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The efficiency of refuse collection services in Spanish municipalities: do non-controllable variables matter?

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THE EFFICIENCY OF REFUSE COLLECTION SERVICES IN SPANISH MUNICIPALITIES: DO NON-CONTROLLABLE VARIABLES MATTER? [a]

Núria Bosch[b], Francisco Pedraja[c], Javier Suárez-Pandiello[d]

ABSTRACT: The aim of this article is to analyse the technical efficiency and cost-efficiency of the refuse collection services in 73 municipalities located in Catalonia, Spain. The analysis has been carried out using a modification of the DEA model in three stages developed by Fried and Lovell (1996), that allows to take into account the influence of those factors that the producer cannot control (non-controllable variables). The results seem to back the hypothesis that non-controllable variables do not affect very much the ease of provision of the service, with the exception of few municipalities.

RESUMEN: El propósito de este trabajo es analizar la eficiencia técnica y de coste de los servicios de recogida de basuras situados en 73 municipios de Cataluña. El análisis se ha llevado a cabo utilizando una modificación del modelo DEA en tres fases desarrolladas por Fried y Lovell (1996), que permite tener en cuenta la influencia de esos factores que el productor no puede controlar (variables no controlables). Los resultados parecen confirmar la hipótesis de que las variables no controlables no afectan en mucho la provisión de los servicios, con la excepción de algunos municipios.

Key words: local public services, efficiency, management
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[a] Comments are welcome. The opinions expressed in the paper do not necessarily reflect the IEB's opinions

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I. - Introduction

The aim of this article is to assess technical efficiency and cost-efficiency in refuse collection services in 73 municipalities of the Autonomous Community of Catalonia (Spain), and to measure the influence of non-controllable variables in the ease of provision of the service.

The empirical works on the measurement of efficiency in the public sector are relatively numerousness, specially in the health sector. Nevertheless, the applications on the local public services are rather limited. In spite of this fact, there are some recent works that have studied the efficiency in the provision of local services, such as De Borger et al. (1992), measuring the productivity of the Belgium municipalities, Deller (1992), referring to conservation of the rural roads, Thanassoulis et al. (1987), on the tax management, Cuenca (1994), on the fire services, and the studies more related to the refuse collection services. These services have been the object of ample attention in international economic literature. Table 1 synthesises the results of some of the principle studies carried out in this field in recent years.

As can be seen in the greater part of the cases, they are studies directed towards making a comparative analysis in terms of costs between public and private operators, and not the analysis of technical efficiency as such, an aspect only considered in the work of Cubbin et. al. (1986), Burgat and Jeanrenaud (1990), and Bosch et al. (2000).

In the efficiency analysis, we use a non-parametric approach, the Data Envelopment Analysis (DEA). Specifically, we apply a model that is a modification of the DEA model in three stages developed by Fried and Lovell (1996). The principal advantage of this method is that allows to evaluate the influence of "non-controllable variables", that is to say, those that the producer cannot control but that reflect the degree of difficulty and the ease involved in providing the service.

II.- Data

The efficiency analysis refers to the refuse collection services in 73 Catalan municipalities in 1998. These data have been obtained from a questionnaire sent to those municipalities with more than 5,000 inhabitants[1]. 5 of these towns have a population of more than 100,000 inhabitants, another 6 between 50,000 and 100,000, 17 between 20,000 and 50,000, 17 between 10,000 and 20,000 and 28 have less than 10,000 inhabitants, but more than 5,000. Table 2 shows the descriptive statistics of the sample.

