



# Service Delivery Forms and Cost Efficiency in Spanish Local Government

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Programa Oficial de Doctorado en Ciencias Económicas y Empresariales



Universidad de Granada





UNIVERSIDAD DE GRANADA

Facultad de Ciencias Económicas y Empresariales

Departamento de Economía Financiera y Contabilidad

**TESIS DOCTORAL**

**SERVICE DELIVERY FORMS AND COST EFFICIENCY  
IN SPANISH LOCAL GOVERNMENT**

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Granada, 2014

Editor: Universidad de Granada. Tesis Doctorales  
Autor: Gemma Pérez López  
ISBN: 978-84-9125-022-7  
URI: <http://hdl.handle.net/10481/39786>



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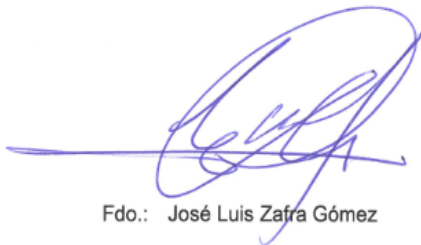
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*A mi familia*





## Ítaca

*Cuando emprendas tu viaje a Ítaca  
pide que el camino sea largo,  
lleno de aventuras, lleno de experiencias.  
No temas a los lestrigones ni a los cíclopes  
ni al colérico Poseidón,  
seres tales jamás hallarás en tu camino,  
si tu pensar es elevado, si selecta  
es la emoción que toca tu espíritu y tu cuerpo.  
Ni a los lestrigones ni a los cíclopes  
ni al salvaje Poseidón encontrarás,  
si no los llevas dentro de tu alma,  
si no los yergue tu alma ante ti.*

*Pide que el camino sea largo.  
Que muchas sean las mañanas de verano  
en que llegues -¡con qué placer y alegría!-  
a puertos nunca vistos antes.  
Detente en los emporios de Fenicia  
y hazte con hermosas mercancías,  
nácar y coral, ámbar y ébano  
y toda suerte de perfumes sensuales,  
cuantos más abundantes perfumes sensuales puedas.  
Ve a muchas ciudades egipcias  
a aprender, a aprender de sus sabios.*

*Ten siempre a Ítaca en tu mente.  
Llegar allí es tu destino.  
Mas no apresures nunca el viaje.  
Mejor que dure muchos años  
y atracar, viejo ya, en la isla,  
enriquecido de cuanto ganaste en el camino  
sin aguantar a que Ítaca te enriquezca.*

*Ítaca te brindó tan hermoso viaje.  
Sin ella no habrías emprendido el camino.  
Pero no tiene ya nada que darte.*

*Aunque la halles pobre, Ítaca no te ha engañado.  
Así, sabio como te has vuelto, con tanta experiencia,  
entenderás ya qué significan las Ítacas.*

K. P. Kavafis. Antología poética.

Alianza Editorial, Madrid 1999.

Edición y traducción, Pedro Bádenas de la Peña.



## **AGRADECIMIENTOS**

Quisiera con estas palabras expresar mi más profundo y sincero agradecimiento a todas aquellas personas que de un modo u otro han contribuido en la realización del presente trabajo.

En primer lugar, me gustaría agradecer a los miembros del tribunal su disposición a formar parte de él, ya que es para mí un gran honor contar con la presencia de unos profesionales de tan alto prestigio.

Igualmente, quiero reconocer en estas líneas el trabajo realizado por mis directores de tesis: Dr. D. Diego Prior y Dr. D. José Luis Zafra Gómez. He tenido la gran suerte de aprender durante estos años de dos de los mejores investigadores, tanto a nivel nacional como internacional. Ha sido para mí un gran honor contar con su ayuda y dirección, así como trabajar con ellos. En especial, quisiera manifestar mi agradecimiento a D. Diego Prior por enseñarme todo lo necesario sobre la metodología aplicada en este trabajo y por su buena disposición y acogida cada vez que he ido a la Universidad Autònoma de Barcelona, así como todos sus comentarios y sugerencias, de los que siempre he podido aprender algo. A D. José Luis Zafra quisiera agradecerle, por un lado, todo su esfuerzo y el cariño con el que ha realizado su labor de dirección. Por otro lado, quisiera agradecerle su amistad, porque antes que director fue amigo y compañero y ha sido para mí todo un privilegio contar con él. Por todos estos motivos, y por la tan buena sintonía que existe entre los tres, espero seguir trabajando y aprendiendo junto a ellos en el futuro.

También, quisiera manifestar mi más profundo agradecimiento a D. Juan A. Máñez, de la Universidad de Valencia, por toda su ayuda prestada con la metodología aplicada en este trabajo.

Asimismo, quisiera dejar constancia de mi agradecimiento a D. Manuel Catilla, con quién pude trabajar durante el último curso de mis estudios universitarios y a D. Antonio M. López Hernández por haber confiado en mí cuando terminé dichos estudios universitarios. Ambos me abrieron las puertas a tan maravillosa profesión.

Por otro lado, quiero agradecer a Dña. Teresa García Valderrama su ayuda para que pudiera contactar con el prof. Dr. Tom Groot, a quién también quisiera manifestar mi más sincero agradecimiento por su asistencia prestada durante mi estancia en Ámsterdam y a Dr. Tjerk Budding, su disposición para iniciar una línea de investigación conjunta. También a todos los compañeros de la Vrije Universiteit, en especial a Dr. Raymond Gradus y a Patrizia Abinta. Por otro lado, a Beatriz Minguela, de la Universidad Complutense de Madrid, agradecerle los buenos momentos compartidos durante nuestra estancia en la Vrije Universiteit, fue una gran suerte que coincidiéramos allí.

No me olvido de mis compañeros del Departamento de Economía Financiera y Contabilidad, quienes siempre han tenido una palabra de ánimo para mí y han estado dispuestos a ayudarme. En especial, quisiera agradecer al equipo de dirección, representado por D. José Manuel Aguayo, su apoyo durante estos años y a todos los compañeros con los que he tenido el placer de compartir asignatura, porque he podido, y puedo, contar siempre con ellos. También quisiera agradecer a mis compañeros del “G6”, ahora renombrado “G6+1”, su acogida y cariño en esta pequeña familia y a José Antonio, que siempre me ayuda (y me aguanta) con todos los temas administrativos.

Una mención especial merece D. David Ortiz, con quién inicié mi experiencia investigadora y del que pude aprender durante los primeros años del doctorado. De él, además de su profesionalidad, quisiera destacar su calidad humana. Es un gran honor tenerlo como compañero y amigo. También quisiera agradecerle a las “contapluses”, a

mi “vecino” y a Esteban su amistad y cariño. A Laura, por las risas y las interminables conversaciones mientras trabajábamos en el despacho, tan interminables que teníamos que aislarnos la una de la otra para poder trabajar. A Eva, que es la alegría y positivismo personificado, quisiera darle las gracias por ser como es. A Ana, con quién inicié mis estudios de doctorado y con quién tengo el placer de trabajar día a día, quisiera agradecerle su alegría. A Raquel, con quién pude compartir despacho, darle las gracias por los buenos momentos compartidos. Y, por último, tanto a Paco como a Esteban agradecerles que siempre estén dispuestos a escucharme y a ayudarme.

Además darle las gracias a mis antiguos compañeros del despacho D-06, Estrella Gómez, José Manuel Mansilla y Luis Enrique Pedauga que siempre me han ayudado con Stata. Hacer extensivo mi agradecimiento a otros compañeros con los que he compartido muy buenos momentos: Vera, José, Mati y Jenny y, a Javier Delgado, quién depositó su confianza en mí para participar en su proyecto de innovación docente y por estar dispuesto siempre a ayudarme.

Saliendo del ámbito profesional, quisiera agradecerle a mis amigos y familia todo el apoyo que me dan cada día porque este viaje no hubiera sido lo mismo sin ellos. De mis amigos, Miriam, Manolo, Pablo, Alfonso, María, M<sup>a</sup> Carmen, Pedro, Caro, Patri y Pili, solo puedo decir que tengo una suerte inmensa por poder contar con ellos. Siempre han estado en los buenos y malos momentos, han compartido mis alegrías y mis penas, hemos reído y llorado juntos. Por todo ello, gracias. En especial, quiero agradecerle a Pablo el trabajo realizado con la portada de esta tesis, nadie mejor que él podría haberse encargado de ello.

A mi familia, que es lo más importante para mí, darle las gracias por su comprensión y aceptarme tal y como soy. A mi tía Inma y a mi prima Inma, que son como una madre y una hermana, darle las gracias por todos los buenos momentos

compartidos. A mi abuela Luisa, que es para mí un gran ejemplo a seguir por su fuerza y tenacidad y a mi yeya Maruja, una mujer de una gran personalidad, quisiera darles las gracias por todo lo que me han enseñado. A Macarena, Paquita, Bea, Álvaro y Leopoldo, por todo el cariño que me dan y por acogerme como una más en la familia, en especial, quiero darle las gracias a Maca, que tiene un lugar muy especial en mi corazón.

A Leo, quisiera darle las gracias por su infinita comprensión, por aguantar mis cambios de humor, por animarme siempre, por saber comprender mis silencios, por apoyarme y por confiar en mí. No hay día que no agradezca haberte conocido.

A mi madre quisiera darle las gracias por apoyarme siempre, aún sin estar de acuerdo conmigo. Porque es para mí un ejemplo a seguir por su bondad y su amor, por su fuerza y su valentía. Por ser mi mejor amiga, y no solo mi madre. Gracias.

A mis hermanos, Juan Ángel, Rafa y Arturo, porque si hubiera podido elegirlos, los hubiera elegido a ellos y a Miriam, que es para mí una hermana mayor. A los cuatro, gracias por protegerme dejando que cometiera mis propios errores, por comprenderme y respetarme. Y a mis dos amores que son mis sobrinos: Ana y Rafa, porque con una sonrisa hacen que el peor de mis días se inunde de alegría.

Ya para terminar, quisiera dedicarle este trabajo a mi padre, porque siempre supo, incluso antes que yo misma, que me dedicaría a esta profesión. Él no puede leer ya estas palabras, pero sé que está siempre a mi lado cuidándome y guiando mis pasos. A él he de agradecerle todo el esfuerzo que realizó para educarnos y cuidarnos. Espero que donde quiera que esté pueda sentirse orgulloso.

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## **RESUMEN**

En los últimos años, dentro del marco de la doctrina de la Nueva Gestión Pública (NGP), los gobiernos locales han asistido a un proceso de reforma de los servicios públicos, con el principal objetivo de mejorar la eficiencia municipal. Esta situación, ha favorecido la construcción de un entramado de estructuras organizativas de muy diversa naturaleza a través de la creación de agencias o descentralización horizontal, la externalización de los servicios y la cooperación con el sector privado y con otros municipios, entre otras. Como resultado de este proceso de reforma, distintas alternativas de prestación de servicios públicos conviven en el seno de la entidad municipal. En este contexto, resulta fundamental conocer el impacto que estas estructuras han producido sobre la eficiencia en costes de las entidades locales.

El estudio de la relación entre eficiencia en costes municipal y formas de gestión puede hacerse desde una doble vertiente. Por un lado, es posible analizar la eficiencia en costes del municipio en su conjunto y, por otro, la eficiencia específica de un servicio público. En concreto, la necesidad de llevar a cabo estudios que analicen desde esta doble perspectiva la relación entre eficiencia en costes y formas de gestión de los servicios públicos locales se debe a la existencia de varios factores. En primer lugar, la evidencia empírica sobre la relación entre las distintas alternativas de prestación propuestas por la NGP y la eficiencia en costes del municipio – considerado en su conjunto – es limitada. Además, los estudios realizados en este sentido no consideran el



diferente entramado de alternativas de gestión del municipio, sino que están más centrados en analizar la relación entre un determinado tipo de forma de gestión y la eficiencia conjunta municipal. Por el contrario, los estudios de servicios específicos contemplan distintas formas de prestación en el análisis de la eficiencia en los gobiernos locales. No obstante, la relación entre eficiencia específica de los servicios públicos locales y formas de gestión requiere un análisis más detallado, que permita determinar qué forma de gestión resulta más adecuada en un determinado servicio considerando la dimensión del municipio. Asimismo, los estudios realizados hasta la fecha sobre la eficiencia específica de un servicio y formas de gestión ponen de manifiesto para un determinado período qué forma de gestión obtiene un menor coste pero, no evalúan la relación causa-efecto que un cambio en la forma de gestión del servicio presenta sobre la eficiencia en costes de ese servicio.

Así, el primero de los objetivos que se plantea es analizar de manera conjunta cómo las diferentes alternativas de prestación de los servicios locales afecta a la eficiencia en costes global del municipio. En este sentido, el primer estudio obtiene, a través de la aplicación de fronteras parciales no paramétricas y la regresión truncada propuesta por Simar y Wilson (2007), evidencia sobre la relación que las diferentes formas de gestión de los servicios propuestas por la NGP tienen sobre la eficiencia global del municipio y el efecto que diferentes escenarios económicos tienen sobre esta relación. Así, los resultados sugieren que, en términos generales, las fórmulas planteadas por la NGP reducen la eficiencia global del municipio, cuando el contexto económico es estable; mientras que durante períodos de inestabilidad económica, estas alternativas tienden a mejorar la eficiencia del municipio. En concreto, los resultados evidencian que la creación de empresas mixtas contribuye a obtener mejores niveles de eficiencia municipal tanto en períodos de estabilidad económica como de recesión.

