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Sustainable Practices in Manufacturing SMEs: The Importance of Technological Collaboration between Supply Chain Partners

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Abstract: The development of new technologies within Industry 4.0 (I4.0) may serve as a catalyst in the development of sustainable practices (SP), particularly in the case of small and medium enterprises (SMEs). This paper contributes to the literature by examining the development of technological collaboration agreements between supply chain partners as an influence factor that may impact the environmental commitment of SMEs. Specifically, we study whether the type of partner within the supply chain impacts a firm's spending or its investment decision toward SP. To that end, we propose an analysis model that considers supplier and customer relationships separately, and the SP measure to be taken distinguishing between expenses and investments. Additionally, empirical research comprising descriptive statistics and econometrics using the regression technique has been conducted on a sample of 1808 Spanish industrial firms. Our results confirm that there are significant differences between SMEs and large companies when developing SP, and that these SP in SMEs depend on the chosen partner and measure. Finally, we offer our main conclusions, as well as relevant recommendations for managers, public administrators, suppliers, and customers, who are essential players in the I4.0 revolution and are under social pressure to promote sustainable development.

Keywords: sustainable practices; industry 4.0; suppliers and customers; SMEs; collaboration agreements

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1. Introduction

For several years, there has been a widespread concern about the damage caused by human action to the environment. In line with this concern, society demands that organizations show a greater commitment to social and environmental issues. Consequently, companies are under great pressure to conduct their activities in an ethical and responsible manner, thereby contributing to a more sustainable growth. In the economic landscape, especially in the European Union, most companies are small- and medium-sized enterprises (SMEs) [1]. While SMEs significantly contribute to global production and job creation, they also leave a strong footprint on the ecosystem. The previous literature has examined the role of SMEs in both developed and developing countries, indicating that their commitment is crucial for effectively implementing sustainable initiatives [2,3]. Therefore, given their significant economic and environmental impact, it is interesting to understand their behavior regarding sustainable practices (SP).

At the same time, the digital transformation of production systems has been a central issue for manufacturing companies in industrialized countries. This revolution, known as Industry 4.0 (I4.0), which is based on the implementation and integration of a wide variety of information and digital technologies such as the internet of things, big data, cloud computing, etc., can be approached as a fourth industrial revolution, mostly driven by digital automation technologies that brings a significant shift in the way goods and services are created [4]. All these technological advances have great implications for organizations that could be very wide and diverse [5,6].

The development of I4.0 is complex since is a broad phenomenon. As Tirabeni et al. [7] argue, to take advantage of the benefits offered by this industry, significant investments are necessary, as is undertaking corporate culture and organizational changes. A single company, let alone an SME, cannot successfully adapt without help, thus requiring cooperation between different agents. Indeed, it requires the involvement of diverse actors, including managers, regulators, policy makers, universities, research institutions, etc., as several recent articles have expressed. Accordingly, following Matt et al. [8], in this I4.0 approach, value cannot be created by a stand-alone company since the relationships and interactions between several institutions and organizations foster the development of knowledge and innovation. Veile et al. [9] highlight the importance of networks, since I4.0 requires extensive data collecting, processing, and analysis, because it impacts not just individual firms but the connections across organizations through supply chains and value creation systems. Furthermore, Benitez et al. [10] state that integrative solutions in the industrial process are required by I4.0 principles in place of single technologies; so, since these solutions require expertise in several complex areas, such as hardware, software, and digital technologies like artificial intelligence or big data, they are inherently difficult to develop. In short, I4.0 consists of an interconnected set of technologies and information systems that is difficult to develop independently by single organizations, especially if it concerns SMEs.

Consequently, in the current context, SMEs face a double challenge: on the one hand, they must produce in a sustainable and responsible manner to meet the pressures of society and the different stakeholders; on the other hand, they are faced with the difficulty of managing a wide range of technologies like those included in I4.0. Therefore, to help SMEs meet these challenges, we propose technological collaboration and present our research question: Does collaboration on technology among SMEs lead to more sustainable manufacturing practices?" To answer this question, the paper presents three main objectives: (1) to analyze if there are significant differences between SMEs and large companies when developing SP; (2) to analyze if there is a positive relationship between technological collaboration agreements and SP; and (3) to analyze if SP in manufacturing SMEs depend on the chosen partner. Accordingly, we aim to contribute to the literature by examining the development of technological collaboration agreements between supply chain partners as an influence factor that may impact the environmental commitment of SMEs.

Although there are previous works in the literature on the subject, research on using I4.0 technology to manage the sustainability of supply chain networks is still scarce [11]. Moreover, papers have traditionally focused on large companies, while research specifically on SMEs is much more limited [3,12–14]. Since the behavior of SMEs is different from that of larger firms in different matters [15], further analysis would be of interest. Indeed, as Bhatia and Kumar [16] state, I4.0 technology can help businesses to achieve sustainability, according to the previous literature; however, most of this literature is conceptual in nature and solely grounded in qualitative or theoretical arguments [9]. Hence, our paper aims to extend the literature by focusing on SMEs and providing empirical evidence with a large sample of 1808 Spanish manufacturing firms. To examine this issue in greater depth, we aim to analyze the company's investments in facilities and equipment, as well as any ongoing environmental protection expenses (investments and expenses). This distinction makes possible to differentiate between short- and long-term environmental policies and SP [17].

Additionally, in the I4.0 literature, most research has been done on the process of supply chain digitization rather than the types of partnerships or collaborations needed to create digital solutions [10]. Thus, in order to shed light on this important issue, our work offers a more detailed analysis by studying the relationships between different partners in the supply chain. Work-in-process inventory, raw material movement and storage, and good logistics from the point of origin to the point of consumption are all included in the supply chain. The management of the flow of goods and services is pursuant to the supply chain optimization, leading to high energy savings and decreased carbon emissions. These principles are used by all types of organizations to plan, assemble, store, distribute, and track products from the beginning to the end of the chain. Today, this supply chain management is broadly applying a wide range of new technologies from I4.0 to integrate and coordinate every link in the chain. This is made possible using advanced analytics techniques to extract important insights from big data and enabling data-driven decision making [18]. Integrating environmental considerations is the idea behind green supply change management, which plays a significant role in determining how any organization engaged in these operations would affect the environment overall. Moreover, this approach can significantly help agents within the chain to improve their SP [19].

