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The influence of cooperative innovation on employment from the perspective of sustainable development goals

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ABSTRACT

Cooperation between different actors in business innovation is crucial for economic development and supports the Sustainable Development Goals (SDGs). This study examines the relationship between innovation cooperation and the employment objectives of firms, such as job maintenance and creation. Using a sample of 5,397 firms from the PITEC database (2010-2016) and a binomial logit model with panel data, the findings indicate that innovation cooperation increases the likelihood that job maintenance and creation become core goals of technological innovation. Furthermore, the involvement of more actors raises the likelihood of establishing employment as one of the objectives of innovation. Such cooperation contributes to SDG 9 (Industry, innovation, and infrastructure) and SDG 17 (Partnerships for the goals), while also positively impacting employment, in line with SDG 8 (Decent work and economic growth). The effect varies by partner type: partners from industry mainly support job maintenance and creation, while universities often focus on creating qualified jobs.

Introduction

Currently, the 2030 Agenda and the Sustainable Development Goals (SDGs) proposed by the United Nations in 2015 are a benchmark for economies and businesses worldwide (Vignini, 2023; Whittingham et al., 2023; Rodríguez-Peña, 2025). According to López-Cabarcos et al. (2025), incorporating the SDGs into the strategic frameworks of companies can contribute to their goal of value creation, positively influencing economic, social and environmental performance. Furthermore, they highlight the fundamental role that companies can play in achieving sustainable development.

Since their conception, the SDGs were understood to be mutually connected (Griggs et al., 2014; Le Blanc, 2015), which has generated growing scholarly interest in examining their mutual interdependencies in recent years. This body of work highlights how progress in one area can support advancement in others (Nilsson et al., 2018; Weitz et al., 2018; Howe, 2019; Pham-Truffert et al., 2020). Kroll et al. (2019) refer to this dynamic as the "virtuous cycle of SDG progress".

Despite such insights, the interactions between SDGs have not received sufficient attention (Anderson et al., 2022; Wu et al., 2022). A comprehensive understanding of these interlinkages is essential (Van Soest et al., 2019; Wu et al., 2022), as sustainable development is more about mutually reinforcing achievements than isolated progress (Pradhan, 2019). In this regard, Romero-Goyeneche et al. (2022) argue that the SDGs should not be treated as a set of individual goals but rather as a transformative and interconnected framework capable of addressing complex societal challenges. Furthermore, the interaction between SDGs can result not only in synergies, but also in trade-offs or negative spillovers (Xiao et al., 2023).

SDG 9 (Industry, innovation and infrastructure) the centrality of business innovation to competitiveness and sustainable economic development (Denoncourt, 2019). However, innovation strategies entail costs and risks that may be prohibitive for many firms, prompting them to engage in cooperative arrangements to mitigate such challenges (Bigliardi et al., 2020). In this context, SDG 17 (Partnerships for the goals) underscores the importance of multi-actor collaboration, which enables the pooling of resources, expertise and capabilities, thereby facilitating knowledge transfer and the development of innovative solutions. Inter-organisational cooperation not only enhances innovation performance (Mota et al., 2024), but may also contribute to other SDGs, including SDG 8 (Decent work and economic growth), through job creation and employment enhancement (Grande et al., 2020). In sum, collaboration among diverse stakeholders (SDG 17) is instrumental for fostering innovation (SDG 9), which in turn can support economic development and employment growth (SDG 8).

Against this backdrop, the present study aims to deepen the

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understanding of the interconnections between SDG 8, SDG 9 and SDG 17 by exploring the potential synergies that cooperation in business innovation can have on employment. To this end, it first outlines the theoretical framework, drawing on Etzkowitz and Leydesdorff's (1995) Triple Helix model, and then presents an empirical analysis to provide evidence of the linkages among the three SDGs under examination. Accordingly, the research questions can be summarised as follows: Does a relationship exist between SDGs 8, 9 and 17 that can be characterised as a 'virtuous circle of progress'? And can empirical evidence support the existence of a synergistic effect of cooperation in business innovation on employment?

This is a distinct proposal. While several works have examined SDGs individually—such as SDG 8 (Kreinin & Aigner, 2022), SDG 9 (Costa, 2024), or SDG 17 (Oliveira-Duarte et al., 2021)—or explored selected combinations (e.g., SDGs 8 and 9: Liu et al., 2019; SDGs 7, 8 and 13: Tiwari et al., 2024; SDGs 4, 8, 9 and 16: Pauliukevičienė et al., 2025), and some have even addressed all 17 SDGs (e.g., Mio et al., 2020; Agrawal et al., 2022; Berrone et al., 2023; Mahajan et al., 2024; Domingo-Posada et al., 2024), to the best of our knowledge, no previous research has analysed the interrelationship between SDG 8, SDG 9 and SDG 17 from a business perspective. Moreover, this study contributes not only by helping to narrow the gap in this area of research, but also through its methodological approach, employing panel data analysis to provide robust empirical evidence based on a large sample of Spanish firms. The dynamic nature of SDG interactions (Wu et al., 2022) further underscores the importance of adopting a relatively extended time horizon, such as the one adopted in this study.

The paper is organised as follows: "Literature review" introduces the theoretical framework, focusing on cooperation strategies in business innovation and their impact on employment. "Materials and methods" outlines the methodology and presents the empirical results. Finally, the main conclusions, implications, and limitations are discussed.

Literature review

Etzkowitz and Leydesdorff's (1995) Triple Helix model offers a theoretical framework for understanding the synergistic effects that arise from collaboration among multiple stakeholders in business innovation. This approach identifies three key actors whose interaction plays a pivotal role in driving business innovation and fostering economic development: industry, academia, and government.

This conceptual framework has been supported by extensive empirical evidence demonstrating the positive impact of collaboration with Triple Helix actors on business innovation. In China, Zhuang et al. (2021) find that such collaboration enhances the efficiency of innovation processes. In a comparative study of Spain and Portugal, Mascarenhas et al. (2019) show that cooperation among universities, industry and government significantly contributes to knowledge creation and innovation. They conclude that while innovation is the engine of economic development, cooperation between Triple Helix actors is the fuel that keeps it running. Similarly, Mota et al. (2024) confirm that such collaboration improves innovation outcomes in both, product development and human resource management. In the context of emerging economies, Guerrero and Urbano (2017) highlight the case of Mexico, demonstrating that engagement with Triple Helix actors enhances innovation performance. In Finland, Khan et al. (2022) demonstrate how collaboration among firms, research institutions, and government supports value co-creation and innovation, particularly in the context of Industry 4.0 (I4.0).

The specific synergies achieved through collaboration with each type of actor are discussed in more detail below.

Firstly, cooperation with other firms can facilitate innovation—whether through vertical cooperation with customers or suppliers, horizontal cooperation or coopetition (Khanna et al., 1998), or institutional cooperation with firms within the same group. All these arrangements facilitate identification of opportunity, access to technological capabilities, more efficient resource use, joint knowledge creation and dissemination, and cost and risk reduction (Hagedoorn, 1993; Tsai, 2009; Miotti & Sachwald, 2003; Ritala et al., 2016).

In the current context of Industry 4.0, which is marked by the integration of advanced digital technologies into production and management, Bettiol et al. (2023) stress the value of inter-firm collaboration for generating the knowledge required for both, product and process innovation. Lepore et al. (2022) similarly argue that such collaboration is essential for adopting Industry 4.0 technologies, particularly for SMEs, as collaborative networks help mitigate the costs, uncertainties and complexities associated with their implementation (Messeni Petruzzelli et al., 2022; Audretsch et al., 2023; Audretsch & Belitski, 2024).

