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Sustainability performance in science and technology parks: how can firms benefit most?

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Abstract

Purpose – Achieving good sustainability performance requires balancing higher economic profits with better environmental and social performance. Knowledge plays a key role in improving corporate sustainability performance, but this knowledge is becoming increasingly complex, specific and dispersed among many scientific, technological and business actors. Science and technology parks (STPs) are infrastructures designed to host varying types of organizations that can bring together new, disruptive knowledge. Our purpose is to unveil how these spaces can be drivers of sustainability performance for companies.

Design/methodology/approach – We test our hypotheses on a longitudinal database of Spanish companies over the period 2009–2016 using structural equation models (SEMs).

Findings – This research confirms that a firm's location in an STP helps improve its sustainability performance, provided that conditions are optimal in the STP. These optimal conditions are based on an abundance of knowledge spillovers available to the firm and the firm's ability to harness them, especially those of a more disruptive nature, through absorptive capacity.

Originality/value – Results of this study yield implications for academia in the form of future lines of research and practical implications for policymakers and managers of both STPs and the organizations that host them.

Keywords Sustainability performance, Science and technology parks, Knowledge spillovers, Absorptive capacity, Panel dataset, Structural equation modeling

Paper type Research paper

1. Introduction

The concept of sustainability has dominated the agendas of governmental and non-governmental entities, academic institutions and, more recently, the business sector (Feliciano *et al.*, 2022; Leal-Filho *et al.*, 2021). In the business world, internal and external factors are prompting more companies to voluntarily adopt broader roles and responsibilities, implementing a holistic management approach to balance economic, social and environmental performance for the benefit of current and future generations (Aragón-Correa *et al.*, 2020; Ozbekler and Ozturkoglu, 2020).

Corporate performance and long-term competitiveness increasingly depend on the ability to balance economic, environmental and social expectations (Forés, 2019; De Marchi and Grandinetti, 2013; Hart and Dowell, 2011). There is a general consensus that science and technology (ultimately, knowledge) will play a key role in firms' ability to improve

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competitiveness in terms of sustainability performance and achieve sustainability goals such as the Sustainable Development Goals (SDGs) (e.g. Walsh *et al.*, 2020; Forés, 2019).

Knowledge is becoming increasingly complex and specific, and it is distributed among a wide range of economic agents (Scuotto *et al.*, 2017; Chesbrough, 2003). Accessing external knowledge sources facilitates the development of ecological or social innovations (Kennedy *et al.*, 2017; Laursen and Salter, 2006). To radically innovate, a firm may require information beyond what it can find within its own boundaries; that is, it will need to harness inter-organizational knowledge flows (e.g. Ferraris *et al.*, 2017; Wang *et al.*, 2017).

Science and technology parks (STPs) are infrastructures designed to host very different types of organizations, such as established companies, start-ups, research institutes and spin-offs of university research groups or technological institutes (Díez-Vial and Montoro-Sánchez, 2016; Guadix *et al.*, 2016). In STPs, physical proximity, complementarity and shared services can stimulate interaction between organizations and generate new knowledge (Albahari *et al.*, 2023; Díez-Vial and Montoro-Sánchez, 2016).

Thus, integration in a territorial agglomeration of companies (such as an STP) may be an antecedent of improved corporate sustainability performance (González-Masip *et al.*, 2019), aided by the knowledge spillovers that emerge in these spaces. Although previous research has analyzed how the location of a company in an STP impacts measures of economic and/or innovative performance (e.g. Ubeda *et al.*, 2019), there are still very few studies that explore this company performance measured not only in economic, but also in social and environmental terms. Our proposal therefore aims to contribute to fill this gap in the literature.

Moreover, in this study, we account for the idea that the benefits of being located in an STP do not depend exclusively on the firm having access to more knowledge spillovers, but also on its internal strategies to make effective use of these localized endowments of knowledge (Camisón *et al.*, 2018; Claver-Cortés *et al.*, 2018; Camisón and Forés, 2011). A firm can only take advantage of knowledge spillovers to improve its sustainability performance if it can identify and integrate them into its current knowledge base and later apply them for that purpose (Marrucci *et al.*, 2022; Claver-Cortés *et al.*, 2018; De Marchi, 2012).

In addition, depending on the degree of similarity between knowledge spillovers from the environment and the company's current cognitive bases, some can be easily integrated and combined with the company's knowledge endowments (Camisón *et al.*, 2018; March, 1991). In contrast, other, more tacit, complex, knowledge spillovers at the knowledge frontier require the firm to develop an absorptive capacity capable of multiplying the effect of these localized knowledge endowments on its sustainability performance (Camisón *et al.*, 2018; Camisón and Forés, 2011). There are also few empirical contributions on the direct and indirect effects of absorptive capacity on sustainability performance (e.g. Claver-Cortés *et al.*, 2018).

Consequently, the aim of this research is to advance the literature by providing empirical evidence of the effects of STP location on the sustainability performance of Spanish firms, through the mediating effects of knowledge spillovers and individual firms' absorptive capacity. Specifically, our study aims to provide answers to the following research questions:

RQ1. To what extent can knowledge spillovers and absorptive capacity be considered antecedent factors of sustainability?

RQ2. Does the firms' location in innovation spaces, such as STPs, matter for sustainability performance?

RQ3. What is the effect of STP on the pooling and deployment of knowledge spillovers and the firm's absorptive capacity?

To respond to these questions, we conduct a longitudinal empirical analysis of data extracted from the Panel on Technological Innovation in Spanish Companies (PITEC). The rest of the paper is structured as follows: the next section presents the conceptual framework and hypotheses; then, we describe the methodology and detail the results; finally, the last section presents the conclusions, future lines of research and recommendations for managers to contribute more actively to achieving a more sustainable society.

2. Conceptual framework

Sustainability represents a paradigm shift in today's competitive landscape and poses a major challenge to firms' competitive advantage (Shahzad *et al.*, 2020). Thus, competitive success increasingly depends on firms being able to reconcile economic performance with a reduction in the impact of their activity on the environment, while improving the society in which they operate. Achieving a balance between all these determinants of business success is not straightforward and requires companies to increase their knowledge base on new technologies, business practices, legal regulations and stakeholder expectations, in order to improve their triple bottom line performance (e.g. Walsh *et al.*, 2020; Abbas and Sagsan, 2019).

In today's competitive arena, many studies underline the importance of external knowledge in complementing a company's internal knowledge to meet new business challenges, as a single company may not have all the necessary knowledge on such a complex issue as sustainability within its own boundaries (Hernández-Trasobares and Murillo-Luna, 2020; Roper *et al.*, 2017; Chesbrough, 2003). Knowledge spillovers, understood as the process in which knowledge is transferred from the producer or source of that knowledge to the recipients or users of knowledge (Wang *et al.*, 2017), represent one of the main forms of external knowledge that the firm can access. Implicit in the conception of knowledge spillovers is the effort that the company should make to be an active part of the community of agents, processes and networks in which these knowledge flows are generated (Bellandi and De Propis, 2015; Granovetter, 1985).