In line with Radicic and Pinto [20], we distinguish between collaboration with customers and collaboration with suppliers; since they are at opposite ends of the supply chain, the company's relationship with each party is different and could have diverse effects. In fact, we consider that the analysis of these relationships separately may provide relevant information that can offer interesting implications for all the agents involved in the process, as well as for those responsible for designing policies and facilitating the technological and sustainable development of manufacturing SMEs. In sum, the novelties presented in this paper, compared to the previous literature, involve distinguishing between investments and expenses in environmental protection, and differentiate between collaboration with customers and that with suppliers, potentially revealing distinct behaviors of SMEs in comparison to larger companies regarding SP.

With this objective in mind, the article is structured as follows. Next, the working hypotheses and method of empirical analysis are presented. Then, the results and discussion are developed; finally, the main conclusions are drawn from the analysis and their implications for the different agents concerned are presented.

2. Literature Review

2.1. Size and Sustainable Practices

It is common knowledge that a company's size has an impact on the type and quantity of available resources. For instance, because of their higher financial resources and availability, larger firms have historically been thought to be more active when making decisions about sustainability challenges. However, given SMEs' significant influence on most global economies and their environmental impact, we think it is important to expand our understanding of SP by SMEs.

A study conducted by Elsayed [21] demonstrated that size and resource availability are reliable indicators of a company's ability to respond to environmental changes, using a model of environmental performance and a sample of UK businesses. The concept that larger companies are more likely to develop in accordance with environmental issues is supported by Perrini et al. [22], who used Italian corporations to show their results. Indeed, SMEs are less likely to do so because they rely heavily on internal resources to finance any efforts. Additionally, these businesses tend to be run by the owners, and have very limited operational scopes, which makes it challenging for them to do more than just enforce environmental laws. Bos-Brouwers [23] note that SMEs may be better suited to launch and develop environmental responsibility initiatives because of their unique qualities, which include informal communication methods and adaptable organizational structures. Consequently, when it comes to adaptability and flexibility, SMEs may be advantageous for implementing SP. Based on 123 SME management interviews, Martin-Tapia et al. [24] revealed a favorable correlation between the size of the company and the creation of environmental strategies. Furthermore, the growth of sustainable investment is not aided by a lack of faith in its ability to yield an economic or competitive return. Hoogendoorn et al. [25], using data for SMEs in 36 countries, found that certain characteristics of SMEs may facilitate their engagement in environmental protection activities, suggesting that more studies are required, in this field, to fully separate the impact of firm size on SP. In addition, Tsvetkova et al. [13], based on interviews conducted with Swedish SMEs, found that the degree of a company's sustainability practices is not primarily determined by its size; they point out that SMEs may not consider their size as a driver, perhaps because they are not conscious of the limitations it involves. Balasubramanian et al. [26] reviewed the literature studying the different characteristics of a firm that affect its environmental behavior and found that, in general terms, the implementation of SP is higher in larger firms than in smaller ones. In the same line, Garcés-Ayerbe et al. [27] found a positive relationship between company size and environmental strategies. Finally, Balaguer et al. [17] showed that size has a positive effect on a company's environmental protection efforts; these authors argue that larger companies typically have greater financial and human resources, as well as the potential to benefit from economies of scale and superior management techniques, which facilitates handling the challenges of investing and implementing environmental protection measures.

Accordingly, the previous literature on the behavior of SMEs regarding SP reveals two divergent opinions. Some research show that SMEs are less likely than larger companies to participate in SP; however, other studies suggest that specific SMEs characteristics may encourage them to engage in SP initiatives.

Given this discrepancy in the literature, it is interesting to propose the following hypothesis in order to deepen the analysis of the effect of company size on SP development.

Hypothesis 1 (H1). *Company size influences sustainable practices.*

2.2. Collaboration and Sustainable Practices

As a very complex environment, the adoption of I4.0 technologies requires interconnection among different actors, following the literature on the subject. Matt et al. [8], in their paper based on 52 semi-structured expert interviews, reveal the need for interorganizational activities like networking to supplement research and development efforts and the contribution of all ecosystem actors in the deployment of I4.0. Indeed, firms should work together and cooperate to complement and recombine the various abilities they already possess, such as their competencies in hardware, software, data, or artificial intelligence. Additionally, they could exchange information and statistics regarding shared goods or equipment [8]. This cooperation is especially important along the supply chain. As Veile et al. [9] argue, a key component of I4.0 is the connectivity of businesses in the supply chain; thus, I4.0's full potential can only be appreciated through effective company cooperation. Bag et al. [11] affirm that the adoption of I4.0 technologies requires information openness and appropriate communication between suppliers and customers in the chain network.

Meanwhile, the literature argues that I4.0 can aid to achieve greener production systems and promote sustainable development [4,7,12,18,28]. In the same line, Bhatia and Kumar [16], with a sample of 173 Indian manufacturing firms, found evidence on the connection between I4.0 technologies and environmental commitment. Harrison et al. [29] emphasize how creating business network connectivity fosters structural interconnectedness amongst firms, which is essential to creating sustainable networks and marketplaces. Therefore, given that I4.0 technologies require cooperation among different agents and, at the same time, enhance the adoption of SP, we propose to analyze whether developing cooperation technology agreements fosters the implementation of SP.

Hypothesis 2 (H2). *There is a positive relationship between setting technology agreements and developing sustainable practices.*

In the business field, there is an increasing development of research on supply chain collaboration, since it has become a strategic issue for firms that wish to achieve environmental sustainability [30]. Indeed, cooperation within the supply chain is crucial for the effective development of SP, as strategic collaboration with suppliers and/or customers may facilitate the identification of specific problems and the development of solutions to environmental and social issues that can be introduced in the market [31–33].

