Efficiency and Productivity in the Spanish Food Distribution Sector

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Paper prepared for presentation at the Xth EAAE Congress
'Exploring Diversity in the European Agri-Food System',
Zaragoza (Spain), 28-31 August 2002

Xth CONGRESS

EUROPEAN ASSOCIATION OF AGRICULTURAL ECONOMISTS

(E A A E)

Contributed Paper:

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Efficiency and productivity in the Spanish food distribution sector

Abstract

This study investigated the efficiency and productivity change of a sample of food distribution units (MERCAs) in Spain over the 1.997-1.999 period, applying non-parametric frontier methodology in a sales efficiency framework.

We specified a mean sales model composed of two blocks of variables, the production block, and the marketing management block. Then we applied output oriented DEA methodology to perform the efficiency analysis, also taking into account the overall efficiency decomposition into pure and scale efficiency. The Malmquist index was calculated in order to analyse the components of the productivity change.

The mean pure sales efficiency index was high, around 0.8, the mean scale index being 0,9. As appears from the results, six food distribution units were efficient, but some of the wholesale markets need to adapt their sales technology in order that their input bundle reaches a Most Productive Scale Size unit.

We found no evidence of technical change during the period considered, but concluded that a notable scale efficiency change took place during the studied period.

To summarise, we conclude that improvement in sales efficiency could be reached in the studied sector in both the pure and the scale efficiency.

Keywords: Efficiency, Productivity, DEA method, Malmquist index, Food Distribution Unit.

E**fficiency and productivity in the Spanish food distribution sector**

1.- Introduction

The present work summarises the results of research carried out to measure sales efficiency of the Spanish food distribution units called MERCAs for a panel data set from 1.997 to 1.999, by applying non parametric frontier methodology.

We specified the sales model by defining the factors that influence the total amount of revenues obtained by sales, this variable being considered as an endogenous variable.

We advance the hypothesis that sales obtained by a firm depend directly on two factors, linked respectively to production and marketing management. Therefore, the sales model can be expressed as:

$$S_{it} = f(P_{it}, M_{it}) \qquad (1)$$

S_{it} being the sales for the i-th firm in the t period, and P_{it} and M_{it} being factors related to sales which account for production and marketing management for the i-th firm at the t period, respectively. We call these two blocks “sales factors”

"*Real sales*" (or real revenues from sales) are usually "*below*" the "frontier" sales function. This function is defined as a limit function, that is, maximum revenues obtained by a firm after selling its products (output), for a given production and marketing management.

In the framework of production functions, "*productive efficiency*" is defined as obtaining the maximum level of production for a given set of factors, it being impossible to achieve this level of production using a lower quantity of factors. Therefore we define "*sales efficiency*" using the same theoretical point of view.

In the sales efficiency context, the more sales a firm obtains with a certain level of sales factors, the more efficient the firm is. On the other hand, the less quantity of sales factors the firm uses in obtaining a fixed amount of sales, the more efficient it is. We call the latter approach “factor oriented “, while the former: “sales oriented”.

In the present work, the analysis has been carried out in the context of “sales oriented” as this was also the focus employed by *Dios et al (2.001).* Regarding this point we should like to stress that, as far as we know, this is the only previous work on sales efficiency with the scope of stochastic frontiers. Nevertheless, some references that include econometric sales models[1] have been found. We must point out also that some DEA applications have been performed in order to analyse efficiency in the bank sector considering sales and services as output (*Cook et al, 2000*)

We have applied this methodology to the food distribution units of Spain.

The food distribution sector is suffering major changes, given that the traditional distribution channels (involving the physical presence of products in a wholesale market, e.g., Mercabarna or Mercamadrid) are losing ground

[1] *Roberts (1947), Nerlove and Waugh (1.961), Palda (1.964), Aaker and Carman (1.982), Parker and Segura (1.971), Boyd and Westfall (1972)* beyond others are some good examples.

in favour of the integrated distribution channels, which are becoming more and more important (e.g. Carrefour, El Corte Inglés, etc.). These large distribution chains have bargaining power, which means that they are able to purchase large amounts of products at lower price, and under more favourable conditions, so that they are gaining market share rapidly.

