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Objectives of and Barriers to Innovation: How Do They Influence the Decision to Innovate?

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Abstract: This study focuses on the analysis of the innovation activity of agribusiness in Extremadura (Spain). Using as main variables the objectives of and barriers to innovation perceived by agri-food companies, its objective is threefold: (1) to analyse how the objectives of and barriers to innovation influence the companies' willingness to innovate and competitiveness; (2) to investigate how innovation objectives (strategies) influence the type of innovation developed; (3) to study how barriers to innovation influence the demand for several public actions. The data used for this study were taken from an ad hoc questionnaire sent to agri-food companies from Extremadura during the months of February to April 2021. The results show the influence of the objectives and barriers on the variables analysed (willingness to innovate and competitiveness, types of innovation, and demand for government actions). Specifically, uncertainty and lack of knowledge are barriers that negatively influence the willingness to innovate. Innovative strategies aimed at reducing costs, respecting regulations and the environment, focusing on production and demand, and expanding the market have a positive influence both on the willingness to innovate and competitiveness. The types of innovation developed (product, process, commercial, organizational) were related to various innovative strategies based on the pursued objectives. Finally, evidence is provided by the barriers that lead companies to request specific actions from public administrations. These results may be useful both for managers of agri-food companies and for public administrations, especially at the regional level, in the design of public policies and actions aimed at encouraging innovation in this industry sector.

Keywords: agri-food industry; willingness to innovate; competitiveness; type of innovation; obstacles to innovation; demand for government actions

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1. Introduction

Innovation is generally characterised by changes in a complex and interrelated system between product/service, market, knowledge, and society. Currently, the concept of innovation is moving away from the view that characterised it as an individual act and is beginning to be seen as a system that is an accumulation of several interrelated innovations. The current model of innovation focuses mainly on the role of the company as the driving force of innovation, also paying attention to informal activities as sources of knowledge and generators of new innovative processes. On the other hand, given that innovation also depends on the relationships and interactions between different actors, the formation of networks, and the learning and dissemination of these processes, it is essential to recognise the role of the social and cultural aspects that define us as a society. Lastly, the legal context in which innovation takes place should not be forgotten, as it is also a determining factor.

Numerous studies have highlighted the importance of innovation and its positive effects on productivity, sales, or profits [1–8], as well as the determinants of this

innovation [1,9–13]. However, few studies have analysed the factors that influence companies' willingness to innovate [14,15]. Innovation is not an instantaneous process; rather, innovative companies first define the objectives to be achieved and the obstacles they face and then design the strategies to follow in order to achieve those aims [16,17].

It is also interesting to discover which factors influence how companies consider innovation as an important element of competitiveness. The study of both aspects (willingness to innovate and competitiveness) contributes to filling a gap in research on innovation. This is the first objective of this study: to analyse how the objectives (strategies) of and barriers to innovation determine the willingness to innovate and take innovation risks, as well as finding out if companies consider innovation as an essential element of competitiveness. Secondly, the objectives pursued by these companies when innovating and their influence on the type of innovation developed are analysed. The last important aspect considered is how the perceived obstacles to innovation influence the demand for action from public administrations to encourage the implementation of innovation strategies. Based on these objectives, this study poses the following research questions:

What innovation strategies determine the willingness to innovate? What are the obstacles that influence the willingness to innovate?

What innovation objectives determine the consideration of innovation as an element of competitiveness? Are obstacles to innovation perceived as essential elements of competitiveness?

What objectives do companies pursue when innovating? How do the objectives (strategies) influence the type of innovation developed?

What barriers influence the demand by companies for government actions in order to encourage innovation?

These issues are analysed in a specific industry, the agri-food industry, and in a specific region: Extremadura, Spain. In this region, the agri-food sector is one of the main sources of economic activity. The weight of the agricultural sector and its associated industries is substantially higher than the national average. According to data from the Spanish National Institute of Statistics (INE), in January 2021, there were 1362 companies related to the food, beverage, and tobacco industries (National Classification of Economic Activities 2009 codes 10, 11, and 12), which represents 2.06% of the total of companies in the region. The agri-food companies have a weight of 0.89% in the total of the country's industries. This means that, in Extremadura, the weight represents more than double what is found at the national level [18].

To carry out the study, an ad hoc questionnaire was developed, through which the data were obtained. These data made it possible to carry out a descriptive study on certain aspects related to the characterisation of agri-food companies in general, innovative companies, and certain behavioural patterns and perceptions regarding their innovative behaviour. We then analysed the influence that the objectives (strategies) of and obstacles to innovation have on these issues.

In general terms, the results reveal the influence of the objectives of and obstacles to innovation on the willingness to innovate and competitiveness, types of innovation, and demands for public action.

The objectives of this study and the answers it provides to the research questions posed are novel in several aspects and contribute to filling a gap in the research on innovation in firms. Firstly, the study of how innovation objectives and obstacles to innovation influence the willingness to innovate and the consideration of innovation as an essential element of competitiveness are issues that have not been previously analysed. Secondly, this research also analyses how innovation strategies influence the type of innovation developed. Third, although the literature on barriers to innovation and their effect on innovative activity is abundant, another novelty of this study is that it analyses how barriers influence public actions and the policies to be developed by public administrations to encourage innovation. Finally, the novelty of this study also lies in observing these aspects in a specific industry, the agri-food industry, where the research to date has not focused

on these related aspects, especially not on barriers to innovation. In this sense, most empirical studies of obstacles in the food sector are of a qualitative nature. This study complements this literature with a quantitative analysis that can broaden the understanding of innovation in the agri-food sector.

The main contributions of the study are indicated below. First, it shows how both the motivations that lead to innovation and developing an innovation strategy, as well as the obstacles perceived by companies, influence the willingness to innovate as an essential element of competitiveness. Secondly, a list of innovation strategies is established through the innovative objectives that the company wishes to achieve with the type of innovation developed. Finally, evidence is provided by the barriers that lead companies to demand specific actions from public administrations.

This paper is organised as follows. Section 2 reviews the literature related to the aspects developed in this research. Next, the design of the research and the method of obtaining the data, as well as the methodology used in the study, are detailed. In Section 4, the descriptive study of the data is carried out, and the main results of the empirical study are presented. Section 5 presents the discussion of the results, and finally, Section 6 summarizes the main conclusions.

2. Background

Innovation is a complex process where several factors must come together. Given the high cost, risks, and uncertainty that characterize innovation, a company must make a series of decisions and design a strategy that determines the innovative objectives it intends to achieve. The knowledge generated by innovation is considered a non-rival good that is difficult for companies to appropriate [19,20]. The lack of appropriability, together with the high risk and uncertainty, as well as other barriers, forces them to carry out an internal and external analysis to design a series of innovative strategies with the goal of overcoming the various obstacles before achieving a sustainable competitive advantage [21].

If innovation is considered as a process, the first decision to be adopted by the company is whether it is willing to innovate or not. This decision will have some important present and future repercussions on the company, and one of them will be increasing its competitiveness in the market.

If the company decides to innovate, and they consider that innovation is an essential element to improving their competitive position, the second decision, then, consists in devoting efforts to designing an innovative strategy that, among other aspects, identifies the reasons that drive this innovation and its objectives. It is necessary to define an innovation strategy for the company to achieve its maximum effectiveness and efficiency [22–29]. However, although many companies have a clear willingness to innovate, establishing a well-defined strategy and setting goals is not an easy task, especially when they face barriers to innovation [30].

Numerous studies have analysed the barriers to innovation in companies in general or by sectors. The obstacles can be determined by the existence of scarce financial resources or difficulties in finding financing [31–39]. Credit constraints particularly affect small- and medium-sized enterprises (SMEs) and young innovative firms [40–45].

From the point of view of economic factors, another barrier is the high cost of innovation [33,46–53]. Likewise, the lack of information andmarket conditions [31,49,50,54], the perception of a high economic risk [37,38,55], and the lack of qualified personnel [36,39,48,50,51,55–58] are barriers that have been highlighted in various studies.

The reasons that lead companies to innovate are diverse. The strategy that each company adopts will depend on the reasons it pursues innovation. Those reasons can be related to the market, the demand, or the competition. Companies may need to substitute outdated products or processes, offer a wider range of goods or services, offer higher-quality goods or services, increase their market share, or penetrate new markets. These objectives are positively related to product innovations, where the quantification of the

benefit generated by this type of innovation acquires a special importance, allowing these innovations to be differentiated from simple isolated improvements [59–61]. They may also be related to innovations in packaging in the case of the agri-food industry [59].