In general terms, I4.0 technologies can make it possible to allocate resources like energy, water, materials, and products more effectively by using real-time data from supply chain partners and manufacturing systems [34]. González-Benito and González-Benito [35] stated that because end producers pass along the pressure they experience to their suppliers, the level of environmental demands is consistent across all supply chain participants. Awaysheh & Klassen [36] found, for Canadian firms, that when there are more companies in the supply chain and when brands are more well-known in the marketplace, managers need to take a further active role in overseeing the growth of socially responsible supplier practices inside their organizations. Moreover, Testa et al. [37] pointed out that the pressures received by the company from its suppliers contribute to the adoption of SP. However, it is interesting to highlight that pressures from customers tend to cause superficial and misleading adoption of SP. Hofman et al. [33] showed, for the Chinese context, that community pressure has a positive effect on supplier collaboration, which further leads to greater eco-innovation process, but that this was not so with customer pressure. Engaging with suppliers may be an effective way to develop SP; however, this path will take time and effort. As well, they claim that supply chain collaboration for SP cannot be based on a one-size-fits-all approach but depends on the analyzed context. Akhtar et al. [38] found, from 213 manufacturing firms from different industries, that supplier collaboration is significantly associated with environmental performance, while customer collaboration is positively related to economic performance. They also found advanced manufacturing technology to enhance the cooperation with both customers and suppliers within the supply chain.

The idea of setting technology agreements with suppliers and/or customers that promotes the growth of sustainability initiatives within supply chains is supported by empirical data and theoretical frameworks. Still, according with Radicic and Pinto [20] and Hofman et al. [33], we consider that the dynamics that the firm develops with its suppliers may be different from those it develops with its customers and that they can each vary depending on different analyzed contexts. Thus, we aim to examine whether the setting of technological agreements with these agents has an impact in the development of the firm's SP. Accordingly, the following hypotheses are formulated:

Hypothesis 2a (H2a). *There is a positive relationship between setting technological agreements with suppliers and the development of sustainable practices.*

Hypothesis 2b (H2b). *There is a positive relationship between setting technological agreements with customers and the development of sustainable practices.*

2.3. Collaboration in SMEs and Sustainable Practices

Beyond the standard industrial technologies employed in the SME sector, I4.0 is currently becoming more prevalent because of recent modifications in the industrial rules that result in new changes based on the constant development of information and communication technologies [39]. Indeed, technological innovation is progressing at an unprecedented pace, which is difficult for SMEs to keep up with. The previous literature shows that SMEs have their own characteristics that are different from those of larger firms. Overall, SMEs lack easily available technical resources and are financially constrained; thus, they struggle in the field of research and development [15]. Given the need for the heavy investment required by new technologies, SMEs are under restrictions and play a subordinate role [3]. As argued by Tirabeni et al. [7], SMEs frequently use cautious investing techniques and shy away from being among the first to adopt new technologies. In fact, most SMEs cannot afford I4.0 professionals. Therefore, to exploit the advantages of these new technologies, they need external support and to organize networks with other organizations. In the same line, Kumar et al. [12] point out that promoting Industry 4.0 technology for SMEs might be difficult because of a range of operational and financial limitations, and that effective coordination is required between the various supply chain participants. Benitez et al. [10], who conducted a survey on 77 SMEs, point out that given the breadth and complexity of technologies involved in I4.0, these types of companies may need support from different players. Santos et al. [1], in their paper applying the case study to five Portuguese SMEs, also found innovative collaboration networks essential to face the challenges of I4.0 development and implementation.

In terms of SP, SMEs can also find, in collaboration with other firms, a solution to the difficulties inherent to their smaller size. Triguero et al. [40] found that cooperation has a significant positive effect on eco-innovation across SMEs in a range of 27 European countries. According to Lewis et al. [2], for New Zealand's SMEs, cooperative strategies are crucial for overcoming the unique resource limitations faced by SMEs in their pursuit of greater environmental performance and responsibility. They also add that because of their size and/or related qualities, SMEs may be able to overcome some of the obstacles to adopting environmental initiatives through collaborative connections. Tsvetkova et al. [13] argue that SMEs are thought to have a good attitude toward joining local networks that strive to collaboratively solve ecological and societal challenges because of their limited resources. These authors conclude that such networks' influence may have played a greater role in encouraging the adoption of SP, but that they did not, however, serve as a primary driver for the maintaining these SP. Moreover, this collaboration should be developed with other SMEs, as well as with larger companies. As noted by Lopes et al. [3], although global corporations may have the necessary funding and resources, only working with SMEs will actually be able to achieve more sustainable production systems.

Regarding supply chain collaboration to develop SP in SMEs, Jo and Kwon [41] found that this cooperation in the supply chain is an important driver for green innovation capacity for manufacturing-based Korean SMEs. This study confirms that the potential for green innovation is directly impacted by high levels of collaboration with partner companies and internal organizations in the supply chain. In the same line, Khan et al. [39] showed how blockchain technology affects sustainable supply chain operations, with information from manufacturing businesses SMEs in Pakistan and China. The main findings indicate that green information systems and blockchain technology have a positive effect on sustainable supply chain operations. Furthermore, they confirm a strong positive correlation between these operations and green information systems. In sum, sustainability and sustainable supply chain strategies are positively and significantly correlated.

Consequently, to deepen the analysis of the relationship between technological cooperation agreements with customers and suppliers in the supply chain and the development of SP by SMEs, we propose the following hypothesis:

Hypothesis 3a (H3a). *There is a positive relationship between setting technological agreements with suppliers and the development of sustainable practices in manufacturing SMEs.*

Hypothesis 3b (H3b). *There is a positive relationship between setting technological agreements with customers and the development of sustainable practices in manufacturing SMEs.*

3. Materials and Methods

3.1. Sample and Data Collection

This study uses information collected from the Survey on Business Strategies (SBS), widely used in academic research. The SBS collects data from an annual business survey sent to a panel of Spanish manufacturing companies. The survey, started in 1990, is the result of an agreement between the Spanish Ministry of Industry and the SEPI Foundation, which manages the design, control, completion, and analysis of the SBS. Since then, 1808 firms have been surveyed each year using a survey with 107 questions, more than

500 specific fields, and 721 variables. In this range, companies are chosen by stratified samples grouped by activity sector and number of employees. This procedure was used to select firms participating in the survey, allowing us to estimate the distribution of any of the characteristics of the population of Spanish manufacturing firms with information available from our data set. This selection is conducted using the same proportions as in the original sample. It collects information on various aspects related to companies' strategic behavior and decision making, as well as on their results and account balances.

