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EVOLUTION OF THE TECHNICAL EFFICIENCY OF SPANISH LIVESTOCK FARMING UNDER THE COMMON AGRICULTURAL POLICY (CAP) (1993 TO 2005)

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Resumen

Este artículo tiene como objetivo medir la eficiencia técnica de las Orientaciones Técnico Económicas ganaderas a partir de la información de la Red Contable Agraria Nacional para el período 1993-2005 y realizar un análisis comparativo entre las ramas ganaderas en función de sus niveles de eficiencia. El marco metodológico para medir la eficiencia será la función frontera estocástica propuesta por Battese y Coelli (1992), y la forma funcional elegida para su estimación es una Cobb-Douglas, la base de datos está constituida por un panel de 6 variables, 13 años y 11 orientaciones ganaderas. Los resultados de las estimaciones, indican que a lo largo del periodo los niveles de Eficiencia han disminuido y, del conjunto de orientaciones, son las ramas Bovinas las que presentan menores índices y tasas de variación mientras que las granívoras son las que obtienen los mejores resultados debido a su proceso de integración productiva.

Palabras clave: Eficiencia técnica; Frontera estocástica de producción; Ganadería.

Abstract

The aim of this paper was to measure the technical efficiency of various sub-sectors of livestock farming in Spain on the basis of information released by the Spanish National Agricultural Accounting Network for the period 1993 to 2005, in order to perform a comparative analysis of these various sub-sectors and to attempt to determine the factors which affected their efficiency. The methodological framework for measuring the efficiency was the stochastic frontier function suggested by Battese and Coelli (1992) and the form

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chosen for it estimation was a Cobb-Douglas production function. The data base was composed with six variables, thirteen different accounting years and eleven types of livestock farming. The results of estimation indicate that, over the period considered, the efficiency levels decreased. The bovine sub-sector had the worst levels and growth rates, whilst the grain-fed sub-sector had the best results, probably because it is the most integrated.

Keywords: Livestock; Stochastic production frontier; Technical efficiency.

1. Introduction

The White Book on Agriculture and Rural Development issued by MAPA (MAPA, 2003), the Spanish Ministry of Agriculture, Fisheries and Food in 2003, makes an analysis of the evolution of the Spanish agriculture, among their findings highlighted that the agricultural activity is fully subject to the rules of economics, it is becoming more technical, and increasingly subject to market forces. Hence, the agricultural sector is, or tends to be, just one more sector of the economy like all the others, even if it has characteristics of its own that make its functioning different from the dynamics of the secondary and tertiary sectors. The steadily declining level of protection for producers in the Spanish primary sector, together with growing exposure to the circumstances of a changing and unstable economic environment, implies that an efficient use of the resources available is a crucial aspect of the production policy of any farm. Agricultural owners must use market criteria when managing their farms, since current regulations mean that the route to ensuring survival in competitive surroundings lies in improvements in production and financial efficiency.

Of all the features unique to this sector, the present paper was intended to investigate one in particular, which is the fact that improvements in the financial results and in incomes in this sector cannot always be achieved through increases in productivity based on the use of more productive factors (MAPA, 2003). Taking this idea as a starting point, this paper had as its objective an analysis of the technical efficiency of Spanish livestock farming. For this purpose, a production function of a stochastic nature was to be estimated on the basis of the data available from RECAN, the Spanish National Agricultural Accounting Network.

During the early years of the twenty-first century, the CAP was confronted with a changing internal and external context that made its reform advisable. On the one hand, huge amounts of aid were being given to large agricultural producers, without any subtlety of assignment. On the other hand, there was a fear that the potential for production in the countries that were about to join the European Union would grow in the longer term, which would place current agricultural regulations in a position of some difficulty. Furthermore, it was necessary to consolidate a climate of financial equilibrium in the expanded Union, at least until hasta 2013. Finally, there was a requirement for the CAP for a twenty-seven-member Union to be compatible with the commitments to liberalization of trade that were being negotiated in the context of the Doha Round of the World Trade Organization (Cejudo & Maroto, 2010).

