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Beyond intentions and institutions: Could cooperatives foster eco-innovation in the service sector?

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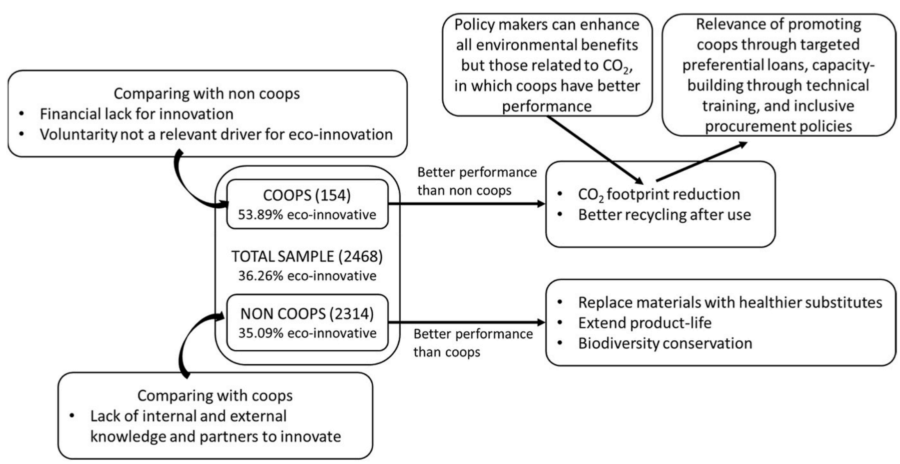
HIGHLIGHTS

- Taxes, subsidies and public procurement emerge as the most effective drivers.
- Internal motives show weak links to eco-innovation suggesting a capacity-intent gap.
- Coops lead in eco-innovation, particularly in CO_2 reduction and end-user recycling.
- Coops lag in capital-intensive areas like biodiversity and product life extension.
- Coops could be key to promote some eco-innovations that governments cannot.

GRAPHICAL ABSTRACT



ABSTRACT

Eco-innovation, defined as innovation that reduces environmental impacts, has gained prominence in sustainability research. However, research rarely integrates the service sector and cooperatives, leaving a gap in understanding how this governance interacts with sector-specific dynamics. This study addresses this gap by analyzing the drivers, constraints, and outcomes of eco-innovation in service firms in the Basque Country (Spain), focusing on cooperatives. Using data from the 2022 Innovation Survey, and grounded in environmental innovation theory, probit models are estimated for twelve types of environmental benefits. Findings reveal that cooperatives are more likely to engage in eco-innovation, particularly in CO_2 reduction and end-user recycling, but underperform in capital-intensive areas such as biodiversity conservation and product life extension. Public policy instruments—especially environmental taxes, subsidies, and public procurement—emerge as the most effective drivers, while current regulation shows limited influence. Internal motivations such as voluntary commitment and cost-saving are linked to fewer environmental benefits, suggesting a disconnect between intent and implementation capacity. Cooperatives face greater financial constraints but can play a key role in promoting eco-innovations difficult for public institutions to support. These findings contribute to a more nuanced understanding of eco-innovation by integrating organizational form and sectoral context. They also offer insights for policymakers aiming to promote sustainable innovation in service-based economies, highlighting the strategic role of cooperatives and the leverage of anticipatory regulation and public procurement. The study underscores the need for differentiated policy approaches and calls for further research into the interplay between internal motivations, organizational structure, and eco-innovation outcomes.

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1. Introduction

Eco-innovation, defined as innovation that reduces environmental impacts, is key to sustainable development. It encompasses technological and organizational practices that limit environmental harm while supporting economic goals. The OECD (2009) and European Commission (2011) stress its firm-strategic and policy relevance. Regulatory pressure is often its main driver, especially where market or technological incentives fall short (Díaz-García et al., 2015; Bossle et al., 2016; Jové-Llopis and Segarra-Blasco, 2020; Afeltra et al., 2023). However, the influence of drivers varies by sector and region, shaped by firm capabilities, stakeholder expectations, and institutional contexts (Demirel and Kesidou, 2011; Doran and Ryan, 2016; Horbach, 2016).

The transition to a more sustainable and inclusive development model (Fusco and Migliaccio, 2018) highlights cooperatives—autonomous associations of natural or legal persons, known as members, who voluntarily contribute capital to establish a structure of joint ownership and democratic control—as key to local economic development and social cohesion (Puusa et al., 2016; Bretos and Marcuello, 2017; Camargo Benavides and Ehrenhard, 2021; Hoffman, 2022). Their inherent alignment with the UN 2030 Agenda and the SDGs (Chaves-Avila and Gallego-Bono, 2020) is supported by the International Cooperative Alliance (2015), which includes sustainability among its principles. The UN General Assembly's 2023 resolution and the Secretary-General's report raise awareness of their impact on sustainability and recommend promoting cooperatives and adapting legislation to enhance their growth and influence (United Nations, 2023). The European Social Economy Action Plan (European Commission, 2021) and the ILO (2002) also echo cooperatives' role in sustainable development.

Globally, around 3 million cooperatives engage 12 % of the population as members, workers, or users (International Cooperative Alliance, 2025). The 300 largest cooperatives generated over $2.4 trillion in 2021 (International Cooperative Alliance, 2024). In Spain, 24,800 cooperatives support over 1 million direct and indirect jobs (CEPES, 2025). This paper focuses on the Basque Country (Spain), home to Mondragon—one of the largest cooperative groups in the world—comprising 81 cooperatives across sectors, with 70,000 workers, operations in 45 countries, 12 R&D centers, a corporate university, and 11,000 million euros in turnover in 2023 (Mondragon Corporation, 2025). Although cooperatives are fewer than conventional firms, their economic and social impact is significant, especially in key service sectors like finance and distribution.

Strikingly, empirical findings on cooperatives' environmental performance are mixed. Some studies highlight their role in sustainable practices, especially in agriculture (Yu et al., 2021; Zhang et al., 2023), while others find no significant differences with conventional firms (Calle et al., 2020; Carchano et al., 2023). Factors such as financial constraints, governance, and sectoral context may influence their eco-innovation capacity (Maietta and Sena, 2010; Basterretxea and Martínez, 2012).

This paper also focuses on the service sector, which, despite representing 70 % of EU GDP and employment (European Commission, 2025), remains underexplored in eco-innovation research. While prior research has examined eco-innovation drivers in manufacturing (Horbach, 2008; Doran and Ryan, 2016), evidence for services is scarce and fragmented (Peiró-Signes et al., 2014; Jové-Llopis and Segarra-Blasco, 2020; Merlin-Brogniart and Nadel, 2021), showing that they differ from manufacturing in eco-innovation dynamics and can have substantial environmental impacts through energy consumption, waste generation, and indirect effects via customer use.

However, while the literature on eco-innovation has gained relevance, studies focusing specifically on the service sector or cooperatives remain scarce and inconclusive. This gap is particularly relevant given the structural weight of services in modern economies and the distinctive role cooperatives play in promoting inclusive and resilient development models. Existing research often lacks clarity on whether cooperatives outperform traditional firms in eco-innovation, and under what conditions. Moreover, service-specific characteristics are seldom integrated into eco-innovation frameworks. Even fewer have examined the intersection of these two dimensions.

The recent support cooperatives have received from international organizations, together with their proven ability to foster local employment and include minority groups, highlights their relevance. However, in Spain, even though there are national and regional laws regulating these enterprises, the policies to support them are still clearly lacking. Therefore, this paper aims to stress the key role cooperatives play in promoting eco-innovation, and to encourage governments to adopt more comprehensive support measures.

This study addresses these gaps by combining sectoral and governance perspectives to provide a more nuanced understanding of eco-innovation. The drivers, constraints, and outcomes of eco-innovation in service firms in the Basque Country are analyzed, with a focus on cooperatives. Using data from the 2022 Innovation Survey by the Basque Institute of Statistics (Eustat, 2023), and grounded in environmental innovation theory, the following questions are explored:

(1) Which are the main drivers, constraints and outcomes of eco-innovation in service firms?
(2) How do service cooperatives compare to non-cooperatives in these areas?

In the sample, the most frequently reported environmental benefits are those achieved at the user level, such as CO_2 reduction and recycling. This is in line with previous studies suggesting that eco-innovation in services often emphasizes user-level benefits (Merlin-Brogniart and Nadel, 2021). Yet, service firms in the sample frequently deprioritize eco-innovation due to financial constraints. Empirical results show that service-sector cooperatives are more likely to achieve eco-innovation outcomes related to CO_2 reduction and end-user recycling, while they underperform in capital-intensive areas such as biodiversity conservation and product life extension. This reflects value-driven motivations limited by structural barriers. Moreover, public policy instruments—such as environmental taxes, subsidies, and public procurement—are the most effective drivers, surpassing regulations and internal motivations. Paradoxically, firms motivated by voluntary commitment or cost savings often achieve fewer environmental benefits, revealing a gap between intent and capacity. In this context, cooperatives, despite financial constraints, achieve greater environmental benefits in CO_2 reduction, the most challenging area for public institutions to address with their policies.

