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Determining Factors for Economic Efficiency in the Organic Olive Oil Sector

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Abstract: Spain looms large worldwide in organic olive oil production. However, this productive potential contrasts with the low internal consumption of the product. This situation makes Spain a world leader in its export. Companies in this sector have clear deficiencies, which must be corrected to ensure their survival over time. In this context, the aim of this study is to analyse the level of efficiency, in economic terms, of organic olive oil producers and to identify the factors explaining the best organizational practices. To do so, Data Envelopment Analysis (DEA) and Qualitative Comparative Analysis (QCA) have been used. The results reveal low levels of economic efficiency and the variables determining said efficiency.

Keywords: agri-food sector; organic products; information and communication technologies; DEA; fsQCA

1. Introduction

The organic produce sector in Spain has undergone a continuous path of growth since the late 1990s, with a considerable increase in productive factors, and hence, in organic output [1]. This has led to Spain currently occupying a privileged position globally [2], which contrasts, however, with the scant internal demand for organic agri-food products, causing an important gap between supply and demand, which means that the main destination of national organic produce is exportation [3]. Disinformation (the consumers' confusion about the differentiating features of this type of food), high prices (the price differential between organic foods and their conventional equivalents), and distribution (a scarcity of points of sale and little variety on offer) problems have been shown to be the main inhibitors for internal consumption of these products and, in particular, organic olive oil [4].

Olive oil is one of Spain's strategic products, with a production volume representing approximately 60 percent of that of the EU and 45 percent of world production [5]. Similarly, Spain also looms large in organic olive oil production, positioning herself as one of the main producers and exporters worldwide [6]. Therefore, this product holds great importance for the Spanish economy, being one of the main agricultural crops in production volume, as well as in the organic products sector nationally [7]. In particular, it must be pointed out that the region of Andalusia brings together the largest volume of olive oil production, both in its traditional [8] and its organic modality [7].

Literature shows that the organic olive grove exceeds the traditional crop production system in economic, technical, sociocultural, and environmental terms [9], but it also shows its low productivity as one of the main limitations [10,11], since this type of production requires the use of techniques that are less profitable and which involve additional costs [12]. For this reason, it is interesting to establish levels of general economic efficiency in this sector, comprising organizations with great potential, but that are held back, in general, by a serious commercial problem [13]. One must bear in mind that the commitment to organic farming cannot be justified alone by the economic and financial results that can be obtained, but also by moral and social ones [14].

What has been outlined above justifies the aim of this study, which consists of analysing organic olive groves in terms of economic efficiency. To this end, we have employed the Data Envelopment Analysis (hereinafter DEA) method to perform an analysis of the level of economic efficiency in organizations in the sector, referring to technical and scale efficiency. Likewise, via a Quality Comparative Analysis (hereinafter QCA), a second DEA stage has been carried out and applied to previously obtained levels of efficiency. With this second analysis, it is hoped to identify the factors that justify the higher efficiency indexes obtained by the companies in the sample. To reach said objectives, we have structured the study as follows: after this introduction, the contextual framework is set out which details the hypotheses in this study; then, the methodological procedure is outlined and next the results; finally, the main conclusions are drawn, which include the limitations of the study and future lines of research.

2. Contextual Framework and Working Hypothesis

Efficiency has been described as a comparative concept, which reflects the ability of organizations in the management of their resources, maximizing outputs or minimizing their inputs to achieve a competitive advantage [15]. There are many studies of efficiency that have been undertaken in the agri-food sector [13,16]. Many of them have brought up the controversy of whether organic agri-food operators or their traditional counterparts are the ones that work most efficiently [17]. However, there are few who have tried to delve into discovering what the factors are that explain the achievement of higher levels of efficiency. This paper attempts to bring new knowledge to this line of research.

A variable that is often considered to be critical for explaining the performance of organizations is that of the leading manager in the organization [13,18,19]. Specifically, many studies have determined that the most efficient organizations are the ones managed by people with the highest level of education [20]. Therefore, the abilities and skills of the manager are deemed important characteristics in the development of the organization [21,22], especially if the former has a high level of academic training, since it will stimulate their commitment to innovation and the implementation of more efficient organizational practices [4]. Such arguments lead us to formulate the following hypothesis:

Hypothesis 1. *The academic training of the manager is an explanatory factor for the economic efficiency of the company.*