In relation to the variables used in the efficiency analysis, there is a broad consensus about the most relevant factors of production in refuse collection. Thus, the list of the required inputs includes the number of containers and their geographical distribution; the vehicles used, expressed in terms of collection capacity or as the number of kilometres they travel to internalise the effect of the distance between the centres of

[1] The questionnaire was sent to all Catalan municipalities with more than 5,000 inhabitants, a total of 161, but only the data from 73 provided the minimum of information, in terms of quantity and quality, necessary to be taken into account. The survey process and the data offered by the municipalities were audited by the *Court of Auditors of Catalonia*.

collection and those of disposal; and, of course, the number of workers, or to be more precise, the number of working hours, which, given the presumed simultaneous presence of full-time and part time workers, makes it possible to homogenise the labour factor. Further refinements can be made to discriminate among the different subcategories of inputs. For example, containers can be classified according to their capacity, the vehicles according to their special features (crushers, for instance) and finally employees can be divided between white and blue collar.

The main output is the number of tons of refuse collected and subsequently transported to the corresponding dump. However, a distinction can also be made here between the various types of refuse, such as general and organic refuse (usual in domestic collection), voluminous refuse (furniture, domestic appliances...), the collection that is more irregular in time, specific collection in markets, peripheral areas, abandoned vehicles... or selective collection for ecological reasons such as recycling (glass, paper, cardboard, batteries, medicines, etc.). In this sense, refuse collection is a quasi-exception to the problem of output measurement. Unlike other public services such as education, health or the administration of justice, it is well defined and can be measured reasonably well.

In a first stage of the analysis, we use the following variables:

Outputs:

This first group comprises not only variables used to measure quantitative production (T) but also those relating to quality (F):

T: number of tons collected of organic material refuse per year[2].

F: weekly collection frequency of waste[3].

Inputs:

To provide the service, containers and vehicles (capital factor) and labour (labour factor) are used. Various ways of measuring utilisation of capital and labour factors can be envisaged. In this case, we use the following variables:

CC: container capacity in litres (number of containers X their capacity).

VC: vehicle fleet capacity in litres (number of vehicles X their capacity).

WH: number of hours worked by drivers and loaders per year.

Non-controllable variables:

Here we take into account this factors that affect the ease of provision of the service. The first variable to be consider is the number of kilometres covered by refuse collection vehicles between the centres of collection and the disposal site (D), and the second variable is the seasonal population (SP). This last variable is to take into account

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[2] Organic refuse still represents the essential core of the service. According to a study made by the CEA (1994) in 31 municipalities in the metropolitan area of Barcelona (Catalonia), such refuse grouped into domestic collection represented 85.8% of the total costs of the service.

the problems of some municipalities that because of the number of tourists they attract have to maintain a sufficient refuse collection service for a population well above their normal resident population.

D: distance in km. to the disposal site.

SP: seasonal population.

In a second stage, we analyse the efficiency substituting the physical inputs used in the first stage by the annual total cost (TC) of the refuse collection service.

III. - The Models

In this paper, we search for the measuring of both, technical efficiency and cost-efficiency of municipal refuse collection services. To do this we present two DEA models, one for each aim. In both cases DEA models are input oriented with varying returns to scale[4].

To calculate technical efficiency we use three controllable inputs, Container Capacity in litres (CC), Vehicle Fleet Capacity in litres (VC) and the Number of Hours Worked by drivers and loaders per year (WH) an two outputs, Number of Tons collected of organic

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[3] Burgat and Jeanrenaud (1992) also present a model to measure efficiency of refuse collection service that include this variable of quality.

[4] Although some previous works take the position of the existence of constant returns, among others Hirsch (1965), Kemper and Quigley (1976), Collins and Downes (1977) and Cubbin et al. (1986), in a former analysis of this sector in Spanish municipalities we detected by parametric methods the presence of varying returns. See Bosch et al. (2000).

material refuse per year (T), as a quantitative measure, and Weekly Collection Frequency of Waste (F), as a qualitative approach.

In the measurement of cost-efficiency we use as single input, the total cost of the service, because of the lack of more desegregated information, maintaining the same outputs.

