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Drivers of environmental sustainability: environmental capabilities and supply chain integration

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Abstract

Purpose – This paper examines the moderating effect of environmental capability development on the relationship between supply chain integration and both environmental and financial performance.

Design/methodology/approach – The authors use empirical data collected from three diverse sources in the horticultural marketing sector. A total of 97 responses were used. An ordered logit analysis and ordinary least squares (OLS) regression were employed to test the hypotheses.

Findings – The results confirm that firm environmental capability development enhances the effects of supply chain integration on firm environmental performance. Additionally, supplier integration and environmental capabilities may be considered firm strategic capabilities that are positively related to financial performance. Thus, public policies should encourage the development of firms' individual environmental capabilities and supply chain integration to improve environmental sustainability.

Originality/value – This study recognizes the importance of environmental capability development as a strategic objective and its fundamental role as a complementary capability with supply chain integration. This paper contributes by empirically analyzing how firms along the supply chain can promote environmental sustainability through the development of environmental and integration capabilities.

Keywords Supply chain integration, Environmental capabilities development, Environmental performance

Paper type Research paper

1. Introduction

Recently, there has been growing concern about the serious adverse effects of pollution, environmental disasters and climate change (Lo *et al.*, 2018; Qu and Liu, 2022) on the life of the planet. Companies in all sectors have sought to develop environmental competencies that contribute to the improvement of their environmental performance and facilitate the creation of competitive advantages (Wong and Ngai, 2021). Environmental capability development (ECD) affects all phases of the production process, from product design to marketing and includes practices to facilitate recycling, reduce energy consumption, reuse products and materials, reduce waste and residues and adopt a proactive attitude in the design of environmental management strategies (Marcus and Anderson, 2006). By developing these competencies, companies have sought to respond to the growing demands of stakeholders to reduce and mitigate the environmental impact of their products and services.

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However, changing toward a more sustainability-friendly attitude requires both extending the boundaries of responsibility beyond the reach of a firm's ownership and direct control (Giménez and Tachizawa, 2012) and firm individual strategy to a global strategy that includes the different actors in the supply chain (Sharma and Iyer, 2012).

Companies can increase their ability to survive and grow not only by interacting with and satisfying other partners within the supply chain but also by making environmental sustainability a primary organizational goal in addition to profit-making (Li, 2014). Likewise, integration gives firms within the supply chain the opportunity to involve their partners in strategic collaborative relationships. Thus, supply chain integration (SCI) has been considered a strategic capability for companies and a source of competitive advantages (El Mokadem *et al.*, 2023; Liao *et al.*, 2021).

Although a firm may choose to become directly involved and invest its own resources to improve the environmental practices of supply chain partners (Vachon and Klassen, 2006), the effectiveness of integrating environmental issues involves efforts beyond simple collaboration with customers and suppliers (Khan and Yu, 2021). Consequently, a prominent level of environmental performance achieved by one firm might be negated by its suppliers' and/or customers' poor environmental management (Çankaya and Sezen, 2019).

Research into environmentally sustainable supply chains has been approached in many ways (Choudhary *et al.*, 2020). One of the most widely considered is the identification of different practices related to an improvement in performance (Golicic and Smith, 2013). On the one hand, they require the integration of environmental criteria into internal management systems (Margerum and Born, 2000) and strategic collaboration with supply chain partners (Klassen and Whybark, 1999). On the other hand, to be globally effective, there must be an extension of environmental management practices across the entire supply chain (Negri *et al.*, 2021).

Firms are facing two challenges: including environmental criteria in their current management and information systems (Wong *et al.*, 2018) and standardizing those criteria to support the coordination of environmental management activities among functions and across firms (Eggert and Hartmann, 2021). SCI is positioned as a key element for environmental sustainability within the supply chain, as it coordinates with both suppliers and customers (Krishnan *et al.*, 2020).

These arguments support the notion that SCI and a firm's environmental capabilities may be complementary assets (Christmann, 2000; Riley *et al.*, 2017). Firms that simultaneously develop both capabilities can improve their financial performance and outperform their competitors in environmental performance (Al-Sheyadi *et al.*, 2019).

In sum, several studies have highlighted the need to integrate environmental practices along the supply chain to improve firms' economic and environmental performance (Krishnan *et al.*, 2020). Thus, many studies have analyzed the impact of SCI on company performance (i.e. Bae *et al.*, 2021). Other works have examined the relationship between green SCI and firms' performance (i.e. Kong *et al.*, 2021; Samad *et al.*, 2021). However, there is a dearth of studies that jointly analyze the role of SCI and firm ECD (Khan *et al.*, 2022) and their complementary relationships. This is an important research question because it responds to the call to investigate how firms can enhance their environmental sustainability through the development of management practices supporting different strategic capabilities.

The aim of this paper is twofold. First, by disaggregating SCI into its traditional dimensions (internal, with suppliers and with customers), this study is able to identify the potentially different effects of SCI and ECD on environmental and financial performance. Second, it examines how the effect of the different dimensions of SCI on a firm's environmental and financial performance may be enhanced by ECD. In other words, these capabilities moderate the relationship between SCI and firm performance.

