennings & Ziegler, 2004; Segarra-Oña et al., 2011; Triguero et al., 2013), or their technological trajectory (Jové-Llopis & Segarra-Blasco, 2018; Peiró-Signes & Segarra-Oña, 2018; Sáez-Martínez et al., 2016) have been reported as influential.

The external factors refer to a firm's interaction with its stakeholders. Often, the factors reported relate to the institutional and regulatory framework (de Marchi, 2012; Horbach, 2008; Rennings, 2000; Zhou et al., 2018) and the market or demand pull (de Marchi, 2012; Doran & Ryan, 2016; Horbach, 2008; Kesidou & Demirel, 2012; Rennings, 2000). In this context, the lack of internal knowledge and capabilities is forcing companies to incorporate them through cooperation and collaboration with firms' stakeholders. Indeed, cooperation has been identified as an important factor for the development of eco-innovation (Bossle et al., 2016; Chistov et al., 2021; Dangelico, 2016; Díaz-García et al., 2015; He et al., 2018; Hojnik & Ruzzier, 2016; Rabadán et al., 2020). Also, as discussed by Pereira et al. (2020), cooperation is relevant because it allows to reduce costs and risks.

Afterwards, in-line with its trigger or motivation, environmental innovation may be shown through a variety of mechanisms that may have different targets, such as opening new markets, launching new products or services (product eco-innovations) and reducing operational costs by optimizing the usage of natural resources (process eco-innovations) (Mondéjar-Jiménez et al., 2015). Additionally, firms can develop new business practices for organizing the procedures, work responsibilities, decision making or external relations, aiming to reduce negative environmental impacts (organizational eco-innovations) or through the implementation of new marketing strategies that integrate environmental aspects in the design, packaging, product placement, promotion or pricing (marketing eco-innovations) (Marcon et al., 2017). However, product and process eco-innovations have received more attention in the literature (Rehfeld et al., 2007; Rennings et al., 2006).

Environmental orientation is increasingly becoming a subject of interest for companies that seek to reduce their damage to the environment, motivated by the identification of new opportunities that may lead to new revenue sources or cost reduction by process optimisation (Gadenne et al., 2009; Segarra-Oña et al., 2011). For example, previous research such as Alos-Simo et al. (2020), which included 2094 firms, showed that eco-innovation had influenced revenue positively regardless the industry. As discussed by Yurdakul and Kazan (2020), eco-innovation represents a pollution prevention potential as well as a cost advantage. However, this is not always the case; cost can be also a barrier for eco-innovation as identified by Salo et al. (2020). The environmental orientation evidences a firm's concern for the environment, a concept that refers to the organization's awareness of the environment, typically understood as management acknowledgement of the importance of sustainability (Feng et al., 2018). A firm with environmental orientation will show this attitude towards environmental conservation, influencing its relationships with external stakeholders such as providers, communities and government (Feng et al., 2018). Moreover, this attitude will be reflected in the firm's culture and strategy, affecting the products, processes and practices of the firm (Adams et al., 2016; Mondejar Jimenez et al., 2013).

Accordingly, when it comes to innovation, companies that have shifted to an environmental focus would also be expected to reflect these sustainable principles in the innovation context, aligning the strategy, internal processes and relationships with external stakeholders. Firms that successfully implement and maintain an environmental vision see opportunities related to sustainability and focus their innovation efforts on the development of new techniques or products to reduce their damage to the environment (Mondejar Jimenez et al., 2013). Therefore, environmental orientation is also translated into eco-innovation, affecting not only the current processes and products, but also all prospective developments. Complementing firms' green management commitment, several factors may also interact to foster this environmental proactivity. The existing literature has shown a positive influence of firms' internal approaches to innovation, such as product and process orientation, on the eco-orientation of firms' innovative activities (Peiró-Signes et al., 2013; Peiró-Signes & Segarra-Oña, 2018). These authors also reveal the positive influence of firms' dependence on market information sources on the environmental orientation of the firms by empowering product and process innovation. However, information dependence represents a limited engagement between firms and external stakeholders. A higher commitment between these actors through cooperation has proven to be a key factor in innovation (Belderbos et al., 2004; Simonen & McCann, 2008) and particularly for eco-innovations.

2.1 | Product innovation and environmental orientation

Customer awareness of environmental aspects has been increasing constantly for the past two decades. Environmentally conscious customers produce a demand for green and eco-innovative products (Horbach, 2008; Triguero et al., 2013). A better understanding of their expectations and requirements (Doran & Ryan, 2016; Grunwald, 2011; Horbach et al., 2012; Wagner & Llerena, 2011) and their segments (i.e., through market research) increases the propensity of firms to develop eco-products (Wagner, 2008) and to increase their market share through them (Triguero et al., 2013). Additionally, changes in market trends represent a strategic opportunity. Firms aiming to differentiate themselves from competitors find in environmental innovation initiatives a way to reduce the environmental impact of their production (de Marchi, 2012) and also a way to convey differentiation strategies (Cuerva et al., 2014).

Consequently, firms that have a customer or market orientation (product-oriented innovators), that is, firms that orientate their innovative activity to enter into a new market, increase market share or increase or update their products or the quality of their products, will also be willing to consider the environmental aspects. This will thus lead the innovative activity to develop product eco-innovations.

> **Hypothesis H1.** Product innovation orientation positively affects environmental innovation orientation.

2.2 | Process innovation and environmental orientation

Process improvements have been reported as important motivators for eco-innovations. Eco-innovations result in positive externalities. Besides the environmental impact reduction, the search for more efficient ways of developing firms' operations results in a reduction of resource usage, i.e., materials or energy, and consequently in cost reduction, which encourages eco-innovation (Pereira & Vence, 2012; Triguero et al., 2013) and environmental R&D (Demirel & Kesidou, 2011).

> **Hypothesis H2.** Process innovation orientation positively affects environmental innovation orientation.

2.3 | Innovation information sources and environmental orientation

General innovation theory points out the importance of technological capabilities as drivers of innovation. Technological capabilities within a firm depend on human capital and accumulated knowledge. The capacity of the firm not only to generate but also to absorb knowledge from external sources is key to its capacity to innovative (Cohen & Levinthal, 1990). The absorptive capacity includes the ability to detect valuable external information and to assimilate and apply it to the firm. Therefore, companies with absorptive capacity will be able to recognize the potential of eco-innovation and to develop (Mondejar Jimenez et al., 2013). Indeed, technological capabilities have been related to an increase in environmental innovation (Horbach, 2008; Triguero et al., 2013).

Eco-innovation is based often on a relatively new technology, which in many cases requires specific knowledge and capabilities that are not present within the firm. It then requires more sources of information and knowledge from outside the firm (Belin et al., 2011; Cainelli et al., 2015; de Marchi, 2012; de Marchi & Grandinetti, 2013; Pereira & Vence, 2012). The engagement with customers (Doran & Ryan, 2016; Grunwald, 2011; Horbach et al., 2012; Wagner & Llerena, 2011; Wu, 2013); public institutions, such as universities (Cainelli et al., 2011); suppliers (Wu, 2013) or competitors has been reported to be beneficial for the development of eco-innovations (Cainelli et al., 2015; de Marchi, 2012).

Hypothesis H3a. The importance of external information sources for innovative activity positively affects product innovation orientation.

Hypothesis H3b. The importance of external information sources for innovative activity positively affects process innovation orientation.

Hypothesis H3c. The importance of external information sources for innovative activity positively affects environmental innovation orientation.

2.4 | Cooperation and environmental orientation

Cooperation for eco-innovation also has been a matter of interest in the area. In this study, we consider that cooperation is the active participation of an external agent in the innovative activities of the firm (Li-Ying et al., 2018). Thus, it goes beyond the mere capture of information and excludes outsourcing. The lack of in-house resources, knowledge or capabilities usually has been deemed as the key motivator for companies to cooperate to eco-innovate (de Marchi, 2012; Horbach, 2008; Petruzzelli et al., 2011), especially in small and medium enterprises (Triguero et al., 2015, 2016). This is because a higher uncertainty, complexity and level of novelty of eco-innovations, compared to regular innovations, require going beyond the actual firms' core competences (Horbach, 2008; Horbach et al., 2013; Triguero et al., 2013). Thus, there is a need to involve external actors to conduct successful and valuable environmental innovations (Petruzzelli et al., 2011; Wagner & Llerena, 2011). Additionally, cooperation produces economies of scale, sharing resources and costs (Chadha, 2011; Duran-Romero & Urraca-Ruiz, 2015; Fabrizi et al., 2018; Lin, 2019), and reduces risks (Chadha, 2011), as the evolution of the technology is more easily anticipated.