Within these contexts for actions, the agreement reached by the Council of Agriculture Ministers in June 2003 brought in a new model for support to the European agriculture sector organized along two main axes: uncoupling aid from production, based on historical details; and obligatory adjustments through the parallel introduction of a mechanism for financial discipline (Massot, 2003). Today's CAP is developing as a function of demand, the preoccupations of consumers and tax-payers takes fully into account, while simultaneously leaving farmers within the Union free to produce what the market requires (Leguen, 2005). This will in the end allow the survival only of farms that are efficient, which justifies the policy and encourages the carrying out of studies like the work presented here.

The sequential application of the various modifications and priorities in the Common Agricultural Policy in Spain has triggered a change of direction and alterations of considerable extent in production, based on the following features[2]:

- growing mechanization,
- a decrease in agricultural work,
- a reduction in the total number of farms, changes in their production characteristics and an increase in their average size,
- the incorporation of ever-growing numbers of livestock.

All these aspects have caused a profound change in the provision of factors within the Spanish agricultural sector. In a good few cases, farms have ceased to be simply a means of subsistence, becoming production units of a size sufficient to be economically viable. It is clear that the bigger the average size of the farm, the more intense this process is, since the sector shows a positive correlation between a growth in the apparent productivity of the labour factor and the average size of farms.

The aim of the work being reported here was to analyse whether the changes described have led to greater production efficiency on livestock farms or whether, on the contrary, it has not permitted better use to be made of the factors incorporated into the production process.

An analysis of technical efficiency in the Spanish agricultural sector has been the core concern of a number of pieces of work, most of them considering the whole sector or concentrating on one specific branch. For example, Iráizoz & Rapún (1996) applied this methodology to measuring the technical efficiency of the Spanish agri-food industry, with particular emphasis on livestock, Iráizoz & Atance (2004) undertook a study of technical efficiency on livestock farms producing beef and veal in Spain. There is a greater range of work in the area of arable farming, among which the studies by Colom (1994) on the production of maize, and by Calatrava & Cañero (1999, 2001a, 2001b) on the olive-growing, wine-growing and winter crop sub-sectors respectively, should be mentioned. Finally, the thesis by Pardo (2001) on the topic of measuring efficiency in the

[2] The results listed were obtained through consideration of the data from Agricultural Censuses in 1989 and 1999, and the Survey of the Structure of Farms of 2007, Spanish National Statistical Institute (INE).

production of milk in the Province of Cordova is worthy of note because of its compendious nature.

2. Materials and methods

In carrying out studies of this type, one of the first problems arising is the choice of a group of farms sufficiently representative to ensure adequate validity of the results obtained. Of the possible alternatives, the present work opted for the use of data incorporated in annual publications of RECAN. This network obtains its information from a yearly sampling. Each of the elements in the sample is processed in accordance with the typology covered by Decision 853/77/EEC, which stipulates that the establishment of valid sets of farms requires a uniform classification to be followed. This is based on their technical and economical orientation and their financial dimension, and is designed in such a way as to allow the delimiting of more or less detailed sets of homogenous farms. Finally, the data is organized in several Technical and Financial Orientations (TFO). These orientations are determined by the main activity undertaken by the farm. All farms are classified as belonging to the group of activities from which it derives at least 2/3 of its total Gross Standard Margin (GSM)[3].The quality of data from RECAN has steadily improved in recent years as an outcome of the introduction of more and better quality controls for primary data, and the implementation of technological improvements in computer processing of data (San Juan, 1994).

The studied period is from 1993 to 2005, this year is the latest one published on the MARM website. The choice of this period was motivated by the view that it was appropriate to start the study with a consideration of the consequences for Spanish farms of the MacSharry Reform of the CAP, linking this event with an analysis of a cycle of expansion in the Spanish economy. These were thirteen decisive years for the Spanish agricultural sector, during which it consolidated its role within the European context, and years that shaped specific structures for production provided with a combination of factors that will determine its future viability. Finally, with the previous results, we build a farm type for each orientation with the average value of production variables.

