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EFFICIENCY AND QUALITY IN LOCAL GOVERNMENT MANAGEMENT. THE CASE OF SPANISH LOCAL AUTHORITIES

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ABSTRACT

This study analyses efficiency levels in Spanish local governments and their determining factors through the application of DEA (Data Envelopment Analysis) methodology. It aims to find out to what extent inefficiency arises from external factors beyond the control of the entity, or on the other hand, how much it is due to inadequate management of productive resources. The results show that on the whole, there is still a wide margin within which managers could increase local government efficiency levels, although it is revealed that a great deal of inefficiency is due to exogenous factors. It is specifically found that the size of the entity, per capita tax revenue, the per capita grants or the amount of commercial activity are some of the factors determining local government inefficiency.

Keywords: Local government performance; Data Envelopment Analysis, Efficiency and Quality.

JEL Classification: D60, H71, H72

1. INTRODUCTION

In recent years, governments have become increasingly concerned about the need to manage their resources more efficiently, with the aim of reducing public expenditure without affecting the standard of the services they provide. In this article, we focus our analysis on local government management. Local governments play an important role in the provision of public services, and form a subsection that, over time, has taken on more responsibilities. This in turn has led to an accumulation of operations, and a consequent increase in expenditure and greater weight in the country's economy. In the Spanish experience, following the approval of the 1978 Constitution, important changes have been experienced which have led to an increase in the responsibilities of state and local governments in the provision of public services. Table 1 in section 2.2 shows how local administration accounts for more than 6% of GNP and, excluding Social Security, absorbs 20% of public resources.

The principal objective of this study is to analyse the levels of both efficiency and quality in these entities, and determine what financial, socio-economic and budgetary characteristics are shared by local governments with similar efficiency level values. In this way, we will be able to find out whether inefficiencies can be explained by external factors, and as such are beyond the control of the authorities, or whether they are due solely to bad management. It could also be the case that inefficiency is due to a combination of both aspects. As set out below (in section 2.3), the variables related to quality are categorical. As they are non-continuous variables, and different from those representing inputs and outputs, a suitable procedure to deal with this type of variable had to be established. From the various available alternatives, we have followed the proposal set out by Banker and Morey (1987), as we consider it to be the most suited to the characteristics of our sample.

The article is divided into four sections. Section 2 sets out the methodology used in the efficiency analysis, the sample of local authorities analysed, and the variables, the inputs used and the outputs obtained, which are defined. The third section analyses the results of the empirical analysis, while the final section presents the essential conclusions drawn from the study.

2. METHODOLOGY

2.1. MATHEMATICAL FORMULATION OF THE DEA

The choice of the DEA (Data Envelopment Analysis) model for the analysis of local government efficiency is due to its conceptual simplicity and its versatility as a work tool, both of which enable the elimination of many of the difficulties inherent in the study of public services. Amongst these difficulties, its multi-product nature and the fact that market prices do not exist are worthy of note.

The DEA model is posed as a problem of linear programming that enables an efficiency analysis to be carried out, subject to a series of restrictions. Within the public sector, more often than not, outputs are either totally or partially set externally, and for this reason, it makes more sense to evaluate efficiency in terms of the minimisation of inputs. Therefore, the mathematical formulation of the DEA, in the version aimed at the control and reduction of inputs, can be expressed as follows:

$$\underset{q\ ,\ l}{Min}\ q \qquad [1]$$

$$\begin{aligned} s.a. \quad & -y_i + Yl \geq 0 \\ & q x_i - Xl \geq 0 \\ & l \geq 0 \end{aligned}$$

Where *è* represents the factor that weights the inputs of the evaluated unit, and its value measures the efficiency of unit *'i'* subject to evaluation (Decision Making Unit, or DMU, is the term used in the literature on this subject). *X* and *Y* are defined as the input and output matrices which contain all the units (DMUs) to be evaluated, while x_i and y_i represent the DMU inputs and outputs subject to evaluation. Finally, ë is a weight vector which describes the importance of the DMUs considered to determine the virtual producer or reference unit which is used as a comparison in order to evaluate unit *'i'*.

Programme [1] must be resolved the same number of times as there are units to be evaluated (once for each DMU). The DEA methodology defines a linear programme that compares each producer with the "best" producers which make up the "best practice frontier". The key to the analysis consists of finding the best virtual DMU for each real DMU. The model sets out with two restrictions: the first ($Yl \geq y_i$), forces the virtual DMU to produce at least as many outputs as those obtained by the DMU under analysis. The second restriction ($qx_i - Xl \geq 0$) enables us to determine the lowest possible input consumption.

By resolving the linear programming corresponding to each one of the units under study, we obtain a coefficient *q* for each DMU. If *q*i is the same as the unit, the unit is defined as efficient,[1] while in the remaining cases, i.e. when *q*i < 1, it indicates inefficient performance in relation to the units located at the frontier.