Regarding the agents, companies engage in cooperation activities with public institutions, such as universities, R&D or research centres (Petruzzelli et al., 2011) or with market actors, such as customers, suppliers or competitors (Galliano & Nadel, 2015; Petruzzelli et al., 2011; Triguero et al., 2015). The cooperation with public institutions increases the technological capabilities to develop eco-innovations and particularly radical ones (del Río et al., 2015). In particular, universities and research centres have been highlighted as having a positive impact on the development of eco-innovations (Triguero et al., 2016). Customers' involvement provides future perspectives on the expected demand and how to satisfy it (de Marchi & Grandinetti, 2013; Junquera et al., 2012; Melander, 2018), while suppliers give firms access to new environmental technologies (de Stefano & Montes-Sancho, 2018; Fabrizi et al., 2018) and help to redesign products and processes (Ibañez-Forés et al., 2016).

Partnerships can be produced at a local or more global scale. On one hand, international partnerships allow access to more environmentally conscious contexts and, therefore, to broader sources of knowledge for eco-innovation (Duran-Romero & Urraca-Ruiz, 2015; Fabrizi et al., 2018; Peñasco et al., 2017). On the other hand, local connections and geographical proximity facilitate knowledge interchange (Galliano et al., 2017).

Besides the agent and the scale, some characteristics of the relation between firm and agent are also important. The diversity, depth and reciprocity of the relation or the complementarity and compatibility of the companies are indicators of the level of engagement of this relation. Sometimes, cooperation involves establishing a relationship between the firm and more than one agent (Huang & Li, 2018; Martinez-Perez et al., 2015). Greater diversity of the agents involved (Junquera et al., 2012; Melander, 2017; Petruzzelli et al., 2011) increases the chances to compensate for the lack of internal capabilities needed to eco-innovate (Kiefer et al., 2019; Mothe & Nguyen-Thi, 2017). The stability and consistency of the relationship overcome communication problems (Melander, 2017) and intensify the interaction (Kiefer et al., 2019; Melander, 2017). Additionally, mutually beneficial relationships based on trust improve the share and exploitation of knowledge and assets (Li-Ying et al., 2018) and are beneficial for eco-innovation outcomes (Melander, 2018). Finally, the complementarity and compatibility of knowledge and assets allow better combination, integration and alignment (Huang & Li, 2018) of the resources, leading to a positive impact on eco-innovation (Shou et al., 2018).

Consequently, cooperation may be considered to have a positive impact on green innovation and therefore on the environmental orientation of companies.

Hypothesis H4. Companies that cooperate also are more likely to consider the environment in their innovative activities.

Hypothesis H5. In companies that cooperate, the drivers of innovation act with a positive higher strength than in firms that do not cooperate.

In other words, these two hypotheses provide two different perspectives and complement each other to analyse the broad the impact of cooperation. On one hand, we hypothesize that companies that cooperate give more importance than their counterparts to the environmental aspects in their innovative activities (H4) and, on the other, that cooperation is moderating the impact of the drivers of environmental orientation of the firms while innovating (H5). For further details, please refer to Figure 1.

3 | RESEARCH METHOD

For our study, we used the Spanish Technological Innovation Panel (PITEC) database. PITEC is a panel study performed by the Spanish Statistical Institute which monitors the innovative activities of Spanish companies over time. The PITEC survey is equivalent to the Community Innovation Survey performed by Eurostat, and the variables used in the study have been supported and used for several years on the study of environmental aspects (Cainelli et al., 2015; del Río et al., 2015; Horbach, 2016; Jové-Llopis & Segarra-Blasco, 2018; Peiró-Signes & Segarra-Oña, 2018). For the analysis, we used data from 2016, the latest year available. Out of more than 7,000 companies in the database, we focused on the 4,518 that are reported as innovative companies.

These companies represent the full range of business activities. The majority of the manufacturing companies come from the food industry (7.9%); chemical, pharma and plastics (14.4%); metallics (7.4%); electric, electronic and other equipment (13.8%) and transport equipment (4.5%). On the service side, commerce, transport and storage (7.1%); consulting services (6.7%) and other services (20.2%) completed the industry spectrum. According to the European size classification, 35% corresponded to small companies, 33.8% to medium-size companies and 31.2% to large companies. In the survey, around 45% of the companies reported having cooperated in their innovative process. According to size, the percentages of companies that cooperate and that do not cooperate change significantly (Pearson chi-square significant at $p < .001$). Indeed, 38.2% of the companies that cooperate are large, while large companies represent only 25.4% of companies that do not cooperate. In contrast, among small companies, 28.7% cooperate, and 40.2% do not do so. In medium-sized companies, the proportions are similar, 33.1% cooperate and 34.3% do not.

To analyse the impact of cooperation on the environmental orientation of companies, we based our model on the one developed by Peiró-Signes et al. (2013) and Peiró-Signes and Segarra-Oña (2018) related to the drivers affecting the environmental orientation of companies while innovating. The model relates the orientation to product and process innovation, as defined in the OECD's Oslo Manual (2005), to the orientation to environmental innovations. It also uncovers the importance for the innovative activities of the information from the market (customers, suppliers and competitors), driving companies to a higher orientation towards any type of innovation.

Firms' innovation orientation (product, process or environmental) is evaluated using multi-item scales corresponding to the questions in the survey evaluating the innovation objectives (see Table 1). For example, product orientation (PdO) represents the importance for the innovation activities in the last 3-year period of the increase in the range of goods or services, the increase of the market share or the improvement of the quality of goods or services to develop, among others. These items are coded in the survey in four categories attending to their importance (1 = *high*, 2 = *medium*, 3 = *low*, 4 = *not important*), and they have a reflective relationship with the corresponding firm's orientation latent variable, as they cover different aspects of the concept which they are representing (Podsakoff et al., 2006).

External information sources (EIS) *represent* the information sources that provided information for new innovation projects or contributed to the completion of the existing ones in the last 3-year period. The items in the construct are coded in the same way as firms' orientation constructs. This multi-item construct has a formative character because the items are established exogenously, they are not mutually correlated and they determine the desired concept (Chin, 1998; Jarvis et al., 2003; Mackenzie et al., 2005).

Finally, cooperation represents active participation with other enterprises or non-commercial institutions on innovation activities in the last 3-year period. Both partners do not need to commercially benefit, and participation excludes pure outsourcing. Cooperation is

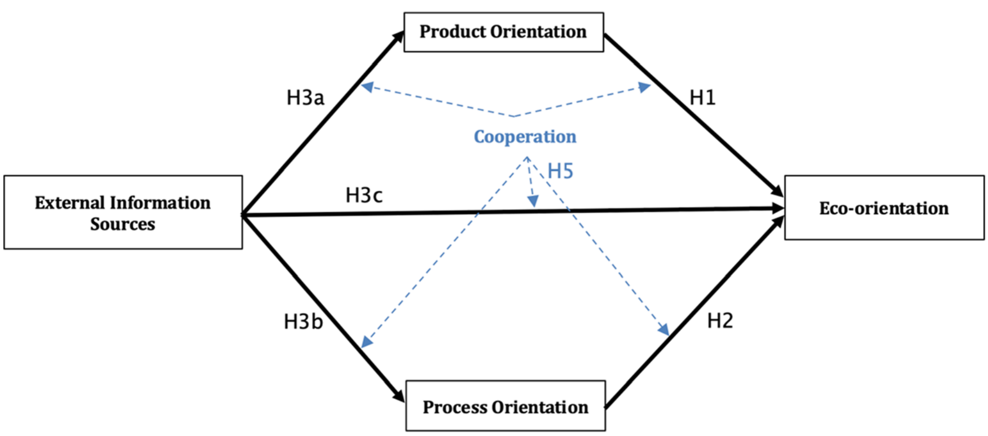

FIGURE 1 Relationships between the different hypothesis

TABLE 1 Measurement model indicators

	Outer loadings	CR/rho_A	Average variance extracted (AVE)	VIF	Outer weights
External information sources (EIS)					
Suppliers of equipment, materials, components or software	.691			1.312	.309***
Clients or customers (private)	.762			1.709	.336***
Clients or customers (public)	.537			1.586	−.03 n.s.
Competitors or other enterprises in your sector	.707			1.707	.147***
Consultants, commercial labs or private R&D institutes	.636			1.744	.108***
Universities or other higher education institutions	.562			2.233	.082**
Government or public research institutes	.555			2.844	−.019 n.s.
Private research centres	.606			2.535	.066*
Conferences, trade fairs, exhibitions	.761			2.423	.201***
Scientific journals and trade/technical publications	.727			2.579	.119***
Professional and industry associations	.69			2.146	.086**
Product orientation (PdO)		.866/.901	.645		
Increase range of goods or services	.785				
Replace outdated products or processes	.716				
Enter new markets	.84				
Increase market share	.875				
Improve quality of goods or services	.792				
Process orientation (PcO)		.898/.917	.688		
Improve flexibility for producing goods or services	.765				
Increase capacity for producing goods or services	.791				
Reduce labour costs per unit output	.865				
Reduce materials costs per unit output	.86				
Reduce energy costs per unit output	.861				
Environmental orientation (EO)		.922/.950	.864		
Reduce environmental impact	.914				
Improve health and safety	.936				
Meet environmental, health and safety regulations	.939				