Regarding the sector economic structure, it must be noted that at the MERCA´s network, 4,07 millions of tonnes of fruit and vegetables and 528681 tonnes of fish were commercialised in 1.999. So that during this period, these wholesale markets supplied 65% of the national consumption of fruit and vegetables, and 55% of the national consumption of fish and seafood. They are polyvalent as they offer not only the above mentioned products (fruit and vegetables, fish), but also meat, flowers and non-perishable goods.

MERCAs have Complementary Activity Areas (CAA), where companies, wholesalers and external agents who provide elementary services such as transport, logistics, banks, etc., carry out their business. As time goes by, these CAA are becoming increasingly important; new technologies are developing, and consumers want new services added to the products they buy. In this sense, the usual customers are medium and large distribution firms, restaurants, catering and institutional consumers.

Nevertheless, the wholesale sector has suffered much damage from integrated distribution, especially large-scale distribution, which has moved away from the wholesale markets. This leads to a concentration of supply and demand, the first consumer being in direct contact with the supplier. The large-scale distribution's market share is expanding: for instance, in Spain, the number of hypermarkets has increased dramatically in the last few years.

Given this situation, we consider that new research should be carried out with the aim of study the capacity of Mercas to halt this losing of their share of the market. We think that an appropriate efficiency analysis would show us whether the food distribution unit had been applying the best management practices. The scale efficiency study would detect whether there were firms not having an optimal size, which would mean that they were not operating with a Most Productive Scale Size. On the basis of these findings we should propose the adoption of measures to improve efficiency and productivity in order that these firms become more competitive in the trade food distribution sector.

The object of this study is to investigate the sales efficiency of these food distribution units in Spain, paying special attention to the scale component with the aim of detecting improvement possibilities in the firms which have turned out to be inefficient.

The above is section 1 of this paper which is divided into five sections. In section 2 we describe the methodology applied in order to analyse sales efficiency, continuing with section 3 where data are presented. Section 4 shows the main results. We finish with section 5 which contains some remarks and conclusions.

2.- Methodology

Firstly we study the sales performance of the food distribution unit sector taking as a basis the sales model (1).

We specified this as:

$$S_{it} = f(P_{it}, M_{it}) + \varepsilon_{it} \qquad (2)$$

assuming the ε_{it} to be independent and identically distributed random errors, having $N(0, \sigma_\varepsilon^2)$ distribution, P_{it} represents the Production block and M_{it} the Marketing Management block.

MERCAS are not sellers of products. They merely provide the services which make it possible for the real sellers of products to carry out their business. Nevertheless we consider that the sales model is perfectly adaptable to the function of the MERCAS.

We considered that Labour and Capital were the two classical factors that adequately explained a firm's Production.

In respect of the Marketing Management explanation, there was no data available relating to this block of factors. Thus, we have taken the presence on the internet as a proxy variable reflecting proper practice in Marketing Management.

The variables used in the study were:

Output: Sales measured by revenues, in 1000 euros.

Production block:

Labour, number of employees.

Capital, assets, in 1000 euros.

Marketing block:

Webpage, a dummy variable which takes the value 1 if the food distribution unit has a web page and 0 if not.

The variables sales and capital, expressed in current money values, were deflated by the Consumer Price Index (CPI, 1.999, the base year). The web page variable was obtained by visiting each web page wherever it was possible.

For our analysis, a Cobb-Douglas sales function was assumed to specify the sales performance of the food distribution units. Nevertheless, we must point out that, after several trials, we adopted the following expression:

$$Ln(S_{it}) = \beta_0 + \beta_1 Ln(labour_{it}) + \beta_2 Ln(capital_{it}) + \beta_3 webpage_{it} + \varepsilon_{it} \qquad (3)$$

where *Ln* represents the natural logarithm;
the subscripts, i and t, represent the i-th sample food distribution unit (i=1,2,...,22) and the t-th year of observation (t=1, 2, 3), respectively.

It should be noted that the webpage variable is not in a log form.

The least squared method was applied and tests to validate the estimations were carried out.

We calculated the elasticities of sales with respect to factors and their standard deviation applying the methodology developed in *Dios (2000)*.