2. Theoretical background and research hypotheses

2.1 Supply chain integration and performance

Within the context of environmentally sustainable supply chains, firms must respond to the environmental requirements and demands of customers, suppliers, internal and external stakeholders and society (Narasimhan and Carter, 1998). Wolf (2011) theorized that downstream sustainable supply chain management integration and strategy integration would lead to an improvement in firms' environmental performance. Some studies also support the idea that integration and environmental management are closely related (Sarkis *et al.*, 2011).

The desire to be integrated with supply chain partners arises from the need to facilitate communication and cooperation among them (Ettlie and Reza, 1992). Therefore, firms maintain intraorganizational processes while coordinating with external parties to facilitate the interorganizational fulfillment of joint environmental goals (Wong *et al.*, 2015). In addition, firms will only improve in the final phase of environmental management when they act as an entire system by including customers, suppliers and other players in the supply chain (Walton *et al.*, 1998).

SCI has been identified as having special relevance in several aspects, such as in the process of internally integrating environmental objectives and information from customers and suppliers (Klassen and Vachon, 2003); in the development of environmentally friendly processes through the unified effort of all members of the supply chain (Vasileiou and Morries, 2006); and in becoming a source of new ideas and a way of learning from customers and/or suppliers to identify and choose those options that might address a particular environmental challenge (Liu *et al.*, 2018). Additionally, a stable integration relationship has been demonstrated to foster the disclosure of information concerning environmental issues, which has allowed firms to pay more attention to environmentally sound operations or products and thus reduce complexity (Vachon and Klassen, 2006).

To effectively consider environmental issues in the supply chain, firms must overcome diverse obstacles such as supplier and customer awareness. Therefore, SCI reduces opportunism and encourages customers and suppliers to become involved with the firm to jointly improve environmental performance. Thus, through SCI, firms gather essential information that allows them to obtain much more knowledge about suppliers and customers and influence them to raise awareness (Hart, 1995). This process contributes to reducing uneconomical recycling, saving energy, reducing pollution and waste and ensuring that the firms put pressure on supply management (Lintukangas *et al.*, 2015).

Developing SCI involves a mutual understanding of environmental risk and responsibilities. This understanding gives rise to joint decision-making to resolve environmental problems and achieve common environmental goals among suppliers and customers (Yang *et al.*, 2013). For instance, suppliers contribute to preserving the environment using appropriate raw material and adopting mandatory environmentally friendly practices. In sum, the integration of environmental issues within firms that are strategically integrated will lead to better performance.

2.1.1 Internal supply chain integration and performance. Supply chain operations touch on every aspect of firms and therefore have a high potential to achieve environmental improvement (Tate *et al.*, 2010). Information flows are facilitated by internal integration, which encourages communication between parties in the organization, ensuring an increase in trust and confidence among departments (Vallet-Bellmunt and Rivera-Torres, 2013). Working together leads to the pooling of goals and interests while also sharing costs. Thus, internal integration facilitates cross-functional cooperation toward environmental protection and encourages firms to adopt environmental management systems (Wu *et al.*, 2012). Likewise, over time, a close relationship among departments can generate an effective relationship characterized by trust and commitment (Basnet, 2013). Thus, top management can take advantage of this relationship to improve employee participation in environmental initiatives (Zhu *et al.*, 2008).

H1a. Internal integration is positively related to environmental performance.

When firms are committed to the development of internal integration, they try to keep all departments as closely integrated as possible. This integration breaks down functional barriers and encourages cooperation, which, in turn enables firms to increase their internal communication, which has been demonstrated to be crucial when seeking an improvement in financial performance (Flynn *et al.*, 2010; Huo, 2012).

H1b. Internal integration is positively related to financial performance.

2.1.2 External supply chain integration and performance. SCI can be considered interactive because the advantages of integration with suppliers and customers come from sharing information and collective development (Lau *et al.*, 2010). Thus, external integration can enhance mutual understanding among supply chain partners, promote collaboration and establish cross-firm problem-solving routines (Wong *et al.*, 2011). Therefore, external SCI leads to an increase in knowledge sharing and professional expertise, helps firms resolve conflicts, improves the efforts of supply chain partners and improves performance (Lau *et al.*, 2010).

Developing closer relationships also includes exchanging knowledge about green techniques and managing source materials as well as cooperation with these partners to further ecological designs that meet environmental standards (Vachon and Klassen, 2006; Zhu and Sarkis, 2007). Both dimensions of integration foster environmental management programs and enable firms to modify products by using recycled or less hazardous materials and redesign manufacturing processes to reduce waste (Vachon, 2007).

As firms become more integrated, they will have fewer conflicting goals and better knowledge of suppliers and customers. In these circumstances, investments in environment-related activities become less risky as organizations increase their knowledge of each other. Additionally, such levels of integration provide a basis for achieving cooperative solutions to reduce the environmental impact of the material flows among supply chain members (Vachon and Klassen, 2006). This advantage can assist with the development and implementation of new, more environmentally friendly supply chain practices, which often require an understanding of complex interfirm links (Vachon and Klassen, 2006).