Of all the TFOs represent in RECAN, this study concentrated on those relating to livestock, because this area of activity is probably the most heterogeneous, from the point of view of production, and hence of greatest interest when it comes to drawing any possible conclusions.

The classification of TFOs is by means of four-digit sub-divisions of the various main activities that may be undertaken by farms. Over time, the orientations have been modified by the inclusion or elimination of given sub-groups. The final result is shown in Table 1.

3 GSM: the margin between the standard value of production and the standard total for certain specific costs. This margin is to be determined for the various types of arable and pastoral farms in each region, in accordance with Article 4 of the Commission's Decision 85/377/EEC. (San Juan, 2004).

Table 1. Selected Livestock TFO

	Code
Dairy cattle (4100)	O1
Breeding cattle (4210)	O2
Fattening cattle (4220)	O3
Cattle for dairy, breeding and fattening purposes (4300)	O4
Sheep (4410)	O5
Mixed pastoral (4450)	O6
Pig farming (5010)	O7
Poultry for meat (5022)	O8
Mixed grain-fed (5030)	O9
Mixed primarily livestock (7000)	O10
Mixed arable and livestock (8000)	O11

The variables selected for the quantitative analysis and their units were the following:

Gross Output (GO): Total of gross output of crops, animals and other products (€).
Agricultural Work Units (AWU): Total labour force of the farm (units).
Useful Agricultural Area (UAA): Measured in hectares, this includes all arable land on the farm, whether irrigated or not, together with permanent pastures (has).
Livestock Units (LU): Total livestock on the farm expressed as large animal units (units).
Intermediate Costs (IC): Costs Specific to Crops + Costs Specific to Livestock + General Costs (€).
Capital (K): This is calculated as the sum of elements that constitutes the assets (€).

The deflators used were obtained from the Spanish National Statistical Institute (INE). The final panel was made up with six variables of eleven farms belonging to each productive orientation of livestock farming, and thirteen years (1993 to 2005).

The basic statistics for the variables are shown in Table 2

Table 2. Basic Statistics of the Variables (Base 2000)

	GO	AWU	UAA	LU	IC	K
Mean	55371.72	7.75	38.91	44.38	34851.58	150951.37
Median	43587.11	1.20	28.00	28.60	23695.27	117774.28
Standard deviation	40789.37	15.27	49.77	57.53	30509.26	77151.27
Minimum	14563.44	0.90	0.00	0.80	7423.07	60578.97
Maximum	205056.74	65.90	311.80	311.00	160858.25	440406.16

Source: Own calculations from RECAN data.

The average values of the variables by each orientation are shown in Table 3.

Table 3. Average Values for Variables by TFO (Base 2000)

	GO	AWU	UAA	LU	G I	K
O1	39254.85	4.18	15.02	18.87	21121.17	133526.68
O2	18988.94	12.85	28.60	19.39	10859.78	118946.91
O3	55652.95	6.52	32.04	34.67	43356.18	145256.34
O4	22834.24	4.29	15.38	17.03	13274.53	116989.06
O5	37505.55	7.92	34.86	29.00	17811.90	138542.32
O6	34114.66	12.46	61.31	29.02	16945.55	136861.25
O7	118522.67	5.00	76.97	114.58	76895.59	213628.33
O8	131419.21	2.07	35.05	131.32	94452.59	226634.21
O9	55147.48	3.00	36.36	26.24	33580.52	127494.27
O10	54408.46	13.48	47.64	44.25	32876.18	156183.36
O11	41239.87	13.44	44.83	23.80	22193.36	146402.32

Source: Own calculations from RECAN data.

