# Agri-food industry in Extremadura: obstacles to innovation, willingness to innovate, and demanded public actions

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**ABSTRACT:**

The purpose of this paper is to analyse the barriers perceived by agribusiness companies in Extremadura; how these barriers influence their disposition to innovate and the type of public actions demanded by these companies in order to boost innovation. Data comes from an *ad hoc* survey conducted in 2013. The methodology used combines descriptive analysis with factor analysis and econometric analysis. Main results show that *high costs and risks, lack of human resources* and *difficulties of appropriability* are the barriers that reduce the probability to innovate, and that there are important differences among the perceived factors of obstacles and demands of public actions. This can be a reference to develop government policies specifically geared towards boosting innovation in this kind of industry.

**KEYWORDS:** Agribusiness, innovation, barriers, innovation policies.

**JEL CLASSIFICATION:** D22; H25; 038.

## Industria agroalimentaria en Extremadura: obstáculos a la innovación, disposición a innovar y políticas públicas demandadas

**RESUMEN:**

El objetivo de este trabajo es analizar las barreras percibidas por las empresas agroalimentarias en Extremadura; cómo estas barreras influyen en su disposición a innovar y el tipo de acciones públicas que demandan estas empresas para impulsar la innovación. Los datos provienen de una encuesta *ad hoc* realizada en 2013. La metodología utilizada combina el análisis descriptivo con el análisis factorial y econométrico. Los principales resultados muestran que los costes y riesgos elevados, la falta de recursos humanos y las dificultades de apropiabilidad son las barreras que reducen la probabilidad de innovar, y que existen diferencias importantes entre los factores de obstáculos percibidos y las demandas de las acciones públicas. Esto puede ser una referencia para desarrollar políticas gubernamentales orientadas específicamente a impulsar la innovación en este tipo de industria.

**PALABRAS CLAVE:** Industria agroalimentaria, innovación, barreras, políticas de innovación.

**CLASIFICACIÓN JEL:** D22, H25, 038.

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## 1. INTRODUCTION

The agri-food industry occupies a position of great importance within the manufacturing industry (Núñez-Fernandez, 2000), especially in the case of the Autonomous Community of Extremadura where this industry employs 2.7 % of the total amount of industrial workers and accounts for 2.3% of the net sales total (MAGRAMA, 2015b). Here, the weight of the agricultural sector and associated industries are significantly higher than the national average. The agricultural and agri-food sectors have developed activities strongly related to the territory that play a role as important drivers for business activity in rural villages and constitute a key factor for maintaining the population. Noronha *et al.* (2006) highlight the importance of these industries in the rural areas' economy by differentiating various types of companies according to their innovative behaviour. Both sectors are closely linked, being the agri-food industry responsible for transforming and commercializing raw materials and providing a greater added value. In this sense, 6/2015 Law, 24th March, of Land in Extremadura establishes that "any action upon the agricultural sector should also take into account the agri-food production industry, especially quality-differentiated productions". In this way, Agri-food Quality constitutes a fundamental pillar which guarantees the commercialisation of products originating from agriculture and animal husbandry, essential to differentiate the productions in a highly-competitive market. However, in spite of its importance in the regional development, the agribusiness from Extremadura manifests chronic problems caused by an inadequate dimension (86.7% of companies have 10 employees or fewer) such as their local character, the lack of business clusters or the scarce innovation activity registered (Corchuelo & Mesías, 2017). Innovation in all its manifestations plays a key role in the competitiveness for companies and territories in the medium and long term (Porter, 1990; Castillo & Crespo, 2011).

Hence, Public Administrations show a special interest in fostering scientific and technological investigations[1]. Nevertheless, despite all the actions aimed to encourage innovation, there is considerable scope for further improvement, specially making the public administrations aware of the needs and services demanded by businesses to encourage and promote innovation, with the intention to detect and reduce the obstacles perceived by these companies aiming to develop new projects and innovative actions. This is the main objective of this paper: To analyse Extremaduran's agribusiness companies' perceptions of the main obstacles to innovation, to analyse if these barriers influence the probability to innovate as well as the relation with the demanded public actions to increase innovative behaviours. We consider firms belonging to NACE code 10 (Manufacturing of food products). The study differentiates between cooperative and non-cooperative firms, given the special role the first ones play in the regional economy (Corchuelo & Rodríguez, 2017). An essential characteristic of cooperatives is their ability to efficiently exercise the entrepreneurial function. Its role is a key to address not only structural problems of the agri-food sector, but to boost the development of rural areas and contribute to the rationalization of the structures on which the agri-food system is based (Martín de Prado & Llerena, 2004: 200).

This paper is novel in its objective and it has two distinct aspects. On one hand, in Extremadura, the ratio of domestic expenditure in R&D over gross domestic product (GERD/GDP) in 2015 was 0.66%, well below the national total (1.22%) and of UE28 (2.03%). If we consider activity sectors, business expenditure on R&D (BERD) only accounts for 0.3 % of the total expenditure in Spain. This is very low compared to other Spanish Autonomous Communities. Close to 90% of R&D expenditure is made by small to medium a company (SMEs) which is the predominant business size in the region (Economy, Industry and Competitiveness Ministry, 2015). Given the importance of the agri-food industry, it is interesting to analyse both the obstacles perceived and the demanded public actions that could encourage activity in the sector. On the other hand, although there are some papers about innovation at

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[1] In this sense, e.g. 14/2011 Law, 1st June, of Science, Technology and Innovation, and Law 5/2016, 7th June (modification of Law 10/2010, 16th November, of Science, Technology and Innovation of Extremadura). In the current VI Regional Plan of Researching, Technological development and Innovation (2017-2020) agribusiness is established as a top priority within the strategic and socioeconomic lines of action in the region. The agri-food industry is also set out as an area of excellence within the priorities of the Community.

regional or national level, as discussed further below, there are only a few studies focusing on this type of industry and even fewer focusing on Extremadura.

This paper is organized as follows: in the next section a review of the studies related to the subject to analyse is carried out; Section 3 presents the data, how it has been obtained and the final sample to perform the study; Next, the methodology used is explained; The results and the discussion are raised in section 5 ending with a final conclusions section.

## 2.  BACKGROUND

There are numerous studies on innovation related to the regions. In Buesa (1998) the regional allocation of I+D activities and their results are analysed, revealing that the existence of innovative firms is the most influential factor in the relative position occupied by the different regions in Spain and the interregional differences between them. Buesa *et al.* (2002) establishes a typology of the regional innovation systems (RIS), and Badiola and Coto (2012) explain the decisive ones generating innovation in the Spanish regions. At international level, Cooke (2008) makes a brief history of the RIS concept and explains, at the policy level, RIS strategies that have been adopted in recent years by countries such as South Korea, China, Norway and Sweden; Santos and Simoes (2014) analyse the structural barriers and opportunities to promote regional innovation strategies in Portugal; and Niembro (2017) makes a first typology of RIS in Argentina; in a more general way, Zukauskaite (2018) explains the variety of RIS and their institutional characteristics.

Several studies can be found with regard to the analysis of the innovative activity in particular regions and their companies such as Ruiz (2005) and EOI (2011) that analyse the regional innovation and the capacity for innovation of SMEs in Andalucía; González-Pernía *et al.* (2009) and López-Rodríguez *et al.* (2010) focus on the study of the impact of the Basque Country's Regional Innovation System; Corchuelo and Carvalho (2013), and Corchuelo and Mesías (2015 a) assess, from a descriptive perspective, the innovative activity in Extremadura.