This paper advances eco-innovation research by addressing three gaps: the overlooked service sector, the role of organizational form—particularly cooperatives—and the relative influence of institutional, demand, and supply drivers. Results show these drivers vary across sectors. Findings emphasize policy incentives and market pressures as primary, while regulation plays a secondary role. It is also showed that policymakers should adopt tailored measures—anticipatory regulation, financial support, and cooperative-specific incentives—to overcome barriers and leverage cooperatives' CO_2-reduction potential, the main weakness for governments. For managers, evidence highlights the need to embed eco-innovation in strategy, as motivation and cost-saving alone exert little influence.

The remainder of the paper is structured as follows: the next section presents the conceptual framework, followed by the methodology. The empirical findings are then presented, and a final section offers a comprehensive discussion of the results, their implications, the study's limitations, and potential directions for future research.

2. Eco-innovation in service sector and cooperatives: drivers and characteristics

Eco-innovation, aimed at reducing the environmental impact of economic activity, has a well-established foundation but still faces key challenges. Institutions like the OECD (2009) and the European Commission (2011) have long worked to define, measure and promote it. Academic research has explored its growing relevance (Díaz-García et al., 2015), key drivers (Bossle et al., 2016), corporate effects (He et al., 2018), and conceptual evolution (Afeltra et al., 2023). Its benefits include reduced pollution, lower resource use, safer materials, and increased recycling.

2.1. Drivers of eco-innovation

A central theme in eco-innovation research is identifying its main drivers. Rennings (2000) outlines three: technological capacity ("technology push"), market demand ("market pull"), and regulation ("regulatory push/pull"). These are echoed in environmental innovation theory, which includes demand side, supply side, institutional and political influences, and firm-specific factors (Horbach, 2008; Triguero et al., 2013; Jové-Llopis and Segarra-Blasco, 2020). Regulation is widely seen as essential, especially when market and technology factors fall short (Afeltra et al., 2023). Other authors also identify regulatory pressures as the primary driver (Bossle et al., 2016; Jové-Llopis and Segarra-Blasco, 2020). Similarly, Díaz-García et al. (2015) highlight the importance of policy instruments—such as current and future regulations, subsidies, and fiscal incentives.

However, the influence of drivers varies by region and type of innovation. Horbach (2016) finds stronger effects of regulation in Eastern Europe, which the author links to lower environmental awareness among the population, and highlights how different drivers affect distinct eco-innovation outcomes. Regulation is key for "traditional end-of-pipe" improvements (e.g., air, water, hazardous substances), while cost savings are more relevant for innovations targeting energy or material efficiency, and subsidies are especially important for CO_2 reduction.

Doran and Ryan (2016) find that eco-innovation drivers vary depending on whether they stem from demand, supply, or policy factors. Díaz-García et al. (2015) contrast the regulatory emphasis in environmental economics literature with the innovation literature's focus on firm capabilities and societal demands. Demirel and Kesidou (2011) also highlight the role of cost savings in promoting environmental R&D.

Bossle et al. (2016) offer a comprehensive classification of drivers into external and internal factors, also considering control variables such as firm size, public funding, and sector. External drivers include regulatory pressures, cooperation with stakeholders, and industry-level technological characteristics. Internal drivers involve efficiency improvements, environmental certifications, leadership, culture, human resources, and overall firm performance.

In the Basque Country, Tamayo-Orbegozo et al. (2017) identify environmental concern, regulation, technological development, and collaboration as key external drivers, while internal ones include knowledge, resources, and skills. Basterretxea et al. (2024) emphasize the role of anticipated regulations, public procurement, reputation, and market demand.

2.2. Specificity of eco-innovation in the service sector

Although eco-innovation research has traditionally focused on the industrial sector, the service sector—despite accounting for around 70 % of GDP and employment in the EU (European Commission, 2025)—remains comparatively underexplored (Tamayo-Orbegozo et al., 2017; Liao and Tsai, 2019; Jové-Llopis and Segarra-Blasco, 2020; Merlin-Brogniart and Nadel, 2021; Arranz et al., 2023).

From a theoretical standpoint, eco-innovation in services differs markedly from manufacturing. Service firms are less capital-intensive, produce intangible outputs, and depend on customer interaction (Peiró-Signes et al., 2014; Jové-Llopis and Segarra-Blasco, 2020). Consequently, service eco-innovation focuses on organizational, process changes, and user-level benefits (e.g., facilitating recycling, reducing energy use during service delivery) rather than technological innovations typical of manufacturing (Peiró-Signes et al., 2014). These differences suggest market demand, customer engagement, and reputation are stronger drivers in services, while regulation and technological capabilities dominate in manufacturing (Jové-Llopis and Segarra-Blasco, 2020). Recognizing these distinctions is crucial for interpreting evidence and shaping policy.

Jové-Llopis and Segarra-Blasco (2020), using the Spanish Innovation Survey, find notable differences in eco-innovation between manufacturing and service firms, as well as among service subsectors. Manufacturing firms tend to show stronger environmental orientation—a finding also observed in Segarra-Oña et al. (2014, 2016) — while service firms rely more on market pull factors. Internal R&D, firm size, and eco-innovation persistence are relevant in both sectors, but regulation and cooperation are more prominent in manufacturing.

Merlin-Brogniart and Nadel (2021), analyzing French data, report that 41.56 % of service firms had adopted some form of eco-innovation, with benefits often in final consumption phases—such as reducing energy use, pollution, or improving recycling. Cost reduction is a key driver across sectors, while regulation has varying effects, especially in trade and transport. Subsidies appear less effective, possibly due to their industrial focus. Their results show that eco-innovation combines technological and non-technological innovations, especially in work organization, which seems reasonable given the specificity of services.

Arranz et al. (2023), based on data from 3192 service firms in Spain, show that cooperation fosters eco-innovation in services, and vice versa, suggesting a mutually reinforcing relationship. De Marchi (2012) previously studied this in the industrial sector. Peiró-Signes et al. (2014), in a study with 6253 firms in Spain, find that process orientation has a stronger impact on eco-orientation in services than in industry. Liao and Tsai (2019), studying 1717 Taiwanese service firms, identify market demand and environmental proactivity as key drivers, while technological competence shows no significant effect.

2.3. Environmental concern and eco-innovation in cooperatives

From a theoretical perspective, cooperatives differ from conventional firms in several organizational and motivational aspects that may influence their eco-innovation behavior. Cooperatives are defined by democratic governance, member orientation, and a strong commitment to community and environment (International Cooperative Alliance, 2015; Puusa et al., 2016; Bretos and Marcuello, 2017; Camargo Benavides and Ehrenhard, 2021; Hoffman, 2022). The International Cooperative Alliance (2015) explicitly includes sustainable development among its core principles, emphasizing economic, social, and environmental sustainability, as well as the connection between local and global concerns. It also highlights commitments regarding climate change or the preservation of the planet. Cooperative principles, such as mutual aid, democracy, equality, and solidarity, are expected to foster more environmentally responsible models (Carchano et al., 2023), particularly in areas that directly benefit members and local communities. However, cooperatives may also face unique barriers, such as limited access to external capital and a tendency toward risk aversion due to collective ownership and decision-making processes (Basterretxea and Martínez, 2012; Maietta and Sena, 2010). In the service sector, where innovation often involves organizational change, stakeholder engagement, and intangible outputs, these cooperative attributes may either enable or constraint eco-innovation depending on the context.

Nonetheless, empirical evidence remains mixed. Candemir et al. (2021) and Liang et al. (2023) highlight the role of agricultural cooperatives in promoting sustainable practices, but also point to potential trade-offs between economic and environmental goals. Some studies report no significant differences (Li et al., 2021), and others even identify negative environmental outcomes, such as in Ethiopian cooperatives (Abebaw and Haile, 2013).

In China, however, agricultural cooperatives have shown more consistent positive results. Yu et al. (2021) and Zhang et al. (2023) find that cooperative membership increases the likelihood of adopting Green Control Techniques. Luo et al. (2022) emphasize the role of cooperative education in promoting green technologies, while Dong et al. (2023) show that participation in cooperatives encourages the adoption of green technologies even without strong market incentives. Ma et al. (2018) and Liu and Wu (2022) also report greater investment in organic soil amendments and reducing harmful inputs.

Research on eco-innovation in cooperatives remains limited and inconclusive. Carchano et al. (2023), studying 239 Spanish wine firms (53 cooperatives), find that being a cooperative moderates the relationship between internal and external stakeholders in relation to eco-innovation, but do not confirm that cooperatives achieve a better relationship between eco-innovation and environmental performance. Similarly, Calle et al. (2020), analyzing 251 firms (51 cooperatives) in the same sector, report no significant differences between cooperatives and non-cooperatives regarding environmental behavior. In the Spanish olive oil sector, Rabadán et al. (2021) highlight strong sustainability commitments in large cooperatives, emphasizing the role of cooperation with stakeholders to implement eco-innovation. However, factors like firm size and Protected Designation of Origin status significantly influence the implementation of eco-innovation. These findings underscore the importance of including control variables in the models to properly isolate the effect of cooperative status on eco-innovation outcomes.