From the viewpoint of a productive economy, the term efficiency is associated with a rational use of the available resources. This term is used to describe the production process that uses optimally all production factors, given a level of technology. Koopmans (1951) was the first person to offer a definition of technical efficiency, indicating that a firm that uses multiple inputs to produce multiple products is technically efficient if it is impossible to produce more of any product without producing less of another product or use more of the inputs. Farrell (1957)[4] became the pioneer in studying efficiency for each unit of production. According to this author, when an enterprise achieves maximum output, given a set of inputs, or when it uses a minimum of inputs to produce a given output, sit will be on the so-called production frontier. Álvarez (2001) established that in practice it seems to be accepted that inefficiency will exist. This is due to the fact that, although all enterprises share the objective of maximizing profit, not all of them achieve this, hence giving rise to situations of inefficiency.

In this context, the stochastic frontier model considers that deviations relative to the frontier are the result of technical inefficiency and statistical noise. This noise is a consequence of the omission of relevant variables and of measurement errors associated with the functional form of the model (Coelli, Prasada Rao, O'Donnell & Battese, 2005).

Production frontiers are classified as a function of the technique employed to determine them. Hence, the specialized literature puts forward two basic methodological lines for constructing them: the parametric and the non-parametric methods. The first imposes a functional form to represent technology, whilst in the second the frontier is calculated by assuming a series of basic suppositions for the technology and making use of mathematical programming techniques. A review of the differences between the two approaches can be found in the work by Fried, Lovell & Schmidt (2008).

[4] Based on work by Debreu (1951) and Koopmans (1951).

The present study opted for the parametric method, on the basis of the model proposed by Battese & Coelli (1992)[5].These authors established the following model for a panel with effects through orientation which are taken to be distributed as truncated normal variables and which can vary over time (Battese & Coelli (1995):

$$Y_{it} = f(x_{it};\beta)exp(V_{it} - U_{it}) \quad [1]$$

where: Y_{it} is the output of the i-th unit at time t, x_{it} is a vector (K*1) of inputs, β is the vector of unknown parameters to be estimated. V_{it} random variables iid$N(0,\sigma^2_v)$, independent of the U_{it} values, these being non-negative random variables that record the technical inefficiency of production in accordance with the expression:

$$U_{it} = (U_i \ exp(-\eta\ (t-T))) \quad [2]$$

Thus, inefficiency is defined as an exponential function of the effects of technical inefficiency in the latest period. The U_{it} values are not negative, η being a parameter to be estimated that allows determination of changes in inefficiency over time. In model [1], in order to determine if there are effects from inefficiency on the error term, it is necessary to estimate the variances of the error terms ($\sigma^2 = \sigma_u^2+\sigma_v^2$) and $\gamma = \sigma_u^2/(\sigma_v^2+ \sigma_u^2)$ (Coll & Blasco, 2009). If $\gamma = 0$, the stochastic frontier model will be equivalent to a basic regression model.

With this methodological structure in use, the functional form chosen for estimating the production frontier was a Cobb-Douglas function. This function has been the object of numerous applications relating to technical efficiency in agricultural production systems, for example, in livestock farming. Bravo & Rieger (1990) used four versions of this function to estimate the production of cow's milk in New England and New York. Murua & Albisu (1993) determined the output of pig-farming in Aragon in Spain by means of the Cobb-Douglas function in its logarithmic form, applying as exogenous variables the feed supplied, capital and technical management. Colom, Sabate & Saez (1996) performed an economic and financial study of the competitiveness and productive efficiency of a group of cereal-growing companies in the Spanish Province of Huesca, using the Cobb-Douglas function to calculate the value of product sold per season. Finally, Toro, García, Aguilar, Acero, Perea & Vera (2010) included it in their work relating to the econometric modelling of production functions as a good alternative form of function.

The final function adopts the following expression:

$$GO_{it} = \beta_0 + \beta_1 AWU_{it} + \beta_2 UAA_{it} + \beta_3 LU_{it} + \beta_4 IC_{it} + \beta_5 K_{it} + \beta_6 T + e_{it} \quad [3]$$

The sub-indices refer to orientation (i) and point in time (t), the variables are transformed into logarithms and a trend variable is introduced to determine the effect of

[5] The stochastic production frontier appeared for the first time in articles by Aigner, Lovell & Schmidt (1977) and by Meeusen & van den Broeck (1977). A good overview of the econometric approach to the measurement of efficiency is to be found in Chapter 2, by W. Greene, of the book by Fried *et al*. (2008).

technological change during the period under consideration (T_{it}). Finally, e_{it} corresponds to the composite error term.

