

A sensitivity analysis of organic versus conventional systems of sheep-farming

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Abstract

The progressive decline of traditional farming systems of small ruminants in Spain has an interesting alternative in organic production. This communication is involved in a research project that addresses these issues. One of the aims of this project is to analyze the evolution of a group of milk sheep farms consisting of conventional farms and organic farms. The results presented in this paper are a case study of the differences in the production function of the two types of farms. The main result indicates that the rate of change of gross production of organic sheep is 53% greater than the conventional, if all other factors remain constant. This result supports the effectiveness of a more respectful and sustainable production system in rural areas.

Introduction

The decline and practical disappearance of the traditional farming model of the Mediterranean Basin is an outcome of a decrease in its population and of legislation on land use (El Aich et al. 1996). Simultaneously there has been a slow but steady movement towards greater intensification in milk production systems (Chassany et al. 1996). In this situation, organic production constitutes a possibility for sustainable development because it is strongly linked to the environment; it has the potential to keep a population in place with a decent work. This system could offer a solution to those depressed areas that they still maintain traditional systems for small ruminants. The peripheral zones of Castilla y León have the best characteristics for matching the needs of organic production (Palacios 2010). The aim of this paper is to attempt to establish differences between the conventional systems, as opposed to organic farms. Across the analysis of these differences we would obtain conclusions about the level of efficiency of one system as against the other.

Material and methods

A group of researchers from the Universities of Leon and of Salamanca has been analysing the situation of the farms of small ruminants of Castilla y León through the research project: "Impact on the quality of products and the environment of the different systems of livestock with small ruminants of milk production. Use of economic, social and environmental indicators and characterization of systems". This project was financed by the Spanish National Institute for Agricultural Research with the reference code RTA2010-00064-C04. The project made it feasible to monitor a group of seventeen milk sheep for a whole year. The group includes fifteen conventional farms, and two organic farms. The information gathered covered all the data relating to technical and economic management, and other questions like social and environmental features. This procedure was carried out with great thoroughness, so that the information obtained was of extremely high quality. Despite this, we know that the results must be interpreted as a case study because of the limitations from the amount of data available.

In a productive sector, there can be different techniques for production, with specific technical installations, different production processes, differing forms of organization, business management and division of labour. Each situation can be represented functionally by the relationship that links the value of output to the quantities of the production inputs used. These relationships make it possible to investigate aspects connected to economic efficiency. This information may be used to establish feeding and management strategies, even it may be used to determine how one input can be partially replaced by another (Grossman and Koops 1988).

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The variables that we have used to analyse the productive systems are:

- Gross Output (GO): Total output of the farm, obtained by adding all the farm products destined for sale (expressed in euro).
- Worker Units (WU): Number of workers, permanent or hired, employed full time on the farm (expressed in units).
- Surface Area (SA): Total area owned or rented by the farm (expressed in hectares). This variable did not include common pasture because of the difficulty of quantifying individual uses in such land.
- Number of Sheep (SHEEP): Size of the flock. Number of productive sheep (expressed in head of sheep).
- Assets (ASSETS): Value of the buildings and machinery own by the farm, less the accumulated depreciation (expressed in euro).
- F_i : Dummy variable. It takes the value 0 for conventional farms and 1 for organic systems.
- u_i : Random variable.

The model specification is linear and defines the link between production and inputs. The independent term of the model includes an element which gives us the differences between the two systems of production under supervision.

This specification is an approximation to a Cobb-Douglas function (a very interesting overview of the functional forms for the production functions can be found in Griffin 1987). The original variables have been transformed into logarithms, so that the coefficients approximate to the elasticity concept. The estimation was carried out by the Ordinary Least Squares (OLS) method.

Results

The estimated model is:

$$LGO_i = \beta_1 + \beta_2 LWU_i + \beta_3 LSA_i + \beta_4 LSHEEP_i + \beta_5 LASSETS_i + \beta_6 F_i + u_i$$