Other reasons are to improve efficiency, effectiveness, and flexibility and implementing a production or cost reduction strategy (lower labour costs, fewer materials, less energy per unit produced). These goals relate to process innovations. Innovation in the process area of the food industry is aimed at improving the internal functioning of brands, factories, and industries in order to improve distribution and customer service, while trying to reduce costs in materials, infrastructure, and personnel [62]. These innovations have an advantage over product innovations, since they normally happen internally within companies, lowering the barriers of appropriability or imitation by competitors.

Other motivations may include respect for the environment [21,63,64], the improvement and health of employees, or compliance with regulatory requirements in health or safety, especially in the food sector [10]. Like the previous ones, these motivations have been positively associated with process innovations [65].

Finally, much importance has recently been given to human resources. Employment retention or the increase in total employment and qualified employment are becoming fundamental objectives in companies to improve innovative performance [66]. This way, the objectives of innovation can be determined with a certain innovation strategy [67,68].

It is also interesting to highlight that one of the main problems that researchers face when determining whether to carry out research and development (R&D) or an innovation activity is to define the criteria that will enable them to distinguish innovation from a simple improvement of the product or investment in R&D from a simple investment of capital. To distinguish them, there must be an absolute novelty and originality of content, form, and process by which they are carried out to obtain product and process innovations. In this context, R&D activities are considered as the set of activities that allow the development and introduction of technological innovations.

Even so, the relationship between innovation and R&D activities is not always so simple. Until recently, the innovation model was thought to follow a linear model that began with research (R&D phase), continued with invention, followed by innovation, and ended with diffusion. This model, however, has been widely questioned, because the consideration of innovation as a simple sequence of stages reduces the dimension of interaction and complementarity between them [69,70].

In addition, it is possible to grant greater importance to R&D activities and to neglect other activities such as, for example, the results of innovation. For this reason, R&D activity should not be considered only in the first phases of the production process, but it should be manifested in all its phases. The growing importance of human capital and its training is accompanied by a certain willingness of companies to invest in material and immaterial resources to rationalize production management systems [71].

Furthermore, those activities that represent an important novelty in the organisation or marketing processes of the company allow the introduction of non-technological innovations. This in turn leads to the identification of the four types of innovation: technological (product and process innovation) and non-technological (organisation and commercial innovations), according to the definitions in the Oslo Manual [72].

Therefore, innovation cannot be expected as an isolated event but rather is a set of actions that favour not only the profitability of companies but also the economic and social development of regions. Despite the importance of studying innovation and thus implementing mechanisms that tend to the optimization of agro-industrial development, there are few studies that have analysed these aspects in a sector of vital importance for the economy of Extremadura, the agri-food sector.

3. Materials and Methods

3.1. Research Design and Data Collection

The information that can be obtained on innovative activities of companies in Spain is mostly at the national level through the Survey on Technological Innovation and the Survey on Innovation of Companies, prepared by the Spanish National Institute of Statistics (NIS) [73,74]. The data that correspond to Extremaduran companies are scarce, especially those referring to a specific sector of activity.

In addition, with the information available, little can be deduced about the expectations of the companies and their opinions about their future innovation activities, the strategies based on their objectives of innovation, the obstacles that the companies perceive for their development, and what aspects of public policies could be modified to better meet the needs of companies in such a way that they would effectively act as incentives for innovation activities and reduce the obstacles to their realization. This information gap justified the use of primary data and the design of an ad hoc questionnaire targeted at Extremaduran agri-food companies.

The questionnaire was developed to focus on issues not contemplated in other existing innovation surveys at the national level. This allowed us to obtain information from companies with fewer than 10 workers, which represents the most common size in the region. Through the questionnaire, data were collected to analyse other aspects than those usually considered in the official reports and statistics, such as the expectations of companies and their opinions on innovation activities, perceived obstacles to innovation, objectives and motivations, and the actions demanded from public administrations.

The questionnaire was structured in three blocks of questions. The first block was about general characteristics of the companies and the respondents (name and position in the company). The information obtained in this section made it possible to differentiate the companies based on their location, year of creation, sector of activity, description of the activity, legal form, size, approximate turnover range, if they have other centres in Spain or abroad, and their export activity. The type of questions asked were open, closed, dichotomous, and multiple-choice.

In the second block, companies were asked about issues related to the innovation developed in the last 2–3 years. Then, innovative firms were questioned about the type of innovation carried out (product, process, commercial, organisational) according to the definitions of the Oslo Manual [72]. At the end of the questionnaire, a brief explanation of what is considered innovation and the types of innovation was included, since one of the main problems faced by this research was to determine whether companies really engaged in innovative activities. Other questions related to innovation concerned the type of expenditure on technological innovation (product/process) and/or non-technological innovation (commercial/organisational). Innovative firms were also asked about how the innovative activity was developed (only by the company, the company together with other companies or public or private institutions, or only through other companies). The form of protection and financing of the innovation and the knowledge and use of direct public financing (grants or soft loans) and/or indirect financing (tax incentives) were other questions in this block of the questionnaire.

This block of questions ended with the assessment of companies on two issues. One of them was the *willingness to innovate and take innovation risks*. This variable was valued by agri-food companies on a 0–10 Likert scale (0: low willingness, and 10: high willingness). The second one was the *consideration of innovation as an essential element of competitiveness.* This variable was also valued on a 0–10 Likert scale (0: low consideration, and 10: high consideration). Questions assessing these variables were asked to all the firms (innovative and non-innovative firms).

Finally, the third block of questions contains perceptions about the objectives, barriers, and demands for the public administration. First, all firms indicated the degree of importance of 16 objectives in implementing innovative activities, which were valued on

a 0–10 Likert scale (0: very unimportant, to 10: very important). Second, firms were asked about the degree to which 19 barriers made it difficult to carry out innovation activities in the company, also valued on a 0–10 Likert scale (0: no difficulty, 10: high difficulty). Finally, the questionnaire ended with a multiple-choice question about several actions that the public administration could take to boost innovation activities in agri-food companies.

As an activity prior to the design of the questionnaire, a report/directory of agri-food companies in Extremadura was prepared, which served as a target population to whom the questionnaire was sent. The information was obtained from the crossing and analysis of different databases (NIS, Extremaduran Agri-food Cooperatives, and Iberian Balance Analysis System-SABI [18,75,76]), having as search base the Extremadura companies of the National Classification of Economic Activities (NCEA-2009), codes 10 (agri-food industry), 11 (beverages), and 12 (tobacco).

In the preparation of this report, it was found that various companies were duplicated, some extinct, without activity at the current time, or with wrong contact information. The information extracted from each of them was completed with information from their web pages. The report contains data on a total of 734 agri-food companies of various legal forms and sizes. At the end of the report, they were categorized based on the classification of the activities they carry out.

This total population was the one we sent the questionnaire to, and they answered both by the Google Docs form and by telephone. The data collection was carried out during the months of February to April 2020. The pandemic of COVID-19 and the confinement decreed in mid-March 2020 in Spain resulted in an increase in the time needed for data collection. The companies participated on a voluntary basis. The sample obtained comprised 194 agri-food companies. These data made it possible to carry out a descriptive study on certain aspects related to the characterisation of agri-food companies in general, innovative companies, and certain behavioural patterns and perceptions regarding their innovative behaviour.

3.2. Methodology

First, a descriptive study was carried out to differentiate between innovative and non-innovative companies. This descriptive study was focused on the analysis of some important variables, such as the *willingness to innovate and take innovation risks*, the *consideration of innovation as an essential element of competitiveness*, *objectives* of innovation, *barriers* perceived by companies, and the *demand for actions* to come from the public administration. The results are presented in Section 4.1, differentiating between innovative and non-innovative firms in order to observe whether there are differences in characteristics and perceived ratings. For the valuation questions, the analysis of differences in median ratings was conducted using the non-parametric Mann–Whitney test for independent samples.