Studies are scarce with regard to the agri-food industry; Capitanio *et al* (2010) and Baregheh *et al.* (2012) at an international level, or Alarcón and Sánchez (2012; 2014 a b), Fearne *et al* (2013), and Alarcón *et al.* (2014) in Spain. Among the most recent studies, García-Álvarez-Coque *et al* (2015) analyse the agry-food firms' willingness to participate in R&D projects; Arias *et al.* (2016) make a characterisation of the agri-food firms according to the barriers to innovation. In Corchuelo and Mesías (2017), different typologies of Extremaduran agri-food businesses are analysed according to the willingness to innovate and innovation risk taking, considering innovation a key element in competitiveness.

There are only a few studies focusing on the agri-food cooperatives. The study carried out by Marí-Vidal *et al.* (2014) reveals that innovation and training are external opportunities for the agri-food cooperatives to take advantage of and avoid business failure. Server-Izquierdo and Lajara-Camilleri (2016) analyse innovation as a source of competitiveness in agri-food cooperatives and study the contributing factors.

This study brings new evidence to the studies focused on the analysis of innovation in the regions, with special attention to the region of Extremadura, and to a specific and strategic industry of the region: agri-business. We focus especially on the perceived barriers to innovation and the demands for public actions made by agri-food firms; and how these barriers impinge on the decisions to innovate and on the demand for public actions to foster innovation. In this sense, there are numerous studies that have analysed the influence of obstacles to innovation on the probability to innovate. Some of them highlight the negative relationship between financial obstacles and the probability to innovate (Savignac, 2008; Schneider *et al.*, 2010; Blanchard *et al.*, 2013; Pellegrino & Savona, 2017). Other studies point out the influence of other types of obstacles whether they are knowledge or market conditions (Kamalian *et al.*, 2011; Canales & Álvarez, 2017; Pellegrino & Savona, 2017). In Spain, at regional level, Segarra *et al.*

(2007) show that cost and knowledge barriers seem to be the most important and there are substantial sectoral differences in the way that Catalonian firms react to barriers. Despite the high number of studies focused on the analysis of barriers to innovation, in this aspect of analysis there are not, in our knowledge, studies on barriers to innovation and investment decisions in innovation in the agri-food industry, which is the main novelty of this study.

## 3.   DATA AND METHODOLOGY

### 3.1. DATA

Data used in this study comes from a survey conducted among Extremaduran companies in June 2013. The surveying methodology was carried via a personal interview by means of a computer assisted telephone interview (C.A.T.I. system). The design consisted of a stratified sample in proportion to the different activity sectors (manufacturing and knowledge-intensive business services) and business size. The questionnaire includes five blocks of questions (general data, innovative activity implemented, barriers to innovation, public support to R&D received, and demanded public policies)[2]. A final sample of 524 companies is obtained. Different statistical tests were carried out to ensure its robustness compared to the total population found in the General Directory of Spanish Companies (DIRCE-INE)[3].

A subsample of 124 agri-food firms was obtained from the total sample[4] which represents 9% of the total number of agri-food companies in the region this year[5]. Overall, 70% of the companies have fewer than 10 employees and 24.2% have between 10 and 50 employees, so small-sized companies predominate which points out to the high degree of fragmentation within the agri-food industry[6]. With regard to the legal form, 24.2% of the analysed companies (30) are cooperative companies which represents 10.3 % of the total number of cooperatives in the region attending to dates from 2012 (OSCAE, 2013). Comparatively, cooperative companies have a relative size greater than non-cooperative ones. Table 1 shows the sample according to the number of workers.

TABLE 1.
Agri-food companies by number of workers

| No. of workers | Total (%) | Cooperatives (%) | Non-cooperatives (%) |
|---|---|---|---|
| < 10 workers | 87 (70.2%) | 19 (63.3%) | 68 (72.3%) |
| 10-50 workers | 30 (24.2%) | 7 (23.3%) | 23 (24.5%) |
| > 50 workers | 7 (5.6%) | 4 (13.4%) | 3 (3.2%) |
| Total companies | 124 | 64 | 94 |

### 3.2. METHODOLOGY

Firstly, a descriptive study was conducted to show the main characteristics of the innovative agri-food companies, differentiating between cooperative and non-cooperative firms. The descriptive study focuses on the analysis of the perceived barriers to innovation and the public aids adapted to the needs expressed by the companies (Blocks 3 and 4 in the questionnaire).

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[2] The questionnaire can be made available at the request of those interested.
[3] On 1st January 2013 there were 63.353 companies in the region, representing the 2.01% of the total number of Spanish companies.
[4] We consider firms available in the data set belonging to NACE2009 code 10 (Manufacturing of food products).
[5] A total number of 1383 companies from the agri-food business were registered in the region in 2013. (MAGRAMA, 2015 b). The sample obtained is representative in terms of the size of the total population.
[6] The business size is similar to the industry size in the Spanish economy where 96.3% of companies have fewer than 50 employees and 79.6% fewer than 10 employees (MAGRAMA, 2015 a).

Secondly, the factor analysis is used as a tool to determine the main dimensions of the barriers to innovation perceived by Extremaduran companies. Factor analysis is a multivariable technique based on the elimination of some redundancy in many variables (Bisquerra, 1989). This technique attempts to explain the variability of the variables set, with the fewest number of factors or components, to provide an overview of interrelationships between these variables (Peña, 2002; Hair *et al., 2008*).

Finally, the effects of the perception of barriers on the probability to innovate and on the demand of certain public actions to stimulate innovation were analysed. For each decision, a probit model is used taking the following form:

$$Y_i^* = \beta_i X_i + C_i F_{ki} + \varepsilon_i > 0 \qquad (1)$$

The latent variable is not observed. What is observed is the realization of what simply depends on the decision of the firm, so that:

$$Y_i = \left\{ \begin{array}{ll} 1 & if\ Y_i^* > 0 \\ 0 & otherwhise \end{array} \right. \qquad (2)$$

whereby the decision of the company "*i*" is a function dependent on factors obtained in the previous factor analysis related to innovation barriers ($F_k$) and a set of explanatory variables ($X$). The explanatory variables used are binary variables of the companies' characteristics: company size (1: fewer than 10 employees, 0: more than 10 employees) (*size*); exporting company (1: exporting , 0: not exporting) (*export*); the size of the locality in which the company is located (1: >15.000 inhabitants; 0: <15.000 inhabitants) (*location*); company with more work centres located in Spain (1: company with more work centres in Spain; 0: company without) (*C. Spain*); to be a cooperative (1: the company is a cooperative; 0: the company is not a cooperative) (*coop).*

Using this methodology several decisions are analysed: "probability to be innovative" and "demand for some public actions". In the first case, the latent variable adopts value 1 when the company reported to have performed innovative activities (product, process, organizational or commercial) within the last 2-3 years, and 0 otherwise. This proxy to measure the probability to innovate has been used in some studies as Silva et al. (2008) or Canales and Álvarez (2017). In the second case, the latent variable adopts the value 1 when the company demands for the implementation of those public support actions to encourage innovative activities, and 0 otherwise.

## 4.   RESULTS AND DISCUSSION

### 4.1. DESCRIPTIVE STUDY

Firstly, with regard to the innovative activity, 51.6% of the companies reported to have undertaken some innovation activities in the last 2/3 years. 64 % of them have fewer than 10 employees and 92.2% fewer than 50 employees. The innovative activity is slightly higher in cooperatives (53.3 % of the total of cooperatives) than in non-cooperative companies (51 % of the total of no cooperatives). Furthermore, the main differences detected between cooperative companies compared to non-cooperatives are that the first ones are more export-oriented (68.8% against 38.3%)[7] and comparatively, they develop further product-innovations (62.5% against 60.4% of non-cooperative companies) whilst the percentage of non-cooperative companies that support process innovations is higher (56.2% against 43.8% of cooperatives). Another noteworthy difference between cooperative and non-cooperative companies is the higher level of collaboration for innovation with other companies (43.8% compared to 14.6% of non-cooperative). Overall, the percentage of innovative agri-food companies that collaborate is

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[7] In 2015 agri-food cooperatives from Extremadura exported more than 144 million euros which is 17% of the total number of exports in the region.

reduced (31.3%). Cooperative companies use more protective systems of innovation (60% against 49% of non-cooperatives). The higher percentage in terms of public funding in cooperative companies compared to non-cooperative ones is another interesting aspect to emphasize (30% opposite 17% of non- cooperative ones).[8] Table 2 summarizes these aspects.

