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Analysis of the contribution of sales of Ternasco de Aragón PGI to the economic results of farms

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SUMMARY – This work analyses the possible influence that the sale of a product with a differentiated quality, the "Ternasco de Aragón" PGI, has on the economic results of a sample of sheep farms forming part of an Aragonese cooperative. Different models of multiple regression are drawn up in which, in addition to the percentage of sales of this product variable, other variables of different types (socio-cultural, structural, commercial, income and costs) that are also considered to be of relevance in explaining farm results, are taken into account. The percentage of Ternasco de Aragón sales is a variable that is explicative of results when the income from subsidies variable is not introduced in the model, otherwise this latter variable has a greater explanatory power, increasing the coefficients of determination of the models.

Keywords: PGI, Ternasco de Aragón, sheep farm, multiple regression.

RESUME – *"Analyse de la contribution des ventes de l'IGP 'Ternasco de Aragon' aux résultats d'exploitations des fermes". Ce travail analyse la possible influence que la vente du produit de qualité différenciée, l'IGP "Ternasco de Aragón" a sur les résultats économiques d'un échantillon d'exploitations ovines qui appartiennent à une coopérative aragonaise. On a formulé différents modèles de régression multiple dans lesquels outre la variable pourcentage de ventes de ce produit on a tenu compte d'autres variables de différents types, importants pour expliquer les résultats des exploitations: aspects socio-culturels, structurels, commerciaux, recettes et dépenses. Le pourcentage des ventes de "Ternasco de Aragon" est une variable explicative des résultats quand on n'introduit pas dans le modèle la variable revenu provenant de subventions, dans ce cas cette variable a plus de pouvoir explicatif et augmente les coefficients de détermination des modèles.*

Mots-clés : *IGP, Ternasco de Aragón, exploitation ovine, régression multiple.*

Introduction

Quality policies form one of the basic pillars of the Common Agricultural Policy (CAP). These policies have essentially been promoted due to the beneficial effects that they afford two links in the agro-food chain: producers and consumers. Indeed, products that are covered by Regulations 2081/92 and 2082/92 as well as others that could be termed products with "specific quality characteristics", would enable their producers to obtain a specificity income given the higher prices that consumers would be willing to pay for their differentiating characteristics. This, in turn, would help maintain the social fabric of the rural environment whilst our diet would benefit from products based on techniques of natural preparation that respect the cultural and food traditions of the different EU countries.

After a couple of decades, the volumes of differentiated quality products produced and marketed have increased but, as yet, an analysis has not been carried out on the repercussions that this production has on the economic results of farms. In the Autonomous Community of Aragón, "Ternasco de Aragón" (TA) (Lamb of Aragón) was the first fresh meat in Spain to obtain a Specific Designation (SD) achieving the status of Protected Geographical Indication (PGI) in the European Union some time later, in 1996.

The aim of this study is to analyse how the production and sale of lambs that come within this PGI contribute to the economic results of farms. Up until now research has focused on analysing the repercussions on sheep farms, of sales during the second half of the year when prices are higher, observing a clearly positive effect on the results of farms (Pardos *et al*., 2004).

Methodology

The farms analysed (119 in total), form part of the technical-economic management programme for meat-producing sheep farms, which has been running since 1993, in collaboration with Carnes Oviaragón farm co-operative and the University of Zaragoza's Escuela Politécnica Superior de Huesca. The farms are located throughout the region of Aragón and the data analysed refer to 2004. The statistical methodology employed has been that of Multiple Regression Analysis. This is a general statistical technique to analyse dependency relationships between a single criterion variable and a set of independent variables (predictors). Its basic formulation is as follows:

$Y_1 = a + b_1 X_1 + b_2 X_2 + ... + b_n X_n$

where values a, b_1, b_2,.....b_n are constant values.

The objective is to use the independent variables with known values to predict a single criterion variable selected. The set of weighted independent variables is also known as the theoretical value of the regression, a linear combination of the independent variables that best predicts the criterion variable (Hair *et al.,* 2000). The sequential search method used has been that of stagewise (stepwise) estimation.

In the study carried out, variables relating to the economic results of farms have been selected as criterion variables and a set of variables which, according to initial hypotheses, are capable of explaining said results have been selected as predictors.

When selecting predictor variables it has been taken into account that it is advisable to choose a sufficient number of variables to avoid specification errors in the model (the most frequent of these being the omission of relevant variables) and, at the same time, that number should be such that, when related to the sample size, the required statistical power is ensured. Given that that the sample size is 119 and there are 8 predictor variables, the ratio is approximately 15 observations per independent variable, which would ensure that the results are generalisable if the sample size is representative.

Results and discussion

Selection of the predictor variables

Along with the % of sales of Ternasco de Aragón variable, a series of variables which, together, would explain economic results obtained have also been chosen. These variables are of different types:

(i) Socio-cultural variables referring to the farmer: age and level of qualification (X_1 and X_2 respectively)
(ii) Structural: flock size (X_3);
(iii) Technical ratios: number of lambs sold per sheep (X_4);
(iv) Sales analysis: mean price of lamb (X_5), % sales in the second semester (X_6) and we also include in this section the % of sales of Ternasco de Aragón (X_7);
(v) Income: income from the sale of lambs per sheep (X_8); and
(vi) Costs: total costs per sheep (X_9).