Second, an exploratory factor analysis was used as a tool to determine the main dimensions (components) of the *objectives* of innovation and the perceived *obstacles* (barriers). Factor analysis is a multivariable technique based on the elimination of redundancy among many variables [77]. This technique tries to explain the variability of the set of variables, with the least number of factors or components, to provide an overview of the interrelationships between these variables [78,79]. The goals of the factor analysis in this study were to determine the number of fundamental influences underlying the set of variables for the objectives of and barriers to innovation, to quantify the extent to which each variable is associated with the factors, and to obtain information about their nature from observing which factors contribute to their respective performance [80]. To carry out the factor analysis of the *innovation objectives* and *barriers to innovation* variables, the validity of the sample was first verified. For this, the Bartlett sphericity test and the Kaiser–Meyer–Olkin (KMO) measure of sample adequacy were applied. The former was used to verify that the correlation matrix is close to an identity matrix, that is, a matrix with all diagonal elements joined and non-diagonal elements null [81]. The KMO measure was used to

compare the observed correlation coefficients with the partial correlation coefficients. The results obtained from the factor analysis are presented in Section 4.2.

Then, the influence of the factors obtained from the innovation objectives and the perceived obstacles on the *willingness to innovate (WILLINGNESS*) and the *consideration of innovation as an essential element of competitiveness* (*COMPETITIVENESS*) were analysed as dependent variables using a linear regression model.

$$WILLINGNESS_i = \alpha + \beta_i X_i + \sum_{j=1}^{n} \delta_{ij} FObj_{ij} + \sum_{j=1}^{n} \eta_{ij} FBarr_{ij} + \varepsilon_i \quad (1)$$

$$COMPETITIVENESS_i = \alpha + \beta_i X_i + \sum_{j=1}^{n} \delta_{ij} FObj_{ij} + \sum_{j=1}^{n} \eta_{ij} FBarr_{ij} + \varepsilon_i \quad (2)$$

In both equations, the score obtained from the valuations of the company "*i*" is related to the factors obtained from the factorial analysis "*j*", including the factors of *objectives of innovation* (*FObj*) and the factors of *obstacles to innovation* (*FBarr*) obtained, as well as a set of explanatory variables (*X*). The explanatory variables used are binary variables of the companies' characteristics: size of the company (1: fewer than 10 employees, 0: more than 10 employees) (*microenterprises*); exporting status of the company (1: exports, 0: does not export) (*exports*); and innovative status of the company (1: having carried out innovation in the last 2–3 years, 0: not innovative) (*innovative firm*).

Next, the probability of developing a *type of innovation* was analysed in relation to the factors of *objectives* (strategies) of innovation, using the subsample of innovative companies. A probit model (binary choice) was used, expressed in the following form:

$$TINNOV\,*_i = \beta_i X_i + \sum_{j=1}^{n} \eta_{ij} FObj_{ij} + \varepsilon_i > 0 \quad (3)$$

where the decision of the company "*i*" is a function dependent on the factors obtained in the factorial analysis related to the *objectives (strategies) of innovation* (*FObj*) and a set of explanatory variables (*X*). The explanatory variables used are binary variables of the characteristics of the companies: size of the company (1: fewer than 10 employees, 0: more than 10 employees) (*microenterprises*) and age of the company (1: less than 10 years since its creation, 0: otherwise) (*young)*.

The latent variable was not observed. What was observed is the implementation of the types of innovation, so:

$$TINNOV_i = \begin{cases} 1\ if\ TINNOV\,*_i > 1 \\ 0\ otherwise \end{cases} \quad (4$$

The latent variable takes the value 1 when the company indicates that it has carried out some type of innovation (product, process, marketing, organisational) and 0 otherwise.

Finally, the probability of *demanding certain public administration actions* in relation to the factors of *obstacles* (barriers) to innovation was analysed. For each demand (*DEMAND*), a probit model was used, expressed in the following form:

$$DEMAND\,*_i = \beta_i X_i + \sum_{j=1}^{n} \eta_{ij} FBarr_{ij} + \varepsilon_i > 0 \quad (5)$$

where the response of the company "*i*" is a function dependent on the factors obtained in the factorial analysis related to the barriers to innovation (*FBarr*) and a set of explanatory variables (*X*). The explanatory variables used are binary variables of the characteristics of the companies: size of the company (1: fewer than 10 employees, 0: more than 10 employees) (*microenterprises*); innovative status of the company (1: innovates; 0: does not innovate) (*innovative firm*), and age of the company (1: less than 10 years since its creation, 0: otherwise) (*young*).

As in the specification of the previous model, the latent variable indicates the implementation of what depends on the company's response, so:

$$DEMAND_i = \begin{cases} 1 \; if \; DEMAND^*_i > 1 \\ 0 \; otherwise \end{cases} \quad (6)$$

In this case, the latent variable takes the value 1 when the company demands the implementation of those public actions to promote innovative activities and 0 otherwise.

4. Results

4.1. Descriptive Study

A descriptive analysis of the data obtained from the responses to the questionnaire was carried out, which made it possible to analyse the situation of innovation in the Extremaduran agri-food industry. The general characteristics of agri-food companies were first analysed. Next, the study focused on the innovative activity of the companies that declared to have carried it out in the last two or three years, comparing and analysing differences between innovative and non-innovative companies. Other aspects that were analysed are the willingness to innovate and the consideration of innovation as an essential element of competitiveness, the objectives of innovation, the main barriers to innovation detected, and the demands made by companies to the regional administration to promote innovation. The questionnaire was addressed to the main managers of agri-food companies.

4.1.1. General Characteristics of the Sample

Table 1 shows some general characteristics of the companies. The sample obtained was 194 companies (136 companies established in 64 municipalities in the province of Badajoz, which represents 70.1% of the total sample, and 58 companies established in 42 municipalities in the province of Cáceres), which represents 26.4% of the total population (734 companies, according to the report previously prepared).

Regarding the companies' size, it is observed that they are mostly small (microenterprises), with 55.7% of companies having fewer than 10 employees, and 88.7% of the total having fewer than 50 workers. Most of the companies are limited liability companies (57.7% of the total). It is also worth highlighting that 27.3% of the companies (53 companies) are cooperatives, which play a fundamental role in the development of the agri-food activity of this region. More than 25% of the companies are in meat industries.

Table 1. General characteristics of the sample.

Total Sample (*n* = 194) Total Population (*n* = 734)				
Province	**Companies**	**% sample**	**Companies**	**% population**
Badajoz	136	70.1	489	66.6
Cáceres	58	29.9	245	33.4
Size	**Companies**	**% sample**	**Companies**	**% population**
<10 employees	108	55.7	515	70.2
10–49 employees	64	33	175	23.8
50–199 employees	20	10.3	41	5.6
>200 employees	2	1	3	0.4
Legal form	**Companies**	**% sample**	**Companies**	**% population**
Cooperative	53	27.3	132	18
Limited liability companies	112	57.7	518	70.6
Public limited companies	22	11.4	76	10.4
Other legal forms	7	3.6	8	1.1
Agro-industrial activity [1]	**Companies**	**% sample**	**Companies**	**% population**

Meat industry (10)	51	26.3	193	26.3
Fruits/vegetables (10)	46	23.7	155	21.1
Animal feeding (10)	26	13.4	120	16.3
Beverages (11)	23	11.9	72	9.8
Fats and oils (10)	22	11.3	56	7.6
Others (10,11,12)	26	13.4	138	18.8

[1] Agro-industrial activity: Classification based on the Cajamar report [82] and the NCEA-2009 codes (10: Agri-food industry. 11: Beverages. 12: Tobacco).

4.1.2. Innovative Activity

Of the total sample obtained (194 companies), 137 companies (70.6% of the sample) indicated that they had carried out innovation activities. Table 2 compares the main characteristics, differentiating the results between innovative and non-innovative agro-industries. In relation to size, innovative companies in the sample are larger than non-innovative ones (86.2% have fewer than 50 workers compared to 94.7% of non-innovative ones). A total of 30.4% of the innovative companies are cooperatives, which represents 72.2% of the total number of cooperatives in the sample. The turnover range of innovative companies is higher than non-innovative ones. Furthermore, the percentage of innovative companies that export (55.8%) is higher than that of non-innovative companies (31.6%).

In the last column of Table 2, Pearson's Chi-square test allows for determining whether there are statistically significant differences among these variables depending on being an innovative or non-innovative company. According to Pearson's Chi-square test, the variables company size, foreign trade activities, and turnover range present significant statistically differences. This means that there is a dependency between the size of the companies, their turnover and exports, and being an innovative company. On the contrary, no significant differences are observed in the province, legal form, or business activity variables. Therefore, innovative companies have a larger size, exhibit higher turnover, and export more compared to non-innovative agri-food companies.

Table 2. Comparison of the characteristics of innovative and non-innovative companies.