Theories such as that of scale or scope highlight the importance of the size of organizations when performing their operational functions more efficiently [23]. In this way, several authors defend the existence of a positive relationship between efficiency and the size of the company [24]. Furthermore, studies in agrarian sectors have pointed to organizational size as an explanatory element of greater profitability [25]. Consequently, SMEs are generally less efficient than their larger counterparts [22]. In the olive oil sector, in which cooperatives predominate, size acquires particular importance for making the most of environmental opportunities based on the criteria of profitability and efficiency [26,27]. These statements lead us to put forward the following hypothesis:

Hypothesis 2. *The size of the organization positively affects economic efficiency.*

In the already mentioned context in which the Spanish organic olive oil sector operates, characterized by a demand incapable of absorbing the production supplied, the commitment to foreign markets becomes an essential factor for company growth and competitiveness [28]. Exporting firms obtain a better entrepreneurial performance, especially when adopting strategic decisions to adapt the marketing mix to the needs of foreign markets [29]. Similarly, exports have also been shown to be a variable which enables company results to be improved and, hence, increased profitability [30,31]. In this respect, several research papers reveal that organizations that are committed to internationalization work more efficiently [13,32]. This line of argument leads us to formulate the following hypothesis:

Hypothesis 3. *Exports are a variable that positively affects the economic efficiency of an organization.*

In recent years, firms have been obliged to carry out environmental reforms and innovation as a result of pressure from society [33]. The adoption of innovations in business is fundamental for company development and growth [34], as well as for attaining competitive advantage [35,36]. In the particular case of the use of Information and Communication Technologies (hereinafter ICT), they are able to reduce transaction costs, improving the efficiency of business activities across the value chain [37]. In this respect, there is much research that shows that the degree of innovation, as well as the commitment to ICT improve company productivity and enable it to operate more efficiently [4,38–40]. Therefore, the presence of a website, as a reception point for Internet users, the existence of a virtual shop as an online sales channel, and the use of virtual social networks, as a communications channel and contact marketing strategy, are low cost elements which enable competitiveness to be increased in this sector and, consequently, the efficiency of resources employed [41,42]. These arguments lead us to put forward the following hypothesis:

Hypothesis 4. *Commitment to ICT based on the Internet, such as a website, virtual shop or the use of virtual social networks improve a company's economic efficiency.*

The use of ICT and, in particular, electronic commerce is particularly useful for the organic agri-food sector, due to the commercial problems that these types of products face [43]. Disinformation among consumers on organic products, the high prices that they reach in some outlets compared to their traditional counterparts and the lack of proximity of this supply to the consumer, makes electronic commerce a very useful alternative channel for increasing sales [44]. The Internet has helped to enable fast, easy and cheap contact and to develop transnational business practices [45]. Similarly, this type of commerce avoids, in part, the problem of geographical distance, thereby making direct and immediate entry into foreign markets easier [46]. Conversely, the profile of the online Internet user is similar to that of the organic consumer [13], which is an added stimulus for achieving better sales results. In this respect, the commercial potential of electronic commerce and its added low cost is synonymous with greater productivity and efficiency [43]. Based on these precedents, the fifth hypothesis is proposed:

Hypothesis 5. *Internet sales will positively affect a company's economic efficiency.*

3. Materials and Methods

As has been outlined earlier, this study focuses on the main Spanish agri-food sector of organic olive oil production and geographically on its main producing region, Andalusia. To define the population to be studied, we contacted the autonomous bodies which manage and administer organic production in Andalusia (the Andalusian Regional Government) with a view of obtaining the register of producers. Once the population had been ascertained, a structured telephone survey was carried out aimed at company managers of said producers. The characteristics of this study are shown in Table 1.

Table 1. Technical specifications of the study.

Study population	Andalusian organic olive oil companies
Geographical area	Andalusia
Date undertaken	July 2015
Population record	Organic Production Information System (Spanish abbreviation (SIPEA))
Size of population	188 organizations
Sample unit	Producer of organic olive oil
Sample	147 organizations
Sample error	3.8% sample error
Confidence interval	Confidence Interval 95%

The next step was the evaluation of economic efficiency of the companies to be studied. To meet said objective we employed the DEA method, which is the most frequent and popular technique used in the literature [47,48]. Proposed by Charnes, Cooper and Rhodes in 1978, this methodology has become widespread and applied to different scenarios and areas, which is an indication of its flexibility [49]. (In research on the efficiency of a set of economic units, three methods are highlighted: DEA, stochastic frontier analysis and deterministic frontier analysis [50]. According to Liu et al. [48], efficiency analyses and, in particular, those of DEA have aroused great interest in the scientific community, due to the growing number of publications that have appeared in recent years, since 2010, and their importance in evaluating resource exploitation by companies.) In particular, the aim of this technique is to compare different homogeneous decision-making units (hereinafter DMUs), by evaluating the production factors or inputs they employ to generate a specific final product or output, in order to allocate different levels of efficiency. So, based on the linear programming technique and considering identical inputs and outputs, totally efficient companies that are in the so-called efficiency frontier can be determined [51].