The SEPI Foundation preserves the consistency and quality of the time series and produces the corresponding Annual Report and Statistical Tables. The available information has been used in many papers [14,16,20,27,28,42–44]. Table 1 summarizes the technical data of the study regarding the population and sampling (type, size, error, confidence, and treatment).

Table 1. Technical data of the study.

Population	
Unit	Spanish manufacturing sector
Sampling	
Type of sampling	Random stratified census according to activity sector and firm size
Sample size	1808 Spanish manufacturing firms
Sampling error (approx.)	0.028 (p = q = 0.50)
Level of confidence	95% (K = 2 sigma)
Data treatment	IBM SPSS Statistics

Source: author-compiled data.

3.2. Variables and Measures

3.2.1. Dependent Variables

We aim, with this paper, to examine the development of technological collaboration agreements between supply chain partners as an influence factor that may impact the environmental commitment of SMEs. In this context, SPs refer to voluntary actions adopted by companies aimed at enhancing environmental protection. Indeed, the efficient and successful implementation of SPs taken by a firm to limit the negative environmental effects of its activities is the central characteristic of environmental sustainability [26]. Examining whether the organization allocates a part of its financial resources to these endeavors is one approach to determine whether it engages in this kind of activity. Therefore, an objective metric has been used to determine if the business takes these accountable steps by looking at the amount of money it allocates to environmental protection [42]. To achieve a more comprehensive analysis, we employ two dependent variables: investment on environmental protection, focused on the long term, refers to investments in equipment and facilities related to environmental pollution control; expenditure on environmental protection, focused on the short term, refers to current expenses related to environmental protection, such as payments to other companies, maintenance of environmental protection equipment, personnel expenses involved in environmental protection activities, etc. As we will see later in the analysis methodology, the use of two dichotomous dependent variables will require the estimation of two different binary logistic models.

The SBS allows access to this information, including a direct question on this aspect. In both cases, the dependent variable was defined as dichotomous, a categorical variable that indicates whether the company invests (0, no; 1, yes) and whether the company spends (0, no; 1, yes) in environmental protection activities. Both dependent variables have been widely used in the previous literature. [14,17,28] include investment on environmental protection as a measure of SP, while [17,27,43] prefer expenses on environmental protection as a good indicator of the SP.

3.2.2. Independent Variables

As stated earlier, our paper aims to investigate the influence of various business aspects on the development of SP. Specifically, it seeks to analyze the impact of firm size and the existence of cooperative relationships with suppliers and customers. To achieve our goal, we define these as independent variables (Table 2): company size (SIZE), small and medium-sized enterprises (SMEs), collaboration with suppliers (C_SUPP), and collaboration with customers (C_CUST).

Regarding size, two independent variables relate to this firm characteristic. SIZE is a numeric variable that reflects the total number of employees in the company. It is a common measure of firm size [17]. Balasubramanian et al. [26], based on a rigorous literature screening (1996–2020), analyzed 1603 papers, asserting that the total number of employees was found to be used as the proxy, in most cases, to measure firm size. Variable SIZE will be used to test the hypotheses H1, H2, H2a, and H2b. However, we consider it relevant to use another measure of business size to test the hypotheses H3a and H3b, in which we deepen the analysis of the relationship between technological cooperation agreements with suppliers and customers and the development of SP by SMEs. By focusing on part of the business sample, the variable SME is defined as a categorical variable that indicates whether the company is a SME (0, no; 1, yes). According to the European Commission, SMEs are those with less than 250 employees. Since variables (SIZE) and (SME) are closely related, and to prevent this fact from affecting the reliability of the results, these two independent variables were used in different regression models, as we shall see below.

About technological collaboration with suppliers and customers, the SBS includes questions on these aspects. A dichotomous variable has been constructed, C_SUPP, to indicate whether the company collaborates technologically with suppliers (0, no collaboration; 1, collaboration). Likewise, C_CUST indicates whether the firm has developed a technological cooperation agreement with customers (0, no collaboration; 1 collaboration). The previous literature shows papers that have used these variables measure dichotomously [14,20].

3.2.3. Control Variables

The paper considers control variables such as company age, investment on environmental protection, and expenses on environmental protection. Company age (AGE) reflects the firm's year of constitution and has been used in the previous literature [26,42].

Investment on sustainable practices (SP_INVEST) and expenses on sustainable practices (SP_EXPEND), which were previously defined as dependent variables, have, in turn, been used as control variables. Following Benito-Hernández et al. [14], expenses on environmental protection are considered as measurement of environmental performance, and, therefore, represent a commitment to develop of SP. Indeed, expenses on environmental protection can be considered as short-term policies that may strengthen investments on environmental protection in the long term. On the other hand, these investments create a corporate structure and know-how that will later result in expenditures on operating procedures related to environmental protection [17].

3.3. Analysis Methodology

To develop the analysis, a sample of 1808 firms was considered. A statistical regression estimation based on a binary logistic model was used to evaluate whether technology collaboration in SMEs contribute to more sustainable manufacturing practices. This type of statistical analysis was chosen because the dependent variables (SP_INVEST and SP_EXPEND) are dichotomous, and the estimation of a model through an OLS regression analysis can produce bias, even heteroscedasticity. Therefore, a symmetric logistic distribution and a maximum-likelihood estimator must be used as in a binary logistic model. Other related papers have employed this methodology before [14,21,42–44].

Table 2. Variables of the study.

Type of Variable	Study Variables	Variable to Analyze	Definition	Name	Values
Dependent	Sustainable practices	Investment on environmental protection	Categorical variable that indicates whether the company invests on environmental protection	SP_INVEST	1 = Investment on environmental protection 0 = No investment on environmental protection
		Expenses on environmental protection	Categorical variable that indicates whether the company spends on environmental protection	SP_EXPEND	1 = Expenditures on environmental protection 0 = No expenditures on environmental protection
Independent	Size	Company size	Numeric variable with total employees	SIZE	Number of employees
		Small and medium-sized enterprises	Categorical variable that indicates whether the company is a small and medium-sized enterprise	SMEs	1 = SME (from 1 to 250 employees) 0 = No SME (larger than 250 employees)
	Technological collaboration	Collaboration with suppliers	Categorical variable that indicates whether the company collaborates with suppliers	C_SUPP	1 = Collaboration relationships with suppliers 0 = No collaboration relationships with suppliers
		Collaboration with customers	Categorical variable that indicates whether the company collaborates with customers	C_CUST	1 = Collaboration relationships with customers 0 = No collaboration relationships with customers

Source: author-compiled data.