These knowledge spillovers that can help firms to improve their performance come from different sources (Hernández-Trasobares and Murillo-Luna, 2020; García-Martínez *et al.*, 2017; Rodríguez *et al.*, 2017), such as suppliers, customers, or competitors (Rodríguez *et al.*, 2017; De Marchi, 2012). Other sources of knowledge spillovers include education and research entities such as universities, research or technology centers and consultants (Rodriguez *et al.*, 2017). Finally, relevant knowledge spillovers can be easily produced and distributed in conferences and trade fairs or scientific journals and trade publications (Rodriguez *et al.*, 2017; Laursen and Salter, 2006).

If they are similar to the firm's existing knowledge and experiences, some of these knowledge spillovers can enhance efficiency or provide new solutions to develop skills, products, or processes, stimulating the creation of synergies between both sets of knowledge without requiring dynamic learning capabilities (Camisón *et al.*, 2018; March, 1991). In light of the above, we propose that:

H1. Knowledge spillovers have a positive effect on sustainability performance

However, not all external knowledge is related to the company's existing knowledge background and cognitive models (Camisón *et al.*, 2018). In these situations, knowledge spillovers tend to be tacit, complex and innovative in nature, meaning firms' absorptive capacity (Zahra and George, 2002; Cohen and Levinthal, 1990) becomes crucial.

According to Albort-Morant *et al.* (2018), absorptive capacity allows firms to have cutting-edge knowledge of technologies and innovations that promote more sustainable products and processes. Similar results are found by Abbas and Sagsan (2019) for a sample of 302 Pakistani manufacturing and service firms, confirming that absorptive capacity influences the adoption of more sustainable technologies and management practices, impacting the triple bottom line.

Contrary to the previous hypothesis, absorptive capacity always implies exploring and integrating new combinations of internal and external knowledge, requiring greater learning efforts on the part of the firm (Camisón *et al.*, 2018; March, 1991; Cohen and Levinthal, 1990). Therefore, absorptive capacity, as a dynamic capacity (Hussain *et al.*, 2022; Claver-Cortés *et al.*, 2020; Forés and Camisón, 2016), leads to disruptive changes in the company's stock of knowledge, technological assets and functional capabilities that have a direct impact on the development of new products, the redeployment of production processes, market positioning and compliance with legal requirements in the field of sustainability (Shahzad *et al.*, 2020; Abbas and Sagsan, 2019). Thus:

H2. Absorptive capacity has a positive effect on sustainability performance

2.1 The mediating effect of absorptive capacity

However, in this competitive arena with frequent, sophisticated changes in technologies and markets, firms cannot rely solely on their internal knowledge creation capabilities or the adoption of new incremental knowledge aimed at more efficiently exploiting the firm's existing capabilities (Guisado-González *et al.*, 2021; Forés and Camisón, 2016). To develops resources and capabilities that can have a truly disruptive impact on firm performance, exposure to a wide range of novel sources of knowledge is not enough; the knowledge needs to be properly identified, evaluated, assimilated and institutionalized to be able to apply it to the firm's purposes (Hussain *et al.*, 2022; Song *et al.*, 2018; García-Martínez *et al.*, 2017; Forés and Camisón, 2016). This process is not free of costs, as harnessing these knowledge spillovers requires the firm to first generate a critical mass of knowledge internally that allows it to apply this radical new knowledge (Song *et al.*, 2018; Cohen and Levinthal, 1990).

We consider that absorptive capacity ensures the acquisition, assimilation, transformation and exploitation of different knowledge spillovers, enabling the generation of new functional capabilities (e.g. production, marketing, etc.) that help improve firms' sustainability performance to meet the demands of their environment and stakeholders (Hussain *et al.*, 2022; Dzhengiz and Niesten, 2020; Forés and Camisón, 2016). A company with adequate absorptive capacity will be able to multiply the impacts of the knowledge spillovers from its environment, which will ultimately have a significant effect on enhancing sustainability performance. Therefore:

H3. Absorptive capacity mediates the relationship between knowledge spillovers and sustainability performance

2.2 Direct effects of integration in a science and technology park on knowledge spillovers

Since the pioneering work of Alfred Marshall (1890), there has been a consensus in the academic literature that the creation of knowledge applicable to new innovations and capable of boosting firm competitiveness is more successful when it is geographically bounded (e.g. Ascani *et al.*, 2020; Arranz *et al.*, 2019; Hervás-Oliver *et al.*, 2018). Indeed, STPs are a policy tool aimed at fostering the creation of knowledge and organizational learning processes in a specific environment by stimulating the links between industry and academia, encouraging the creation of new knowledge-based companies, as well as providing on-park companies with other benefits such as improved image and prestige, or easy access to customers, technological research centers and a highly trained workforce (González-Masip *et al.*, 2019; Gwebu *et al.*, 2019; Arauzo-Carod *et al.*, 2018).

Notwithstanding, the endowment of this bundle of market resources derived from the location alone cannot fully explain why some STPs are able to help on-park companies to improve their performance. Therefore, this co-location of organizations may serve as a trigger for enhancing localized knowledge spillovers through the relationships developed between companies, R&D institutions, experts and consultants and local institutions (Albahari *et al.*, 2023; Camisón and Forés, 2011).

Moreover, in order for organizations to correctly identify these knowledge spillovers, they must have a sense of embeddedness in or belonging to the processes, networks and institutions in the STP (Hervás-Oliver *et al.*, 2018; Camisón and Forés, 2011). Therefore, a firm that is located inside an STP but keeps its distance from other co-localized agents will be deprived of access to these knowledge spillovers, or even incapable of correctly identifying them. Therefore:

H4. The organization belonging to a STP has a positive effect on knowledge spillovers

2.3 The mediating effects of knowledge spillovers and absorptive capacity on sustainability performance

Although the literature notes the advantages of an organization being located in an STP, due to a lack of empirical studies, there is no clear consensus as to whether this location is a driver of business success, especially concerning sustainability performance. Thus, while certain empirical studies confirm the beneficial effect of STP location on economic or innovative performance (e.g. Arauzo-Carod *et al.*, 2018; Albahari *et al.*, 2017; Díez-Vial and Fernández-Olmos, 2017), other research reports opposite results or, at best, declares a non-significant effect of the STP (e.g. Lamperti *et al.*, 2017; Liberati *et al.*, 2016; Hansson *et al.*, 2005) and rules it out as a determinant of business success.

Several empirical studies relying on the resource-based view (e.g. Ubeda *et al.*, 2019; Zahra and George, 2002) argue that the aforementioned disparity in the findings about the effect of on-park location lies in the internal dynamics of the firm and how it can take advantage of the benefits and opportunities offered by these STPs (e.g. Ubeda *et al.*, 2019; Claver-Cortés *et al.*, 2018; Hervás-Oliver *et al.*, 2018; Díez-Vial and Montoro-Sánchez, 2016). It can thus be concluded that a company located in an STP that aims to improve its performance, especially if this performance is measured from the triple bottom line of sustainability, must make conscious efforts to take advantage of the knowledge and resources provided by this environment.