Secondly, collaboration between universities and firms enhances business innovation outcomes (Tian et al., 2022). Universities are a valuable source of knowledge (Badillo et al., 2017) and offer a structured framework for addressing complex problems (Miller et al., 2014). They also provide access to infrastructure, equipment and highly skilled researchers (Callejón et al., 2007; Franco & Pinho, 2019). Such partnerships can help improve efficiency, strategic planning, and technological capabilities (Bamford et al., 2024), while also promoting regional innovation and competitiveness (Skute et al., 2019).

A systematic literature review by Cohen et al. (2024) identifies six categories of impact resulting from university–industry R&D collaboration: intellectual (Zavale & Schneijderberg, 2021), economic (Puerta-Sierra et al., 2021; Roncancio-Marin et al., 2022), technological (Audretsch et al., 2019), environmental (Zhang et al., 2022), social (Apa et al., 2021; Acebo et al., 2021) and strategic (Galan-Muros & Davey, 2019; De Silva et al., 2021).

Thirdly, government involvement plays a vital role in supporting business innovation through financial incentives and policy measures, such as advisory services and innovation dissemination mechanisms (Freitas & Von Tunzelmann, 2008). Xie et al. (2023) highlight how this support provides access to venture capital, enables firms to acquire new technologies and enhances intellectual property protection. Such support is especially important for SMEs during times of crisis, as shown by Adam and Alarifi (2021), who advocate for policies offering financial aid, advisory services, and training. Tian et al. (2019) find that strong government–business relations significantly enhanced innovation capacity in the Chinese manufacturing sector.

The Triple Helix model aligns with Kroll et al.'s (2019) concept of the "virtuous cycle of SDG progress", offering a framework to understand how cooperation (SDG 17) positively influences innovation (SDG 9). Moreover, Pham-Truffert et al. (2020) underscore the potential of SDG 17 to generate co-benefits with other SDGs without producing trade-offs.

Additionally, Calabrese et al. (2021) identify SDG 9 as essential for aligning business value creation with sustainable development goals. The idea of a "virtuous cycle" can thus be seen as complementing the Triple Helix framework, suggesting that cooperation in innovation not only enhances firm competitiveness, but also contributes to other SDGs (Mariani et al., 2022; Dzhunushalieva and Teuber, 2024). Specifically, SDG 9 is shown to support SDG 8 (Wu et al., 2022).

Previous studies have also suggested that cooperation among Triple Helix actors can positively affect employment outcomes (Harrison et al., 2014; Farinha et al., 2016; Acemoglu & Restrepo, 2018; Osabohien et al., 2022; Etzkowitz et al., 2023). Cui and Diwu (2024) and Wang and He (2024) highlight the importance accorded by firms to employment-related goals, especially in terms of human capital development, to enhance innovation capacity. Skilled employees offer a competitive advantage in digital transformation processes (Ullrich et al., 2023), improve decision-making under uncertainty (Jin et al., 2023), and increase organisational inimitability (Muñoz-Castellanos & Salinero-Martín, 2011). Plata (2024) finds that industry–academia collaboration improves innovation efficiency and indirectly boosts job creation. Likewise, Bianchini and Pellegrino (2019) demonstrate that persistent innovation, particularly in products, positively influences employment growth, especially for SMEs. Public support for

entrepreneurship also promotes job creation (Alawi et al., 2023), leading López et al. (2024) to call for greater policy support for business collaboration.

Accordingly, the following hypothesis is proposed:

H1. *Cooperation with other actors in business innovation increases the likelihood that firms will regard employment as one of the objectives of innovation processes.*

Moreover, earlier research suggests that a larger number of collaborating actors generates stronger effects on innovation outcomes (Becker & Dietz, 2004; Hernández-Trasobares & Murillo-Luna, 2020). Zhou and Wang (2023), in their study on start-up incubation in China, find that multi-actor collaboration—particularly involving government and academia—yields better results than single-partner cooperation. Ahn et al. (2020), using data from Korean manufacturing firms, show that government subsidies stimulate broader collaboration beyond firms' traditional networks. O'Dwyer et al. (2023) also emphasise the key role of government support in university–industry partnerships.

Participation in knowledge-sharing networks enhances firm performance and creates synergies, especially among SMEs (Fabrizi et al., 2020), which contribute significantly to national employment (Aliyev, 2023; Vaidya, 2023). De Lima Figueiredo et al. (2023) highlight that government involvement not only increases the likelihood of inter-actor cooperation but is also crucial for national economic development.

This is consistent with Pham-Truffert et al.'s (2020) assertion that SDG 17 encourages mutually beneficial interactions with other SDGs, magnifying their effects and accelerating progress. Accordingly, we propose the second hypothesis:

H2. *The larger the number of actors involved in cooperation in business innovation, the greater the likelihood that firms will regard employment as one of the objectives of the innovation process.*

If the above hypotheses are confirmed, the analysis of the interconnections between SDG 8, SDG 9, and SDG 17 could be further advanced. According to Novick (2008), technological change driven by business innovation can contribute to the creation of higher-quality jobs, provided there is adequate institutional support to promote, sustain, and strengthen innovation processes. Conversely, Müller et al. (2018) argue that technological innovation within firms tends to foster the creation of low-skilled jobs. In this context, Novick (2008) also notes that empirical evidence on the relationship between innovation strategies and employment remains limited. Accordingly, Mofakhami (2022) calls for further research into the impact of innovation on job quality.

Mathieu and Boethius (2021) explore the complex relationship between innovation, job quality, and employment outcomes. Their findings suggest that innovation generally increases employment and enhances job quality, particularly by generating more skilled and fewer low-skilled positions. However, they emphasise the presence of mediating factors that influence how innovation affects job quality. Similarly, Grande et al. (2020), in their study of firms across 32 European countries, highlight the significance of business cooperation in the creation of skilled jobs. They also find that different types of innovation have varying effects on employment quality, once again suggesting the role of mediating factors in improving job quality within firms. Warhurst et al. (2018) analyse the relationship between innovation and job quality in the European Union and concur that it is complex and multidimensional, producing diverse outcomes. They recommend that future research consider additional variables that may shape this interaction.

Building on the above, and drawing on the Triple Helix framework, we also consider whether the type of actors involved might influence the effect of innovation cooperation on employment quality. Prior studies suggest that business–university collaboration can support the creation of skilled jobs (Messina et al., 2022; Tereshchenko et al., 2024). Evers and Østergaard (2025) highlight how such partnerships facilitate knowledge transfer and access to highly skilled talent. Other authors (Lam, 2007; Ankrah et al., 2013) argue that these collaborations support career progression, helping individuals transition to more secure employment. In Germany, Hajrizi et al. (2025) show that cross-border university–industry collaboration contributes positively to both, innovation and career development, particularly in high-tech sectors.

These considerations lead to a third hypothesis:

H3. *The positive effect of cooperation in business innovation on employment is not homogeneous but depends on the actors involved in the cooperation.*

In sum, the three hypotheses posit that cooperation for business innovation with Triple Helix actors positively affects employment; that this effect increases with the number of cooperating agents; and that it varies depending on the specific actors involved. By integrating the Triple Helix model (Etzkowitz & Leydesdorff, 1995) with the virtuous cycle concept (Kroll et al., 2019), we can better understand how cooperation (SDG 17) drives innovation (SDG 9), and how this, in turn, fosters employment (SDG 8). This perspective aligns with Van Zanten and Van Tulder's (2021) view of the systemic, interconnected nature of sustainable development, and the key role firms play in achieving the SDGs (Suárez-Serrano et al., 2025).

