Efficiency of organic farming companies that operate in an online environment

Recebimento dos originais: 12/10/2015
Aceitação para publicação: 29/03/2016

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Abstract

The Internet is increasingly used as a sales channel for organic products and is providing solutions to many of the obstacles that this sector has traditionally faced. This paper examines factors that account for the efficiency of companies which have opted to offer their organic products through their website. Through a case study of Spanish organic olive oil producers in 2012, it examines the relationship between efficiency and internationalisation or e-business, together with aspects such as the age of the company, the quality of its website and its social

networking presence. The results confirm a direct association between efficiency and e-business or exports in organic producers with an Internet presence. They also find a positive association between efficiency and young companies. These results show that business decisions such as opening the company to foreign or online markets can help to improve the efficiency of a sector which, despite being one of the largest producers in the world, encounters major problems in marketing its output.

Keywords: Organic farming companies. Electronic commerce. Efficiency.

1. Introduction

Increasing consumer awareness of environmental deterioration (EUROPEAN COMMISSION, 1999) has been reflected in changing consumption habits over the past two decades and, on the supply side, in a substantial rise in organic production, making this one of the most dynamic sectors in the agri-food sphere (WILLER; YUSSEFI, 2004).

One defining characteristic of the growth in the organic food market in Europe is its uneven distribution across the region: demand is mainly concentrated in central and northern European countries, while southern Europe has specialised in growing and exporting these products. Spain provides one of the best examples of this imbalance. Its certified organic farming surface area is the largest in Europe and the fifth-largest worldwide (WILLER ET AL., 2013) and shows an impressive growth rate, having multiplied by five over the 1999-2009 period. On the demand side, however, the market share of organic products in Spain is under 0.7% because of the very low proportion of these products (barely 1%) in the Spanish consumer's shopping basket (SCHAACK ET AL., 2010). As a result, over 80% of Spanish organic products end up in foreign markets, mainly the Netherlands, Germany, the United Kingdom and France (MAGRAMA, 2009).

In general, there is consensus on the main factors hindering the development of demand for organic foods in Spain: poor distribution – a scarcity of points of sale and little variety on offer – the price differential between organic foods and their conventional equivalents and, lastly, the consumers' confusion about the differentiating features of this type of food (SCHOBESBERGER ET AL., 2008; ROITNER ET AL., 2008).

The organic farming sector has reacted to these inhibiting factors in different ways, including strengthening the availability of organic products through unconventional sales channels such as direct selling over the Internet (GONZÁLEZ; COBO, 2000). Using the Internet for sales purposes provides a solution to the obstacles mentioned in the previous

paragraph, as the Internet is able to concentrate the supply side in an online environment, reducing the importance of geographical distance, to cut out intermediaries by fostering direct contact with the producer, and to allow large volumes of information to be distributed attractively and cheaply. Its attractiveness is proved by the steady rise in the number of online companies that are including organic products in their range.

In view of the above, the general aim of this study is to examine the level of efficiency attained by organic farming companies that have opted to use the Internet as a sales channel. In particular, on the one hand it attempts to quantify their efficiency and, on the other, to identify some of the factors that may explain the level of efficiency attained in each case. To this end, the present paper is organised as follows. After this introduction, the second section presents the hypotheses with a review of the literature on which each is based. The third section explains the research method and the fourth section highlights the main results. Following the discussion, the study closes with some conclusions and the references.

2. Literature Review and Hypotheses

Social networking for commercial purposes has intensified in recent years. Platforms based on social media (blogs, forums, social networks, etc.) offer low-cost communication channels (GUNELIUS, 2011) in which the content exchanged through interaction with the users and the trust generated among them (LAI ET AL., 2011) can increase the sales of companies with a web presence (WEI PHANG ET AL., 2013; CHENG; XIE, 2008) and thereby improve the efficiency of the resources employed. Some authors also highlight the ability of the social media to discover new products that have previously been ignored by conventional media (WEI ET AL., 2013, DELLAROCAS ET AL., 2010), such as organic products. Based on the above, the first hypothesis is that:

H1: Organic farming companies with a social networking presence are more efficient than the rest.