TABLA 2.
Innovative companies

| Characteristics | Total (% total companies) | Cooperatives (% total cooperatives) | Non-cooperatives (% total non-cooperatives) |
|---|---|---|---|
| Innovative companies | 64 (51.6%) | 16 (53.3%) | 48 (51%) |
| Size: | | | |
| < 10 workers | 41 (64%) | 8 (50%) | 33 (68.8%) |
| 10-50 workers | 18 (28.2%) | 5 (31.2%) | 13 (27.1%) |
| > 50 workers | 5 (7.8%) | 3 (18.2%) | 2 (4.2%) |
| Innovative exporters companies | 29 (46%) | 11 (68.8%) | 18 (38.3%) |
| Types of innovation: | | | |
| Product | 39 (61%) | 10 (62.5%) | 29 (60.4%) |
| Process | 34 (53.1%) | 7 (43.8%) | 27 (56.3%) |
| Organizational | 3 (4.7%) | 0 (0%) | 3 (6.3%) |
| Commercial | 8 (12.5%) | 1 (6.3%) | 7 (14.6%) |
| Collaboration with other companies | 20 (31.3%) | 7 (43.8%) | 7 (14.6%) |
| Protection of innovation | 31 (51.7%) | 9 (60%) | 22 (49%) |
| Financing with subsidies | 25 (20.2%) | 9 (30%) | 16 (17%) |

Secondly, a set of questions about the companies' perception on several barriers to innovation has been included in the questionnaire, distinguishing 17 barriers to innovation. Figure 1 differentiates the obstacles perceived by cooperatives and non-cooperative companies, differentiating at the same time innovative from non- innovative companies[9].

In Figure 1, it can be observed for both cooperative and non-cooperative companies, that non-innovative firms perceive relatively greater hindrances to innovation compared to innovative firms, although the differences are fewer in terms of valuations in the case of non-cooperative ones. Segarra and Teruel (2010) conclude that in terms of Spanish businesses, innovative companies perceive more obstacles, especially those related to cost of projects and knowledge access, which reveals that the existing barriers for the Extremaduran agri-food companies are more of the type of the *disincentive* to innovation.

Given the two types of companies, and for both innovative and non-innovative companies, the highest valuation corresponds to the *lack of support from Public Administrations*. Moreover, economic barriers are specially valued: *too-high costs and lack of internal and external funding*. Finally, there is the fact that non-innovative companies perceive more as a barrier the existence of *high economic risk* posed by innovating. Hernández and González de la Fe (2013) show in their study that the lack of support from public administrations is the main obstacle to innovation.

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[8] In Corchuelo and Mesías (2015 b) it can be found a more detailed descriptive analysis of the sample.
[9] The valuations are made in a Likert 0-10 scale where the average valuation has been made according to the number of answers.

FIGURE 1.
Average valuation of barriers to innovation
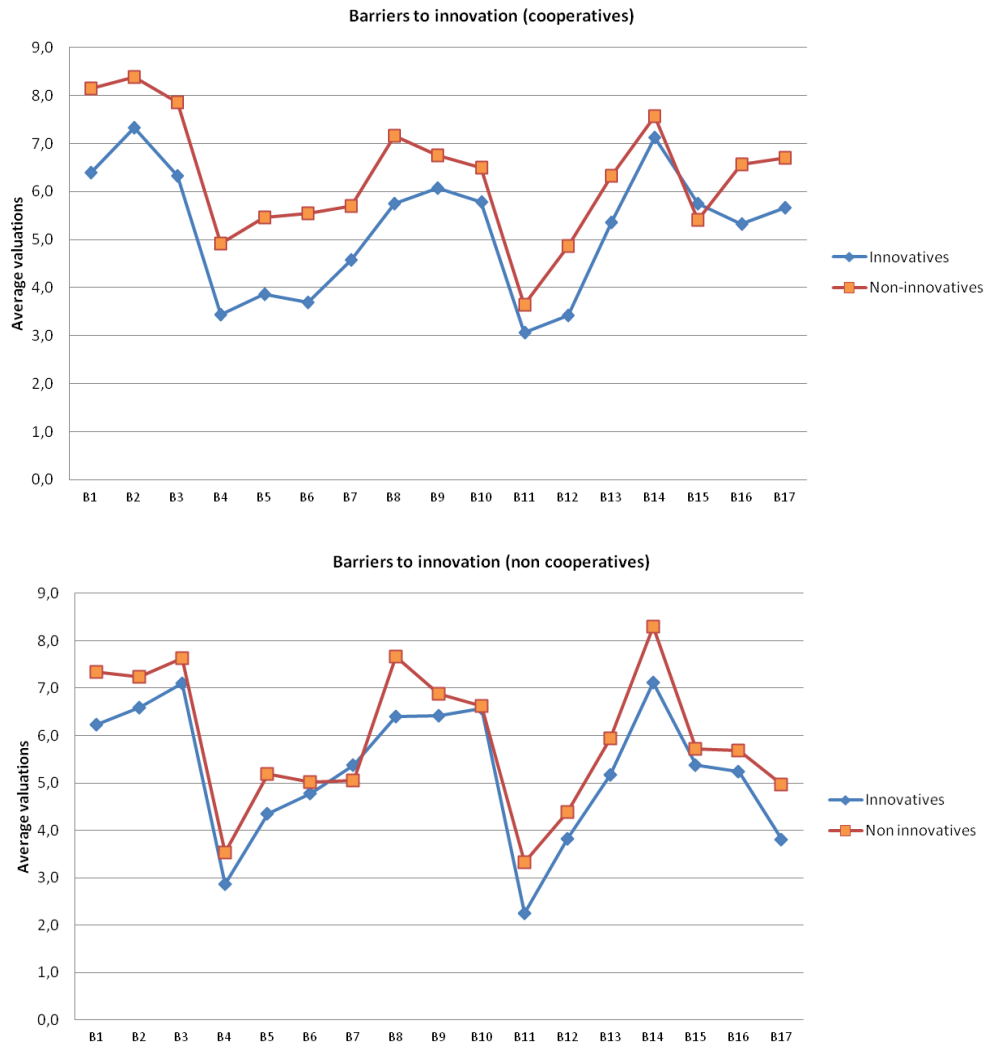


**Notes:** B1: Lack of internal funding; B2: Lack of external funding; B3: Too-high costs; B4: Lack of qualified personnel; B5: Lack of information technology; B6: Lack of information on markets; B7: Difficulty to find cooperation; B8: High economic risk; B9: Markets dominated by well-established companies; B10: Insufficient flexibility of rules and regulations; B11: Rigidity in organization practices; B12: Difficulty protecting innovations; B13: High risk of imitation; B14: Lack of support from public administrations; B15: Lack of demand for innovation from customers; B16: Lack of mediators for innovation; B17: Market conditions don't imply the need to innovate.
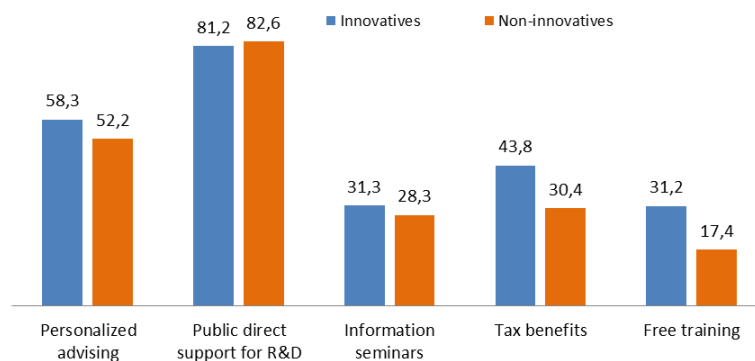**Source:** Own elaboration.