In their study on eco-innovation in industrial cooperatives in the Basque Country, Basterretxea et al. (2024) find that cooperatives incorporate more environmentally beneficial innovations, despite facing financial constraints (Maietta and Sena, 2010; Basterretxea and Martínez, 2012). However, when controlling for various drivers and firm characteristics, cooperative status does not significantly influence the introduction of any type of eco-innovation. Surprisingly, voluntary initiatives are not found to be more prominent drivers in cooperatives, challenging assumptions about their social orientation.

After analyzing the contextual framework, we identify that, overall, prior research has not systematically explored how the cooperative status influences eco-innovation in service firms. This gap underpins the conceptual model proposed in Fig. 1 and the empirical analysis that follows. The model integrates ideas from environmental innovation theory to explore the impact of various drivers and cooperative status on eco-innovation in the service sector.

3. Methods

3.1. Sample

The empirical analysis uses microdata from the 2022 Innovation Survey, carried out by the Basque Institute of Statistics (Eustat, 2023), which follows the methodological guidelines of the Community Innovation Survey (CIS) of the European Commission. The survey provides harmonized and internationally comparable information on firms' innovation inputs, activities, and outcomes. It focuses on diverse business establishments across various sectors and sizes in the Basque Country. The data pertain to the year 2022, although specific inquiries on eco-innovation cover the 2020–2022 period.

The total sample of Eustat's Innovation Survey includes 3216 establishments (214 of them worker cooperatives) in the services sector and industrial sector. The total sample is not used; instead, the analysis focuses exclusively on service firms, given the scarcity of studies addressing this type of company. Additionally, concentrating on a more homogenous sample makes it easier to compare innovation drivers, practices and outcomes.

The initial sample of this study encompasses 2468 service establishments (154 of them are worker cooperatives). Within this sample, 6.24 % of establishments belong to cooperative firms, contributing to 7.88 % of the total employment. To work with the probit model, the sample is then reduced to only service establishments that have obtained an environmental benefit resulting from eco-innovation, thereby reducing zero inflation without compromising representativeness or validity and ensuring more balanced and reliable probit estimations. Thus, the second iteration of the sample consists of 895 establishments, of which 83 belong to a cooperative firm. In this adjusted sample, the proportion of establishments belonging to cooperatives is 9.27 % and represents 10.24 % of employment.

3.2. Variables

Building on CIS's definition and existing literature, eco-innovation is measured considering the outcomes of innovative endeavors. If innovations generate favorable environmental impacts, they are classified as eco-innovations. The establishments were asked to respond to the following question:

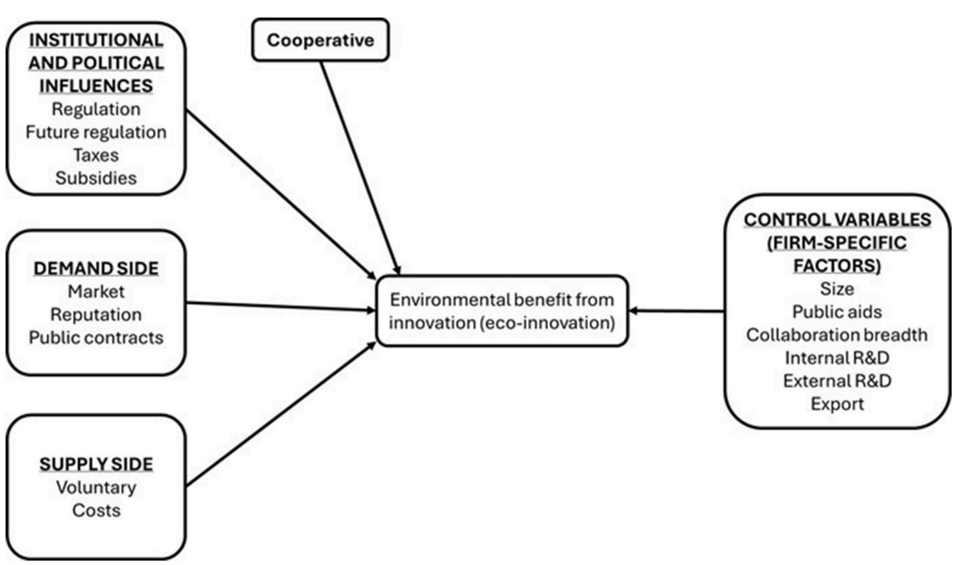

Fig. 1. Proposed conceptual model.
Source: compiled by the authors

"During the three years 2020–2022, did your enterprise introduce innovations with any of the following environmental benefits and, if yes, was their contribution to environmental protection significant or insignificant?"

Table 1 presents seven variables measuring environmental benefits within the firm and five measuring benefits from after-sales use of services by the end user.

The questionnaire also asks about the importance of several factors, mainly external, in driving the firm's decision to introduce innovations with environmental benefits. Table 2 shows the nine variables used to measure these eco-innovation drivers. Following the approach taken by environmental innovation theory (Horbach, 2008; Triguero et al., 2013; Jové-Llopis and Segarra-Blasco, 2020), these drivers are grouped into three categories.

Although not included later in the probit models, the initial, more descriptive section includes variables related to the constraints faced by establishments when implementing innovation initiatives. Even though these constraints are about innovation in general and not linked just to eco-innovation, given the limitations that cooperatives show to innovate and, consequently, to eco-innovate, it is considered valuable to briefly analyze these variables (Table 3). These constraints can also be categorized into the same three groups as the drivers.

The dummy variable *coop* is also included, taking the value 1 when the establishment belongs to a cooperative firm and 0 otherwise, to measure the effect of being a cooperative on environmental benefits of eco-innovation.

As control variables (Table 4), the analysis takes into account the establishment's level of spending on R&D, both internal and external (*int.R&D* and *ext.R&D*) or the use of receipt public funding for innovation (*pub.aid.inn*). The analysis also includes controls for the number of

Table 1
Variables measuring environmental benefits, their definition and measurement.

Variable		Definition	Measurement
Environmental benefits of eco-innovation within the firm	material	Reduced material or water use per unit of output	Dummy variable with value 1 if the establishment significantly achieves this type of environmental benefit through eco-innovation, 0 otherwise
	CO_2	Reduced energy use or CO_2 'footprint' within the firm	
	pollution	Reduced soil, noise, water or air pollution within the firm	
	substitute	Replaced a share of materials with less polluting or hazardous substitutes	
	energy	Replaced a share of fossil energy with renewable energy sources	
	recycling	Recycled waste, water, or materials for own use or sale	
	biodiversity	Biodiversity conservation	
Environmental benefits of eco-innovation from use of products by the end user	CO_2.user	Reduced energy use or CO_2 'footprint' by the end user	
	pollution.user	Reduced soil, noise, water or air pollution by the end user	
	recycling.user	Facilitated recycling of product after use	
	product.life	Extended product life through longer-lasting, more durable products	
	biodiversity.user	Biodiversity conservation	

Source: compiled by the authors

Table 2
Variables measuring drivers of eco-innovation, their definition and measurement.

	Variable	Definition	Measurement
institutional and political influences	d.regulation	Existing environmental regulations	Ordinal variable (Likert) measured from 0 to 3, according to the relevance of each driver to carry out eco-innovation actions
	d.future.regulation	Environmental regulations or taxes expected in the future	
	d.taxes	Existing environmental taxes	
	d.subsidies	Government grants, subsidies or other financial incentives for environmental innovations	
demand side	d.market	Current or expected market demand for environmental innovations	
	d.reputation	Improving the enterprise's reputation	
	d.pub.contracts	Need to meet requirements for public procurement contracts	
supply side	d.voluntary	Voluntary actions or initiatives for environmental good practice within the sector	
	d.costs	High costs of energy, water or materials	

Source: compiled by the authors

Table 3
Variables measuring constraints to eco-innovation, their definition and measurement.

	Variable	Definition	Measurement
institutional and political influences	c.lack.pub.finan	Difficulties in obtaining public subsidies or grants	Ordinal variable (Likert) measured from 0 to 3, according to the level at which this constraint limits innovation in the establishment
demand side	c.mkt.uncertainty	Uncertainty regarding the market demand for the firm's ideas.	
	c.high.compet	Too much competition in the market	
supply side	c.lack.int.finan	Lack of financing within the firm or group of firms	
	c.lack.ext.pr.finan	Lack of funding from external private sources	
	c.high.costs	Excessively high costs	
	c.lack.skilled.w	Lack of qualified workers in the firm	
	c.lack.partners	Lack of partners for collaboration	
	c.lack.ext.knowledge	Lack of access to external knowledge	
	c.other.priorities	There are other priorities in the firm	

Source: compiled by the authors

interorganizational cooperation channels on innovation establishment (*coll.breadth*) and the *export* variable. Firm size is included, as larger firms may benefit from greater resources and economies of scale that enhance innovation (Vaona and Pianta, 2008). To capture this, two variables are used: *firm.employment* and *est.turnover*, representing the size of the firm and the establishment, respectively. While both are common proxies for firm size, they reflect distinct dimensions—turnover indicates economic capacity and market reach, whereas employment reflects organizational structure and operational scale. Including both helps avoid underestimating size effects, especially in the service sector, where productivity per employee varies widely. To ensure model robustness, Variance Inflation Factor diagnostics are conducted, obtaining values of 1.3 for both variables—well below the threshold of 10—confirming that their joint inclusion does not introduce harmful multicollinearity and enhances model interpretability.