Successful use of the Internet for commercial purposes depends on the corporate website's ability to exert a positive influence on the user's impression of the company, which can be decisive for the final decision to engage in a long-term relationship with it (VAN DER HEIJDEN ET AL., 2003). This impression is influenced by the potential of the information

supplied through the website to compensate for the absence of personal contact between the agents, in many cases, and to generate sufficient trust between them (MCKINNEY ET AL., 2002). According to the classification of Brunso et al. (1996), the organic product consumer's profile fits the group of rational, conservative and adventurous consumers, who are typically more concerned about attributes related to the quality, environmentally-friendly production and authenticity of the food product than about its price (MORLEY ET AL.,2000). They therefore seek alternatives to the mass-produced products offered by the supermarkets and tend to use alternative sales channels, such as the Internet (PICKERNALL ET AL., 2004). The low cost of the Internet and its ability to attract and retain new customers must have a positive effect on the efficiency of the resources the company employs. This reasoning leads to the following hypothesis:

H2: Organic farming companies with better-quality websites are more efficient than the rest.

The website is an attractive sales channel for organic food. On the demand side, it is noticeable that the features of the Internet user's profile (INE, 2011) are basically identical to those of organic product consumers: higher educational level (MINETTI, 2002; FRAJ; MARTÍNEZ, 2002), younger (MACEVOY, 1992, FRAJ; MARTÍNEZ, 2002) and higher income levels (MINETTI, 2002).

With regard to the supply side, the Internet has the potential to bring prices down, largely because it makes it easier for consumers to choose between different products and because it cuts production overheads (BICKERTON ET AL., 2000). On the latter subject, information and communication technologies (ICT) have the potential for reducing transaction costs and the risk inherent in each transaction (STRADER; SHAW, 1997; BENJAMÍN; WIGAND, 1997), as well as improving efficiency in the value chain (EVANS; WURSTER, 1997; GHOSH, 1998).

Moreover, Dholakia and Kshetri (2004) showed that, as an answer to the problem of the dispersion of supplies, the Internet provides economies of reach. It does this by improving inter-business cooperation and opening up routes. Based on the foregoing, the third hypothesis is:

H3: Organic farming companies that sell their products on the Internet are more efficient than

the rest.

Exporting is a necessity, in view of the gap between the supply and demand for organic products in Spain (VIDAL ET AL., 2013). Merino (1998) points out that theoretical works have not established a general model which explains why companies decide to sell part of their output on international markets. Given the principle of maximizing profits, however, he considers that if operating on foreign markets entails a better return on the resources employed than could be achieved by remaining in the home market, the company will implement an export strategy. Following this reasoning, different factors that could have a positive effect on the efficiency and profits of the exporting company can be identified. They include taking advantage of economies of scale if the home market is not sufficiently large, or economies of reach that become available in the context of a diversification policy. Ottaviano et al. (2007), in a study of EU companies, concluded that internationalized companies are more productive than those that do not have an international dimension. Their results agree with those of other authors such as Aw et al. (2000), Lu and Beamish(2006) and Cassiman et al. (2010). From these arguments, the next hypothesis to be tested is:

H4: Organic farming companies that export are more efficient than those which allocate all their output to the home market.

Works that link the age of the company to greater business efficiency (HOPENHAYN, 1992) do not abound in the literature. However, others indirectly suggests the possibility of an inverse relationship between the two variables. For instance, a number of papers consider that there is no positive association between company age and export activity. Authors such as Oviatt and McDougall (1997), Zahra et al. (2000) and Autio et al. (2000), among others, show that companies can do business successfully with commercial partners from other countries practically from the moment they are formed, sidelining the importance of company age when starting to export. Greater integration of the respective national economies, lower communication and transport costs, entrepreneurs and/or executives with an international outlook, focus and experience, and information and communication technologies, all favour recently-created companies' crossing national borders in order to create value within the organization.