Anyway, as we have noticed above, measuring correctly refuse collection efficiency requires to take into account not only the inputs that are directly controllable by the managers of the service, but also some factors whose quantity cannot be modified by the producer and can influence the results. In our case, the non-controllable inputs are (in both cases) the distance in km. to the disposal site (D) and the seasonal population (SP), as proxy to the tourist attractive.

To face the problem of non-controllable variables, in this paper we use the approach of Fried & Lovell (1996), with the modification proposed by Muñiz (2000).

Essentially, this method consists in using three stages in the evaluation of the efficiency of the producers when non-controllable variables are incorporated.

So, in the first stage we do a DEA excluding the non-controllable variables, it is to say, only including the values of the inputs that can be discretionary controlled by the managers and, of course the values of the outputs.

In the second stage we make some new DEAs, whose targets is to reach the minimum slacks unavoidable (for each variable -input and output-), given the values of the non-controllable variables. To do this, each DEA in this second stage uses as input the value of the total slack obtained in the first stage for every variable[5], being the outputs the values of the non-controllable variables. Obviously, these DEAs are input oriented. With the results so obtained, we modify the original data of the controllable variables in order to correct the negative effects that non-controllable variables could be causing in the behaviour of the producers. To do this, and according to the proposal of Muñiz (2000) we deduct (add) of the original values of controllable inputs (outputs) the minimum slack (target) obtained in the second stage.

Finally, in the third stage we make a new DEA with the modified values, from which we will obtain the expected true values of the efficiency, once avoided the effects of non-controllable variables.

IV. - The Results

IV.1. - Technical Efficiency

Table 3 shows the results of the first DEA model with three controllable inputs and two outputs. From this table we can notice that only 6 units (Sabadell, Igualada, Olot, Malgrat de Mar, Sant Andreu de la Barca and mainly Escala) could have been harmed if non-controllable variables had not been taken into account.

[5] It is made so many DEAs as variables used in the first stage.

Similarly, Table 4 summarises the efficient units, including theirs appearances in the reference sets, as a way to approach the degree of intensity or reliability of their values, given the flexibility (and, sometimes the kindness) of the DEA technique. So, we can see how only 2 of the 19 units declared efficient (Piera and Montmeló) are efficient by defect, not being in the reference set of other units different of themselves. Because that we can value the results as relatively reliable, being the average efficiency 77.33 %.

IV.2. - Cost Efficiency

Table 5 shows the results of the second DEA model with only a controllable input and two outputs. Here the importance of non-controllable variables is bigger. Even though the differences are not very wide, there are 19 units that could have been harmed if this variables had not been taken into account. Nevertheless, there are three cases where the differences are particularly significant. They are Sant Andreu de la Barca, Almacelles and, above all, Malgrat de la Mar.

Additionally, Table 6 resumes the efficient units, including theirs appearances in the reference sets, as Table 4 did in the first model. Once again, only 1 of the 8 units declared efficient (Malgrat the Mar) is efficient by defect. Nevertheless, the average efficiency in this case only reaches 58.29 %.

V. - Final Remarks

The analysis of efficiency carried out allows to point out the following:

- The non-controllable variables do not have a very big influence in the provision of refuse collection services, with the exception of few municipalities.

- In the DEA approach with physical inputs (CC, VC and WH), the average efficiency only ranges from 76.24% to 77.33% and the indices of efficiency are only increased in 6 municipalities (Table 3), taking into account non-controllable variables. The indices of efficiency of Escala, Malgrat de Mar and Sant Andreu de la Barca are specially affected if the non-controllable variables are not included in the analysis. In the cases of Escala and Malgrat de Mar, the seasonal population is very important, since that are tourist places. On the other hand, the distance of the disposal site (38 km. in relation to an average distance of 16.53 km.) could influence the provision of refuse collection in Sant Andreu de la Barca.