No obstante, con este tipo de estudios no es posible identificar de manera concreta qué forma de gestión resulta más conveniente – en términos de eficiencia en costes – en la prestación de cada uno de los servicios públicos. Por lo que, en el segundo estudio se plantea el análisis de la eficiencia de un servicio concreto: el servicio de recogida de residuos, ya que se trata de uno de los servicios de mayor complejidad e importancia presupuestaria y medioambiental. Así, el segundo objetivo consiste en analizar qué alternativa de prestación del servicio obtiene mejores niveles de eficiencia en costes, considerando además la diferente dimensión de los municipios. Para ello, se aplica, además de las fronteras parciales no paramétricas, el concepto de metafrontera desarrollado por Battese y Rao (2002) y Battese et al. (2004). Así, de la comparación de la frontera derivada de la eficiencia en costes de cada una de las formas de gestión con la frontera conjunta creada con la totalidad de los municipios, es posible determinar qué forma de gestión obtiene mejores niveles de eficiencia. En este sentido, los resultados sugieren que las fórmulas de cooperación intermunicipal son, en términos generales, más adecuadas en la prestación del servicio de recogida de residuos. No obstante, cuando la dimensión municipal es tomada en cuenta, se observa que las fórmulas de cooperación son más convenientes en los municipios de menor tamaño; mientras que, en los municipios que cuentan con una población superior a 20.000 habitantes, la externalización del servicio obtiene mayores niveles de eficiencia en costes.

Sin embargo, estos resultados únicamente reflejan qué alternativa obtiene mejores niveles de eficiencia en el servicio de recogida de residuos para un año concreto y, aunque la literatura previa haya manifestado la necesidad de considerar la dimensión temporal en el análisis de la relación entre eficiencia de los servicios y formas de gestión, hasta la fecha no se han llevado a cabo estudios en este sentido. Por tanto, el

tercer objetivo que se plantea es analizar desde una perspectiva dinámica la relación causa-efecto que la implantación de la externalización de recogida de residuos presenta en la eficiencia del servicio. En este caso, el tercer estudio propone una nueva aproximación metodológica a través de la aplicación de un análisis en dos etapas, compuestas de un lado, por la estimación de la eficiencia en costes del servicio a través de fronteras parciales no paramétricas y el concepto de fronteras intertemporales y, de otro, por la aplicación de la técnica del *matching*. Así, los resultados obtenidos evidencian que durante el primer año en que la externalización es implantada en el servicio de recogida de residuos la eficiencia en costes del servicio disminuye. Sin embargo, a partir del cuarto año de implantación la eficiencia en costes aumenta, llegando incluso a compensar las pérdidas obtenidas durante el primer año.

La elaboración del presente trabajo permite, dada la diferente naturaleza de los estudios realizados, contribuir desde distintas perspectivas a la literatura existente sobre la relación de las formas de gestión y la eficiencia en costes de los gobiernos locales. En este sentido, cuando esta relación se analiza desde el punto de vista global del municipio, se pone de manifiesto que el uso de las formas de gestión propuestas por la NGP empeora en general la eficiencia municipal. Por otro lado, se determina qué forma de gestión del servicio de recogida de residuos es más eficiente según la dimensión del municipio, así como, se pone de manifiesto la existencia de un determinado tamaño poblacional a partir del cual resulta más aconsejable acudir a la externalización del servicio. Finalmente, se demuestra la necesidad de analizar la relación eficiencia-externalización desde una perspectiva dinámica, determinando de esta forma la relación causa-efecto de la misma, contribuyendo así a la literatura que trata de analizar la efectividad de la externalización del servicio de recogida de residuos.

Todo ello ha sido validado para el contexto español pero, con el presente trabajo se abren además nuevas vías en la investigación de la eficiencia en costes de las diferentes formas de gestión de los servicios públicos locales, que requieren validación en otros países, dado que la cultura administrativa y el contexto socioeconómico puede dar lugar a resultados diferentes.



# **CHAPTER 1: INTRODUCTION**



## **INTRODUCTION**

The efficient management of public resources is a particularly important issue in local government (Geys and Moesen 2009) due to its proximity to the citizen as a provider of public services and to the severe budgetary constraints currently faced. In recent decades, as the number of public services provided by local authorities has increased, reforms have been undertaken to achieve greater accountability, transparency and efficiency.

This process of vertical decentralisation (national, regional and local government) has at the same time involved a horizontal decentralisation at the local level, due to the increased powers assumed. The aim of this reform is to achieve greater flexibility and to improve the efficiency of public administrations, as well as to apply certain techniques and procedures borrowed from the private sector (Hood 1995; Christensen and Læg Reid 2011). This process has been termed New Public Management (NPM), and is inspired by ideas such as managerialism, public choice theory, neo-liberalism, agency theory and the theory of transaction costs (Boston 2011; Christensen



and Lægreid 2011). A major tenet of NPM is that “management matters” (Verhoest et al. 2010).

In local government, measures based on NPM, seeking to obtain greater efficiency, have been adopted, for example, through the introduction of various alternatives for the provision of public services (Pollitt and Bouckaert 2004a; Andrews 2011; Andrews and Entwistle 2013; Andrews and Van de Walle 2013). For this purpose, NPM draws on the tenets of the theory of public choice (Niskanen 1971; Savas 1987), the managerialist tradition (Osborne and Gaebler 1992), economies of scale (Donahue 1989) and the theory of transaction costs (Coase 1937; Williamson 1981), which proposed the following main alternatives: decentralisation (or the creation of public agencies) (Hood 1995); the contracting out of local public services (Moore 1987; Hood 1995); public-private partnerships (Bel and Fageda 2010a); or collaboration with other municipalities (Bel and Fageda 2006; Warner 2006). Thus, public managers have a wide range of alternatives for the provision of local services, and their choice will depend on the type of service to be provided and on the specific characteristics of the municipality, including its size (Ferris and Graddy 1986; Brown and Potoski 2003a, 2005; Rodrigues et al. 2012; Zafra-Gómez et al. 2013; Bel et al. 2014).

Traditionally, studies of the relationship between local government efficiency and the management forms for public services have focused on the dichotomy between public and private production (Dubin and Navarro 1988; Dijkgraaf et al. 2003; Balaguer-Coll et al. 2010; Simões and Marques 2012), and no general agreement has been reached in this respect (Bosch et al. 2000). In recent research this analysis has been extended to new forms of management such as public-private partnerships (Marra 2007; Warner and Hefetz 2008; Bel and Fageda 2010a; Greve and Hodge 2011; Brown et al.

2012) or cooperation between municipalities (Warner and Hebdon 2001; Dijkgraaf and Gradus 2003, 2013; Bel and Mur 2009; Mohr et al. 2010; Zafra-Gómez et al. 2013). However, empirical evidence on the cost efficiency improvements gained from different forms of management is limited and even contradictory (Andrews 2011; Andrews and Van de Walle 2013; Hood and Dixon 2013; Cuadrado-Ballesteros et al. 2013). Moreover, these previous studies mainly focus on analysing one or two alternatives, and few have conducted a joint analysis of various management alternatives in relation to the efficiency of local public services (Bel and Fageda 2010a; Simões et al. 2013; Cuadrado-Ballesteros et al. 2013; Zafra-Gómez et al. 2013).

In view of these considerations, the main motivation for the present study is to extend the analysis made of the impact of different forms of management for local public services on the cost efficiency of municipalities, considering a broad range of alternatives. The results obtained could facilitate decision making by the managers of local government public services. In addition, we propose several alternative methods for studying the effects on efficiency of these different ways of managing local public services.

Local government efficiency can be studied from various standpoints because, in the economic context, efficiency can be defined in different terms (Hood and Dixon 2013). Therefore, we must first establish the concept of efficiency that is being referred to. On the one hand, we can speak of technical efficiency or of economic (or cost) efficiency, depending on which magnitudes are taken for measurement, i.e., physical units of production or economic magnitudes (Woodbury and Dollery 2004).

On the other hand, depending on the scope of analysis of this efficiency measure, we may refer to the overall efficiency of the public services provided by local

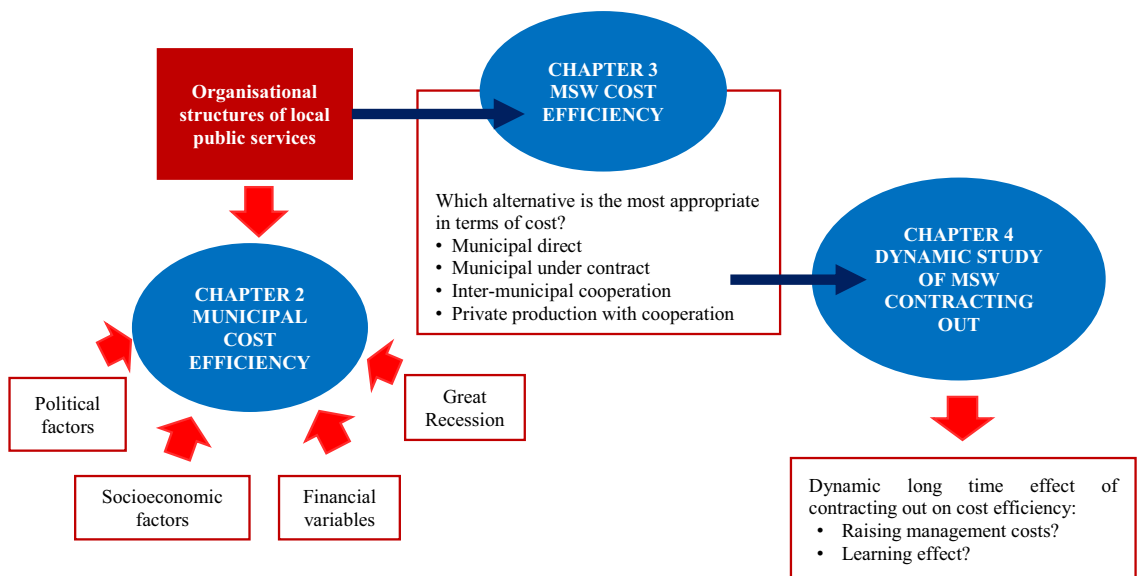
government (De Borger and Kerstens 1996a, 1996b; Giménez and Prior 2003, 2007; Vanden Eeckaut et al. 1993; Worthington 2000; Afonso and Fernandes 2008; Balaguer-Coll et al. 2007; Borge et al. 2008; Bosch et al. 2012) or to the specific efficiency of each service (Bosch et al. 2000; García-Sánchez 2008; Benito-López et al. 2011; Benito et al. 2012; Zafra-Gómez et al. 2013). Within the latter category, that of municipal solid waste (MSW) service is one of the most commonly studied in the literature, due to the complexity of its provision and the considerable cost involved; moreover, there are increasing environmental concerns in this respect (Bel and Fageda 2010b; Benito-López et al. 2011; Simões and Marques 2012; De Jaeger and Rogge 2013; Jacobsen et al. 2013; Zafra-Gómez et al. 2013).

Accordingly, in the present thesis we consider three main objectives, related to the analysis of the relation between cost efficiency – measured as the ratio of municipal expenditure to the outputs of the services provided – and different forms of management of local public services, using for each case different measures of efficiency, namely the overall efficiency and the specific efficiency of each service. To achieve these goals, three different studies were carried out (Figure 1).

In the first study, we examine how the organisation of local public services under different forms of management affects the cost efficiency of these municipalities as a whole, i.e., with respect to all the public services provided by the local authority. In the second analysis, a different approach is taken to assessing the performance of the public sector, and we focus on the relationship between the specific efficiency of a particular service – MSW – and the form of management by which it is provided. This method enables us to analyse the particular characteristics of the relation between service efficiency and management method applied. Finally, in the third study, a

dynamic analysis is made of the effects on MSW cost efficiency resulting from contracting out the service. This analysis evaluates the period from the year prior to the change until three years afterwards, and represents a new methodological approach to this kind of study, producing a considerable improvement in the cause-and-effect analysis of the contracting out of local public services because, traditionally, this type of study has been limited to the evaluation of a single year.

*Figure 1. Structure of the thesis*



*Source: The author*

In Chapter 2, the main objective is to analyse whether different organisational structures presented by municipalities contribute to efficiency improvements in the organisation's overall performance. Thus, we obtain an initial general impression of the relationship between management forms and cost efficiency. In this analysis, it is taken into account that the study period covers the first years of the current financial and economic crisis (known as the Great Recession) and that the objectives of improving efficiency and reducing the costs of local public services have become even more pressing with this crisis (Broadbent 2010; Andrews 2011). We seek to contribute to the

debate on NPM and to provide empirical evidence either of the greater effectiveness of the management methods proposed under this doctrine or, on the contrary, that of the tenets of post-NPM (Christensen and Lægreid 2007) or new Weberian administration (Pollitt 2009), according to which local public services should be recentralised and the size of the local public sector reduced.

After this first consideration of municipal cost efficiency and its relationship with organisational structures, our analysis then focuses on the efficiency of a particular service. Thus, the third chapter examines which management form of the MSW service is most suitable in terms of cost efficiency. This specific service was chosen for analysis due to its budgetary importance and to the complexity inherent to its provision, as acknowledged in previous studies in this respect carried out in the European context (Simões and Marques 2012; Jacobsen et al. 2013) and in Spain (Zafra-Gómez et al. 2013).

As discussed above, most previous studies of service delivery forms have focused on the distinction between public and private management. However, the complexity of the MSW service and the variety of types of municipalities that provide it led us to consider other alternatives, such as inter-municipal cooperation, which mostly takes place among smaller municipalities (Bel and Fageda 2006, 2008; Bel et al. 2014).

There are several reasons why small municipalities should prefer joint service-provision management. First, private operators are often reluctant to operate in small municipalities, where economies of scale may not be achieved (Kodryzski 1994; Warner and Hefetz 2003). Second, the municipality might incur higher costs if the service were provided directly (Bel and Fageda 2006, 2008; Mohr et al. 2010; Zafra-Gómez et al. 2013). Moreover, several municipalities could combine their resources and

obtain economies of scale and cost savings (Warner and Hefetz 2003; Dijkgraaf et al. 2003; Warner 2006; Zullo 2009). In addition, a joint operation among municipalities could be managed either through a public agency or contracted out to a private operator (Zafra-Gómez et al. 2013; Bel et al. 2014). In the latter case, the municipalities would also obtain cost advantages from the private management of the service, and the offer would be more attractive for the private operator. However, the fact that entities of different sizes may be involved could influence the level and quantity of services provided, and this would require us to perform the efficiency analysis in greater detail. Therefore, the present study examines the question of cost efficiency in the management of the MSW service in relation to the population size of the municipality.