The existence of obstacles -specially derived from financial constraints[10], lack of appropriability of results and the existence of high fixed costs- has given rise to *market failures* to the provision of innovation which has traditionally justified from an economical point of view the intervention of governments through *scientific and technology policies*. The aim of these policies is not only to stimulate innovation activities in these companies but also to stimulate and support the whole economic innovation system. There are studies such as Mohnen and Roeller (2005) that provide evidence, based on the barriers to

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[10] It has been argued that this problem affects specially small and medium sized companies (SMEs) and young innovative companies through credit constraints (Hall, 2002 2005; Hubbard, 1998, or Höfer, 2002).

innovation faced by companies[11], of the necessity to articulate a package of public measures to encourage non-innovative companies to innovate and to make the innovative ones even more so.

In this sense, the last block of questions in the questionnaire is oriented to asking companies about the kind of public aids companies demand in order to boost innovative activities. Firms are asked about five types of demanded public actions: two of them linked to an increase in public financial support (*subsidies* or *tax benefits*), and the others aimed at offering *personalized advising* to companies, organize specific short *information seminars* on aspects related to innovation, or *free training courses* of longer duration. The results from all the sampled companies are shown in Figure 2. It appears that the main actions demanded from companies are the granting of public subsidies and other types of financial public support. A difference is detected between cooperative and non-cooperative companies on the fact that non-cooperatives demand more personalised advising whereas cooperatives demand, especially innovative ones, more tax benefits.

FIGURE 2.
### Demanded Public actions (% companies)
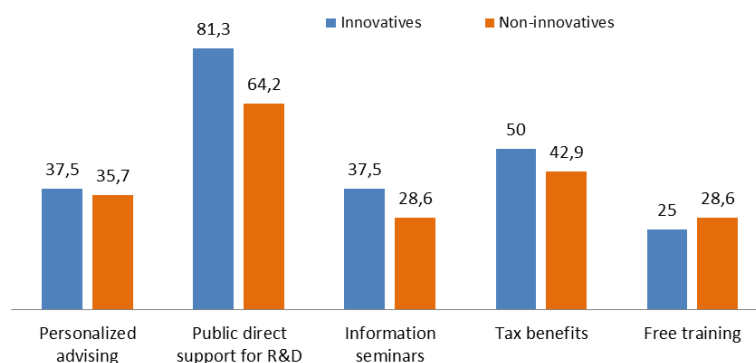


**Source:** Own elaboration.

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[11] Without trying to be too exhaustive for space reasons, we highlight that there are studies which have analysed in an international/national level the effectiveness of public funding support to innovation (subsidies and tax benefits) are very numerous. Focusing on Spain, there are several studies which have analysed the effectiveness of subsidies to innovation (Busom, 2000; González *et al.*, 2005; González & Pazó, 2008) and tax benefits separately (Marra, 2004; Corchuelo, 2006; Corchuelo & Martínez-Ros, 2010) whereas studies by Marra (2008); Busom *et al* (2010, 2011) analyse them together. A recent study made by Busom *et al.* (2014) shows the relationship between market failures (appropriability and financial constraints, which are barriers to innovation) and the use of public support (national subsidies and tax benefits) for a representative sample of Spanish manufacturing companies with more than 10 employees taken from PITEC (FECYT and INE) database. The study concludes that, in average, for small and medium size companies, subsidies are more beneficial to reduce the barriers which produce under-investment in R&D activities than tax benefits.

## 4.2. FACTOR ANALYSIS OF BARRIERS TO INNOVATION

Once the data was analysed in a descriptive way, and as stated in the methodology, a factor analysis (FA) is applied to all companies in the sample (innovative and non-innovative firms) to reduce the number of variables needed to categorize companies linked to the perception of obstacles to innovation. Bartlett's sphericity test and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were applied to test the validity of the sampling. The former is used to check that the correlation matrix is close to an identity matrix, i.e., one with all the diagonal elements unity and the off-diagonal elements null (Visauta 1998). The KMO measure is used to compare the observed correlation coefficients with the partial correlation coefficients. Results for both tests (KMO = 0.794; and Bartlett's sphericity test=357.917; sig.= 0.000) indicate that the sample is adequate for FA.

From the FA six factors/components have been obtained whose definition is obtained from the rotated component matrix (Table 3), which allows a better explanation of the generated factors.

TABLE 3.
Rotated Component Matrix

|  | Factor | | | | | |
|---|---|---|---|---|---|---|
|  | **1** | **2** | **3** | **4** | **5** | **6** |
| B1: Lack of internal funding |  |  |  |  | 0.739 |  |
| B2: Lack of external funding |  |  |  |  | 0.846 |  |
| B3: High costs |  |  | 0.680 |  |  |  |
| B4: Lack of qualified personnel |  | 0.608 |  |  |  |  |
| B5: Lack of information on technology | 0.883 |  |  |  |  |  |
| B6: Lack of information on markets | 0.890 |  |  |  |  |  |
| B7: Difficulty to find innovation's partners | 0.444 |  |  |  |  |  |
| B8: Economical risks |  |  | 0.887 |  |  |  |
| B9: Markets dominated by established companies |  |  | 0.556 |  |  |  |
| B10: Insufficient flexibility in rules and regulations |  |  |  |  |  | 0.590 |
| B11: Rigidity in organisational practices |  | 0.677 |  |  |  |  |
| B12: Difficulty to protect innovations |  | 0.736 |  |  |  |  |
| B13: High risk of imitations |  | 0.706 |  |  |  |  |
| B14: Lack of public support |  |  |  |  |  | 0.759 |
| B15: Lack of demand for innovation |  |  |  | 0.788 |  |  |
| B16: Lack of innovation mediators |  | 0.539 |  |  |  |  |
| B17: No need for innovation in the market |  |  |  | 0.851 |  |  |

The next factors have been found:

Factor 1: Explains 32.5% of the variance and shows high scores in "lack of information on technology", "lack of information on markets", and "difficulties to find partners and cooperation". This is a factor related to "*obstacles to innovation due to non-cooperation and lack of information*".

Factor 2: This factor explains 9.7% of variance and it is mainly related with the barriers "rigidity in organisation practices", "lack of qualified personnel", "difficulty to protect innovation", "high risks of imitation" and "lack of mediators for innovation". Therefore, this is a factor related to intrinsic aspects of the companies and, in consequence, it has been defined as "*Obstacles to innovation due to the lack of human resources and appropriability*".

Factor 3: The third component explains 8.7% of the variance and it is related to "too high costs", "high economic risk" and "markets dominated by well-established companies" variables. It has been defined as "*obstacles to innovation due to high costs and risks*".

Factor 4: The fourth component, with a 7.2% of variance, is linked to "lack of demand for innovation" and "no need for innovation in markets" variables. It has been defined as "*obstacles to innovation due to no need for innovation*".

Factor 5: The fifth component explains 5.7% of variance and it is related with the barriers "lack of internal funding" and "lack of external funding" variables. This is a factor related to "*Obstacles to innovation motivated by financial constraints*".

Factor 6: Finally, the last factor, with a 5.5% of variance, is linked to "insufficient flexibility of rules and regulations" and "lack of support from public administrations" variables. It is defined as "*obstacles to innovation due to institutional reasons*".