3.3. Econometric tools

In the section of preliminary analysis of results, two tests are used to contrast the values of the different variables in the group of cooperative and non-cooperative firms. Pearson's Chi-square test is a non-parametric statistical test that evaluates the association between two categorical variables, looking at whether there is a significant difference between the observed frequencies and the expected frequencies in the categories. The Mann-Whitney U is a nonparametric statistical test used, among other scenarios, to compare an ordinal dependent variable with another binary variable that forms two independent groups. The ranks of all the combined values of both groups are calculated. The ranks of each group are then summed and calculated.

In terms of modelling, given the connections between variables revealed in the relevant economic literature and the empirical studies reviewed, that the dependent variables are binary, and, given the assumption that each eco-innovation operates independently, a separate probit model is estimated for each environmental benefit associated with eco-innovation (totaling 12), using Maximum Likelihood method with robust standard errors to correct possible heteroscedasticity. The endogenous variable is defined as $Y_i = 1$, when the establishment obtained environmental benefits. The models are formulated as follows (Greene, 2012):

(1) $\Pr(Y_i = 1) = F(X_i\text{‘}\beta + Z_i\text{’}\gamma)\ i = 1, \ldots, 895$
(2) $\Pr(Y_i = 0) = 1 - F(X_i\text{‘}\beta + Z_i\text{’}\gamma)\ i = 1, \ldots, 895$

Where:

- Yi is the dependent variable: environmental benefits.
- Xi is the matrix of the explanatory variables.
- Zi is the matrix of the control variables.
- F( ) is the standard Normal Distribution.

It should be noted that the estimation parameters of the probit model are not the marginal effect. In general, the marginal effects are $\partial \Pr(Y = 1)/\partial X = f(X_i\text{‘}\beta)\ \beta$, and these values vary with the values of X (and Z). Therefore, when interpreting the estimated model, it is necessary to calculate the marginal effects at the sample means of the data. These probit models have been estimated with QML robust standard errors to avoid heteroscedasticity.

The estimated coefficients associated with the eco-innovation drivers are expected to display a positive sign, as these factors are theoretically and empirically linked to an increased likelihood of achieving environmental benefits. Similarly, the control variables are also anticipated to have positive signs, reflecting their role in enhancing firms' innovation capabilities. By contrast, the expected sign of the coefficient for the variable *coop* is the most uncertain and constitutes the core focus of this study.

When building this model, it is also important to consider the possible multicollinearity between the variables that make up the model. A Variance Inflation Factor analysis shows that all values are below the critical threshold of 10, which rules out severe collinearity. Several are between 2 and 3.6, indicating moderate, but not alarming, correlations. Principal Component Analysis reveals that the largest factor accounts for only 32.09 % of the variance. This means that, according to Harman's Single Factor Test, there is no significant evidence of common method bias. To verify the robustness of the results, various model iterations are tested using different control variables prior to selecting the final specifications presented in the paper. These iterations consistently preserved the significance of the variables of interest.

Although the model includes a comprehensive set of control variables to mitigate estimation bias, it is important to acknowledge that the *coop* variable may be subject to endogeneity. Cooperative status could be correlated with unobserved factors, such as organizational culture, environmental leadership, or prior sustainability engagement. Due to the cross-sectional nature of the dataset and the absence of valid instruments, it was not feasible to apply econometric techniques such as instrumental variables or panel data models to avoid this. Nevertheless, the analysis is restricted to service firms within a single region, and different model specifications with alternative sets of control variables were tested during the process, which helps reduce unobserved heterogeneity and enhances the reliability of the estimated effects.

4. Results

4.1. Preliminary analysis

Table 5 shows that 895 establishments (36.26 % of the sample) incorporate some form of eco-innovation. This proportion is higher among cooperatives (53.90 %) compared to non-cooperatives (35.10 %).

Isolating the eco-innovative establishments (Table 6) reveals significant differences in the types of benefits obtained, both within the firm

Table 4
Name, definition and measurement of control variables.

Variable	Definition	Measurement
firm. employment	Size of the firm in terms of employment	Continuous variable measured as the natural logarithm of the number of employees of the firm to which the establishment belongs, divided by 10.
est.turnover	Size of the establishment in terms of its revenue	Continuous variable measured as the natural logarithm of the turnover of the establishment, divided by 10.
pub.aid.inn	Use of public support for innovation	Dummy variable with value 1 if the establishment uses public support received to innovate, and 0 otherwise.
coll.breadth	Breadth of interorganizational cooperation for innovation	Count adding 1 for each type of interorganizational cooperation for innovation in which the establishment is involved, out of a total of 8; divided by 10.
int.R&D	Internal R&D expenditure	Continuous variable measured as the natural logarithm of the internal R&D expenditure of the establishment, divided by 10.
ext.R&D	External R&D expenditure	Continuous variable measured as the natural logarithm of the external R&D expenditure of the establishment, divided by 10.
export	Export intensity	Continuous variable measured as the percentage of turnover of the establishment coming from exportation

Source: compiled by the authors

and for the end user. For instance, *recycling.user* is present in 63.91 % of all cases, and *CO2* and *CO2.user* (45.03 % and 44.13 % respectively) are the next most prominent. On the other hand, only two fall below 20 %: *biodiversity* and *biodiversity.user* (17.54 % and 18.44 % respectively).

Service cooperatives obtain significantly higher average environmental benefits than non-cooperatives in terms of CO_2 reduction (both internal and for the end user) and end-user recycling. In contrast, as shown in Fig. 2, establishments belonging to non-cooperative companies stand out significantly in *substitute*, *product.life*, *biodiversity*, and *biodiversity.user*.

Among eco-innovative establishments (both those belonging to cooperatives and non-cooperatives), Table 6 shows that the main obstacles to innovation are primarily due to the existence of other priorities (*c.other.priorities*, 1.59, with 3 being the maximum), followed by high costs (*c.high.costs*, 1.44), lack of funding (*c.lack.int.finan*, internal, 1.25; *c.lack.pub.finan*, public, 1.20; *c.lack.ext.pr.finan*, private, 1.05), and market uncertainty (*c.mkt.uncertainty*, 1.23). Analysis by enterprise type indicates that the lack of skilled workers (*c.lack.skilled.w*), partners (*c.lack.partners*), and external knowledge (*c.lack.ext.knowledge*) are significantly more limiting for non-cooperatives. In contrast, the lack of internal funding (*c.lack.int.finan*) and external private funding (*c.lack.ext.pr.finan*) are significantly more limiting for cooperatives (Fig. 3).

When looking at the drivers of eco-innovation, for the overall sample, the most relevant are voluntariness (*d.voluntary*, 1.78, with 3 being the maximum), reputation (*d.reputation*, 1.75), cost reduction (*d.costs*, 1.74) and regulation (*d.regulation*, 1.72). On average, establishments belonging to non-cooperative service companies rate all drivers more highly than those from cooperatives as factors that motivated their eco-innovation. This difference is statistically significant in all cases (Fig. 4) except for future regulation (*d.future.regulation*) and public subsidies (*d.subsidies*).

4.2. Econometric results

This section presents the econometric results based on probit estimations (Table 7).

Cooperatives achieve better average results in environmental benefits related to *CO2* (20.8 % higher probability of achieving this environmental benefit than non cooperatives), *CO2.user* (17.5 % higher probability), and *recycling.user* (17.5 % higher probability), but their results are significantly worse in *pollution*, *substitute*, *biodiversity*, *biodiversity.user*, and *product.life* (between 8.3 % and 16.3 % lower probability than non cooperatives). Current regulation (*d.regulation*) is not a significant driver for any eco-innovation benefit, while future regulation (*d.future.regulation*) only influences internal company benefits, such as *pollution* (increases probability by 5.1 %), *substitute* (7.4 %), and energy (11.9 %). Taxes (*d.taxes*) turn out to be the most motivating driver for achieving eco-innovation benefits. This is particularly true at the external level, where they have a positive impact on all benefits (between 6 % and 18.4 % higher probability) except *CO2.user*. At the internal level, they are beneficial for *material* (8.4 %), *pollution* (4.2 %), and *recycling* (9.6 %). Public subsidies (*d.subsidies*), while also having a positive effect on *pollution.user* (3.3 % higher probability) and *biodiversity.user* (5.8 %), mainly have a positive impact on internal eco-innovation benefits, such as *pollution*, *substitute*, *energy*, and *biodiversity* (between 4.3 % and 7 %). Market demand (*d.market*) is a beneficial driver for *material* (9.9 % higher probability), *CO2* (7.2 %), *biodiversity* (3 %), and *pollution.user* (4 %). Reputation (*d.reputation*) is a good driver for *energy* (5 %), *CO2.user* (12.5 %), and *pollution.user* (8.3 %). Although they also seem to help drive eco-innovation benefits in *material* (4.1 %) and *biodiversity* (2.5 %), public contracts (*d.pub.contracts*) are the main driver for eco-innovations that promote benefits achieved by the end user, positively affecting all of them (between 3 % and 6.2 % higher probability).