The underlying technology in programme [1] shows constant returns to scale. In other words, there is no restriction that would impede the comparison of low (high) dimension units with other units of a superior (inferior) size. In this way, the vector *ë* elements will show whether the best practice frontier is made up of smaller units (if *ë>1*) or larger sized units (if *ë<1*) than the evaluated DMU. More suitable technological assumptions can be introduced when the reference technology is defined. Thus, if we want the comparison to consider only units of a similar size to that of the evaluated DMU, we can introduce the assumption of the variable returns to scale. That only requires adding one further restriction to programme [1]:

$$\sum_{i=1}^{I} l = 1 \qquad [2]$$

2.2 SAMPLE SELECTION

The relative size of the local public sector is set in table 1. It shows how local administration accounts for more than 6% of GNP and, excluding Social Security, absorbs 20% of public resources.

Table 1. Spanish public sector composition (as percentage of GNP)

	Current resources 1995	Capital resources 1995	Current resources 1999	Capital resources 1999
Central Administration	19.51	0.58	19.47	0.40
Regional Administration	5.40	0.86	6.65	1.11
Local Administration	5.47	0.48	5.68	0.58
Social Security	18.02	0.17	17.60	0.18

Source: BADESPE DATABASE (Public Administration Accounts)
Web page address: http://www.estadief.minhac.es/badespe/bancodedatos/capublicas.htm

In order to carry out the study, statistical information from the Valencian Audit Institution and the Ministry for Public Administration was used (the authorities analysed are taken from the Valencian Autonomous Community, an area of considerable industrial and service activity on the Mediterranean coast in the east of Spain). The outputs were obtained from information gathered in a survey of local infrastructure and equipment devised by the Ministry for Public Administration, while inputs came from the budget data of local authorities in the Valencian Community which presented information to the Valencian Audit Institution in the years under study (1992-95). The sample was thus made up of 258 municipalities.

It is important to highlight the fact that when the data was selected, it was decided to use implemented expenditures and revenues (net charges recorded and net liabilities recorded) instead of forecasts, although in some cases, this was at the expense of being up-to-date due to publication delays. However, the use of budgeted data would have greatly distorted the conclusions, since it is well known that budgeted figures generally underestimate expenditure and overestimate revenues.

2.3 DEFINITION OF INPUT AND OUTPUT VARIABLES

In output specifications we differentiate on the one hand, production variables and on the other, quality variables. The information available on the variable of the quality of services provided is of a categorical nature (the quality of the services offered is arranged in three classifications: good, normal or bad). It is quantified using the proposal set out by Banker and Morey (1986), which involves breaking down the quality variable into two categorical variables: d_1 and d_2. Thus, for one unit *j*, the values taken by d_1 and d_2 will be the following:

$dj_1 = dj_2 = 0$, *if the quality is bad*.
$dj_1 = 1$ and $dj_2 = 0$, *if the quality is normal*.
$dj_1 = dj_2 = 1$, *if the quality is good*.

In terms of output production, the specification of variables has be representative of the essential services provided by local corporations. In the first place, with the aim of setting bounds on what essential services are, we refer to Municipal Law where we have found the minimal services required (table 2 contains these services depending on Council size and the related variable according to the availability of the data bases we have utilized).

[1] The literature describes this situation as one of weak efficiency. A more robust definition, based on Pareto's optimality concept, requires additional conditions. An excellent presentation of the various notions of efficiency can be found in Cooper,

Given the difficulty of quantifying public sector output, it is often essential to look for proxy variables. For this reason, and based on the work of De Borger and Kerstens (1996a, b), Taïrou (2000) and Vanden Eeckaut (1993), the number of inhabitants is chosen to reflect the basic administrative services provided to the local population.

Table 2 Output indicators based on the minimum services provided

Population bands	**Minimum services provided**	**Output indicators**
In all local authorities	- Public street lighting. - Cemetery - Waste collection - Street cleaning - Supply of drinking water to households - Access to population centres - Surfacing of public roads - Regulation of food and drink	- Number of lighting points - Total population - Waste collected - Street infrastructure surface area - Population, street infrastructure surface area - Street infrastructure surface area - Street infrastructure surface area - Total population
In local authorities with populations of over 5.000, in addition	- Public parks - Public library - Market - Treatment of collected waste	- Surface area of public parks - Total population - Total population - Waste collected
In local authorities with populations of over 20.000, in addition	- Civil protection - Provision of social services - Fire prevention and extinction - Public sports facilities - Abattoir	- Total population - Total population - Street infrastructure surface area - Total population - Total population
In local authorities with populations of over 50.000, in addition	- Urban passenger transport service - Protection of the environment	- Total population and total surface area - Total surface area

The descriptive values of the outputs used are given below (Table 3).