- In the cost-efficiency analysis, the average efficiency varies from 58.29% to 56.47% and the indices of efficiency of 19 municipalities, which include the 6 municipalities affected by the non-controllable variables in the technical efficiency approach, are harmed if non-controllable variables are not taken into account (Table 5). Among the 19 municipalities affected, 4 (Alcanar, Calella, Escala and Malgrat de Mar) have a big seasonal population, and the distance to the disposal site is superior to 30 km. for 15 municipalities.

Nevertheless, most of the municipalities are very slightly affected by the non-controllable variables. Only Almacelles, Malgrat de Mar and Sant Andreu de la Barca are specially influenced by those variables.

- Finally, Table 7 summarises the best practices of the two models presented. 5 municipalities appear completely efficient in both models, and 11 municipalities present values of the indices of efficiency above 70% also in the two analysis of efficiency. This result contributes to the reliability of the analysis carried out.

Table 1
Comparative Efficiency of Refuse Collection Services

Authors and date	**Place and period of investigation**	**Method**	**Findings**
HIRSCH (1965)	24 cities and municipalities in the St. Louis County, 1960	Average cost function	No statistically significant cost differences between private and public collection
PIER et al (1974)	24 cities and municipalities in Montana State	Comparison of production functions for governmental and private production of the garbage collection service	• With respect to labour, public production is more efficient at all output levels • With respect to capital, the public sector is less efficient at low output scales but more efficient elsewhere • Public production is more efficient than private collection except in smaller communities
KITCHEN (1976)	48 Canadian municipalities with population and more than 100,000, 1971	Average cost function	The average cost is lower in case of contracting out of the service instead of direct provision by the municipality
COLLINS & DOWNES (1977)	53 cities and municipalities in St. Louis County	Cost (per residential unit) function	No significant cost differences
PETROVIC & JAFREE (1977)	83 U.S. Midwestern cities		Direct collection by the city is more costly than the price of contracting private collectors
POMMEREHNE & FREY ((1977)	103 largest Swiss municipalities, 1979	Average cost function	The average cost of the public sector is higher than the cost of the private sector, as far as the refuse collection market is competitive
SAVAS (1977)	City of Minneapolis 1971-75	Average cost comparisons	• No significant differences between private and public collection • The introduction of more competition in the refuse collection market induced a decrease in the cost of private collection
STEVENS (1978)	U.S. municipalities, 1970-71	Total cost function	The total collection cost is lower if the producer of the service is private
BENNET & JOHNSON (1979)	One public firm and 29 private firms, in Fairfax County, Virginia, 1977	Comparison of the prices charged to households for refuse collection	The price charged by the private firm is lower than the price charged by the public firm

Source: Pestieau & Tulkens (1990) and Bosch, Pedraja & Suárez-Pandiello (1998).

Table 1 (Cont.)
Comparative Efficiency of Refuse Collection Services

Authors and date	Place and period of investigation	Method	Findings
TICKNER & MCDAVID (1986)	100 Canadian municipalities with population of more than 10,000, 1981	Total cost function	Private collection is less costly than public collection
PELLETIER (1986)	100 Canadian cities, 1984	Average cost function	• The average cost is higher if the service is provided by the public sector • Lower cost if more competition between private firms
LAWARREE (1986)	136 cities and municipalities in Belgium, 1983	Total cost function	• The private sector is less costly • The introduction of more competition induces lower collection cost
DOMBERGER et al. (1986)	403 local communities in England and Wales, 1983-84 and 1984-85	Total cost function	Competitive tendering induces a decrease in the collection cost, as well as in the case of private provision than in the case of public provision
CUBBIN et al. (1986)	317 local communities in England and Wales, 1984-85	“Farrell” non-parametric production frontier	• Higher productive efficiency for private collection • Higher productive efficiency of tendered services
BURGAT & JEANRENAUD (1990)	98 Swiss cities and municipalities with population of more than 5,000, 1989	• Parametric and non-parametric production frontier • Total cost frontier	Higher productive efficiency in case of contracting out of the service to a private firm
BOSCH, PEDRAJA, SUÁREZ-PANDIELLO (2000)	75 Spanish municipalities, 1984	Parametric and non-parametric production frontier	The results seem to support the idea that the framework for competition in which the service is provided could be more relevant than the private-public management dichotomy.