Materials and methods

Sample

This study draws on the PITEC (Panel on Technological Innovation) database, compiled by the Spanish National Statistics Institute (INE), using data from the Survey on Technological Innovation in Companies and the Statistics on R&D Activities (Spanish National Statistics Institute [INE], 2017, 2022). The PITEC follows the criteria established by the European Community Innovation Survey (CIS) and provides information on technological innovation activities and strategies for the period 2003-2016. It is one of the most widely used sources in innovation research (De Marchi, 2012; Teruel & Segarra-Blasco, 2022; Peiró-Signes et al., 2024).

The initial sample comprised 171,511 observations, representing 12,849 firms over the period 2003–2016. However, due to the unavailability of data for key variables, particularly those related to employment prior to 2010, the sample was restricted to the period 2010–2016. This adjustment reduced the sample to 102,678 observations. Subsequently, firms with incomplete records due to acquisitions, closures (temporary or permanent), inactivity, or untraceable status, as well as statistical outliers, were excluded. To ensure sample homogeneity, only firms with data for at least four consecutive years were retained. The final sample comprises an unbalanced panel of 5,397 Spanish firms, totalling 27,876 observations.

It should be noted that the sample used could not incorporate more recent information as the Spanish National Statistics Institute (INE) has not collected additional data for the years following 2016. Although this constitutes a limitation, the large number of observations and companies included in the sample allows for the derivation of significant results and conclusions regarding the phenomenon under analysis. The sample size lends ~~significant~~ statistical power to the study, reducing the probability of error and enabling the generation of robust and reliable results within the period considered. Additionally, the study facilitates the identification of structural patterns or behaviours that, by their nature, may transcend a specific time frame and retain explanatory validity beyond the sample's temporal scope.

Furthermore, the dataset enables the identification of structural patterns and firm behaviours that are likely to persist beyond the sampled period, due to contextual similarities. From an institutional perspective, the cooperative innovation model analysed in this study remains a cornerstone of both, European and national innovation policies, as demonstrated by the continuity from Horizon 2020 to Horizon Europe (European Commission, 2021) and the CDTI Innovation Report (Centro para Desarrollo Tecnológico y la Innovación, 2023). Moreover,

for collaborating agents, structural motivations for engaging in innovation, such as risk reduction, access to complementary knowledge, and resource sharing, remain highly relevant in today's innovation ecosystems (Bogers et al., 2018; Freire & Goncalves, 2022). It is also worth noting that the sample period was shaped by the aftermath of the global financial crisis and the subsequent recovery-conditions that are comparable to those of recent years, marked by the COVID-19 pandemic and its recovery phase. In both contexts, heightened uncertainty reinforced the strategic importance of innovation collaboration, offering meaningful parallels for comparing organisational behaviour.

Variables

To test the hypotheses, three dependent variables were defined, reflecting the role that employment-related objectives play in firms' decisions to pursue technological innovation. These were derived from PITEC questions that ask whether maintaining or creating employment influences a firm's innovation activities. Respondents could rate the importance of these objectives as high, medium, low, or not relevant. Based on this, the following binary variables were created: (a) INC_EMP takes the value of 1 if the importance of job creation is rated as high or medium, otherwise 0; (b) MAIN_EMP takes the value of 1 if the importance of job maintenance is rated as high or medium, otherwise 0; (c) INC_QUA_EMP, takes the value of 1 if the importance of creating qualified employment is rated as high or medium, otherwise 0. The construction of these variables is consistent with previous studies that used PITEC (e.g., De Marchi, 2012; Marzucchi & Montresor, 2017; Arranz et al., 2020; Afcha et al., 2023).

The explanatory variables are based on PITEC indicators of cooperation in the innovation process. PITEC identifies various cooperation partners, including universities or higher education institutions, public or private research organisations, technology centres, affiliated firms, suppliers, customers, competitors, consultants, commercial labs, and private R&D institutes.

Following Hernández-Trasobares and Murillo-Luna (2020) and Murillo-Luna and Hernández-Trasobares (2023), and based on the Triple Helix model, cooperation agents were grouped into three categories: (a) Universities: cooperation with universities or other higher education institutions; (b) Government: cooperation with governmental bodies and/or receipt of regional, national, or international subsidies; (c) Industry: cooperation with companies in the same group or sector, suppliers, customers, or competitors.

As such, the cooperation variables were based on the number and type of agents involved in cooperation. All of them were dummy variables that take a value of 1 if cooperation occurs as described, and 0 otherwise. This set of cooperation variables was structured into three distinct groups based on the nature of the cooperative relationships being measured.

The first, more general group indicated whether a firm engages in cooperation and, if so, specifies the type or types of partners involved. This group included the following variables: (a) COOP: the firm cooperates with any type of agent; (b) IND_C: the firm cooperates with industry agents; (c) UNI_C: the firm cooperates with academia; and (d) GOV_C: the firm cooperates with government or receives public subsidies. These variables are not mutually exclusive, allowing a firm to be included in multiple categories if it collaborates with more than one type of agent.

The second group of variables quantified the total number of distinct agent types with which a firm cooperates, regardless of the specific combination. This group included the following variables: (e) TRIPLE_C: cooperation with all three types of actors; (f) DOUBLE_C: cooperation with two of the three types of actors in the model; (g) SINGLE_C: cooperation with one of the three types of actors in the model. These variables are mutually exclusive; a firm can only be assigned to one category within this group in any given period. The classification for a given firm may change annually, depending on variations in the number of agents with which it cooperates.

Finally, the third group of cooperation variables considered both, the number and specific combination of cooperating agent types. This group included the following variables: (h) TRIPLE_UGI: cooperation with university, government and industry (analogous to TRIPLE_C); (i) DOUBLE_UG: cooperation with university and government; (j) DOUBLE_UI: cooperation with university and industry; (k) DOUBLE_GI: cooperation with government and industry; (l) SINGLE_U: cooperation only with university; (m) SINGLE_I: cooperation only with industry; (n) SINGLE_G: cooperation only with government. Similar to the second group, these variables are mutually exclusive, and a firm's classification within this group may change annually.

Additionally, the analysis included a set of control variables, in line with prior research (Fitjar & Rodríguez-Pose, 2013; González-Pernía et al., 2015; García-Pozo et al., 2018; de Lima Figueiredo et al., 2023; Teruel & Segarra-Blasco, 2022; Peiró-Signes et al., 2024). It is worth noting that a logarithmic transformation was applied to certain variables to reduce their scale and mitigate data dispersion. This transformation helps stabilise the variance and minimise heteroscedasticity (Greene, 2012; Wooldridge, 2016). The control variables included: (a) SIZE: firm size (log of sales volume); AGE: firm age (log of years since establishment); (c) INN: innovation dummy (1 if the firm innovates in products or processes); (d) PUBLIC: public ownership dummy (1 if the firm is state-controlled); (e) GROUP: group affiliation dummy (1 if the firm is part of a corporate group); (f) EXPORT: export activity dummy (1 if the firm exports); (g) GTINN: total innovation expenditure (log--transformed); (h) GROWTH: difference in the log of number of employees between consecutive years. Sector and year dummy variables (not reported in the results tables) were also included to improve model specification.

