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Effects on milk supply of different systems of livestock feeding

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Introduction

Determining the competitive position of dairy farms depends on several technological, economic and institutional variables. Among them, those related to animal feeding, the main item of dairy farm costs, are remarkable. The particularity of livestock feed is the possibility of either being purchased in the market or self-produced on the farm by taking advantage of the provision of a specific factor as land.

This study focus on the case of the European Union, where the process of trade liberalization and abolition of quotas will be accomplished in 2015. In this new institutional scenario, the competitive position of farms and its relation to livestock feed will be crucial to assess the effects on production, trade and welfare.

Objetive

In this context, the aim of our study is to analyze milk supply and the competitiveness of dairy farms. To that end, dairy farms are distinguished based on different models of animal feeding and land intensification, with greater reliance on market purchases or self-production of livestock feeding.
The opportunity of this study is emphasized by the current context of high variability in the prices of livestock feeding products

Methodology

This study is based on an econometric approach to a variable cost function of dairy farms. The econometric model is based on a system of input demand equations variables on the basis of a Multiproduct Symmetric Generalized McFadden cost function.

$$C(w,z,y)=\frac{1}{2}(\theta' w)^{-1}(\varphi' y)w'Aw+\alpha' w+(\varphi' y)\beta' w't+w'Fy+w'Cz$$
$$+(\theta' w)\left[y'Ey+z'Bz+y'Gz\right]$$

Where *w* are variable input prices, *z* are quasi fixed factors, *y* are outputs and *t* is a temporal trend.

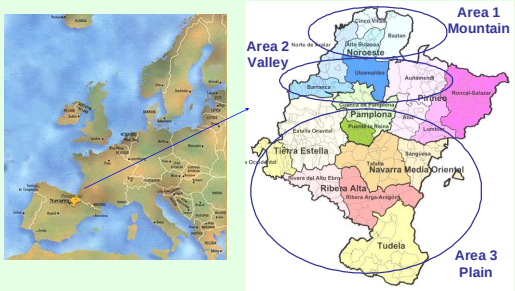
Variables

The empirical analysis uses an unbalanced data panel of 139 dairy farms, covering the period between 1994-2005. Farm data set is provided by 'Instituto Técnico y de Gestión Ganadero', and its scope is the specialized dairy farms in Navarre (a region in the north of Spain). Milk farm activity is represented by four variable inputs, two quasi-fixed factors and two products of milk activity.

INPUTS	
External animal feed	cow feed from the market (47% of variable cost)
Cow expenses	veterinarian expenses, other expenses for the animal handle and attributed cost to dairy cow stock.
Other variable expenses	general expenses not previously included and amortization of the machinery and installations.
Non-family labour	wage-earning labour force in the milk farm is also included as variable input
QUASI-FIXED FACTORS	
Land	presence of land is not an essential factor in the milk production (5% of the sample data are null, all in zone 3).
Family labour	
OUTPUTS	
Milk production	92% of total income
Associated products	complimentary meat production (births and the renewal of old animals)

Systems of feeding by area

In this region there are 3 different geographical areas in relation to the availability of grazing land. The first area is distinguished by small grasslands and difficulties to the use of machinery. The second area is characterized by large grasslands, is also adequate to the use machinery and is easier to handle. The third area takes advantage of nearby agricultural land. These different characteristics allow a good approximation to the different models of animal feed.



Estimation process

Previously to estimation:

- The absence of sample selection bias has been tested.
- A fixed effect model by conventional test has been selected.
- Linear homogeneity and concavity in prices to ensure the regularity of the underlying technology have been imposed.

The parameters of input demand system expressed in differences respect to the farm average are estimated by using the procedure SUR (TSP 4.5).

Corrected coefficients of determination are satisfactory, reaching 96% for external feed and cows, 92% for general inputs, and 39% for wage-earning labour force.

- Estimated parameters present a high significance level, with 80% significant at 95%.
- Presence of constant economies of scale is rejected by the corresponding Wald test.
- Non joint production is also rejected by test.
- Estimated cost function satisfies concavity conditions in quasi-fixed factors.

Results

The main results on the supply of milk is presented below.

Milk Price (€/t)	Marginal Cost	Average Cost	Quota Rent /Price	Marginal Cost's Curve elasticity
325	251	185	0.23	0.54
Marginal Costs are higher than Average Costs in all cases, and quota rent is positive for 95%. Farms are positioned on competitive supply.				

Quota rent dispersion between farms do not diminish during the studied period, despite having suffered the strong sector re-organisation. The institutional lack of flexibility in the transfer of quota might be a direct cause of this result.

The results indicate that the expansion of milk production is based on equivalent increases of external feeding (elasticity 0.95). This phenomenon occurs independently of land stock. This observation evidences the importance of market feed price in order to determine the profitability of increasing the production in dairy farms.

This indicates the combined usage of land, capital and external labour in the farm management of the land. Besides, the land shows a replacement relationship over the usage of the external feeding (0.176).

Morishima elasticities indicate a production replacement relationship between the external feeding and the expenses in milk cows (0.769 and 0.600). This implies that, for a dairy production level, dairy farms adapt the ratio between the number of cows and the external feedstuff. This ratio is strongly dependent on the input price evolution. Somehow, the cows' productivity is conditioned by the price of the feed, intensifying (reducing) the productive pressure of the cows together with reductions (increases) of the feed price.

	Milk Price (€/t)	Marginal Cost	Average Cost	Quota rent /price
MOUNTAIN	325	261	216	0,20
Mountain area experience problems in restructuring farms due to scarcity of land and upper costs for transport feed.				
VALLEY	330	225	151	0,32
Valley area shows the best results in marginal and average costs, corresponding to bigger herd and land availability.				
PLAIN	319	271	192	0,15
Plain area reduces average cost by means of increasing herd, but depends directly of external feed and has highest marginal cost				

Results showed the presence of growing economies of scale in average for the whole sample, but decreasing during the studied period from 1.43 in the first triennium to 1.16 in the last one. Grazing land resources enable greater exploitation of economies of scale present in the dairy sector.

Plant capacity utilization is near optimal level. However, evaluating the plant capacity utilization for non-homothetic technologies allows to differentiate the presence of family labour overcapacity and over-utilization of land.

Conclusions

The study showed a flexible milk farm supply with respect to the price of milk and dependent on the evolution of feed prices. This aspect has been emphasized by the restructuring of farms, characterized by strong size increases and productivity gains based on a greater reliance on purchases of animal feed. In high variability in feed prices conditions, these effects can decisively affect to the farm economic results.

The provision of grazing land plays an important role in determining the average variable costs and farm profitability. In addition, the grazing land resources enable greater exploitation of economies of scale that are present in the dairy sector.

To sum up, the degree of farms dependence on purchased or self-produced feed play an important role in milk supply and in competitive position of dairy farms.

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