The variables relating to age and level of qualification of the farmer have been chosen given that a predisposition to participate in a mechanism that differentiates their production, as is the case of the Ternasco de Aragón PGI, could be influenced by this type of characteristics. Similar hypotheses have been considered by some authors (Atance *et al*., 2003) when studying the differentiation of production in the beef sector. The mean age of the farmers in the sample studied is 45.5 years old and the level of qualification has been rated on a scale of 1 to 10, obtaining a mean value of 6.5. Both variables show little dispersion.

As a structural variable we have chosen the number of sheep in the flock which, as is known, is of

great importance as it is one of the chief differentiating factors of sheep farms (Chertouh *et al.,* 2003). The mean size of the farms that take part in the Programme is 712 breeding ewes, which is greater than the mean size in the region (363 ewes per farm) (Sierra, 2003).

The "number of lambs sold per sheep" variable was chosen as the technical ratio since it largely covers other types of ratios relating to fertility, prolificacy, mortality, etc. The mean is 1.23 which is a figure that coincides with that of 2003 and is also the highest of the last 11 years for which data are available in the Programme. Nevertheless, this variable was finally disregarded as it showed a strong correlation with income from sale of lambs, which was not desirable for the proposed regression model.

Given that commercial aspects are currently of fundamental importance in the study of sheep farming, three basic variables have been considered in the analysis of sales: the mean price of lambs, percentage of sales in the second semester and the % of sales of Ternasco de Aragón variable, the latter being that for which we are interested in measuring its contribution to explaining results. The first two variables are related to each other, given the higher prices of lamb in the second semester of the year; however their coefficient of correlation has not been considered high enough to reject one of them. The mean price of lamb throughout 2004 was 61.60 euros and the mean sales percentage in the second semester was 50.4%.

From an exploratory study of the % of sales of Ternasco de Aragón variable, it has been observed that 23.5% of the farms do not market the "Ternasco de Aragón" PGI, although in spite of this fact the marketed mean is 61.2%. If we examine the percentile values we observe that, although 25% of the farms do not sell lamb under the PGI or sell less than 27%, another 25% sell between 27% and 77% and the remaining 50% of the farms sell over 77%. 25% of the farms sell more than 90% of their production under the GPI.

Lastly and given the very definition of the result (gross margin) that we wish to explain, two fundamental variables for its calculation have been taken into account, income from the sale of lambs and total costs per sheep. The income obtained from the sale of lambs is 75.60 euros compared to an income per animal of 115.90 euros. With regards to costs, the total cost per sheep is 89.90 euros, the main component being feed costs: 48.30 euros per sheep.

Contribution to explaining the economic results

The economic results measured on the farms participating in the study are their gross margins either in relation to, in this case the gross margin per sheep, or to the farm. Moreover in each case they are expressed in four different ways depending on whether or not subventions and/or family labour are included or not

Assumptions of linearity, constant variance and normality have been evaluated for the individual variables and for the theoretical value, through residual plots and partial regression plots, the Levene test for homogeneity of variance and residual normal probability plots.

Along with the regression equation, the coefficient of determination and the standard errors in the estimates of regression coefficients are indicated. As is known, the first of these measures the percentage of total variance of the dependent variable explained by the regression model, whilst smaller standard errors indicate more certain predictions.

Although they have not been able to be included, significance tests have been carried out for each estimate of the model, both the Student's t-test to measure the level of significance of the independent variables introduced and the F values which indicate that the explanation of the variance of the dependent variable obtained by the regression model is significant and to what degree.

Lastly, the degree of co-linearity of the variables has been measured by calculating the tolerance and its inverse, the VIF (variance inflation factor) values. The high tolerance values found point to reduced co-linearity in the variables.

Economic results/sheep

The predictor variables that explain gross margin without subventions are basically income from lamb sales and total costs; however, the model differs depending on whether family labour is considered or not. When it is not contemplated in the gross margin, flock size is introduced as an explanatory variable although with a negative sign, decreasing the model's determination coefficient.

Gross margin without subventions and without family labour:

$$Y = 15.078 + 0.923\ X_8 - 0.784\ X_9 - 0.007\ X_3 \qquad R^2 = 0.794$$
(4.758) (0.048) (0.051) (0.002)

Gross margin without subventions and with family labour:

$$Y = -3.126 + 0.985\ X_8 - 0.927\ X_9 \qquad R^2 = 0.888$$
(3.490) (0.037) (0.039)

In the explanation of gross margin with subventions, the model takes into account the % of sales of Ternasco de Aragón variable and differs, in the rest of the variables, depending on whether or not family labour is considered in the calculation of results.