With respect to the efficiency analysis, we thought that the stochastic frontier approach would have achieved acceptable results, given that the fit of the estimated sales model was good. Nevertheless, considering that we were also interested in the productivity change study and its decomposition,

we applied output oriented DEA (*Data Envelopment Analysis*) methodology (*Charnes et al, 1997)*

The output oriented DEA approach, assuming a constant returns to scale (CRS) technology, consists in the resolution of the following mathematical programming model for each DMU (Decision making unit):

$\max_{\phi,\lambda} \phi$,

s.t.

$$-\phi y_{is} + Y_s \lambda \geq 0$$

$$x_{is} - X_s \lambda \geq 0 \qquad (4)$$

$$\lambda \geq 0$$

As a result of the above optimisation method, a (CRS) solution is calculated.

The CRS model (4) can easily be modified to a variable returns to scale (VRS) model by adding the constraint $\sum\lambda=1$.

DEA methods allow us to estimate the efficiency index under three different concepts. We define the efficiency index of a firm as the ratio between its observed output and the output that this firm would have produced if it had been on the frontier, let us say, if it had been efficient.

Firstly, we assumed a constant returns to scale (CRS) technology. In this case, the calculated efficiency index was the "overall efficiency index". Nevertheless, in order to account for the scale efficiency, we also resolved the DEA model assuming (VRS) technology, the " pure efficiency index" being the calculated index, taking into account this (VRS) frontier.

Firms which improved their efficiency level under this framework, in comparison with the overall efficiency, were considered as being inefficient firm from the scale point of view. As a result, the "scale efficiency index" is the ratio between the overall and the pure efficiency index.

By running model (4) with a non-increasing return to scale (NIRS) constraint ($\sum\lambda\leq1$), we can conduct researching into the question of whether increasing or decreasing returns to scale prevail. We would conclude that a firm is operating in an increasing returns to scale point if the efficiency index arising from the (NIRS) model is different from the calculated index assuming VRS technology. In the opposite case, decreasing returns to scale would exist.

We have also applied a multi-stage DEA methodology (Coelli, 98). In this approach a sequence of radial movements is performed in order to supply information on peers and target of each of the inefficient firms in the sample. The peers of an inefficient firm are role-model firms. The targets provide the input and output quantities that the inefficient firm should be able to achieve if it were to operate on the efficient frontier.

Taking as a basis DEA results, the Malmquist TFP (Total Productivity of Factors) index measures the TFP change between two data points corresponding to two different periods.

As is outlined in *Coelli, Rao and Battese, (1997, ch 10)* we define a feasible production technology in terms of correspondence between the output set, *P(x)*, which represents the set of all output vectors, *y*, and the input vector *x*. That is:

P(x) = { *y* : *x* can produce *y* } (5)

We assume that the technology satisfies the axioms listed *in Coelli, Rao and Battese, (1997, ch 3)*. The output distance function *(Shephard, 1970)* is defined as:

$$d_o(x,y) = \min \{\delta : (y/\delta) \in P(x)\} \qquad (6)$$

This indicates the potential radial expansion of production up to the output set isoquant.

Following *Färe et al (1994)*, the Malmquist output-orientated TFP change index between period s (the base period) and period t is given by:

$$m_o(y_s, x_s, y_t, x_t) = \left[\frac{d_o^s(x_s, y_s)}{d_o^s(x_t, y_t)} \times \frac{d_o^t(x_s, y_s)}{d_o^t(x_t, y_t)} \right]^{1/2} \qquad (7)$$

where the notation $d_o^S(x_t, y_t)$ represents the distance from a sample point observed in the t period to the s period frontier. An equivalent way of writing this productivity index is:

$$m_o(y_s, x_s, y_t, x_t) = \frac{d_o^s(x_s, y_s)}{d_o^t(x_t, y_t)} \left[\frac{d_o^t(x_t, y_t)}{d_o^s(x_t, y_t)} \times \frac{d_o^t(x_s, y_s)}{d_o^s(x_s, y_s)} \right]^{1/2} \qquad (8)$$

In equation 8 we may observe the decomposition of the Malmquist index into two components: efficiency change (the ratio outside the square brackets) and technical change (the remaining part of the index). Efficiency change is equivalent to the ratio of the Farrell *(Farrell, 1957)* technical efficiency in period t to the Farrell technical efficiency in period s, and technical change corresponds to shifts at the frontier level.