The drivers from the supply side do not seem to have had much impact on the introduction of eco-innovations. Voluntariness (*d.voluntary*) only positively affects benefits in *biodiversity* (4.9 % higher probability of achieving this benefit), *biodiversity.user* (5.1 %), and *recycling.user* (6.9 %). Cost savings (*d.costs*) only motivate eco-innovation with benefits in *energy* (8.6 %). Interestingly, these drivers appear to have a particularly negative effect on environmental benefits. Establishments that indicate a higher voluntary predisposition to eco-innovate are those that later obtain significantly fewer eco-innovation benefits in *material*, *energy*, *CO2.user*, or *pollution.user* (between 4.7 % and 8.7 % lower probability). Establishments that indicate cost savings as a major reason to eco-innovate subsequently obtain significantly fewer benefits from eco-innovation in *recycling*, *recycling.user*, *biodiversity*, *biodiversity.user*, and *pollution.user* (between 3.3 % and 10.3 % lower probability).

The main drivers related to environmental benefits are *taxes* (*d.taxes*), *public contracts* (*d.pub.contracts*), and *public subsidies* (*d.subsidies*), positively impacting 7, 7, and 6 environmental benefits, respectively. Future regulation (*d.future.regulation*) affects 3 of the environmental benefits.

Table 5
Characterization of the sample: eco-innovative and cooperative establishments.

	Eco-innovative	Non eco-innovative	TOTAL
Cooperatives	83	71	**154**
Non-cooperatives	812	1502	**2314**
TOTAL	**895**	**1573**	**2468**

Source: compiled by the authors

5. Discussion of findings

The results of this study challenge and reinforce some established assumptions in the literature, particularly regarding the role of supply side drivers, institutional and political influences, and organizational form.

5.1. Sector-specific dynamics in services

Focusing on the service sector adds a valuable and often overlooked dimension to eco-innovation research, which has traditionally centered on manufacturing firms (Liao and Tsai, 2019; Jové-Llopis and Segarra-Blasco, 2020; Arranz et al., 2023). Eco-innovation in services differs notably in its drivers, constraints, and outcomes. In the sample, 36.26 % of firms are eco-innovators, a figure consistent with the 41.56 % reported by Merlin-Brogniart and Nadel (2021) in France. In line with that same paper, benefits in services often materialize at the user level, underscoring the importance of service design, customer engagement, and lifecycle thinking. This pattern accords with the service-specific emphasis on organizational/process innovations, customer interfaces, and lower fixed-capital intensity (Merlin-Brogniart and Nadel, 2021; Peiró-;Signes et al., 2014; Jové-Llopis; Segarra-;Blasco, 2020). Biodiversity-related innovations are rare, likely due to their novelty, recent inclusion in surveys, and the difficulty of measuring such impacts in non-material contexts.

The most cited constraint to eco-innovation is the presence of competing business priorities, suggesting that sustainability efforts often take a back seat to profitability, efficiency, or growth. This aligns with findings by Doran and Ryan (2016) and Horbach (2016). High costs, limited financing, and market uncertainty are also key constraints, especially in a sector with intangible outputs and lower capital intensity, which may limit access to traditional innovation funding mechanisms. Despite these challenges, firms report strong alignment with external motivations. Key drivers include voluntary environmental commitment, reputation enhancement, regulatory compliance, and cost savings—indicating growing awareness of sustainability's strategic value for brand image and stakeholder trust.

Table 6
Main statistics.

		service sector ecoinnovative firms					
		all		cooperatives (n = 83)		non cooperatives (n = 812)	
		(n = 895)		coop = 1		coop = 0	
		mean	min/	mean	min/	mean	min/
		(sd)	max	(sd)	max	(sd)	max
coop		0.0927	0.00/	1.0000	1.00/	0.0000	0.00/
		(0.2902)	1.00	(0.0000)	1.00	(0.0000)	0.00
environmental benefits of ecoinnovation within the firm	material	0.2939	0.00/	0.2410	0.00/	0.2993	0.00/
		(0.4558)	1.00	(0.4303)	1.00	(0.4582)	1.00
	CO2	0.4503	0.00/	0.6988	0.00/	0.4249	0.00/
		(0.4978)	1.00	(0.4616)	1.00	(0.4946)	1.00
	pollution	0.2101	0.00/	0.1566	0.00/	0.2155	0.00/
		(0.4076)	1.00	(0.3657)	1.00	(0.4114)	1.00
	substitute	0.2905	0.00/	0.1205	0.00/	0.3079	0.00/
		(0.4542)	1.00	(0.3275)	1.00	(0.4619)	1.00
	energy	0.2816	0.00/	0.2289	0.00/	0.2869	0.00/
		(0.4500)	1.00	(0.4227)	1.00	(0.4526)	1.00
	recycling	0.3318	0.00/	0.2651	0.00/	0.3387	0.00/
		(0.4711)	1.00	(0.4440)	1.00	(0.4735)	1.00
	biodiversity	0.1754	0.00/	0.0723	0.00/	0.1860	0.00/
		(0.3805)	1.00	(0.2605)	1.00	(0.3893)	1.00
environmental benefits of ecoinnovationfrom use of products by the end user	CO2.user	0.4413	0.00/	0.6506	0.00/	0.4200	0.00/
		(0.4968)	1.00	(0.4797)	1.00	(0.4939)	1.00
	pollution.user	0.2458	0.00/	0.2169	0.00/	0.2488	0.00/
		(0.4308)	1.00	(0.4146)	1.00	(0.4326)	1.00
	recycling.user	0.6391	0.00/	0.8193	0.00/	0.6207	0.00/
		(0.4805)	1.00	(0.3871)	1.00	(0.4855)	1.00
	product.life	0.2950	0.00/	0.1446	0.00/	0.3103	0.00/
		(0.4563)	1.00	(0.3538)	1.00	(0.4629)	1.00
	biodiversity.user	0.1844	0.00/	0.0723	0.00/	0.1958	0.00/
		(0.3880)	1.00	(0.2605)	1.00	(0.3971)	1.00
control variables	firm.employment	0.5192	0.00/	0.6049	0.19/	0.5104	0.00/
		(0.2435)	0.80	(0.1872)	0.80	(0.2470)	0.80
	est.turnover	1.4590	0.74/	1.5040	1.04/	1.4540	0.74/
		(0.2110)	1.91	(0.1436)	1.88	(0.2163)	1.91
	pub.aid.inn	0.3888	0.00/	0.7108	0.00/	0.3559	0.00/
		(0.4878)	1.00	(0.4561)	1.00	(0.4791)	1.00
	coll.breadth	0.1865	0.00/	0.5181	0.00/	0.1526	0.00/
		(0.3174)	1.10	(0.4185)	1.00	(0.2845)	1.10
	int.R&D	0.2400	0.00/	0.6610	0.00/	0.1970	0.00/
		(0.5109)	1.54	(0.5969)	1.54	(0.4813)	1.54
	ext.R&D	0.0951	0.00/	0.1172	0.00/	0.0928	0.00/
		(0.3124)	1.45	(0.3020)	1.24	(0.3136)	1.45
	export	0.0575	0.00/	0.0182	0.00/	0.0615	0.00/
		(0.1740)	1.00	(0.0648)	0.45	(0.1811)	1.00
government	d.regulation	1.7210	0.00/	1.3250	0.00/	1.7610	0.00/
		(1.1600)	3.00	(1.0010)	3.00	(1.1680)	3.00
	d.future.regulation	1.2740	0.00/	1.1330	0.00/	1.2880	0.00/
		(1.0950)	3.00	(0.9724)	3.00	(1.1060)	3.00
	d.taxes	1.2020	0.00/	0.9398	0.00/	1.2290	0.00/
		(1.0570)	3.00	(0.7706)	3.00	(1.0790)	3.00
	d.subsidies	1.0390	0.00/	0.9880	0.00/	1.0440	0.00/
		(1.0950)	3.00	(0.9434)	3.00	(1.1100)	3.00
	c.lack.pub.finan	1.1970	0.00/	1.0600	0.00/	1.2110	0.00/
		(1.1030)	3.00	(0.9920)	3.00	(1.1130)	3.00
demand side	d.market	1.4040	0.00/	1.1690	0.00/	1.4290	0.00/
		(1.1160)	3.00	(1.0340)	3.00	(1.1220)	3.00
	d.reputation	1.7540	0.00/	1.3370	0.00/	1.7970	0.00/
		(1.1160)	3.00	(1.0850)	3.00	(1.1110)	3.00
	d.pub.contracts	1.3310	0.00/	1.1080	0.00/	1.3530	0.00/
		(1.1080)	3.00	(1.0120)	3.00	(1.1160)	3.00
	c.mkt.uncertainty	1.2270	0.00/	1.3980	0.00/	1.2090	0.00/
		(1.0580)	3.00	(1.0590)	3.00	(1.0570)	3.00
	c.high.compet	1.0940	0.00/	1.1330	0.00/	1.0900	0.00/
		(1.0190)	3.00	(0.9209)	3.00	(1.0290)	3.00
supply side	d.voluntary	1.7840	0.00/	1.4340	0.00/	1.8200	0.00/
		(1.1030)	3.00	(1.0610)	3.00	(1.1010)	3.00
	d.costs	1.7400	0.00/	1.4100	0.00/	1.7730	0.00/
		(1.1300)	3.00	(1.1270)	3.00	(1.1260)	3.00
	c.lack.int.finan	1.2540	0.00/	1.5780	0.00/	1.2200	0.00/
		(1.1670)	3.00	(1.2980)	3.00	(1.1480)	3.00
	c.lack.ext.pr.finan	1.0460	0.00/	1.4700	0.00/	1.0020	0.00/
		(1.0990)	3.00	(1.3000)	3.00	(1.0670)	3.00