The proposed approach, to evaluate cost efficiency according to the population size of the municipalities involved, responds to a perceived research gap in this respect, which would be so even if the study were restricted to the analysis of a single year. However, according to our review of the literature, there is also a need for research focusing on the dynamic evaluation of efficiency, when a change takes place from one delivery mode to another. This is so because most prior research has analysed whether the introduction of private sector management increases or decreases efficiency in a given year. However, the results of these studies are inconclusive (Bel et al. 2010c), and the empirical evidence remains unclear. Thus, in some cases efficiency is reported to have improved (Kitchen 1976; Tickner and McDavid 1986; Hodge 2000; Reeves and Barrow 2000; Simões et al. 2012) while in others it has worsened (Stevens 1978; Dubin and Navarro 1988; Ohlsson 2003; Bel and Fageda 2010b). This phenomenon might be explained by the fact that the measures for these studies were obtained at different stages of the implementation of contracting out.

There is a need to explore the nature of the phenomenon and the methodological issues that characterise the study of these processes, for various reasons. First, as noted above, most previous studies are of a cross-cutting nature, and therefore the data used may have been compiled at different stages – at the start, during the consolidation or on conclusion of the contracting out. And in each of these periods, different levels of efficiency may be observed. Furthermore, any implementation of a process of this nature requires a learning period or practical experience before it becomes fully operational.

In view of these premises, a new methodological stage must be created to properly evaluate processes of contracting out and to reflect the true dynamic nature of this phenomenon, taking into account the entire period from when the process was begun until a subsequent moment at which its ultimate effects can be appreciated. For this reason, Chapter 4 presents a methodological proposal for a dynamic analysis of the contracting-out process, considering a broad time horizon, and its impact on the cost efficiency of the MSW service.

Among the forms in which this service can be managed, contracting out is one of the most commonly used, among other reasons for the possibility it offers of achieving efficiency improvements and cost savings (Greene 1996a; Warner and Hedbon 2001; Brown and Potoski 2005), and in consequence it has been widely studied (Bel et al. 2010c). Nevertheless, the results of previous research in this field in the international context are inconclusive. Another justification for the present study is that the current economic crisis has led to contracting out being proposed as a means of improving the efficiency of local public services.

Therefore, taking into account the temporal dimension of the contracting-out process (Bel and Fageda 2007; González-Gómez and Guardiola 2008) and considering the theory of organisational learning (Fiol and Lyles 1985; Argote 2011) and the experience curve (Wright 1936; Hirsch 1952; Spence 1981; Dutton and Thomas 1984), we propose a new approach to this phenomenon, in which we examine the cause-effect relationship between contracting out and cost efficiency in MSW service over time, from the outset until three years after the start of the process. By this means it will be possible to determine whether, after the implementation of contracting out, municipalities suffer worsened levels of cost efficiency, due the impact of contract management costs, as suggested by the theory of transaction costs, and whether this inefficiency persists or decreases due to the learning process that is generated over time.

To address each of the above objectives, we examined a large sample of Spanish municipalities for which information is available on multiple variables, constructed from various databases, and referring to an extended period of time<sup>1</sup>. Specifically, this study is applied to all Spanish municipalities with a population between 1,000 and 50,000 inhabitants. This size restriction was applied in view of the limited data available for the finances and for the local public services provided in municipalities with fewer than 1,000 or more than 50,000 inhabitants.

Finally, it should be noted that the samples used in these three studies are different, because of the different characteristics of the local governments in question and the differing aims pursued in each study. These differences reside mainly in the distinction made between overall efficiency and specific efficiency. More budgetary

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<sup>1</sup> Spanish municipalities are required by law to provide a minimum range of services according to different population size but they are allowed to use whatever delivery form to provide these services (articles 26 and 85, *Ley 7/1985, de 2 de abril, Reguladora de las Bases del Régimen Local*, amended by *Ley 27/2013, de 27 de diciembre, de racionalización y sostenibilidad de la Administración Local*).



data are available when the information is aggregated, and so a larger number of municipalities were included in the sample for the analysis of overall efficiency; on the other hand, less budgetary information is available with respect to services, and thus the sample is smaller.

As for the methodology used in this thesis, various methods are used, depending on the objectives in question. However, as the common, central axis for all three studies, we apply robust partial frontiers, in the form of order- $m$  frontiers, to obtain the cost efficiency scores for each local government in the sample.

The nonparametric approach has traditionally been implemented through Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) (Cazals et al. 2002). However, the results obtained through these methodologies are overly sensitive to the presence of outliers, due to their deterministic nature (Daouia and Simar 2007), and to errors of measurement (De Witte and Marques 2010). To overcome these limitations, we propose as an alternative to use partial nonparametric frontiers, which allow the presence of super-efficient units; unlike DEA and FDH, which compare each unit with the total units sampled, order- $m$  frontiers obtain more robust results, by comparing each unit with  $m$  pairs of individuals (Simar and Wilson 2008).

Furthermore, to specifically address the goals established for each of the three studies, we propose the use of bootstrapped truncated regression, the application of the concepts of metafrontier and intertemporal frontier, and the matching methodology. Thus, in the second chapter, we apply the truncated regression proposed by Simar and Wilson (2007), with fixed effects, to analyse how municipalities' organisational structures, together with other factors, affect their overall efficiency (obtained by the application of partial nonparametric frontiers).

In the third chapter, we apply the concept of metafrontier that was developed by Battese and Rao (2002) and Battese et al. (2004) to determine which service delivery form is the most appropriate for the municipal MSW service in terms of cost efficiency.

Finally, in the fourth chapter, in order to analyse the effects produced by the contracting out of the MSW service, we first apply the concept of intertemporal frontier (Tulkens and Vanden Eeckaut 1995a) to obtain cost efficiency values that are comparable over time; thus, we can calculate the rate of variation of cost efficiency (also obtained by applying order- $m$  frontiers). In the second stage of this analysis, we apply the propensity score matching method (Rosenbaum and Rubin 1985), which compares the variation in cost efficiency obtained by municipalities that have contracted out the MSW service with the variation that would have been obtained if no such contracting out had been implemented.

This thesis, therefore, is structured into five chapters. After this first introductory chapter, the theoretical and methodological contributions of the thesis are presented, followed by the results supporting this approach, in the next three chapters. Finally, the fifth chapter sets out the main conclusions drawn from these studies and the theoretical and methodological implications with respect to cost efficiency and the forms in which public services may be managed. The limitations present in each of the different analyses are acknowledged, and possible lines of future research are suggested.



**CHAPTER 2: DO NEW PUBLIC MANAGEMENT  
DELIVERY FORMS CONTRIBUTE TO IMPROVING  
LOCAL GOVERNMENT EFFICIENCY? EXPLORING  
THE LONG-TERM EFFECT ON SPANISH  
MUNICIPALITIES**



## **1. INTRODUCTION**

As it has been explained in the previous chapter, the first study included in the thesis set out a global picture of the relationship between NPM delivery forms and cost efficiency, analysing the overall cost efficiency of all local public services in local government.

As stated before, the search for greater government efficiency within the framework of NPM is a topic of great interest in the field of public administration (Pollitt and Bouckaert 2004a; Andrews 2011; Andrews and Van de Walle 2013). In this area, local governments are no exception, since they are responsible for providing public services directly to citizens. These governments are subject to financial and budgetary constraints, and so the efficient management of municipal resources is a prime area of concern (Geys and Moesen 2009). Among the key features of the NPM doctrine is the adoption of organisational forms and management techniques from the private sector (Christensen and Læg Reid 2011), the main purpose of which is to improve the efficiency of local government (Hood 1991, 1995; Gregory 2012), originally interpreted from the perspective of cost reduction (Hood and Dixon 2013). NPM

literature is extensive and covers many areas, including performance management, accountability, decentralisation, contracting out, public-private partnerships, e-government and collaborative networks. However, there is limited empirical evidence for the effective achievement of efficiency and cost reduction that NPM is held to enable via the restructuring of public service delivery (Andrews 2011; Da Cruz and Marques 2011; Andrews and Van de Walle 2013; Hood and Dixon 2013).

Under NPM, revisions have been proposed in the management of local public services (Andrews and Entwistle 2011), instrumented through organisational changes to municipal services (Fernández and Pitts 2007; Nieto et al. 2013). In this respect, diverse strategies have been implemented, ranging from formulas that favour the management of public services by the private sector (mixed firms and contracting out) to others aimed at the decentralisation of local administration (agencification) (Andrews and Van de Walle 2013), making public organisations more like private entities (Hood 1991, 1996; Boyne 2002; Nieto et al. 2013), as well as forms of cooperation and collaboration between municipalities for the joint provision of local public services (Mohr et al. 2010).

This study aims to contribute to the analysis of the relationship between NPM delivery forms and municipal efficiency, identifying for a broad time horizon the delivery forms that would minimise municipal costs. Furthermore, we seek to establish whether the use of management forms proposed by NPM achieves greater efficiency or, conversely, provides an argument in favour of re-centralisation, as defended by the theory of neo-Weberian bureaucracy, through the creation of more integrated services (Goldfinch and Wallis 2010) in opposition of fragmented local governments (Christensen and Læg Reid 2007). Local governments can select different organisational

forms for service delivery (Hefetz and Warner 2012; Rodrigues et al. 2012) and the choices adopted may affect the efficiency and the management of the local administration (Simões et al. 2012; Bel et al. 2014).

In addition to the above, this study considers the current economic situation, to determine whether in periods of crisis (such as the Great Recession of 2008-2010) local governments seek to improve municipal efficiency and, if so, which NPM delivery form best contributes to raising levels of cost efficiency in these special circumstances. The recent financial and economic crisis has foregrounded the objectives of improving efficiency and reducing the costs of local public services as a prime area for attention in the public agenda (Andrews 2011; Hood and Dixon 2013). Local administrations in Spain, as well as in other countries, are facing considerable difficulties in the provision of public services, as the crisis has led to falling revenues and greater limitations on borrowing (López-Hernández et al. 2012), while municipalities must deal with costs that are unchanged or even higher than before. Accordingly, there is a need for a proper management of financial resources to reduce costs and improve efficiency in the delivery of public services. For this reason, local administrators are seeking new forms of organising local public services.

To achieve the aims of this study, a two-step analysis was applied to a sample of 1,058 Spanish municipalities from the 3,045 local governments with populations ranging from 1,000 to 50,000, for the period 2001 to 2010. This approach allowed us to examine which of the main NPM delivery forms are most likely to improve local government efficiency. In the first stage, using the order-*m* estimation method, we obtained a measure of the cost-efficiency of local governments. In the second phase, we analysed the factors that influence efficiency, making use of the methodology proposed



by Simar and Wilson (2007). Specifically, we considered the impact made by NPM delivery forms on cost efficiency and their relationship with other variables, such as socio-economic, financial and political factors under different economic conditions.

Thus, the current study contributes to the literature in two major respects. The first contribution is to perform a joint analysis of the relationship between cost efficiency in local services and different NPM delivery forms. To date, studies of this issue have considered only a single delivery form and/or they have been more oriented toward analysing the opposition between public and private provision (Dijkgraaf et al. 2003; Benito et al. 2010; Simões et al. 2010; Simões et al. 2012; Zafra-Gómez et al. 2013; Bel et al. 2014). The second contribution made by the present study is its consideration of different economic scenarios for the purposes of its analysis, as a result of which it is shown that the efficacy of different forms of management depends on the prevailing economic conditions. Although empirical results show that the adoption of NPM delivery forms does not generally achieve higher levels of cost efficiency, it does tend to improve cost efficiency in periods of recession, especially with respect to resource management. Specifically, the use of agencies, contracting out and inter-municipal cooperation actually reduces levels of cost efficiency in local governments in the absence of financial crisis. During the Great Recession, however, both inter-municipal cooperation and contracting out tended to improve municipal cost efficiency. Finally, the mixed firm formula is the one delivery form that contributes to improving cost efficiency in municipalities both in times of crisis and when there are no such problems. Accordingly, the post-NPM approach is more appropriate in healthy economic times.

The rest of this chapter is structured as follows. In the second section, we review the existing literature about municipal efficiency and NPM delivery forms and formulate the hypothesis proposed. Section 3 explains the effect of Great Recession and section 4 describes other determinants of the municipal efficiency. Section 5 presents the research methodology and the data used in the empirical model as well as the results obtained. Finally, in Section 6 we present the main conclusions and a brief discussion.

## **2. NPM DELIVERY FORMS AND MUNICIPAL EFFICIENCY: A REVIEW OF THE LITERATURE**

In the context of NPM, the management reform of local public services as a strategy to improve local government efficiency is based on various theories, including managerialism, public choice theory, neo-liberalism, agency theory and transaction cost theory (Christensen and Læg Reid 2011). This set of doctrines favours the decentralisation of government (Hood 1991, 1995; Osborne and Gaebler 1992) and participation by the private sector in the provision of public services, through cooperation agreements with local governments (Greve and Hodge 2011) and/or the contracting out of local services (Niskanen 1971; Savas 1987; Osborne and Gaebler 1992; Hood 1995). In addition, in recent times other forms of public service management within the NPM framework, such as inter-municipal cooperation, have also proliferated (Mohr et al. 2010; Hefetz et al. 2012a).

However, the effectiveness and impact of these measures are difficult to evaluate (Christensen and Læg Reid 2011), since not all organisational changes in public administration are aimed at improving its efficiency and effectiveness (Ter Bogt 2008); this process can give rise to organisational complexity, and requires careful coordination (Christensen et al. 2008). Studies have shown that NPM has encouraged the proliferation of overlaps between different public entities, which has led to increased

costs and reduced efficiency in the public sector (Rhodes 1996; Diefenbach 2009). As yet there is still insufficient evidence of NPM methods producing real improvement in the efficiency of different service management forms (Andrews 2011; Andrews and Van de Walle 2013; Hood and Dixon 2013).