The DEA method considers the classic CCR (Charnes, Cooper and Rhodes) and BCC (Banker, Charnes and Cooper) models (this latter includes the returns to scale variable), as well as the additive and multiplicative models. In this study, we will make use of the former, the most popular ones in the literature and which will enable us to contrast the results in terms of technical and scale efficiency [49]. Likewise, between the two existing approaches, minimizing inputs or maximizing outputs, the latter has been followed. Hence, maximization of outputs is considered the most fruitful approach given the significant commercial problem that these companies face. This also addresses farming issues because inputs are subject in part to the seasonality of crops.

In addition, the main weakness of the DEA method is to be found in its high sensitivity to extreme values, due to extreme values being the basis for determining the efficiency frontier [52]. Therefore, we need to identify and eliminate atypical observations or outliers [53]. To overcome this problem, the super-efficiency technique has been used, ruling out any observations that present a maximum value of two, as a reference threshold [54]. After ruling out those companies with missing values and outliers, the number of entities to be studied was reduced to 136. Despite this, a sample error of 5 percent was not exceeded for a confidence interval of 95 percent.

To tackle the second objective of the study, a second stage DEA was performed. With this it was hoped to determine the organizational variables associated with higher levels of efficiency. For this procedure, common in studies using the DEA method [47], the use of regression models is frequent [48]. However, in this study a fuzzy set QCA (fsQCA) was undertaken, which we consider adequate and useful for testing jointly technological and organizational variables which may explain greater levels of efficiency.

In particular, the QCA technique is based on Boolean algebra, using verbal, conceptual and mathematical language which makes it a qualitative and quantitative approach, bringing together their main advantages [55,56]. Thus, this methodology enables a set of cases to be analysed systematically to determine causal patterns in the form of necessity and sufficiency relations between a set of conditions and a result [57]. The main developments of this method are the so-called Crisp Sets (csQCA), Fuzzy

Sets (fsQCA) and Multivalue Sets (mvQCA) [58]. Among them, the fsQCA variant is the most used, because it resolves one of the main problems and criticism of csQCA, which is its strictly dichotomous approach [59], and this is the reason that this model has been used.

4. Results and Discussion

First, a general economic efficiency analysis was performed, considering the main expenditure and revenue items for the population analysed. To do so, a super-efficiency analysis was done which served to identify and eliminate extreme values. Table 2 shows the variables used in the DEA model, together with their average values.

Table 2. Data Envelopment Analysis (DEA) model and average value of the variables of which it is made up.

	Variables	Average Value
Input	Staffing expenditure	€454,034
Input	Expenditure on raw materials and other materials	€10,953,098
Input	Depreciation of plant and equipment	€171,869
Output	Volume of turnover	€12,815,195

The results obtained in this first analysis are detailed in Table 3 (the analysis was performed with the MaxDEA 7 program). As observed, the number of organizations deemed totally efficient is very small, being around 10 and 12 percent of the companies analysed, for both models considered, CCR and BCC respectively. The technical efficiency indexes, on average, for all the organizations are at 50.19 percent, and 55.40 percent considering too the scale efficiency (BCC). These data show that there is a large gap between organizations on the efficiency frontier and the rest, there being levels of inefficiency, on average, which may be considered high, if compared with other similar studies already mentioned [13].

Table 3. Summary of the efficiency results obtained.

	CCR	BCC
Number of efficient DMUs	13	16
Percentage of efficient DMUs	9.56%	11.76%
Average efficiency	50.19%	55.40%
Standard deviation	0.25	0.25
Average inefficiency	55.08%	50.55%

To determine what the factors explaining these levels of efficiency are, we carried out an fsQCA analysis. Thus, Table 4 outlines the variables proposed.

Table 4. Variables considered in the fuzzy set Qualitative Comparative Analysis (fsQCA).