Table 1 presents the variables used in the study.

Econometric techniques

In accordance with the characteristics of the sample and the nature of the dependent and explanatory variables, we employed logistic panel data models, specifically random-effects models (Larsen et al., 2000). Fixed-effects models were discarded because they do not account for cases wherein the dependent variables remain constant over time, thereby reducing the number of degrees of freedom (Wooldridge, 2002; Faraway, 2006). Moreover, in fixed-effects models, dummy variables or any variables that do not vary over time were excluded from the estimation (Greene, 2012). The logit panel data models were estimated using Stata 11 econometric software.

The probability model used to test the hypotheses was specified as:

$$P\left(\text{Employment Variables}_{i,t}=1 \mid \text{Cooperation Variables}_{i,t}, \text{Control Variables}_{i,t}, \text{Sector Variables}_{i,t}, \text{Year Variables}_{i,t}; \varepsilon_{it}\right) = \Lambda\left(\beta_0 + \beta_1 \text{Cooperation Variables}_{i,t} + \beta_2 \text{Control Variables}_{i,t} + \beta_3 \text{Sector Variables}_{i,t} + \beta_4 \text{Year Variables}_{i,t}\right) + \varepsilon_{it}$$

Where Λ (z) is the logistic function, ε_{it} is the random-effect, β_0 the constant, β_1, β_2, β_3 and β_4 the estimated coefficients that measure the marginal effect, i is the firm (i= 1,…n) and t is time (t= 1,…,t).

The variables included in the analysis were grouped as follows: (1) Employment variables (dependent variables): INC_EMP, MAIN_EMP, and INC_QUA_EMP; (2) Cooperation variables (explanatory variables): COOP, IND_C, UNI_C, GOV_C, TRIPLE_C, DOUBLE_C, SINGLE_C, TRIPLE_UGI, DOUBLE_UG, DOUBLE_UI, DOUBLE_GI, SINGLE_U, SINGLE_G, and SINGLE_I; (3) Control variables: SIZE, AGE, INN, PUBLIC, GROUP, EXPORT, GTINN, and GROWTH; (4) Sector variables: eight sectoral dummy variables were included; (5) Year variables: annual dummy variables for the period 2010-2016; (6) ε_{it}: unobserved firm-specific effects. All variables are described in detail in Table 1.

Table 1
Description of the variables.

Dependent variables (dummy variables)	
INC_EMP	Dummy variable equal to 1 if the importance of job creation is rated as high or medium.
MAIN_EMP	Dummy variable equal to 1 if the importance of job maintenance is rated as high or medium.
INC_QUA_EMP	Dummy variable equal to 1 if the importance of creating qualified employment is rated as high or medium.
Explanatory variables (dummy variables)	
COOP	Dummy variable equal to 1 if the firm engages in any form of cooperation.
IND_C	Dummy variable equal to 1 if the firm cooperates with industry.
UNI_C	Dummy variable equal to 1 if the firm cooperates with academia.
GOV_C	Dummy variable equal to 1 if the firm cooperates with government.
TRIPLE_C	Dummy variable equal to 1 if the firm cooperates with industry, academia and government.
DOUBLE_C	Dummy variable equal to 1 if the firm cooperates with two agents (industry-academia, industry-government or academia-government).
SINGLE_C	Dummy variable equal to 1 if the firm cooperates with a single agent (industry, academia or government).
TRIPLE_UGI	Dummy variable equal to 1 if the firm cooperates with all three agents.
DOUBLE_UG	Dummy variable equal to 1 if the firm cooperates with academia and government.
DOUBLE_UI	Dummy variable equal to 1 if the firm cooperates with academia and industry.
DOUBLE_GI	Dummy variable equal to 1 if the firm cooperates with government and industry.
SINGLE_U	Dummy variable equal to 1 if the firm cooperates only with academia.
SINGLE_G	Dummy variable equal to 1 if the firm cooperates only with government.
SINGLE_I	Dummy variable equal to 1 if the firm cooperates only with industry.
Control variables	
SIZE	Log (sales volume).
AGE	Log (years since establishment).
INN	Dummy variable equal to 1 if the firm innovates in products or processes.
PUBLIC	Dummy variable equal to 1 if the firm is state-controlled.
GROUP	Dummy variable equal to 1 if the firm is part of a corporate group.
EXPORT	Dummy variable equal to 1 if the firm exports.
GTINN	Log (total innovation expenditure).
GROWTH	Log (number of employees in year *t*) – Log (number of employees in year *t-1*).
SECTOR	Dummy variable equal to 1 if the firm operates in the reference industry; eight industries are considered.
YEAR	Dummy variable equal to 1 if the observation corresponds to the reference year in the period 2010–2016.

Results

Table 2 presents the descriptive statistics of the sample firms for all variables considered, both, sector-wise and aggregates. The final sample comprised 5,397 companies, predominantly operating in the sectors of Industry and Construction, Consumer Services, and Consumer Goods.

With respect to the dependent variables, 59.74% of firms report that maintaining employment is an important objective in their innovation processes. In contrast, 44.15% believe that creation of qualified jobs is important, while 34.95% prioritise the general objective of increasing employment. Employment-related objectives are particularly relevant in the Industry and Construction, and Consumer Goods sectors (especially for job maintenance and growth), and in Technology and Communications (notably for the creation of qualified jobs).

Regarding cooperation, 56.43% of companies engage in some form of collaborative activity, primarily with industrial agents (46.08%), followed by government bodies (40.54%) and universities (34.08%). In terms of the number of cooperating agents, 28.43% of firms engage with all three actor types, while 20.59% cooperate with only one, and 7.40% with two. The most common cooperation pattern is triple collaboration (university–government–industry), followed by cooperation with industry alone (11.58%) and government alone (approximately 7.40%). By contrast, two-actor models are the least frequent, representing only 3.27% of the cases. Cooperation levels are highest in the Oil and Energy (78.69%), Agriculture and Fishing (62.54%), and Technology and Communications (59.81%) sectors, although there is considerable variation across sectors.

Table 2 also reveals that 86.90% of firms engage in innovation, mainly in Financial and Real Estate Services. Additionally, 2.5% of companies are state-controlled, especially in Real Estate Services. Half of the firms (50.01%) belong to a business group, particularly in Financial Services. Regarding internationalisation, 79.15% of firms report export activity, especially in the Consumer Goods sector. The average company size, measured by sales turnover, is approximately 11.7 million euros, with the largest firms found in Financial Services and Oil and Energy. The average firm age is 29.37 years, with the oldest companies located in the Financial and Real Estate Services sectors. The highest levels of total innovation expenditure are also concentrated in Financial Services and Oil and Energy. Finally, firm growth is observed primarily in the Agriculture and Fishing, and Oil and Energy sectors, while a downward trend in growth is evident across the remaining sectors, particularly Financial Services.

Appendix A includes the correlation matrices (Tables A1, A2, and A3). Overall, a positive correlation is observed between innovation cooperation—particularly involving multiple actors—and the prioritisation of employment objectives. As for control variables, employment-related outcomes are positively associated with innovation activity, exporting, innovation expenditure, and firm growth, and negatively associated with firm age and public ownership. Cooperation variables also generally demonstrate positive correlations with control variables, except for age. When broken down by cooperation type and partner combination, both positive and negative associations emerge.