However, studies such as those of Chuang et al. (2007) or Weltevreden and Boschma (2008a and 2008b) maintain that there is no positive relation between age and the possibility of adopting E-business models and, consequently, of taking advantage of the benefits offered by ICTs. This has negative repercussions for company efficiency. In the same way, authors such as Baptista (2000) and Mitchell (1992) consider that the age of the company can hinder the introduction of innovations, such as e-business. These studies suggest that company age acts as a brake on opening up the company to new markets, such as the online market or international markets. In this case, the hypothesis to be tested is:

H5: The age of an organic farming company and its technical efficiency are inversely related.

3. Materials and Methods

3.1. Population

The present study focuses on Spanish organic olive oil companies with a website. After defining the total census (195 companies), the next step was to use the main search engines to locate the websites of all the organic olive oil producing companies. The companies identified as having websites numbered 112. The CEOs of 100 companies were interviewed by telephone. Technical information on the survey data is shown in Table 1.

Table 1: Technical description of the empirical study

POPULATION	
Sampling units:	Organic olive oil production and marketing companies with a website
Total population:	112 companies
Sample elements:	CEOS of the companies
Scope:	Spain
Timescale:	1 December 2012 to 5 April 2013
SAMPLE	
Type:	Simple random
Sample size:	100 interviews
Valid responses:	89 interviews
Approximate sampling error: for the 89 valid responses)	4.83%, p=q=0.5, CI 95.5%

Source: own compilation

In order to use Data Envelopment Analysis (DEA), companies with incomplete data and/or atypical values had to be removed. The Mahalanobis distance was used for this purpose. The final number of companies included in the study was 89.

3.2. Methods

Measuring efficiency is a historically controversial subject (BITITICI ET AL, 1997; NEELY; WAGGONER, 1998). It seems to be accepted that the ideal way to measure a company's efficiency is to compare its results with results that are considered optimal. However, this would entail knowing all the factors affecting each company and possessing the necessary tools to quantify them (ÁLVAREZ, 2001).

Farrell (1957) abandoned previous assumptions and theories in favour of a new way to measure a company's technical efficiency: comparing each company with what similar companies are doing. The starting point for this new approach is to construct an efficient production frontier based on data on the companies with the best results, or "good practices". These companies are considered efficient. On comparing each company with this efficient production frontier, the distance between the two measures the degree of that company's inefficiency. However, it should not be forgotten that, from this perspective, efficiency is relative and a company is only as good as the best companies in the sample (Färe et al., 1994).

Efficient production frontiers can be constructed through parametric (AIGNER; CHU, 1968; AFRIAD, 1972; AIGNER ET AL., 1977; MEUSEN; VAN DEN BROECK, 1977) and non-parametric approaches. DEA (Data Envelopment Analysis) is a non-parametric method. This way of measuring technical efficiency has become well known and frequently used in recent years, in numerous studies on the agri-food sector in general and the olive oil sector in particular (SUEYOSHI ET AL., 1999; REINHARD ET AL., 2000; SINGH ET AL., 2001; BOYLE, 2004; GOTCH; BALCOMBE, 2006; BAYRAMOGLU; GUNGOGMUS, 2008; SOBOK ET AL., 2009; GUESMI ET AL., 2012; SARASA ET AL., 2013 AND VIDAL ET AL., 2013). For the olive oil sector, see Giannakas et al. (2000), Tzouvelekas et al. (2001), Lamabarraa et al. (2007), Amores and Contreras (2009), Karagiannis e Tzouvelekas (2009) and Dios-Palomares and Martínez (2010), among others. The reasons for choosing DEA for this study include its versatility and flexibility, among other advantages (PICAZO 2012; GUZMÁN ET AL., 2013; BOYD; VANDENBERGHE, 2004). However, because DEA is a

non-parametric technique it also presents a series of drawbacks. One major drawback is the model's high sensitivity to atypical observations (SCHUSCHNY, 2007; GUZMÁN ET AL., 2013; PICAZO, 2012).

In this study, particular attention has been paid to atypical values. The minimum-volume ellipsoid (ROUSSEEUW, 1984; MORITA; AVKIRAN, 2009) is quite a conventional and often-used technique to detect them, and was the method chosen for this purpose. It eliminates the observations furthest from the core distribution set according to the Mahalanobis distance.