Table 3. Descriptive values of the variables

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Population	5556.344	8641.432	23	55457
Number of votes	1349.552	1760.333	11	8824
Number of lighting points	660.2578	1198.776	13	12600
Tons of waste	11253.57	61166.16	14.66	654500
Street infrastructure surface area	140432	205777.2	2230	1308007
Registered surface area of public parks	17937.11	32141.9	70	248147
Quality (dichotomous: d1)	0.9534	0.210	0	1
Quality (d2)	0.7325	0.4434	0	1

Seiford and Tone (2000).

However, before considering these variables as local authority outputs, we will analyse to what extent they are explanatory of the input levels incurred by the entity. The function to be estimated is a cost function f (·) as follows.

$$TC = f(H, C, V, L, R, IV, P) \qquad [3]$$

where,

TC: Total cost

H: Number of inhabitants

C: Weighted quality

V: Number of votes

L: Lighting points

R: Waste collected

IV: Street infrastructure surface area

P: Registered surface area of public parks

Empirical, we estimate (3) as a Cobb-Douglas functional form. Before going on to estimate the regression models, we analyse the degree of linear association between each pair of variables using Pearson's linear correlation coefficient, in order to detect any possible multicolinearity. As is widely known, the overall significance of the results may not be correct if the independent variables are found to be very correlated (Table 4).

Table 4. Correlation matrix amongst the variables

	H	C	V	L	R	I. V	P
H	1	0.170	0.930	0.591	0.181	0.746	0.583
C		1	0.161	0.039	0.054	0.136	-0.013
V			1	0.538	0.195	0.700	0.536
L				1	0.090	0.651	0.410
R					1	0.180	0.069
IV						1	0.570
P							1

H: Number of inhabitants; C: Quality; V: Number of votes; L: Lighting points; R: Tons of waste collected; IV: Street infrastructure surface area; P: Registered surface area of public parks

The most outstanding aspect observed is that the variable "number of inhabitants" is the one which, in general terms, presents a greater correlation to the rest. Therefore, in order to avoid problems of multicolinearity, we have estimated on the one hand, a model with the variable "number of inhabitants", while the rest of the variables are included in another model. The results of the multiple linear regression analysis are shown in Table 5.

Table 5. Results of the regression

Model	Independent Variables*	β (t student)
1	Number of inhabitants	0.956 (52.534)*
2	Quality	0.033 (1.523)**
	Votes	0.330 (8.296)*
	Number of lighting points	0.338 (7.187)*
	Tons of waste	0.153 (4.442)*
	Street infrastructure surface area	0.147 (2.917)*
	Registered surface area of public parks	0.066 (2.584)*

Model 1: R^2 adjusted =0.921
Model 2: R^2 adjusted =0.914

(*) Significant at 1%
(**) Significant at 5%

* The dependent variable in both regressions is total cost.

The explanatory power of the regression models as a whole is good, since adjusted R^2 presents very high values. However, when the adjusted R^2 for model 2 (R^2 adjusted=0.914) is compared with model 1 (R^2 adjusted=0.921) we can conclude that the "number of inhabitants" variable is very good at explaining the variation in the dependent variable.

Before defining the inputs used, it should be pointed out that we chose to carry out two types of evaluation: short-term and long-term frontiers. The short-term frontier is referred to when a frontier for each year of the years analysed (1992-1995) is estimated. On the other hand, when the long-term frontier is determined, the budget outcomes from the expenditure of1992 to 1995 are summed, and the aggregated service provision process of this period is evaluated. We evaluate the efficiency within a long-term budgetary framework, using terms set down by OECD (1997).

There are two reasons for estimating both types of frontier. Firstly, it enables us to verify the existence of the so-called “political-budgetary cycles” (Rogo, 1990) if significant differences are observed between the levels of annual efficiency and the accumulated value for the legislative period analysed. In second place, because in one of the specifications, the number of votes obtained by the governing party in the previous legislature is introduced as a quality “proxy” and it logically follows that this satisfaction derives from a whole legislative period, and not from one particular year.