Many environmental activities are imposed by legal requirements. Thus, a supplier may be forced to shut down because of the improper use of hazardous materials or because it faces a regulatory obligation to restore an initial situation. In the same way, problematic customers might choose to boycott the firm's product because of its environmental impacts. Therefore, firms with a more integrated relationship with suppliers and/or customers may mitigate the negative consequences of environmental contingencies and respond quickly to develop alternatives to solve these issues through the supply chain. As a result, environmental performance will be greater when integration and information systems are in place to facilitate the exchange of knowledge and track the level of achievement of environmental practices (Wong *et al.*, 2020).

In summary, the integration of suppliers and customers with regard to environmental efforts often leads to exchanging best practices and prevents negative effects that could arise from misunderstandings (Wong *et al.*, 2015).

H2a. Customer integration is positively related to environmental performance.

H2b. Supplier integration is positively related to environmental performance.

The direct relationship between SCI, both with customers and suppliers, and performance has been widely studied in the literature. In this sense, the link with financial performance has attracted much attention in diverse studies (Narasimhan and Kim, 2002; Swink and Schoeneherr, 2015). Through SCI, firms can manage information about customers' preferences that, together with the firms' frequent interaction with the customers, can reduce the time to market, adjust the firms' inventory level or improve production planning. This leads to a more efficient response to customers' requirements, which is translated to a higher market share (Swink *et al.*, 2007) and therefore a positive impact on financial performance.

Similarly, integration with suppliers enables the exchange of flows of information, leading to a mutual understanding (Flynn *et al.*, 2010). Therefore, building on that partnership improves certain capabilities within the firm, such as cost, quality, flexibility, or delivery. These benefits facilitate firms' ability to take full advantage of collaborative processes that allow them to improve efficiency and create value for customers, improving overall financial performance (Zhao *et al.*, 2008).

H3a. Customer integration is positively related to financial performance.

H3b. Supplier integration is positively related to financial performance.

2.2 The moderating role of environmental capability development

Environmental strategy is based on the exploitation of resources and capabilities possessed by the firm (Sharma and Vredenburg, 1998). The main objective is to reduce the ecological impact while creating value and increasing firm performance. Thus, an environmental capability can be defined as a firm's capacity to deploy the resources needed to enhance firm performance and conserve the natural environment (Gabler *et al.*, 2015). Among the main strategies involved are to involve all the personnel, continuously improve the process and integrate stakeholders (Christmann, 2000).

In addition, other capabilities not directly related to environmental issues can be of great help in enhancing a firm's environmental performance. Thus, the implementation of environmental actions will be useless if one of the supply chain members does not take part these efforts according to the established specifications. SCI facilitates objective alignment among the members of the supply chain, including the environment (Kamble *et al.*, 2020). In this vein, the degree of development of environmental capabilities may be fundamental to take full advantage of the potential of SCI toward addressing environmental issues.

The advancement of SCI requires changes in the production process if it is intended to affect environmental performance. These changes will require the development of special capabilities. Therefore, firms that develop SCI might not be able to generate the environmental performance expected. In fact, establishing more tightly integrated relationships without environmental capabilities might have no effect on environmental performance or even make the process less efficient than it was previously.

Although firms might have developed both intra- and interorganizational relationships, they need to better understand the procedures or routines necessary to put into practice the required environmental actions. In this sense, the main environmental practices that lead to building environmental capabilities comprise a proactive environmental strategy, energy management, recycling and waste reduction (Marcus and Anderson, 2006).

The development of environmental capabilities may allow firms to progress along the learning curve for environmental activities faster than firms without these capabilities and thus to seize the related advantages (Christmann, 2000). Conversely, firms that do not possess these capabilities for environmental purposes might be better off delaying the use of connections gained through integrative practices to improve environmental performance. Hence, if firms have initially developed environmental capabilities, they have specific knowledge about how to proceed. Therefore, firms can connect and cooperate to manage distinct stages of the supply chain, such as source material, purchasing or storing.

In addition, firms can coordinate environmental practices in conjunction with their partners within the supply chain, avoiding duplications and instead working for diverse purposes. Under this situation, firms are concerned with both customers and suppliers, and they can improve their combined environmental management. Therefore, firms that manage to reduce conflicts are more prone to increasingly invest in environmentally friendly actions, which eventually will reduce their environmental impact.

Conversely, organizations lacking the development of environmental capabilities are not prepared to take full advantage of their integrative abilities and further address environmental issues.

H4. ECD has a positive moderating effect on the relationship between (a) customer integration; (b) supplier integration; (c) internal integration and environmental performance.

Increasingly, environmental objectives are part of the main concerns of firms when establishing interorganizational relationships. The complexity of environmental issues requires the fullest integration with suppliers and customers to reap new business opportunities (Chauhan *et al.*, 2022).