Descriptor	Description	Typed
	Dependent Variable or Result	
efficiency	Efficiency scores (BCC)	Continuous variable
	Independent Variables or Condition	
education	Academic training of the manager	Categorical variable [1]
size	Number of employees in the organization	Continuous variable
exports	Decision to export (yes/no)	Dichotomous variable
active_web	Presence of website, virtual shop and use of virtual social networks	Categorical variable [2]
online_sales	Percentage of online sales	Continuous variable

[1] Four level categorical variable. Calibrated as follows: 0.01 (Primary education), 0.33 (Secondary education), 0.67 (3-year university degree), 0.99 (5-year university degree). Calibrated according to Rihoux & Ragin (2009). [2] Three level categorical variable. Calibrated as follows: 0.01 (presence of website), 0.5 (presence of virtual shop), 0.99 (use of virtual social networks). Calibrated according to Rihoux & Ragin (2009).

Before carrying out this procedure, the corresponding calibration of the variables was undertaken and a necessity analysis for the efficiency scores on the various causal conditions was done. The values obtained are not on or above the recommended limit of 0.9, established by Ragin (2006), for the necessary consistency. Table 5 shows the complex solution of the results after applying fsQCA, the configurations are presented in order of gross coverage (the analysis was performed with the fsQCA 2.0 program).

Table 5. Results obtained in the fsQCA analysis.

	Raw Coverage	Unique Coverage	Consistency
online_sales*education*size	0.409841	0.037543	0.896848
active_web*education*size	0.408553	0.053735	0.820654
export*education*size	0.339371	0.012460	0.876605
export*active_web*education	0.313009	0.091697	0.640671
active_web*~online_sales*~education*~size	0.127291	0.012643	0.861315
~active_web*online_sales*~export*~education*~size	0.037432	0.018306	0.922671
Solution coverage:		0.782661	
Solution consistency:		0.741599	

The first configuration alone explains 40.98 percent of the most efficient organizations. This combination of variables is made up of: the percentage of online sales, the academic training of the company manager and the size of the company, based on the number of workers. Then, the second most important configuration, with a gross margin of 40.85 percent, corresponds to the combination of the following variables: greater web activity and, again, the academic training of the company manager and the size of the company. The third and fourth configurations although less important, need to be considered because of their high gross margins. Overall, this model presents a coverage of 78.26 percent, which shows the proportion of organizations that are explained by the variables considered, and an overall consistency of 70.89 percent of cases.

The results obtained show that the economic efficiency of organizations can be partially explained through the combination of different variables. Organizational size is one of them: large organizations have different intrinsic and extrinsic advantages that will enable them to perform their economic activity more efficiently [22,23]. In addition, in line with other research, the academic training of the manager is a clear factor explaining the economic efficiency of the organization [18–22]. On the other hand, many authors emphasize the relevance of innovation in organizational performance [33–36]. Specifically, there is a clear consensus that the organizational use of new technologies will be a clear determinant of their efficiency [38–42]. Along with these factors, we can also mention export, due to its importance for this sector and as a means for growth and economic efficiency [28–32]. Such statements are evident through this research.

5. Conclusions

The DEA efficiency analysis reveals that only a very small number of entities may be considered efficient in terms of economic profitability. Despite this, the important growth in demand for organic agri-food products in the last few years is an incentive to companies in the sector for them to improve their levels of productivity in the future.

Performing an fsQCA analysis has enabled us to highlight the importance of the variables proposed as explanatory factors for the higher efficiency scores, as well as to determine the combinations of said variables that the most efficient organizations present, in economic terms. Thus, all hypotheses put forward earlier point to several variables to be considered as descriptors of greater economic efficiency in organic olive oil companies. In this respect, the commitment to online sales, the commitment to web tools, the academic training of the leading manager, exports and the size of the organization are variables which, combined, are associated with the most efficient organizations.

By way of the limitations of this study, we can point to several issues which must be considered when interpreting the results. The general economic efficiency model put forward, despite being common in this type of study, may not bring together, in all cases, all the relevant variables which may accurately determine the economic profitability of companies. However, the reliability of this model has been shown in the literature and brings together, broadly speaking, the main items of expenditure and revenue in companies. Likewise, the study focuses on the main organic olive oil producing region; therefore, these results show a relevant picture of this sector, although a wider study is needed to generalize more precisely.

In this regard, the growing relevance of the organic food sector makes it necessary for more in-depth research to understand it. This work could be applied to other sectors and in other contexts in order to make a more exact comparison of the importance of this market, its potential and how it can affect the future of farming organizations dedicated to this production system.

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