In view of these considerations, an approach known as Post-NPM (Christensen and Lægreid 2007) or neo-Weberian administration (Pollitt 2009; Kuhlmann 2010a) has been proposed, questioning the undiluted principles of NPM and suggesting measures aimed at achieving a greater coordination of public services, by means of re-centralisation. To provide more efficient local services, re-centralisation implies a vertical and horizontal coordination in the provision of local services in contrast to the fragmentation and specialisation of local governments proposed by NPM (Christensen and Lægreid 2007). Thus, the traditional debate between public provision versus market-oriented delivery forms has returned. In this regard, Zafra-Gómez et al. (2013) suggested that some of the tenets of NPM should be reconsidered. In this respect, in the current context of crisis, apart from the various cost-cutting policies being applied, measures are being promoted to bring about a greater centralisation of local government and to reduce the overall dimensions of the public sector (Peters et al. 2011), in terms of reducing the number of specialised bodies, in order to achieve a greater degree of control and of value-based management (Pollitt and Bouckaert 2004b; Christensen et al. 2007).

NPM doctrine recommends various reform measures with respect to service delivery (Christensen and Lægreid 2011), with those most frequently recommended being agencification, contracting out, mixed firms and inter-municipal cooperation (Hood 1991, 1995; Osborne and Gaebler 1992; Mohr et al. 2010; Greve and Hodge

2011; Hefetz and Warner 2012). In the following sections, we examine the background of each of these forms and propose various hypotheses to be tested in the empirical model.

#### ***A. AGENCIFICATION***

The managerialist tradition, in particular, among the theories that have inspired NPM, favours the decentralisation and flexibilisation of public administration (Osborne and Gaebler 1992). According to these ideas, once public entities have reached a certain size, they should be split up to create new organisations (agencies) – with autonomy and an independent budget – in order to achieve their objectives in a more efficient manner (Hood 1995). The belief is that decentralised organisations will achieve better results by becoming more flexible and offering a more personalised service (Boyne 1996).

The NPM doctrine has a predisposition to decentralise (Lapsley 2008), through the creation of these agencies, devolving power to independent entities that can operate in a similar manner to private sector organisations, and which will be capable of finding innovative solutions to management problems and reducing the costs of service delivery (Osborne and Gaebler 1992), as well as improving efficiency (Hood 1991; Andrews 2011). Advocates of this approach favour specialisation, with particular agencies being created for specific activities (Christensen et al. 2008), so that executive management can have more freedom to make the organisation effective and efficient (Gregory 2009). Thus, with the decentralisation of services, better results and more personalised and accessible services will be obtained (Boyne 1996).

However, agencification is a complex and multidimensional process (Smoke 2003); it does not guarantee that higher efficiency will be attained, and unintended effects may occur (Hood and Peters 2004), together with fragmentation and loss of

coordination (James and Van Thiel 2011). In addition, municipalities that decentralise their services through the creation of agencies face worst levels of financial performance (Zafra-Gómez et al. 2012), and therefore without appropriate mechanisms to ensure accountability, agencies may become instruments through which local governments can channel their rising levels of debt (Christensen and Læg Reid 2014).

Moreover, assessing the impact of the creation of more specific, market-oriented agencies on the efficiency of local public services can be difficult, and the real autonomy of these organisations has been questioned (Hood et al. 1999). Empirical evidence measuring the effects of agencification is mixed and it is mainly focused more on evaluating changes in process than on considering the effect on efficiency (Dan 2014). In addition, the specific relation between agencification and cost efficiency in local governments is hardly ever measured. This was explained by James and Van Thiel (2011) from a two-fold standpoint: the absence of goal setting and the difficulty of establishing the output of public services. Bilodeau et al. (2007) did not find significant statistical evidence to support the hypothesis of cost efficiency gains with government agencies in Canada, while Andrews (2011), in a review of the relationship between agencies and efficiency, found that 58% of the studies in this respect did not obtain evidence of a relationship between NPM reforms and local efficiency, while the remaining 42% found a positive relationship.

In conclusion, we are unable to predetermine the sign of the relationship between the creation of agencies and the efficiency of local public services, and so the first hypothesis proposed is formulated as follows:

*H<sub>1</sub>: Agencification will have an impact on the cost efficiency of local public services*

***B. CONTRACTING OUT***

The private sector participation suggested by NPM as a means of increasing public service efficiency can take different forms, including contracting out the management of public services (Andrews and Entwistle 2011). Under this approach, the municipality keeps responsibility for the local service and its financing, but transfers service delivery to a private entity (Warner 2012). This policy can raise efficiency levels, due to potentially lower production costs and the more flexible and innovative structures of the private sector (Osborne and Gaebler 1992; Hood 1995; Bel and Fageda 2006). It also has the advantage of introducing a degree of competition into the provision of public services (Tiebout 1956; Osborne and Gaebler 1992; Warner 2012).

According to public choice theory, public administrators are rational decision makers who will seek to maximise their personal interests by increasing the budgets available to them (Niskanen 1971). As a result, they tend to monopolise the provision of public services, thus producing inefficiency (Savas 1987). In response to this situation, the introduction of competition in the provision of public services has been proposed, to reduce costs and raise technical efficiency (Bel and Fageda 2008). Under NPM, contracting out is a key tool for improving the efficiency of public services; it is believed to generate cost savings with respect to public provision, and is thus a more appropriate form of service delivery in situations of fiscal stress (Pallesen 2011).

However, empirical experience suggests that no such cost savings are achieved (Hodge 2000; Bel et al. 2010c; Berg and Marques 2011; Simões and Marques 2012), for various reasons. Firstly, public service remains within a near-monopoly regime, as a result of the absence of competition, and so there is not enough evidence of real cost savings achieved by contracting out (Brudney et al. 2005; Girth et al. 2012; Hefetz and

Warner 2012; Warner 2012). Secondly, there is a loss of control and intervention in the provision of public services by local governments that limits the use of contracting out (Ferris and Graddy 1986). Therefore, government regulation and an appropriate market structure are required for real cost savings to be achieved (Bel and Warner 2008a). In this context, the contracting out of services may incur higher costs due to the inadequate estimation of total contracting-out costs, as a result of the special characteristics and complexity of public services, and perhaps of poor contract specification (Brown and Potoski 2003a; Rodrigues et al. 2012). There may also be opportunism and uncertainty in decision making regarding contracting out, derived from the information asymmetry described by the theory of transaction costs and the theory of incomplete contracts (Bel and Fageda 2006).

In short, the cost savings obtained from contracting out could be cancelled out by high transaction costs, which are not possible to estimate in the negotiation of contracts (Brown et al. 2007, 2010), thus reducing efficiency levels of public services. In consequence, there would be greater uncertainty and complexity in the contracting phase, higher transaction costs in the negotiation, administration and control of contracting out and hence more inefficiency.

In view of these considerations, it is not possible to establish a priori the sign of the relationship between contracting out and the efficiency of local services. Therefore, the second hypothesis is expressed as follows:

*H<sub>2</sub>: Contracting out will have an impact on the cost-efficiency of local public services*

### **C. MIXED FIRMS**

Besides contracting out public services, the private sector participation advocated by NPM can be implemented through public-private collaboration (Greve and Hodge 2011), as an alternative to both direct public provision and the contracting out of local services (Marra 2007; Warner and Hefetz 2008; Bel and Fageda 2010a; Brown et al. 2012). This joint participation between the municipality and the private operator can be carried out by means of a joint venture or mixed firm (institutional cooperation) to manage a particular public service (Da Cruz and Marques 2012). It should be noted that the concepts of mixed firms and mixed delivery differ depending on the context.

In the United States, mixed public-private production is more common at the level of market delivery than in the creation of firms (Warner and Bel 2008). Thus, local governments in the USA use both public and private production for the same service and/or jurisdiction in order to foster competition, thus favouring benchmarking and ensuring delivery of the service even if contracts fail (Warner and Hefetz 2008, 2012).

On the other hand, in Europe and South America – especially in France, Germany, Italy, Portugal, Spain, Colombia, Cuba and Mexico – more use is made of mixed firms (Da Cruz and Marques 2012). Mixed firms (municipal corporation in Portugal or multi-utilities in Italy (Swarts and Warner 2014)) are organisations owned jointly by a local government and by one or more private firms. This structure enables local government to maintain a certain degree of control over the private operator and the service (Warner and Bel 2008; Da Cruz and Marques 2012). When government agencies collaborate with the private sector in this way they may obtain better access to capital funds, gain experience in management, develop more flexible services and share



operational risk (Andrews and Entwistle 2011). Furthermore, such agreements can reduce the direct cost of providing local services, by facilitating participation by a private operator which may be more experienced in providing the service in question and have lower production costs than those incurred by the local government (Dijkgraaf and Gradus 2008). Moreover, this approach helps to minimise contracting-out risks (Brown and Potoski 2003a) and reduces the costs of control and supervision (Marra 2007), thus achieving cost savings (Garrone et al. 2013). Bel and Fageda (2010a) reported that the municipalities which make frequent use of this form of service delivery are those where transaction costs are high.

However, the delivery of local services through mixed companies presents some limitations. Firstly, the literature has suggested the existence of a goal conflict between owners of mixed firms, since the private sector's aim is to maximise profit whereas the public sector wishes to maximise social benefits (Vining et al. 2014). In addition, the creation of a mixed company may affect the efficiency of local services, since the competitive pressure of public tendering may produce benefits in the form of a better (i.e., lower cost) offer being made (Bajari et al. 2014). In some countries such as Germany and Portugal, mixed firms are founded by means of a process of public tendering to select the private firm that will be the owner-partner (Da Cruz and Marques 2012). In other countries, such as Spain, the creation of a mixed firm is not subjected to any process of public tendering, and therefore the outcomes may be different.

Likewise, there is limited empirical evidence concerning the relationship between the efficiency of public services and the adoption of the mixed-firm format (Andrews 2011; Vining et al. 2014). Miranda and Lerner (1995) obtained a negative relationship between mixed delivery and expenditure. Andrews and Entwistle (2011)

found no statistically significant relationship between this type of collaboration and the technical efficiency of public services. Similar results were found by Andrews and Van de Walle (2013), who argued that private sector participation in the provision of public services does not increase the efficiency of public services, suggesting that this type of collaboration is also subject to higher costs in the specification of contracts and transaction costs (Garrone et al. 2013). Swarts and Warner (2014), in their analysis of the restructuring of public transport in Berlin, found that mixed firms are able to reduce transaction and monitoring costs.

A priori, the sign of the relationship between this variable and the efficiency of local public services cannot be determined, and therefore the third hypothesis proposed is as follows:

*H<sub>3</sub>: Mixed firms will have an impact on the cost-efficiency of local public services*

#### ***D. INTER-MUNICIPAL COOPERATION***

Previous studies have shown that the above form of service management is unsuitable for smaller municipalities, since they neither have the same capability as large municipalities to deliver services at a lower cost nor enjoy the same opportunities to enter into contracts with the private sector (which would result in higher monitoring costs). Inter-municipal cooperation can be considered an alternative to contracting out (Warner and Hefetz 2003; Bel and Fageda 2006; Warner 2006; Mohr et al. 2010; Hefetz et al. 2012a; Zafra-Gómez et al. 2013; Bel et al. 2014) and is justified from two standpoints. On the one hand, by the fact that smaller municipalities cannot reach the minimum size necessary to accomplish the creation of agencies (Hood 1995; Mohr et al. 2010). On the other hand, private operators have little incentive to accept a contracting-

out proposal because their profits will be lower in a smaller municipality (Bel and Fageda 2006; Warner 2006).

It should be noted that inter-municipal cooperation in the USA is different from that found in Europe (Bel et al. 2014, Bel and Warner 2014). In the US context, inter-municipal cooperation is normally a type of contracting out; local public services are contracted to a public agency or to another local government (Warner and Hefetz 2002), but it also takes the form of joint governance agreements and informal agreements of mutual assistance (Bel and Warner 2014). However, in Europe, and specifically in Spain, the concept of inter-municipal cooperation is more the notion of cooperation among several local governments under a joint authority (Bel et al. 2014). The justification for inter-municipal cooperation is that it enables the exploitation of economies of scale (Dijkgraaf et al. 2003; Warner and Hefetz 2003; Warner 2006; Zullo 2009). The larger an organisation, the greater the economies of scale obtained, and the more efficient the service provision (Warner and Hebdon 2001; Garrone et al. 2013; Zafra-Gómez et al. 2013). For this reason, small municipalities – usually neighbours – will create a jointly-managed organisation in order to obtain greater efficiency in the delivery of public services, sharing their resources to provide the service (Boyne 1996; Brown et al. 2012). Thus, the provision of public services will be cheaper and more efficient (Warner and Hebdon 2001; Boyne 2002; Hebdon and Jalette 2008).

Bel and Fageda (2006) analysed the use of inter-municipal cooperation by smaller local governments in Spain and obtained empirical evidence of the cost savings achieved. It is concluded, therefore, that this form of service delivery makes small municipalities more efficient. In related studies, Bel and Costas (2006), Zafra-Gómez et al. (2013) and Bel et al. (2014) observed cost savings in refuse collection when this

service was provided by inter-municipal cooperation. Dijkgraaf and Gradus (2013) also found greater cost savings with inter-municipal cooperation in refuse collection services when municipalities deal with growing returns to scale. However, Sørensen (2007) and Garrone et al. (2013) obtained empirical evidence of cost increases following inter-municipal cooperation in Norway and Italy respectively. However, this previous empirical evidence has been mainly developed in single services: waste management and, to a lesser extent, in water delivery. And empirical results may be different according to the type of sector studied and the specific characteristics of municipalities, such as the presence or otherwise of economies of scale (Bel and Warner 2014). In this regard, Simões et al. (2010) and Marques and Carvalho (2014) reported that the intensity of economies of scale varies within the waste and recycling sector in Portugal. Considering the previous empirical evidence, our fourth hypothesis is:

*H<sub>4</sub>: Inter-municipal cooperation will increase the cost efficiency of local public services for smaller municipalities*

### **3. DO NPM DELIVERY FORMS CONTRIBUTE TO IMPROVING MUNICIPAL EFFICIENCY IN TIMES OF CRISIS?**

In recent years, various changes have had a major impact on national economies, worldwide, and chief among these is the economic and financial crisis known as the Great Recession of 2008 (Martin and Martin 2011). This recession, with widespread repercussions, is of a trans-boundary nature and called for specific crisis management. The latter concept refers to the measures taken to address unlikely situations and complex scenarios that may produce unfavourable consequences for the entity and its stakeholders (James and Wooten 2010); such scenarios differ from the difficulties that arise in the normal course of management, and require different reactions and solutions (James et al. 2011). The main features of a trans-boundary crisis are emergency,

turbulence and the expansion of complications at different levels (Ansell et al. 2010; Zahariadis 2013), affecting different countries and involving different sectors and levels of government, which makes management of these special situations particularly difficult (Moynihan 2012; Zahariadis 2013).