In Arias *et al.* (2016), a factor analysis of obstacles to innovation was conducted to analyse the differences in innovation among agri-food companies. For that purpose, innovating companies' data was taken from PITEC (2010-2012). The factor analysis revealed the existence of two factors linked to "*technical capacity to innovate*" and "*economic/financial capacity*". Also, in Corchuelo and Mesías (2015 c) an analysis applied to companies from Extremadura, using the complete sample that includes both manufacturing companies and knowledge-intensive businesses services sectors, revealed the existence of four factors of obstacles to innovation related to "*lack of internal resources and sustainability*", "*costs and financial constraints*", "*risks and market conditions*" and "*lack of demand for innovation*".

## 4.3. AGRI-FOOD COMPANIES DECISIONS

Finally, the decisions made by the agri-food companies are analysed in order to evaluate the influence of the factors obtained as obstacles to innovation, other variables related to the companies' characteristics in regard to the probability to innovate, and the demands required by agri-food companies in order to encourage the innovation. Table 4 shows the mean of the marginal effects for each observation (calculated for each value of the independent variables_$dy/dx$) and significances which underline the influence these different variables have on the probability.

With regard to the probability for innovation it can be observed (Table 4, column 2, model 1) that Factor 3 (*obstacles to innovation due high costs and risks*) has a negative and significant effect on the probability of innovation in the agri-food companies. The existence of obstacles to innovation due to these reasons has been revealed by several studies. With regard to the *high costs*, studies such as Baldwing and Lin (2002) and Tourigny and Le (2004), both of them focused on Canada; Silva *et al.* (2008) focused on Portugal; Kamalian *et al.* (2011) on Iran; and D'Este *et al* (2012) on United Kingdom. The latest study also points to *market conditions* as an important barrier to innovation. In Spain, there are studies carried out by Madrid-Guijarro *et al.* (2009), Segarra and Teruel (2010), Hernández and González de la Fé (2013), and Corchuelo and Mesías (2015 c). The study conducted by Necadová and Schoelleová (2011) in Czech Republic also reveals that besides the existence of costs, a *high economic risk* is also an obstacle to innovation.

TABLE 4.
## Companies' decision: innovation and demanded public performances

| Variable | Innov.(1) dy/dx (s.e.) | Demand 1 (2) dy/dx | Demand 2 (3) dy/dx | Demand 3 (4) dy/dx | Demand 4 (5) dy/dx | Demand 5 (6) dy/dx |
|---|---|---|---|---|---|---|
| Factor 1 | -.027 (n.s.) | .004 (n.s.) | .024 (n.s.) | .006 (n.s.) | .037 (n.s.) | **.083 (\*\*)** |
| Factor 2 | **-.087 (\*)** | .070 (n.s.) | -.055 (n.s.) | -.021 (n.s.) | .030 (n.s.) | -.061 (n.s.) |
| Factor 3 | **-.131 (\*\*.)** | .079 (n.s.) | -.024 (n.s.) | **-.008 (\*\*)** | -.040 (n.s.) | -.051 (n.s.) |
| Factor 4 | -.019 (n.s.) | **.081 (\*)** | .020 (n.s.) | .005 (n.s.) | **.140 (\*\*)** | .002 (n.s.) |
| Factor 5 | -.045 (n.s.) | -.031 (n.s.) | **.031 (\*\*)** | .030 (n.s.) | -.025 (n.s.) | .004 (n.s.) |
| Factor 6 | -.052 (n.s.) | -.009 (n.s.) | .057 (n.s.) | .012 (n.s.) | .031 (n.s.) | .035 (n.s.) |
| Size | -.148 (n.s.) | -.036 (n.s.) | -.197 (n.s.) | .083 (n.s.) | .173 (n.s.) | .156 (n.s.) |
| Export | **.310 (\*\*\*)** | .084 (n.s.) | .137 (n.s.) | .116 (n.s.) | .045 (n.s.) | .110 (n.s.) |
| Location | -.062 (n.s.) | .127 (n.s.) | -.044 (n.s.) | .000 (n.s.) | -.079 (n.s.) | -.016 (n.s.) |
| C Spain | **.289 (\*\*)** | -.099 (n.s.) | **0.299 (\*\*)** | .186 (n.s.) | .102 (n.s.) | .126 (n.s.) |
| Coop | -.064 (n.s.) | **-.225 (\*\*)** | -.135 (n.s.) | .012 (n.s.) | .073 (n.s.) | .050 (n.s.) |
| Nº Observ. | 122 | 122 | 122 | 122 | 122 | 122 |
| Log-likelihood | -73.402 | -77.303 | -68.962 | -73.362 | -75.319 | -63.430 |

**Notes:** (1): the dependent variable takes on value 1 if the company has carried out innovation activities in the last 2/3 years and 0 otherwise; (2) the dependent variable takes on value 1 if the company requests personal advising and 0 otherwise; (3) the dependent variable takes on value 1 if the company requests subsidies and direct public support and 0 otherwise; (4) the dependent variable takes on value 1 if the company requests information seminars and 0 otherwise; (5) the dependent variable takes on value 1 if the company requests tax benefits and 0 otherwise; (6) the dependent variable takes on value 1 if the company demands free training and 0 otherwise.

Each column shows the mean of the estimated marginal effect of the covariates in each joint probability. dy/dx for factor levels is the discrete change from the base level.

\*\*\* P<0,01; \*\* P<0,05; \* P<0,1; n.s. not significant.

Moreover, it is found that the obstacle factor linked to the *lack of human resources and appropriability* (Factor 2) also shows a negative and statistically significant effect on the probability of innovation in agri-food companies. Several studies underline these factors as barriers to innovation. In particular, the *lack of qualified personnel* becomes apparent in studies by Silva *et al.* (2008), McCann (2010), Necadová and Scholleová (2011) and Hernández and González de la Fe (2013). Kamali *et al.* (2011) in Iran, indicate as an obstacle the lack of skilled labour, especially in small and medium-sized companies (SMEs). Piatier (1984), in a research applied to eight European countries highlights, as barriers to innovations, the education system and the skilled workforce. The level of education: human capital limitations, lack of entrepreneurial mindset and absence of adequate tools to innovate in education, are also identified in the research by Comtesse *et al.* (2002). Canales and Álvarez (2017) analyse the impact of knowledge-obstacles such as availability of human resources on the probability of introducing innovations resulting that these type of barriers reduce in approximately 26% the innovation probability in the Chilean firms. It is interesting to highlight that, to our knowledge, there are no studies that reveal the lack of appropriability as an important barrier to innovation. This is caused because, in general, the national innovation surveys do not contemplate this type of barriers, that have been taken into account in our questionnaire. The result shows the importance of these types of barriers (difficulty protecting innovations and high risk of imitation) as deterrent factor of firms' innovation.

The remaining factors motivated by *non-cooperation and lack of information, no need for innovation, funding restrictions* and *institutional reasons* are not significant therefore they do not affect the probability to innovate in the case of the agri-food companies in Extremadura.

With regard to the characteristics of the companies, if a firm exports goods as well as has additional locations in Spain has a positive and significant effect on the probability to be innovative. The relationship between internationalization and innovation has been analysed in several theoretical and empirical researches (Cavusgil & Knight, 2014; Katsikeas *et al.,* 2000). In Server-Izquierdo and Lajara-Camilleri (2016) the existence of a relationship between the degree of innovation and the degree of internationalization can be observed in the agri-food Spanish cooperatives, considering the volume of exports on the company's total turnover. The company size has no bearing on the probability to innovate. Similarly, no empirical evidence is obtained on the existence of a relationship between the size of the company and innovation in agri-food companies in Arias *et al.* (2016) research. However, an evidence is obtained from the research by Server-Izquierdo and Lajara-Camilleri (2016) regarding Spanish citrus cooperatives, and in García-Álvarez-Coque *et al.* (2015) regarding agri-food firms in the region of Valencia. In our case the companies size is primarily small, as mentioned in the descriptive study, and this can influence the fact that this variable proved to be not significant. No difference is observed in the probability to innovate based on whether the company is cooperative or non-cooperative. On the contrary, there are evidences about the effect of legal form of the company in R&D activities in the studies of Fearne *et al.* (2013) and García-Álvarez-Coque *et al.* (2015).