Source: Pestieau & Tulkens (1990) and Bosch, Pedraja & Suárez-Pandiello (1998).

Table 2
Descriptive Statistics

	Outputs		**Inputs**				**Non-controllable variables**	
	Tons	Collection frequency	Container capacity in litres	Vehicle fleet capacity in litres	Number of hours worked by drivers and loaders per year	Total cost of refuse collection service (Thousands of Pesetas)	Distance in km. to the disposal site	Seasonal population
Maximum	88,309	7	5,279,150	329,000	420,480	654,675	42	233,500
Minimum	1,506	4	29,400	4,000	480	8,274	1	3,960
Average	13,180	6.48	646,897	49,095	23,784	91,176	16.53	31,075
Standard deviation	17,930	0.5648	96,6352	61,499	52,406	125,026	11.17	44,267
Coefficient of variation	1.3604	0.0872	1.4938	1.2526	2.2034	1.3713	0.6757	1.4245

Table 3
Technical Efficiency Results

Unit	**Third Stage**	First Stage	Difference
Alcanar	**45.14**	45.14	0.00
Almacelles	**54.97**	54.97	0.00
Badalona	**100.00**	100.00	0.00
Balaguer	**51.35**	51.35	0.00
Banyoles	**78.50**	78.50	0.00
Barberà del Vallès	**80.45**	80.45	0.00
Blanes	**71.88**	71.88	0.00
Calella	**100.00**	100.00	0.00
Canovelles	**94.68**	94.68	0.00
Capellades	**100.00**	100.00	0.00
Cardedeu	**84.16**	84.16	0.00
Cardona	**62.48**	62.48	0.00
Cassà de la Selva	**89.71**	89.71	0.00
Castellar del Vallès	**70.71**	70.71	0.00
Constantí	**99.95**	99.95	0.00
Deltebre	**41.28**	41.28	0.00
Escala	**99.99**	41.00	58.99
Esparreguera	**65.86**	65.86	0.00
Esplugues de Llobregat	**90.34**	90.34	0.00
Figueres	**94.17**	94.17	0.00
Franqueses del Vallès	**58.24**	58.24	0.00
Gironella	**100.00**	100.00	0.00
Hospitalet de Llobregat	**100.00**	100.00	0.00
Igualada	**69.06**	67.38	1.68
Llagosta	**80.83**	80.83	0.00
Llagostera	**100.00**	100.00	0.00
Lliçà d'Amunt	**100.00**	100.00	0.00
Malgrat de Mar	**100.00**	93.34	6.66
Manresa	**80.91**	80.91	0.00
Martorell	**57.34**	57.34	0.00
Masnou	**67.08**	67.08	0.00
Molins de Rei	**55.71**	55.71	0.00
Mollerussa	**84.45**	84.45	0.00
Montcada i Reixac	**64.70**	64.70	0.00
Montmeló	**100.00**	100.00	0.00
Navarcles	**59.43**	59.43	0.00