Once the function and model of inefficiency had been estimated, the following tests were carried out:

- Verify if the frontier function was necessary, or, on the opposite, the production function could be consistently estimated by MCO alone with a symmetrical error term. If the null hypothesis were accepted (H_0: $\gamma = 0$), U_{it} values could be eliminated from the model, since it would present no inefficiencies.
- Test if the inefficiency term is or not invariable over time (H_0: $\eta = 0$) and the type of distribution presented by the inefficiency function (H_0: $\mu = 0$).

2.1. Frontier model

The production function (equation [3]) and the model of inefficiency varying over time (equation [2]) were estimated simultaneously, using the FRONTIER 4.1 software package (Table 4). The signs of the parameters were as expected. Among the set of variables IC stood out, being highly statistically significant. This weighting of IC confirms the tendency in the sector towards greater intensification of production and a larger and larger consumption of resources from outside the sector, this in turn leading to a greater integration of the sector and the rest of the economy. At the opposite extreme, the variable UAA was not statistically significant.

Table 4. Coefficients of the Stochastic Frontier Model

Coefficient	Parameters
β_0(Constant)	3.286*** (6.01)
β_1 (AWU)	0.066*** (2.91)
β_2 (UAA)	0.0109 (1.50)
β_3 (LU)	0.067*** (3.81)
β_4 (IC)	0.534*** (10.62)
β_5 (K)	0.143** (2.40)
β_6 (T)	0.045*** (6.01)
Log F. Probability 91.18	
In brackets, t-ratio ***parameter significant at 1% **parameter significant at 5%	

Source: Own calculations from RECAN data.

Finally, the variable "T" showed a positive and highly significant value. This indicates that in the period under study there were technical advances averaging 4.5% annually, reflecting the growing capitalization of farms.

Since a Cobb-Douglas function is in use, the coefficients associated with the variables are elastic and their sum shows the type of returns with which the sector was operating. In this case, the sum of the coefficients was 0.8209. This result indicates that the production function presents decreasing returns of scale: with an increase of 10% in all factors, production would grow by 8.2%. This reveals that the technology adopted by farms was not having the expected effects on productivity. A possible reason for this behaviour may be found in Coelli, Prasada Rao, O'Donnell & Battese (2005), who established that a farm larger than the efficient size would have decreasing returns with scale and could thus be more productive by reducing its scale of operations. In the Spanish case, the concept of size to which Coelli *et al*. (2005) referred may be interpreted as the excess of capital in place per farm, which in many cases is underused, holding back business results. This same argument serves as a basis for explaining the slightness of the incidence of the variable K on the gross product obtained (0.0143). This is caused by the fact that there is no clear matching of the investment objectives of owners, which at times correspond to personal motivations, and not to the real factor needs of the farm.

The testing of the parameter γ (H_0: $\gamma = 0$) in Table 5 permits detection of the presence of inefficiency in the model. Rejection of the null hypothesis suggests that it is preferable to estimate the production function with a composite error structure, from which it may be concluded that inefficiency forms part of the production function. Finally, in respect of the parameter η, the null hypothesis was rejected, which demonstrates that the inefficiencies varied over time.

Table 5. Tests

Null hypothesis	Log-Likelihood	λ	X^2(*) (critical)	Decision
H_0: $\gamma = 0$ (non-stochastic inefficiency)	55.46	71.44	7.04**	Rejection of H_0
H_0: $\eta = 0$ (Inefficiency unvarying over time)	77.11	28.6	3.84**	Rejection of H_0
H_0: $\mu = 0$ (Semi-normal inefficiency effect)	92.88	3.4	3.84**	No rejection of H_0
** Critical value obtained from Kodde and Pam (1986) Level of significance 5%. Degrees of freedom equal to the number of restrictions imposed by the null hypothesis				

Source: Own calculations from RECAN data.