4. Results and Discussion

The results of the descriptive statistics, correlations, and frequencies of dichotomous variables are shown in Tables 3 and 4. According to our results, only a small part of the sample (22.8%) invest on environmental protection. On the contrary, more than half of the sample firms (57.2%) spend on environmental protection. As expected, of the total number of companies used in the sample, the majority are SMEs (85.6%), and the rest are large companies (14.4%). Technological cooperation within the supply chain is low. Only 19.1% of the companies in the sample cooperate with suppliers, reducing the percentage of companies that cooperate with customers to 13.1%. This may be because SMEs in Spain are smaller than average, being mostly microenterprises [14] that often face resource constraints, in terms of finance and personnel. Technological cooperation frequently requires investments in technology infrastructure, training, and organizational change, and SMEs also may be more hesitant to adopt it because they view it as complicated or unpredictable and show risk aversion. At the same time, they might not be aware of or comprehend the advantages of technology collaboration in the supply chain, because of a lack of knowledge or because they are based on a traditional culture.

Table 3. Descriptive statistics and correlations.

Spanish Companies (n = 1808)	Mean	Standard Deviation	SP_INVEST	SP_EXPEND	SIZE	SMEs	C_SUPP	C_CUST	AGE
SP_INVEST	0.23	0.420	1						
SP_EXPEND	0.57	0.495	0.404 **	1					
SIZE	178.71	605.850	0.400 **	0.400 **	1				
SMEs	0.86	0.351	−0.318 **	−0.212 **	−0.608 **	1			
C_SUPP	0.19	0.393	0.192 **	0.191 **	0.428 **	−0.326 **	1		
C_CUST	0.13	0.338	0.182 **	0.191 **	0.311 **	−0.267 **	0.466 **	1	
AGE	1983.73	18.236	−0.097 **	−0.104 **	−0.124 **	0.127 **	−0.116 **	−0.081 **	1

For each pair of continuous variables, the Pearson coefficient of variation is calculated; in the opposite case, Spearman is used. * $p < 0.05$; ** $p < 0.001$. Source: author-compiled data.

Table 4. Frequencies of dichotomous variables.

Sample (n = 1808)	Yes	No
SP_INVEST	22.8	77.2
SP_EXPEND	57.2	42.8
SMEs	85.6	14.4
C_SUPP	19.1	80.9
C_CUST	13.1	86.9

Source: author-compiled data.

Tables 5 and 6 show the binary logistic regression results. As stated before, the existence of two dichotomous dependent variables—investment on environmental protection (SP_INVEST) and expenses on environmental protection (SP_EXPEND)—required the estimation of two binary logistic models.

According to Tables 5 and 6, we found a positive and significant relationship among SIZE and SP_INVEST and SP_EXPEND; hence, we can accept H1. The previous literature shows two opposing viewpoints in earlier research on SMEs' conduct with relation to SP. While some studies indicate that SMEs are less likely than larger organizations to take part in SP efforts, other research shows that certain qualities of SMEs may motivate them to do so [23,25]. Our results support that company size is a variable that affects the resources that companies dedicate to protecting the environment, in line with the literature in this sense [17,22,26,27]; consequently, larger companies show a greater commitment to the development of SP.

Table 5. Binary logistic regression results for investment on environmental protection (SP_INVEST).

Model			Without Interactions Values	With Interactions Values
Variables	**Hypotheses**	**Sign**		
SIZE	H1	+	0.002 ***	
C_SUPP	H2a		0.179	−0.829
C_CUST	H2b	+	0.315 **	0.287 **
AGE	---		−0.008	−0.008 *
SP_EXPEND	---		2.696 ***	2.749 ***
SMEs	---			−2.000 ***
SMEs* C_SUPP	H3a	+		1.431 ***
SMEs* C_CUST	H3b			−0.132
R^2 Nagelkerke			0.327	0.353

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Source: author-compiled data.

Table 6. Binary logistic regression results for expenses on environmental protection (SP_EXPEND).

Model			Without Interactions Values	With Interactions Values
Variables	**Hypotheses**	**Sign**		
SIZE	H1	+	0.004 ***	
C_SUPP	H2a		0.097	1.017
C_CUST	H2b	+	0.674 ***	−0.403
AGE	---		−0.004	−0.005
SP_INVEST	---		2.541 ***	2.742 ***
SMEs	---			−0.829 *
SMEs* C_SUPP	H3a			−0.660
SMEs* C_CUST	H3b	+		1.374 **
R^2 Nagelkerke			0.306	0.282

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Source: author-compiled data.

Regarding H2, we suggest examining whether creating cooperative technological agreements promotes the implementation of SP, given that I4.0 technologies require cooperation among various agents and, at the same time, improve its adoption. We found the existence of a positive relationship between setting technology agreements and developing SP for agreements with customers, so we can accept, partially, H2. These results are in line with the previous literature [4,7,12,16,18,28,29]. We, then, support the idea that the achievement of I4.0's full potential requires productive corporate collaboration and, at the same time, I4.0 can help create more environmentally friendly production methods and advance sustainable growth.