When firms are not effective in the development of environmental capabilities, they are limiting their internal and external relationships to fully achieve the environmental efficiency level jointly established. This lack of a sound base of environmental capabilities means that employees in tasked with managing the firm's external relationships cannot understand the importance of environmental issues, leading to a decline in financial performance. In contrast, firms that invest resources in the development of environmental capabilities are more prepared to reap the benefits of their SCI, as their performance objectives and environmental thinking are in line with those of suppliers and customers.

H5. ECD has a positive moderating effect on the relationship between (a) customer integration; (b) supplier integration; (c) internal integration and financial performance.

3. Method

3.1 Sample and data collection

To test the hypotheses, data were collected from Spanish horticultural marketing firms. We identified a population of agri-food firms in two geographical areas, one of which specialized in horticultural products (peppers, tomatoes, cucumbers, etc.) and the other in berries (strawberries, blueberries, raspberries, etc.).

To collect the data, three diverse sources were used. First, a questionnaire was conducted. Second, a panel of experts was consulted due to the difficulty in obtaining objective opinions about sensitive information. The authors felt that it would be sensible to hear from experts about environmental performance. Third, archival data from the *Sistemas de Análisis de Balances Ibéricos* (SABI) database for financial performance were considered.

On the one hand, the questionnaire was developed in a three-stage process. The first comprises the development of the questionnaire based on the literature and a review by academic experts in both supply chain research and the agri-food sector. In the second stage, the questionnaire was modified to accommodate the academic experts' comments and suggestions. Third, the definitive version was designed by drawing on the feedback from these firms and was sent to the rest of the sample firms.

The survey was administered by computer-assisted telephone interview (CATI), which enables researchers to improve the quality of responses (Couper, 2011). The starting population was made up of 210 firms. This sample was included under the Statistical Classification of Economic Activities in the European Community (NACE) Rev. 2 business code 46.31 (wholesale of fruit and vegetables) and located in southern Spain. A total of 97 questionnaires were finally completed and included in this study.

On the other hand, the process of obtaining information from the experts was carried out in three steps. The first step comprised the identification of the experts and their suitability to address the topic studied: (1) researchers from nearby universities specializing in agri-business; (2) consulting firms supporting the development of agricultural businesses; and (3) financial companies focused on investment in this sector. In the second step, the willingness of potential experts from each area to participate was assessed. After this process, a total of 9 experts were contacted and involved in providing information. Thus, the last step consisted of sending a questionnaire including, among other items, questions about the environmental performance of the firms analyzed in this study.

This study collected data from three diverse sources, reducing the possibility of this bias. However, to confirm the reliability of the research instrument, the existence of different biases was tested. To assess potential late response bias, a test was conducted using the extrapolation method suggested by Armstrong and Overton (1977). The demographic characteristics of assets, annual sales and the number of employees of early and late responses were compared. At the same time, five items in the questionnaire were randomly selected and compared. No significant differences were found between early and late responses. Accordingly, nonresponse bias is unlikely to be a major concern in this study.

To test for the potential existence of common method variance, confirmatory factor analysis was used. Since we collected data from a single respondent per organization, the potential for common method bias might be an issue (Podsakoff *et al.*, 2003). Therefore, all the variables coming from the questionnaire were loaded into an exploratory factor analysis (EFA). The results show five factors with eigenvalues above 1.0 that explain 80.75% of the total variance. The first factor only explains 35.48% of the variance, which is acceptable for this study, where most of the constructs are correlated, both conceptually and empirically. This suggests that common method bias does not appear to be a problem.

3.2 Measures

The literature was surveyed to identify valid measures for related constructs and adapted to existing scales. Thus, the variables used in this research were developed according to the following description:

3.2.1 Dependent variable. Environmental performance (ENVP) has been considered a general measure following the dimensions proposed by Zhu and Sarkis (2004). Thus, experts were asked to compare each EP with competitors in terms of jointly reducing air emissions, waste, hazardous/toxic materials and environmental accidents. The items were considered on a 4-point Likert-scale, where 1 indicates much worse, 2 indicates worse, 3 indicates better and 4 indicates much better.

Financial performance (FP) was computed as the return on equity (ROE) using data supplied by the SABI database. ROE is calculated as earnings before interest, taxes, depreciation and amortization divided by equity. With this measure, partial profit is assessed more directly, which limits the possibility of outliers (Hendricks and Singhal, 1997).

3.2.2 Independent variables. SCI was divided according to its dimensions: internal integration (II) practices (Flynn *et al.*, 2010) and external integration practices (Flynn *et al.*, 2010; Narasimhan and Kim, 2002). Regarding external integration, this research follows those that have kept the supplier (SI) and customer (CI) elements of integration separate, with the purpose of obtaining their potentially distinct relationships with performance (Narasimhan and Kim, 2002). Thus, respondents were asked to rate the extent to which statements regarding information exchange and involvement both with suppliers and customers applied to their firm. They were considered on a 5-point Likert-scale, where 1 indicates strongly disagree and 5 strongly agree.