Total Sample (*n* = 194) Innovative Companies (*n* = 137) Non-Innovative Companies (*n* = 57)					
Province	**Companies**	**Innovative (%)**	**Companies**	**Non-innovative (%)**	[1] ***Sig.***
Cáceres	42	30.7	16	28.1	*n.s*
Badajoz	95	69.3	41	71.9	
Size	**Companies**	**Innovative (%)**	**Companies**	**Non-innovative (%)**	
<10 employees	69	50.4	39	68.4	*
10–49 employees	49	35.8	15	26.3	
50–199 employees	17	12.4	3	5.3	
>200 employees	2	1.5	0	0	
Legal form	**Companies**	**Innovative (%)**	**Companies**	**Non-innovative (%)**	
Cooperative	38	27.7	15	26.3	*n.s*
Limited liability companies	78	56.9	34	59.6	
Public limited companies	16	11.7	6	10.5	
Other legal forms	5	3.6	2	3.5	
Activity	**Companies**	**Innovative (%)**	**Companies**	**Non-innovative (%)**	
Meat industry	37	27.0	14	24.6	*n.s*
Fruits/vegetables	18	13.1	11	19.3	
Animal feeding	18	13.1	8	14.0	
Beverages	17	12.4	6	10.5	
Fats and oils	15	10.9	7	12.3	
Other	27	19.9	11	19.3	
Export	**Companies**	**Innovative (%)**	**Companies**	**Non-innovative (%)**	

Exporter	76	55.5	18	31.8	**
Non-exporter	61	44.5	39	68.4	
Turnover (€)	**Companies**	**Innovative (%)**	**Companies**	**Non-innovative (%)**	
⩽500,000	29	21.2	17	29.8	**
500,001–1,000,000	12	8.8	14	24.6	
1,000,001–2,000,000	21	15.3	10	17.5	
2,000,001–6,000,000	36	26.3	6	10.5	
6,000,001–10,000,000	14	10.2	3	5.3	
>10,000,000	25	18.2	7	12.3	

[1] *Sig.* (Significance): * $p < 0.1$, ** $p < 0.05$; *n.s.*: non significant.

Among the innovative firms, 75.4% of the companies indicated that the innovation activities were carried out mainly by the company, while the remaining 24.6% said that they were carried out by the company together with other companies or institutions. Only 14.5% of innovative companies (20 companies) reported having an R&D department.

Regarding the type of innovation developed by innovative companies, it was observed that it is mainly technological innovation: process innovation (73.7% of innovative companies) and product innovation (53.2%). A total of 20.4% of the companies indicated making marketing innovations, and 27% indicated making organisational innovations. Some companies indicated making several types of innovations. Companies that carried out all types of innovations represented 6.1% of all innovative companies.

In terms of innovation protection, 98 firms (71.5% of all innovative firms) reported having a means to protect innovations. Of these, 40.8% indicated they have some form of protection. The principal means to protect innovations are trademarks and/or trade names (83.7%), followed by patents and/or utility models (48.8%).

Another aspect analysed was the type of funding. Innovation was mainly financed by their own funds (66.4%) and public subsidies (44.5%), while loans from banks were the least-used financing instruments.

4.1.3. Willingness to Innovate and Competitiveness

Figure 1 shows the valuations of the agri-food companies for the variable *willingness to innovate and take risks to innovate*. The average rating on the scale is 6.2 for innovative firms and 5 for non-innovative firms. In the case of non-innovative companies, there is less willingness to innovate.

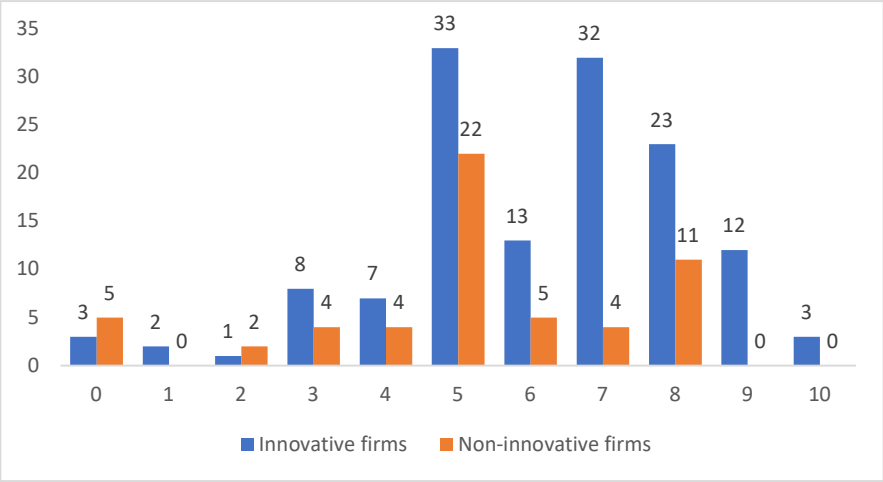

Figure 1. Willingness to innovate and take innovation risks (innovative and non-innovative companies).

In relation with the previous variable, the companies were also asked whether they *consider innovation as an essential element of competitiveness*. Figure 2 shows the responses of the companies, differentiating between innovative and non-innovative companies. The average ratings are 7.4 for innovative companies and 6.9 for non-innovative ones. Interestingly, while the willingness to innovate is weak in the case of non-innovative firms, they consider innovation as an essential aspect of competitiveness.

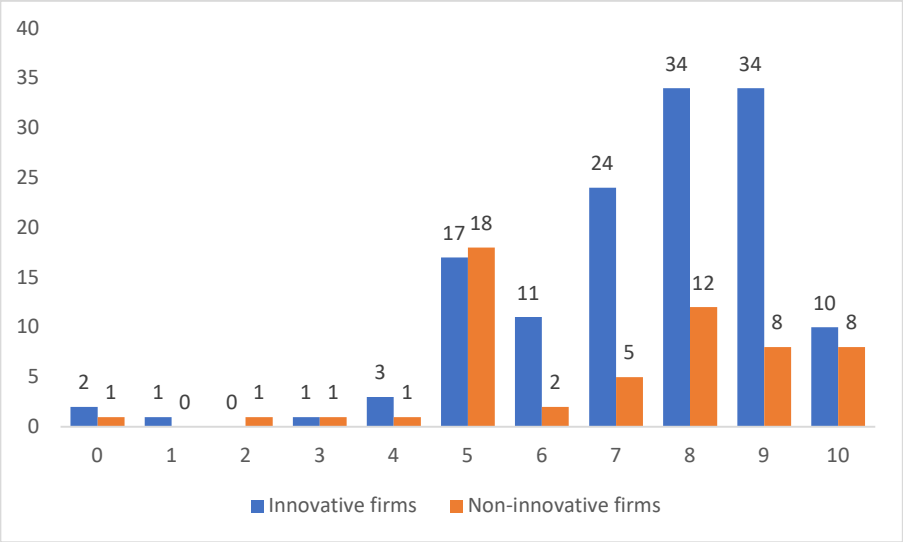

Figure 2. Assessment of innovation as an essential element of competitiveness (innovative and non-innovative companies).

Table 3 shows the results of the Mann–Whitney test between innovative and non-innovative companies in relation to these variables. The existence of a statistically significant difference is observed in the variable *willingness to innovate and take innovation risks*.

Table 3. Mann–Whitney test: willingness to innovate and competitiveness.

	Innovative Firms	Non-Innovative Firms	[1] *Sig.*
Willingness to innovate and take innovation risks	7	5	0.002 *
Consideration of innovation as an essential element of competitiveness	8	7	0.179 *n.s.*

[1] *Sig.* (Significance): * $p < 0.1$; *n.s*: non-significant.

4.1.4. Innovation Objectives

A series of items were considered in the questionnaire to assess the importance that companies attached to carrying out innovation activities. The questions were posed to all the companies in the sample, in relation to 16 objectives or motivations linked to economic reasons for differentiation in markets and costs, environmental issues, and issues related to employment. Table 4 shows the average valuation differences between innovative and non-innovative agri-food companies.

In the case of innovative companies, the main objectives were linked to achieving a higher quality of goods and services, compliance with environmental regulations, health and safety regulatory requirements, and replacement of outdated products and/or processes. The motivations indicated in the case of innovative companies were mainly linked to competing with new and better goods on the market, as well as respecting regulations. In the case of non-innovative companies, greater importance was given to compliance with environmental regulations, health and safety regulatory requirements, and the

improvement of employees. For non-innovative companies, environmental regulations, compliance, and social motivations outweighed market or cost reduction motivations.