The Great Recession provoked a reduction in local government revenue and limited governments' borrowing capacities (López-Hernández et al. 2012), leading public managers to seek new forms of managing local services in order to address these special circumstances. Such periods can, in fact, represent a valuable opportunity, by revealing latent limitations within organisations that need to be overcome (Peters et al. 2011). As we explained in the previous section, NPM delivery forms are aimed at improving the cost efficiency of local public services, and so municipalities may use these measures to reduce the costs of local services in a situation of crisis.

Accordingly, we consider whether, during the Great Recession, municipalities in Spain adopted measures to improve the efficiency of local public services, and whether NPM delivery forms contributed to these local governments obtaining higher levels of efficiency during this period. We expect that in periods of crisis local governments will seek to reduce their costs and thus enhance efficiency. Therefore, the following hypothesis is proposed:

*H<sub>5</sub>: Local government service-delivery efficiency increased during the Great Recession*

However, since it is not possible to establish whether NPM service delivery forms produce an increase or a decrease in municipal efficiency in times of crisis, the latter hypothesis is extended as follows:

*H<sub>6</sub>: During the Great Recession, NPM delivery forms had an impact on the efficiency of local public services*

Furthermore, different NPM delivery forms can be used in different ways to improve local government efficiency in times of crisis, and so the latter hypothesis can be divided into four sub-hypotheses.

*H<sub>6a</sub>: During the Great Recession, agencification had an impact on the efficiency of local public services*

*H<sub>6b</sub>: During the Great Recession, contracting out had an impact on the efficiency of local public services*

*H<sub>6c</sub>: During the Great Recession, the creation of mixed firms had an impact on the efficiency of local public services*

*H<sub>6d</sub>: During the Great Recession, inter-municipal cooperation had an impact on the efficiency of local public services*

#### **4. OTHER FACTORS INFLUENCING LOCAL EFFICIENCY IN MUNICIPALITIES: FINANCIAL, POLITICAL AND SOCIO-ECONOMIC DETERMINANTS**

In analysing the efficiency of local public services, it is common to include socio-economic variables as explanatory factors (Afonso and Fernandes 2008), together with other control variables such as political and financial indicators. Da Cruz and Marques (2014) developed a classification of the operational environments and the determinants that may affect the local performance, grouping them into four types: natural, citizen-related, institutional and legacy determinants. Before describing the determinants in detail, let us recall that the aim of this study is to analyse municipal cost

efficiency, by measuring the relationship between municipal spending and the outputs achieved.

The economic and financial variables most commonly addressed in studies of local government efficiency are budget deficit, municipal debt, transfer rate and revenue capacity (Balaguer-Coll et al. 2007; Zafra-Gómez and Muñiz 2010). It has been argued that there is a negative relationship between cost efficiency and subsidies, or the transfer rate (De Borger and Kersters 1996a; Dijkgraaf et al. 2003; Balaguer-Coll et al. 2007; Borge et al. 2008; Balaguer-Coll and Prior 2009), due to the fact that higher income levels create a fiscal illusion effect that tends to increase overall spending (Worthington 2000; Bosch et al. 2012).

Similarly, a high level of fiscal capacity allows municipalities to provide local public services in an inefficient form (Borge et al. 2008; Balaguer-Coll et al. 2007; Balaguer-Coll and Prior 2009), since in these cases public managers have fewer incentives to provide services as efficiently as possible (Bosch et al. 2012). However, De Borger and Kersters (1996a) and Benito et al. (2010) recorded a positive relationship between tax revenue and efficiency, which is consistent with the interpretation that when there are higher tax revenues, citizens exercise more control and thus higher levels of efficiency are obtained.

Benito et al. (2010) also found a positive relationship between local government indebtedness and efficiency, which they explained by the fact that the credits obtained fund investments by means of which higher levels of efficiency are achieved. Finally, Zafra-Gómez and Muñiz (2010) compared the functions of financial condition and the efficiency achieved in a sample of 923 Spanish municipalities, and concluded that the municipalities which are more cost-efficient are those with a better financial situation.

With respect to political factors, Vanden Eeckaut et al. (1993) included as variables the political ideology and the political strength (or fragmentation), i.e., whether the party governing the municipality has an absolute majority (political strength) or governs in minority together with other parties (political fragmentation). In Spanish local governments, decision-making derives from the mayor, not an independent city manager, and therefore, in relation to local government efficiency, political issues must be analysed, too. The impact of political ideology on the efficiency of local public services is, as yet, unclear. Thus, Vanden Eeckaut et al. (1993) found no significant relationship, perhaps because there are no significant differences in citizens' demands to be addressed by local governments (Benito et al. 2010). However, other empirical studies have shown that municipalities governed by left-wing parties present higher levels of efficiency (De Borger and Kerstens 1996a; Benito et al. 2010). Conversely, Borge et al. (2008) and Kalb et al. (2012) found a negative relationship in this respect, with municipalities governed by conservative parties presenting higher levels of efficiency.

Studies have also considered the possible influence of political fragmentation on the efficiency of local governments (Vanden Eeckaut et al. 1993) and it has been suggested that majority governments achieve higher levels of efficiency (Borge et al. 2008). However, empirical evidence seems to show that municipalities with greater political fragmentation actually present better levels of efficiency (Vanden Eeckaut et al. 1993; Borge et al. 2008; Geys et al. 2010; Kalb et al. 2012), since the lack of political fragmentation is associated with low levels of political competition (Kalb et al. 2012).



As well as the above factors, socio-economic variables are included in the present study. Previous studies have examined the relationship between the rate of unemployment and the efficiency of local public services, although without strictly defining this factor. This relation can be explained by two different arguments: cost effects and preference effects (Geys et al. 2010). On the one hand, it has been suggested that a high rate of unemployment provokes higher levels of local government spending; moreover, the municipalities with the highest unemployment rates are also those with the lowest levels of income (De Borger and Kerstens 1996a) since these municipalities usually present a weak economy and have less power to collect tax revenue and finance public services (Zullo 2009). Accordingly, the unemployment rate may present a negative relation with local efficiency. On the other hand, high unemployment rates could result in lower demands from citizens and therefore lower costs and greater efficiency (Geys et al. 2010; Kalb et al. 2012).

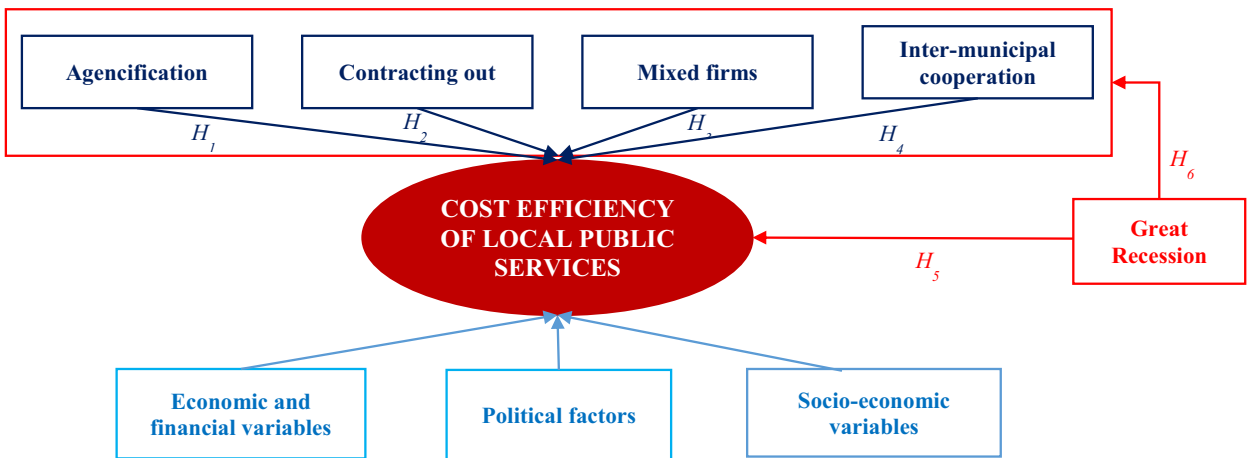
It has also been suggested that the higher the level of tourism in the municipality, the higher the costs to be addressed, which may result in lower efficiency levels (Kalb et al. 2012; Bosch et al. 2012). Nevertheless, some studies have obtained empirical evidence of the opposite relationship (Giménez and Prior 2007).

Finally, important differences appear according to the size of the municipality (Dubin and Navarro 1988; Bel and Costas 2006; Bel and Fageda 2010a), since economies of scale and the levels of services provided both depend on this question. However, researchers disagree about the influence of municipal population on public service efficiency. According to some authors, large municipalities will present lower levels of efficiency (Dubin and Navarro 1988) because they must provide a larger volume of services to a larger number of inhabitants. In this sense, Giménez and Prior

(2003) found smaller municipalities to be more efficient. However, their comparison of similar-sized municipalities suggests that the largest local governments are closer to the levels of efficiency considered as best practice. On the other hand, there is empirical evidence to the contrary, i.e., that areas with a higher municipal population achieve higher levels of efficiency (De Borger and Kerstens 1996a; Giménez and Prior 2007; Benito et al. 2010), due to the presence of economies of scale.

To conclude, Figure 2 includes a summary considering the literature review and the hypothesis proposed.

*Figure 2. Factors influencing the overall cost efficiency in local governments*



Source: The author.

## 5. EMPIRICAL EVIDENCE: RESEARCH METHODOLOGY, DATA, VARIABLES AND RESULTS

### A. RESEARCH METHODOLOGY

In the present study, we analyse the overall efficiency of local government public services, complementing previous research in this respect (Vanden Eeckaut et al. 1993; De Borger and Kerstens 1996a; Worthington 2000; Giménez and Prior 2003, 2007; Balaguer-Coll 2004; Balaguer-Coll et al. 2007, 2010; Borge et al. 2008; Geys

and Moesen 2009; Benito et al. 2010; Bosch et al. 2012). There are various reasons for adopting this approach: firstly, municipalities are organisations that “allocate resources to provide multi-utility” (Giménez and Prior 2007: 123). Therefore, they can be considered as multi-product organisations in which the joint use of inputs gives rise to multiple outputs, thereby generating returns to scale (Cherchye et al. 2014). However, in multi-product organisations there may occur allocation problems between functions (Feiock 2013), and so the existence of isolated efficient functions does not ensure overall efficiency within the organisation. Hefetz et al. (2012b) addressed this issue in local governments by examining the aggregate decisions made by the municipal government, taking into consideration all the different services provided. Secondly, citizens’ evaluation of municipal management usually takes account of all local public services (Bosch et al. 2012). Finally, a broad-based analysis is justified (Borge et al. 2008) when factors exclusive to the municipality are used jointly as explanatory variables.

We also use cost efficiency as a measure of local government efficiency, since the use of technical efficiency coefficients of local public services would be far more difficult, due to the heterogeneity of goals of the services provided (Zafra-Gómez and Muñiz 2010).

The methodology applied consisted of a two-step analysis to determine the effect of NPM delivery forms and of other factors on municipal efficiency, both in periods of crisis and when there is no crisis. In the first phase, a measure of the cost efficiency of local public services was obtained for each municipality by applying the order- $m$  approach, and this measure was subsequently analysed using the methodology proposed by Simar and Wilson (2007).

In efficiency analysis, nonparametric approaches have been applied extensively, in methods such as DEA and the FDH model, introduced by Charnes et al. (1978) and Deprins et al. (1984), respectively (Cazals et al. 2002). However, these techniques present two main disadvantages, due to their deterministic nature (De Witte and Marques 2010): on the one hand they are highly sensitive to outliers and extreme values, since DEA and FDH estimators envelop all data points (Daouia and Simar 2007), and furthermore they are susceptible to measurement errors, because they assume the absence of statistical noise (De Witte and Marques 2010). In response to these problems, the robust partial frontier approach resolves the presence of outliers by allowing the location of observations beyond the estimated efficiency frontier, as such a technique does not envelope all the data (Simar and Wilson 2008).

For these reasons, we applied the robust order- $m$  methodology, a partial approach that accepts the non-convex assumptions of FDH but without enveloping all the data (Cazals et al. 2002; Daouia and Simar 2007), “limiting the number of potential reference partners which constitute the frontier” (De Witte and Marques 2010: 382). While FDH benchmarks a decision making unit (DMU)<sup>2</sup> by the best performing unit in the whole sample, order- $m$  obtains this benchmarking considering only a subsample of  $m$  peers.

The order- $m$  approach can be oriented toward inputs, outputs, costs or revenues. We chose the cost orientation due to the specific characteristics of local administration, which make it more appropriate to evaluate efficiency in terms of minimising costs, as outputs are either totally or partially determined externally, and the assumption of cost minimisation can be used when output prices are unavailable (Cherchye et al. 2014).

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<sup>2</sup> In the present thesis the DMUs are taken to be the local governments.

The algorithm that estimates the order- $m$  efficiency coefficients considers a positive fixed integer  $m$ ; so for a specific level of input ( $x_0$ ) and output ( $y_0$ ), the estimation considers  $m$  random DMU's with output variables ( $Y_1, \dots, Y_m$ ), drawn from the distribution of the output matrix  $Y$  observing the condition  $Y_m \geq Y_0$ . According with Daraio and Simar (2007), we apply the following steps:

1. For a given level of  $y_0$ , a random sample of size  $m$  is drawn with replacement among those  $y_{sm}$ , such that  $y_{sm} \geq y_0$ .
2. Using this random sample, the efficiency coefficient  $\tilde{\alpha}_s$  is estimated.
3. Repeating steps 1 and 2  $B$  times, for each round an efficiency coefficient is estimated, so at the end of the process we have  $B$  efficiency coefficients  $\tilde{\alpha}_s^b$  ( $b = 1; 2; \dots; B$ ).
4. A central value (the arithmetic mean) of the estimated  $B$  efficiency coefficients is computed as:

$$\alpha_s^m = \frac{1}{B} \sum_{b=1}^B \tilde{\alpha}_s^b$$

Due to random replacement, and taking into account that we are applying the cost orientation, the order- $m$  approach can obtain efficiency scores beyond the efficiency frontier when a DMU ( $s$ ) reaches  $\alpha_s^m > 1$ .

