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in

Ranilla M.J. (ed.), Carro M.D. (ed.), Ben Salem H. (ed.), Morand-Fehr P. (ed.).
Challenging strategies to promote the sheep and goat sector in the current global context

Zaragoza : CIHEAM / CSIC / Universidad de León / FAO
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 99

2011
pages 35-40

A quantitative approximation to the transformation of two dairy sheep farms to organic production

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Abstract. The main objective of this work was to analyze the transformation of two dairy sheep farms from conventional herd management to organic management. To achieve this objective, we specified a linear equation of income according to the fixed and operative costs for each of the two production systems. The estimation method was the Ordinary Least Square method. This method quantifies the causal relationship between variables and it was applied to information collected on two farms over a period of four years (2003 to 2006). Estimation was checked using several tests. The obtained results enabled us to make a comparative analysis of the two different production systems, and demonstrated how their structure had been changed to adapt to organic production. The following comprise some of the main results:

- Operative costs have a significant direct impact on the income function, reaching a causal factor of 2.02 for the conventional system, while in the organic system it drops to 0.3.
- The importance of fixed costs is crucial to the income structure of the organic system and the relationship has a positive correlation with a coefficient close to unity.
- Fixed costs show a negative relationship with income for the traditional system, which means that fixed assets and machinery do not explain the farm's income.
- The obtained functions reveal a deep structural change in production schedules, which has enabled us to formulate proposals for future development.

Keywords. Economic behaviour – Organic production – Livestock management – Production functions.

Evaluation chiffrée de la transformation d'une exploitation de brebis laitières en ferme bio

Résumé. *L'objectif principal de cette recherché est d'analyser comment deux exploitations de brebis laitières sont passées d'une production conventionnelle à une production biologique certifiée. A cet effet, nous avons estimé une fonction linéaire des revenus en fonction des coûts variables et fixes des exploitations. La méthode utilisée pour l'estimation est celle des moindres carrés ordinaires. Cette méthode permet de quantifier les liaisons causales qui existent entre les variables sélectionnées sur la base d'informations recueillies durant la période 2003-2006. Les résultats obtenus nous ont permis de réaliser une analyse comparative entre les deux systèmes de production et de montrer comment la structure des revenus s'est modifiée au cours du processus de conversion de la production conventionnelle à la production biologique.*

Voici quelques-uns des principaux résultats:

- *Les dépenses variables ont un grand impact sur la fonction des revenus du système conventionnel car elles atteignent un coefficient explicatif de 2,02; ce dernier chute à 0,3 pour la production biologique.*
- *L'importance des coûts fixes est déterminante dans la structure des revenus du système biologique et cette relation a une corrélation positive avec un coefficient proche de l'unité.*
- *La relation coûts fixes et recettes est négative dans les systèmes conventionnels ce qui peut signifier que le volume des biens immobilisés et des machines ne permet pas d'expliquer le revenu de l'exploitation.*
- *Les résultats révèlent un profond changement structurel dans les itineraries de production, permettant de définir les mesures à développer postérieurement afin d'améliorer les taux de bénéfices.*

Mots-clés. *Gestion économique – Production biologique – Conduite du bétail – Fonctions de production.*

I – Introduction

The food crises which arose at the end of the last century and constant changes in consumer demands have created a tendency among some consumers to turn towards organic products, which are guaranteed by "clean" and environmentally friendly production processes. This latter characteristic converts organic production into an effective tool for achieving harmonious and sustainable land-use development, and therefore an increase in the number of organic producers is both fully justifiable and desirable. The process of transformation to this kind of system is protracted and complicated, as it requires a complete change in livestock and farm management due to the existence of stringent regulations.

The aim of this research was to identify the fundamental changes which occurred at two dairy sheep farms in the province of Zamora, Spain, and which characterised the metamorphism implied by organic production. To achieve this aim, we specified and estimated two production functions, one for each system (conventional and organic). In the following step we compared the results, and it made possible to detect the changes that occur in the transformation process.