Thus, in order to determine local authority behaviour in the local government , three different combinations of DEA models have been applied which depend on the corresponding output specification. These models are the following:

- In *DEA model 1,* the output specifications taken are *production* variables.
- *DEA model 2* includes the variable "*quality* of services" (the objective quality of local authority goods and services) and the variable "level of citizen satisfaction" (subjective appreciation of quality by the population), defined as the number of votes obtained in the current municipal elections by the party in power in the previous elections.
- Finally, in *DEA model 3*, all variables are included (both production and quality variables*).* This model is the most thorough one, which enables us to evaluate both efficiency and quality at the same time.
-

INPUT VARIABLES FOR ALL DEA MODELS:

I_1. Wages and salaries (chapter 1).
I_2. Expenditure on goods and services (chapter 2).
I_3. Current and capital transfers (chapters 4 and 7)
I_4. capital expenditure (chapter 6)

OUTPUT VARIABLES FOR ALL DEA MODELS:

DEA 1

- Total population
- Number of lighting points
- Tons of waste collected
- Street infrastructure surface area
- Public parks surface area

DEA 2

- Total population
- Number of votes obtained in elections by the party in power during the previous legislative period.
- Quality of services (dichotomous: d_1 and d_2)

DEA 3

- Total population
- Number of lighting points
- Tons of waste collected
- Street infrastructure surface area
- Public parks surface area
- Number of votes obtained in elections by the party in power during the previous legislative period.
- Quality of services (dichotomous: d_1 and d_2)

3. RESULTS OBTAINED FROM THE APPLICATION OF THE EFFICIENCY AND QUALITY FRONTIER TO THE SAMPLE OF LOCAL AUTHORITIES ANALYSED

3.1. BREAKDOWN OF GLOBAL TECHNICAL EFFICIENCY INTO PURE TECHNICAL EFFICIENCY AND SCALE EFFICIENCY

To carry out this breakdown, programme [1] was first applied to all the local authorities in the sample. The coefficient obtained (in a technological assumption of constant returns to scale) enabled us to determine the so-called global technical efficiency coefficient (GTE). Programme [1] was applied once more, this time introducing the weights restrictions mentioned in section 2.1, and the pure technical efficiency coefficient (PTE) was obtained in a technological environment of variable returns to scale. Finally, the efficiency (or inefficiency) of scale (ES, which is included in the GTE part due to the assumption of constant returns to scale) was determined by relating GTE and PTE (ES = GTE/PTE).

Table 6 presents a synthesis of the obtained results. The inefficiency due to scale, i.e., that caused by a below optimum size of the entity, is around 8%-24% depending on the different output specifications. In this way, the entities have to accept a level of efficiency of 77%-92% which is impossible to correct if the dimensions of the entity are not modified. Global technical efficiency was between 66% and 75% and pure technical efficiency between 75% and 89% In other words, excessive use of resources occurred (inefficiency in the use of inputs), which oscillated between 11% and 25%

In order to verify whether significant differences in efficiency levels occurred between the initial period and the final period, we applied Wilcoxon's non-parametric test. The results indicate that the differences in averages between groups are significant at a reliability level of 90%.

Table 6. Global Technical Efficiency

DEA models	Years	Mean	Std. Dev.	Min	Max	% efficient DMUs	% inefficient DMUs
DEA 1	1992	66.66	20.74	5.18	100	14.67%	85.33%
	1993	71.33	19.37	15.93	100	15.83%	84.17%
	1994	72.73	19.16	10.79	100	11.97%	88.03%
	1995	73.06	19.59	9.09	100	17.37%	82.63%
	1992-95	75.42	18.03	23.96	100	17.05%	82.95%
DEA 2	1992	62.25	20.69	5.18	100	9.30%	90.69%
	1993	66.11	20.04	15.19	100	9.69%	90.31%
	1994	69.14	20.49	11.07	100	9.69%	90.31%
	1995	67.64	20.74	8.71	100	11.24%	88.76%
	1992-95	69.71	19.61	16.84	100	11.67%	88.33%
DEA 3	1992	67.11	21.03	5.18	100	15.89%	84.11%
	1993	71.52	19.41	15.93	100	16.27%	83.72%
	1994	73.30	19.31	10.79	100	13.17%	86.82%
	1995	73.29	19.67	9.09	100	18.22%	81.78%
	1992-95	75.57	18.06	24.04	100	18.22%	81.78%

Pure Technical efficiency

DEA models	Years	Mean	Std. Dev.	Min	Max	% efficient DMUs	% inefficient DMUs
DEA 1	1992	84.18	19.21	10.89	100	41.31%	58.69%
	1993	86.01	17.34	23.10	100	41.70%	58.30%
	1994	85.18	18.12	20.50	100	41.70%	58.30%
	1995	86.03	18.15	23.68	100	45.56%	54.44%
	1992-95	85.21	17.32	24.18	100	37.21%	62.79%
DEA 2	1992	75.04	21.38	11.16	100	22.86%	77.13%
	1993	76.80	21.18	20.36	100	24.81%	75.19%
	1994	77.41	21.28	18.56	100	25.96%	74.03%
	1995	79.83	22.29	14.86	100	30.62%	69.38%
	1992-95	76.31	20.83	18.52	100	23.64%	76.35%
DEA 3	1992	88.56	17.14	10.89	100	55.04%	44.96%
	1993	88.65	15.92	25.50	100	49.81%	50.19%
	1994	89.67	16.03	36.24	100	56.98%	43.02%
	1995	89.92	16.08	28.75	100	57.36%	42.64%
	1992-95	89.08	15.87	28.77	100	54.65%	45.34%