To perform all the necessary calculations we used the DEAP Version 2.1 computer program designed by Tim Coelli *(Coelli, 1996)*.

3.- Data

Data on sales and factors of 22 food distribution units (MERCAs) over the 3-year period, 1.997-1.999, were obtained from the yearly ALIMARKET Reports of 1.998, 1.999 and 2.000 on distribution in Spain.

Table 1. Summary statistics for variables in the sales analysis for the Spanish food distribution units in 1.997-1.999

Variable	Sample mean	Standard deviation	Minimum	Maximum
Value of sales *(1000 euros)*	3742.33	4818.06	75.14	16810.30
Labour *(Number of employees)*	46.15	56.13	4	198
Capital *(1000 euros)*	9606.52	11843.12	655.10	59706.03

Source: ALIMARKET Reports on Distribution, Year Reports (for 1.998-2.000)

Table 1 presents summary statistics for the variables involved in the analysis. They include the mean value and the standard deviation, together with the minimum and the maximum values of the Spanish food distribution units over the period 1.997-1.999.

Sales are expressed in terms of the values for 1.999 (the base year of CPI), with the average sales of 3742.33 thousand euros, ranging from 75.14 thousand euros for the small MERCA to 16810.30 thousand euros for the largest. The mean capital of a food distribution unit is around 9606.52 thousand euros, with a minimum of 655.10 and a maximum of 59706.03 thousand euros.

The percentage of MERCAs incorporated in web pages is 50%, while there is still another 50% of MERCAs with no web page giving information about their services and location.

4.- Empirical results

The least squared estimates of the sales model is:

$$Ln(S_{it}) = 1.099 + 0.813Ln(labour_{it}) + 0.415Ln(capital_{it}) + 0.227webpage_{it} + \varepsilon_{it}$$

(2.28) (6.26) (14.22) (2.09)

R^2=0.925 $\overline{R}^2$ = 0.921 DW= 2.11 LogL.=-23.88 F=254.09

The numbers in parentheses are the t statistics output by the regression program.

There are a number of points worth noting. First, the sales performance of the distribution units is well explained by the estimated model since the adjusted Coefficient of Determination is 0,92. In addition to this, each of the coefficients of the three variables is statistically significant, the labour variable having a particularly large implied t-statistic (14,22). Appropriate tests were carried out in order to confirm the hypothesis concerning the error variable. So the fit of the model is satisfactory.

We have estimated sales elasticities with respect to sales factors (see Table 2, which also contains the standard deviations).

We can not directly interpret all of the estimated parameter as elasticities, since the web variable is not in a log form. Therefore the web page elasticity and so by definition the returns to scale, depend on whether the firm is on the Internet or not. It has been evaluated at the mean values of the sample.

Table 2. Elasticities of sales with respect to different factors and returns to scale for food distribution units in Spain

Elasticities of mean sales with respect to different factors		
	Value	*St. Err.*
$Ln(labour_{it})$	0.81	*0.06*
$Ln(capital_{it})$	0.42	*0.07*
$webpage_{it}$	0.11	*0.05*
Returns to scale		
	1.34	*0.18*

Source: Own elaboration

Regarding the sales elasticities, it should be noted that labour emerges as the most important factor in explaining sales services performance in the sector. This is followed by capital and finally by the management factor. It is necessary to stress that, on the basis of its calculated elasticities, this last factor (management) has the smallest incidence in comparison with those explaining the production block.

The returns to scale parameter for the sales model is estimated to be (1.34) significantly greater than 1. This means that there are increasing returns to scale at the mean values of the variables for the food distributions units in Spain.

Efficiency Analysis

We based the efficiency analysis on output-orientated DEA models, having calculated the overall efficiency. This efficiency is divided into pure efficiency and scale efficiency, the former being the efficiency left after removing the latter from the overall efficiency.