In terms of the public actions demanded by companies (Table 4 columns 3 to 7), by analyzing their requirements to ease these obstacles and the companies' characteristics it is observed that regarding *personal advising* (Demand 1) there is a negative and significant effect by the cooperatives (Table 4, column 3, model 2). Previously analysed and as it is shown in Figure 2, non-cooperative companies demand this type of actions to a greater extent. This is the only difference perceived between cooperative and non-cooperative agri-food companies as the coefficient of this variable in the remaining regressions is no significant. Regarding obstacles to innovation, it can be seen that Factor 4 (*obstacles to innovation due to no need for innovations*) has a positive and significant impact on the probability to demand for *personalized advising*. The need to be innovative and differentiate from competitors leads companies to demand this type of public action in order to develop innovative products that generate demand in small markets.

With regard to the demand for *subsidies* (Demand 2)*,* the probability to be demanded by agri-food companies which have other work centers in Spain has a positive and significant effect. Factor 5 (*obstacles to innovation due to financial constraints*) also has a positive and significant effect on the likelihood of demand for greater direct public financial support (Table 4, column 4, model 3).

It is interesting to highlight that Factor 3 (*obstacles to innovation due to high costs and risks*), as an important factor that reduces the probability to innovate, has a positive and significant effect on the probability of requesting information seminars (Demand 3) (Table 4, column 5, model 4).

Neither the existence others barriers to innovation nor the company's characteristics affect the demand for *information seminars* (Demand 3), so there are no differences between the firms in this type of demanded action from the public administration (Table 4, column 5, model 4).

Again, the existence of obstacles due to *no need for innovations* (Factor 4) has a positive and significant influence on the probability to demand more *tax benefits* (Demand 4) (Table 4 column 6, model 5). The research by Hernández and González de la Fe (2013) points out that the lack of demand for innovative products is an obstacle to innovation. This result is interesting in the sense that tax benefits could motivate businesses to generate the need to create innovation demands in this market through, for example, improvements in the product's quality according to Law 6/2015, 24th March, Agrarian of Extremadura. This reason could influence the fact that agri-food companies consider these obstacles in the demands of *personalized advising* and *tax benefits*.

Finally, with regard to the demand for *free training* (Demand 5)*,* it must be highlighted that the perception of obstacles in view of the *non-cooperation and lack of information* has a positive and significant effect (Table 4, column 7, model 6). The *lack of cooperation between companies* is underlined as a barrier to innovation in researches by Tiwari and Buse (2007) and Buse *et al.* (2010). Likewise, the *lack*

*of information on technology* is considered in researches by Mc Cann (2010) and Necadová and Scholleová (2011). D'Este et al. (2012) also highlight the *lack of knowledge* as an important barrier. Thus, the demand for more free training is revealed as a need for small companies that suffer from lack of information. Greater cooperation could be fostered for companies to reduce their size-issue in order to access to more training schemes.

## 5. CONCLUSION

The agri-food industry occupies a position of great importance within the manufacturing industry both in the case of Spain as well as in some regions like Extremadura where the weight of the agrarian sector and allied industries is substantially higher than the national average. Despite its importance, the agribusiness in Extremadura suffers several chronic problems, some of them related to the lack of developed innovative activity which is still significantly low. In this sense, public administrations have a special interest in encouraging scientific and technological research. However, despite the actions already carried out there remains scope for improvement, especially sharing their knowledge and communicating with the main actors of innovation (the companies), with the objective to ascertain which public actions are specially demanded attending to the obstacles perceived in order to increase the innovative activity.

Within this framework, the main objective of this study has been to analyse the perceptions of the Extremaduran agri-food companies of the main obstacles to innovation and to analyse if these have an influence in the probability to innovate, as well as the relation with the demanded public actions in order to increase the innovative behaviour.

Results show that, on one hand, the existence of *high costs and risks* and *lack of human resources and difficulties of appropriability* are the factors that have a negative effect on the probability to innovate in Extremaduran agri-food companies; on the other hand, there are important differences among factors of obstacles and demands of public actions. The factor due to *no need of innovations* has a positive effect on the probability to demand *personalized advice* and *fiscal benefits*. *Financial constraints* positively influence the demand for *direct public financial support*. The factor that has the higher negative effect on the probability to innovate (*high costs and risks*) positively influences the demand for *information seminars*. Finally, the obstacle factor due to *no-cooperation and lack of information* has a positive effect on the demand for *free training*.

The consideration of these obstacles and the demanded public actions can be used as a reference to design public policies from the point of view of recommendations oriented to encourage innovation in these type of industries given the importance that have in the regional development. As public recommendations, firstly, it should be taken into account the public actions demanded to reduce the perception of the different barriers to innovation; secondly, it would be interesting to study the demand of additional actions that diminish the perception of, especially, the lack of appropriability of the results of innovation in this industry.

However, the obtained conclusions must be interpreted with caution due to the fact that the data comes from a voluntary survey, yet it is justified given the lack of information concerning of agri-food companies in Extremadura. In addition, conclusive results cannot be drawn comparing them to other researches of other Spanish regions or other countries given the inexistence of such studies. It would have been interesting to make a comparison having had similar data. Despite these limitations, it is considered that this research provides a good approximation to the relationship between the perceived obstacles to innovation and demanded public policies that could be applied to develop public policies and encourage these type of activities in other regions of Spain.

# References

Alarcón, S., & Sánchez, M. (2012). External and internal R&D, capital investment and business performance in the Spanish agri-food industry. *Journal of Agricultural Economics*, *64*(3), 654–675. https://doi.org/10.1111/1477-9552.12015

Alarcón S., & Sánchez, M. (2014a). Cómo innovan y qué resultados de innovación consiguen las empresas agrarias y alimentarias españolas. *Cuadernos de Estudios Agroalimentarios* CEA06, 63-82.

Alarcón S., & Sánchez, M. (2014b). Relations between innovation activities and exports in food and agriculture firms. EAAE 2014 Congress 'Agri-Food and Rural Innovations for Healthier Societies', 26-29 August, Ljubljana (Eslovenia).

Alarcón S., González, L., & Sánchez, M. (2014). Strategies for the development of new products in the Spanish agri-food industry. In *E-Innovation for Sustainable Development of Rural Resources During Global Economic Crisis* (ch. 14, pp. 181-197). EE.UU.: IGI Global. https://doi.org/10.4018/978-1-4666-4550-9.ch14

Arias, P., Alarcón, S., & Botey, M. (2016). La caracterización a través del análisis factorial de las empresas agroalimentarias según sus obstáculos a la innovación. *Economía Industrial,* 400, 139-149.

Badiola, A., & Coto, P.P. (2012). Determinantes de la innovación tecnológica en las regiones españolas. International. XXXVIII Conference on Regional Sciences, 22-23 November, Bilbao (Spain).

Baldwing, J., & Lin, Z. (2002). Impediments to advanced technology adoption for Canadian manufacturers. *Research Policy, 31*(1), 1-18. https://doi.org/10.1016/S0048-7333(01)00110-X

Baregheh, A., Rowley J., Sambrook S., & Davies D. (2012). Innovation in food sector SMEs. *Journal of Small Business and Enterprise Development*, *19*(2), 300-321. https://doi.org/10.1108/14626001211223919

Bisquerra, R. (1989). *Métodos de Investigación Educativa. Guía Práctica*. Barcelona: Ceac.

Blanchard, P. H., Musolesi, A., & Sevestre, P. (2013). Where there is a will, there is a way? Assessing the impact of obstacles to innovation. *Industrial and Corporate Change*, *22*(3), 679-710. https://doi.org/10.193/icc/dts027

Buesa, M. (1998). I+D innovación tecnológica en las regiones españolas. *Documento de Trabajo del IAIF*, nº. 13.