In addition, note that  $\tilde{\alpha}_s^b$  depends on the level of  $m$ , and therefore the higher the value of  $m$ , the more observations are considered in the estimation and the more units will meet the condition  $y_{sm} \geq y_0$ . Thus, when  $m \rightarrow \infty$  the order- $m$  efficiency score will converge with FDH scores.

Likewise the following considerations should be taken into account: firstly, the quality of the approximation can be tuned by increasing  $B$ , and in most applications  $B = 200$  seems to be a reasonable choice (Balaguer-Coll et al. 2012) although,

depending on the sample size,  $B$  can be sufficiently large when  $B = 2,000$  (De Witte and Geys 2013). In the present study, the order- $m$  methodology is applied considering  $B = 2,000$ . Secondly, according to Daraio and Simar (2005) the size of  $m$  is the value for which the percentage of superefficient DMUs decreases marginally with an increase in  $m$ . Concretely, to determine the value of  $m$ , the efficiency scores are computed for different values ( $m = 50, 100, \dots 300$ ). It was found that from  $m=200$  the results were very stable, as the percentage of super-efficient observations declined only marginally with  $m$ . Thirdly the application of the order- $m$  methodology follows a cost orientation such that superefficient DMUs obtain efficiencies below 1.

In the second stage of our analysis, the Simar and Wilson proposal was applied to regress the order- $m$  efficiency-scores with a bootstrapped truncated regression, since it has been shown that other procedures, such as Tobit regression, fail to obtain acceptable estimations considering the characteristics of the order- $m$  coefficient distribution (Simar and Wilson 2007). Concretely, Simar and Wilson (2007) proposed bootstrapped truncated regression, which provides a valid inference within models, explaining efficiency scores and increasing the robustness of the efficiency estimation. The Simar and Wilson procedure assumes the following regression estimation<sup>3</sup>:

$$\alpha_{Si}^m = a + z_i\beta + \varepsilon_i, \quad i = 1, 2, \dots n$$

where:

$\alpha_{Si}^m$ : Averaged DMU order- $m$  efficiency scores (dependent variable)

$a$ : Constant term

$z_i$ : Independent variables, specific variables for DMU  $i$

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<sup>3</sup> Specifically, in the present study the Simar and Wilson procedure is applied introducing a fixed effect for each DMU in the panel data bootstrapped truncated regression.

$\varepsilon_i$ : Statistical noise

There are various reasons for applying this methodology (Barros and Dieke 2008). Firstly, the efficiency scores are not observed directly but are estimated, and so estimations assuming independently distributed error terms are not valid. Secondly, the estimated frontier efficiency is calculated based on the sample used; thus, some efficiency production possibilities are excluded because they are not observed in the sample, resulting in biased efficiency estimations. Thirdly, the explanatory variables for the second stage are not taken into account in the efficiency estimation because it is assumed that they affect only the efficiency scores. Therefore, if these variables are explanatory factors of the frontier estimation, the second-stage results will be biased. Finally, efficiency scores are restricted to a certain interval, from 0 to 1<sup>4</sup> (Simar and Wilson 2007).

To test the proposed hypotheses and to address the study goals, two different models were created. In each model, NPM delivery forms were disaggregated into different types of services, following Cuadrado-Ballesteros et al. (2012), who distinguished eight blocks of services (Appendix 1). Our first model examines the relationship between all the variables mentioned in the previous section, testing Hypotheses 1 to 5. The second model tests the final hypothesis, analysing the effect of periods of crisis in relation to NPM delivery forms.

The specification of these models is as follows:

$$\textbf{Model 1: } \alpha_{S,it}^m = \beta_0 + \beta_1 * \chi_{1,it} + \sum_{a=1}^8 \beta_2^a * \chi_{2,it}^a + GR_t + \varepsilon$$

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<sup>4</sup> In our application, this requirement is relaxed, as the order- $m$  method provides efficiency scores that are only truncated on the left (at point 0).

$$\textbf{Model 2: } \alpha_{S,it}^m = \beta_0 + \beta_1 * \chi_{1,it} + \sum_{a=1}^8 \beta_2^a * \chi_{2,it}^a + \sum_{a=1}^8 \beta_2^a * \chi_{2,it}^a * GR_t + \varepsilon$$

where:

- “*i*” denotes the municipality assessed and “*t*” the year considered
- $\alpha_{S,it}^m$ : Municipal efficiency level
- $\chi_{1,it}$ : Socioeconomic, financial and political variables
- $\chi_{2,it}^a$ : Variables expressing the service delivery form disaggregated by groups of services
- $GR_t$ : Binary variable referring to the years constituting the Great Recession (2008-2010).
- $\varepsilon$ : Error term

### ***B. DATA AND VARIABLES***

For the purposes of this study, a database was constructed for the period 2001-2010 for a sample of 1,058 Spanish municipalities, representing 35% of all Spanish municipalities with a population between 1,000 and 50,000 inhabitants<sup>5</sup>. This study analyses small and medium sized municipalities and considers the beginning of the economic crisis (2008-2010) in the specific context of Spain, and therefore caution is needed in generalising the results obtained. The data used were obtained from various sources.

Concretely, as we have explained before, we apply the order-*m* approach oriented towards costs to compute the cost efficiency scores for each local government. The selection of inputs and outputs in measuring efficiency is a controversial task since it depends on the specific municipal services considered (Da Cruz and Marques 2014);

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<sup>5</sup> The restriction to municipalities with a population between 1,000 and 50,000 is due to the limited availability of financial data for those with a population of less than 1,000 and of data on local services for municipalities with over 50,000 inhabitants.



moreover, outputs can be difficult to measure (Giménez and Prior 2007) and there may be database limitations (Balaguer-Coll et al. 2007). In this context, the budgetary and financial data for each municipality are taken as inputs, given the difficulty of assessing costs in the public sector owing to ‘the lack of an internal control system to determine the costs incurred by the entity in providing each service’ (Balaguer-Coll 2004: 38). In the case of output magnitudes, Vanden Eeckaut et al. (1993) proposed the use of proxy indicators. Among the various result indicators available, the most commonly used is that of population, which is indicative of the volume of services that must be provided by the municipality (Balaguer-Coll 2004). Other outputs considered are those based on the consideration of the area or population sectors that specifically benefit from certain municipal services (the extent of the road network, in the case of public transport) or other indicators related to particular services (tons of waste collected and/or the volume of water supplied) (Zafra-Gómez and Muñiz 2010). In short, considering the limitations inherent to the selection of inputs and outputs and the fact that it is not possible to select all the outputs that reflect each and every one of the specific tasks of municipalities, the variables included in the order- $m$  approach were selected taking into account previous studies of local government efficiency (De Borger and Kerstens 1996a; Balaguer-Coll et al. 2007; Giménez and Prior 2007; Balaguer-Coll and Prior 2009; Benito et al. 2010; Geys et al. 2010; Da Cruz and Marques 2014). These variables are shown in Table 1, and the corresponding descriptive statistics, in Appendix 2.

**Table 1. Inputs and outputs considered in the study. Output indicators by type of services**

<b>Input</b>	
TOTAL MUNICIPAL COST, including:	
<ul style="list-style-type: none"> <li>• Labour costs: wages and salaries</li> <li>• Material consumption: expenditure on goods and services</li> <li>• Investments: capital expenditure</li> <li>• Current transfers</li> <li>• Capital transfers</li> </ul>	
<b>Outputs</b>	
<b>Indicator</b>	<b>Service</b>
Tons of waste collected	Waste management
Number of street lights	Public street lighting
Cemetery surface area	Cemetery services
Surface area of public parks	Public parks
Urban area (ha)	Street cleaning, road maintenance, firefighting and prevention, public transport, environmental protection
Water network length	Water management
Total population	Cemetery services, water management, regulation of food industry, public parks, public library, market, slaughterhouses, civil protection, social services, sports facilities, public transport

*Source: Balaguer-Coll et al. (2007), Giménez and Prior (2007), Balaguer-Coll and Prior (2009), Benito et al. (2010), Real Decreto Ley 2/2004, de 5 de marzo, por el que se aprueba el Texto Refundido de la Ley Reguladora de las Haciendas Locales and the author's own elaboration.*

The variables included in the second stage, together with their sources, are described in Table 2, and descriptive statistics and correlations are shown in Appendix 3.

**Table 2. Description and source of variables included in the study**

<b>Variable</b>	<b>Definition</b>	<b>Source</b>
<b>Municipal Efficiency</b>	Ratio that measures the relationship between municipal spending in relation to the outputs achieved (score obtained through order- <i>m</i> methodology)	<u>Municipal spending</u> : Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury <u>Output variables</u> : Survey of Local Infrastructure and Equipment (EIEL), from the Ministry of Public Administration's website
<b>Unemployment</b>	Percentage of the population out of work	National Institute of Statistics (INE) and the Economic Yearbook of 'La Caixa'
<b>Tourism</b>	Index that measures the tourism-oriented activities of the municipality	The Economic Yearbook of 'La Caixa'

<b>Size</b>	Categorical variable that classifies municipalities according to their size as follows <sup>6</sup> : 1: municipalities with a population between 1,000 and 5,000 inhabitants 2: municipalities with a population between 5,001 and 20,000 inhabitants 3: municipalities with a population between 20,001 and 50,000 inhabitants	National Institute of Statistics (INE)
<b>Income Tax Index</b>	Income tax as a percentage of current income	
<b>Non-financial Current Budgetary result Index</b>	Current budgetary payables and non-financial capital budgetary payables divided by non-financial current budgetary receivables and non-financial capital budgetary receivables	Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury
<b>Cash Index</b>	Percentage of cash over liquidated obligations	
<b>Transfers Index</b>	Percentage of transfers received over total income	
<b>Municipal Debt</b>	Local government debt per capita, measured in logarithmic terms	
<b>Political orientation</b>	Dummy variable that takes the value 0 if the municipal government has a conservative ideology and 1 if it is left-leaning	The author, based on the website of the Ministry of the Interior
<b>Political Strength</b>	Dummy variable that takes the value 0 if the municipal government shares power with other parties and 1 if it has an absolute majority	
<b>Great Recession</b>	Dummy variable that takes the value 1 for the years of the Great Recession (2008-2010) and 0 for the other years of the period considered	Elaborated by the author
<b>Agencification<sup>7</sup></b>	Number of agencies of each local government for the period 2001-2010 for each service. Includes the entities owned by local governments (autonomous bodies, public enterprises and public business entities)	
<b>Contracting out<sup>7</sup></b>	Number of local services outsourced by each local government for the period 2001-2010 and by type of service	Elaborated by the author, based on the Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury, Official Provincial Gazettes (BOP) and municipal web pages
<b>Mixed firms<sup>7</sup></b>	Number of mixed firms in which each local government participated during the period 2001-2010 for each service	
<b>Inter-municipal cooperation<sup>7</sup></b>	Number of inter-municipal associations (consortia and communities) of each local government for the period 2001-2010 for each service	
<b>Interaction variables</b>	Specific variable (NPM delivery form) * GR	

Source: The author.

<sup>6</sup> The variable Size is categorized in three different groups because the Spanish law establishes a minimum number of services to be provided according to the number of inhabitants (*Real Decreto Ley 2/2004, de 5 de marzo*).

<sup>7</sup> The cost of service delivery forms is included in total cost considered in the analysis.

### C. RESULTS<sup>8</sup>

As mentioned above, two different models were analysed. Hypotheses 1-5 were tested, together with other factors discussed in the literature, in Model 1, while in the second model, the Great Recession variable was replaced by variables measuring the interaction of NPM delivery forms, disaggregated by services, with the Great Recession. This procedure highlights the behaviour of a given variable in periods of crisis and of no-crisis, to test the final hypothesis.

The empirical evidence<sup>9</sup> obtained (Table 3) shows, firstly, that the results are consistent among the models, with the variables, in general terms, maintaining the same sign and significance level.

**Table 3. Empirical results of the estimation of determinants of municipal efficiency**

Dependent variable: Efficiency				
Variable <sup>10</sup>	Expected sign	Model 1	Model 2	
			Variable	Interaction
Unemployment	+/-	-.0018147***	.0002613	
Tourism	+/-	.0028036***	.0022739***	
Size	+/-	.0087538	.0012339	
Income Tax Index	+/-	-.0030449	-.0075019	
Payable/Receivable Budgetary Result	+	.2242492***	.2162252***	
Cash Index	+	-.0073751***	-.0055564***	
Transfers Index	-	-.039776*	-.0066273	
Municipal debt	+	-.0003905	.0009354	

<sup>8</sup> Order-*m* efficiency scores were obtained through *The R Project for Statistical Computing* and second stage estimations through Stata 12, by applying a bootstrap truncated regression with fixed effect and 200 replications.

<sup>9</sup> Recent papers (Daraio and Simar (2005, 2007), Carvalho and Marques (2011) and De Witte and Kortelainen (2013)) have pointed out the potential bias that might be caused when the explanatory variables are not separable from the technology. After applying the proposed procedure, the results confirmed that all these variables were perfectly separable from the efficiency estimations, which confirms that the results are unbiased.

<sup>10</sup> The continuous variables in the estimated model were subjected to an outlier treatment process, by the Winsorisation technique. This procedure has been developed, inter alia, by Barnett and Lewis (1994) and Tukey (1962). With this technique, extreme values (upper and lower) are replaced by the closest values located below or above them. In our case, the 90th percentile values above or below the 10th percentile were replaced by the nearest value below or above them, respectively.