II – Materials and methods

The empirical analysis was based on a uniequational model which enabled us to study the principle determinants of farm income for the two production systems, conventional and organic. The estimation method used was the Ordinary Least Square method (OLS) (Pulido and López, 1999). The statistical base employed for constructing the model comprised the time series which was recorded monthly during regular visits to the farms. The time period comprised the entire transformation process, which was divided into two segments. The first corresponded to either the traditional production system or to the process of adaptation to organic production (conversion of cropland or pasture), whilst the second corresponded to a purely organic system. The complexity of the analysis was due to the fact that, although production methods were similar, being determined by the breed or the environment, each farm responded differently as a result of different management strategies. Finally, the validity of the findings was demonstrated by the results obtained from comparisons with the model.

The choice of variables constituted a fundamental determining factor in achieving the proposed aim; these needed to represent as faithfully as possible not only the actual structure of the farm but also the internal management strategy which defined and characterised each farm as unique and difficult to compare. As we were dealing with a production function, it was evident that we would need to relate the product and those factors employed in its production. Identifying the production system clearly was not, in this case, an easy task as two production systems were combined in order to obtain two different products; milk and lamb. Most of the literature on microeconomic analysis simplifies these kinds of studies, establishing a basic model with only one variable factor and one type of product. However, in the case of multiple factors and products, the same issue arises repeatedly; when a business produces various products, a substitution effect is encountered whereby the business diverts some of its input to the production of those goods or services commanding higher prices to the detriment of those which return less income than before for the same amount of input (Gimeno and Guirola, 1997).

In the case of dairy sheep, an additional complication exists in that the farmer cannot opt for the production of one particular product to the detriment of another if the former provides better profits. These kinds of products are known as joint products and the increase or decrease in the production of one of them results in a proportional increase or decrease in the production of the other. The producer, therefore, has no choice (Madala and Miller, 1991). This mode of production is the source of the difficulties encountered in analysis. To solve the problem, we approached the production function as an income function, incorporating the combined economic quantification of the two products obtained. The findings enabled us to establish how the business's outgoings structure determined and quantified evolution of income, as it represented a faithful image allowing us to define the farm's configuration and management. A business's outgoings structure is the consequence of past investment and livestock management decisions. Fixed costs include, among others, the sum of the business's annual capital formation adjustments, whilst operational costs determine, by their very nature, the evolution of the product.

- **Income (I).** This variable was obtained from combining the following data: the sale of lambs and sheep (joint products), subsidies and other income.
- **Operational costs (OC).** This variable was obtained from combining the following data: costs in consumption of bought feed, estimated costs for food produced and used on the farms, health costs, and other operational costs.
- **Fixed costs (FC).** This variable represents the sum of labour costs, livestock depreciation, loan repayments on buildings and machinery, and other outgoings.

All of the series used in this study were transformed into algorithms in order to obtain coefficients which would provide percentage variations in the predetermined variables. Moreover, the coefficients estimated thus approximate the concept of elasticity. This concept allows quantifying the percentage of impact of the endogenous variable (I) due to percentage of changes in exogenous variables (OC, FC).

III – Results and discussion

1. Conventional system model (Farms 1 and 2) (TSM 1-2)

The farming model specification which enabled us to explain income behaviour at the two livestock farms is given in the following equation:

$I_t = \beta_0 + \beta_{1t}\, OC + \beta_{2t}\, FC + u_t$

Estimation results are shown in Table 1 and Fig. 1.

Table 1. Results of TSM 1-2 estimation

Variable	Estimated value	t-*ratio*
C	1.5010	1.018
OC	2.0205	4.3360
FC	-1.1492	-1.8357
	Comparison of goodness of fit	
	R^2	0.80
	DW	1.91

The income function is expressed as follows:

$I_t = 1.5 + 2.02\, OC - 1.14\, FC$

The estimated parameters reflect an approximation to the concept of elasticity, which is the ratio of percent change in one variable to the percent change in another variable. For example, an increase by one unit percent in fixed costs translates into a reduction by 1.1492 unit percent in income. The goodness of fit is considered acceptable because it exceeds the critical point commonly accepted in the specialised literature, which is R^2=0.7 (R^2=0.80) (Fernández, 2005).