*Significant at $p > .05$.
**Significant at $p < .01$. ***Significant at $p < .001$.

operationalized as a dummy variable, with a value of 1 if the company reports having cooperated and 0 otherwise.

We used PLS-SEM with SmartPLS by Ringle et al. (2015) and fsQCA 3.0 (Ragin & Davey, 2019) to analyse the data. On one hand, PLS-SEM allows the evaluation of causal relationships included in a complex model with multiple constructs and dependencies (Hair et al., 2011). Additionally, PLS does not require the assumption of variable normality and can simultaneously handle reflective and formative measures. On the other hand, fsQCA is able to uncover conditions or combinations of conditions that are sufficient to a desired outcome. FsQCA complements the analysis done using regression-based models, such as PLS, because it overcomes some of its limitations related to the assumption of linear and symmetric relationships between variables of interest (Ragin, 2008; Schneider & Wagemann, 2010; Vis, 2012) or regarding the interdependencies between variables (Woodside, 2013).

4 | RESULTS AND DISCUSSION

4.1 | PLS model

PLS evaluation follows a two-step process: the assessment of the measurement model and of the structural model. The measurement model assesses the relationships between the items and the latent variables. Reflective and formative measures are tested differently.

For the reflective measures, we evaluated the reliability and the validity of the reflective measures. Following Chin (1998), we evaluated the reliability of each indicator. Individual items with loadings greater than .7 are considered acceptable (see Table 1), implying that the latent variable explained more than 50% of the variance in a specific item. We evaluated the internal consistency reliability for each construct using composite reliability (CR) and rho-A. The minimum acceptable composite reliability (Nunnally & Bernstein, 1994) and rho-A (Dijkstra & Henseler, 2015) level is .7 for each construct, indicating that the items of a latent construct share sufficient variance among them (Fornell & Larcker, 1981). To assess validity, we examined convergent and discriminant validity. We used Fornell and Larcker's (1981) suggested criterion for convergent validity, the average variance extracted (AVE). Table 1 shows AVE values greater than the suggested threshold of .5, indicating that the items represent the same latent variable. Finally, we evaluated discriminant validity (see Table 2), checking the heterotrait-monotrait ratio of correlations (HTMT) (Henseler et al., 2015). The HTMT is a measure of similarity between latent variables, and values below .85 indicate that each latent variable exhibits sufficient difference with the other latent variables.

For the formative measure, we performed a multicollinearity and a weight-loading analysis (Hair et al., 2014). We evaluated the validity of the measure by assessing the degree of multicollinearity among the formative items (Diamantopoulos & Winklhofer, 2001) by calculating the variance inflation factor (VIF). VIF values in Table 1 were below the suggested threshold of 5 (Hair et al., 2011), showing the absence of multicollinearity problems. We also evaluated the significance of the item weights (see Table 1). Following Hair et al.'s (2014) suggested guide, although some item weights were revealed to be not significant, we retained them as their items' loadings were higher than .5.

These results on the latent variables suggest that the measurement model was assessed with confidence.

Once the measurement model was assessed, we used PLS-SEM to test the hypothesized relationships in the model. The evaluation of the structural model consists of the analysis of the path coefficients,

TABLE 2 HTMT ratio assessment

	Environmental orientation	Process orientation
Process orientation	.680	
Product orientation	.544	.556

the coefficients of determination (R^2) and the predictive relevance (Q^2). Figure 2 shows the results of the structural model proposed for the total sample (Tot), the companies that do not cooperate (DnC) and the companies that cooperate (C). Corresponding partial regression coefficients (β coefficients) are indicated next to the arrows and, inside the endogenous variables, the R^2 for the corresponding regression.

Path coefficients (standardized β) denote the strength of the causal relationships between two constructs. To test the significance of these relationships, we estimated regression coefficients between latent factors, their *t* statistics and *p* values, using a bootstrapping procedure with 5,000 samples (see Table 3). The coefficient of determination (R^2) indicates the variance explained by the model, and it is related to the explanatory quality of the model (Chin, 1998). Values largely exceed the minimum threshold suggested by Falk and Miller (1992) to consider it a good explanatory model (see Table 3). Finally, the Q^2 value indicates the ability of the model to predict the reflective indicator of the endogenous latent variables. We obtained Q^2 values using a blindfolding procedure. Q^2 values above zero (Table 3) indicate that the model has a satisfactory predictive relevance.

The structural model analysis of the total sample confirmed the positive and significant hypothesized relationships. H1, H2 and H3a, H3b and H3c were supported. The environmental orientation of companies while innovating (EO) is positively and significantly affected by the product orientation (PdO) (H1: $\beta = .16$, sig. at $p < .001$), the process orientation (PcO) (H1: $\beta = .462$, sig. at $p < .001$) and the dependence on external information sources (H3a–H3c) in the innovation activities of the companies. In particular, we can see that the dependence of EIS is significantly affecting PdO (H3a: $\beta_{Tot} = .538$, sig. at $p < .001$), PcO (H3b: $\beta_{Tot} = .454$, sig. at $p < .001$) and EO (H3c: $\beta_{Tot} = .188$, sig. at $p < .001$). The lower value of the path linking EIS with EO is caused by the mediating effect of PcO and PdO in the model. Indeed, there is a strong reduction of the path coefficient from .459 (significant at $p < .001$, not reported in the tables) to .188 (significant at $p < .001$) when we added the product and process orientation to

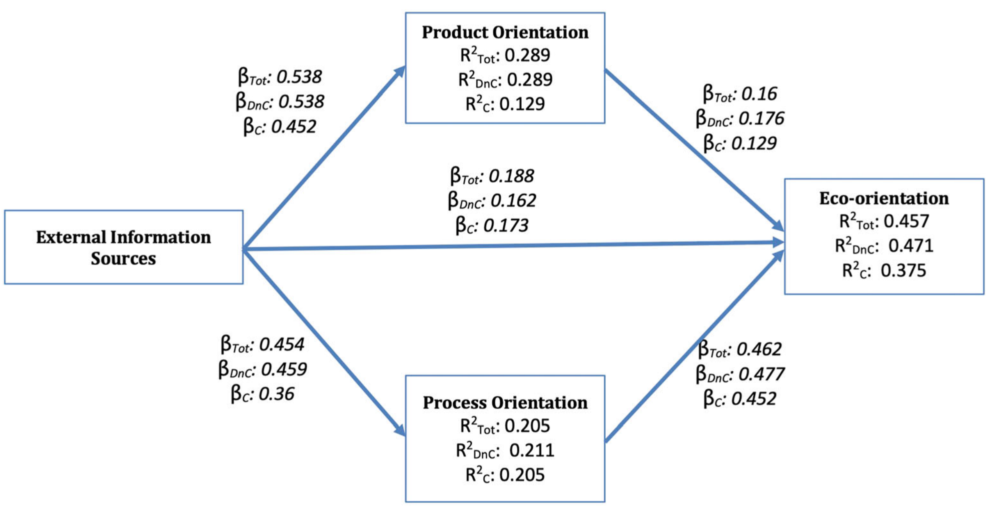

FIGURE 2 Structural equation model [Correction added on 06 June 2022, after first online publication: Figure 2 has been updated in this version.]

the model, which reflects that EIS impacts EO mainly through an increase of the overall innovation orientation (product and process innovation orientation).