Table 3. Pure efficiencies indexes for food distribution units in Spain

MERCAS	Pure Technical Efficiency			
	Years			Mean Period
	1997	1998	1999	
Mercabarna	1.000	1.000	1.000	1.000
Mercamadrid.	1.000	1.000	1.000	1.000
Mercazaragoza	0.886	0.842	0.729	0.819
Mercavalencia.	0.851	0.853	0.880	0.861
Mercamurcia	1.000	1.000	1.000	1.000
Mercabilbao	0.839	0.790	0.746	0.792
Mercalaspalmas	0.871	0.976	0.737	0.861
Mercagranada	0.592	0.560	0.696	0.616
Mercapalma	0.773	0.942	1.000	0.905
Mercamálaga	1.000	0.935	0.940	0.958
Mercalicante	0.559	1.000	0.849	0.803
Mercatenerife	1.000	1.000	1.000	1.000
Mercacórdoba	0.633	0.508	0.465	0.535
Mercairuña	0.689	0.603	0.819	0.704
Mercasturias	0.970	1.000	1.000	0.990
Mercasantander	0.517	0.464	0.572	0.518
Mercasalamanca	0.546	0.602	0.621	0.590
Mercaleón	0.662	0.705	0.501	0.623
Mercajerez	0.494	0.429	0.395	0.439
Mercagalicia	1.000	1.000	1.000	1.000
Mercabadajoz	1.000	1.000	1.000	1.000
Mercasevilla	0.648	0.696	0.677	0.674
MEAN	**0.797**	**0.814**	**0.801**	**0.804**

Source: Own elaboration

Table 3 shows the values of the pure efficiency measures for the three years of the studied period. In order to analyse the pure efficiency of the food distribution units, the fact should be taken into account that six of the firms applied the best management practices, given that they were on the frontier for the whole period. Three firms reached the frontier during at least one year, the rest having always been inefficient during the entire 3 years. Nevertheless we should take into account the fact that two efficient firms from the pure efficiency point of view, Mercabadajoz y Mercagalicia, had very low scale efficiency, so that their input bundles were far from being an MPSS (Most Productive Scale Size).

From the mean values presented in table 4, we see that if we consider the overall technical efficiency, on the basis of a mean efficiency of 0,71, output could be raised 40%, without any extra expenditure of inputs. We found that the mean pure efficiency was 0,804, the mean scale efficiency being 0,889. Therefore firms can improve economic results, by removing both the pure and the scale inefficiencies.

Table 4. Mean efficiencies indexes for food distribution units in Spain

Years	Technical Eff	Pure Technical Eff	Scale Eff
1997	0.688	0.797	0.867
1998	0.714	0.814	0.881
1999	0.735	0.801	0.920
MEAN	**0.712**	**0.804**	**0.889**

Source: Own elaboration

Making a dynamic analysis of the mean efficiencies indexes, we studied the change suffered during this period, and the figures allowed us to ascertain that there was only a minor change, due in the main part to the improvement of scale efficiency. Later on we shall go deeper into this question by performing a Malmquist index approach.

In considering the returns to scale type, it must be pointed out that only three firms had the optimal size.

In respect of the inefficient firms, in the first year of the study all those firms having scale inefficiency were in the increasing returns zone. Nevertheless, in the last year under consideration, three firms (Mercagranada, Mercapalma and Mercamálaga) were operating on decreasing returns to scale, which means that they were too large and should have reduced size to improve sales management.

We performed a 'peers and target' analysis in order to find a group of counterpart efficient firms for each inefficient one. The results of this analysis for the last year of the study are in Table 5. Note should be taken of the absence of Mercagalicia. Although this firm was found to be efficient, no peer was encountered for it.

Table 5. Peers and weights results for food distribution units in Spain

DMU	Mercabarna	Mercamadrid	Mercamurcia	Mercapalma	Mercatenerife	Mercasturias	Mercabadajoz
Mercazaragoza	0.790	0.031			0.179		
Mercavalencia	0.182	0.336			0.482		
Mercabilbao	0.037	0.173			0.790		
Mercalaspalmas	0.067	0.034			0.899		
Mercagranada			0.672	0.093		0.235	
Mercamálaga			0.032	0.968			
Mercalicante	0.091				0.174		0.736
Mercacórdoba	0.056	0.044			0.900		
Mercairuña			0.201			0.172	0.627
Mercasantander			0.195			0.440	0.365
Mercasalamanca			0.179			0.130	0.691
Mercaleón	0.001				0.691		0.307
Mercajerez			0.055			0.581	0.364
Mercasevilla	0.612						0.388

Source: Own elaboration

The three MERCAS which emerged as being associated with a greater amount of inefficient firms are Mercabarna, Mercatenerife and Mercabadajoz, the first one being the role-model for the biggest firms such as Mercasevilla and Mercazaragoza. Medium sized firms would improve their efficiency by taking Mercatenerife as an example. Marcabadajoz, would be the counterpart of small sized food distribution units.