If family labour is not contemplated, the variables considered are similar to the previous ones: income from sale of lambs, total costs, flock size and, in addition, % of sales of Ternasco de Aragón. If we take into account the remuneration of family labour, the variables are: income from the sale of lambs, total costs, mean price of lamb, % of sales of Ternasco de Aragón and farmer's age.

Gross margin with subventions and without family labour:

$$Y = 45.978 + 0.882\ X_8 - 0.729\ X_9 - 0.009\ X_3 + 0.086\ X_7 \qquad R^2 = 0.652$$
(6.837) (0.066) (0.069) (0.003) (0.034)

Gross margin with subventions and with family labour:

$$Y = -7.189 + 0{,}943\ X_8 - 0.846\ X_9 + 0.722\ X_5 + 0.070\ X_7 - 0.255\ X_1 \qquad R^2 = 0.785$$
(18.709) (0.056) (0.056) (0.289) (0.029) (0.115)

In view of the results, it was considered opportune to introduce the income from subventions variable (X_{10}) if this is considered to be an integral part of the results. The models are modified as the income from subventions now explains the results, displacing the % of sales of Ternasco de Aragón variable.

Gross margin with subventions and without family labour including, as an explanatory variable, income from subventions:

$$Y = 13.008 + 0.927\ X_8 - 0.788\ X_9 + 1.057\ X_{10} - 0.007\ X_3 \qquad R^2 = 0.813$$
(6.054) (0.049) (0.051) (0.103) (0.002)

Gross margin with subventions and with family labour including, as an explanatory variable, income from subventions:

$$Y = -2.718 + 0.984\ X_8 - 0.926\ X_9 + 0.988\ X_{10} \qquad R^2 = 0.893$$
(4.511) (0.038) (0.039) (0.080)

Economic results by farm

If the subventions are not taken into account in the economic results of the farms, the explanatory variables of the model are similar to the results per sheep: income from lambs and total costs, the difference lies in the flock size variable which, in this case, is explanatory when family labour is considered with a negative sign, slightly increasing R^2.

Gross margin without subventions and without family labour:

$$Y = 3126.028 + 599.186\ X_8 - 468.399\ X_9 \qquad R^2 = 0.620$$
(4411.896) (47.278) (49.164)

Gross margin without subventions and with family labour:

$$Y = -3018.511 + 574.251\ X_8 - 496.469\ X_9 - 3.285\ X_3 \qquad R^2 = 0.681$$
(4009.351) (40.779) (42.629) (1.608)

If subventions are taken into account, the variables that best explain economic results are, firstly, flock size, secondly income, followed by costs and lastly % of sales of Ternasco de Aragón.

Gross margin with subventions and without family labour:

$$Y = -4161.375 + 34.903\ X_3 + 606.388\ X_8 - 447.660\ X_9 + 98.600\ X_7 \qquad R^2 = 0.777$$
(6446.507) (2.467) (62.630) (65.365) (32.154)

Gross margin with subventions and with family labour:

$$Y = -8259.469 + 30.657\ X_3 + 582.599\ X_8 - 478.645\ X_9 + 80.072\ X_7 \qquad R^2 = 0.793$$
(5634.876) (2.156) (54.745) (57.135) (28.106)

However, if subventions are entered as an explanatory variable of the results, a slightly different model is obtained, as occurred in the results per sheep. Income from subventions becomes an explanatory variable with a greater predictive value than the % of sales of Ternasco de Aragón.

Gross margin with subventions and without family labour, including income from subventions as an explicatory variable:

$$Y = -27{,}950.55 + 36.253\ X_3 + 635.783\ X_8 - 490.364\ X_9 + 824.294\ X_{10} \qquad R^2 = 0.837$$
(6650.699) (2.106) (53.689) (56.249) (113.014)

Gross margin with subventions and with family labour, including income from subventions as an explicatory variable.

$$Y = -30{,}526.09 + 31.839\ X_3 + 610.924\ X_8 - 518.702\ X_9 + 750.829\ X_{10} \qquad R^2 = 0.858$$
(5641.937) (1.787) (45.546) (47.717) (95.872)

Although the models have not been validated with another sample, the value of adjusted R^2 has been compared to R^2 and it has been seen that there is very little difference, indicating that the estimated models have an adequate observations/variables ratio in the theoretical value.

Conclusions

The results obtained show the fundamental importance that the income from sale of lambs/sheep and total costs/sheep variables have in explaining the gross margin of sheep farms. Only the size of the flock, measured by the number of sheep, has a greater explanatory power in the farm's economic results, provided that the amount of the subventions received is taken into account in those results. In the rest of the models the size of the flock has little predictive power of the results and a negative sign; we have not, however, examined these results as they are not the main objective of the study. The percentage of sales of Ternasco de Aragón is an explanatory variable of results both referring to individual sheep and the farm when the income from subventions/sheep variable is not entered in the model, since in the latter case this variable has a greater explanatory power, increasing the models' coefficients of determination. It is noteworthy that the socio-cultural variables, age and level of qualification of the farmer, have practically no importance in the results.

The analyses carried out are considered to be an initial approach to the study of the importance

that quality products have on the economic results of farms, continued research into this subject being necessary in the future.

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