As the aim of the study was to evaluate the differences in eco-innovation orientation between firms that cooperate and those that do not, we performed a multigroup analysis (PLS-MGA). In addition to the bootstrapping results for the total sample and the two groups of interest, we tested differences in the path coefficients in both groups using bias-corrected and accelerated (Bca) 95% confidence intervals (see Table 3).

Regarding the relations in the model, we found a stronger impact of PcO over PdO; thus, process orientation increased the environmental orientation of firms more than product orientation. This indicated that those companies that orientate their innovation towards aspects such as cost reduction, increased capacity or flexibility (process oriented) are more likely to orientate their innovation towards environmental aspects than companies focused on increasing the quality, the number of products or their market share (product oriented).

Additionally, the higher variance explained for the EO in the model due to PcO (28.91% out of 45.7%) indicates a stronger strength of association (Rosenthal & Rosenthal, 2011) between these two latent variables. These results are aligned with previous studies (Peiró-Signes et al., 2013; Peiró-Signes & Segarra-Oña, 2018). A business strategy aiming for more efficient ways to produce products or services and to maximize production capacity focuses on cost improvements through reduction in the consumption of materials, energy and water and the improvement of operational efficiency. These improvements are generally incremental process innovations, and their outcome has a direct effect on the environmental impact of a firm's activity, which is a positive externality of the innovation. On the other side, environmental products and services nowadays are targeted to a specific part of the market. The introduction of innovations in the company's products or services is not always focused on environmentally concerned customers or environmental features of the product or service. Therefore, a company interested in product innovation activities may be uninterested in environmental innovations when its main markets do not include environmentally concerned customers (Jové-Llopis & Segarra-Blasco, 2018).

When comparing companies that cooperate to those that do not cooperate, the differences in the relative product vs. process impact stands, and there is no significant difference in the strength of these relations, rejecting H5. For example, comparing the strength of the relation between product orientation and environmental orientation ($\beta_{DnC} = .477$ and $\beta_C = .452$), we found that bias-corrected and accelerated 95% confidence intervals overlap, indicating that there is no significant difference in the strength of this relation between companies that cooperate and that do not. This suggests that product orientation is related to environmental orientation independently of whether companies cooperate or not with other companies while innovating.

Similar to the total sample, in both groups, process orientation accounts for a significant part of the variance explained in the environmental orientation.

Regarding EIS, the impact on PdO and PcO is significantly higher in companies that do not cooperate over those that cooperate, which is also against our hypothesis (H5). For example, the difference between the path coefficients in the relation between the EIS and the PcO for companies that do not cooperate ($\beta_{DnC} = .459$) and those that cooperate ($\beta_C = .36$) is .09, and it is statistically significant ($p < .05$). Note that the path differences represent the size of the impact, not the actual difference in the value of the construct or latent variable. Thus, to evaluate if there are differences in the levels of the dependence on EIS and the orientation to innovation (H4), we need a complementary analysis. Table 4 displays the results of an ANOVA on ranks or Kruskal–Wallis *H* test for each construct in the model. For the sake of clarity, we used the average values, which are interpreted directly with the scale of the variables in the study, instead of the latent variable scores from the PLS analysis, which result from a normalized measure that has to be interpreted in terms of standard deviations from the average. Both types of values lead to equivalent results. The analysis allows us to determine if there are statistically significant differences between the two groups of interest on the different concepts we are studying and does not require normality in the data.

TABLE 3 Direct effects, explained variances and Q^2 test for endogenous variables

	Direct effect (*t* value)/variance explained			
Effects on endogenous variables	**Total (Tot)**	**Does not cooperate (DnC)**	**Cooperates (C)**	**Bca 95% confidence intervals Does not coop./cooperates**
Effects on EO	$R^2 = .457/Q^2 = .374$	$R^2 = .471/Q^2 = .392$	$R^2 = .375/Q^2 = .293$	
EIS	.188*** (12.536)/9.1%	.162*** (8.106)/7.7%	.173***(7.493)/6.8%	[.121, .2]/[.125, .215]
PcO	.462*** (32.351)/28.91%	.477*** (24.621)/30.5%	.452*** (21.86)/25.7%	[.438, .514]/[.412, .493]
PdO	.16*** (10.71)/7.78%	.176*** (8.85)/8.8%	.129*** (5.771)/5.1%	[.138, .216]/[.087, .175]
Effects on PcO	$R^2 = .205/Q^2 = .133$	$R^2 = .211/Q^2 = .140$	$R^2 = .129/Q^2 = .078$	
EIS	.454*** (34.81)/20.5%	.459*** (26.717)/21.1%	.36*** (16.391)/12.9%	[.423, .491]/[.311, .398] sig.
Effects on PdO	$R^2 = .289/Q^2 = .175$	$R^2 = .289/Q^2 = .183$	$R^2 = .205/Q^2 = .108$	
EIS	.538*** (44.325)/28.9%	.538*** (33.887)/28.9%	.452*** (20.891)/20.5%	[.506, .568]/[.406, .492] sig.

*Significant at $p < .5$. Sig. stands for significant at $p < .05$. **Significant at $p < .01$. ***Significant at $p < .001$.

TABLE 4 ANOVA results on the concepts attending to the cooperation

Concept	Group	Mean	Std. dev.	Median	Average rank	Kruskal–Wallis statistic	*p* value
EIS	DnC	3.205	0.650	3.267	2,747.75	774.07	.000
	C	2.598	0.690	2.556	1,663.24		
PcO	DnC	2.671	0.942	2.6	2,488.34	170.93	.000
	C	2.304	0.856	2.2	1,980.03		
PdO	DnC	2.209	0.970	2	2,497.3	237.1	.000
	C	1.806	0.739	1.6	1,959.08		
EO	DnC	2.835	1.119	3	2,529.08	244.04	.000
	C	2.308	1.053	2	1,930.28		

Note: With the original response, coding a lower numerical value indicates a higher relevance or importance.

In many cases, engaging in innovation requires companies to obtain information and knowledge from external agents, either formally, through active participation (cooperation) or informally, just by obtaining information. Thus, a higher necessity for EIS in a company that has no active channels for external agents to participate (cooperate) in the innovation process is denoting a higher willingness to innovate and, therefore, a higher impact on process and product orientation, than in a company that has already looked for external collaborators for innovation. Note that the actual levels of the dependence on EIS for innovation and the innovative orientation are significantly lower in companies that do not cooperate than in those that cooperate (see Table 4).

As we expected, the results shown in Table 4 indicate that companies that cooperate show a significantly higher dependence on EIS and a significantly higher orientation to any of the types of innovation (PcO, PdO and EO), accepting H4. For example, companies that cooperate are, on average, about a half point (2.308 vs. 2.835) more environmentally oriented than companies that do not cooperate. As the measurement scale represents a 3-point range, this is equivalent to saying that companies that cooperate show, on average, 17.6% higher orientation than those that do not cooperate.

The significantly lower values of the EIS (Table 4) and significantly higher values of the path coefficients linking EIS with PdO and PcO, for companies that do not cooperate vs. companies that cooperate, indicate that the lack of more formal connections between companies and external stakeholders in the innovation process (formal cooperation) increases the dependence on external information sources in those companies that are willing to innovate.

Finally, we obtained no significant differences between the groups in the paths that link EIS to EO. This result might be caused by the partial mediation of the different types of innovation orientation (PcO and PdO) in the relation. These results indicate that most of the EIS needed for the innovation process, in either companies that actively participate with external stakeholders in the innovation activities or those that do not, is needed to encourage process and product innovations rather than eco-innovations.

4.2 | fsQCA

fsQCA allows us to evaluate the causal conditions or combination of conditions that are sufficient for the desired outcome. In our case, the desired outcome is a high environmental orientation (EO) when innovating, and our conditions are the dependence on the external information sources (EIS) in the innovation process, the orientation product (PdO) and process (PcO) when innovating, and whether the companies cooperate with other companies while innovating (Coop).