With regard to the peers results, the most inefficient firm, Mercajerez, should try for better sales management by adopting in the first place as similar an economic structure as possible to that of Mercasturias, and then to that of Mercabadajoz.

Worthy of our attention is the study of the input slacks using the radial projection towards the frontier.

As a constant situation over the studied period, Mercasevilla showed a remarkable labour slack that was higher in the last year, ranging from 72 employees in 1997 to 88 in 1999. It should be taken into account that this slack represented a 43% of the total labour. It is clear that Mercasevilla was oversized in respect of the labour resource, given that Mercabarcelona used fewer employees than the former, which only attained 40% of the output of the latter. We find this comparison worthy of note on the basis of the previous peers analysis.

The other firm with an input slack was Mercalaspalmas, whose capital slack decreased from 1392647 euros to 22806 in the last year of the study. Nevertheless, this was only 0.3% of the total employed capital. We consider that this firm should try to reduce the capital resource in order to obtain an economic structure similar to that of Mercatenerife, which is its counterpart in the peers analysis.

Table 6. Malmquist index decomposition

MERCAS	Productivity Change	Technical Change	Efficiency Change	Pure Efficiency Change	Scale Efficiency Change
Mercabarna	1.036	1.036	1.000	1.000	1.000
Mercamadrid	1.018	1.018	1.000	1.000	1.000
Mercazaragoza	0.941	1.036	0.909	0.907	1.002
Mercavalencia	1.056	1.031	1.025	1.017	1.008
Mercamurcia	1.036	1.036	1.000	1.000	1.000
Mercabilbao	0.994	1.029	0.965	0.943	1.024
Mercalaspalmas	0.993	1.032	0.962	0.920	1.046
Mercagranada	1.086	0.999	1.087	1.085	1.002
Mercapalma	1.070	0.954	1.122	1.138	0.986
Mercamálaga	0.898	0.943	0.952	0.970	0.982
Mercalicante	1.307	1.038	1.259	1.232	1.022
Mercatenerife	0.915	0.938	0.975	1.000	0.975
Mercacórdoba	0.933	1.032	0.904	0.857	1.054
Mercairuña	1.068	0.988	1.081	1.091	0.991
Mercasturias	1.141	0.951	1.200	1.015	1.182
Mercasantander	1.075	1.009	1.065	1.052	1.012
Mercasalamanca	1.048	0.997	1.051	1.066	0.986
Mercaleón	1.002	1.030	0.972	0.870	1.117
Mercajerez	0.962	0.999	0.964	0.894	1.078
Mercagalicia	1.792	0.958	1.871	1.000	1.871
Mercabadajoz	1.021	1.045	0.977	1.000	0.977
Mercasevilla	1.060	1.039	1.020	1.022	0.998
Mean (22)	1.054	1.006			
Mean (19)			1.072	1.004	1.069

Source: Own elaboration

As a last objective in the sales behaviour analysis of food distribution firms in Spain, we turned our attention to the Productivity change and its decomposition into both technological and efficiency change, the latter also being divided into pure and scale efficiency change.

Table 6 presents the results of this issue considering the whole change between 1997 and 1999.

We performed this analysis in the Malmquist index decomposition framework.