As stated in the seminal article by Cohen and Levinthal (1990), the wealth of complex knowledge spillovers that flourish from a firm's embeddedness in an STP can exert a push effect on co-located organizations to increase their absorptive capacity (Song *et al.*, 2018). Thus, access to plentiful knowledge spillovers should encourage firms to increase their absorptive capacity, to better exploit co-located agents' knowledge and thus possess cutting-edge knowledge (Camisón and Forés, 2011).

In light of the above, we propose the fifth hypothesis:

H5. Knowledge spillovers mediate

(a) the relationship between the organization belonging to a STP and sustainability performance

(b) the relationship between the organization belonging to a science and technology and absorptive capacity

Considering that innovation can be a driver of improved environmental (e.g. Parrilli *et al.*, 2023; Shahzad *et al.*, 2020) and social (e.g. Cillo *et al.*, 2019) performance and that absorbed knowledge has been found to enhance economic, environmental and social performance (e.g. Walsh *et al.*, 2020; Albort-Morant *et al.*, 2018; De Marchi and Grandinetti, 2013), we examine the role of absorptive capacity in mediating the relationship between a firm's location in an STP and its triple bottom line performance. From this perspective, absorptive capacity amplifies the sustainability benefits of on-park location in terms of knowledge generation and sharing. An empirical study by Claver Cortés *et al.* (2018) confirms the mediating effect of absorptive capacity on the relationship between STP location and improved innovative performance. Therefore, also considering the arguments raised in H3 and H5b, we pose the following final hypothesis:

H6. The impact of belonging to a STP on sustainability performance is mediated by the influence of knowledge spillovers on absorptive capacity

Figure 1 below presents the model as a whole as well as all the hypothesized relationships between the variables.

3. Methodology and results

3.1 Data and sample

We use data from the Technological Innovation Panel (PITEC) for Spanish companies. The PITEC is based on the Community Innovation Survey (CIS) database used to analyze European Union (EU) firms' innovation activities and results (Estrada and Zhou, 2022).

PITEC, which has a panel structure, contains organization-level data and provides basic company descriptors as well as detailed information on employment, sales and exportation activity. However, most of the information in this database is related to innovation activity.

The reference period for the research is 2009–2016, due to a lack of previous data on some of the study variables (e.g. sustainability performance). In our analysis, we use an unbalanced panel of 8,874 companies which have conducted some sort of sustainability initiatives in the seven-year period, yielding a total sample of 47,870 observations.

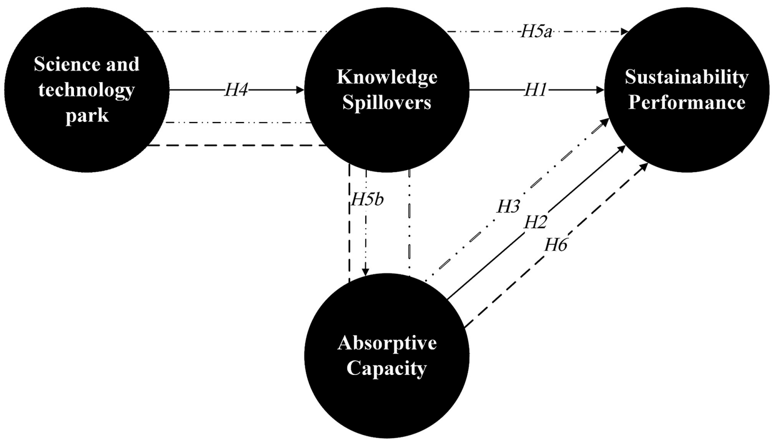
Figure 2 presents the evolution of on- and off-park companies in PITEC from 2009 to 2016, considering not only movements to and from the STP, but also businesses that disappear or come into existence during this period.

As explained in the following section, we have used the number of years located in the park as an alternative measure for the independent variable belonging to an STP, as it is an important determinant of the firm's capacity to benefit from on-park location (Albahari *et al.*, 2023).

3.2 Measures

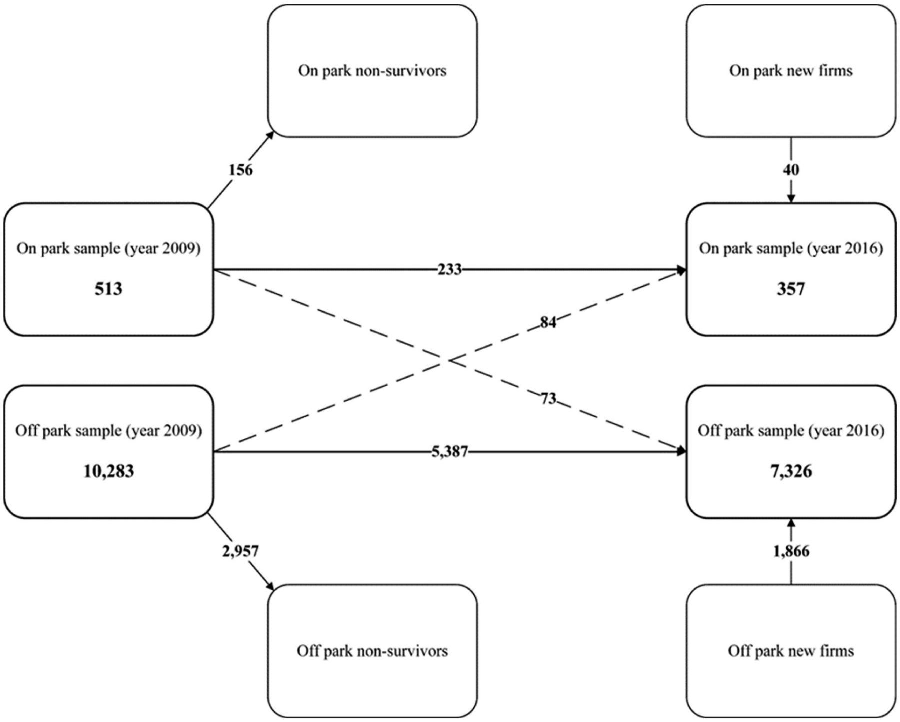
Table 1 presents a precise description of how the study's variables were constructed.

Table 2 presents the summary statistics and Table 3 the correlations among the study variables and variance inflation factor (VIF) coefficients. Correlation values among all



Source(s): Authors' own elaboration

Figure 1.
Research model



Source(s): Authors' own elaboration

Figure 2. Evolution of the organizations in the panel dataset

variables are generally low to moderate (Table 3), indicating a low risk of collinearity issues or redundancies with this set of variables. The highest correlations shown in italics are for alternative measures of the dependent (SUSTAIN) and independent variables (STP and SPILL), introduced in the robustness analysis section. However, these correlations should not be considered in the main analysis. Taking this into account, the highest correlation is 0.578, below what is considered problematic. The rule of thumb is that correlation values should not exceed 0.75, or the stricter limit of 0.6 (Churchill, 1979).