The first step in the fsQCA process is calibration. Calibration consists of the transformation of the conditions and the outcome variables into fuzzy sets. Fuzzy sets vary from 0 to 1, indicating full non-membership and full membership, respectively. We followed Ragin's (2008) direct calibration process. Cooperation in the study is a dummy variable. Therefore, we maintained it as a crisp set, with 1 denoting those companies that cooperate and 0 denoting those companies that do not cooperate. The rest of the variables in the study used a 4-point scale (1, *high*; 2, *medium*; 3, *low*; and 4, *not relevant*). We calculated the average value of the variables in each of our constructs and used percentiles to determine the thresholds for full membership (Beynon et al., 2016; Dul, 2016), full non-membership and crossover point. We set full membership in the 95% percentile, full non-membership in the 5% percentile and the cross over point in the 50% percentile. Following Ordanini et al. (2014), we transformed the original scores to odds ratios and calculated their degree of membership (exp [log odds])/(1 + exp [log odds]) to transform construct values into fuzzy sets.

The second step is to produce a truth table. Following Ragin (2008), we selected a consistency cut-off of .75 and, because of the large sample size, a minimum frequency of 30 cases for further analysis.

Finally, we performed a logical minimization. Logical minimization produces three solutions—complex, parsimonious and intermediate—depending on how logical reminders (combinations in the truth table with no cases in the sample) are considered. Table 5 displays the intermediate solution, which is reported (Woodside, 2013) as being superior to the others, for high and low levels of environmental orientation.

TABLE 5 fsQCA summary results

	High levels Of EO				Low levels Of EO	
Configuration	1	2	3	4	5	6
PcO			●	●	⊗	
PdO		●		●		⊗
EIS	●	●				⊗
Coop	●		●			
Consistency	.808	.82	.808	.804	.818	.885
Raw coverage	.355	.566	.437	.775	.774	.523
Unique coverage	.005	.014	.012	.147	.297	.047
Overall solution consistency	.755				.806	
Overall solution coverage	.843				.82	

Note: Black circles (●) indicate the presence of a condition. Crossed-out circles (⊗) denote the absence of a condition.

We obtained four and two solutions (see Table 5) for high and low levels of EO, respectively. The overall solution consistency for the model for high levels of environmental orientation is .755, higher than the suggested threshold of .75. Consistency has similar meaning to significance in statistical models (Schneider & Wagemann, 2010) and measures the degree to which a subset relation is been approximated. The overall solution coverage is .843. Solution coverage is similar to R^2 in a regression (Ragin, 2006) and assesses the empirical relevance of a consistent subset. Thus, the solution is covering a substantial part of the companies showing high levels of environmental orientation.

This model is indicating that a high dependence on EIS with the presence of cooperation or high levels of PdO (solutions 1 and 2, respectively) are sufficient conditions to achieve high levels of EO. Additionally, high levels of PcO in companies that cooperate or in companies that show high levels of PdO (solutions 3 and 4, respectively) lead to the same outcome. From the analysis of the raw (.775) and unique coverage (.147), clearly, the most important path to the high levels of EO is a high overall innovative orientation (PdO•PcO, solution 4). Thus, high orientation to product and process innovation is likely to have high EO when innovating. Indeed, most of the companies (77.5%) showing high EO also showed simultaneously high levels of PdO and PcO. The other solutions suggest that some kind of engagement with external stakeholders, either formal (through cooperation) or informal (EIS for innovation), alone or in combination with a high PdO or PcO, is sufficient for high levels of EI.

Similarly, we can evaluate the strategies leading to low levels of EO. We obtained two paths, an overall solution consistency of .806 and a solution coverage of .82. The first and most important strategy (raw coverage = .774) indicates that low levels of PcO represent a sufficient condition to get low levels of environmental orientation. In the second strategy, the joint presence of low levels of PdO and low levels of EIS leads to the same outcome. The fsQCA results are aligned with PLS analysis in the direction of the effects, the positive impact of PdO, PcO and EIS on EI and the mediation found in the relation between EIS and EI. However, fsQCA gives us additional insights about how the different conditions interact to lead to high or low levels of EI. In particular, results show the lack of symmetry in the paths to high and low levels of EI and reinforce de idea that companies that cooperate are more likely to consider the environment in their innovative activities (H4).

5 | CONCLUSIONS

Our study offers empirical evidence for the impact of cooperation in eco-innovation orientation, its drivers and the relation between them. First, our study shows a higher environmental, product and process orientation of companies that cooperate compared to those that do not cooperate. It is well known that the lack of information and knowledge inside firms is a key motivator for cooperation with external agents (Bossle et al., 2016; de Marchi, 2012; Triguero et al., 2013). Firms compensate for the absence of the necessary technological capabilities to develop innovations, especially those related to environmental knowledge and capabilities, through active engagement of external stakeholders in firms' innovation activities of any kind. Specifically, this fact is accentuated when talking about SMEs (Gadenne et al., 2009). The smaller percentages of SMEs that report cooperation in our study can be justifying part of the differences found.

Second, like previous studies (e.g., Hojnik & Ruzzier, 2016; Moyano-Fuentes et al., 2018; Sáez-Martínez et al., 2014), our results highlight the key role that orientation to product and process innovation plays on firms' eco-innovation and, in particular, to achieve high levels of environmental orientation. Thus, innovation drives eco-innovation. Although previous studies (Peiró-Signes et al., 2013; Peiró-Signes & Segarra-Oña, 2018) revealed a higher impact of process orientation over product orientation in the environmental orientation, our complementary analysis with fsQCA uncovered that the combination of high levels of the two orientations is the primary path to high levels of eco-innovation. Moreover, the engagement with external stakeholders, through active cooperation or just by using them as information sources in the innovation process, provides alternative paths to achieving high levels of consideration of environmental aspects when innovating.

These results are particularly relevant for companies and policymakers that try to foster eco-innovative attitudes within firms.

5.1 | Managerial implications managerial implications

First, promoting innovative culture is essential to promote eco-innovation orientation. On one hand, managers in companies should promote operational efficiency improvements. These improvements are likely a result of small organizational or process innovations, which in addition to the cost-related benefits will create positive environmental externalities. On the other hand, companies will be building knowledge and capabilities that can be extended to other operations within the firm and to speed up new process innovations. The positive evolution of both cost and environmental indicators should encourage firms to work in this line as they realize the wide impact of these innovations.

Second, environmental standards and regulations and customers' demand for environmentally friendly products and practices could be more determinant in firms' motivation to eco-innovate. It seems clear from the study that having a market orientation when innovating, for example, by looking to develop new products or services or to increase the market share through innovation, is not sufficiently aligned with an eco-innovative mindset. Thus, managers should work on detecting and developing the opportunities that new eco-products and eco-practices can bring to improve a firm's competitive position.

Third, cooperation and the search for new knowledge outside the companies constitute an alternative path to eco-innovation activities. The higher level of novelty, uncertainty and the lack of knowledge can be overcome by promoting firms' links with their stakeholders. In this context, the role of managers, in detecting and establishing links with relevant actors that hold the knowledge and competences, and of policymakers, in creating appropriate environments for collaborations, can boost the innovation and, particularly, the eco-innovation activities within the firm.

5.2 | Policy making implications

Similarly, policymakers should continue creating an adequate framework for increasing customer awareness of environmental implications of the products and services that they consume and for the development of more sustainable markets through regulations. Eventually, the development of a demand for more sustainable products will act as a substitute for the actual non-sustainable products, forcing companies to adapt and consider environmental aspects in their innovative process.

5.3 | Research limitations

This study has some limitations which can be addressed in future studies. The study is focused on the Spanish innovation survey (PITEC). First, PITEC is a panel survey, and in our study, we only considered cross-sectional data, which does not make it possible to analyse the evolution of the relationship between the variables considered in the model and, particularly, how cooperation affects these relations. Second, most PITEC responses are based on a subjective measure by the respondent, typically, a firm's R&D department or top managers. However, some authors have found that the subjective measures are consistent with objective measures of innovation (Mairesse & Mohnen, 2004). Third, variables considered in the study are limited; therefore, some factors that might influence the relationships in the model may not be present. Finally, Spain is a moderate innovator according to the Eco-Innovation Scoreboard (Eco-IS 2015). The study findings should be corroborated in other countries with similar or different innovation intensities.

ACKNOWLEDGEMENTS

Open access funding enabled and organized by Projekt DEAL.