Table 3 (Cont.)
Technical Efficiency Results

Unit	**Third Stage**	First Stage	Difference
Navàs	**100.00**	100.00	0.00
Olot	**62.55**	61.45	1.10
Palafrugell	**50.56**	50.56	0.00
Palau de Plegamans	**41.78**	41.78	0.00
Pallejà	**50.71**	50.71	0.00
Piera	**100.00**	100.00	0.00
Prat de Llobregat	**74.76**	74.76	0.00
Premià de Dalt	**47.58**	47.58	0.00
Premià de Mar	**73.38**	73.38	0.00
Ripollet	**100.00**	100.00	0.00
Roquetes	**41.95**	41.95	0.00
Rubí	**97.99**	97.99	0.00
Sabadell	**99.96**	99.86	0.10
Sallent	**65.80**	65.80	0.00
Salou	**61.20**	61.20	0.00
Salt	**100.00**	100.00	0.00
Sant Adrià de Besòs	**100.00**	100.00	0.00
Sant Andreu de la Barca	**75.48**	64.28	11.20
Sant Boi de Llobregat	**100.00**	100.00	0.00
Sant Celoni	**60.26**	60.26	0.00
Sant Cugat del Vallès	**100.00**	100.00	0.00
Sant Feliu de Llobregat	**52.77**	52.77	0.00
Sant Fruitós de Bages	**78.22**	78.22	0.00
Sant Joan Despí	**95.42**	95.42	0.00
Santa Coloma de Farners	**99.71**	99.71	0.00
Santpedor	**100.00**	100.00	0.00
Sénia	**83.11**	83.11	0.00
Solsona	**48.55**	48.55	0.00
Tarragona	**72.36**	72.36	0.00
Terrassa	**100.00**	100.00	0.00
Tiana	**45.46**	45.46	0.00
Tordera	**82.47**	82.47	0.00
Torredembarra	**53.04**	53.04	0.00
Tortosa	**55.16**	55.16	0.00
Vallirana	**68.06**	68.06	0.00
Valls	**53.25**	53.25	0.00
Viladecans	**100.00**	100.00	0.00
Average efficiency	**77.33**	76.24	1.09

Table 4
Technical Efficiency Results (Third Stage)

Efficient Units	Number of appearances in the reference sets
Capellades	**22**
Llagostera	**22**
Ripollet	**21**
Sant Adrià de Besòs	**18**
Santpedor	**15**
Calella	**14**
Lliçà d'Amunt	**13**
Hospitalet de Llobregat	**11**
Gironella	**7**
Salt	**6**
Malgrat de Mar	**5**
Viladecans	**4**
Sant Cugat del Vallès	**3**
Navàs	**2**
Sant Boi de Llobregat	**2**
Badalona	**1**
Terrassa	**1**
Piera	**0**
Montmeló	**0**
Number of Efficient Units	**19**
Average Efficiency	**77.33**

Table 5
Cost Efficiency Results

Unit	**Third Stage**	First Stage	Difference
Alcanar	**79.29**	73.53	5.76
Almacelles	**100.00**	83.07	16.93
Badalona	**68.13**	68.13	0.00
Balaguer	**29.95**	29.95	0.00
Banyoles	**81.75**	81.75	0.00
Barberà del Vallès	**49.78**	49.78	0.00
Blanes	**48.42**	48.42	0.00
Calella	**54.07**	52.91	1.16
Canovelles	**19.79**	19.79	0.00
Capellades	**63.08**	63.08	0.00
Cardedeu	**53.27**	52.45	0.82
Cardona	**44.98**	44.98	0.00
Cassà de la Selva	**82.21**	82.12	0.09
Castellar del Vallès	**48.62**	46.89	1.73
Constantí	**100.00**	100.00	0.00
Deltebre	**50.51**	50.51	0.00
Escala	**16.71**	15.14	1.57
Esparreguera	**55.60**	55.60	0.00
Esplugues de Llobregat	**27.58**	27.58	0.00
Figueres	**53.92**	53.92	0.00
Franqueses del Vallès	**21.87**	21.87	0.00
Gironella	**64.29**	64.29	0.00
Hospitalet de Llobregat	**100.00**	100.00	0.00
Igualada	**32.19**	27.51	4.68
Llagosta	**52.98**	50.08	2.90
Llagostera	**69.28**	69.28	0.00
Lliçà d'Amunt	**49.94**	45.55	4.39
Malgrat de Mar	**100.00**	49.83	50.17
Manresa	**64.29**	64.29	0.00
Martorell	**56.26**	56.26	0.00
Masnou	**38.52**	38.52	0.00
Molins de Rei	**24.60**	24.60	0.00
Mollerussa	**77.49**	77.49	0.00
Montcada i Reixac	**58.94**	58.94	0.00
Montmeló	**71.30**	65.80	5.50
Navarcles	**100.00**	100.00	0.00