Table 3 presents the results of the random-effects logistic regression models, which examine the influence of general innovation cooperation (and by actor type) on employment-related objectives. Coefficients are expressed as marginal effects, with standard errors indicated in parentheses. Significance levels at 1%, 5%, and 10% are indicated. The findings confirm a positive and significant relationship between innovation cooperation and the importance firms attribute to employment maintenance and creation (including qualified employment) thus supporting Hypothesis H1.

Cooperation in innovation enables firms to pool resources, knowledge, and capabilities from diverse actors, generating synergies that enhance organisational efficiency and competitiveness (Powell & Gianella, 2010; Weber & Heidenreich, 2018). Innovation implementation often requires not only maintaining the current workforce, but also new staff to meet technological and organisational demands (Freire & Gonçalves, 2022), especially in high-tech or disruptive contexts (Schneider et al., 2010). These dynamics help explain why cooperation with industrial agents is positively associated with prioritising employment objectives (see Table 3).

In terms of qualified employment, collaboration with universities has a more pronounced effect than with other actors. Universities play a central role in knowledge transfer and innovation (Zhou & Wang, 2023), providing highly trained personnel essential for roles created through innovation processes and helping reduce knowledge transfer costs (Dooley & Kirk, 2007; Fitjar & Gjelsvik, 2018).

On the other hand, the implementation of cooperation agreements between firms and governments (including public financial funds) can promote the business innovation process, with a positive impact on regional development and employment generation (Lundberg & Andresen, 2012; Alawi et al., 2023). However, it is crucial that such agreements and the allocation of resources are guided by strict efficiency criteria. Otherwise, there is a risk of generating distortions, such as creating jobs tied to subsidies that do not enhance firms' competitiveness and, therefore, disappear once funding ends (Lanahan et al., 2021).

This issue can be reflected in the results presented in Table 3 where,

Table 2
Descriptive statistics of the study variables (mean values).

Variable	Total	Standard deviation	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8
INC_EMP	**34.95**	**0.47**	29.58	26.90	36.36	37.45	31.96	19.78	33.51	36.84
MAIN_EMP	**59.74**	**0.49**	56.92	59.93	62.44	61.35	55.15	39.20	57.63	36.84
INC_QUA_EMP	**44.15**	**0.49**	40.07	41.03	45.58	44.58	41.98	29.76	44.77	36.84
COOP	**56.43**	**0.49**	62.54	78.69	55.10	53.50	58.83	58.80	59.81	39.47
IND_C	**46.08**	**0.49**	42.69	67.48	44.81	45.69	47.12	58.07	45.68	26.13
UNI_C	**34.08**	**0.47**	44.19	60.76	34.52	32.64	34.36	10.34	34.06	13.15
GOV_C	**40.54**	**0.49**	46.44	62.33	42.10	36.05	40.93	7.25	44.26	21.05
TRIPLE_C	**28.43**	**0.45**	29.58	51.12	30.18	26.90	27.17	6.71	26.30	7.89
DOUBLE_C	**7.40**	**0.26**	11.61	9.64	5.97	7.07	9.24	3.44	11.58	5.26
SINGLE_C	**20.59**	**0.40**	21.34	17.93	18.94	19.52	22.41	48.63	21.93	26.31
TRIPLE_UGI	**24.43**	**0.45**	29.58	51.12	30.18	26.90	27.17	6.71	26.30	7.89
DOUBLE_UG	**1.34**	**0.11**	4.86	2.24	1.01	1.13	1.58	0	2.69	0
DOUBLE_UI	**2.79**	**0.16**	4.49	4.48	1.98	3.27	3.65	3.26	3.49	5.26
DOUBLE_GI	**3.27**	**0.17**	2.24	2.91	2.97	2.66	4.05	0.18	5.39	0
SINGLE_U	**1.50**	**0.13**	5.24	2.91	1.33	1.33	1.95	0.36	1.56	0
SINGLE_G	**7.40**	**0.26**	9.73	6.05	7.92	5.34	8.16	0.36	9.87	13.15
SINGLE_I	**11.58**	**0.32**	6.36	8.96	9.67	12.85	12.28	47.91	10.49	13.15
SIZE	**16.28**	**2.09**	15.75	18.00	16.16	17.12	15.93	19.06	15.05	15.71
AGE	**3.38**	**0.52**	3.35	3.42	3.43	3.53	3.25	3.88	3.03	3.58
INN	**86.90**	**0.33**	80.14	78.92	87.56	88.58	83.99	94.91	86.08	92.10
PUBLIC	**2.50**	**0.15**	2.62	21.52	1.09	0.34	6.23	1.81	3.31	31.57
GROUP	**50.01**	**0.50**	50.93	66.59	48.61	58.04	44.60	85.48	41.45	71.05
EXPORT	**79.15**	**0.40**	70.78	36.54	88.71	91.90	58.51	37.74	62.33	55.26
GTINN	**12.65**	**1.80**	12.35	13.19	12.69	12.87	12.19	13.66	12.63	12.55
GROWTH	**-0.006**	**0.21**	0.018	0.115	-0.007	0.002	-0.013	-0.025	-0.008	-0.016
FIRMS (N)	**5,397**	**—**	53	88	2,438	1,041	1,111	114	541	11

Note: Sector 1: Agriculture and Fishing; Sector 2: Oil and Energy; Sector 3: Industry and Construction; Sector 4: Consumer Goods; Sector 5: Consumer Services; Sector 6: Financial Services; Sector 7: Technology and Communications; Sector 8: Real Estate Services.

Table 3
Influence of cooperation on the employment objective by type of collaborating agent: Industry, University, or Government (random-effects logit estimations).

	INC_EMP		**MAIN_EMP**		**INC_QUA_EMP**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
COOP	0.307***		0.522***		0.463***	
	(0.052)		(0.049)		(0.050)	
IND_C		0.233***		0.378***		0.234***
		(0.060)		(0.058)		(0.058)
UNI_C		0.228***		0.293***		0.487***
		(0.072)		(0.071)		(0.070)
GOV_C		0.072		0.164***		0.116*
		(0.065)		(0.063)		(0.062)
SIZE	-0.029	-0.031	-0.108***	-0.110***	-0.035	-0.037
	(0.024)	(0.024)	(0.023)	(0.023)	(0.021)	(0.023)
AGE	-0.588***	-0.579***	-0.239***	-0.227***	-0.426***	-0.411***
	(0.091)	(0.090)	(0.084)	(0.083)	(0.086)	(0.086)
INN	0.167**	0.146**	0.311***	0.288***	0.330***	0.306***
	(0.068)	(0.069)	(0.063)	(0.063)	(0.065)	(0.066)
PUBLIC	-0.670***	-0.693***	-0.559**	-0.587***	-0.733***	-0.777***
	(0.224)	(0.246)	(0.216)	(0.215)	(0.229)	(0.229)
GROUP	-0.063	-0.061	-0.143**	-0.143**	-0.021	-0.019
	(0.076)	(0.076)	(0.072)	(0.072)	(0.073)	(0.073)
EXPORT	0.179**	0.181***	0.255***	0.252***	0.175**	0.177**
	(0.079)	(0.079)	(0.075)	(0.075)	(0.076)	(0.076)
GTINN	0.244**	0.266***	0.243***	0.231***	0.312***	0.297***
	(0.020)	(0.020)	(0.018)	(0.018)	(0.019)	(0.019)
GROWTH	0,507***	0,503***	0.199**	0.194**	0.437***	0.431***
	(0,958)	(0,095)	(0.085)	(0.085)	(0.090)	(0.090)
CONSTANT	-2.249***	-2.390***	-0.790	-0.666	-3.252***	-3.145***
	(0.590)	(0.590)	(0.541)	(0.539)	(0.563)	(0.562)
Number of observations	27,876	27,876	27,876	27,876	27,876	27,876
Number of groups	5,397	5,397	5,397	5,397	5,397	5,397
Log-likelihood	-13,732.81	-13,714.40	-14,584.59	-14,548.08	-14,541.47	-14,489.67
Wald X^2	447.11***	481.98***	502.52***	572.22***	610.84***	706.70***
Likelihood-ratio test	7,474.59***	7,446.21***	7,159.75***	7,044.21***	7,520.99***	7,455.15***
Variance Inflation Factor (VIF)	4.60	4.45	4.60	4.45	4.60	4.45