ORCID

Ines Diez-Martinez https://orcid.org/0000-0002-7248-9402
Angel Peiro-Signes https://orcid.org/0000-0002-1549-6972
Marival Segarra-Oña https://orcid.org/0000-0001-9674-9056

REFERENCES

Adams, H. D., Luce, C. H., Breshears, D. D., Allen, C. D., Weiler, M., Hale, V. C., Smith, A. M. S., & Huxman, T. E. (2012). Ecohydrological consequences of drought- and infestation-triggered tree die-off: Insights and hypotheses. *Ecohydrology*, *5*, 145–159. https://doi.org/10.1002/eco.233

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented innovation: A systematic review. *International Journal of Management Reviews*, *18*(2), 180–205. https://doi.org/10.1111/ijmr.12068

Alos-Simo, L., Verdu-Jover, A. J., & Gomez-Gras, J. M. (2020). Does activity sector matter for the relationship between eco-innovation and performance? Implications for cleaner production. *Journal of Cleaner Production*, *263*, 121544. https://doi.org/10.1016/j.jclepro.2020.121544

Belderbos, R., Carree, M., & Lokshin, B. (2004). Cooperative R&D and firm performance. *Research Policy*, *33*(10), 1477–1492. https://doi.org/10.1016/j.respol.2004.07.003

Belin, J., Horbach, J., & Oltra, V. (2011). Determinants and specificities of eco-innovations—An econometric analysis for the French and German industry based on the Community Innovation Survey (No. 2011–17). In Cahiers du GREThA.

Beynon, M. J., Jones, P., & Pickernell, D. (2016). Country-based comparison analysis using fsQCA investigating entrepreneurial attitudes and activity. *Journal of Business Research*, *69*(4), 1271–1276. https://doi.org/10.1016/j.jbusres.2015.10.091

Borin, N., Lindsey-Mullikin, J., & Krishnan, R. (2013). An analysis of consumer reactions to green strategies. *The Journal of Product and Brand Management*, *22*(2), 118–128. https://doi.org/10.1108/10610421311320997

Bossle, M. B., de Barcellos, M. D., Vieira, L. M., & Sauvée, L. (2016). The drivers for adoption of eco-innovation. *Journal of Cleaner Production*, *113*, 861–872. https://doi.org/10.1016/j.jclepro.2015.11.033

Burke, T. A., Cascio, W. E., Costa, D. L., Deener, K., Fontaine, T. D., Fulk, F. A., Jackson, L. A., Munns, W. R. Jr., Orme-Zavaleta, J., Slimak, M. W., & Zartarian, V. G. (2017). Rethinking environmental protection: Meeting the challenges of a changing world. *Environmental Health Perspectives*, *125*(3), A43–A49. https://doi.org/10.1289/EHP1465

Cainelli, G., de Marchi, V., & Grandinetti, R. (2015). Does the development of environmental innovation require different resources? Evidence from Spanish manufacturing firms. *Journal of Cleaner Production*, *94*, 211–220. https://doi.org/10.1016/j.jclepro.2015.02.008

Cainelli, G., Mazzanti, M., & Zoboli, R. (2011). Environmental innovations, complementarity and local/global cooperation: Evidence from north-east Italian industry. *International Journal of Technology, Policy and Management*, *11*, 328–368. https://doi.org/10.1504/IJTPM.2011.042090

Chadha, A. (2011). Overcoming competence lock-in for the development of radical eco-innovations: The case of biopolymer technology. *Industry and Innovation*, *18*, 335–350. https://doi.org/10.1080/13662716.2011.561032

Chen, Y., Lai, S., & Wen, C. (2006). The influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*, *67*, 331–339. https://doi.org/10.1007/s10551-006-9025-5

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern Methods for Business Research*, *295*(2), 295–336.

Chistov, V., Aramburu, N., & Carrillo-Hermosilla, J. (2021). Open eco-innovation: A bibliometric review of emerging research. *Journal of Cleaner Production*, *311*, 127627. https://doi.org/10.1016/j.jclepro.2021.127627

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*, 128–152. https://doi.org/10.2307/2393553

Cuerva, M. C., Triguero-Cano, A., & Córcoles, D. (2014). Drivers of green and non-green innovation: Empirical evidence in low-tech SMEs. *Journal of Cleaner Production*, *68*, 104–113. https://doi.org/10.1016/j.jclepro.2013.10.049

Dangelico, R. M. (2016). Green product innovation: Where we are and where we are going. *Business Strategy and the Environment*, *25*(8), 560–576. https://doi.org/10.1002/bse.1886

de Marchi, V. (2012). Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. *Research Policy*, *41*, 614–623. https://doi.org/10.1016/j.respol.2011.10.002

de Marchi, V., & Grandinetti, R. (2013). Knowledge strategies for environmental innovations: The case of Italian manufacturing firms. *Journal of Knowledge Management*, *17*, 569–582. https://doi.org/10.1108/JKM-03-2013-0121

de Stefano, M. C., & Montes-Sancho, M. J. (2018). Supply chain environmental R&D cooperation and product performance: Exploring the network dynamics of positional embeddedness. *Journal of Purchasing and Supply Management*, *24*(4), 288–303. https://doi.org/10.1016/j.pursup.2018.10.003

del Río, P., Peñasco, C., & Romero-Jordán, D. (2015). Distinctive features of environmental innovators: An econometric analysis. *Business Strategy and the Environment*, *24*(6), 361–385. https://doi.org/10.1002/bse.1822

Demirel, P., & Kesidou, E. (2011). Stimulating different types of eco-innovation in the UK: Government policies and firm motivations. *Ecological Economics*, *70*, 1546–1557. https://doi.org/10.1016/j.ecolecon.2011.03.019

Diamantopoulos, A., & Winklhofer, H. M. (2001). Index construction with formative indicators: An alternative to scale development. *Journal of Marketing Research*, *38*(2), 269–277. https://doi.org/10.1509/jmkr.38.2.269.18845

Díaz-García, C., González-Moreno, Á., & Sáez-Martínez, F. J. (2015). Ecoinnovation: Insights from a literature review. *Innovations*, *17*(1), 6–23. https://doi.org/10.1080/14479338.2015.1011060

Dijkstra, T. K., & Henseler, J. (2015). Consistent and asymptotically normal PLS estimators for linear structural equations. *Computational Statistics & Data Analysis*, *81*, 10–23. https://doi.org/10.1016/j.csda.2014.07.008

Doran, J., & Ryan, G. (2016). The importance of the diverse drivers and types of environmental innovation for firm performance. *Business Strategy and the Environment*, *25*, 102–119. https://doi.org/10.1002/bse.1860

Dul, J. (2016). Identifying single necessary conditions with NCA and fsQCA. *Journal of Business Research*, *69*(4), 1516–1523. https://doi.org/10.1016/j.jbusres.2015.10.134

Duran-Romero, G., & Urraca-Ruiz, A. (2015). Climate change and eco-innovation. A patent data assessment of environmentally sound technologies. *Innovations*, *17*(1), 115–138. https://doi.org/10.1080/14479338.2015.1011062

Fabrizi, A., Guarini, G., & Meliciani, V. (2018). Green patents, regulatory policies and research network policies. *Research Policy*, *47*(6), 1018–1031. https://doi.org/10.1016/j.respol.2018.03.005

Falk, R. F., & Miller, N. B. (1992). *A primer for soft modeling*. The University of Akron.

Feng, L., Zhao, W., Li, H., & Song, Y. (2018). The effect of environmental orientation on green innovation: Do political ties matter? *Sustainability*, *10*(12), 4674. https://doi.org/10.3390/su10124674

Fernández, S., Torrecillas, C., & Labra, R. E. (2021). Drivers of eco-innovation in developing countries: The case of Chilean firms. *Technological Forecasting and Social Change*, *170*, 120902. https://doi.org/10.1016/j.techfore.2021.120902

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.1177/002224378101800104

Gadenne, D. L., Kennedy, J., & McKeiver, C. (2009). An empirical study of environmental awareness and practices in SMEs. *Journal of Business Ethics*, *84*, 45–63. https://doi.org/10.1007/s10551-008-9672-9

Galliano, D., Goncalves, A., & Triboulet, P. (2017). Eco-innovations in rural territories: Organizational dynamics and resource mobilization in low density areas. *Journal of Innovation Economics*, *24*(3), 35–62. https://doi.org/10.3917/jie.pr1.0014

Galliano, D., & Nadel, S. (2015). Firms eco-innovation intensity and sectoral system of innovation: The case of French industry. *Industry and Innovation*, *22*(6), 467–495. https://doi.org/10.1080/13662716.2015.1066596