This is confirmed by the analysis of the variance inflation factor. The maximum variance inflation factor value is 1.22, well below the rule-of-thumb cut-off of 10, which again indicates that there are no serious multicollinearity problems in the models (Hair *et al.*, 2006).

In addition, we performed a number of statistical analyses to assess the severity of common method bias. First, the Harman's one-factor test indicated that common method bias was not an issue: multiple factors were detected, and the variance did not stem only from the first factors (Podsakoff *et al.*, 2003). In fact, the independent variables included in the model form several factors with eigenvalues higher than 1 and the first two factors capture only 22.25 and 15.8% of the total variance, respectively. We also included control variables that have a bivariate correlation with the other variables in the model of below 0.4 (Siemsen *et al.*, 2010).

3.3 Model estimation and results

We analyzed the main relationships of our model using SEM techniques, as they are very useful for analyzing mediation hypotheses (James *et al.*, 2006). The main hypotheses of our

Measure	Definition	Variable	Scale
Dependent variable: Sustainability performance Cronbach's Alpha = 0.91	This construct was formulated to include the three dimensions considered in the literature (e.g. Shang *et al.*, 2020): environmental, economic and social sustainability	Following previous antecedents in the literature (e.g. Acebo *et al.*, 2021; González-Blanco *et al.*, 2018), we calculate this construct as the sum of the scores about the importance of the following 16 organizational sustainability objectives (i) Increase in the offered number of products or services; (ii) Old product substitution; (iii) New market penetration; (iv) Increase in market share; (v) Increase in quality; (vi) Increase in product flexibility; (vii) Increase in production capacity; (viii) Labor cost reduction (per unit produced); (ix) Material cost reduction (per unit); (x) Energy cost reduction (per unit); (xi) Reduction in environmental impact; (xii) Compliance with environmental, health and safety regulation; (xiii) Increase in total employment; (xiv) Increase in qualified employment; (xv) Maintenance of employment; and, (xvi) Increase in employees' health and safety. These questions were answered on a four-point scale of importance (ranging from between 0 for "not used" and 3 for "high importance"), but, before summing the items, we coded these questions as binary variables (1 if the company indicates either "medium" or "high" importance, 0 otherwise)	0–16
Independent variables			
Belonging to a science and technology park (STP)	This variable distinguishes companies that are located in science and technology parks from those that are not (e.g. Diez-Vial and Fernández-Olmos, 2017)	Following previous studies in the literature (e.g. Diez-Vial and Fernández-Olmos, 2017; Yang *et al.*, 2009), this dichotomous variable takes the value of 1 when an organization is located in a science and technology park and 0 otherwise	0–1

Table 1.
Study's variables

(*continued*)

Measure	Definition	Variable	Scale
Knowledge spillovers Cronbach's Alpha = 0.82	Knowledge spillovers are any original, valuable knowledge which becomes publicly accessible (Cohen and Levinthal, 1989)	Following previous studies (e.g. González-Blanco *et al.*, 2018; Rodríguez *et al.*, 2017), the aggregate construct is the sum of the scores about the importance of the following 11 information sources for the innovation process: (i) Sources within the organization's enterprise group; (ii) Suppliers; (iii) Clients; (iv) Competitors; (v) Consultants and commercial labs; (vi) Universities or other higher education institutions; (vii) Public research institutes; (viii) Technological institutes; (ix) Conferences; (x) Scientific journals and technical publications; and, (xi) Professional and industry associations Each source was measured with an item capturing the degree of importance (ranging between 0 for "not used" and 3 for "high"). We rescaled each item before aggregating them, assigning a value for 0 (not used and low importance), or 1 (medium and high importance). Thus, with 10 items in total, the final external knowledge sources measure ranges from 0 to 11	0–11
Absorptive capacity (ACAP) Cronbach's Alpha = 0.6	The ACAP is the firm's ability to "recognize the value of new, external information, assimilate it and apply it to commercial ends" (Cohen and Levinthal, 1990, p. 128)	As proposed in previous studies (e.g. Diez-Vial and Fernández-Olmos, 2017), we sum the scores obtained in the following five binary variables aimed at capturing whether the respondent's company has carried out any of the following activities: (i) Internal research and development; (ii) External research and development; (iii) Acquisition of machinery and equipment; (iv) Acquisition of external knowledge; and, (v) Internal and external training for innovation activities	0–5
Control variables (Albahari *et al.*, 2023; Arranz *et al.*, 2019; De Marchi, 2012)			
Size (SIZE)	–	To capture the effect of the company's size on sustainability performance, we introduced the number of employees	Continuous

(*continued*)

Table 1.

Measure	Definition	Variable	Scale
Exports (EXPORTS)	–	We control of the firm's international scope (Arranz *et al.*, 2019) based on a question asking about the percentage of company turnover generated in foreign markets	Continuous
Industry (INDUSTRY)	–	We introduce a dummy variable that takes the value 1 if the business belongs to the manufacturing industry and 0 if it belongs to the service industry	0–1

Table 1.

Source(s): Authors' own elaboration

Variable	Obs	Mean	Std. Dev	Min	Max
SUSTAIN	47,870	8.502	4.998	0	16
ECOSUSTAIN	47,870	5.139	2.621	0	8
ENVIROSUSTAIN	47,870	1.57	1.46	0	4
SOCIALSUSTAIN	47,870	1.793	1.629	0	4
STP	71,571	1.049	0.216	1	2
STPMAT	102,678	0.222	1.242	0	8
SPILL	47,870	4.502	3.041	0	11
MARKSPILL	47,870	2.733	1.551	0	5
SCIENSPILL	47,870	1.77	1.928	0	6
ACAP	71,571	0.87	1.049	0	5
SIZE	71,571	337.806	1617.855	1	40,924
EXPORTS	71,571	1066.852	283195.61	0	75,762,636
INDUSTRY	71,571	0.512	0.5	0	1

Table 2.
Descriptive statistics

Source(s): Authors' own elaboration

model are confirmed (Table 4 and Figure 3), with consistent results for the main independent variables. The results also show that all the control variables considered (SIZE, EXPORTS and INDUSTRY) have a positive significant effect on sustainability performance.

Additionally, tests were performed to verify the consistency, goodness of fit and predictive relevance of the model. With respect to model consistency—the R2 value of the dependent variable—the model explains 37.40% (Figure 3) of the total variance in sustainability performance. The comparative fit index (CFI) and Tucker–Lewis index (TLI) fit statistics are close to 1, and the root mean square error of approximation (RMSEA) value is below 0.05 with a probability also near to 1 (Bentler, 1990), showing the good fit and predictive power of the model (see Appendix, part 1).

The mediating effects established in the model (hypotheses 3, 5 and 6) are all confirmed using additional Monte Carlo tests using STATA software (see Appendix, part 2).

3.4 Robustness analysis

To confirm the consistency of the results presented in the last section, we performed a series of robustness checks for the independent and dependent variables of our conceptual model.