(*continued on next page*)

Table 6 (*continued*)

	service sector ecoinnovative firms					
	all		cooperatives (n = 83)		non cooperatives (n = 812)	
	(n = 895)		coop = 1		coop = 0	
	mean (sd)	min/ max	mean (sd)	min/ max	mean (sd)	min/ max
c.high.costs	1.4350 (1.0970)	0.00/ 3.00	1.4220 (0.9642)	0.00/ 3.00	1.4360 (1.1100)	0.00/ 3.00
c.lack.skilled.w	0.9620 (0.9959)	0.00/ 3.00	0.7229 (0.9667)	0.00/ 3.00	0.9865 (0.9962)	0.00/ 3.00
c.lack.partners	0.8179 (0.8945)	0.00/ 3.00	0.5422 (0.7539)	0.00/ 3.00	0.8461 (0.9033)	0.00/ 3.00
c.lack.ext.knowledge	0.8212 (0.8820)	0.00/ 3.00	0.5301 (0.7381)	0.00/ 3.00	0.8510 (0.8904)	0.00/ 3.00
c.other.priorities	1.5850 (1.1610)	0.00/ 3.00	1.6990 (1.2170)	0.00/ 3.00	1.5740 (1.1550)	0.00/ 3.00

Source: compiled by the authors

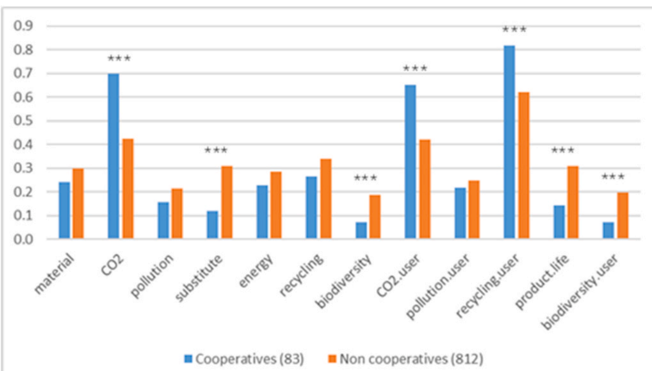

Fig. 2. Proportion of eco-innovative units reporting each environmental benefit (0–1 scale).
Pearson Chi-square test, p value: '***' 0.01 '**' 0.05 '*' 0.1.
Source: compiled by the authors

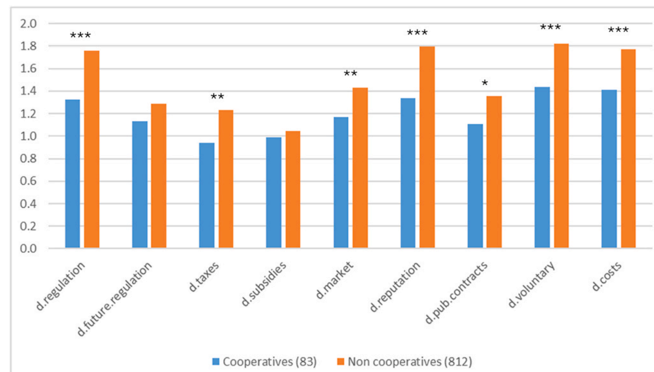

Fig. 4. Relevance of eco-innovation drivers in eco-innovative units (average Likert score 0–3).
Mann-Whitney *U* test, p value: '***' 0.01 '**' 0.05 '*' 0.1.
Source: compiled by the authors

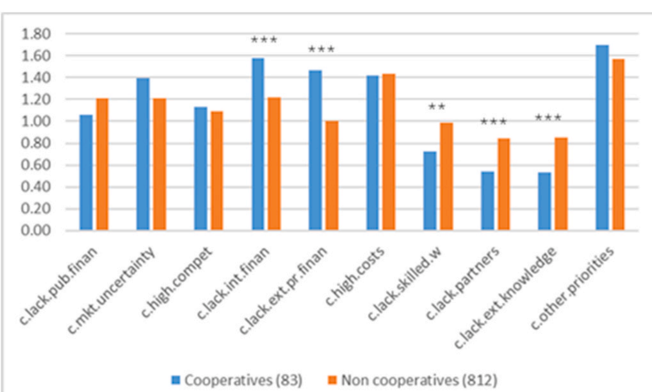

Fig. 3. Relevance of innovation constraints in eco-innovative units (average Likert score 0–3).
Mann-Whitney *U* test, p value: '***' 0.01 '**' 0.05 '*' 0.1.
Source: compiled by the authors

5.2. *The role of cooperatives in eco-innovation*

Service cooperatives are generally more eco-innovative than non-cooperatives, consistent with Basterretxea et al. (2024), who found similar trends in manufacturing. Service cooperatives more often reported eco-innovation outcomes related to CO_2 reduction (internal and user-level) and end-user recycling—the three most common benefits in the total sample. This reflects cooperative principles of community concern and sustainability (International Cooperative Alliance, 2015), supporting the view that cooperatives are inherently more environmentally responsible. However, they underperformed in areas such as internal pollution reduction, substitute materials, biodiversity conservation, and product life extension. These mixed results suggest cooperatives may prioritize stakeholder-visible sustainability but lack resources for more complex or capital-intensive innovations. Notably, service cooperatives outperform those in manufacturing, where cooperative status had no significant direct effect on specific eco-innovations, once drivers and characteristics are controlled (Basterretxea et al., 2024). Similarly, the results of service cooperatives contrast with those of the agrifood sector, which show inconclusive studies on environmental performance. (Calle et al., 2020; Carchano et al., 2023; Rabadán et al., 2021).

As measured on a 0–3 Likert scale, non-cooperative firms assign higher average importance on most eco-innovation drivers, with statistically significant differences across nearly all variables—except for expected future regulation and public subsidies, which appear equally influential, serving as universal policy levers. This divergence may reflect differences in strategic orientation and institutional context. Non-cooperative firms, often in competitive, profit-driven environments, respond more to external pressures like market demand, reputation, and regulation. Cooperatives, by contrast, may view eco-innovation through internal values. In manufacturing, cooperatives are more influenced by demand-side drivers such as public procurement, reputation and market

Table 7
Probit models estimations (marginal effect, slope at the mean).