ECD was adapted from Marcus and Anderson (2006). It was considered an environmental practice that firms have to develop if they want to achieve a steady capability. The measure comprises the main aspects of those areas of firms that have a direct impact on the environment, such as the use of renewable energy, their emissions, waste generation, recycling activities and environmental proactivity in general. Thus, respondents were asked to rate the extent to which statements fit their firm. These items were considered on a 5-point Likert-scale, where 1 indicates strongly disagree and 5 strongly agree.

3.2.3 Control variables. Additionally, the study considered five different control variables. First, the size (SIZE) of the firm was considered a factor that could affect EP because it is assumed that larger firms possess greater and more heterogeneous resources to develop and implement environmental actions. SIZE was measured as a natural logarithm of the number of employees.

The remaining four control variables are closely related to the characteristics of the sector. The horticultural sector is internationalized; thus, these firms usually obtain important revenue from international markets. Thus, the exportation (EXPORT) variable was created as a dummy, where 0 indicates less than 50% of revenue coming from international markets and 1 otherwise. Another characteristic of this industry is the classification of the raw materials into diverse categories according to the quality demanded by customers. Therefore, after the internal transformation processes, firms obtain diverse categories of products, where those of greater quality are expected to generate higher revenues. Therefore, the variable premium quality (PQ) was created as a dummy, where 0 indicates generating a greater percentage of premium quality categories than competitors and 1 otherwise.

Likewise, the relevance of the disclosure of information about the company was considered. Consequently, the variable RSC was created as a dummy, where 0 indicates that the firm does not consider the disclosure of information about its corporate social responsibility to be relevant and 1 otherwise. Finally, the legal form of the firms was considered, as the sample can be split into social economy companies (cooperatives) and private limited companies. Therefore, the variable TYPE was created with the value 0 when the firm is a private limited company and the value 1 when it is a cooperative.

4. Data analysis and results

Confirmatory factor analysis (CFA) was conducted to assess the convergent and discriminant validity. The CFA results suggested that the model was a good fit for the data. The measurement model fit statistics (χ^2 = 137.669, df = 97, χ^2/df = 1.42, comparative fit index (CFI) = 0.952, Tucker Lewis index (TLI) = 0.941, root mean square error of approximation (RMSEA) = 0.06) indicate acceptable model fit (Hair *et al.*, 2006). All individual items in the measurement model had significant factor loadings on the hypothesized construct (Anderson and Gerbin, 1988). These results provided evidence of convergent validity (see Table 1). Discriminant validity is supported by the correlations between all latent constructs compared to the square root of the AVE for each construct (Fornell and Larcher, 1981; see Table 2).

Two methods were employed to examine reliability: Cronbach's alpha and composite reliability (CR) (McFadden *et al.*, 2009). These tests produced Cronbach's alpha values ranging from 0.73 to 0.91 (figures in parentheses, first column of Table 2) and CR values ranging from 0.74 to 0.92 (figures in parentheses, first file of Table 2), all of which indicate acceptable reliability (Swafford *et al.*, 2006).

To test the hypotheses, two different analyses were performed to compare the relationship between SCI and environmental performance and the moderating effects of ECD on this relationship. On the one hand, an ordered logit analysis was performed to test those hypotheses where EP was the dependent variable (H1a, H2a, H2b, H4a, H4b, H4c). On the other hand, ordinary least squares (OLS) regression was performed to test those hypotheses where FP was the dependent variable (H1b, H3a, H3b, H5a, H5b, H5c).

Construct	Indicator	Standard Coefficient	*t*-Value
Supplier integration (CI)	SUP INT01	0.7019	12.87
	SUP INT02	0.8991	36.11
	SUP INT03	0.8991	36.13
	SUP INT04	0.9166	40.91
Customer integration (CI)	CUS INT01	0.6464	9.95
	CUS INT02	0.9226	21.08
	CUS INT03	0.7985	15.65
	CUS INT04	0.7818	13.74
Internal integration (II)	INT INT01	0.9007	22.76
	INT INT02	0.6944	11.33
	INT INT03	0.7908	16.38
	INT INT04	0.6181	8.85
Environmental capability Development (ECD)	ECD1	0.7377	9.97
	ECD2	0.7418	10.12
	ECD3	0.6183	7.49
	ECD4	0.4409	4.51

Note(s): Model fit: χ^2/df = 0.994, p = 0.4843, CFI = 0.952, RMSEA = 0.065, standardized root mean square residual (SRMR) = 0.07
Source(s): Own elaboration

Table 1. Measurement model statistics

Table 3 shows the regression results from the ordered logit analysis. The first model included the control variables, variables about integration and the variable measuring the development of environmental capabilities. Thus, the three remaining models each included one of the interaction effects to test the hypothesis regarding the moderating effect of ECD.

Hypothesis 1a suggests that the development of internal integration positively contributes to environmental performance. The data do not support this hypothesis. As shown in Model 1, internal integration has a nonsignificant coefficient.

Hypotheses 2a and 2b suggest that customer integration and supplier integration positively contribute to environmental performance. Neither hypothesis is supported.