In the case of the independent variables, we have estimated the SEM model using an alternative measure of the dichotomous variable STP, which indicates the number of years

Table 3. Correlation and VIF coefficients

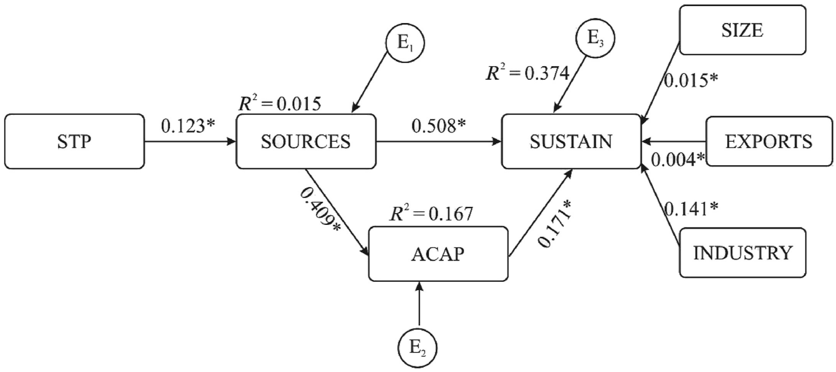
Variables	(1)	(1a)	(1b)	(1c)	(2)	(2a)	(3)	(3a)	(3b)	(4)	(5)	(6)	(7)	VIF = 1.09
(1) SUSTAIN	1.000													
(1a) ECOSUSTAIN	0.902*	1.000												
	(0.000)													
(1b) ENVIROSUSTAIN	0.862*	0.636*	1.000											
	(0.000)	(0.000)												
(1c) SOCIALSUSTAIN	0.845*	0.587*	0.724*	1.000										
	(0.000)	(0.000)	(0.000)											
(2) STP	0.041*	0.040*	0.029*	0.035*	1.000									1.05
	(0.000)	(0.000)	(0.000)	(0.000)										
(2a) STPMAT	0.045*	0.042*	0.033*	0.040*	0.953*	1.000								
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)									
(3) SPILL	0.578*	0.533*	0.468*	0.495*	0.123*	0.125*	1.000							1.21
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)								
(3a) MARKSPILL	0.581*	0.582*	0.443*	0.448*	0.073*	0.076*	0.841*	1.000						
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)							
(3b) SCIENSPILL	0.444*	0.373*	0.382*	0.419*	0.136*	0.135*	0.901*	0.523*	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
(4) ACAP	0.386*	0.377*	0.293*	0.316*	0.136*	0.139*	0.409*	0.374*	0.344*	1.000				1.22
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
(5) SIZE	0.027*	0.022*	0.013*	0.034*	−0.018*	−0.017*	0.035*	0.045*	0.019*	0.057*	1.000			1.02
	(0.000)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
(6) EXPORTS	0.007	0.005	0.008	0.006	−0.001	−0.001	0.008	0.004	0.010*	−0.003	0.000	1.000		1
	(0.133)	(0.275)	(0.096)	(0.175)	(0.821)	(0.829)	(0.070)	(0.413)	(0.028)	(0.409)	(0.899)			
(7) INDUSTRY	0.158*	0.111*	0.158*	0.163*	−0.107*	−0.100*	0.016*	0.063*	−0.025*	0.150*	−0.112*	−0.004	1.000	1.05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.307)		

Note(s): *Shows significance at $p < 0.05$
Source(s): Authors' own elaboration

Standardized	Coefficient	std. err	z	Robust $p > z$	[95% conf	Interval]
Structural						
SPILL						
SPT	0.123	0.005	26.210	0.000	0.114	0.133
_cons	0.946	0.021	44.660	0.000	0.904	0.987
SUSTAIN						
SPILL	0.508	0.004	132.540	0.000	0.500	0.515
ACAP	0.171	0.004	44.110	0.000	0.163	0.178
SIZE	0.015	0.003	4.530	0.000	0.008	0.021
EXPORTS	0.004	0.000	77.730	0.000	0.004	0.005
INDUSTRY	0.141	0.004	38.830	0.000	0.134	0.148
_cons	0.576	0.008	70.600	0.000	0.560	0.592
ACAP						
SPILL	0.409	0.004	107.37	0.000	0.401	0.416
_cons	0.643	0.007	86.97	0.000	0.629	0.658
var(e.SPILL)	0.985	0.001			0.983	0.987
var(e.SUSTAIN)	0.626	0.004			0.619	0.633
var(e.ACAP)	0.833	0.003			0.827	0.839

Note(s): Structural equation model, Number of obs = 47,870
Estimation method: ml
Log pseudolikelihood = −1457329.3
Source(s): Authors' own elaboration

Table 4.
SEM model estimation results



Source(s): Authors' own elaboration

Figure 3.
SEM model estimation results

the firm has been in an STP, or its STP maturity (STPMAT) [1]. We believe this variable may better capture the firm's structural characteristics linked to its experience in the park that explain both the firm's embeddedness in the knowledge spillovers and its capacity to harness them for innovation (Albahari *et al.*, 2023; Camisón and Forés, 2011). The results obtained (Appendix, part 3) are similar to those of the original model (Figure 3).

We also run the model distinguishing market spillovers (MARKSPILL) (enterprise group; suppliers, clients; competitors; consultants and commercial labs) from scientific and professional spillovers (SCIENSPILL) (universities or other higher education institutions; public research institutes; technological institutes; conferences, trade fairs and exhibitions;

scientific journals and technical publications; and professional and industry associations) (Diez-Martinez *et al.*, 2022; Del Río *et al.*, 2017). We also obtain consistent results for the main independent variables (Appendix, part 4), confirming the validity and robustness of the relationships in our conceptual model.

To confirm the mediating effects in the model, we also carry out a hierarchical regression analysis using panel data. To control for endogeneity and autocorrelation bias, we estimate the model using fixed-effects with robust standard errors (Acebo *et al.*, 2021), based on the results from the Hausman specification test. Following the methodology proposed by Baron and Kenny (1986), the results (Appendix, part 3) show that there is a significant relationship between STP and SUSTAIN (Model 1), between STP and SPILL (Model 2) and STP and ACAP (Model 3). However, when considering the effect of the independent variables, STP and SPILL, on ACAP (Model 4) and of STP, SPILL and ACAP on SUSTAIN (Model 4), the direct effect of STP on both ACAP and SUSTAIN disappears. These results confirm that SPILL fully mediates both the relationship between the organization belonging to an STP and SUSTAIN (H5a) and the relationship between the organization belonging to an STP and ACAP (H5b). The results from the regression analysis in Model 1 also indicate that only EXPORTS has a positive significant effect on sustainability performance.