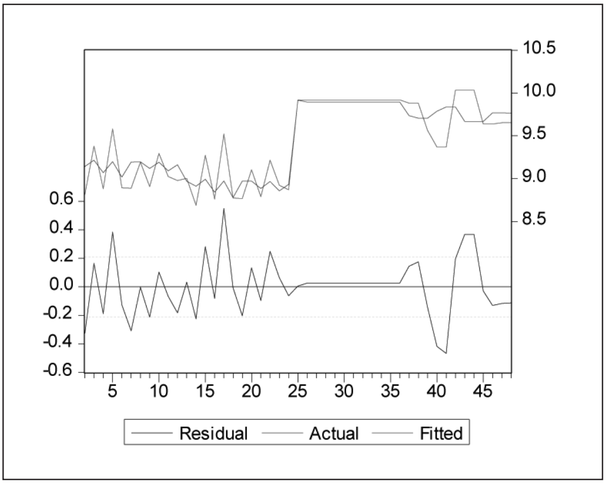

Fig. 1. Results of TSM 1-2 estimation.

2. Organic system model (Farms 1 and 2) (OSM 1-2)

The farming model specification which enabled us to explain income behaviour at the two livestock farms studied for this production system is the same as in the previous case:

$I_t = \beta_0 + \beta_{1t}$ OC + β_{2t} FC+ u_t

Estimation results are shown in Table 2 and Fig. 2:

Table 2. Results of OSM 1-2 estimation

Variable	Estimated value	t-*ratio*
C	-1.7136	0.0334
OC	0.3058	0.2325
FC	0.9655	0
Comparison of goodness of fit		
	R^2 0.80	
	DW 2.05	

The income function is now expressed by the following formula:

I_t = -1.7+ 0.3 GV +0.9 GF

As with the results shown in Table 1, the results given in Table 2 also approximate the concept of elasticity.

The results obtained for these two estimations were validated using the ADF Test (Augmented Dickey-Fuller Test), which compares the existence of unit roots. In both cases it can be seen that the ADF statistic presented a value lower than Mackinnon critical values for all levels of signification. We can therefore accept the null hypothesis for the existence of a unit root in each of the series involved in the models. In the analysis of coefficient stability, anomalous points were not observed outside the levels of confidence corresponding to more/less twice standard deviation, and a graphic representation of the self-correlation and partial self-correlation coefficients shows some coefficients which oscillate around the mean (zero value). Thus, we can establish that the results obtained are valid (Pulido and López, 1999).

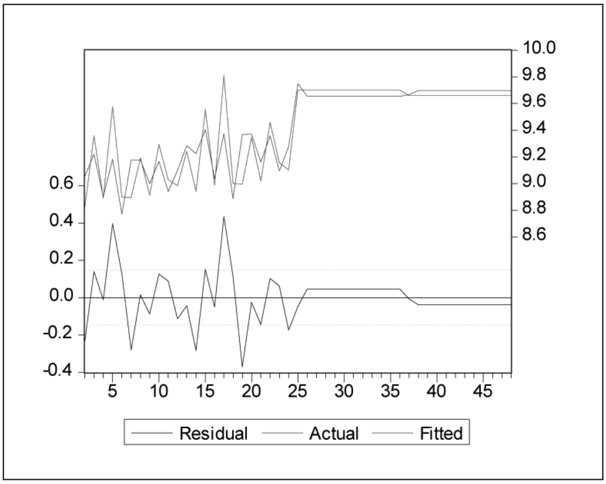

Fig. 2. Results of OSM 1-2 estimation.