Note: ***, **, * denote significance at the 1%, 5% and 10% levels, respectively. Sector and year dummy variables are included.

although cooperation with government bodies has a positive effect, it is less than half the impact of cooperation with industrial agents or universities. In short, as a first approximation, these results underscore the role of cooperation among diverse stakeholders (SDG 17) as a catalyst for achieving other SDGs, particularly by promoting innovation (SDG 9), which, in turn, contributes to job creation and economic growth (SDG

8).

The results in Table 4 reflect the influence of the total number of cooperating agents (triple, double, or single) on the importance allocated to job maintenance and creation. These findings confirm those presented in Table 3. Cooperation increases the likelihood of job maintenance and creation (both general and qualified employment), being regarded as key factors in the innovation process, regardless of whether the triple, double, or single cooperation model is adopted.

A positive correlation is observed between the number of cooperating agents and the importance assigned to employment objectives, especially in case of triple cooperation, followed by two- and single-agent cooperation. A greater number of cooperating agents allows for broader collaboration among different actors, facilitating the use and exchange of more information, practices, and processes. When properly managed, such cooperation can generate knowledge flows that drive the innovative process (Chesbrough, 2020). Indeed, the larger the number of participating actors, the greater the impact on business innovation activities (Becker & Dietz, 2004; Hernández-Trasobares & Murillo-Luna, 2020).

Furthermore, a larger number of collaborating agents can lead to greater complementarities by combining resources, favouring the success of developed products and services (Laursen & Salter, 2014). Consequently, cooperating firms expand their production scale or launch new products, directly impacting employment. While an initial reduction in the workforce might occur, compensation mechanisms may counteract this decline, implying that innovation fosters demand for new employees, particularly more qualified ones, thus leading to job creation (Viverelli, 2014). This supports the inclusion of employment among firms' strategic objectives.

Nevertheless, the benefits of multi-actor cooperation must outweigh the increased coordination, transaction, and intellectual property management costs associated with more complex partnerships (Provan et al., 2007; Alexy et al., 2013). The results in Table 4 confirm the positive effect of a greater number of innovation collaborators on employment objectives, thereby supporting Hypothesis H2.

Table 5 presents the influence of cooperation in business innovation on job creation and maintenance objectives in more detail, considering all types of cooperation. Once again, a positive relationship is observed between the number of cooperating agents and the importance attributed to job maintenance and creation.

However, the results suggest that the types of agents involved in cooperation influence the degree of importance attributed to employment-related goals, thereby supporting Hypothesis H3.

In all cases, three-way cooperation (university-government-industry) exerts the greatest influence on employment variables, confirming the findings presented in Table 4 and discussed in H2. For two-agent cooperation, the effects vary depending on the agents involved: university-industry cooperation, the only form of cooperation associated with a positive effect on the general objective of increasing employment, exerts the strongest positive effect on job maintenance and creation. Finally, in the case of single-agent cooperation, partnerships with industrial agents exhibit a stronger positive influence on job maintenance and overall employment creation, while cooperation with universities has a greater impact on the creation of qualified jobs.

These findings confirm that the type of actors involved in innovation cooperation influences the priority accorded to maintaining or creating employment. More specifically, cooperation with industrial agents positively influences both, the maintenance and creation of ~~(~~general~~)~~ employment, regardless of whether a triple, double, or single

Table 4
Influence of cooperation on the employment objective by number of collaborating agents: triple, double, or single (random-effects logit estimations).

	INC_EMP	MAIN_EMP	INC_QUA_EMP
TRIPLE_C	0.560***	0.865***	0.866***
	(0.066)	(0.064)	(0.064)
DOUBLE_C	0.194**	0.457***	0.374***
	(0.087)	(0.085)	(0.084)
SINGLE_C	0.165***	0.318***	0.222***
	(0.060)	(0.056)	(0.057)
SIZE	-0.030	-0.108***	-0.035
	(0.024)	(0.023)	(0.021)
AGE	-0.557***	-0.224***	-0.409***
	(0.090)	(0.083)	(0.086)
INN	0.154**	0.298***	0.313***
	(0.068)	(0.063)	(0.066)
PUBLIC	-0.692***	-0.584***	-0.776***
	(0.246)	(0.215)	(0.229)
GROUP	-0.057	-0.141*	-0.019
	(0.076)	(0.072)	(0.073)
EXPORT	0.175**	0.247***	0.169**
	(0.079)	(0.075)	(0.076)
GTINN	0.231***	0.228***	0.292***
	(0.020)	(0.018)	(0.019)
GROWTH	0.503***	0.194**	0.430***
	(0,095)	(0.085)	(0.906)
CONSTANT	-2.387***	-0.687	-3.111***
	(0.590)	(0.539)	(0.562)
Number of observations	27,876	27,876	27,876
Number of groups	5,397	5,397	5,397
Log-likelihood	-13,713.591	-14,549.40	-14,491.33
Wald X^2	483.50***	569.64***	703.34***
Likelihood-ratio test	7.448.69***	7,047.32***	7,460.63***
Variance Inflation Factor (VIF)	4.33	4.33	4.33

Note: ***, **, * denote significance at the 1%, 5% and 10% levels, respectively. Sector and year dummy variables are included.

Table 5
Influence of cooperation on the employment objective by type of collaborating agent: University, Government, and Industry (random-effects logit estimations).

	INC_EMP	MAIN_EMP	INC_QUA_EMP
TRIPLE_UGI	0.552***	0.854***	0.858***
	(0.066)	(0.064)	(0.064)
DOUBLE_UG	0.045	0.407**	0.447***
	(0.175)	(0.176)	(0.169)
DOUBLE_UI	0.440***	0.621***	0.629***
	(0.134)	(0.130)	(0.129)
DOUBLE_GI	0.052	0.320***	0.124
	(0.121)	(0.120)	(0.118)
SINGLE_U	-0.077	0.138	0.314**
	(0.179)	(0.165)	(0.166)
SINGLE_G	0.111	0.203**	0.139*
	(0.088)	(0.083)	(0.084)
SINGLE_I	0.227***	0.414***	0.253***
	(0.075)	(0.070)	(0.072)
SIZE	-0.033	-0.111***	-0.038
	(0.024)	(0.023)	(0.023)
AGE	-0.579***	-0.227***	-0.411***
	(0.091)	(0.083)	(0.086)
INN	0.148**	0.289***	0.306***
	(0.069)	(0.063)	(0.060)
PUBLIC	-0.700***	-0.589***	-0.780***
	(0.246)	(0.215)	(0.229)
GROUP	-0.062	-0.146*	-0.021
	(0.076)	(0.075)	(0.073)
EXPORT	0.177**	0.250***	0.174**
	(0.079)	(0.075)	(0.076)
GTINN	0.234***	0.231***	0.297***
	(0.020)	(0.018)	(0.019)
GROWTH	0.505***	0.196**	0.433***
	(0.095)	(0.085)	(0.090)
CONSTANT	-0.234***	-0.651	-3.121***
	(0.591)	(0.539)	(0.563)
Number of observations	27,876	27,876	27,876
Number of groups	5,397	5,397	5,397
Log-likelihood	-13,709.99	-14,545.05	-14,486.01
Wald X^2	491.43***	577.38***	712.73***
Likelihood-ratio test	7,455.781***	7,044.31***	7,459.86***
Variance Inflation Factor (VIF)	3.87	3.87	3.87