		environmental benefits of eco-innovation within the firm														environmental benefits of eco-innovation from use of products by the end user									
		material		CO2		pollution		substitute		energy		recycling		biodiversity		CO2.user		pollution.user		recycling.user		product.life		biodiversity. user	
const			***		***		***				***		***		***		***		***				*		***
		(0,393)	−5017	(0,376)	−6360	(0,403)	−4671	(0,342)	0,562	(0,369)	−3158	(0,334)	−4796	(0,380)	−4247	(0,345)	−4083	(0,371)	−3440	(0,328)	−1092	(0,344)	−1743	(0,394)	−4335
coop		−0,023		0,208	***	−0,104	**	−0,163	***	−0,097		−0,060		−0,083	*	0,175	**	−0,038		0,175	***	−0,152	***	−0,093	**
		(0,178)	−0,402	(0,173)	3065	(0,225)	−2119	(0,212)	−2799	(0,229)	−1594	(0,190)	−0,907	(0,244)	−1850	(0,174)	2538	(0,205)	−0,657	(0,195)	2737	(0,198)	−2739	(0,227)	−2203
control	firm.	0,256	***	0,282	***	−0,030		0,445	***	0,356	***	−0,156	*	0,058		0,039		−0,162	**	−0,362	***	−0,409	***	0,001	
variables	employment	(0,245)	3153	(0,231)	3084	(0,259)	−0,441	(0,238)	5672	(0,250)	4715	(0,228)	−1898	(0,276)	0,921	(0,226)	0,441	(0,244)	−2265	(0,225)	−4354	(0,234)	−5282	(0,271)	0,016
	est.turnover	0,136		0,367	***	0,102		−0,415	***	−0,240	***	0,251	***	−0,014		0,092		0,025		0,328	***	−0,009		−0,006	
		(0,257)	1600	(0,247)	3757	(0,258)	1497	(0,237)	−5312	(0,243)	−3289	(0,230)	3033	(0,260)	−0,244	(0,231)	1012	(0,249)	0,339	(0,232)	3824	(0,235)	−0,119	(0,259)	−0,107
	pub.aid.inn	0,063		0,075		0,139	***	0,066		−0,030		0,072		0,121	***	0,170	***	0,000		0,034		0,131	***	0,114	***
		(0,131)	1444	(0,127)	1481	(0,133)	3778	(0,131)	1506	(0,149)	−0,668	(0,127)	1574	(0,141)	3573	(0,126)	3418	(0,141)	0,012	(0,129)	0,725	(0,129)	3014	(0,137)	3385
	coll.breadth	0,007		0,381	***	0,227	***	−0,158	**	0,264	***	0,105		−0,109	*	0,348	***	0,232	***	0,120		0,095		−0,075	
		(0,220)	0,096	(0,214)	4488	(0,232)	3704	(0,231)	−2079	(0,233)	3750	(0,204)	1434	(0,265)	−1800	(0,224)	3948	(0,218)	3628	(0,214)	1514	(0,218)	1318	(0,250)	−1288
	int.R&D	−0,157	***	−0,095	*	−0,153	***	0,018		−0,041		−0,064		−0,034		−0,093	*	−0,029		−0,006		−0,055		−0,039	
		(0,137)	−3479	(0,129)	−1851	(0,145)	−3990	(0,131)	0,419	(0,142)	−0,960	(0,123)	−1443	(0,145)	−1023	(0,126)	−1890	(0,129)	−0,768	(0,127)	−0,119	(0,125)	−1320	(0,144)	−1169
	ext.R&D	0,061		0,065		0,023		−0,001		0,194	***	−0,058		−0,021		0,146	**	0,095	**	−0,182	***	−0,044		−0,009	
		(0,154)	1191	(0,160)	1020	(0,157)	0,552	(0,180)	−0,019	(0,164)	3935	(0,147)	−1090	(0,200)	−0,471	(0,164)	2254	(0,162)	2003	(0,150)	−3272	(0,167)	−0,799	(0,189)	−0,195
	export	0,074		−0,038		0,060		0,093		0,176	*	0,119		0,045		0,169		0,192	**	0,012		0,234	**	0,029	
		(0,273)	0,822	(0,291)	−0,332	(0,308)	0,741	(0,274)	1033	(0,303)	1923	(0,271)	1221	(0,309)	0,646	(0,269)	1597	(0,276)	2376	(0,289)	0,116	(0,283)	2498	(0,338)	0,369
Institutional	d.regulation	−0,013		0,031		−0,011		−0,011		0,000		0,001		−0,014		0,003		−0,030		−0,052	*	−0,010		−0,014	
and		(0,085)	−0,474	(0,074)	1061	(0,087)	−0,481	(0,078)	−0,417	(0,083)	−0,019	(0,075)	0,049	(0,094)	−0,646	(0,072)	0,106	(0,090)	−1128	(0,072)	−1958	(0,080)	−0,396	(0,092)	−0,648
political	d.future.	−0,019		−0,019		0,051	**	0,074	***	0,119	***	−0,039		0,000		−0,038		−0,014		−0,051		0,023		−0,033	
influences	regulation	(0,083)	−0,699	(0,078)	−0,629	(0,088)	2185	(0,081)	2781	(0,091)	4338	(0,076)	−1420	(0,090)	0,002	(0,080)	−1215	(0,083)	−0,590	(0,089)	−1541	(0,078)	0,913	(0,087)	−1609
	d.taxes	0,084	***	0,037		0,042	*	0,026		−0,044		0,096	***	0,021		0,033		0,062	**	0,184	***	0,060	**	0,060	***
		(0,083)	3065	(0,082)	1143	(0,087)	1811	(0,085)	0,920	(0,098)	−1469	(0,078)	3422	(0,085)	1065	(0,083)	1022	(0,088)	2393	(0,097)	5149	(0,079)	2277	(0,087)	2975
	d.subsidies	−0,009		−0,026		0,057	***	0,043	**	0,051	***	0,012		0,070	***	0,012		0,033	*	0,004		0,024		0,058	***
		(0,059)	−0,449	(0,058)	−1133	(0,061)	3544	(0,058)	2268	(0,061)	2758	(0,057)	0,586	(0,066)	4673	(0,059)	0,523	(0,062)	1779	(0,059)	0,176	(0,058)	1223	(0,065)	3828
demand side	d.market	0,099	***	0,072	***	−0,007		0,021		0,012		0,026		0,030	*	0,028		0,040	*	0,019		0,007		0,004	
		(0,069)	4320	(0,068)	2697	(0,072)	−0,366	(0,068)	0,922	(0,070)	0,582	(0,064)	1130	(0,079)	1680	(0,066)	1074	(0,070)	1947	(0,066)	0,789	(0,067)	0,298	(0,077)	0,211
	d.reputation	0,001		0,004		−0,008		−0,010		0,050	*	0,038		−0,027		0,125	***	0,083	***	−0,083	***	0,006		0,007	
		(0,084)	0,049	(0,075)	0,142	(0,085)	−0,343	(0,080)	−0,363	(0,091)	1804	(0,073)	1463	(0,083)	−1440	(0,077)	4110	(0,090)	3147	(0,077)	−2930	(0,075)	0,243	(0,082)	0,364
	d.pub.	0,041	**	0,003		0,000		−0,007		−0,031	*	0,002		0,025	*	0,042	**	0,062	***	0,040	**	0,052	***	0,030	**
	contracts	(0,055)	2233	(0,051)	0,172	(0,057)	−0,003	(0,053)	−0,429	(0,059)	−1749	(0,054)	0,107	(0,059)	1849	(0,051)	2061	(0,060)	3569	(0,053)	2070	(0,052)	3052	(0,057)	2269
supply side	d.voluntary	−0,047	**	−0,008		−0,015		−0,037		−0,067	***	−0,010		0,049	***	−0,087	***	−0,059	**	0,069	***	−0,020		0,051	***
		(0,070)	−2010	(0,065)	−0,322	(0,068)	−0,827	(0,071)	−1563	(0,084)	−2651	(0,063)	−0,446	(0,075)	2869	(0,068)	−3225	(0,079)	−2532	(0,067)	2772	(0,069)	−0,901	(0,072)	3002
	d.costs	−0,019		−0,016		−0,018		0,017		0,086	***	−0,042	**	−0,045	***	0,012		−0,046	**	−0,103	***	0,007		−0,033	**
		(0,062)	−0,947	(0,059)	−0,703	(0,068)	−1015	(0,060)	0,875	(0,068)	4238	(0,058)	−1998	(0,070)	−2858	(0,058)	0,528	(0,065)	−2405	(0,059)	−4752	(0,059)	0,372	(0,070)	−2027
Sample size		895		895		895		895		895		895		895		895		895		895		895		895	
Dependant variable																									
mean		0,294		0,450		0,210		0,291		0,282		0,332		0,175		0,441		0,246		0,639		0,295		0,184	
(SD)		0,456		0,498		0,408		0,454		0,450		0,471		0,381		0,497		0,431		0,481		0,456		0,388	
McFadden R2		0,122		0,160		0,128		0,141		0,247		0,054		0,132		0,158		0,135		0,126		0,119		0,134	
Adjusted McFadden R2		0,089		0,131		0,089		0,108		0,213		0,022		0,089		0,129		0,099		0,095		0,086		0,092	

QML robust standard deviations. p value: '***' 0.01 '**' 0.05 '*' 0.1.
Source: compiled by the authors

expectations (Basterretxea et al., 2024). In line with Basterretxea et al. (2024), and contrary to assumptions about their social mission, cooperatives give significantly less importance to voluntary initiative as a driver for eco-innovation than non-cooperatives.

The analysis of innovation constraints reveals a dual reality for cooperatives. They face greater challenges in accessing internal and external private financing, partly due to members' reluctance to invest in long-term projects without transferable ownership rights, and the difficulty of attracting external investors who seek influence (Maietta and Sena, 2010). Members are often small-scale investors concentrating capital in a single venture, increasing risk aversion (Basterretxea and Martínez, 2012). These financial limitations may explain weaker performance in capital-intensive eco-innovations like biodiversity and product life extension. Conversely, cooperatives report fewer constraints related to knowledge, skilled labor, and collaboration, considered key enablers of eco-innovation (Tamayo-Orbegozo et al., 2017; Arranz et al., 2023). This suggests stronger social capital, cohesion, and embedded networks, which may offset financial barriers. These findings highlight the multidimensional nature of eco-innovation, shaped by both resource availability and organizational values.

5.3. *The strategic leverage of public policy*

Our mapping of drivers to outcomes echoes Horbach's (2016) insight that different drivers affect distinct eco-innovation benefits, yet diverges from studies that elevate current environmental regulation as a main driver (Rennings, 2000; Díaz-García et al., 2015; Bossle et al., 2016), as it finds no significant effect on any of the twelve environmental benefits analyzed. Only anticipated future regulations had a modest positive impact, and only for internal benefits such as pollution reduction, hazardous material substitution, and renewable energy use. This suggests that regulatory certainty and forward-looking policies may be more effective than reactive compliance. These findings raise concerns about the enforcement and specificity of current regulations in the service sector, which may be less stringent or relevant than in manufacturing. They align with Jové-Llopis and Segarra-Blasco (2020), who found that in services market pull is more influential, and with Basterretxea et al. (2024), who also noted the stronger role of future regulation compared to the current one, in manufacturing.