IV – Conclusions

The conclusions reached from the estimated functions are revealing. In the case of the traditional system, the first result we can observe concerns the signs preceding the costs variables (Table 1, Fig. 1); whilst operational costs have a positive influence on income evolution, fixed costs have a negative influence, leading to the conclusion that in this type of production, the importance of feed and health is a determinant in the production of milk and lamb, whereas the structure of capital does not generate a positive production dynamic. The explanation for this quantitative phenomenon is easy to comprehend. If the operational costs variable includes those concepts most closely related to the handling and management of livestock, it is logical that an increase in such outgoings, providing this corresponds to the specific needs of the flock, will result in a greater increase in income.

The next result we can report is that the positive impact of the operational costs variable on the income variable is much greater, almost double, than the negative impact corresponding to the fixed costs variable (Table 1, Fig. 1), which identifies a clear production strategy as an operational model for farms maintaining a conventional system. The importance of the concepts of feed and health should have priority over any other decision regarding outgoings.

In our final point concerning this group of results, we would not like to neglect the opportunity provided by the coefficients obtained to comment on an idea which frequently arises in the analysis of economic management of farms, but which we can now support with the results obtained from an economic model. We refer to the problem of overcapitalisation of farms. A farming concern is generally subject to much more pressure from fixed capital than is really necessary. This constitutes a hindrance to development and growth, in that it generates different concepts of fixed costs, such as repayments, which in turn provokes a parallel, and sometimes irreversible, reduction in the farm's rate of income. A systematic and rational reduction of this fixed asset would permit a systematic reduction in fixed costs, together with a reduction in a significant proportion of current expenses, which have no other end than to maintain unused capital operational.

In this type of livestock management, the operational costs determine the income function, and repayments reduce profits. The operational strategy is generally dictated by size, so that costs are reduced by unit of production and by a more stringent control of operational costs, which becomes a key factor in profitability. Another determining factor is, as we have seen, planning and suitable size of investment.

In the case of the organic method, the signs obtained in the equation enabled us to arrive once again at revealing conclusions (Table 2, Fig. 2). If, in the case of the traditional system, there was a correlation between income and outgoings, direct in the case of the operational variables and indirect in the case of the fixed variables, in the case of the organic system, the correlation is direct in both cases. We can conclude form this that a change in production management will determine a change in the weight of factors involved in the production process. If in conventional systems, the weight of overcapitalisation determines and hinders income growth, the necessary transformation of farming structure required by the transition to organic production would seem to endow economic rationality to the farm's fixed capital, making it a determinant in the productive system. Bought feed and health no longer have the quantitative importance found in the previous analysis, and lose much explanatory relevance.

Free-range, organic farms are strongly influenced by their territorial structure, which is reflected in the concept of fixed costs. It is therefore logical that the negative sign converts to a positive one, and that its importance as a determinant of income increases, multiplying by three the influence of operational costs. The new system of flock management is based on self-management of resources, and therefore, the "external sector" and "external farming" components, comprising the purchase of feed and health costs, are reduced significantly, giving rise to a parallel reduction in the impact of income coefficients.

These types of farm depend on controlling operational outgoings and repayments, and their results are more conditioned by the effectiveness of this control than by higher income, as the higher milk prices will be offset by lower production.

In conclusion, estimation of the income functions has enabled us to identify variations in the profit structures of the two systems analysed: certified organic production and conventional production. The proposed method has provided a better understanding of the management changes which occur in dairy sheep farms, and we have been able to identify those elements which exercise most influence on each of the two production processes in order to establish the most appropriate decision-making mechanisms in each case.

References

Fernández A. 2005. *Econometría.* Madrid. Prentice Hall.

Gimeno J. and Guirola J. 1997. *Introducción a la economía*. Madrid. Mc. Graw-Hill. p. 96.

Madala G. and Miller E. 1991. *Microeconomía.* México. Mc. Graw-Hill. p. *222.*

Pulido A. and López A. 1999. *Predicción y simulación aplicada a la economía y gestión de empresa*. Madrid. Pirámide.