DEA makes it possible to ascertain which Decision Making Units (DMUs) apply efficient practices. These efficient DMUs, which are assigned a value of 1, are located at – and constitute – the efficient production frontier. The distance between the other companies and this frontier lies on a scale of 0 to 1, with the lowest values indicating the least distance.

The original DEA model created by Charnes et al. (1978), known as the CCR model, assumes constant returns to scale (CRS). Banker et al. (1984) subsequently proposed an extension to the CCR model known as the BCC model, which allows variable returns to scale (VRS), comparing each company with companies of a similar size. Both models allow technical efficiency to be measured in two different directions: input minimization or output maximization. According to Coelli et al. (2005), under constant returns to scale both directions give identical results, but not under variable returns to scale. However, they state that in both directions the efficient production frontier is defined through the same efficient DMUs.

The BCC model was chosen for the present study as it is better suited to the study sample characteristics, since the company size differs considerably between the DMUs. Otherwise, each company would be compared with others of different sizes, giving rise to inefficiencies of scale. In the same way, an input-type technical efficiency calculation was used in this study, applying the following formula:

$$Min\ \theta_{BCC}$$

Subject to: $\sum_{j=1}^{n} \lambda_j x_{ij} + S_i \leq \theta_{xi0}, i = 1, \ldots, m,$

$\sum_{j=1}^{n} \lambda_j y_{rj} - S_r \geq y_{r0}, r = 1, \ldots, s,$

$\sum_{j=1}^{n} \lambda_j = 1, j = 1, \ldots, n,$

$s_i, s_r, \lambda_j \geq 0$

Where:

θ, proportion by which all the inputs can be reduced; j, subset of DMUs studied; i, input subscript ; r, output subscript; λ_j, intensity of DMUj share in composite DMU formation; x_{ij}, quantity of inputs i used by DMUj; y_{rj}, quantity of outputs r used by DMUj; x_{i0}, quantity of inputs i used by the DMU analysed; y_{r0}, quantity of outputs r used by the DMU analysed.

For calculating company efficiency through DEA, the output chosen for this study was operating income, a classic variable used in many of the studies that employ the DEA method.

Financial variables were not considered suitable inputs in this case, as the olive oil sector is dominated by cooperatives, whose accounting rules differ from those of other companies in that they adjust the costs of materials and raw materials to their operating income (zero or near-zero profits). For this reason, labour was chosen as the factor for calculating technical efficiency. Because of the high level of temporary work in the olive oil sector, labour was divided into the following four variables for inclusion in the model as inputs: number of permanent office staff, number of temporary office staff, number of permanent factory staff and number of temporary factory staff.

The technical efficiency analysis was performed with the DEAP 2.1 program developed by Coelli (1996). An econometric regression was then performed to identify which variables (x_1, x_2, x_3,…) affect the technical efficiency level ($\hat{Y}$) of the companies, an analysis known as second-stage DEA (HOFF, 2007), using the following econometric model:

$$\hat{Y} = \beta_0 - \hat{\beta}_1.x_1 + \hat{\beta}_2.x_2 + \hat{\beta}_3.x_3 + \hat{\beta}_4.x_4 + \hat{\beta}_5.x_5$$

There seems to be no consensus on the type of regression to use, since the uniqueness of the dependent variable (taking values between 1 and 0) complicates the choice (PUIG-JUNOY, 2000). Consequently, this study used logistic regression (SÁNCHEZ, 2000). This type of regression makes it possible to examine the relationship between a series of quantitative or categorical independent variables and a binary independent variable (Table 2).

Table 2: Variables chosen for logistic regression

Dependent variable	Technical efficiency: dichotomous variable with a value of 1 when the DMU is efficient, otherwise 0 ($\hat{Y}$)
Independent variables	Company age: continuous variable (x_1)
	E-business: categorical variable with a value of 1 when the DMU sells through online shops, otherwise 0 (x_2)
	Website quality (WQ)*: continuous variable with values between 0 and 37 (x_3)
	Social networks: categorical variable with a value of 1 when the DMU has a social networking presence, otherwise 0 (x_4)
	Exports: categorical variable with a value of 1 when the DMU has an element of foreign trade, otherwise 0 (x_5)

Source: own compilation

* Table 4 shows how this variable is calculated

3.3. Data

The study data were collected through telephone interviews with the CEOs of the companies. Table 3 summarises the main descriptive statistics of the variables used in the DEA.