In contrast, public policy tools—such as environmental taxes, subsidies, and public procurement—emerged as the most effective eco-innovation drivers. This underscores the strategic role of the public sector, as the most influential drivers are policy-dependent. Based on Table 8, external benefits are best promoted through public procurement and tax incentives, while internal benefits respond more to subsidies, tax advantages, and forward-looking regulation.

Notably, public authorities appear to struggle in achieving significant CO_2 reductions—both within firms and at the user level—through policy alone. Interestingly, this is the area where cooperatives perform best, suggesting that their presence may inherently support eco-innovation aimed at CO_2 reduction, where public policy has limited reach. Public procurement was the only driver that significantly influenced all user-level benefits, indicating that government demand can be a strong catalyst for eco-innovation in service delivery. This may be because, when acting as the end user, the public sector tends to demand services with higher environmental standards.

5.4. *The paradox of internal motivations*

A particularly counterintuitive finding concerns internal motivations—specifically, voluntary environmental commitment and cost-saving goals. These supply-side drivers show negative or insignificant effects on eco-innovation outcomes in the sample. Firms motivated by voluntary action report fewer benefits in material efficiency, energy use, CO_2 reduction by end users, and user-level pollution reduction, with positive effects only in biodiversity-related benefits (both within the firm and for the end user). Similarly, cost-saving motivations correlate with weaker results in recycling (both within the firm and for the end user), biodiversity, and user-level pollution reduction, with energy being the sole area of positive impact. This contrasts with studies that highlight cost savings as a stimulus for environmental R&D and efficiency-oriented eco-innovations (Demirel and Kesidou, 2011; Horbach, 2016), and with frameworks that assign meaningful roles to internal capabilities and proactivity (Bossle et al., 2016; Díaz-García et al., 2015; Liao and Tsai, 2019). This paradox may reflect a gap between intention and capability. Firms driven mainly by internal motivations may lack the strategic alignment, technical expertise, or resources to implement effective eco-innovation. Alternatively, respondents may report these drivers as effective either due to a lack of knowledge or as a result of social desirability bias; in either case, however, these drivers may ultimately fail to demonstrate actual effectiveness. The findings highlight the critical role of external pressures and incentives in enabling impactful eco-innovation.

5.5. *Implications for theory and practice*

This study advances the theoretical understanding of eco-innovation by highlighting the nuanced interplay between organizational form, motivational drivers, and institutional context in the service sector, in contrast to Horbach (2008), who focused on manufacturing. Unlike Bossle et al. (2016), who attribute balanced relevance to both internal and external factors, findings show that internal motivations—such as voluntary commitment or cost-saving intentions—are not relevant to generate meaningful environmental outcomes from innovation. Instead, the results underscore the importance of external, policy-driven incentives and market-based pressures in catalyzing effective eco-innovation. Surprisingly, and again in contrast to the findings of Bossle et al. (2016), regulatory pressure does not emerge as one of the key drivers of eco-innovation, although it does exert some influence. This aligns with and extends the environmental innovation theory (Horbach, 2008; Triguero et al., 2013; Jové-Llopis and Segarra-Blasco, 2020), suggesting that the relative weight of supply-side versus demand-side drivers may vary significantly depending on sectoral and organizational characteristics.

Table 8
Influence of policy decisions on each environmental benefit.

Policy-makers' measures	environmental benefits of ecoinnovation within the firm							environmental benefits of ecoinnovation from use of products by the end user				
	material	CO2	pollution	substitute	energy	recycling	biodiversity	CO2. user	pollution. user	recycling. user	product. life	biodiversity. user
d.future. regulation	NO	NO	**YES**	**YES**	**YES**	NO	NO	NO	NO	NO	NO	NO
d.taxes	**YES**	NO	**YES**	NO	NO	**YES**	NO	NO	**YES**	**YES**	**YES**	**YES**
d.subsidies	NO	NO	**YES**	**YES**	**YES**	NO	**YES**	NO	**YES**	NO	NO	**YES**
d.pub.contracts	**YES**	NO	NO	NO	NO	NO	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**

Source: compiled by the authors

From a practical perspective, this study offers several insights. First, since competing priorities are the main barrier to eco-innovation in service firms, policymakers could provide financial or technical support to ease these pressures and allow firms to focus more on environmental initiatives. Second, the strong impact of public policy instruments—especially on user-level benefits—highlights the government's key role in shaping eco-innovation outcomes. Anticipatory regulation appears especially influential and should be prioritized. Third, cooperatives are particularly effective in driving CO_2 reduction eco-innovations, where policy influence is limited. Supporting cooperatives through targeted preferential loans, capacity-building through technical training, and inclusive procurement policies could serve as a strategic, indirect approach to advancing eco-innovation, in these areas where regulatory leverage is otherwise constrained. Overall, policymakers should adopt tailored strategies that reflect the unique drivers and constraints of the service sector and shift from reactive regulation toward specific, outcome-oriented incentives such as tax benefits and procurement criteria. It is worth noting, however, that such stimulus measures often entail regulatory complexity and significant financial costs.

In Mondragon's case, cooperatives benefit from a unique legal and fiscal framework supported by the Basque Government. This includes preferential tax treatment—such as reduced corporate rates and reinvestment deductions—and targeted subsidies for job creation, internationalization, and technological development. Cooperative-specific legislation further promotes democratic governance and labor equity, strengthening the resilience and competitiveness of the Mondragon model within the social economy.

As for managers, the results highlight the need to move beyond symbolic or reactive environmental strategies. Firms that rely solely on internal motivations without aligning their innovation processes with external opportunities and regulatory frameworks may struggle to achieve substantial environmental benefits. Integrating eco-innovation into broader strategic planning, investing in collaborative networks, and leveraging public support mechanisms are likely to yield more impactful outcomes.

Managers should also consider that voluntary commitment without technical capability or financial backing risks becoming symbolic rather than transformative.

6. Conclusions

This study set out to explore the drivers, constraints and benefits of eco-innovation in service sector firms in the Basque Country, with a particular focus on the role of cooperatives. Drawing on data from the 2022 Innovation Survey and grounded in the theoretical framework followed by Horbach (2008), Triguero et al. (2013), and Jové-Llopis and Segarra-Blasco (2020), findings reveal that cooperatives are more likely to engage in eco-innovation, particularly in CO_2 reduction and end-user recycling, but underperform in capital-intensive areas such as biodiversity conservation and product life extension. Taxes, subsidies, and public procurement emerge as the most effective drivers, while current regulation shows limited influence. Internal motivations such as voluntary commitment and cost-saving are linked to fewer environmental benefits, suggesting a disconnect between intent and implementation capacity. Cooperatives face greater financial constraints but can play a key role in promoting eco-innovations difficult for public institutions to support. These findings integrate organizational form and sectoral context. They also offer insights for policymakers aiming to promote sustainable innovation in service-based economies, highlighting the strategic role of cooperatives. In this sense, the study underscores the need for differentiated policy approaches.

6.1. Limitations and future research

While this study provides valuable insights, several limitations should be noted. The use of cross-sectional data from the 2022 Innovation Survey restricts causal inference, as relationships remain interpretative despite probit models controlling firm-level characteristics. Due to data constraints, the potential endogeneity of the *coop* variable could not be addressed through specific econometric corrections, such as instrumental variable techniques or panel methods. While the inclusion of multiple control variables—such as firm size, R&D intensity, cooperation breadth, export activity, and public innovation support—and the limitation of the sectoral and regional context help mitigate this concern, the possibility of reverse causality or omitted variable bias cannot be entirely ruled out. Similarly, potential endogeneity of variables like regulation and subsidies (Bitat, 2018; Shao et al., 2020) is not addressed, as standard practice treats them as exogenous. Additionally, unobserved heterogeneity—stemming from missing data on firm age, managerial traits, or competition intensity—may persist despite sectoral focus and control variables. Self-reported eco-innovation measures may also introduce bias, particularly for abstract indicators such as biodiversity benefits. Moreover, the focus on service firms in the Basque Country, while contextually rich, limits generalizability to other regions or sectors. Finally, limitations include the exclusion of innovation constraints as explanatory variables and the decision not to model cooperative status as a moderator, both due to complexity and data limitations.

Future research could address these issues through longitudinal designs, larger cooperative samples, instrumental variable techniques or comparative analyses across sectors or regions, to assess the generalizability of our findings and clarify whether the strong role of policy instruments observed here is context-specific. The inclusion of objective environmental indicators (e.g., carbon emissions, ISO 14001 certifications) could validate self-reported claims. Further, exploring governance mechanisms, leadership orientation, and absorptive capacity could illuminate why internal motivations (voluntary and cost-saving motivations) fail to translate into effective eco-innovation outcomes. This would be even more interesting in the case of cooperatives. Finally, research could examine policy mixes and cooperative-specific incentives to identify which combinations most effectively overcome financial constraints and foster capital-intensive eco-innovations such as biodiversity conservation.

CRediT authorship contribution statement

Josu Santos-Larrazabal: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Jorge Gutiérrez-Goiria:** Writing – review & editing, Writing – original draft, Visualization, Methodology, 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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Data availability

Data will be made available on request.

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