The Mann–Whitney test does not show statistically significant differences in the medians of the valuations of the innovative and non-innovative companies with respect to the innovation objectives (Table 4).

Table 4. Mann–Whitney test: innovation objectives.

Innovation Objective	Innovative Companies	Non-Innovative Companies	[1] *Sig.*
Offering a wide range of goods/services	8	7.5	0.095 *n.s*
Replacement of outdated products/processes	8	8	0.221 *n.s*
Penetration into new markets	8	7	0.157 *n.s*
Larger market share	8	7	0.351 *n.s*
Higher quality of goods or services	8	8	0.151 *n.s*
Increased flexibility in production/service delivery	8	7	0.292 *n.s*
Greater production capacity/provision of services	8	8	0.767 *n.s*
Lower labour costs per unit produced	8	8	0.361 *n.s*
Fewer materials per unit produced	7	7	0.615 *n.s*
Less energy per unit produced	8	8	0.947 *n.s*
Less environmental impact	8	8	0.510 *n.s*
Employee improvement and health	8	8	0.430 *n.s*
Compliance with environmental/health/safety regulatory requirements	9	9	0.423 *n.s*
Increase in total employment	8	8	0.700 *n.s*
Increase in skilled employment	8	8	0.291 *n.s*
Employment retention	8	8	0.799 *n.s*

[1] *Sig*. (Significance): *n.s*: non-significant.

4.1.5. Barriers to Innovation

Another fundamental aspect of the study was the analysis of the barriers or obstacles to innovation perceived by agri-food companies. Nineteen barriers to innovation were considered, among them: internal factors of the company, including problems with the company's organisation and lack of culture of innovation; factors related to public actions, including lack of support from public administrations, insufficient flexibility of rules and regulations, and absence of mediators of innovation; and appropriability factors, including difficulty in protecting innovations and high risk of imitation. These barriers are especially interesting, especially those related to the lack of appropriability, since they can be considered novel, as they have not been covered by other innovation surveys.

The positive externalities towards other companies produced by the transmission of knowledge derived from innovation prevent or hinder innovators from fully appropriating the results of these innovations, becoming a fundamental factor that discourages their undertaking [19,20]. In a company, to guarantee the return on investment of its innovation, it is essential that there be resources that prevent other companies from imitating its innovative developments (of production or knowledge).

The longer the company maintains these barriers, the longer it will maintain its competitive advantage and the more profit it will obtain from the new product/service [83]. However, private incentives to invest in these activities may be reduced depending on the degree of difficulty that the company has in guaranteeing the appropriability of the income derived from the information and being able to offset the costs that the production of the information generates. If the risk of imitation is very high, it acts as a negative externality, reducing the benefits of innovation.

Hence, some projects are not carried out, even though they might be socially profitable, in the absence of some mechanism that would restore private incentives. However, not all innovation projects generate positive externalities. There are innovations that are of an imitative nature, that represent a novelty for the company but not in the sector at a global level, and, therefore, although highly desirable both from a private and social perspective, they do not generate additional externalities and would be carried out equally with or without public aid. Competition and the elimination of barriers of entry are usually the best stimuli for this type of innovation [84].

Analysing the average valuations, innovative companies detect high costs, high economic risk, markets dominated by established companies, lack of internal financing, lack of support from public administrations, and uncertainty regarding demand as the main barriers. Non-innovative companies perceive high economic risk, high costs, lack of internal financing, and uncertainty regarding demand as major obstacles.

The Mann–Whitney test (Table 5) does not show statistically significant differences in the medians of the evaluations of both the innovative and non-innovative companies with respect to the barriers to innovation.

Table 5. Mann–Whitney test: barriers to innovation.

Innovation Barriers	Innovative Companies	Non-Innovative Companies	[1] *Sig.*
Lack of internal financing	8	8	0.907 *n.s*
Lack of external financing	8	8	0.597 *n.s*
High costs	9	8	0.094 *n.s*
Lack of qualified personnel	7	8	0.844 *n.s*
Lack of information technology	7	8	0.654 *n.s*
Lack of information on the markets	7	7	0.665 *n.s*
Difficulty cooperating with companies	7	7	0.624 *n.s*
High economic risk	8	8	0.883 *n.s*
Markets dominated by established companies	8	8	0.166 *n.s*
Uncertainty regarding the demand for innovative goods and services	8	8	0.274 *n.s*
Insufficient flexibility of rules and regulations	8	8	0.312 *n.s*
Lack of support from public administrations	8	7.5	0.577 *n.s*
Absence of innovation mediators	7	8	0.865 *n.s*
Difficulty protecting innovations	7	7	0.436 *n.s*
High imitation risk	7	6	0.602 *n.s*
Lack of customer demand for innovation	7	6	0.608 *n.s*
Market conditions do not imply the need to innovate	7	6	0.823 *n.s*
Company organisation problems	6	6	0.632 *n.s*
Lack of innovation culture	7	7	0.714 *n.s*

[1] *Sig*. (Significance): *n.s*: non-significant.

In addition to the questions raised to assess according to this scale, other barriers to innovation were specified by some companies: difficulty in obtaining permits from the public administration, the precariousness of the market, stagnant public aid systems, lack of incentive by management, lack of access to skilled labour, or lack of agreement between partners.

4.1.6. Demands for Government Actions to Encourage Innovation

Finally, the demands for government actions to boost innovation were analysed. Figure 3 summarizes the responses in percentage, differentiating between innovative and non-innovative companies. It is observed that, both in innovative and non-innovative agri-food companies, the greatest demands are for more direct government support (subsidies and/or soft loans).

The companies interviewed for this survey also mentioned personalised advice and tax benefits as government actions that would foster innovation, especially tax benefits in the case of the innovative companies and personalised advice for the non-innovative ones. In general, and as shown, the size of the non-innovative agribusiness firms is substantially smaller than the innovative ones, a fact that limits the possibility of having more specific personnel for the management and development of innovations.

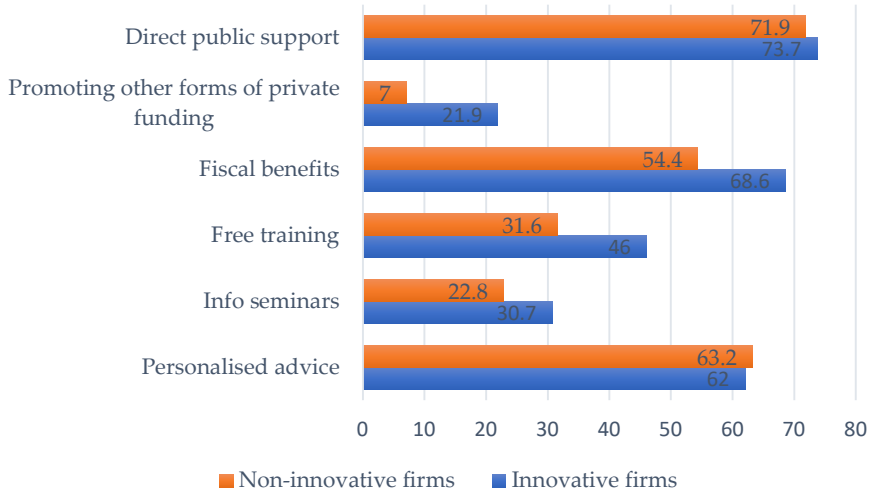

Figure 3. Demands for government actions (% innovative and non-innovative firms).

Additionally, other demands were specified to promote cooperation between companies in the same sector, to simplify procedures and to resolve them more quickly, and not to limit certain expenditure items.

The agri-food companies had previously been asked in the questionnaire about their knowledge and use of the different types of direct public financial support at the international, national, and regional levels and of tax incentives for investment in R&D.

Regarding direct public financial support, 70.6% of all companies (137 companies) declared being aware of R&D subsidies. Of these, less than half, 45.9% (61 companies), declared having requested subsidies. Regarding the type of support, 83.6% indicated they knew the existence of regional subsidies (51 companies), 36% knew about national subsidies (22 companies), and 29.5% were aware of the subsidies from the European Union (EU) (18 companies). A total of 88.5% of the companies that applied for subsidies (54 companies) were granted some type of R&D subsidy.

In relation to indirect public financial support, less than half of the total sample (41.4%) stated they knew of the existence of tax incentives for R&D. Of those, only 50.8% (31 companies) declared using this type of tax benefit. Among the main reasons indicated by the companies for not applying for tax benefits was the difficulty of providing meaningful data and the fact that the procedure takes a long time.