Political sign	+/-	.0018764	.0044317	
Political Strength	+/-	-.0087365**	-.0088148**	
Great Recession	+	.0975586***		
<hr/>				
Agencies	+/-			
Water		.0147382	.0119147	.0240775
Urban waste		.0439086*	.0390253	.013815
Culture		-.035817***	-.0488168***	-.0045003
Social		-.0281156	-.0353994	.0055917
Promotion		.0084509	.0007015	.0031431
Transportation		-.0131785	.0348674	-.0442308**
Urban		-.0245825**	-.0428194***	.0234353***
Others		.0171618	-.0154068	.0292306
<hr/>				
Contracting out	+/-			
Water		-.0280023***	-.0517179***	.0485688***
Urban waste		-.0069631	-.0071848	.0048864
Culture		.0050955	-.0100115	.0250687**
Social		-.0241263***	-.0222678	-.0067749
Promotion		-.0294403*	-.0337342**	-.0009695
Transportation		-.01083	.0216498	-.0297866
Urban		-.0099935	.0077172	-.0301646***
Others		.007791	.009128	.0011478
<hr/>				
Mixed Firms	+/-			
Water		.0748503***	.1140708***	-.0416929*
Urban waste		-.4035791***	-.3954582***	-.0604279*
Culture		.0486059***	.0374012**	.0244093*
Social		.2786197***	.2995624***	-.0463373
Promotion		-.0045637	.002199	-.0010889
Transport		-.0814684***	-.0736447***	-.0610311***
Urban		.0449527*	.0830967***	-.0411553***
Others		-.0847634**	-.0865983	-.0366049**
<hr/>				
Inter-municipal cooperation	+			
Water		-.0139447	-.0017689	.0222942***
Urban waste		-.0379636***	-.05015***	.0380356***
Culture		-.0406843***	-.0486865***	.019868***
Social		-.0204393	-.0014004	-.0043021
Promotion		-.0299369***	-.02677***	.0047968
Transportation		-.0240345	-.0958905***	.0814783***
Urban		-.0167905	-.0454424***	.0261381***
Others		-.0759248***	-.1055954***	.0388693***
<hr/>				
Constant		.9150204***	.9563453***	
<hr/>				
<b>Robustness<sup>11</sup></b>		62.827367%	62.936301%	

<sup>11</sup> Rough estimate of the degree of association, computed by correlating the dependent variable with the predicted value and squaring the result.

\* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

Taking into account the main aim of this study, we first analysed NPM delivery forms. For Model 1, it can be seen that agencification and mixed firms have different behaviours depending on the public service to which they are applied; in some cases, they contribute to improving cost efficiency in local governments, but in others they produce lower levels of efficiency, which highlights the importance of the nature of the services considered in deciding which form of service delivery should be adopted (Ferris and Graddy 1986; Brown and Potoski 2003a, 2005; Rodrigues et al. 2012).

Contracting out and inter-municipal cooperation generally give rise to poorer levels of performance, in most of the services analysed. In accordance with previous studies (Hodge 2000; Bel et al. 2010c), the results suggest that contracting out does not achieve cost savings, while the empirical evidence obtained for inter-municipal cooperation contradicts the previous conclusions reported by Bel and Costas (2006), Bel and Fageda (2006), Zafra-Gómez et al. (2013) and Bel et al. (2014) in the context of specific services. This outcome may be due to the cost reductions obtained by this strategy being offset by other expenses arising. An alternative explanation in the Spanish context is that the creation of a new entity, in conjunction with other municipalities, may incur higher costs. We emphasise that in contrast to the present study, in which the overall cost-efficiency of local governments is analysed, the most recent empirical evidence on inter-municipal cooperation (Zafra-Gómez et al. 2013; Bel et al. 2014) arose from the study of a particular service, and so the cost identified does not reflect other structural costs that are not directly related to the service in question (e.g., sharing manpower among different services). This is what is known as the Fox Paradox, which arises when the product level may be efficient, but this does not necessarily imply overall organisational efficiency (Hefetz et al. 2012b). Additionally,

the years under study are different from the present piece of work, since Bel et al. (2014) analyses data for the year 2008 and Zafra-Gómez et al. (2013) for the period 2002 to 2008.

These results are consistent with the results obtained for Model 2, in which the final hypothesis proposed ( $H_6$ ) was tested in terms of the interaction between NPM delivery forms (disaggregated by services) and the Great Recession. It was found that NPM delivery forms presented different relationships with cost efficiency in periods of crisis and of no-crisis. Inter-municipal cooperation contributed to raising levels of efficiency in periods of crisis for the vast majority of the public services analysed, while the remaining forms of NPM service delivery presented different effects depending on the type of service.

However, the question must be considered: what is the overall effect, in the services analysed, on cost efficiency caused by variations in the form of service delivery, both during the Great Recession and in times of no-crisis?

The Figures included in Appendix 4 show for each year the predicted efficiency values (on the vertical axis, ranging from 0 to 1) and the number of services delivered under each NPM delivery form<sup>12</sup> (on the horizontal axis), illustrating the variations in cost-efficiency among the different forms of NPM-service delivery, during periods of crisis and of no-crisis. Figure A shows the predicted efficiency scores that municipalities may achieve when the number of services provided through agencies increases, taking into account the results obtained in Model 2. The subsequent Figures show the same relation with respect to contracting out, mixed firms and inter-municipal

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<sup>12</sup> The predicted values were obtained by the post estimation command (predict) with Stata 12, considering the significance of the variables included in the specification of the model.

cooperation. Broadly speaking, these Figures show that during periods of no-crisis, when the number of agencies, contracting-out operations and inter-municipal cooperation agreements increased, so did inefficiency. However, the more mixed firms that were created, the greater the cost efficiency that was obtained.

Focusing on the difference between periods of no-crisis and the Great Recession, it can be seen that both inter-municipal cooperation and contracting out presented changes during the Great Recession period. Thus, the increased use of these delivery forms led to higher levels of cost efficiency than in times of no-crisis. On the other hand, agencification and mixed-firms forms of service delivery presented a similar behaviour pattern during the Great Recession and during periods of no-crisis, with cost efficiency falling with rising numbers of agencies, and rising when there were more mixed firms. In summary, the impact of diverse forms of NPM-service delivery on cost efficiency, for the whole range of services, differs depending on the type of service-delivery form and on the presence or absence of the Great Recession.

A question arises with regard to the fact that cost efficiency in the provision of municipal services increased during the Great Recession, since this variation may have been provoked by decreased municipal expenditure. For this reason, Appendix 5 shows the average expenditure per capita per year. It can be seen that this value increased until 2009, and then fell back. A significant factor in this respect is that fiscal cut-backs were delayed during the Great Recession in countries such as the UK, Germany and the Netherlands (Kickert 2012), as well as in Spain. Therefore, inter-municipal cooperation, contracting out and mixed firms are suitable forms of public service delivery during periods of crisis, since they enable local governments to adjust their use of resources to improve efficiency, before reducing expenditure per capita.



To conclude this summary of the results obtained, let us observe the relationships found among the financial variables. In this respect, the budgetary result, which is especially important due to its prominence in the concerns of municipal government, presented a positive and significant relationship with municipal cost efficiency. The negative effect of the cash index suggests that the greater the availability of resources, the more efficiency requirements will be relaxed, since municipalities can cover their cost increases; this finding contrasts with the results obtained by Zafra-Gómez and Muñiz (2010), who found that municipalities with a better financial situation obtain better levels of efficiency. In the same line, and in accordance with previous studies, the transfer rate was found to be inversely related to cost efficiency (De Borger and Kersters 1996a; Dijkgraaf et al. 2003; Balaguer-Coll et al. 2007; Borge et al. 2008; Balaguer-Coll and Prior 2009), due to the fiscal illusion effect generated. With respect to political variables, our results show that local governments that are unaffected by political fragmentation (i.e., where the political strength variable is higher) present lower levels of efficiency, which is in line with the findings of previous studies (Vanden Eeckaut et al. 1993; Geys et al. 2010; Borge et al. 2008; Kalb et al. 2012). Finally, as regards socio-economic variables, our empirical evidence suggests that the higher the unemployment rate, the lower the levels of cost efficiency achieved; this contradicts the empirical results obtained by Kalb et al. (2012)<sup>13</sup>. The level of tourism in municipalities was found to have a positive and significant effect, which is consistent with the empirical evidence found by Giménez and Prior (2007).

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<sup>13</sup> This variable is not significant in the latter model, when the variable Great Recession is removed. The correlation between these variables (Appendix 3) is important, although this does not imply a problem of collinearity.

## 6. CONCLUSIONS AND DISCUSSION

Achieving the efficient delivery of public services is a major policy goal at every level of public administration. Managing public services in such a way as to ensure greater efficiency within public entities is one of the main ideas underpinning the development and implementation of NPM, although researchers have yet to find conclusive empirical evidence that NPM delivery forms and efficiency are linked (Lapsley 2008; Hood and Dixon 2013). In this chapter, we conduct a joint analysis of the main forms of NPM service delivery in relation to variations in municipal cost efficiency. Specifically, to test the relation between NPM delivery forms and efficiency, we performed a longitudinal analysis to identify the effects produced by the creation of NPM delivery forms on cost efficiency in local governments, over a prolonged period of time, together with a cross-sectional study to analyse the influence of variations in NPM delivery form on municipal cost efficiency, for each of the years during the same period. The use of this extensive period of time allowed us to determine the influence of these NPM delivery forms on cost efficiency during the Great Recession, and thus confirm the presence or absence of fluctuations with respect to periods of no-crisis.

Prior studies analysing the cost efficiency of NPM delivery forms have been mainly focused on the study of one specific alternative or on the dichotomy between public and private provision (Benito et al. 2010; Simões et al. 2012). Moreover, studies considering different modes of delivering public services have mostly centred on one specific local service (Zafra-Gómez et al. 2013; Bel et al. 2014). In this context, the present study contributes to the existing literature by jointly analysing different NPM delivery forms – agencification, contracting out, mixed firms and inter-municipal cooperation – with respect to overall municipal cost efficiency.

In addition to the above, the study provides empirical evidence on this relation under different economic conditions, since two different periods are considered: the healthy economic interval from 2002 to 2007 and the beginning of the global economic crisis from 2008 to 2010. In this sense, the contribution of the study lies in its finding that the cost efficiency of NPM delivery forms depends largely on the prevailing economic and financial conditions.

The empirical results obtained suggest that the use of NPM delivery forms depends on the type of service in which they are implemented (Ferris and Graddy 1986; Brown and Potoski 2003a, 2005; Rodrigues et al. 2012). In general, the creation of agencies and/or the adoption of contracting out and inter-municipal cooperation tend to increase cost inefficiency in local governments, and thus reduce overall efficiency. Only the creation of mixed firms contributes to improving municipal cost efficiency. In consequence, the higher the number of public services delivered by mixed firms, the better the level of municipal cost efficiency, both during the Great Recession and in times of no-crisis. The results obtained with respect to the special situation of financial crisis show that inter-municipal cooperation and contracting out slightly improved levels of cost efficiency in local governments during the Great Recession.

Consequently, this study opens the way for a new debate in the literature, with its finding that the use of NPM delivery forms results in poorer levels of cost efficiency during robust economic cycles, which argues in favour of the principles of post-NPM, or neo-Weberian Administration, which advocate the horizontal recentralisation of public services, citing reasons such as the additional costs provoked by complexity and overlapping in agencification and inter-municipal cooperation, together with increased transaction costs in the negotiation of a contracting-out agreement. These suppositions

would give rise to the empirical situation observed in our study, namely the greater inefficiency encountered in local administration service delivery when NPM forms were introduced. Only the introduction of joint service delivery, featuring collaboration between the public sector and the private sector, was found to achieve better overall results for the provision of public services. However the NPM doctrine seems to be viable when the economy runs into a downturn. Therefore, the ‘mixed firm’ formula should be adopted by local governments seeking to improve cost efficiency.

However, further studies in this respect are needed, to obtain more evidence to corroborate our results, in other countries where the implementation of NPM in local government reflects the traditional administrative culture and regime applied in each country, as developed over a long period of time (Pollitt and Bouckaert 2004b). Countries like New Zealand, Australia, USA and UK clearly differ from the NPM implementation conducted in countries with a continental tradition, such as Germany, Italy and France. In the latter country, the implementation of NPM in local government presents similarities with the Spanish case, and has been described by Kuhlmann (2010a) as “NPM with doctrine”. Although our methodology is unlike that employed by Kuhlmann, the latter also concluded that there is no clear evidence of a NPM-productivity gains relationship, and that transaction costs increase as a result of the implementation of NPM practices (pp. 1126-1127). Future research should investigate whether the relationships we have observed between NPM delivery forms and efficiency are equally present in other environments and/or countries with different administrative cultures and regimes, determining the characteristics of NPM in local



**CHAPTER 3: COST EFFICIENCY IN MUNICIPAL  
SOLID WASTE SERVICE: ALTERNATIVE DELIVERY  
FORMS FOR SMALL AND MEDIUM-SIZED LOCAL  
GOVERNMENTS IN SPAIN**



## **1. INTRODUCTION**

As discussed in the previous chapter, understanding the relationship between efficiency and service delivery forms for the provision of local public services is a question of vital importance for the public manager, because the control of these services is viewed as a fundamental issue in local government (Geys and Moesen 2009), especially in view of the current economic and financial crisis.

As also observed above, the efficiency of local public services can be analysed from two standpoints, according to the objectives pursued: overall or service-specific efficiency (De Borger and Kerstens 2000). Thus, in the second chapter we examined how different forms of NPM service delivery affect the overall cost efficiency of Spanish municipalities; in the latter approach, the whole organisation (the municipality) was taken as the basis for study. The results obtained from this analysis suggest that NPM organisational structures, as a whole, are associated with higher costs for the municipality, and thus reduced efficiency, except in the case of mixed firms. However, the results of this first study also indicate that the effect of certain NPM delivery forms varies during times of economic recession.