Hypotheses 4a, 4b and 4c suggest that firms with high levels of ECD achieve improved environmental performance from the implementation of customer integration, supplier integration and internal integration, respectively. The results shown in Table 3 (Model 2 to Model 4) support Hypotheses 4a and 4c. On the one hand, Model 2 shows that the interaction term between environmental capabilities and customer integration is positive and significant ($p > 0.05$). The pseudo R^2 increases from 0.1557 without the interaction term to 0.1709 with it. In addition, a likelihood ratio test reveals that this incremental increase in pseudo R^2 is significant ($p < 0.01$). On the other hand, Model 4 shows that the interaction of environmental capability development and internal integration is positive and significant ($p < 0.01$). The pseudo R^2 of the model increases from 0.1557 without the interaction term to 0.1870 with it. This incremental increase in pseudo R^2 is significant ($p < 0.01$). Although the interaction of environmental capabilities and supplier integration is positive, the incremental increase in pseudo R^2 is only marginally significant ($p < 0.10$). Thus, the results of Model 3 (Table 3) provide marginal support for Hypothesis 4 b.

Table 4 shows the regression results from the OLS analysis to test Hypotheses 5a, 5b and 5c. The baseline model (Model I) includes the control variables, variables about integration and the variable measuring the development of environmental capabilities. The three remaining models include each of the interaction effects to test the hypothesis regarding the moderating effect of environmental capability development.

Table 2.
Composite reliability (CR), cronbach's alpha, descriptive statistics, average variance extracted (AVE), and correlations

	Mean	SD	1	2	3 CR = 0.86	4 CR = 0.92	5 CR = 0.84	6 CR = 0.74	7	8	9	10
1. Environmental performance	3.46	1.09										
2. Financial performance	0.12	0.49	0.2488*									
3. Customer integration ($\alpha = 0.87$)	3.92	0.893	*0.3552****	0.0735	*0.63/0.79*							
4. Supplier integration ($\alpha = 0.91$)	3.9	0.952	0.1988	0.1732	*0.4929****	*0.74/0.86*						
5. Internal integration ($\alpha = 0.83$)	4.02	0.769	*0.2402**	0.0854	*0.6071****	*0.4512****	*0.60/0.77*					
6. Sustainable capabilities ($\alpha = 0.73$)	3.54	0.663	0.0374	*0.2520**	0.1930	0.0012	0.1380	*0.52/0.72*				
7. No. Employees (size)	138	184	*0.2206**	−0.0232	0.1287	−0.0116	0.0584	0.0032				
8. Exportation	n/a	n/a	*−0.2219**	−0.1682	−0.1000	0.0676	−0.0489	−0.0649	*0.5502****			
9. Premium quality	n/a	n/a	*−0.2420**	−0.2098*	−0.1499	−0.0126	*−0.2361**	−0.1353	*0.4453****	*0.5879****		
10. RSC	n/a	n/a	*0.2263**	0.1305	0.0354	−0.0559	0.0718	0.0859	0.1922	0.1101	−0.0524	
11. Type	n/a	n/a	−0.0552	*−0.2085**	−0.0212	0.0928	0.0529	*−0.2256**	0.1808	*0.2650***	*0.3382****	0.0335

Note(s): (1) The AVE for each variable is shown italic on the diagonal immediately followed by the square root of AVE for discriminant validity testing
(2) *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$
Source(s): Own elaboration

Table 3.
Empirical results for the ordered logit regression

	Model 1		Model 2		Model 3		Model 4	
Size	*0.4874******	(0.1199)	*0.4875******	(0.1210)	*0.4975******	(0.1209)	*0.4953******	(0.1217)
Export	*−1.009****	(0.3242)	*−1.0275***	(0.3269)	*−0.9722***	(0.3268)	*−1.0410***	(0.3286)
PQ	*−0.5975**	(0.3065)	*−0.6236**	(0.3090)	*−0.6808**	(0.3125)	*−0.5904**	(0.3099)
RSC	*0.5023**	(0.2381)	*0.4889**	(0.2394)	*0.5570**	(0.2413)	*0.5305**	(0.2408)
Type	0.0312	(0.2625)	0.1428	(0.2703)	−0.0518	(0.2636)	−0.0187	(0.2636)
II	−0.0630	(0.1977)	−0.1513	(0.2031)	−0.0653	(0.1983)	−0.1136	(0.2028)
CI	0.2274	(0.1756)	0.3405	(0.1861)	0.2396	(0.1762)	0.2175	(0.1775)
SI	0.2746	(0.1481)	0.2677	(0.1487)	*0.2843**	(0.1486)	*0.3333**	(0.1511)
ECD	−0.0940	(0.1835)	−0.2030	(0.1939)	−0.1286	(0.1866)	−0.0876	(0.1899)
ECDxCI			*0.4963**	(0.2497)				
ECDxSI					0.3271	(0.1969)		
ECDxII							*0.6887***	(0.2457)
Pseudo R^2	0.1557		0.1709		0.1662		0.1870	
LR χ^2	*41.50****		*45.53****		*44.30****		*49.84****	
ΔPseudo R^2			0.0152		0.0105		0.0313	
p for ΔPseudo R^2			*0.0447*		0.0943		*0.0039*	

Note(s): (1) Environmental performance is the dependent variable. Standard errors in parentheses. Italics mean statistical significance
(2) *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$
Source(s): Own elaboration

Hypothesis 1b states that the development of internal integration positively contributes to financial performance. The data give no support to this hypothesis. As shown in Table 4, internal integration has no significant effect.