Efficiency on Scale

DEA models	Years	Mean	Std. Dev.	Min	Max	% efficient DMUs	% inefficient DMUs
DEA 1	1992	79.40	16.82	26.00	100	14.73%	85.27%
	1993	83.13	14.22	27.51	100	15.89%	84.11%
	1994	85.71	13.92	27.51	100	12.02%	87.98%
	1995	85.30	14.71	25.64	100	18.22%	81.78%
	1992-95	88.77	11.75	50.41	100	17.83%	82.17%
DEA 2	1992	83.26	14.30	25.28	100	12.02%	97.98%
	1993	86.60	12.29	48.95	100	13.95%	86.05%
	1994	89.66	12.16	37.15	100	15.50%	84.50%
	1995	88.62	13.19	30.60	100	22.86%	77.14%
	1992-95	92.01	10.94	39.19	100	29.07%	70.93%
DEA 3	1992	76.88	17.92	23.72	100	15.89%	84.11%
	1993	80.64	15.16	27.37	100	16.28%	83.72%
	1994	81.67	15.42	27.51	100	12.79%	87.21%
	1995	81.47	15.83	23.28	100	18.21%	81.79%
	1992-95	85.02	14.06	33.22	100	18.22%	81.78%

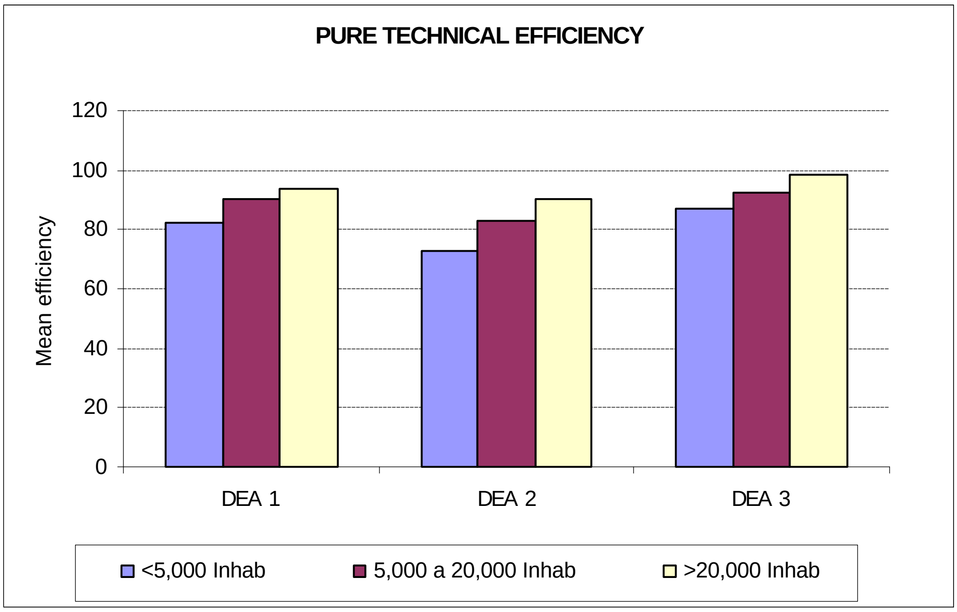
3.2. EFFICIENCY ACCORDING TO LOCAL AUTHORITY SIZE

Pure technical inefficiency levels are very different if we classify local authorities according to their number of inhabitants. Pure technical inefficiency, i.e., inefficiency caused by excessive consumption of resources, is greater in entities with a lower number of inhabitants. Of the entities with a population of over 5,000, 21.33% are efficient in all output specifications, whereas only 15.93% of the populations of under 5,000 inhabitants are efficient. It can be observed in Graph 1 how the average of the efficiency levels is higher in entities with larger number of inhabitants. However, this inefficiency does not take problems of scale into account, and only compares entities with those of similar sizes.