Finally, based on the previous multiple regression analysis, we cross-checked our results using alternative measures for our dependent variable sustainability performance based on the triple bottom line conceptualization of the construct (Ben Arfi *et al.*, 2018). Specifically, we consider each dimension that makes up the sustainability performance construct: economic (comprising items related to market product and process technology), environmental (items related to green technology and compliance with standards) and social (items related to employment and employees' qualifications and welfare). We thus ran three additional model specifications: Model 6 for economic performance (ECOSUSTAIN), Model 7 for environmental performance (ENVIRONSUSTAIN) and Model 8 for social performance (SOCIALSUSTAIN) (see Appendix, part 5). Comparing the estimates with those from the baseline model, we can confirm the main results of the baseline model hold with only very minor changes. The direction of the effects of the explanatory variables remains the same across the models (Appendix, part 5).

4. Discussion, conclusions and future lines of research

Academic research and international frameworks such as the 2030 Agenda show that organizations can no longer conduct business as usual; they must make greater efforts to ensure a more sustainable world (Hernández-Trasobares and Murillo-Luna, 2020; Walsh *et al.*, 2020; Forés, 2019). To do so, companies will need to broaden their knowledge bases and develop through learning processes.

As confirmed in H1 ($\beta = 0.508$, $p < 0.001$; Table 4), a greater diversity of knowledge spillovers positively impacts triple bottom line sustainability performance. The capacity of the firm to accumulate new knowledge, encapsulated in the absorptive capacity construct, is also shown to be an important determinant of sustainability performance, confirming H2 ($\beta = 0.171$, $p < 0.001$; Table 4). This result provides support to previous literature on the importance of dynamic capabilities for the generation of new products, processes and organizational forms that have an impact on the market, the environment and the society.

In addition, findings show that certain radical new knowledge spillovers, relative to the firm's previous knowledge stock, require a prior absorption process to have an impact on improving sustainability performance. This study thus shows the role of absorptive capacity as a catalyst of knowledge spillovers' effect on sustainability results, supporting H3 ($\beta = 0.07$, $p < 0.001$; Table 4).

STPs have been categorized as learning centers, in which there is a confluence of scientific, technological and business actors (Link and Scott, 2018). However, as the literature on knowledge management and innovation has underlined, merely being located in a space rich in knowledge spillovers does not necessarily mean a firm can correctly identify, assimilate and exploit new external knowledge (e.g. Ubeda *et al.*, 2019; Claver-Cortés *et al.*, 2018; Camisón and Forés, 2011). Our analysis of Spanish firms using the PITEC panel database allows us to confirm previous research findings about the successive influence of knowledge flows and then absorptive capacity on the relationship between STP location and better sustainability performance.

The effects of on-park location are not the same for these two antecedents of sustainability performance: while it has a direct impact on the knowledge spillovers that the firm can identify and exploit, absorptive capacity does not. Our empirical study shows that on-park location impacts the generation of spillovers and their degree of diversity as measured by the number of agents involved, confirming hypothesis 4 ($\beta = 0.123$ $p < 0.001$; Table 4). It also confirms the fully-mediating role that knowledge spillovers play in the relationship between the organization belonging to an STP and sustainability performance, as posited in hypothesis 5a ($\beta = 0.063$, $p < 0.001$; Table 4).

The results indicate that the company should integrate into the social structure and cognitive community of the STP, so that it can access and correctly identify the knowledge spillovers accumulated there to improve its sustainability performance (Porter, 1998; Granovetter, 1985).

Due to their degree of similarity with the company's existing cognitive bases, mental models, or knowledge resources, some of the knowledge spillovers present in an STP will be more easily exploitable, i.e. without requiring a complex absorption process by the company (Camisón *et al.*, 2018). Synergies can thus be generated between the existing and the new knowledge endowments, which can be applied to improve the company's triple bottom line sustainability performance.

In contrast, other knowledge spillovers that abound in an STP cannot be so readily exploited by the organization (Ubeda *et al.*, 2019; Claver-Cortés *et al.*, 2018; Forés and Camisón, 2016). To benefit from the impact that these more complex, tacit and novel knowledge spillovers can have on improving sustainability performance, the organization needs a well-developed absorptive capacity (Song *et al.*, 2018; Cohen and Levinthal, 1990).

This study shows that STP location does not have a direct effect on the development of this absorptive capacity, confirming the fully mediated effect of knowledge spillovers on this relationship, as established in hypothesis 5b ($\beta = 0.05$, $p < 0.001$; Table 4). Therefore, absorptive capacity has a multiplier effect on the impact of knowledge spillovers on sustainability performance, as posited in hypothesis 6 ($\beta = 0.09$, $p < 0.001$; Table 4). By increasing its absorptive capacity, the company can better combine and apply external knowledge spillovers to sustainability ends.

Additional robustness analysis confirms the validity of the conceptual model, as the direction and significance of the main relationships among constructs remain the same when distinguishing between different types of spillovers. These additional tests show that although STP location has a positive influence on the development of the different types of spillovers considered, the effect is substantially stronger on the generation and availability of scientific spillovers for companies properly embedded in the STP. This result empirically ratifies previous research (e.g. Germain *et al.*, 2022; Ubeda *et al.*, 2019) which claims that STPs are an industrial policy instrument aimed at enhancing member firms' access to the most cutting-edge and innovative scientific knowledge and differentiates the value proposition of these technology enclaves from other models of territorial agglomeration of firms, such as clusters or industrial districts (e.g. Bellandi and De Propis, 2015).

The robustness analysis also confirms that market knowledge sources have more impact on both sustainability performance and absorptive capacity than scientific and professional knowledge sources. These results confirm and extend previous studies by Diez-Martinez *et al.* (2022), Acebo *et al.* (2021) and Del Río *et al.* (2017) showing that competitors', clients' and suppliers' environmental attitudes, knowledge and practices may influence firms' sustainability performance.

Although we might have expected scientific and professional spillovers to have a greater impact on absorptive capacity than market knowledge sources, it is logical that information from firms' competitive environment is more important, considering the market-oriented nature of the innovation measurement variables in the absorptive capacity construct (Segarra-Oña *et al.*, 2016).

4.1 Theoretical implications for academia

This longitudinal study contributes to the literature on open innovation and knowledge management by demonstrating the impact of localized knowledge spillovers on a firm's sustainability performance and thus its long-term competitiveness. Our empirical evidence confirms that the firm's on-park location does matter, but does not directly impact its sustainability performance; rather, it creates the conditions for improving performance (Bellandi and De Propis, 2015), including triple bottom line sustainability performance. This study, therefore, contributes to the literature by confirming the beneficial effects of STP location on the triple bottom line of on-park companies.

This research also confirms the effects of industrial agglomerations in terms of boosting knowledge spillovers by encouraging the interaction of co-located agents and firms. Previous research also highlights the role that absorptive capacity, as a dynamic capability, can play in harnessing novel, tacit and cutting-edge external knowledge flows and applying them to improve sustainability performance. Our study with longitudinal data allows us not only to corroborate these previous findings but also to infer causality in the relationship, which cannot be established using a cross-sectional database.

On the other hand, our measure of sustainability performance holistically integrates the three widely recognized dimensions of sustainability: social, economic and environmental (e.g. Hussain *et al.*, 2018; Engert *et al.*, 2016). We, therefore, respond to calls made in recent research for further exploration of triple bottom line sustainability (e.g. Ben Arfi *et al.*, 2018; Engert *et al.*, 2016).