Hypotheses 3a and 3b suggest that customer integration and supplier integration positively contribute to financial performance, respectively. The data do not support Hypothesis 3a but do support Hypothesis 3b. Table 4 shows that supplier integration has a positive and significant effect on financial performance.

Hypotheses 5a, 5b and 5c suggest that firms with higher levels of environmental capability development gain greater financial performance from the implementation of customer integration, supplier integration and internal integration, respectively. The data support these three hypotheses. Model II shows that the interaction term (environmental capabilities and customer integration) is positive and significant ($p < 0.05$). The adjusted R^2 increases from 0.1045 without the interaction term to 0.1517 with it ($p < 0.05$). Model III shows that the interaction between environmental capabilities and supplier integration is also positive and significant ($p < 0.05$). The adjusted R^2 increases from 0.1045 to 0.1546 with the presence of the interaction term ($p < 0.01$). Finally, Model IV shows that the interaction term (environmental capability and internal integration) has a positive and significant effect ($p < 0.01$). In addition, the adjusted R^2 increased from 0.1045 to 0.1641 ($p < 0.01$).

5. Discussion

Conducting integration within a supply chain (or being already integrated) will help firms attain better financial performance. In addition, it was argued that SCI is an essential dimension for the environmental sustainability of firms and supply chains. SCI also helps to improve environmental performance because firms will already have developed connections among parties and have stable communication channels. For instance, SCI improves access to information, which can create new sustainable models. This can be materialized through the scheduling of activities and processes in a more intelligent way that supports the responsible use of resources while reducing consumption (e.g. water, energy, etc.) (Ding *et al.*, 2017).

Table 4. Empirical results from OLS regression

	Model 1		Model 2		Model 3		Model 4	
Size	0.0600	(0.0480)	0.0495	(0.0470)	0.0577	(0.0467)	0.0517	(0.0465)
Export	−0.1858	(0.1322)	−0.1827	(0.1286)	−0.1522	(0.1291)	−0.1800	(0.1277)
PQ	−0.1125	(0.1304)	−0.1141	(0.1270)	−0.1514	(0.1277)	−0.0980	(0.1261)
RSC	0.1229	(0.0989)	0.1128	(0.0963)	0.1475	(0.0966)	0.1236	(0.0955)
Type	−0.1359	(0.1095)	−0.0757	(0.1094)	−0.1156	(0.1067)	−0.1310	(0.1058)
II	−0.0181	(0.0831)	−0.0568	(0.0825)	−0.0214	(0.0808)	−0.0392	(0.0807)
CI	−0.0891	(0.0744)	−0.0402	(0.0752)	−0.0829	(0.0723)	−0.0919	(0.0719)
SI	*0.1540**	(0.0613)	*0.1431**	(0.0598)	*0.1531**	(0.0596)	*0.1654***	(0.0594)
ECD	*0.1643**	(0.0769)	0.1142	(0.0777)	0.1398	(0.0754)	*0.1669**	(0.0743)
ECDxCI			*0.2342**	(0.0969)				
ECDxSI					*0.1933**	(0.0779)		
ECDxII							*0.2413***	(0.0899)
Const	−0.7948	(0.4057)	−0.6028	(0.4028)	−0.7229	(0.3953)	−0.7407	(0.3925)
R^2 (Adj)	0.1045		0.1517		0.1546		0.1641	
F	*2.25**		*2.72***		*2.76***		*2.89***	
ΔR^2			0.0472		0.0501		0.0596	
p for ΔR^2			*0.0116*		*0.0096*		*0.0052*	

Note(s): (1) Financial performance is the dependent variable. Standard errors in parentheses. Italics mean statistical significance
(2) *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$
Source(s): Own elaboration

Similarly, access to this information can improve delivery accuracy and unnecessary waiting times. This finding is in line with studies reporting that enhanced supply chain coordination improves reverse logistics, which will help reduce emissions, waste and overall consumption (Stock *et al.*, 2016).

Similarly, knowledge becomes a valuable resource because it allows integrated companies to learn how to be more efficient in the use of resources, avoiding, for example, the economic implications of disposing of resources in an unsustainable way. Then, companies learn how to identify the processes that need to be integrated and understand how to develop an environmentally sustainable business model.

This study provides evidence that SCI and ECD are complementary capabilities to enhance a firm's environmental performance. However, the effect on environmental performance varies when considering different SCI dimensions, with its enhancing effect being particularly meaningful in the case of customer integration and internal integration.

ECD and the links created among departments (and the stability of information flows) have no effect on environmental performance by themselves. Only firms that simultaneously develop environmental capabilities and internal integration may reach the full potential of both capabilities.