The effects of inefficiency presented a semi-normal distribution, since the null hypothesis was not rejected (Table 5). Analysis of the levels of average efficiency in truncated normal and semi-normal distributions (Table 6) showed that the difference is minimal (1%), so that rejection of the hypothesis does not affect the validity of the estimation.

Table 6. Average Efficiency of the Frontier Function

	Truncated Normal	Semi-Normal
Average	74.81%	73.14%

Source: Own calculations from RECAN data.

The value of γ was statistically significant (Table 7), indicating what percentage of total variability is associated with production inefficiency. In this case, 80% of unexplained variations in production could be explained by variations in inefficiency and the remainder was the percentage attributed to random components. The value of the parameter η shows changes over time in inefficiency: a negative value indicates that inefficiency grows as time passes.

Table 7. Inefficiency parameters

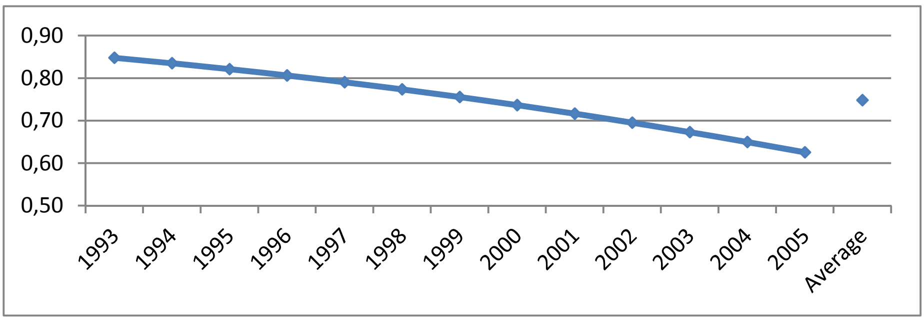
Inefficiency	Livestock Farming
η(Eta)	-0.092*** (5.72)
μ(MU)	0.438*** (3.320)
Parameters of Variance	
σ^2 (sigma-squared)	0.06***(8.675)
γ (Gamma)	0.804***(18.314)
In brackets, t-ratio ***parameter significant at 1%	

Source: Own calculations from RECAN data.

3. Results

The average value for technical efficiency for TFOs taken together was 0.75 (Table 6). Hence, with the combination of inputs they use they obtain only 75% of the output that they might achieve. Thus, they were 25% away from optimum output, with the logical repercussions this situation has on profits and viability.

Figure 1. Average annual efficiency (All TFOs)

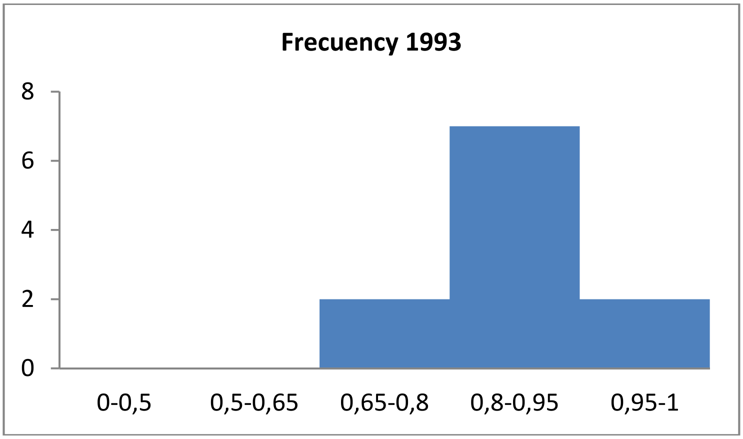


Source: Own calculations from RECAN data.

Figure 1 shows the changes in average efficiency over the period considered. It may be observed that the effects of technical inefficiency tend to grow with time, which highlights the need to analyse in detail the functioning of the various production orientations.