Finally, concerning the reasons for using public financial support, most of the companies indicated the usefulness of public financial aid to start innovation activities (75.3%). A total of 47.9% of the companies indicated having undertaken new projects and innovations, and 32.5% included new lines of business in their strategies and maintained or

increased the R&D&I budget. This indicates the need to increase public financial support and make it more visible to encourage innovative activity, especially at the regional level.

4.2. Factor Analysis

Once the data were analysed descriptively, an exploratory factor analysis of the objectives of and obstacles to innovation variables was carried out to reduce the number of variables necessary to categorize the companies.

4.2.1. Factor Analysis: Innovation Objectives

Regarding the factor analysis of the variables of *innovation objectives*, the results of the KMO tests (0.880) and Bartlett's sphericity test (1599.931; sig. = 0.000) indicate that the sample is suitable.

From the factor analysis, four factors (components) were found from the rotated component matrix (Table 6), which allowed for a better explanation of the generated factors. The number of components was obtained following the Kaiser rule (1958), which recommends retaining only the components with eigenvalues greater than unity [85].

Table 6. Rotated coefficient matrix: innovation objectives.

	Factor			
	1	**2**	**3**	**4**
Offering a wide range of goods and services		0.659		
Replacement of outdated products/processes		0.588		
Penetration into new markets				0.875
Larger market share				0.808
Higher quality of goods or services		0.730		
Increased flexibility in production/service delivery		0.768		
Greater capacity to produce/provide goods and services		0.721		
Lower labour costs per unit produced	0.778			
Fewer materials per unit produced	0.770			
Less energy per unit produced	0.850			
Less environmental impact	0.686			
Employee improvement and health	0.639			
Compliance with environmental, health, or safety regulatory requirements	0.556			
Increase in total employment			0.856	
Increase in skilled employment			0.805	
Employment retention			0.692	

Note: 71.31% of the total variance is explained by the factors. N = 194. The table shows the coefficients of the highest components.

According to the results of Table 6, the objectives can be classified into four groups (factors) that relate to different innovation strategies of the company:

Cost, regulatory, and environmental strategy (*FObj*$_1$). This factor explains 45.99% of the variance and has the highest scores in *lower labour costs per unit produced*, *fewer materials per unit produced*, *less energy per unit produced*, *lower environmental impact*, *improvement and employee health*, and *compliance with environmental, health, or safety regulatory requirements*. The objectives considered for this factor are related to an innovation strategy that seeks to compete with lower production costs, be respectful of the environment, and meet regulatory requirements.

Production and demand strategy (*FObj*$_2$). It explains 10.09% of the variance and is related to *offering a wide range of goods and services*, *substitution of outdated products and processes*, *higher*

quality of goods and services, *greater flexibility in the production or provision of goods and services*, and *greater capacity in the production of goods and services*. These objectives are linked to an innovative strategy that approaches competing by improving production capacity and flexibility and offering more and better services in the markets to satisfy customer needs.

Employment strategy (*FObj*$_3$). This factor explains 8.47% of the variance and is related to *increase in total employment*, *increase in qualified employment*, and *maintaining employment*. The innovative strategy seeks to compete by improving the quantity and quality of employees.

Market expansion strategy (*FObj*$_4$). It explains 6.76% of the variance and is related to *penetration in new markets* and *increase in market share*. The innovation strategy seeks to compete in current and new markets.

4.2.2. Factor Analysis: Barriers to Innovation

Regarding the factor analysis of the barriers to innovation variables, the results of the KMO tests (0.858) and the Bartlett sphericity test (1544.456; sig. = 0.000) indicate that the sample is suitable. From the explanatory factor analysis, four factors (components) were obtained from the rotated component matrix (Table 7).

Table 7. Matrix of rotated components: barriers to innovation.

	Factor			
	1	**2**	**3**	**4**
Lack of internal financing	0.768			
Lack of external financing	0.787			
High costs	0.767			
Lack of qualified personnel		0.764		
Lack of information technology		0.839		
Lack of information on the markets		0.779		
Difficulty cooperating with companies		0.699		
High economic risk				0.555
Markets dominated by established companies	0.504			
Uncertainty regarding the demand for goods and services				0.561
Insufficient flexibility of rules and regulations	0.487			
Lack of support from public administrations	0.648			
Absence of innovation mediators			0.470	
Difficulty protecting innovations			0.600	
High imitation risk			0.626	
Lack of customer demand for innovation			0.854	
Market conditions do not imply the need to innovate			0.780	
Company organisation problems				0.696
Lack of innovation culture				0.731

Note: 64.96% of the total variance is explained by the factors. N = 194. The table shows the coefficients of the highest components.

According to the results, the obstacles (barriers) were classified into four groups:

Economic and institutional barriers (*FBarr*$_1$). This factor explains 40.55% of the variance and shows high scores in *lack of internal financing*, *lack of external financing*, *high costs*, *markets dominated by established companies*, *insufficient flexibility of rules and regulations,* and *lack of support from the public administrations.*

Knowledge barriers (*FBarr*$_2$). It explains 9.68% of the variance and is related to the barriers *lack of qualified personnel*, *lack of information on technology*, *lack of information on markets*, and *difficulty in cooperating with companies*.

Lack of appropriability barriers (*FBarr*$_3$). This factor explains 8.53% of the variance, presenting higher scores in the obstacles: *absence of mediators of innovation*, *difficulty of protecting innovations*, *high risk of imitation*, *lack of demand for innovation from customers*, and *market conditions do not imply the need to innovate.*

Uncertainty barriers (*FBarr*$_4$). It explains 6.20% of the variance and is related to the obstacles *high economic risk*, *uncertainty regarding the demand for goods and services*, *company organization problems*, and *lack of innovation culture.*

4.3. Willingness to Innovate and Competitiveness

Table 8 shows the results obtained from the linear regressions of Equations (1) and (2) that relate the variables *Willingness* to innovate and *Competitiveness* with the factors of objectives of and barriers to innovation.

Column 2 of Table 8 shows that, in relation to the characteristics of the companies, the coefficient of being innovative (innovative) is significant and positive, so being innovative is related to the willingness to innovate and take innovation risks. Regarding the factors that hinder the willingness to innovate, the coefficients of the barriers of *uncertainty* (*FBarr*$_4$) and *lack of knowledge* (*FBarr*$_2$) are statistically significant and are negatively related to the willingness to innovate. Regarding the objectives of innovation that are positively related to the willingness to innovate, there are *production and demand strategies* (*FObj*$_2$), *cost, regulatory, and environmental strategies* (*FObj*$_1$), and *market expansion* (*FObj*$_4$).

In relation to the variable considering innovation as an essential element of competitiveness (column 3), it can be noted that a small size (*micro-firm*) is negatively related. Unlike the willingness to innovate, the fact of being innovative or not does not seem to exert an influence. None of the coefficients of factors of barriers to innovation are statistically significant, so they do not affect this relationship. As in the previous case, the *cost, regulatory, and environmental* strategy (to compete with lower costs and with respect to the environment and regulations), as well as innovation strategies oriented towards *production, demand, and the market* (to compete by offering a greater and better range of goods and services in new national and international markets), are statistically and positively related to the consideration of innovation in competitiveness.

Table 8. OLS willingness to innovate and competitiveness. (Dependent variables: *WILLINGNESS*; *COMPETITIVENESS*).

Variables	***DISPE***		***COMPE***	
	Coef. (st. err.)	[1] ***Sig.***	**Coef. (st. err.)**	[1] ***Sig.***
FObj$_1$	0.444 (0.158)	***	0.302 (0.147)	***
FObj$_2$	0.668 (0.158)	***	0.734 (0.148)	***
FObj$_3$	0.069 (0.155)	*n.s*	0.131 (0.144)	*n.s*
FObj$_4$	0.374 (0.151)	***	0.256 (0.141)	*
FBarr$_1$	−0.250 (0.156)	*n.s*	0.129 (0.145)	*n.s*
FBarr$_2$	−0.275 (0.152)	*	0.157 (0.141)	*n.s*
FBarr$_3$	−0.053 (0.155)	*n.s*	−0.131 (0.144)	*n.s*
FBarr$_4$	−0.389 (0.163)	***	−0.035(0.152)	*n.s*
Micro-firm	−0.399 (0.308)	*n.s*	−0.518 (0.287)	**
Export	0.225 (0.309)	*n.s*	0.049 (0.287)	*n.s*
Innovative	0.750 (0.327)	***	0.177 (0.304)	*n.s*
Constant	5.423 (0.367)	***	7.391 (0.342)	***
Nº observ.	194		194	
R^2	0.222		0.221	

[1] *Sig.* (Significance): * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$; *n.s*: non-significant.