González-Moreno, A., Triguero, A., & Sáez-Martínez, F. J. (2019). Many or trusted partners for eco-innovation? The influence of breadth and depth of firms' knowledge network in the food sector. *Technological Forecasting and Social Change*, *147*, 51–62. https://doi.org/10.1016/j.techfore.2019.06.011

Grunwald, A. (2011). On the roles of individuals as social drivers for eco-innovation. *Journal of Industrial Ecology*, *15*, 675–677. https://doi.org/10.1111/j.1530-9290.2011.00395.x

Hair, J. F. Jr., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2014). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage Publications.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

He, F., Miao, X., Wong, C. W. Y., & Lee, S. (2018). Contemporary corporate eco-innovation research: A systematic review. *Journal of Cleaner Production*, *174*, 502–526. https://doi.org/10.1016/j.jclepro.2017.10.314

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modelling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hojnik, J., & Ruzzier, M. (2016). The driving forces of process eco-innovation and its impact on performance: Insights from Slovenia. *Journal of Cleaner Production*, *133*, 812–825. https://doi.org/10.1016/j.jclepro.2016.06.002

Horbach, J. (2008). Determinants of environmental innovation- new evidence from German panel data sources. *Research Policy*, *37*(1), 163–173. https://doi.org/10.1016/j.respol.2007.08.006

Horbach, J. (2016). Empirical determinants of eco-innovation in European countries using the community innovation survey. *Environmental Innovation and Societal Transitions*, *19*, 1–14. https://doi.org/10.1016/j.eist.2015.09.005

Horbach, J., Oltra, V., & Belin, J. (2013). Determinants and specificities of eco-innovations compared to other innovations—An econometric analysis for the French and German industry based on the community innovation survey. *Industry and Innovation*, *20*(6), 523–543. https://doi.org/10.1080/13662716.2013.833375

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact - the role of regulatory push/pull, technology push and market pull. *Ecological Economics*, *78*, 112–122. https://doi.org/10.1016/j.ecolecon.2012.04.005

Huang, J. W., & Li, Y. H. (2018). How resource alignment moderates the relationship between environmental innovation strategy and green innovation performance. *The Journal of Business and Industrial Marketing*, *33*(3), 316–324. https://doi.org/10.1108/jbim-10-2016-0253

Ibañez-Forés, V., Pacheco-Blanco, B., Capuz-Rizo, S. F., & Bovea, M. D. (2016). Environmental product declarations: Exploring their evolution and the factors affecting their demand in Europe. *Journal of Cleaner Production*, *116*, 157–169. https://doi.org/10.1016/j.jclepro.2015.12.078

Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). Critical review of construct indicators and measurement model misspecification in marketing research. *Journal of Consumer Research*, *30*, 199–218. https://doi.org/10.1086/376806

Jové-Llopis, E., & Segarra-Blasco, A. (2018). Eco-innovation strategies: A panel data analysis of Spanish manufacturing firms. *Business Strategy and the Environment*, *27*(8), 1209–1220. https://doi.org/10.1002/bse.2063

Junquera, B., del Brío, J. Á., & Fernández, E. (2012). Clients' involvement in environmental issues and organizational performance in businesses: An empirical analysis. *Journal of Cleaner Production*, *37*, 288–298. https://doi.org/10.1016/j.jclepro.2012.07.029

Kammerer, D. (2009). The effects of customer benefit and regulation on environmental product innovation. *Ecological Economics*, *68*(8–9), 2285–2295. https://doi.org/10.1016/j.ecolecon.2009.02.016

Kemp, R., & Pearson, P. (2007). Final report MEI project about measuring eco-innovation. *Project Deliverable* 25. http://www.oecd.org/env/consumption-innovation/43960830.pdf

Kesidou, E., & Demirel, P. (2012). On the drivers of eco-innovations: Empirical evidence from the UK. *Research Policy*, *41*, 862–870. https://doi.org/10.1016/j.respol.2012.01.005

Kiefer, C. P., Gonzalez, P. D., & Carrillo-Hermosilla, J. (2019). Drivers and barriers of eco-innovation types for sustainable transitions: A quantitative perspective. *Business Strategy and the Environment*, *28*(1), 155–172. https://doi.org/10.1002/bse.2246

Kopnina, H. (2011). Chapter: Introduction: Environmental anthropology of yesterday and today. In E. Shoreman-Ouimet (Ed.), *Environmental anthropology today*. Routledge. https://doi.org/10.4324/9780203806906

Lin, H. Y. (2019). Government-business partnerships for radical eco-innovation. *Business and Society*, *58*(3), 533–573. https://doi.org/10.1177/0007650316684822

Li-Ying, J., Mothe, C., & Nguyen, T. T. U. (2018). Linking forms of inbound open innovation to a driver-based typology of environmental innovation: Evidence from French manufacturing firms. *Technological Forecasting and Social Change*, *135*, 51–63. https://doi.org/10.1016/j.techfore.2017.05.031

MacKenzie, S. B., Podsakoff, P. M., & Jarvis, C. B. (2005). The problem of measurement model misspecification in behavioural and organizational research and some recommended solutions. *Journal of Applied Psychology*, *90*, 710–730. https://doi.org/10.1037/0021-9010.90.4.710

Mairesse, J., & Mohnen, P. (2004). The importance of R&D for innovation: A reassessment using French survey data. *Journal of Technology Transfer*, *30*(1–2), 183–197. https://doi.org/10.1007/s10961-004-4365-8

Marcon, A., de Medeiros, J. F., & Ribeiro, J. L. D. (2017). Innovation and environmentally sustainable economy: Identifying the best practices develop by multinationals in Brazil. *Journal of Cleaner Production*, *160*, 83–97. https://doi.org/10.1016/j.jclepro.2017.02.101

Martinez-Perez, A., Garcia-Villaverde, P. M., & Elche, D. (2015). Eco-innovation antecedents in cultural tourism clusters: External relationships and explorative knowledge. *Innovations*, *17*(1), 41–57. https://doi.org/10.1080/14479338.2015.1011058

Melander, L. (2017). Achieving sustainable development by collaborating in green product innovation. *Business Strategy and the Environment*, *26*(8), 1095–1109. https://doi.org/10.1002/bse.1970

Melander, L. (2018). Customer and supplier collaboration in green product innovation: External and internal capabilities. *Business Strategy and the Environment*, *27*(6), 677–693. https://doi.org/10.1002/bse.2024

Mondejar Jimenez, J., Vargas Vargas, M., Segarra Oña, M., & Peiró Signes, A. (2013). Categorizing variables affecting the proactive environmental orientation of firms. *International Journal of Environmental Research*, *7*, 495–500.

Mondéjar-Jiménez, J., Segarra-Oña, M., Peiró-Signes, A., Payá-Martínez, A. M., & Sáez-Martínez, F. J. (2015). Segmentation of the Spanish automotive industry with respect to the environmental orientation of firms: Towards an ad-hoc vertical policy to promote eco-innovation. *Journal of Cleaner Production*, *86*, 238–244. https://doi.org/10.1016/j.jclepro.2014.08.034

Mothe, C., & Nguyen-Thi, U. T. (2017). Persistent openness and environmental innovation: An empirical analysis of French manufacturing firms. *Journal of Cleaner Production*, *162*, S59–S69. https://doi.org/10.1016/j.jclepro.2016.12.063

Moyano-Fuentes, J., Maqueira-Marín, J. M., & Bruque-Cámara, S. (2018). Process innovation and environmental sustainability engagement: An application on technological firms. *Journal of Cleaner Production*, *171*, 844–856. https://doi.org/10.1016/j.jclepro.2017.10.067

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill. ISBN 0-07-047849-X.

OECD (Organisation for Economic Co-operation and Development). (2005). Oslo manual: Proposed guidelines for collecting and interpreting technological innovation data. OECD.