In relation to the analysis of setting technology agreements, distinguishing between suppliers and customers, we can accept H2b, but it is not possible to accept H2a. Regardless of the chosen dichotomous dependent variable (SP_INVEST or SP_EXPEND), we did not find a significant relationship between technological collaboration with suppliers (C_SUPP) and SP, so hypothesis H2a should be rejected. These results contrast with those of González-Benito and González-Benito [35], who assert that all supply chain participants encounter the same number of environmental demands since end manufacturers transfer their pressure to their suppliers. On the contrary, and again, regardless of the chosen dichotomous dependent variable (SP_INVEST or SP_EXPEND), the results show a positive and significant relationship between technological collaboration with customers (C_CUST) and SP, which, as previously indicated, leads us to accept the hypothesis H2b. Although both theoretical frameworks and empirical evidence support the idea that setting technology agreements with suppliers and/or customers encourages the adoption of SP, our results are in accordance with Hofman et al. [33] and Radicic and Pinto [20], taking into consideration the possibility that the dynamics a company creates with its suppliers may differ from those it creates with its customers, and that they both may vary depending on the different analyzed backgrounds. In our case, for the Spanish manufacturing context, we can prove that technological collaboration with customers really improves SP, but this is not so in the case of suppliers. This may be due to customer demands for sustainable products or services, collaborative innovation efforts with customers leading to sustainable solutions, or strategic partnerships focused on sustainability goals. On the other hand, the lack of a significant relationship between technological collaboration with suppliers and SP may be due to other specific factors.

Finally, if we focus on hypotheses H3a and H3b, we find interesting results for manufacturing SMEs. These two hypotheses seek to deepen the analysis of the relationship between technological cooperation agreements with suppliers (H3a) and those with customers (H3b) in the context of SMEs. In contrast to previous papers that only considered investment on environmental protection [14,28] or expenses on environmental protection [27,43], we include both variables. According to Table 5, we found a positive and significant relationship between SMEs*C_SUPP and SP_INVEST. On the contrary, we did not find a significant coefficient for the relationship between SMEs*C_CUST and SP_INVEST. These results would allow us, initially, to accept hypothesis H3a and to reject H3b. But, if we take into consideration the results showed in Table 6, they are diametrically opposed. Indeed, when the dependent variable is SP_EXPEND, the model estimated leads us to reject the hypothesis H3a and to accept H3b. This is due to the existence of evidence of a significant relationship between SMEs*C_CUST and SP_EXPEND. To summarize, regarding H3a and H3b, both hypotheses should be accepted, but depending on the chosen partner and on the SP measure to be undertaken. SMEs are committed to a higher degree of SP investment when they set up technological agreements with suppliers. Consequently, they consider that a long-term SP investment time horizon must be maintained with the suppliers at the beginning of the supply chain. On the other hand, when taking into account the end of the supply chain and the relationships with customers, the time horizon changes to the short term, and then, SMEs choose to spend on SP, but the association with these partners may not be as strong in the long term. The acceptance of both hypotheses demonstrates the nuanced approach that SMEs take toward SP, which is different with respect to larger companies. This approach emphasizes short-term spending on sustainable practices to satisfy pressing customer demands, as well as long-term technological investment with suppliers for sustainability benefits from I4.0. These results offer helpful guidance to SMEs trying to negotiate the challenges of sustainability in their supply chains and create plans of action that fit their goals, as well as their dynamics with their partners. Our results are as expected and are in line with the previous literature [39,41]. Indeed, Khan et al. [39] confirm a strong positive correlation between sustainable supply chain operations and green information systems for SMEs in China and Pakistan. Furthermore, Jo and Kwon [41] found that the cooperation in the supply chain is an important driver for green innovation capacity for manufacturing-based Korean SMEs. In sum, our results also allow us to shed more light on and advance our understanding of the relationship with supply chain partners in SMEs and the development of SP.

5. Conclusions and Contributions

This paper addressed the question of whether manufacturing SMEs that set up technological collaboration agreements are more likely to undertake actions aimed at environmental preservation. We broaden this subject by distinguishing between different partners in the supply chain—customers and suppliers—as well as by distinguishing between investment and expenditure as different ways of approaching SP. To answer our research question, we provide empirical evidence with a sample of 1808 firms in the context of the Spanish manufacturing sector.

The results obtained allow us to corroborate that firm size influences SP. Given the discrepancy in the previous literature, we support the line that SMEs are less likely than larger organizations to perform SP [17,26,27]. Given that they generally have fewer resources and greater difficulty in accessing new financing, the initiatives they decide to implement tend to rely on internal resources. This means that, on many occasions, efforts to undertake actions to minimize their negative impacts on the environment are limited to complying with the law. Our results also agree with the previous literature [4,16,28], and we confirm that agreements within the I4.0 can help to promote SP. We found a positive and significant relationship between technological collaboration with customers and SP; nevertheless, we did not find this positive relationship with suppliers in the analyzed context. Today, an increasing proportion of society is environmentally conscious and places a higher priority on environmental preservation than on economic growth. This could explain why, when the company looks towards the end of the supply chain (customers), it is concerned about committing to SP, while, when it looks towards the back (suppliers), this concern is reduced. The closer the final customer, the higher the pressure, because SMEs mainly concentrate their demands on the most immediate partner. Thus, it seems that the pressure exerted by the citizenship appears to weaken higher up the supply chain. However, focusing the analysis on manufacturing SMEs, we obtained interesting results on how they approach SP differently than larger organizations. We found that when smaller companies get into technology agreements with suppliers, they commit to a greater level of SP investment. This reflects a strategic approach of SMEs aimed at fostering strong, enduring technology partnerships with suppliers to take advantage of I4.0, to drive sustainable outcomes. However, the time frame shifts to the short term when considering the technology agreements with customers at end of the supply chain. At that point, smaller companies decide to spend on SP to prioritize meeting immediate customer demands and expectations for sustainability.

This paper makes several theoretical and practical contributions. From a theoretical point of view, we advance the debate on the effect that firm size has on SP, shedding light on the existing discrepancy. Secondly, we contribute to the analysis by differentiating the type of partner in the supply chain. Finally, we introduce the behavior of SMEs in their relationships with customers and suppliers by distinguishing between investment and expenditure when developing SP.

Our findings provide useful direction for SMEs attempting to deal with the sustainability issues in their supply chains and design strategies that suit their objectives and partner dynamics. Indeed, regarding practical implications, our paper aims to provide insights for manufacturing SMEs managers into how they can best respond to social pressures on sustainable commitment and contribute towards responsible development. We recommend that smaller companies look to the creation of technological cooperation to find a solution to take advantage of I4.0. This is especially important in times of uncertainties, with constant, rapid, and unexpected changes, in which, otherwise, they may not be able to implement it alone. Moreover, collaborating with suppliers and customers helps SMEs overcome difficulties related to developing new business models and effectively addressing both the technological innovation and sustainability challenges. Furthermore, this collaboration should be established both with other SMEs and with larger companies. We agree with Lopes et al. [3] that, while large companies have the necessary resources to implement new technologies enabling greener production, only in collaboration with SMEs can sustainable initiatives be effectively developed. Despite having fewer resources, they have other characteristics, such as flexible organizational structures, which allow them to adapt more quickly to the pace of technological advancement. Indeed, the role of these companies is crucial for achieving the transition towards a sustainable development.