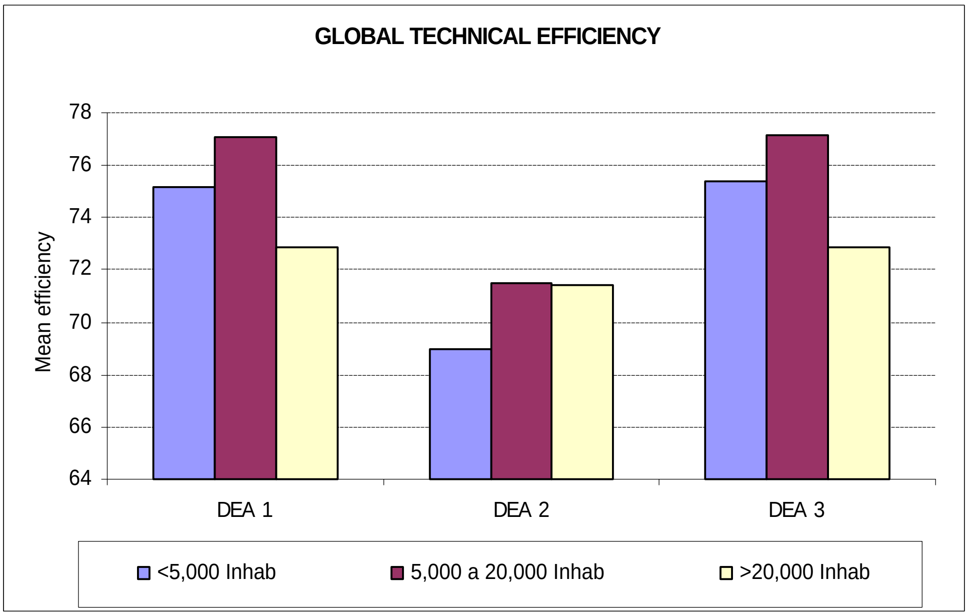
Global technical efficiency covers all entities, irrespective of their size, and the study indicated that local authorities with populations of 5,000 and 20,000 showed a higher GTE in practically all of the output specifications. This result could indicate this population band as being the optimum size for an entity to be considered efficient (Graph 2).

Inefficiency of scale increases as the number of inhabitants grows, which suggests that the level of inefficiency is impossible to correct without modifying the dimensions of the entity. In a public entity, there is little sense in looking for solutions to these inefficiencies, since, unlike private companies, it is practically impossible to change the size of a town (Graph 3).