OECD (Organisation for Economic Co-operation and Development). (2013). Agricultural innovation systems: A framework for analyzing the role of the government. OECD. Publishing https://doi.org/10.1787/9789264200593-en

Ordanini, A., Parasuraman, A., & Rubera, G. (2014). When the recipe is more important than the ingredients: A qualitative comparative analysis (QCA) of service innovation configurations. *Journal of Service Research*, *17*(2), 134–149. https://doi.org/10.1177/1094670513513337

Peiró-Signes, A., & Segarra-Oña, M. (2018). How past decisions affect future behavior on eco-innovation: An empirical study. *Business Strategy and the Environment*, *27*, 1233–1244. https://doi.org/10.1002/bse.2071

Peiró-Signes, A., Segarra-Oña, M., Meseguer-Santamaría, L., & Mondéjar-Jiménez, J. (2013). Can eco-innovative orientation be explained? An attempt to understand uncovered patterns. *Environmental Engineering and Management Journal*, *12*(10), 1933–1939. https://doi.org/10.30638/eemj.2013.241

Peñasco, C., del Rio, P., & Romero-Jordan, D. (2017). Analysing the role of international drivers for eco-innovators. *Journal of International Management*, *23*(1), 56–71. https://doi.org/10.1016/j.intman.2016.09.001

Pereira, A., & Vence, X. (2012). Key business factors for eco-innovation: An overview of recent firm-level empirical studies. *Cuadernos de Gestion*, *12*, 73–103. https://doi.org/10.5295/cdg.110308ap

Pereira, R. M., MacLennan, M. L. F., & Tiago, E. F. (2020). Interorganizational cooperation and eco-innovation: A literature review. *International Journal of Innovation Science*, *12*(5), 477–493. https://doi.org/10.1108/IJIS-01-2020-0008

Petruzzelli, A. M., Dangelico, R. M., Rotolo, D., & Albino, V. (2011). Organizational factors and technological features in the development of green innovations: Evidence from patent analysis. *Innovation: Management, Policy and Practice*, *13*, 291–310. https://doi.org/10.5172/impp.2011.13.3.291

Podsakoff, N. P., Shen, W., & Podsakoff, P. M. (2006). The role of formative measurement models in strategic management research: Review, critique, and implications for future research. In A. Ketchen & D. D. Bergh (Eds.), *Research methodology in strategy and management* (Vol. 3) (pp. 197–252). Emerald Group Publishing Limited. https://doi.org/10.1016/S1479-8387(06)03008-6

Rabadán, A., Triguero, Á., & Gonzalez-Moreno, Á. (2020). Cooperation as the secret ingredient in the recipe to foster internal technological eco-innovation in the agri-food industry. *International Journal of Environmental Research and Public Health*, *17*(7), 2588. https://doi.org/10.3390/ijerph17072588

Ragin, C. C. (2006). Set relations in social research: Evaluating their consistency and coverage. *Political Analysis*, *14*(3), 291–310. https://doi.org/10.1093/pan/mpj019

Ragin, C. C. (2008). *Redesigning social inquiry: Fuzzy sets and beyond* (pp. 190–212). University of Chicago Press. https://doi.org/10.7208/chicago/9780226702797.001.0001

Ragin, C. C., & Davey, S. (2019). *Fuzzy-set/qualitative comparative analysis 3.0; Department of Sociology*. University of California.

Rehfeld, K.-M., Rennings, K., & Ziegler, A. (2007). Integrated product policy and environmental product innovations—An empirical analysis. *Ecological Economics*, *61*, 91–100. https://doi.org/10.1016/j.ecolecon.2006.02.003

Rennings, K. (2000). Redefining innovation-eco-innovation research and the contribution from ecological economics. *Ecological Economics*, *32*(2), 319–332. https://doi.org/10.1016/S0921-8009(99)00112-3

Rennings, K., & Ziegler, A. (2004). Determinants of environmental innovations in Germany: Do organizational measures matter? A discrete choice analysis at the firm level (No. 04–30). ZEW discussion papers. http://hdl.handle.net/10419/24036

Rennings, K., Ziegler, A., Ankele, K., & Hoffmann, E. (2006). The influence of different characteristics of the EU environmental management and auditing scheme on technical environmental innovations and economic performance. *Ecological Economics*, *57*, 45–59. https://doi.org/10.1016/j.ecolecon.2005.03.013

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). *SmartPLS 3*. SmartPLS GmbH. http://www.smartpls.com

Rosenthal, G., & Rosenthal, J. A. (2011). *Statistics and data interpretation for social work*. Springer publishing company.

Sáez-Martínez, F., Díaz-García, C., & González-Moreno, A. (2014). Environmental orientation as a determinant of innovation performance in young SMEs. *International Journal of Environmental Research*, *8*(3), 635–642. https://doi.org/10.22059/ijer.2014.758

Sáez-Martínez, F. J., Díaz-García, C., & Gonzalez-Moreno, A. (2016). Firm technological trajectory as a driver of eco-innovation in young small and medium-sized enterprises. *Journal of Cleaner Production*, *138*, 28–37. https://doi.org/10.1016/j.jclepro.2016.04.108

Salo, H. H., Suikkanen, J., & Nissinen, A. (2020). Eco-innovation motivations and ecodesign tool implementation in companies in the Nordic textile and information technology sectors. *Business Strategy and the Environment*, *29*, 2654–2667. https://doi.org/10.1002/bse.2527

Schneider, C. Q., & Wagemann, C. (2010). Standards of good practice in qualitative comparative analysis (QCA) and fuzzy-sets. *Comparative Sociology*, *9*(3), 397–418. https://doi.org/10.1163/156913210X12493538729793

Segarra-Oña, M., Peiró-Signes, A., Albors-Garrigós, J., & Miret-Pastor, P. (2011). Impact of innovative practices in environmentally focused firms: Moderating factors. *International Journal of Environmental Research, Spring*, *5*(2), 425–434.

Shou, Y. Y., Che, W., Dai, J., & Jia, F. (2018). Inter-organizational fit and environmental innovation in supply chains: A configuration approach. *International Journal of Operations & Production Management*, *38*(8), 1683–1704. https://doi.org/10.1108/ijopm-08-2017-0470

Simonen, J., & McCann, P. (2008). Innovation, R&D cooperation and labor recruitment: evidence from Finland. *Small Business Economics*, *31*, 181–194. https://doi.org/10.1007/s11187-007-9089-3

Triguero, A., Moreno-Mondejar, L., & Davia, M. (2015). Eco-innovation by small and medium-sized firms in Europe: From end-of-pipe to cleaner technologies. *Innovations*, *17*(1), 24–40. https://doi.org/10.1080/14479338.2015.1011059

Triguero, A., Moreno-Mondéjar, L., & Davia, M. A. (2013). Drivers of different types of eco-innovation in European SMEs. *Ecological Economics*, *92*, 25–33. https://doi.org/10.1016/j.ecolecon.2013.04.009

Triguero, A., Moreno-Mondejar, L., & Davia, M. A. (2016). Leaders and laggards in environmental innovation: An empirical analysis of SMEs in Europe. *Business Strategy and the Environment*, *25*(1), 28–39. https://doi.org/10.1002/bse.1854

Vis, B. (2012). The comparative advantages of fsQCA and regression analysis for moderately large-N analyses. *Sociological Methods & Research*, *41*(1), 168–198. https://doi.org/10.1177/0049124112442142

Wagner, M. (2008). Empirical influence of environmental management on innovation: Evidence from Europe. *Ecological Economics*, *66*, 392–402. https://doi.org/10.1016/j.ecolecon.2007.10.001

Wagner, M., & Llerena, P. (2011). Eco-innovation through integration, regulation and cooperation: Comparative insights from case studies in three manufacturing sectors. *Industry and Innovation*, *18*, 747–764. https://doi.org/10.1080/13662716.2011.621744

Woodside, A. G. (2013). Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory. *Journal of Business Research*, *66*(4), 463–472. https://doi.org/10.1016/j.jbusres.2012.12.021

Wu, G. C. (2013). The influence of green supply chain integration and environmental uncertainty on green innovation in Taiwans IT industry. *Supply Chain Management*, *18*, 539–552. https://doi.org/10.1108/SCM-06-2012-0201

Yurdakul, M., & Kazan, H. (2020). Effects of eco-innovation on economic and environmental performance: Evidence from turkeys manufacturing companies. *Sustainability*, *12*(8), 3167. https://doi.org/10.3390/su12083167

Zhou, Y., Hong, J., Zhu, K., Yang, Y., & Zhao, D. (2018). Dynamic capability matters: Uncovering its fundamental role in decision making of environmental innovation. *Journal of Cleaner Production*, *177*, 516–526. https://doi.org/10.1016/j.jclepro.2017.12.208

How to cite this article: Diez-Martinez, I., Peiro-Signes, A., & Segarra-Oña, M. (2023). The links between active cooperation and eco-innovation orientation of firms: A multi-analysis study. *Business Strategy and the Environment*, *32*(1), 430–443. https://doi.org/10.1002/bse.3145