4.2 Implications for practitioners

This research has relevant implications for three types of practitioners: policymakers, managers of STPs and company managers. As far as policymakers and park management teams are concerned, our results show that if STPs can host numerous scientific, technological and business agents, and if these agents generate knowledge spillovers through networking processes, these parks can be a space in which companies can improve their triple bottom line sustainability performance. These findings justify public actions aimed at improving the infrastructure endowments of these spaces, the provision of high-value-added services to on-park organizations and the creation of on-park networks.

Our research also provides valuable insights for company managers, especially regarding location. Despite the globalization and digitalization of markets, location continues to play a decisive role in the ability to access high-value knowledge to improve sustainability performance. Therefore, managers should be aware that, while location alone is no guarantee of improved performance, it should be carefully selected to place the company in an environment that can provide the best market, technological, legal and consumer preference knowledge.

Given the complex nature of sustainability performance, managers should consider developing a comprehensive strategy for acquiring and integrating knowledge from both market and scientific knowledge spillovers. Lastly, the company's management should increase efforts to create internal capabilities that enable it to acquire, assimilate, transform and exploit the knowledge that flourishes in its environment.

4.3 Limitations and future lines of research

Despite its contributions to the literature, this study is not free of limitations. The first is that we use a database that only covers data from Spanish companies. STPs are a global phenomenon, so it would be interesting to test whether our hypotheses hold in culturally different environments in America, Europe, or Asia.

Although the design of the PITEC questionnaire solves problems of endogeneity between the knowledge spillovers variable and absorptive capacity, future research with this database should introduce a lag in the measurement of the knowledge spillovers variable. In future studies, it would also be interesting to employ another database in order to use alternative measures of these knowledge spillovers, such as scales previously validated in the literature.

Our study confirms that the greater the interdependence between actors and knowledge flows in an STP, the more progress on-park companies will make in terms of sustainability and innovation. Industry 4.0 technologies have been identified as transformative factors in an STP, capable of contributing to aspects such as the integrated management of global value chains, the digitalization of companies, the reduction of the gender gap in technological entrepreneurship, improved knowledge management, or the transition towards a circular economy (e.g. Sanz *et al.*, 2023; UNIDO, 2023).

Therefore, future research should, through the use of new databases and statistical procedures, assess how Industry 4.0 technologies enable companies located in an STP to respond to global challenges and increase their competitiveness. Special attention should be paid to the composition and competences of the governance and management bodies of STPs and how they act as agents of change using Industry 4.0 technologies as leverage (e.g. Sanz *et al.*, 2023). The role of public-private collaboration as a combined action capable of generating positive externalities for the economy, society and the environment should also be explored in such research (Sanz *et al.*, 2023).

Note

1. We thank an anonymous reviewer for this suggestion.

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Appendix
Goodness of fit and robustness analysis

1 Fit Indexes SEM

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(8)	777.066	model vs. saturated
p > chi2	0.000	
chi2_bs(15)	33160.683	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.045	Root mean squared error of approximatior
90% CI, lower bound	0.042	
upper bound	0.048	
pclose	0.999	Probability RMSEA <= 0.05
Information criteria		
AIC	2.915e+06	Akaike's information criterion
BIC	2.915e+06	Bayesian information criterion
Baseline comparison		
CFI	0.977	Comparative fit index
TLI	0.956	Tucker-Lewis index
Size of residuals		
SRMR	0.024	Standardized root mean squared residual
CD	0.045	Coefficient of determination

Source(s): Authors' own elaboration

2 Testing indirect effects with SEM: Monte Carlo tests

Partially-mediating effect of ACAP on the relationship between SPILL and SUSTAIN: Hypothesis 3

Significance testing of indirect effect (unstandardised)

Estimates	Delta	Sobel	Monte Carlo*
Indirect effect	0.318	0.318	0.318
Std. Err.	0.013	0.013	0.013
z-value	25.413	25.413	25.351
p-value	0.000	0.000	0.000
Conf. Interval	0.293 , 0.342	0.293 , 0.342	0.294 , 0.343

Source(s): Authors' own elaboration

Fully-mediating effect of SPILL on the relationship between STP and SUSTAIN: Hypothesis 5

Significance testing of indirect effect (unstandardised)

Estimates	Delta	Sobel	Monte Carlo*
Indirect effect	1.494	1.494	1.494
Std. Err.	0.048	0.048	0.048
z-value	31.398	31.398	31.381
p-value	0.000	0.000	0.000
Conf. Interval	1.401 , 1.587	1.401 , 1.587	1.401 , 1.587

Source(s): Authors' own elaboration

Partially-mediating effect of SPILL on the relationship between STP and ACAP: Hypothesis 6

Significance testing of indirect effect (unstandardised)

Estimates	Delta	Sobel	Monte Carlo*
Indirect effect	0.663	0.663	0.663
Std. Err.	0.020	0.032	0.032
z-value	33.857	21.040	20.979
p-value	0.000	0.000	0.000
Conf. Interval	0.625 , 0.701	0.601 , 0.725	0.602 , 0.726

Source(s): Authors' own elaboration

3 Robustness analysis: SEM model estimation results with an alternative measure for STP

3.1. SEM model estimation results: table

Number of obs = **47,870**
Estimation method: ml
Log likelihood = −1550181.8

		Robust				
Standardized	Coefficient	std. err.	z	P>z	[95% conf.	interval]
Structural						
SPILL						
STPMAT	0.125	0.004	26.870	0.000	0.116	0.134
_cons	1.449	0.005	285.630	0.000	1.436	1.459
SUSTAIN						
SPILL	0.508	0.004	132.970	0.000	0.500	0.515
ACAP	0.171	0.003	44.110	0.000	0.163	0.178
SIZE	0.015	0.000	4.530	0.000	0.008	0.021
EXPORTS	0.004	0.004	77.750	0.220	0.004	0.005
INDUSTRY	0.141	0.008	38.840	0.000	0.134	0.148
_cons	0.576	0.003	70.590	0.000	0.560	0.592
ACAP						
SPILL	0.409	0.004	106.310	0.000	0.401	0.401
_cons	0.643	0.007	86.970	0.000	0.629	0.629
var(e.SPILL)	0.984	0.001			0.982	0.987
var(e.SUSTAIN)	0.626	0.004			0.618	0.633
var(e.ACAP)	0.833	0.003			0.827	0.839