Table 5 (Cont.)
Cost Efficiency Results

Unit	**Third Stage**	First Stage	Difference
Navàs	**100.00**	100.00	0.00
Olot	**20.34**	18.57	1.77
Palafrugell	**15.40**	15.31	0.09
Palau de Plegamans	**43.23**	42.07	1.16
Pallejà	**43.53**	43.53	0.00
Piera	**36.20**	36.20	0.00
Prat de Llobregat	**51.97**	51.97	0.00
Premià de Dalt	**45.24**	45.24	0.00
Premià de Mar	**37.44**	37.44	0.00
Ripollet	**20.41**	20.41	0.00
Roquetes	**66.73**	66.73	0.00
Rubí	**66.51**	66.51	0.00
Sabadell	**90.15**	89.10	1.05
Sallent	**76.16**	76.16	0.00
Salou	**55.14**	55.14	0.00
Salt	**85.71**	85.71	0.00
Sant Adrià de Besòs	**100.00**	100.00	0.00
Sant Andreu de la Barca	**64.65**	37.37	27.28
Sant Boi de Llobregat	**100.00**	100.00	0.00
Sant Celoni	**92.97**	90.60	2.37
Sant Cugat del Vallès	**64.38**	64.38	0.00
Sant Feliu de Llobregat	**31.05**	31.05	0.00
Sant Fruitós de Bages	**38.51**	35.18	3.33
Sant Joan Despí	**55.91**	55.86	0.05
Santa Coloma de Farners	**40.79**	40.79	0.00
Santpedor	**66.47**	66.47	0.00
Sénia	**76.48**	76.48	0.00
Solsona	**93.18**	93.18	0.00
Tarragona	**75.36**	75.36	0.00
Terrassa	**94.03**	94.03	0.00
Tiana	**47.30**	47.30	0.00
Tordera	**19.68**	19.68	0.00
Torredembarra	**47.77**	47.77	0.00
Tortosa	**33.30**	33.30	0.00
Vallirana	**43.43**	43.43	0.00
Valls	**21.49**	21.49	0.00
Viladecans	**84.58**	84.58	0.00
Average efficiency	**58.29**	56.47	1.82

Table 6
Cost Efficiency Results (Third Stage)

Efficient Units	Number of appearances in the reference sets
Sant Adrià de Besòs	**54**
Navàs	**26**
Navarcles	**22**
Sant Boi de Llobregat	**14**
Constantí	**7**
Almacelles	**6**
Hospitalet de Llobregat	**4**
Malgrat de Mar	**0**
Number of Efficient Units	**8**
Average Efficiency	**58.29**

Table 7
Best Practices Summary

Efficient Units	**Technical Efficiency**	**Cost Efficiency**
Hospitalet de Llobregat	**100.00**	**100.00**
Malgrat de Mar	**100.00**	**100.00**
Navàs	**100.00**	**100.00**
Sant Adrià de Besòs	**100.00**	**100.00**
Sant Boi de Llobregat	**100.00**	**100.00**
Constantí	**99.95**	**100.00**
Terrassa	**100.00**	**94.03**
Salt	**100.00**	**85.71**
Viladecans	**100.00**	**84.58**
Montmeló	**100.00**	**71.30**
Sabadell	**99.96**	**90.15**
Cassà de la Selva	**89.71**	**82.21**
Mollerussa	**84.45**	**77.49**
Sénia	**83.11**	**76.48**
Banyoles	**78.50**	**81.75**
Tarragona	**72.36**	**75.36**

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