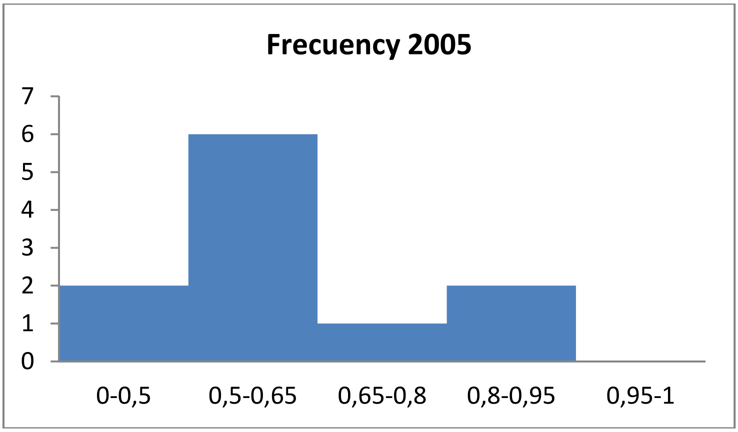
The technical efficiency for each TFO is shown in the frequency histograms for efficiency indices for the first and last years of the period under study (Figures 2 and 3).

Figure 2. Frequency Histogram, TFOs 1993



Source: own calculations from RECAN data.

Figure 3. Frequency Histogram, TFOs 2005

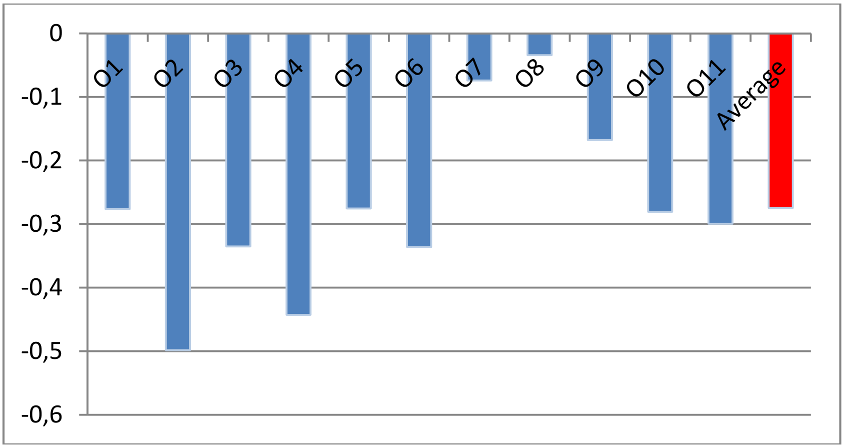


Source: Own calculations from RECAN data.

In 1993, the majority of livestock TFOs presented efficiency indices in the range 0.8 to 0.95. However, in the last year considered it may be seen that the main part of livestock farms had efficiency indices between 0.5 and 0.65. The maximum frequency group, between 0.95 and 1.0, has disappeared. Figure1 and the histograms highlight a clear retreat in levels of technical efficiency in livestock farming.

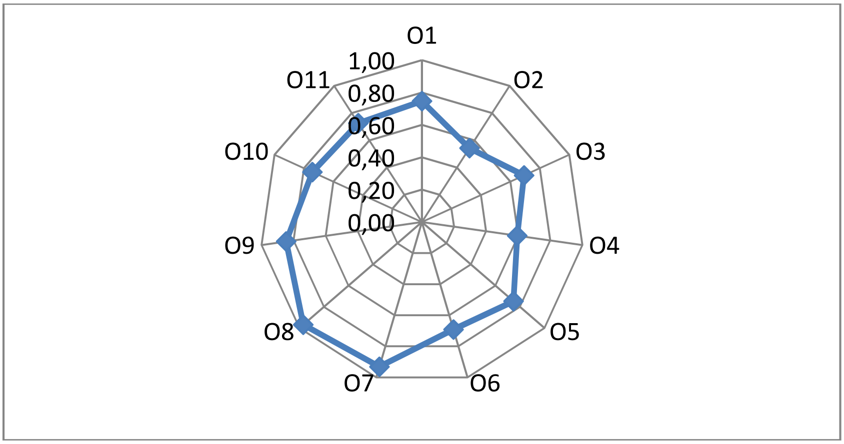
The TFOs with a significantly losses of efficiency (Figure 4) were cattle breeding and cattle fattening. At the opposite extreme, the orientations that saw the smallest drop in their efficiency indices were those involving grain-fed stock, which covers pig and poultry sub-sectors.