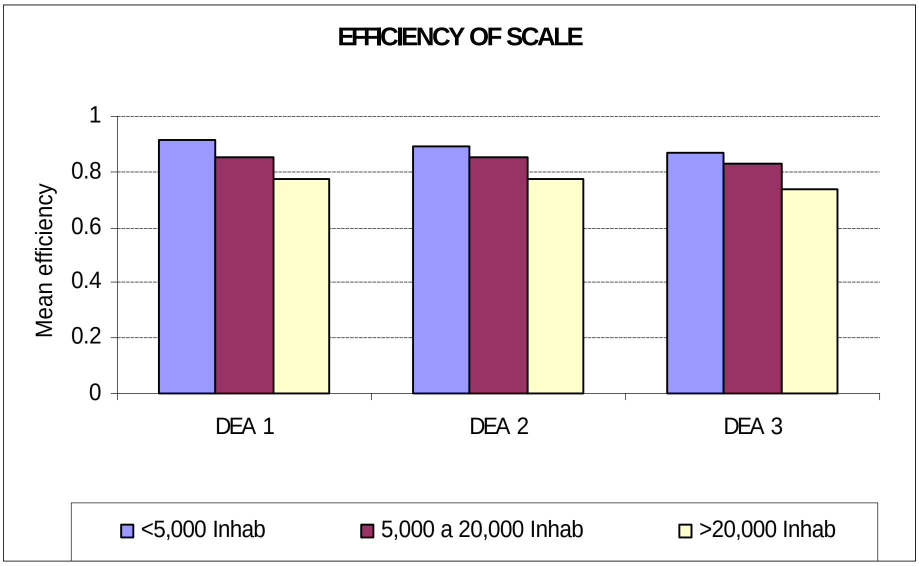
GRAPH 1



GRAPH 2

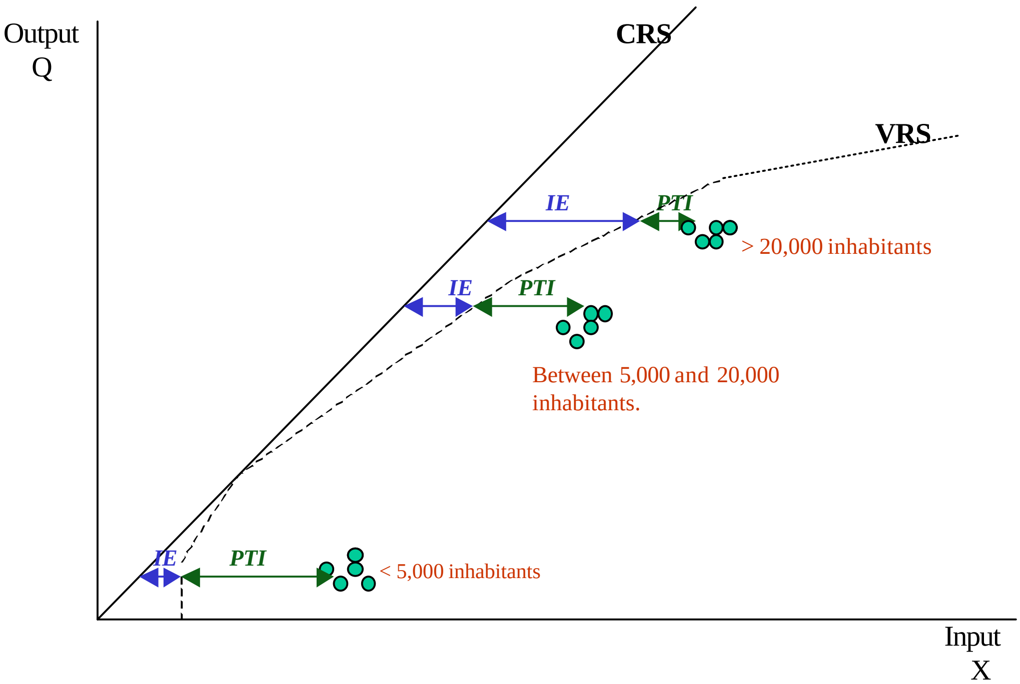


GRAPH 3



These results can be interpreted as follows. The optimum size corresponds to relatively small municipalities, since inefficiency of scale is lower in the under 5,000 population band. However, larger municipalities are nearer to the frontier. In other words, although they are not the optimum size, they have better and greater resources (qualified staff, better information technology resources etc.), which places them very close to their frontier in variable performance (Graph 4).

GRAPH 4
BREAKDOWN OF EFFICIENCY BY POPULATION BANDS



VRS: Varying Returns to Scale; **CRS:** Constant Returns to Scale

IE: Inefficiency of Scale; **PTP**: Pure Technical Inefficiency

3.3. BUDGETARY STRUCTURE AND EFFICIENCY. ANALISIS OF THE OBSERVED RELATION

We now attempt to analyse whether the entities display similar budgetary structures. Through this analysis, we are able to find out whether local authority managers should base the formulation and implementation of budgets on a particular model, or if on the contrary, the composition of the budget has insignificant bearing on whether the local authority is classified as efficient.

To carry this out, we used Finger and Kreinin's similarity index (1979). This index has been used in the field of international commerce, and when applied to the case in point, is represented by the following expression:

$$S(ab) = \sum_i \{Min[x_i(a), x_i(b)]\} * 100$$

In our study, S(ab) measures the similarity between two entities "a" and "b" with regard to the budgetary structure of expenditures and revenues. *Xi (a)* and *Xi (b)* represent the percentages of item "*i*" in entities *a* and *b* respectively.

S(ab) oscillates between 0 and 100, i.e., the closer *S (ab)* is to 100, the greater the similarity between the two entities will be. Hence, the two extreme cases would be the following:

- S(ab)=100 when Xi(a)=Xi(b) for each item "i", i.e., when the composition of the two entities is identical
- S(ab)=0 when the composition of Xi(a) is totally different from that of Xi(b).

This index, however, is limited in that it only allows for the comparison of similarity between two entities. Since our study sets out to calculate similarity between various entities, we attempt to get round this limitation by calculating a similarity index for each local authority with respect to the rest.

By using the similarity indexes applied to the budget (expenditures and revenues), we analyse the behaviour that these indices on average presented from 1992 to 1995, together with dispersion.

In order to find out whether the level of similarity is higher in entities classified as efficient, in all the defined output specifications two groups were differentiated: on the one hand, efficient entities (with a result of 990 similarity indices) and on the other, all the entities (with 3,3.150 indices) –Table 7-.

Table 7. Descriptive values of similarity indices

Entities	Nº of similarity indices	Mean		Std. Dev.	
		Expenditures	*Revenues*	*Expenditures*	*Revenues*
Total	33,150	68.77	73.47	15.58	13.54
Efficient	990	67.54	65.74	17.68	16.74

In order to be able to interpret the results, we tested the null hypothesis of equal averages between the groups, against the alternative hypothesis of difference of averages. A non-parametric sign test was used to carry this out, the results of which indicate that at a significance level of 0.05, the null hypothesis of equal averages was not rejected. We can therefore conclude that significant differences do not exist between the budgetary structures of efficient local authorities and the rest of the local authorities. In other words, there is no specific budgetary structure which we could classify as efficient, and thus an explanation for these inefficiencies must be sought in other factors.