Buesa, M., Martínez, M., Heijs, H., & Baumert, T. (2002). Los sistemas regionales de innovación en España. Una tipología basada en indicadores económicos e institucionales. *Economía Industrial*, 347, 15-32.

Buse, S., Tiwari, R., & Herstatt, C. (2010). Global innovation: an answer to mitigate barriers to innovation in small and medium sized enterprises? *International Journal of Innovation and Technological Management*, *7*(3), 215-227. https://doi.org/10.1109/ICMIT.2008.4654504

Busom, I. (2000). An empirical evaluation of the effects of R&D subsidies. *Economics of Innovation and New Technology*, *9*(2), 111-148. https://doi.org/10.1080/10438590000000006

Busom, I., Corchuelo, B., & Martínez-Ros, E. (2010). Efectividad de los incentivos públicos de innovación e innovación empresarial. In: *Análisis sobre la Ciencia e Innovación en España.* Madrid: FECYT.

Busom, I., Corchuelo, B., & Martínez-Ros, E. (2011). Obstáculos a la innovación y uso de incentivos ¿subvenciones o estímulos fiscales. *Economía Industrial*, 382, 35-44.

Busom, I., Corchuelo, B., & Martínez-Ros, E. (2014). Tax incentives... or subsidies for R&D? *Small Business Economics, 43*(3), 571-596. https://doi.org/10.1007/s11187-014-9569-1

Canales, M., & Álvarez, R. (2017). Impacto de los obstáculos al conocimiento en la innovación de las empresas chilenas. *Journal of Technology and Management Innovation*, *12*(3), 78-85. http://dx.doi.org/10.4067/S0718-27242017000300008

Capitanio, F., Coppola, A., & Pascucci, S. (2010). Product and process innovation in the Italian food industry. *Agribusiness*, *26* (4), 503–518. https://doi.org/10.1002/agr.20239

Castillo, D., & Crespo, P. (2011). La financiación de la innovación empresarial. *Revista de Contabilidad y Dirección*, 12, 145-166.

Cavusgil, S.T., & Knight, G. (2014). The born global firm: an entrepreneurial and capabilities perspective on early and rapid internationalization. *Journal of International Business Studies,* 46, 3-16. https://doi.org/10.1057/jibs.2014.62

Cooke, P. (2008). Regional innovation systems: origin of the species. *International Journal Technological Learning, Innovation and Development*, *1*(3), 393–409. https://doi.org/10.1504/IJTLID.2008.019980

Comtesse, X.L., Hodgkinson, A., & Krug, E. (2002). Success factors and barriers to innovation in Switzerland. Avenir Suisse and Enterprise Forum of Switzerland.

Corchuelo, B. (2006). Incentivos fiscales y decisiones de innovación. *Revista de Economía Aplicada,* 40, 5-34.

Corchuelo, B., & Martínez-Ros, E. (2008). Aplicación de los incentivos fiscales a la inversión I+D en las empresas españolas. *Hacienda Pública, Revista de Economía Pública*, *187*(4-2008), 9-39.

Corchuelo, B., & Martínez-Ros, E. (2010). Who benefits from R&D tax policy? *Cuadernos de Economía y Dirección de la Empresa,* 45, 145-170. https://doi.org/10.1016/S1138-5758(10)70027-X

Corchuelo, B., & Carvalho, A. (2013), Obstáculos a la innovación y políticas públicas orientadas al fomento de la innovación. *Revista de Economía Aplicada*, 27, 231-264.

Corchuelo, B., & Mesías, F. J. (2015). Innovation Policies and Barriers to Innovation: An Analysis in Extremadura (Spain). In L. Carvalho (Ed.), *Handbook of Research on Internationalization of Entrepreneurial Innovation in the Global Economy* (pp. 29-48). Hershey, PA: IGI Global. https://doi.org/10.4018/978-1-4666-8216-0.ch002

Corchuelo, B., & Mesías, F.J. (2015 b). Tendencias, aversión y barreras a la innovación en las agroindustrias extremeñas. XLI Conference of Regional Sciences. Reus (Tarragona).

Corchuelo, B., & Mesías, F.J. (2015 c). Innovation in Extremadura: opportunity for companies or obstacle for their development. In L. Carvalho (Ed.), *Handbook of Research and Entrepreneurial Success and its Impact on Regional Development* (p. 345-375). Hershey, PA: IGI Global. https://doi.org/10.4018/978-4666-9567-2-ch016

Corchuelo, B., & Mesías, F.J. (2017), Disposición a innovar y competitividad en la agroindustria extremeña. *ITEA-Información Técnica Económica Agraria*, *113*(2),176-191. https://doi.org/10.12706/itea.2017.011

Corchuelo, B., & Rodríguez, J.A. (2017). Actividad innovadora en la agroindustria extremeña. In: *La Agricultura y la Ganadería Extremeña 2016.* Badajoz: Fundación Caja Badajoz.

Demirbas, D. (2008). How do entrepreneurs perceive barriers to innovation? Empirical evidence from Turkish SMEs. *Newcaslte Business School Research Paper*.

Decree 91/2017, 20th June, approving the VI Regional Plan for Research, Technological Development, and Innovation (2017-2020).

D'Este, P., Iammarino, S., Savona, M., & von Tunzelmann, N. (2012). What hampers innovation? Revealed barriers versus deterring barriers. *Research Policy*, *41*(2), 482-488. https://doi.org/10.1016/j.respol.2011.09.008

EOI (2011). Diagnóstico de las capacidades de innovación de las pymes de Andalucía y su incidencia en el empleo. Retrieved 15/5/2017 from: https://www.eoi.es/es/savia/publicaciones/20450/diagnostico-de-las-capacidades-de-innovacion-de-las-pymes-de-andalucia-y-su-incidencia-en-el-empleo

Fearne, A., García-Álvarez-Coque, J.M., López-García, T., & García, S. (2013). Innovative firms and the urban/rural divide: the case of agro-food system. *Management Decision, 51*(6), 1293-1310. https://doi.org/10.1108/MD-12-2011-0482

Fernández-Núñez, T. (2000). La industria agroalimentaria en España: características generales y comportamiento empresarial. *Boletín Económico del ICE*, 2657, 17-27.

Gália, F., & Legros, D. (2004). Complementarities between obstacles to innovation: evidence for France. *Research Policy, 33*(8), 1185-1199. https://doi.org/10.1016/j.respol.2001.06.004

García-Álvarez-Coque, J.M., Más-Verdú, F., & Sánchez, M. (2015). Determinants of agri-food firms' participation in public funded research and development. *Agribusiness, 31*(3), 314-329. https://doi.org/10.1002/agr.21407

González, X., Jaumandreu, J., & Pazó, C. (2005). Barriers to innovation and subsidy effectiveness. *Rand Journal of Economics, 36*(4), 930-949.

González, X., & Pazó, C. (2008). Do public subsidies stimulate private R&D spending? *Research Policy, 37*(3), 371-389. https://doi.org/10.1016/j.respol.2007.10.009

González-Pernía, J.L., Maritarena, A., Navarro, M., & Peña, I. (2009). Estudio sobre la capacidad de innovación y actividad emprendedora en el ámbito sub-regional: El caso de la Comunidad Autónoma del País Vasco. *Journal of Regional Research/Investigaciones Regionales*, Monográfico, 55-88.

Hadjimanolis, A. (1999). Barriers to innovation for SMEs in a small less developed countries (Cyprus). *Technovation, 19*(9), 561-570. https://doi.org/10.1016/S0166-4972(99)00034-6

Hair, J., Anderson, R., Tatham, R., & Black, W. (2008). *Análisis Multivariante*. Prentice Hall.