Table 1: Results of Estimation

	Coefficients	Student's t	VIF
β_1 (constant)	3.45	0.90	
β_2 (LWU)	0.47	0.85	4.14
β_3 (LSA)	0.11	0.60	1.76
β_4 (LSHEEP)	0.65	1.03	4.64
β_5 (LASSETS)	0.26	1.68	1.38
β_6 (F)	0.43	0.94	1.43

$$R^2=0.672229; F_{(5,11)}=4.51; F_{RESET}=0.78; JB= 0.14$$

The small size of the sample implies few degrees of freedom for statistical tests. Because of this reason, the tests reach modest levels of significance. Nonetheless, the results are of great interest from the viewpoint of a case study, as they lead to some interesting conclusions. The signs for the parameters were as expected and to complete the analysis, a collinearity test (Variance Inflation Factor VIF), a specification test (Regression Equation Specification Error Test F_{RESET}) and a test of normality of residuals (Jarque-Bera JB) were performed. The model did not show multicollinearity because the VIF factors are under 10. The F_{RESET} test points out that the model is valid at a 0.05 significance level; and finally, the JB test indicates that residuals follow a normal distribution. As we can see in the figure 1 the degree of fit of the model is very high.

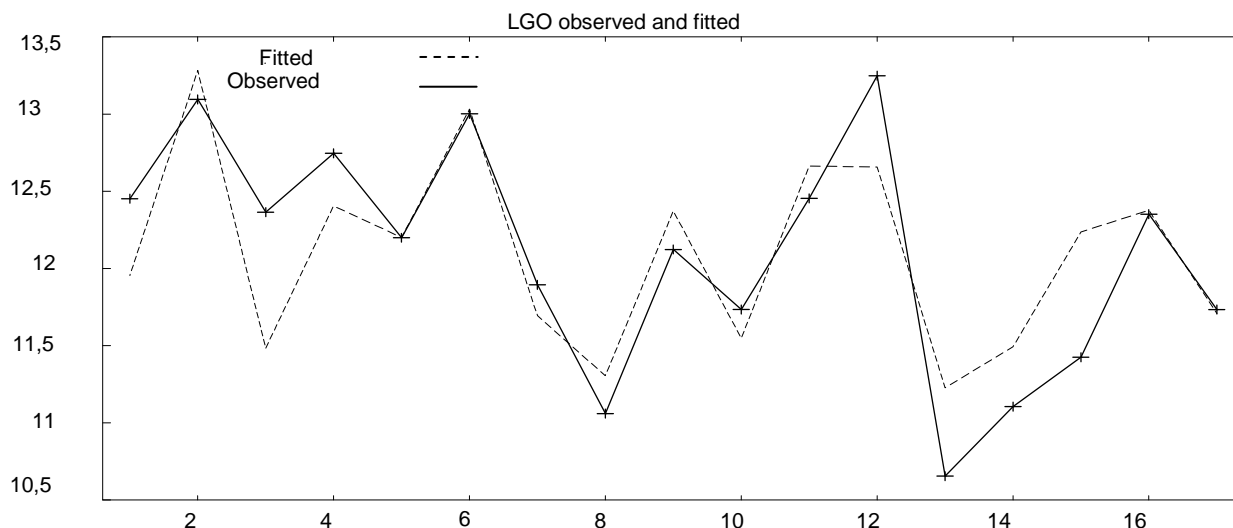


Figure 1. Fit of model

The parameters β_2 (WU) and β_4 (SHEEP) have the greatest influence on GO. As we worked with elasticity, an increase of 1% in one of these variables, ceteris paribus, implies a rise of $\beta_i\%$ in the GO of the farm. For example, an increase of 1% in WU means a growth of 0.47% in GO and an increase of 1% in the SHEEP means a rise of 0.65% in GO.

The interpretation of the dummy variable coefficient (β_6) (Table 1) in a model with logarithms is the percentage variation of the variable GO between organic and conventional farms when they have the same input combination (Uriel, 2013). It is calculated as: $100 \times (e^{0.43} - 1) = 53\%$. This percentage shows that the organic system has a 53% more GO than a conventional one.

Discussion

Over the last thirty years, the transhumance systems have suffered a progressive decline (Manrique et al. 1996) and processes of intensified production replaced the traditional farm management of small ruminants. Intensification has caused environmental degradation and depopulation. In this scenario, organic production becomes an interesting alternative. This type of production might be sufficiently viable; it can offer an alternative that would contribute to retain population, to generate business activity, to attract tourism and to guarantee jobs. At the present time, there is a growth in certified farming products in Spain. Since 2008, Spain has been the European Union country with the greatest totals of certified land and of certified farmers (Palacios et al 2008). The previous results let increase the viable possibilities for the organic farms and they allow guaranteeing the future for the sector.

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