Table 3: Descriptive statistics of the variables chosen for the dea study of technical efficiency

	OUTPUT	**INPUTS**			
	Operating income (Euro)	**Permanent office employees**	**Temporary office employees**	**Permanent factory employees**	**Temporary factory employees**
Mean	2,148,391.64	2.97	0.20	2.30	3.74
SD	10,342,260.05	3.14	0.46	3.85	4.17
Maximum	69,471,876.00	20	2	33	24
Minimum	37,146.00	0	0	0	0

Source: own compilation

SD: standard deviation

A company website checklist was used to complete the data. The checklist made it possible to identify different elements of website content, which were grouped into the following categories: usefulness, information on the company, information on the product, user-friendliness, privacy, customer care, the languages in which the information was presented and whether or not the company had an online store (BERNAL; MOZAS, 2008). The data from the website analysis were used to construct a website quality (WQ) index. For each item, a positive response scored 1 and a negative response scored 0. The maximum score a company could achieve was 37.

$$QW_j = \sum_{x=1}^{n} x_i$$

The website quality index data, shown in Table 4, were taken as the independent variable in the logistic regression performed after the DEA in order to discover whether website quality and DMU efficiency were related to any significant degree (Hypothesis 2).

Table 4: Website quality items

CONTENT (X_i)	**N**	**%**	**CONTENT (X_i)**	**N**	**%**
USEFULNESS			**PRIVACY**		
Up to date	48	53.93	Secure payment info.	13	14.61
Complete (not under constr.)	66	74.16	Privacy of information	34	38.20
INFORMATION ON THE COMPANY			CUSTOMER CARE		
Background/History	63	70.79	Customer register	11	12.36
Location	85	95.51	Cookies	57	64.04
Information on the chairman	13	14.61	E-mail	80	89.89
Surroundings	34	38.20	Telephone	84	94.38
Designation of origin	22	24.72	Chatroom	7	7.87
PRODUCT INFORMATION			**FAQs**	**2**	**2.25**
Production methods	43	48.31	Satisfaction survey	2	2.25
Quality control	49	55.06	Members-only area	10	11.24
Environmental care	42	47.19	LANGUAGES AVAILABLE		
Catalogue	72	80.90	Spanish	88	98.88
Prices	34	38.20	English	47	52.81
Price calculator	21	23.60	French	15	16.85
Discounts on online sales	2	2.25	Other	18	20.22

Product use recommendations	26	29.21	TRANSACTIONS		
Delivery time information	9	10.11	Online shop	36	40.45
USER-FRIENDLINESS					
Links	40	44.94			
Banners	23	25.84			
Audio	16	17.98			
Video	12	13.48			
Search engines	18	20.22			
Site map	8	8.99			

Source: own compilation

4. Results

The results obtained by DEA may be observed in Table 5. It should be noted that the technical efficiency of the companies studied was 0.611 and that only 31 companies (34.83%) could be considered efficient according to the DEA model.

Table 5: Data envelopment analysis (dea) results

DEA EFFICIENCY INDICES	ORGANIC OIL COMPANIES
Mean	0.611
Standard deviation	0.318
Maximum	1
Minimum	0.096
No. of efficient firms	31
Percentage of efficient firms	34.83%

Source: own compilation

As regards the explanatory factors for these efficiency results, the econometric analysis (see Table 6) indicated that the technical efficiency of these companies was unrelated to their social networking presence or to the quality of their website, disproving Hypotheses 1 and 2 (see section 2 above).