4.4. Types of Innovation and Strategies

Table 9 shows the results of the estimates on the probability (probit model) of carrying out types of innovation (product, process, commercial, and organisation) based on the innovation strategies in Equations (3) and (4). Marginal effects of the mean of each independent variable (dy/dx) were calculated [86]. The coefficients are interpreted as the marginal change in the probability of developing a type of innovation in response to changes in the value of the explanatory variables, so they indicate the influence that the variables have on the probability [1].

The results indicate that the probability of carrying out *product innovation* (column 2) has a significant and positive relationship with the strategies of *production and demand* ($FObj_2$) and *market expansion* ($FObj_4$). The cost, regulatory, and environmental strategy ($FObj_1$) does not seem to be a significant variable, even if it does show a negative sign. The employment-oriented strategy ($FObj_3$), as expected, shows a positive relationship, although this relationship is not significant.

The performance of *process innovation* (column 3) has a positive relationship with the cost-oriented, regulatory, and environmental strategy ($FObj_1$). The strategies of production and demand and expansion of the market, although not significant, show negative relationships. As in the previous estimation, the employment-oriented strategy shows a positive relationship, although it is not significant. In both cases (product innovation and process innovation), neither the size nor the age of the companies has a significant impact.

In relation to *commercial innovation* (column 4), a significant and positive relationship is observed with the market expansion strategy ($FObj_4$). The relationship is also positive with the production and demand strategy, although it is not significant. The relationship with the other strategies (costs, regulations, and environment and employment) is negative, although not significant. Finally, the fact of being a young company increases the probability of carrying out commercial innovation by 16.8%.

Finally, in the probability of carrying out *organisational innovations* (column 5), a significant and positive relationship with the employment strategy is observed ($FObj_3$). Positive relationships, although not significant, are observed with the cost, regulatory, and environmental strategy and the production and demand strategy, and a negative one with the market expansion strategy. Being a small company (fewer than 10 workers) is significantly and negatively related to developing organisational innovations.

Table 9. Types of innovation.

Variables	Products (1)		Process (2)		Commercial (3)		Organisational (4)	
	dy/dx (st.err.)	[1] ***Sig.***	**dy/dx (st. err.**	[1] ***Sig.***	**dy/dx (st. err.)**	[1] ***Sig.***	**dy/dx (st. err.)**	[1] ***Sig.***
$FObj_1$	−0.027 (0.044)	*n.s*	0.080 (0.041)	**	−0.004 (0.034)	*n.s*	0.020 (0.040)	*n.s*
$FObj_2$	0.122 (0.052)	***	−0.064 (0.047)	*n.s*	0.040 (0.036)	*n.s*	0.003 (0.044)	*n.s*
$FObj_3$	0.060 (0.045)	*n.s*	0.009 (0.037)	*n.s*	−0.026 (0.032)	*n.s*	0.074 (0.036)	***
$FObj_4$	0.095 (0.046)	***	−0.071 (0.058)	*n.s*	0.119 (0.049)	***	−0.004 (0.038)	*n.s*
Micro-firm	−0.100 (0.089)	*n.s*	−0.111 (0.103)	*n.s*	−0.044 (0.066)	*n.s*	−0.131 (0.074)	*
Young	0.125 (0.121)	*n.s*	−0.002 (0.074)	*n.s*	0.168 (0.115)	*	0.096 (0.103)	*n.s*
Nº observ.	137		137		137		137	
Log-likelihood	−87.923		−73.799		−62.764		−73.362	

[1] *Sig*. (Significance): * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$; *n.s*: non-significant. Notes: (1): the dependent variable takes a value of 1 if the company indicated carrying out product innovation and 0 otherwise; (2) the dependent variable takes the value 1 if the company indicated carrying out process innovation and 0 otherwise; (3) the dependent variable takes the value 1 if the company indicated carrying out commercial innovation and 0 otherwise; (4) the dependent variable takes the value 1 if the company indicated carrying out organisational innovation and 0 otherwise.

4.5. Demand for Government Actions and Obstacles to Innovation

Table 10 shows the results of the probit regression in Equations (5) and (6). As in the previous case, the marginal effect of the mean of each observation is shown (calculated for each value of the independent variables dy/dx), as well as the statistical significance that indicates the influence that these different variables have on the probability of demand for these government actions.

Table 10. Demand for government actions.

Variables	Demand 1 (1)		Demand 2 (2)		Demand 3 (3)		Demand 4 (4)		Demand 5 (5)		Demand 6 (6)	
	dy/dx (st. err.)	[1] *Sig.*	dy/dx (st. err.)	[1] *Sig.*	dy/dx (st. err.)	[1] *Sig.*	dy/dx (st. err.)	[1] *Sig*	dy/dx (st. err.)	[1] *Sig.*	dy/dx (st. err.)	[1] *Sig.*
FBarr$_1$	0.003 (0.037)	*n.s*	0.046 (0.036)	*n.s*	0.058 (0.038)	*n.s*	0.085 (0.037)	***	0.118 (0.031)	***	0.033 (0.033)	***
FBarr$_2$	0.099 (0.038)	***	0.016 (0.035)	*n.s*	0.001 (0.039)	*n.s*	0.028 (0.038)	*n.s*	0.005 (0.025)	*n.s*	−0.037 (0.035)	*n.s*
FBarr$_3$	0.004 (0.038)	*n.s*	0.019 (0.034)	*n.s*	0.079 (0.039)	***	0.076 (0.037)	***	0.017 (0.025)	*n.s*	0.017 (0.033)	*n.s*
FBarr$_4$	0.024 (0.038)	*n.s*	0.041 (0.035)	*n.s*	0.050 (0.038)	*n.s*	−0.004 (0.037)	*n.s*	0.051 (0.026)	**	0.009 (0.034)	*n.s*
Micro-firm	0.040 (0.074)	*n.s*	0.007 (0.066)	*n.s*	−0.046 (0.074)	*n.s*	−0.138 (0.070)	**	0.056 (0.047)	*n.s*	0.033 (0.065)	*n.s*
Young	−0.308 (0.108)	***	0.279 (0.109)	*	0.118 (0.114)	*n.s*	0.273 (0.076)	***	0.115 (0.091)	*n.s*	−0.041 (0.092)	*n.s*
Innovative	0.016 (0.080)	*n.s*	0.076 (0.070)	*n.s*	0.125 (0.077)	*n.s*	0.095 (0.080)	*n.s*	0.137 (0.043)	***	0.009 (0.071)	*n.s*
Nº observ.	194		194		194		194		194		194	
Log-likelihood	−73.402		−77.303		−68.962		−73.363		−75.319		−63.430	

[1] *Sig*. (Significance): * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$; *n.s*: non-significant. Notes: (1): the dependent variable takes the value 1 if the company requests personalised advice and 0 otherwise; (2) the dependent variable takes the value 1 if the company requests information seminars and 0 otherwise; (3) the dependent variable takes the value 1 if the company requests free training and 0 otherwise; (4) the dependent variable takes the value 1 if the company requests tax benefits and 0 otherwise; (5) the dependent variable takes the value 1 if the company requests to promote forms of private financing and 0 otherwise; (6) the dependent variable takes the value 1 if the company requests direct public financial support and 0 otherwise.

The results show that, in relation to the probability of requesting *personalised advice* (demand 1, column 2), being a young company reduces the probability of requesting this type of action by 30.8% (the relationship is significant and negative). The coefficient of the variable lack of knowledge barrier (*FBarr*$_2$) is significant and increases the probability of requesting this type of action from the public administration.

In relation to *information seminars* (demand 2, column 3), age (being a young company) is significant and positively related to the probability of requesting this type of action. No obstacle factor seems to be significant when explaining this demand, even though they present a generally positive sign.

Regarding *free training* (demand 3, column 4), it does not seem to be related to the characteristics of the companies (small size, young, or innovative), but there is a significant and direct relationship with the barrier of lack of appropriability (*FBarr*$_3$).

Concerning the demand for *tax benefits* (demand 4, column 5) in relation to the characteristics of the companies, a significant and positive relationship is noted with the fact of being a young company, and a negative one is noted with being a micro-enterprise.