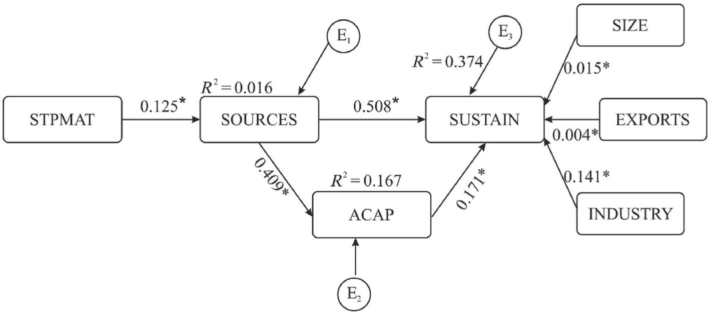
Source(s): Authors' own elaboration

3.2. Fit Indexes SEM

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(8)	762.631	model vs. saturated
p > chi2	0.000	
chi2_bs(15)	33160.922	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.044	Root mean squared error of approximation
90% CI, lower bound	0.042	
upper bound	0.047	
pclose	1.000	Probability RMSEA <= 0.05
Information criteria		
AIC	3.101e+06	Akaike's information criterion
BIC	3.101e+06	Bayesian information criterion
Baseline comparison		
CFI	0.977	Comparative fit index
TLI	0.957	Tucker-Lewis index
Size of residuals		
SRMR	0.024	Standardized root mean squared residual
CD	0.046	Coefficient of determination

Source(s): Authors' own elaboration

3.3. SEM model estimation results: graph



Source(s): Authors' own elaboration

4 Robustness analysis: SEM model estimation results extending SPILL

4.1. SEM model estimation results: table

Structural equation model
Estimation method: ml
Log likelihood = −1515770.4

Number of obs = 47,870

Standardized		Coefficient	Robust std. err.	z	P>z	[95% conf.	interval]
Structural							
MARKSPILL							
	STP	0.073	0.004	17.280	0.000	0.065	0.081
	_cons	1.446	0.020	73.230	0.000	1.408	1.485
SCIENSPILL							
	STP	0.136	0.005	27.220	0.000	0.126	0.146
	_cons	0.329	0.022	14.930	0.000	0.285	0.372
SUSTAIN							
	MARKSPILL	0.426	0.004	98.820	0.000	0.417	0.434
	SCIENSPILL	0.171	0.004	39.250	0.000	0.163	0.180
	ACAP	0.162	0.004	42.070	0.000	0.155	0.170
	SIZE	0.009	0.003	2.790	0.005	0.003	0.015
	EXPORT	0.005	0.000	88.110	0.000	0.005	0.005
	INDUSTRY	0.127	0.004	35.280	0.000	0.120	0.134
	_cons	0.451	0.008	54.590	0.000	0.435	0.467
ACAP							
	MARKSPILL	0.266	0.005	56.970	0.000	0.257	0.275
	SCIENSPILL	0.205	0.005	40.740	0.000	0.195	0.215
	_cons	0.591	0.008	74.900	0.000	0.575	0.606
var(e.MARKSPILL)		0.995	0.001	0.993	0.996	0.995	0.001
var(e.SCIENSPILL)		0.982	0.001	0.979	0.984	0.982	0.001
var(e.SUSTAIN)		0.603	0.004	0.596	0.610	0.603	0.004
var(e.ACAP)		0.830	0.003	0.824	0.836	0.830	0.003
cov(e.MARKSPILL,e.SCIENSPILL)		0.519	0.003	157.650	0.000	0.513	0.526

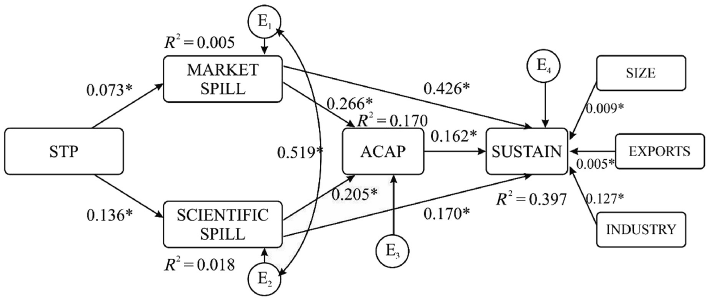
Source(s): Authors' own elaboration

4.2. Fit Indexes SEM

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(11)	1143.482	model vs. saturated
p > chi2	0.000	
chi2_bs(22)	51012.143	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.046	Root mean squared error of approximation
90% CI, lower bound	0.044	
upper bound	0.049	
pclose	0.995	Probability RMSEA <= 0.05
Information criteria		
AIC	3.032e+06	Akaike's information criterion
BIC	3.032e+06	Bayesian information criterion
Baseline comparison		
CFI	0.978	Comparative fit index
TLI	0.956	Tucker-Lewis index
Size of residuals		
SRMR	0.026	Standardized root mean squared residual
CD	0.044	Coefficient of determination

Source(s): Authors' own elaboration

4.3. SEM model estimation results: graph



Source(s): Authors' own elaboration

5 Robustness analysis: regression analysis using panel data with fixed-effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
VARIABLES	SUSTAIN	SPILL	ACAP	ACAP	SUSTAIN	ECOSUSTAIN	ENVIRONSUSTAIN	SOCIALSUSTAIN
STP	0.540**	0.470**	0.112*	0.0585	0.108	0.0559	0.0360	0.0161
	(0.0265)	(0.0380)	(0.0231)	(0.0138)	(0.00531)	(0.00524)	(0.00606)	(0.00243)
SPILL				0.0816***	0.795***	0.399***	0.183***	0.213***
				(0.238)	(0.484)	(0.463)	(0.381)	(0.398)
ACAP					0.597***	0.358***	0.107***	0.133***
					(0.125)	(0.142)	(0.0762)	(0.0848)
SIZE	2.24e−05	7.55e−06	2.42e−05**	2.60e−05**	5.19e−07	9.27e−06	−5.50e−06	−3.25e−06
	(0.00780)	(0.00432)	(0.0374)	(0.0434)	(0.000181)	(0.00616)	(−0.00656)	(−0.00348)
EXPORTS	9.24e−08***	6.41e−08***	−1.51e−08***	−2.03e−08***	5.04e−08***	1.19e−08***	2.01e−08***	1.85e−08***
	(0.00640)	(0.00730)	(−0.00407)	(−0.00675)	(0.00349)	(0.00157)	(0.00476)	(0.00393)
INDUSTRY	0.347	0.142	0.137***	0.0933	0.171	0.0305	0.0469	0.0939
	(0.0343)	(0.0231)	(0.0654)	(0.0442)	(0.0169)	(0.00574)	(0.0159)	(0.0285)
Constant	7.719***	3.916***	0.674***	0.808***	3.932***	2.797***	0.545***	0.590***
Observations	47,870	47,870	71,571	47,870	47,870	47,870	47,870	47,870
Number of ident	8,874	8,874	10,999	8,874	8,874	8,874	8,874	8,874
R-within	0.000	0.001	0.001	0.046	0.263	0.236	0.146	0.167
R-between	0.041	0.0274	0.056	0.318	0.474	0.421	0.323	0.365
R-overall	**0.028**	**0.016**	**0.043**	**0.176**	**0.364**	**0.314**	**0.235**	**0.267**

Note(s): Robust standard error in parentheses; $p < 0.05$; $p < 0.01$; $p < 0.001$

Source(s): Authors' own elaboration