Hall, B.H. (2002). The financing of research and development. *Oxford Review of Economic Policy*, *18*(1), 35-51. https://doi.org/10.1093/oxrep/18.1.35

Hall, B.H. (2005). The financing of innovation. In S. Shane (ed.): *Handbook of Technology and Innovation Management*. Oxford Blackwell Publishers, Ltd.

Hernández, N., & González de la Fe, T. (2013). Crisis e innovación. La percepción de los obstáculos a la innovación en las microempresas. XI Spanish Conference of Sociology, July 2013.

Höfer, R. (2002). Corporate finance and R&D. Theoretical considerations and empirical results: a survey. In Gretmacher, N., G. Hutschenreiter and W. Polt (eds.): *Changing Strategies for Business R&D and Their Implications for Science and Technology: Proceedings of the tip workshop* (p. 39-53).

Hubbard, R.G. (1998). Capital markets imperfections and investment. *Journal of Economic Literature*, *36*(1), 193-225.

Kamalian, A., Rashki, M., & Arbabi, M.L. (2011). Barriers to innovation among Iranian SMEs. *Asian Journal of Business Management*, *3*(2), 79-90.

Katsikeas, C.S., Leoniodu, L.C., & Morgan, N.A. (2000). Firm-level export performance assessmente: review, evaluation, and development. *Journal of the Academy of Marketing Science*, *28*(4), 493-511.

Law 5/2016, 7th June, of modification of Law 10/2010, 16th November, of Science, Technology and Innovation of Extremadura.

Law 6/2015, 24th March, of Land in Extremadura.

Law 14/2011, 1st June, of Science, Technology and Innovation.

Law 10/2010, 16th November, of Science, Technology and Innovation in Extremadura.

López-Rodríguez, J., Faiñas, A., & Manso, G. (2010). Sistemas de innovación regionales: el caso del País Vasco. *Revista Galega de Economía*, 19, 1-17.

McCann, J. (2010). *Locating the obstacles to UK innovation: Evidence from the 2009 Community Innovation Survey*. Stockholm: KTH Royal Institute of Technology.

Madrid-Guijarro, A., Domingo, G., & Howard, V.A. (2009). Barriers to innovation among Spanish manufacturing SMEs. *Journal of Small Business Management*, *47*(4), 465-488. https://doi.org/10.1111/j.1540.627X.2009.00279.x

Marra, M.A. (2004). Incentivos fiscales, inversión en actividades de I+D y estructura de costes. Un análisis por tamaño para una muestra representativa de empresas manufactureras españolas 1991-1999. *Hacienda Pública Española/ Revista de Economía Pública*, 170-(3/2004), 9-35.

Marra, M.A. (2008). Efecto de los incentivos fiscales y subvenciones públicas a la inversión en I+D+i de las empresas manufactureras españolas. *Hacienda Pública Española/Revista de Economía Pública*, 184, 35-66.

Marí-Vidal,S., Marín-Sánchez, M., Seguí-Mas, E., & Michael-Zamorano M (2014). Análisis cualitativo de los determinantes en la predicción del fracaso empresarial en cooperativas agroalimentarias. *Información Técnica Económica Agraria*, *110*(3), 300-320. https://doi.org/10.12706/itea.2014.019

Martín de Prado, A., & Llerena, J.L. (2004). El cooperativismo agroalimentario en Extremadura. In; *Libro de la Agricultura y la Ganadería Extremeñas 2003,* 197-211, Badajoz: Fundación Caja Badajoz.

Ministerio de Agricultura, Alimentación y Medio Ambiente (MAGRAMA) (2015 a): *Informe Anual de la Industria Alimentaria Española Período 2014-2015.*

Ministerio de Agricultura, Alimentación y Medio Ambiente (MAGRAMA) (2015 b): *Principales Indicadores y Datos Significativos de la Industria Alimentaria Española.*

Ministerio de Economía, Industria y Competitividad (2015): *I+D+i en las empresas españolas. Datos 2015.*

Mohnen, P., & Roeller, L. (2005). Complementarities in innovation policy. *European Economic Review*, 49, 1431-1450. https://doi.org/10.1016/j.euroecorev.2003.12.003

Niembro, A. (2017). Hacia una tipología de los sistemas regionales de innovación en Argentina. *Journal of Regional Research/Investigaciones Regionales*, 38, 117-149.

Noronha, M., Cesario, M., & Fernandes, S (2006). Interaction between innovation in small firms and their environments: an explanatory study. *European Planning Studies*, *14*(1), 95-117. https://doi.org/10.1080/09654310500339893

Necadová, M., & Scholleová, H. (2011). Motives and barriers of innovation behavior of companies. *Economics and Management, 16,* 832-838.

OSCAE (2013). *Macromagnitudes del Cooperativismo agroalimentario español*, OSCAE- Observatorio Socioeconómico del Cooperativismo Agroalimentario Español-Cooperativas Agro-alimentarias de España.

Pellegrino, G., & M. Savona (2017). No money, no honey? Financial versus knowledge and demand constraints on innovation. *Research Policy, 46* (2), 510-521. https://doi.org/10.1016/j.respol.2017.01.001

Peña, D. (2002). *Análisis de datos multivariante*, Mc Graw-Hill.

Piatier, A. (1984). *Barriers to Innovation,* London: Frances Pinter Publishers Ltd.

Porter, M.E. (1990). The competitive advantage of nations. *Harvard Business Review*, March – April, 73-91.

Ruiz, F. (2005). *I+D y territorio. Análisis y diagnóstico de la innovación empresarial en Andalucía.* Colección Premios de Investigación. Consejo Económico y Social de Andalucía.

Santos, D., & Simoes, M.J. (2014). Regional innovation systems in Portugal: a critical evaluation. *Journal of Regional Research/Investigaciones Regionales*, 28, 37-56.

Savignac, F. (2008). The impact of financial constraints on innovation: What can be learned from a direct measure? *Economics of Innovation and New Technology, 17*(6), 553-569. https://doi.org/10.1080/10438590701538462

Segarra, A., García-Quevedo, J., & Teruel, M. (2007). Barriers to innovation and public policy in Catalonia. *Document de Treball IEB*, 2007/9/6.

Segarra, A., & Teruel, M. (2010). Obstáculos de las empresas para innovar. In: *Análisis sobre la Ciencia y la Innovación en España.* Madrid: FECYT.

Server-Izquierdo, R.J., & Lajara-Camilleri, N. (2016). Factores coadyuvantes de la innovación en las cooperativas agroalimentarias. Caso estudio de las citrícolas españolas. *ITEA-Información Técnica Económica Agraria, 112*(2), 185-199. https://doi.org/10.12706/itea.2016.012

Silva, M.J., Leitão, J., & Raposo, M. (2008). Barriers to innovation faced by manufacturing firms in Portugal: how to overcome it for fostering business excellence? *International Journal Business Excelence*, 1, 92-105. https://doi.org/10.1504/IJBEX.2008.017568

Tiwari, R., & Buse, S. (2007). Barriers to innovation in SMEs: can the internationalization of R&D mitigate their effects? Concord 2007, Proceedings of the first European Conference on Knowledge for Growth: Role and Dynamics of Corporate R&D (CONCORD 2007), Sevilla (Spain).

Tourigny, D., & Le, C.D. (2003). Impediments to innovation faced by Canadian manufacturing firms. *Economic Innovation and New Technology,* 13, 217-250. https://doi.org/10.1080/10438590410001628387

Visauta, B. (1998). *Análisis estadístico con SPSS para Windows. Estadística multivariante*, Madrid: MacGraw Hill.

Zukauskaite, E. (2018). Variety of Regional Innovation Systems and their institutional characteristics". In Isaken, A., Martin, R., & Trippl, M. (eds.), *New Avenues for Regional Innovation Systems-Theoretical Advances, Empirical Cases and Polity Lessons,* Springer.

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