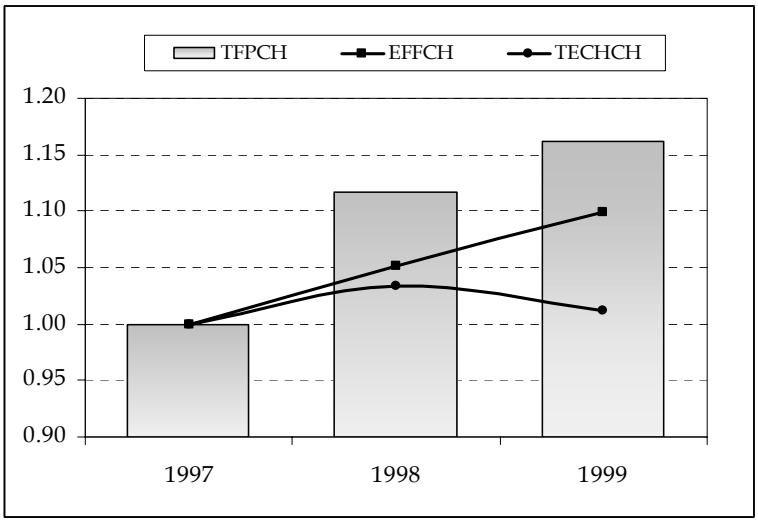
Table 6 also shows the mean values of the five indexes. We must point out that the mean efficiency change indexes did not include the three firms that were efficient during the whole period. In figure 1 the accumulated evolution of the three studied magnitudes is represented.

As a general interpretation of the obtained results from the Malmquist analysis, we must say that a figure greater than unity tells us that an increasing change was occurring, what is more, the greater the change the more the value exceeds unity. In our study we found all mean indexes reflecting an increasing change.

In respect of the productivity change, the mean value was 1,054. The firms with an index less than 1 accounted for 30% of the total, most of them having values around 0,9. Mercamálaga presented the lowest score of the sample (0,898) which means a decrease in productivity from 1997 to 1999. On the other hand, we can see that Mercagalicia considerably improved its productivity having an index of 1,792.

The mean technical change in the studied sector was quite near 1 (1,006), and it is important to observe that it had a very low variance, so nearly all the firms maintained an even technological level through out the period. Thus, there was no technical progress, nor a change in the frontier. Therefore an efficiency change could have been the determinant of the productivity change, and so it was, taking into account the calculated values. The mean change of the overall, pure and scale efficiency were 1,072, 1,004 and 1,069 respectively. These values confirmed that the efficiency change was the component which provoked the productivity change and the scale change was in its turn the principal cause of the former. In this respect the scale efficiency improvement performed by Mercagalicia (SEC= 1,87) is to be noted, this change having considerably raised the productivity level.

Figure 1. Accumulated evolution of the Malmquist index components



Source: Own elaboration

The foregoing is clearly illustrated in Figure 1 where it can be seen that there was no significant change in the technological frontier, but that the sector had improved its efficiency. This means that the firms under consideration were nearer to the frontier in the last year than in 1997.

5.- Final remarks and conclusions

This study investigated the sales efficiency of a sample of food distribution units (MERCAs) in Spain over the 1.997-1.999 period. It is necessary to note that we applied non-parametric frontier methodology in a sales efficiency framework.

We specified a mean sales model composed of two blocks of variables, the production block, and the marketing management block. Then we applied output oriented DEA methodology to perform the efficiency analysis, also taking into account the overall efficiency decomposition into pure and scale efficiency. The Malmquist index was calculated in order to analyse the components of the productivity change.

Labour is the most important factor in the mean sales model explanation, followed by capital and finally the management factor.

There were six food distribution units which emerged as efficient but some of the wholesale markets need to adapt their sales technology in order that their input bundle reaches a Most Productive Scale Size unit.

The mean pure sales efficiency index is high, around 0.8, the mean scale index being 0,9.

We may conclude from the results of our investigation that improvement in sales efficiency could be reached in the studied sector in both the pure and the scale efficiency, paying special attention to those MERCAs with the lowest efficiency index. Further work might be done in each particular case, taking into account its counterpart in the peers analysis results. Mercabarna was found to be the reference for the big firms, Mercatenerife for the medium and Mercabadajoz for the small.

We found no evidence of technical change during the period considered, but concluded that a notable scale efficiency change took place during the studied period.

Concerning the decreasing market share of the MERCAS by virtue of the highly concentrated distribution centres, we think that the former would be able to survive providing they applyied measures to remove their lack of efficiency, paying special attention to the scale component.

In order to be multifunctional they must acquire logistics. This involves increasing the Complementary Activity Area´s role so as to provide all sorts of services.

Acknowledgments

We wish to thank Tomás de Haro Jimenez for useful comments on the food distribution sector

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