3.4. DETERMINING FACTORS OF TECHNICAL EFFICIENCY LEVELS

In order to analyse whether the explanation for the differences in efficiency levels between distinct entities was to be found in a series of socio-economic and financial variables, we applied the Tobit model. This technique has been employed by authors such as De Borger *et al.* (1994), Martin and Page (1983) and Rhodes and Southwick (1989), amongst others, and is used in cases in which the dependent variable is censored. In this study, the censored variable is that of the efficiency levels, which cannot be higher than the unit. For our purposes, standard Tobit model can be defined in the following way:

$$y_i^* = x_i^{'} b + u_i, \qquad i = 1, ..., n$$

$$y_i = y_i^* \qquad si \quad y_i^* < 1$$

$$y_i = 1 \qquad si \quad y_i^* \geq 1$$

Where u_i are assumed to be i.i.d. drawings from N(0, s^2). The latent variable y_i^* is not directly observable. Its observed counterpart is the efficiency index y_i. For y_i^* less than 1 both y_i and x_i are observed while for $y_i^* \geq 1$ the x_i are observed and the y_i equal the limit value of 1. It is well-know that the Tobit estimates to any violation in the in the underlying assumptions.

In our case, y_i^* represents efficiency levels (censored variable) and x_i' are the socio-economic and financial variables. Specifically, the variables appearing in Table 8 are those taken as independent variables.

Table 8. Socio-economic and financial variables

ABREV.	VARIABLE	FV/SV
TAX REVENUE	Tax revenue / Number inhabitants	FV
GRANTS	Grants / Number inhabitants	FV
FINAN.LIAB	Financial liabilities (chapter 9 revenues) / Number inhabitants	FV
UNEMPLOYMENT	% Unemployment / Legal population	SV
TOURISM	Tourism index	SV
COMMERCIAL	Level of commercial activity	SV
ECON. LEVEL.	Economic level	SV

FV: Financial variables
SV: Socio-economic variables

The results obtained from the Tobit analysis appear in Table 9.

Table 9. Determining factors of efficiency levels: Tobit Results

	DEA 1 (4 Inputs/ 5 Outputs)	DEA 2 (4 Inputs/ 3 Outputs)	DEA 3 (4 Inputs/ 6 Outputs)
TAX REVENUE	-0.679	-0.110	-0.056
	(-0.885)*	(-5.557)*	(-2.048)**
GRANTS	-0.115	-0.131	-0.164
	(-3.360)*	(-4.468)*	(-4.127)*
FINAN. LIAB	0.147	-0.111	0.118
	(1.824)	(-1.715)	(1.243)
UNEMPLOYMENT	-0.746	-0.396	-0.382
	(-0.539)	(-0.332)	(-0.231)
TOURISM	-0.077	-0.098	-0.743
	(-1.275)	(-1.875)	(-1.006)
COMMERCIAL	0.094	0.159	0.124
	(2.110)**	(4.021)*	(2.121)**
ECON LEVEL.	-2.430	-1.467	-1.530
	(-1.295)	(-0.920)	(-0.686)
CONSTANT	120.29	120.38	126.04
	(11.673)*	(13.757)*	(10.188)*

The figures brackets are t statistics.
(*) Significant at 1%
(**) Significant at 5%

The results indicate that the socio-economic variables, such as unemployment, level of tourism, economic level[2], do not significantly affect the level of efficiency in public administrations. Of all the socio-economic and financial variables included in this study, only the per capita tax revenue, the per capita grants and the level of commercial activity appear to have any bearing on efficiency levels (Table 10).

4. CONCLUSIONS

This paper analyses the determining factors of local government efficiency levels, in an attempt to distinguish the factors which can be influenced by management decisions from those which are exogenous. In this vein, the results obtained indicate that there is a wide margin available to public managers for optimisation in the use of public resources, but that some of these inefficiencies are due to exogenous factors, such as *entity size, per capita tax revenue, per capita grants* and *level of commercial activity.*

With regard to *entity size*, the optimum size is that of relatively small municipalities. However, those with the largest populations, despite not being the optimum size, have better and greater resources at their disposal, placing them very near their frontier in variable returns to scale.

The *per capita tax revenue* and the level of *per capita grants* also affect efficiency levels. The results obtained indicate that entities with higher tax revenues and/or those receiving higher grants are the most inefficient in the management of their resources. The same results were obtained in studies carried out by De Borger *et al*. (1994, pp. 354) and De Borger and Kerstens (1996a, pp. 168) into Belgian local authorities. It therefore seems reasonable to expect that a local authority with a high capacity for obtaining resources (through tax revenue and/or grants) would be less motivated to manage them adequately. In contrast, the *level of commercial activity* has a positive impact on efficiency levels. This can also be observed in the work of Giménez and Prior (2000) on Catalonian local authorities. The authors consider that local authorities with a higher level of commercial activity subject their local authority managers to greater pressure to administer the services provided in the most efficient way.

[2] The Spanish Annual Commercial Report (Anuario Comercial de España) takes the municipal per capita disposable household income as the economic level indicator.

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