Figure 4. Rate of Variation by Production Orientation (1993 to 2005)



Source: Own calculations from RECAN data.

Figure 5. Average Efficiency by Production Orientation (1993 to 2005)



Source: Own calculations from RECAN data.

A comparison of the levels of average efficiency of the various orientations (Figure 5), confirms the previous results.

The poor levels of efficiency of the cattle sector in Spain may be attributed to the production structure of Spanish farms raising cattle for meat and to a Europe-wide aid policy under the CAP for the sector which is poorly suited to the realities of production in Spain.

In the raising of cattle in Europe two models of production exist side by side (Ramos, 2010). The first one is the extensive model, which uses pasture as the principal source of food. It is a pattern of farming that predominates in northern and central Europe. The second one is the mixed model, present in the Mediterranean area, and hence in Spain, in which two types of farm live together. One type is the extensive farms, located in mountainous and cultivated meadowland zones where there is some availability of pasture. The other types are the intensive farms. They are sited in areas where climatic conditions limit the existence of permanent grassland.

The aids from the CAP, during the studied period, this sector has a complex system of grants, poorly matched to the realities of Spain. The system caused considerable distortions in the market. The business strategies of the sector have been oriented at gaining subsidies and this fact has reduced technical efficiency. The economic crisis and the volatility of raw material prices over recent years have complicated even more the development and future of the sector.

At the opposite extreme, the orientations that have seen the smallest drops in their efficiency indices are those relating to grain-fed stock (O7 and O8). According to data from the Spanish Ministry of the Rural and Marine Environment (MARM, 2011), pig-farming represents 11.51% of Spain's total agricultural output and the production of poultry meat and eggs, taken together, 7.03% of the overall figure. In both instances, this means a weighting similar to values for the European Union as a whole.

One of the fundamental features of this sector, involving a large qualitative difference from cattle farms, is the low level of aid it receives and the constant liberalization of its international trade, especially relating to pigs, since the Uruguay Round. This fact and a highly integrated business structure, has led the competitiveness of this activity to be the greatest of all in Spanish livestock farming.

From the above, it may be concluded that the pig and poultry sub-sectors are the most modern and dynamic in Spanish livestock farming. This makes them fully comparable with the European Union in levels of technology, specialization of production and degree of industry integration.

4. Discussion

The agricultural activity is fully subject to the rules of economics, it is becoming more technical, and increasingly subject to market forces.

The CAP has brought about a number of profound changes in production on the Spanish agricultural scene such as the increased mechanization or lowering of the labour factor and the number of farms.

The term "efficiency" is used to describe the production process that uses optimally all production factors, given a level of technology but usually the farms cannot achieve this objective, hence giving rise to situations of inefficiency.

Efficiency can be consistently estimated with a stochastic frontier model applied to a production function Cobb-Douglas. The estimation reveals that the production function presents decreasing returns of scale (0.82). The inadequacy of capital of farms factor causes such inefficiencies in the sector. This same argument serves as a basis for explaining the slightness of the incidence of the variable K on the gross product obtained (0.0143).

The average value for technical efficiency for the sample was 0.75, so they were 25% away from optimum output. The TFOs with a significantly losses of efficiency between 1995 and 2005 were cattle breeding and cattle fattening. At the opposite extreme, the orientations that saw the smallest drop in their efficiency indices were the pig and poultry sub-sectors. They are the most intensive and integrated sectors and they have better future prospects. Concepts like production associations and lengthening the chain of value (whether backwards or forwards) permit more efficient uses of factors, guaranteeing survival

The only way forward must be through efficient use of production factors appropriate to the needs of each farm. In this way, solid bases can be laid for undertaking medium-term improvement plans guaranteeing the financial viability of rural surroundings.

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