Likewise, a positive and significant relationship is observed with economic and institutional barriers ($FBarr_1$) and lack of appropriability ($FBarr_3$).

The demand for the government to *promote forms of private financing* (demand 5, column 6) is positively related to being innovative. Economic and institutional barriers ($FBarr_1$) and uncertainty ($FBarr_4$) increase the probability of requesting this type of action.

Finally, in relation to *direct public financial aid* (demand 6, column 7), economic and institutional barriers ($FBarr_1$) are significantly and positively related to this request by companies.

5. Discussion

Some aspects obtained in the results in relation to previous studies are highlighted. Firstly, as can be observed in the descriptive analysis, agri-food innovative companies have a larger size, exhibit higher turnover, and they export more compared to non-innovative agri-food companies. These characteristics coincide with the study by Heijs et al. [87], where regional systems in Spain were analysed and a direct relationship between business size, turnover, and innovation was detected. The study by Corchuelo and Mesías [14] also stated that there is a positive and direct relationship between foreign trade activities and innovation.

Secondly, the results show that the main type of innovation performed by innovative companies is technological innovation (process and product innovation). Several studies that have analysed business innovation highlight that companies mainly develop innovations aimed at improving their products and processes to improve their performance [88]. The study by Castillo [89], which analysed innovation in small- and medium-sized companies (SMEs) in the food and beverage sector in Colombia, pointed out that the incorporation of technological innovations (product and process) is more beneficial for SMEs, since it generates a competitive advantage in the short–medium term, unlike non-technological innovations, such as organizational ones, which usually lead to long-term improvements.

In addition, in terms of innovation protection, more than half of the companies reported having an instrument to protect innovations, especially trademarks and/or trade names and patents and/or utility models. Although few studies have analysed the protection of innovations, the study by Acemoglu and Akcigit [90] showed that the market leaders have higher incomes, and this means that they have more resources to protect the development of their innovations, substantially avoiding the risks of imitation of their inventions and developments.

With regard to the willingness to innovate and competitiveness, it was observed that non-innovative companies were less willing to innovate than the innovative ones. Nevertheless, while the willingness to innovate is weak in the case of non-innovative firms, they still considered innovation as an essential aspect of competitiveness. These results coincide with a previous study carried out with data from Extremaduran agri-food companies, which found that companies associate low willingness to innovate with a lack of company funds and support from public administrations [14].

Regarding the demands for government actions to boost innovation, it was observed that both innovative and non-innovative agri-food companies demand more direct government support (subsidies and/or soft loans). This trend is also observed in other sectors of activity. A study by Hussinger [91] showed that public subsidies have a positive effect on companies spending on R&D. Therefore, direct government support would boost innovation activities for companies that already carry them out and would also be a financial boost for those declared non-innovative. The study by Roper and Hewitt-Dundas [92] analysed and quantified the concept of "additionality", which relates the degree to which government support encourages innovative activity that would not have been achieved without it. In our research, it has been found that economic and institutional barriers are positively related to this request by companies. The companies also mentioned *personalised advice* and *tax benefits* as government actions that would foster innovation. The

existence of personalised advice helps agribusinesses to better guide and monetize their innovative activity or to start to develop it in the case of non-innovative firms, as is shown in the study by [14].

According to the results of the factor analysis, the obstacles (barriers) were classified into four groups using a factor analysis: economic and institutional barriers, knowledge barriers, lack of appropriability barriers, and uncertainty barriers. The use of this methodology and these results is substantively different from the approaches taken in most of the literature, where obstacles are grouped into factors solely on theoretical grounds (cf. [36,50]). Only Fuentes et al. [58] used a similar methodology in a study dedicated to the food sector in Chile. In this research, obstacles to innovation were grouped into five types: cost-based, knowledge-related, market problems, lack of necessity for innovations, and regulatory.

As in our findings, the results of this research [58] revealed a negative relationship with lack of knowledge barriers and the willingness to innovate (considering it as a binary variable of any innovations expenditure or none). We found that other barrier, uncertainty and lack of knowledge, were negatively related to the willingness to innovate. These results coincide with other existing studies that have also revealed the negative relationship of these barriers with the performance of innovative activities [31,37,38,48–51,54–58].

Regarding the objectives of innovation, the demand strategies, cost, regulatory, and environmental strategies, and market expansion strategies have been positively related to the willingness to innovate. This finding coincides with previous studies that have highlighted their value [93,94]. The same strategies have also been found to be positively related to the consideration of innovation in competitiveness.

Finally, according to the results obtained, the probability of carrying out product innovations is related to production strategies, demand, and market expansion (competing in current markets and new markets). These strategies have been linked in previous studies to product innovations [59]. Similarly, the probability of carrying out process innovations is linked with cost reduction strategies regarding regulations and the environment. Environmental objectives and the improvement of employees' health have also been linked to the innovation of processes in the studies of [10,63,65,95].

6. Conclusions

In this study, an analysis of the innovative activity of Extremaduran agro-industrial companies was carried out. Using the objectives of and perceived obstacles to innovation as main variables, several aspects were analysed. The first part focused on how these factors influence the willingness to innovate and compete. Then, the way these innovation strategies influence the type of innovation developed was examined. Finally, the issue of how perceived obstacles to innovation influence the demand for various public actions was investigated.

The descriptive study made it possible to make a general and initial diagnosis of innovation in the Extremaduran agri-food industry. The results show that the Extremaduran agro-industrial fabric is fundamentally small (fewer than 10 workers); companies are constituted with the legal form of a private limited company, although cooperatives also stand out, potentially contributing to the development of the region of Extremadura; the average turnover reaches €2,000,000 for companies of more than ten years in age, and it is worth noting that they are mostly exporters.

Four objective factors linked to innovation strategies were detected (cost, regulatory, and environmental strategy; production and demand strategy; employment strategy; and market expansion strategy), as well as four barrier factors to innovation (economic and institutional barriers; lack of knowledge; lack of appropriability; and uncertainty).

The main findings show that, first, the uncertainty and lack of knowledge are barriers that negatively influence the willingness to innovate. Innovative strategies aimed at reducing costs and respecting regulations and the environment, focusing on production and

demand, and expanding the market have a positive influence both on the willingness to innovate and the consideration of innovation as an essential element of competitiveness.

Second, the types of innovation developed were related to various innovative strategies based on the pursued objectives. Thus, the probability of carrying out product innovations is related to production strategies (competing by improving production capacity and flexibility), demand (competing with more and better products), and market expansion (competing in current markets and new markets). Similarly, the probability of carrying out process innovations is linked with cost reduction strategies regarding regulations and the environment. Commercial innovation is related to the market expansion strategy (penetration into new markets and increase in market share), organisational innovation, and the employment strategy (to compete by improving the quantity and quality of workers).

Finally, it was found that the perceived barriers influence the demand for government actions to encourage innovation. Thus, the demand for personalised advice is related to barriers of lack of knowledge (lack of qualified personnel, lack of information about technology, lack of market information, and lack of cooperation with other companies). The demand for free training is related with barriers of lack of appropriability. The economic and institutional barriers are related to the demand for greater tax benefits, direct public financial support (subsidies and/or soft loans), and obtaining other forms of private financing. The barrier of lack of appropriability is also related to the demand for tax incentives, and uncertainty is related with the demand for other forms of private financing.

The results obtained can be useful both for the managers of agri-food companies in the process of carrying out innovative activities and for public administrations, especially at the regional level, in the design of public policies and actions aimed at encouraging innovation in this industry sector.

This research has several limitations. First, its cross-sectional nature is a limitation, which is a result of the data representing only one year. Second, it has analysed the agri-food industry in only one specific region. Considering these limitations, our future line of research will aim to extend the questionnaire and data at a national level, covering the available sample of agri-food companies found in the whole Spanish territory. In particular, our aim is to analyse the issues raised in relation to the objectives of and barriers to innovation and the decision to innovate by comparing the results obtained for Extremadura and other Spanish regions.

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Note

1. In addition to the univariate probits, two bivariate probit models have been estimated considering technological innovation (product innovation and process innovation) and non-technological innovation (commercial innovation and organisation innovation) as dependent variables. In both cases, the value of the variable Rho of the bivariate probit model is not significantly different from zero, which indicates that the error term of the two equations in each of the bivariate models is uncorrelated. As such, the univariate probit model methodology for each type of innovation is preferable to the estimation of a bivariate probit model.

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