Firms that simultaneously develop customer integration and environmental capabilities improve their environmental performance. In the horticultural marketing context, the behavior of suppliers and customers differs, so differentiated actions must be considered to manage the relationships. Customers concentrate their decision-making power in the supply chain (Daugherty, 2011). In this way, the entire supply chain responds to customer demand. Customers are environmental evaluators of firms and are ultimately responsible for transmitting consumers' requirements to firms. Bearing in mind that customers can be crucial for the competitiveness of firms, these firms may feel obligated to maintain their customers' expectations about their environmental management above the minimum legal requirements.

Although other studies have found that green purchasing practices have a significant favorable association with environmental sustainability (Khan *et al.*, 2022), our study does not show a robust positive relationship between the interaction of supplier integration and ECD and environmental performance (the relationship is marginally significant). It has been argued that integration with suppliers generates a constant flow of information that allows both parties to better understand whether the requirements necessary to keep working together have been met. Therefore, our results are partially aligned with those stating that the coordination of logistic flows between suppliers and firms improves efficiency, reduces waste and improves opportunities for reuse and recycling (Tarifa-Fernández, 2021). Although this coordination can have clear direct effects on financial performance, it can also be extended to environmental performance.

Our results can be explained by the fact that supplier integration practices related to environmental initiatives are not clearly differentiated among the companies in the sample, although their average level may be relatively high. The fact that these practices are adopted by many companies implies that their relationship with environmental performance, although positive, is not particularly significant. Both supplier integration and ECD may be considered firms' strategic capabilities that are positively related to financial performance. Firm ECD moderates the relationships between each dimension of SCI and firm financial performance.

These results show that the relationship between SCI and financial performance is complex and may depend on the characteristics of the supply chain (e.g. bargaining power of each party). Also, ECD may be at the foundation of the development of competitive advantages as a strategic capability that combines with other capabilities (SCI) to generate profits and improve supply chain performance.

5.1 Theoretical implications

This study advances the literature on both SCI and organization and environmental research. There is extensive research analyzing the connection between SCI and firm performance, considering different moderating variables (see Tarifa-Fernández and de-Burgos-Jiménez, 2017). This study adds to this literature by analyzing a strategy capability that can be considered complementary to SCI to explain both the environmental performance and the financial performance of firms. Thus, within the theoretical framework of the resource-based view and the notion of complementary resources (Teece, 1986; Christmann, 2000), this study highlights the consideration of SCI as a firm strategic capability that combines with other resources and capabilities to facilitate the generation of competitive advantages and environmental sustainability.

Developing environmental or green capabilities has been emphasized as a means of reducing the environmental impact of firms' activities without compromising their long-term survival. ECD facilitates, on the one hand, significant cost savings because of a reduction in waste generated, greater energy efficiency and a reduction in the pollution generated by a firm's activities (Ding *et al.*, 2017). On the other hand, ECD improves firm reputation and facilitates the differentiation of its products and services (Khan *et al.*, 2021). However, the development of individual environmental competencies by a firm may not be sufficient to achieve environmental sustainability. The extension of environmental knowledge and environmental protection activities through higher levels of SCI can simultaneously contribute to the improvement of firm performance and the environmental performance of suppliers and customers. Thus, this study stresses the notion that ECD should be extended to all actors in the supply chain.

5.2 Managerial implications

The findings of this study also have notable managerial implications that may help firms improve the management of SCI and environmental proactivity. SCI, together with the development of environmental capabilities, can enhance environmental performance without compromising financial returns. This means that managers should consider the advantages gained in the development of SCI and go beyond economic results. Thus, when seeking to include environmental issues in the firm, it is important to know to what extent external relationships have been developed and what the level of development of environmental capabilities is. As these elements have to be aligned across partners within the supply chain, they should be a priority for managers when developing a solid environmental strategy.

Given the strategic nature of SCI and environmental capabilities, management should involve all employees in the process of taking greater responsibility for environmental issues. In doing so, managers can take advantage of synergies derived from the establishment of steady relationships with supply chain partners and the internal development of environmental capabilities.

The findings of this study suggest that public policies should promote and incentivize the implementation of environmental technologies and activities in all companies along the supply chain rather than focusing on a particular type of company or specific industry. In addition to promoting the integration of companies in the supply chain, incentives and training offered should focus on the connections between the activities, processes and technologies of all factors that contribute to improving and achieving the environmental sustainability of the supply chain.

5.3 Limitations and future research

Like all research, this study is not without limitations. The specificity of the sample population, which is restricted to one industry, may affect the generalizability of the findings. Thus, an initial extension of this research would be to replicate it in other industries to examine whether the relationships found in this study are similar in other industries.

SCI, environmental performance and environmental capabilities are measured at the same point in time, an approach that does not consider the disparate effects of these factors between the short run and long run. It is possible that SCI and environmental capabilities require higher initial investment that, in the short run, shows less impact on environmental performance, while leading to a greater impact in the long run. This time lag could be responsible for the lack of significance among some of the results. Analogously, different measures of environmental performance and economic performance should be analyzed for robustness checks of results and implications.

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