Note: ***, **, * denote significance at the 1%, 5% and 10% levels, respectively. Sector and year dummy variables are included.

cooperation model is adopted. In contrast, the creation of qualified jobs is more likely to be prioritised when universities are involved in cooperation agreements (whether triple, double or single). The participation of industrial agents particularly fosters employment maintenance or creation, in general, while the involvement of universities is essential for the creation of qualified employment.

This heterogeneity in the positive effect of innovation cooperation on employment can be explained by the divergent nature of the agents involved, the resources and knowledge they contribute, and the ultimate objectives they pursue through cooperation agreements. The participation of universities in such agreements enables access to more advanced scientific knowledge and technological capabilities (Zhou & Wang, 2023), rendering them particularly relevant in innovation processes that require highly qualified personnel (Perkmann & Walsh, 2007). This may explain the greater influence of university cooperation on the creation of highly qualified employment across triple, double, and single cooperation modes.

Conversely, cooperative engagements among firms and their extended networks (including suppliers, distributors, and other linked entities) are fundamentally driven by objectives of cost reduction, risk mitigation, and efficiency (Tsai, 2009; Ritala et al., 2016). While these collaborations may not always exhibit the high degree of research or scientific specialisation found in university partnerships, they contribute substantially to process improvement and the successful introduction of new products (Weber & Heidenreich, 2018). Such advancements frequently require the recruitment of additional personnel (Freire & Gonçalves, 2022). In this context, the new jobs generated do not necessarily require higher skills, as this depends on the specific characteristics of the sector in which the firm operates (Vivarelli, 2014). As evidenced in Table 5, the positive impact of industrial cooperation on employment primarily manifests in job maintenance and creation, and to a lesser extent in qualified employment—an area where universities play a more relevant role.

Finally, the limited influence of government participation in cooperation agreements is confirmed, as anticipated in Table 3. This result may be explained by several factors: the potential distortion in the allocation of government funds and resources during cooperation processes, which would undermine their effectiveness (Lanahan et al., 2021); the moderating effect of certain demographic characteristics (Alawi et al., 2023); or the limited influence of government funding on firms' performance outcomes (Mondal & Mellor, 2025). Nonetheless, this finding underscores the need for further analysis and points to an emerging line of research (Lanahan et al., 2021).

Considering the control variables, both firm age and size negatively impact employment creation and maintenance, mainly the former (Lawless, 2014). As a firm grows older and larger, it may reach or exceed its optimal size, which complicates management, increases bureaucracy, and raises operating costs, thereby reducing incentives to create new jobs (Besanko et al., 2009; Liu, 2024). Additionally, an increase in firm age may result in lower productivity (Loderer & Waelchli, 2010), which negatively affects its capacity to generate employment (Lawless, 2014; Liu, 2024).

Moreover, the public character of a company implies that its primary objective is not job creation, but the efficient provision of goods and services of general interest, especially in strategic sectors (Hart et al., 1997). In this context, staff recruitment is not an end in itself, but a means subordinated to the fulfilment of this function (Grossi & Reichard, 2008). This efficiency-oriented approach (Hart et al., 1997) justifies hiring only when strictly necessary, which may explain the results obtained.

The various estimated models highlight the positive effects of innovation—both the decision to innovate and the total costs associated with the process—and growth on employment. Greater competitiveness among innovative firms enhances their market share, requiring the recruitment of additional personnel, including qualified workers (Dachs & Peters, 2014; Dahl, 2015; Van Roy et al., 2018).

Similarly, the sale of products and services to multiple countries fosters company growth, resulting in increased personnel needs, thereby justifying the positive influence of exporting on employment (Liu et al., 2019; Lassmann, 2020).

In contrast, in models where the dependent variable corresponds to the objective of increasing employment (whether overall or qualified), the constant term is negative and statistically significant. This suggests that when all explanatory variables are equal to zero, the baseline propensity to prioritise employment growth is relatively low—an outcome—unlikely to be due to random variation. Conversely, in models addressing the objective of maintaining employment, the statistical significance of the constant is weaker or non-existent. This indicates that the likelihood of setting employment maintenance as an objective is similar to that of not doing so when the explanatory variables are zero (Cameron & Trivedi, 2005).

Discussion

The results obtained in this study may serve as an example of what Kroll et al. (2019) describe as the 'virtuous circle of SDG progress'. More specifically, they illustrate how cooperation among diverse actors (SDG 17) can contribute to the achievement of other SDGs by fostering innovation (SDG 9) and, consequently, generating employment (SDG 8).

These findings align with the integrative framework proposed by Romero-Goyeneche et al. (2022), who categorise the SDGs into three types: (1) those related to 'socio-technical systems' (including SDG 9); (2) those that integrate social and ecological approaches in the processes of socio-technical system transformation (including SDG 8); and (3) those that advocate for broad participation in this transformation, as well as the formation of networks among multiple stakeholders (including SDG 17). The authors underscore the importance of understanding the interrelationships among these types of SDGs in order to harness synergies and accelerate progress. Moreover, they highlight the transformative potential of these three SDG types when approached from an integrative perspective.

The key implications of these results—from theoretical, managerial, and public policy perspectives—are elaborated below.

Theoretical implications

Previous research, such as that conducted by Van Zanten and Van Tulder (2021), has emphasised the systemic and interconnected nature of the SDGs. This study provides empirical evidence supporting this claim. It suggests that progress on the SDGs should be examined through theoretical frameworks capable of analysing the interrelationships among the goals, rather than focusing on isolated achievements (Sachs et al., 2019).

Moreover, Wu et al. (2022) highlight the importance of engaging a wide range of stakeholders in this process, including universities, governments, and businesses (Romero-Goyeneche et al., 2022). In this regard, combining Etzkowitz and Leydesdorff's (1995) Triple Helix model with Kroll et al.'s (2019) concept of the 'virtuous cycle of SDG progress' may offer a useful theoretical foundation for expanding the potential outcomes of business collaboration with Triple Helix actors. From an SDG perspective, such cooperation (SDG 17) facilitates business innovation (SDG 9) and contributes to job creation (SDG 8).

Managerial implications

Managers should assess and manage the interactions among the SDGs to maximise co-benefits. The findings of this study suggest that innovation-oriented collaboration with Triple Helix actors can enhance firms' competitiveness by leveraging synergies, while simultaneously reducing costs and mitigating risks (Audretsch et al., 2023). Furthermore, this type of collaboration has indirect implications for employment, as the workforce and the skills required for innovation represent a

key source of competitive advantage for firms in the current Industry 4.0 landscape (Ullrich et al., 2023; Córcoles et al., 2025).