On the other hand, this entire process must be supported by public administrators, who should provide backing to manufacturing SMEs in the development of their operations so that they can take advantage of I4.0 technologies and, consequently, facilitate sustainable behavior. Traditionally, this support has been provided through financial means, including direct subsidies and/or tax incentives. However, considering our results, we believe that, additionally, public administrations should promote meeting points among the various actors involved in the supply chain, to foster relationships, connectivity, information exchange, and ultimately, technological cooperation. To solve the many sustainability issues originating from the usage of old manufacturing methods and technologies, such as ecological gaps, global warming, or increasing pollution, it is essential to integrate I4.0 concepts in today's business models.

The main limitations of our paper arise from the sample. Although it covers 1808 companies, which allows to assert that it is representative and reliable, it is limited to one year, one country, and only the manufacturing sector. It would be interesting to consider, for future research, expanding this sample with greater diversity, in terms of geographic and industry scope. Finally, in this same line of research, our future aim is to analyze in greater depth other variables as measures of technological collaboration with suppliers and customers in the supply chain. It would be relevant to incorporate more items that capture in detail the various technologies of I4.0 in the activities of production, marketing, and the distribution of products and services.

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References

1. Santos, B.; Dieste, M.; Orzes, G.; Charrua-Santos, F. Resources and capabilities for Industry 4.0 implementation: Evidence from proactive Portuguese SMEs. *J. Manuf. Technol. Manag.* **2023**, *34*, 25–43. [CrossRef]
2. Lewis, K.V.; Cassells, S.; Roxas, H. SMEs and the potential for a collaborative path to environmental responsibility. *Bus. Strategy Environ.* **2015**, *24*, 750–764. [CrossRef]
3. Lopes, J.D.; Estevão, J.; Toth-Peter, A. Industry 4.0, multinationals, and sustainable development: A bibliometric analysis. *J. Clean. Prod.* **2023**, *413*, 137381. [CrossRef]
4. Awan, U.; Gölgeci, I.; Makhmadshoev, D.; Mishra, N. Industry 4.0 and circular economy in an era of global value chains: What have we learned and what is still to be explored? *J. Clean. Prod.* **2022**, *371*, 133621. [CrossRef]
5. Lasi, H.; Fettke, P.; Kemper, H.G.; Feld, T.; Hoffmann, M. Industry 4.0. *Bus. Inf. Syst. Eng.* **2014**, *6*, 239–242. [CrossRef]