Table 6: Logistic regression results

VARIABLE	COEFFICIENT	SE	p
Constant	-0.399	1.074	0.710
Company age	-0.028*	0.014	0.055
Transactions online	1.054**	0.502	0.036
Website quality	-0.006	0.054	0.905
Social networks	-0.361	0.603	0.549
Exports	1.083**	0.553	0.050

Source: own compilation
SE: standard error
*** p<0.01; ** p<0.05; * p<0.1

The remaining hypotheses were corroborated by the results. Consequently, the companies' technical efficiency was found to be directly related to their business activities on international markets and on the online market, through online shops, at a 95% confidence level. In the same way, the technical efficiency of the organic olive oil producing and marketing companies was inversely related to the age of the company, at a 90% confidence level.

6. Discussion

Using the Internet as a sales channel for organic products overcomes many of the obstacles this sector faces, such as high prices compared to the conventional equivalents, the few and scattered points of sale, and disinformation among the potential customers. The agri-food sector has taken note of this potential, as shown by the proliferation of organic products being offered online in recent years.

The results obtained through DEA and logistic regression in the present study show a positive relationship between the efficiency of company and its active attitude towards e-business and foreign trade. In companies with an Internet presence, youth favours innovation and has a positive effect on their efficiency, suggesting that company age may be related to limiting effects in terms of taking advantage of the new technologies to access new markets.

Moreover, these results indicate that using the Internet as a mere communications channel does not affect the technical efficiency of a company, as no relation was found

between technical efficiency and the use of social networks or the quality of the corporate website. Particular features of the sector under study may explain these results.

Although most studies have observed the commercial potential of social networking, it is also true that some have noted that this cannot be generalised to any company in any sector. For instance, Kahar et al. (2012) suggested that it is more complicated to obtain positive results in rural areas than in urban ones, and also in small companies, both of which apply to the companies examined in the present study. Other studies suggest that social networks have little influence on the purchasing preferences of certain groups (CELESTE, 2013), such as students (LEWIS ET AL., 2012), and that cultural traits or geographical area, even within the same country, give rise to significant differences in their influence (MOON ET AL., 2008). The results obtained by these authors would explain the absence of a direct relation between efficiency and the use of social networks in the case of organic olive oil companies of limited size located in rural areas.

With regard to the lack of relation between website quality and efficiency, Carr (2004) considered that access to ICTs is not a strategic resource, as although it adds value, it is easily available to any company. An analysis of variance (Table 7) found no significant difference in website quality between the organic olive oil sector companies which were considered efficient and those considered inefficient, which indicates that ICTs are indeed a generalised resource and therefore cannot explain the differences in efficiency shown by these companies. At all events it should also be borne in mind that authors such as Brynjolfsson and Hitt (2000, 2003) highlight the importance of complementary investments if ICTs are to raise the productivity of the company to any substantial degree. As Bharadwaj (2000) maintains, the main potential of new technologies comes from combining them with other existing company resources, in other words, with innovations in the organization's operating system. Website quality is therefore a prerequisite for competing on the market, but is not in itself sufficient to foster an efficient market presence. The profiles of the companies studied (very small companies with few employees, low levels of professionalism and few ICT skills) may be another factor to explain the absence of any relation between website quality and efficiency. Moreover, in the year 2012 only 10% had drawn up ICT investment and use plans for their companies.

Table 7: Analysis of variance (anova)

	Sum of squares	Degrees of liberty	Quadratic mean	F	p
Inter-group	0.166	1	0.166	0.006	0.940
Intra-group	2561.474	87	29.442		
Total	2561.640	88			

Source: own compilation

In view of these results, strategies to strengthen the use of Internet as a sales channel, both on the home market and abroad, may be essential for the development of the organic farming sector in countries such as Spain, which despite being the third-largest organic producer in the world has a home market with insignificant demand but great potential. At all events, these strategies must be based on the premise that ICT use can only increase the technical efficiency of companies when combined with changes in the way they operate. Nowadays the olive oil sector faces serious obstacles in this regard, such as the age of its farm holdings and their small size, lack of administrative staff and lack of training among the managers.

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Acknowledgments

This work was financially supported by the Regional Government of Andalusia, the Ministry of Science and Innovation and the FETYC (Proyecto de Excelencia: P110-AGR-5961: "Fortalezas y debilidades en la internacionalización del sector oleícola provincial de Jaén"). The manuscript was translated into English by Mary Georgina Hardinge.