Additionally, these dynamics contribute to the advancement of corporate social responsibility by fostering cooperation with industry, academia, and government (SDG 17), facilitating business innovation (SDG 9), and promoting employment (SDG 8). This approach aligns with the four-stage process proposed by Berrone et al. (2023) for embedding the SDGs into corporate strategy: identifying the most strategically relevant SDGs for the firm, contextualising them within the firm's geographical and industrial environment, engaging with key stakeholders, and innovating business processes accordingly.

Ultimately, these findings underscore the pivotal role of the private sector in advancing the 2030 Agenda (Van Zanten & Van Tulder, 2021) and demonstrate that integrating the SDGs into corporate strategies can yield mutually beneficial outcomes (Domingo-Posada et al., 2024).

Public policy implications

From the perspective of governments, there is currently significant interest in designing mechanisms to foster innovation and employment (Jugend et al., 2020). These findings can inform policymaking and the establishment of governmental priorities for the implementation of the 2030 Agenda (Wu et al., 2022), particularly in the post-pandemic context, where the fragility of certain SDGs has become increasingly evident (Naidoo & Fisher, 2020).

Governments should prioritise and implement effective policies that promote innovation strategies fostering collaboration between firms and other actors—such as universities, industry, and public institutions. Furthermore, they should support the creation of platforms that facilitate the exchange of ideas among these stakeholders, while also providing financial assistance, advisory services, and training opportunities. Such external support is especially critical during periods of crisis, and particularly for SMEs (Adam & Alarifi, 2021). This will not only enhance the capacity of firms to survive and increase their competitiveness but will also generate a positive and direct impact on employment, thereby contributing to broader economic growth (López et al., 2024).

Conclusions

Romero-Goyeneche et al. (2022) highlight the transformative potential of the SDGs and advocate for the adoption of integrative approaches to monitor their progress. The findings presented in this study provide evidence supporting the value of studying the SDGs from an interconnected, systemic perspective. Specifically, this research enhances understanding of the interrelationships among selected SDGs, particularly SDGs 8, 9 and 17. It examines the impact of innovation-related cooperation in the business sector on job retention and creation, complementing Etzkowitz and Leydesdorff's (1995) Triple Helix model with Kroll et al.'s (2019) concept of the 'virtuous cycle of SDG progress'.

Drawing on a significant sample of Spanish firms, the study provides empirical evidence of the positive influence that innovation cooperation with Triple Helix actors exerts on employment—specifically, on the extent to which employment is considered a core objective within the technological innovation process.

First, the findings show that cooperation with industry, universities, and/or government bodies in innovation activities increases the likelihood that job maintenance and creation will be considered among the objectives of business innovation. In this regard, partnerships across sectors (SDG 17) promote innovation (SDG 9), in turn, supporting employment generation (SDG 8). Second, the results indicate that the greater the number of cooperating agents, the higher the probability that firms will consider employment retention and creation as objectives of their innovation strategies. Third, the study argues that the type of cooperating partner influences the nature of employment outcomes. Collaboration with industry is more strongly associated with overall job retention and creation, regardless of whether it occurs within triple, double or single cooperation models. In contrast, cooperation with universities—whether as part of triple, double or single arrangements—has a greater impact on the creation of qualified employment.

This research thus contributes to advancing knowledge on the interplay between SDGs 8, 9 and 17, underscoring the synergistic potential of innovation cooperation in promoting employment. Its contribution lies not only in its focus on the nexus between these three specific SDGs, but also in its methodological approach—panel data analysis—which yields robust empirical evidence from a representative sample of Spanish firms.

Nonetheless, the study acknowledges certain limitations, along with unresolved questions that point to fruitful avenues for future research.

Limitations

The first limitation concerns the period under analysis (2010–2016). Although the sample is large and possesses strong statistical potential, it is necessary to extend and update the time frame—particularly in light of the dynamic nature of interactions among the SDGs (Wu et al., 2022). Doing so would allow for an assessment of the stability of the results over time and help determine whether the influence of innovation cooperation on employment has evolved.

Secondly, the study uses the importance attributed to employment creation and retention within innovation partnerships as the dependent variable. While this measure offers valuable insight into firms' strategic orientations, it does not necessarily indicate that such intentions will materialise in actual job preservation or growth in subsequent years. It is, therefore, crucial to further investigate the extent to which the stated prioritisation of employment has translated into measurable outcomes, particularly with respect to the retention or expansion of qualified jobs.

Future research lines

The research has highlighted the relatively limited influence of government participation in innovation cooperation agreements on employment. Previous studies have reported mixed effects of government involvement, even on innovation itself. Zhuang et al. (2021) and Ahn et al. (2020), for example, warn of the risks associated with excessive public funding, which may reduce the incentive to collaborate. Kim and Park (2021) report that the impact of government cooperation varies depending on the time horizon—short- versus long-term—which may explain the inconclusive results regarding its influence on employment.

Further investigation is required to explore potential causes of this limited impact. These may include a misalignment between governmental objectives and those of other stakeholders (Lundberg & Andersen, 2012), the creation of subsidy dependency effects (Abdurakhmonov et al., 2021), inefficient resource allocation (Bronzini & Piselli, 2016), or administrative and bureaucratic burdens associated with government entities (Wen et al., 2021). As Ahn et al. (2020) emphasise, designing effective policy instruments to foster innovation is essential. A clearer understanding of the reasons behind the limited influence of government involvement could contribute to enhancing the efficiency of public intervention in collaborative initiatives, thereby improving both, innovation performance and employment outcomes.

Moreover, while this study focuses on the mutual relationships and potential synergies among three specific SDGs—SDGs 8, 9 and 17—it is equally important to consider the potential for trade-offs (United Nations, 2023). As noted, systemic interactions are inherently complex, and actions taken to advance one goal may both, support or hinder progress in others (Lusseau & Mancini, 2019; Bennich et al., 2020; Anderson et al., 2022). It is crucial to pursue progress in one area without compromising others, in order to fulfil the overarching ambition of the 2030 Agenda to 'leave no one behind' (Wu et al., 2022). This issue

warrants further investigation, as existing findings in the literature remain inconclusive. For instance, Anderson et al. (2022) note that while the literature often highlights the potential for SDGs and their targets to act as levers for one another, their global model—based on historical systemic interactions between indicators across countries—suggests that SDGs 8 and 9 are among the goals most affected by trade-offs. By contrast, Kroll et al. (2019) identify significant synergies between these two SDGs, arguing that others—such as SDG 17—may involve more substantial trade-offs. Understanding these interdependencies is essential in order to optimise synergies and minimise negative interactions (Pham-Truffert et al., 2020).

Finally, it is important to acknowledge that this study focuses exclusively on the Spanish context. As several authors have indicated (Lusseau & Mancini, 2019; Pradhan, 2019; Wu et al., 2022), the interactions between SDGs vary according to country-specific socio-economic conditions. Therefore, sustainable development requires that individual countries examine SDG synergies and trade-offs within their own national contexts.

Availability of data and materials

Data were requested from the Spanish Institute of Statistics (INE) and Spain's Science and Technology Foundation (FECYT), exclusively for the purpose of this research work. The authors do not have permission to share data.

CRediT authorship contribution statement

Alejandro Hernández-Trasobares: Writing – review & editing, Writing – original draft, Validation, Resources, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Josefina L. Murillo-Luna:** Writing – review & editing, Writing – original draft, Validation, Resources, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jik.2025.100786.

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