6. Ghobakhloo, M. Industry 4.0, digitization, and opportunities for sustainability. *J. Clean. Prod.* **2020**, *252*, 119869. [CrossRef]
7. Tirabeni, L.; De Bernardi, P.; Forliano, C.; Franco, M. How can organisations and business models lead to a more sustainable society? A framework from a systematic review of the industry 4.0. *Sustainability* **2019**, *11*, 6363. [CrossRef]
8. Matt, D.T.; Molinaro, M.; Orzes, G.; Pedrini, G. The role of innovation ecosystems in Industry 4.0 adoption. *J. Manuf. Technol. Manag.* **2021**, *32*, 369–395. [CrossRef]
9. Veile, J.W.; Schmidt, M.C.; Müller, J.M.; Voigt, K.I. Relationship follows technology! How Industry 4.0 reshapes future buyer-supplier relationships. *J. Manuf. Technol. Manag.* **2021**, *32*, 1245–1266. [CrossRef]
10. Benitez, G.B.; Ferreira-Lima, M.; Ayala, N.F.; Frank, A.G. Industry 4.0 technology provision: The moderating role of supply chain partners to support technology providers. *Supply Chain Manag. Int. J.* **2022**, *27*, 89–112. [CrossRef]
11. Bag, S.; Telukdarie, A.; Pretorius, J.C.; Gupta, S. Industry 4.0 and supply chain sustainability: Framework and future research directions. *Benchmarking Int. J.* **2021**, *28*, 1410–1450. [CrossRef]
12. Kumar, R.; Singh, R.K.; Dwivedi, Y.K. Application of industry 4.0 technologies in SMEs for ethical and sustainable operations: Analysis of challenges. *J. Clean. Prod.* **2020**, *275*, 124063. [CrossRef]
13. Tsvetkova, D.; Bengtsson, E.; Durst, S. Maintaining sustainable practices in SMEs: Insights from Sweden. *Sustainability* **2020**, *12*, 10242. [CrossRef]
14. Benito-Hernández, S.; López-Cózar-Navarro, C.; Priede-Bergamini, T. The influence of government support over environmental protection investment on SMEs: R&D collaboration and financial aspects. *Bus. Ethics Environ. Responsib.* **2023**, *32*, 836–846. [CrossRef]
15. Mittal, S.; Khan, M.A.; Romero, D.; Wuest, T. A critical review of smart manufacturing Industry 4.0 maturity models: Implications for small and medium-sized enterprises (SMEs). *J. Manuf. Syst.* **2018**, *49*, 194–214. [CrossRef]
16. Bhatia, M.S.; Kumar, S. Linking stakeholder and competitive pressure to Industry 4.0 and performance: Mediating effect of environmental commitment and green process innovation. *Bus. Strategy Environ.* **2022**, *31*, 1905–1918. [CrossRef]
17. Balaguer, J.; Cuadros, A.; Garcia-Quevedo, J. Does foreign ownership promote environmental protection? Evidence from firm-level data. *Small Bus. Econ.* **2023**, *60*, 227–244. [CrossRef]
18. Zhang, Z.; Li, J. Big-data-driven low-carbon management. In *Big Data Mining for Climate Change*; Elsevier: Amsterdam, The Netherlands, 2020; Chapter 10; pp. 287–299. [CrossRef]
19. Chin, T.A.; Tat, H.H.; Sulaiman, Z. Green supply chain management, environmental collaboration and sustainability performance. *Procedia CIRP* **2015**, *26*, 695–699. [CrossRef]
20. Radicic, D.; Pinto, J. Collaboration with external organizations and technological innovations: Evidence from Spanish manufacturing firms. *Sustainability* **2019**, *11*, 2479. [CrossRef]
21. Elsayed, K. Reexamining the expected effect of available resources and firm size on firm environmental orientation: An empirical study of UK firms. *J. Bus. Ethics* **2006**, *65*, 297–308. [CrossRef]
22. Perrini, F.; Russo, A.; Tencati, A. CSR strategies of SMEs and large firms. Evidence from Italy. *J. Bus. Ethics* **2007**, *74*, 285–300. [CrossRef]
23. Bos-Brouwers, H.E.J. Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice. *Bus. Strategy Environ.* **2009**, *19*, 417–435. [CrossRef]
24. Martin-Tapia, I.; Aragon-Correa, J.; Rueda-Manzanares, A. Environmental strategy and exports in medium, small and micro-enterprises. *J. World Bus.* **2010**, *45*, 266–275. [CrossRef]
25. Hoogendoorn, B.; Guerra, D.; van der Zwan, P. What drives environmental practices of SMEs? *Small Bus. Econ.* **2015**, *44*, 759–781. [CrossRef]
26. Balasubramanian, S.; Shukla, V.; Mangla, S.; Chanchaichujit, J. Do firm characteristics affect environmental sustainability? A literature review-based assessment. *Bus. Strategy Environ.* **2021**, *30*, 1389–1416. [CrossRef]
27. Garcés-Ayerbe, C.; Rivera-Torres, P.; Murillo-Luna, J.L.; Suárez-Gálvez, C. Does it pay more to be green in family firms than in non-family firms? *Rev. Manag. Sci.* **2022**, *16*, 1365–1386. [CrossRef]
28. Díaz-Chao, Á.; Ficapal-Cusí, P.; Torrent-Sellens, J. Environmental assets, industry 4.0 technologies and firm performance in Spain: A dynamic capabilities path to reward sustainability. *J. Clean. Prod.* **2021**, *281*, 125264. [CrossRef]
29. Harrison, D.; Prenkert, F.; Hasche, N.; Carlborg, P. Business networks and sustainability: Past, present and future. *Ind. Mark. Manag.* **2023**, *111*, A10–A17. [CrossRef]
30. Chen, L.; Zhao, X.; Tang, O.; Price, L.; Zhang, S.; Zhu, W. Supply chain collaboration for sustainability: A literature review and future research agenda. *Int. J. Prod. Econ.* **2017**, *194*, 73–87. [CrossRef]
31. Dai, J.; Cantor, D.E.; Montabon, F.L. How environmental management competitive pressure affects a focal firm's environmental innovation activities: A green supply chain perspective. *J. Bus. Logist.* **2015**, *36*, 242–259. [CrossRef]
32. Neutzling, D.M.; Land, A.; Seuring, S.; do Nascimento, L.F.M. Linking sustainability-oriented innovation to supply chain relationship integration. *J. Clean. Prod.* **2018**, *172*, 3448–3458. [CrossRef]
33. Hofman, P.S.; Blome, C.; Schleper, M.C.; Subramanian, N. Supply chain collaboration and eco-innovations: An institutional perspective from China. *Bus. Strategy Environ.* **2020**, *29*, 2734–2754. [CrossRef]
34. de Sousa Jabbour, A.B.L.; Jabbour, C.J.C.; Foropon, C.; Godinho Filho, M. When titans meet–Can industry 4.0 revolutionise the environmentally-sustainable manufacturing wave? The role of critical success factors. *Technol. Forecast. Soc. Change* **2018**, *132*, 18–25. [CrossRef]

35. González-Benito, J.; González-Benito, Ó. A study of determinant factors of stakeholder environmental pressure perceived by industrial companies. *Bus. Strategy Environ.* **2010**, *19*, 164–181. [CrossRef]
36. Awaysheh, A.; Klassen, R.D. The impact of supply chain structure on the use of supplier socially responsible practices. *Int. J. Oper. Prod. Manag.* **2010**, *30*, 1246–1268. [CrossRef]
37. Testa, F.; Boiral, O.; Iraldo, F. Internalization of environmental practices and institutional complexity: Can stakeholders pressures encourage greenwashing? *J. Bus. Ethics* **2018**, *147*, 287–307. [CrossRef]
38. Akhtar, F.; Huo, B.; Wang, Q. Embracing green supply chain collaboration through technologies: The bridging role of advanced manufacturing technology. *J. Bus. Ind. Mark.* **2023**, *38*, 2626–2642. [CrossRef]
39. Khan, S.A.; Godil, D.I.; Jabbour, C.J.; Shujaat, S.; Razzaq, A.; Yu, Z. Green data analytics, blockchain technology for sustainable development, and sustainable supply chain practices: Evidence from small and medium enterprises. *Ann. Oper. Res.* **2021**. [CrossRef]
40. Triguero, A.; Moreno-Mondéjar, L.; Davia, M.A. Drivers of different types of eco-innovation in European SMEs. *Ecol. Econ.* **2013**, *92*, 25–33. [CrossRef]
41. Jo, D.; Kwon, C. Structure of green supply chain management for sustainability of small and medium enterprises. *Sustainability* **2021**, *14*, 50. [CrossRef]
42. Benito-Hernández, S.; López-Cózar-Navarro, C.; Priede-Bergamini, T. Influence of Government Support on Proactive Environmental Strategies in Family Firms. *Sustainability* **2021**, *13*, 13973. [CrossRef]
43. López-Cózar-Navarro, C.; Priede-Bergamini, T.; Benito-Hernández, S. How family character affect the financing of environmental protection strategies and energy-saving measures. *Amfiteatru Econ.* **2023**, *25*, 503–521. [CrossRef] [PubMed]
44. Manzaneque, M.; Rojo-Ramírez, A.A.; Diéguez-Soto, J.; Martínez-Romero, M.J. How negative aspiration performance gaps affect innovation efficiency. *Small Bus. Econ.* **2020**, *54*, 209–233. [CrossRef]