Nevertheless, analysis of the overall efficiency in municipal costs does not show how different forms of management affect the efficiency of each of the local public services provided, and thus cannot determine the most appropriate form for each service. In this sense, since local governments are multiproduct organisations, a policy adopted at the product level may be advantageous for that particular level but not for the organisation as a whole and vice versa. This is known as the “Fox Paradox” (Fox 1999), that means that the product level may be efficient, but this does not necessarily imply overall organisational efficiency (Hefetz et al. 2012b). In the case in question, therefore, one service delivery form may be appropriate for a specific service but in the municipality as a whole, the benefits thus obtained are diluted within the overall cost efficiency. For this reason, it is particularly interesting to conduct specific studies to examine which service delivery forms obtain the highest levels of cost efficiency.

In order to conduct a more profound study of the relationship between efficiency and NPM delivery forms, in this third chapter we focus on a specific service to determine which form of management is most appropriate in this particular case. Among the great variety of services offered by local governments, that of municipal solid waste (MSW) collection and disposal is one of the most widely studied, due to the complexity of its provision, the significant cost involved and increasing environmental concerns in this respect (Bel and Fageda 2010b; Benito-López et al. 2011; Simões and Marques 2012; De Jaeger and Rogge 2013; Jacobsen et al. 2013; Zafra-Gómez et al. 2013).

Recent studies on the question of MSW services have focused on determining which form of service delivery might achieve the highest levels of efficiency and cost savings (Bel and Mur 2009; Bel and Fageda 2010b; Simões et al. 2012; Dijkgraaf and

Gradus 2013; Zafra-Gómez et al. 2013; Bel et al. 2014). The question of the public or private provision of this service, and of the corresponding impact on efficiency, has been widely discussed in the literature (Simões and Marques 2012), although further study is still needed of this question and of the impact that other forms of MSW service provision might have on efficiency. Further empirical evidence would be useful to determine whether the public provision of this service achieves higher levels of cost efficiency than contracting out, or vice versa, and an issue of great current importance is the impact of the current global economic and financial crisis on this relationship. Studies are now being undertaken into the effects of diverse forms of joint management (Rodrigues et al. 2012; Hefetz and Warner 2012; Bel et al. 2014) as a cost-saving alternative to contracting out (Bel and Fageda 2006, 2008; Mohr et al. 2010), especially in smaller municipalities. In view of this background, it seems clear that research that only takes into account whether management of the service is public or private is insufficiently specific, and that the different management alternatives for the MSW service must be defined. Within the wide range of possible forms of provision, those of municipal direct (MUD), municipal under contract (MUC), inter-municipal cooperation (IC) and private production with cooperation (PPC) are among the alternatives most commonly used in managing MSW services (Plata-Díaz et al. 2014).

In short, the aim of the present study is to contribute to the literature on the analysis of cost efficiency in the provision of the MSW service, by analysing the differences that arise in cost efficiency from different ways of providing this service among Spanish local governments, and thus to identify which management form is best suited to its provision.

To address this goal, we have examined a database composed of 771 Spanish municipalities, each with a population of 1,000-50,000 inhabitants, for the years 2004, 2006, 2008 and 2010.

Traditionally, the efficiency of local public services is studied through the application of nonparametric methods such as DEA, under which the initial hypothesis is that all municipalities operate under the same conditions. However, those which have a given service delivery form are not comparable to those operating under a different one, and so, in our opinion, differences inherent to each management form hamper the comparison of efficiency levels for the MSW service. In this respect, Balaguer-Coll et al. (2012) analysed the efficiency of Spanish municipalities, grouping them according to three criteria: output mix, environmental conditions and level of powers. These authors concluded that differences among municipalities corresponding to different groups are important when they are grouped according to environmental conditions and output mix. From this, it follows that any comparison of municipalities that operate on different scales and under different socioeconomic backgrounds should be conducted with great caution.

In the context of our own study, a difference in efficiency between service delivery forms would mean that two municipalities with similar characteristics that apply different delivery forms to their MSW service cannot be compared in terms of efficiency, since, for example, one town may present lower levels of efficiency than another but be among the most efficient within its own form of management. In such a case, this town could improve its efficiency only by changing its delivery form to one that is more appropriate. For these reasons, the present study seeks to determine which service delivery form is most efficient for the MSW service.

In view of its characteristics, it is essential for this study to be addressed using a methodology that distinguishes the different technological processes provided by each management form and reflects their impact on efficiency, taking into account all the units concerned. In this respect, we use the concept of metafrontier – frontier separation – developed by Battese and Rao (2002) and Battese et al. (2004), because the efficiency of DMUs (in the present case, municipalities) that implement a given form of MSW service management is not comparable with that of other units implementing a different form. To determine the cost efficiency of the MSW service for each of the municipalities in the sample, we propose the use of robust partial frontiers, applying order- $m$  frontiers (Cazals et al. 2002; Daouia and Simar 2007). As an alternative to DEA, order- $m$  frontiers are robust to the presence of outliers and extreme values, and are unaffected by problems of dimensionality (Balaguer-Coll et al. 2012). This choice was also made because DEA has been criticised by some authors as being deterministic (Daouia and Simar 2007; De Witte and Marques 2010), a fact that can influence the results obtained and impact on the acceptance or otherwise of the different theories examined by means of this methodology.

The results obtained suggest that cooperative or joint formulas achieve the highest levels of cost savings in the MSW service. However, the evidence indicates differences in cost efficiency between different service delivery forms according to the population size of the municipality. In consequence, smaller municipalities may achieve higher levels of efficiency if inter-municipal cooperation is combined with contracting out, while in municipalities with a larger population the use of contracted out management would be more appropriate.

This chapter is organised as follows. In the second section, we present a theoretical review of the question of cost efficiency in MSW service delivery. The third section introduces the concept of metafrontier, the methodology applied in this study. In the fourth section, we present the data used in the analysis and the results obtained. Finally, the fifth section summarises the key findings and acknowledges the limitations of the study conducted.

## **2. MSW SERVICE: COST EFFICIENCY AND SERVICE DELIVERY FORMS**

MSW collection and disposal is a public service of great importance, due in part to the high cost and complexity of its provision (Huang et al. 2011). Its management depends on several factors (Sørensen 2007; Rogge and De Jaeger 2013), including the presence of specific high-value assets (Sørensen 2007; García-Sánchez 2008; Huang et al. 2011) that require significant investment, a factor that often results in a lack of competition in the provision of this service (Carr et al. 2008).

For this reason, the MSW service has often been subjected to organisational reform, with the main aim of minimising its cost (Abrate et al. 2014). The debate over public or private management and its relationship to the cost of the service has been widely discussed (Hirsch 1965; Stevens 1978; Dubin and Navarro 1988; Dijkgraaf and Gradus 2003, 2013; Ohlsson 2003; Bel and Fageda 2007, 2010b; Bel and Warner 2008b; Bel and Mur 2009; Bel et al. 2010c; Simões et al. 2012; Jacobsen et al. 2013; Zafra-Gómez et al. 2013; Bel et al. 2014). This question is of great current interest due to the need to know which form of local service provision is most efficient (Bel et al. 2014), among the wide variety of management forms possible (Jacobsen et al. 2013). Moreover, recent research has added another option to the range of possibilities, that of joint service management (Warner and Hebdon 2001; Warner and Hefetz 2002;

Dijkgraaf and Gradus 2003, 2013; Bel and Mur 2009; Carr et al. 2009; Bel and Fageda 2010b; Zafra-Gómez et al. 2013).

Diverse theories have been proposed regarding the use of different service delivery forms, including public choice theory, property rights, transaction costs, organisational theory, the theory of incomplete contracts or the application of economies of scale (Bel and Fageda 2006, 2008; Simões et al. 2012; Zafra-Gómez et al. 2013). According to public choice theory, the inefficiency of public services arises basically from the monopolisation of public services (Savas 1987) and from the fact that public managers are rational decision makers who seek to maximise their personal interests (Niskanen 1971). The advantages obtained from the contracting out of public services mainly result from the introduction of competition into municipal service provision (Warner 2012); in particular, cost savings are facilitated by the fact that the private sector often presents lower production costs than is the case of the public sector (Bel and Fageda 2006; Wassenaar et al. 2010). In addition, if the service is contracted out, the private operator may have the possibility of providing the same service in different municipalities, which enables fixed costs to be shared among the different locations in which it operates, thus obtaining economies of scale and service cost reductions (Donahue 1989). Accordingly, contracting out has been proposed as a means of reducing the costs of local service provision and of achieving higher levels of efficiency (Bel and Fageda 2008).

However, the empirical evidence in this respect is unclear (Bel and Warner 2008a, 2008b) and conflicting results have been obtained. On the one hand, some studies have reported no significant differences in MSW service costs between public and private production (Hirsch 1965; Dijkgraaf and Gradus 2003; Bel and Costas 2006;

Bel and Mur 2009; Bel and Fageda 2010b). But on the other hand, research into the relationship between efficiency and private management of the service has presented evidence that the implementation of private management reduces service costs (Kitchen 1976; Tickner and McDavid 1986; Hodge 2000; Reeves and Barrow 2000; Simões et al. 2012). On the contrary, other studies have concluded that private management is associated with higher costs; thus Stevens (1978) and Dubin and Navarro (1988), who examined competition in service provision, found that private management was more costly. Finally, Ohlsson (2003) and Zafra-Gómez et al. (2013) suggest that private service production does not achieve lower costs than public management.

This disparity in results is due, first, to the fact that in the provision of public services there continues to be, in many cases, a lack of competition (Girth et al. 2012; Hefetz and Warner 2012; Warner 2012). Authors such as Littlechild (1988) and Rees (1998) have argued that the lack of success of municipal contracting out is primarily due to the structure of the market in which the service is provided. The MSW service continues to be a public good, whose ownership and management responsibility reside in the municipality; its management can be contracted out, but competition in the sector is low, due to the virtual monopoly situation regarding the infrastructure required for the MSW service (Warner and Bel 2008; Girth et al. 2012).

The diverse results produced by the above-mentioned studies are also justified by the theory of incomplete contracts and by the presence of transaction costs that affect the negotiation of contracts (Bel and Fageda 2006). Contracting out the MSW service requires appropriate regulation and a suitable market structure (Bel and Warner 2008a). The cost savings of contracting out this service may be offset by the transaction costs incurred from the complexity inherent in this provision of public goods and services and

the failure to consider certain costs during contract negotiations related to the management and monitoring of contracts (Brown et al. 2007, 2010; Rodrigues et al. 2012; Bel et al. 2014). Therefore, the greater efficiency obtained by contracting a private operator may be counterbalanced by the higher costs involved (Carr et al. 2008). However, if the local government itself provided the service, this would require considerable investment, and municipalities have severely limited resources and capabilities (Brown et al. 2012), a situation that hampers the direct provision of the MSW service (Brown and Potoski 2003b; Shrestha and Feiock 2011). Therefore, despite the transaction costs of contracting out the service, local governments could achieve greater savings in production costs by avoiding the need to make investments in specific assets (Carr et al. 2008).

Furthermore, there is evidence that smaller municipalities can obtain better results from formulas other than contracting out the MSW service (Bel et al. 2014). This is because private operators may be unable to obtain economies of scale in these smaller municipalities (Kodryzski 1994; Warner and Hefetz 2003; Warner and Hebdon 2001; Bel and Fageda 2006). Not only may small and medium-sized municipalities not be large enough to reduce the cost of the service (Bel and Fageda 2006, 2008; Mohr et al. 2010; Zafra-Gómez et al. 2013), but they may also lack the negotiating power to conclude beneficial contracts with private operators (Kodryzski 1994; Warner and Hefetz 2003). In consequence, these municipalities are less likely to contract out the service (Bel et al. 2014). Furthermore, contracting out requires the strict formulation of contracts and considerable supervision and control capabilities, which are often absent in the case of small and medium-sized municipalities (Mohr et al. 2010). Accordingly, inter-municipal cooperation or joint management has been considered as an alternative to contracting out (Kodryzski 1994; Warner and Hebdon 2001; Warner and Hefetz



2003; Bel and Fageda 2006, 2008; Mohr et al. 2010). For this reason, certain municipalities, usually neighbouring ones, may choose to implement inter-municipal cooperation, jointly organising the service with the intention of exploiting latent economies of scale, and thus sharing the costs of service provision among two or more local governments (Warner and Hefetz 2003; Dijkgraaf et al. 2003; Warner 2006; Zullo 2009).

Bel and Fageda (2006, 2008) and Bel et al. (2014) have shown that municipalities with smaller populations are more likely to adopt inter-municipal cooperation. Moreover, other studies have reported that smaller municipalities can obtain cost savings through collaborative or cooperative management formulas (Bel and Mur 2009; Zafra-Gómez et al. 2013).

However, for this type of municipality, there is an alternative to pure contracting out, namely the establishment of a joint contracting out among municipalities that have opted for inter-municipal cooperation, a format known as private production with cooperation (Zafra-Gómez et al. 2013; Bel et al. 2014). This configuration of the MSW service offers several advantages: first, it reduces the costs faced by each of the municipalities involved, and, second, it provides access to the advantages offered by private provision of the service, thus obtaining overall cost savings and greater efficiency.

In all, therefore, four alternative forms of service delivery are distinguished in the present study, thus improving upon previous research in this field in which the only distinction normally made is that between public and private management. In this study, we differentiate the following forms of MSW service provision: direct provision by the municipality, or municipal direct (MUD); contracted out or municipal provision under

contract (MUC); inter-municipal cooperation (IC); and private production with cooperation (PPC) (Plata-Díaz et al. 2014).

We propose a scenario in which a large sample of municipalities can be used to confirm or reject various hypotheses related to the theoretical assumptions reviewed above. Specifically, we propose two major hypotheses: first, a general one, related to the differences between contracting out and public management; and a second, more specific one, referring to the differences among service delivery forms according to the size of the municipality. Thus, the following hypotheses are proposed:

*H<sub>1</sub>: Municipal provision under contract (MUC) provides higher levels of efficiency than municipal direct (MUD).*

*H<sub>2a</sub>: In smaller municipalities, joint management – inter-municipal cooperation and private production with cooperation (IC and PPC) – provide higher levels of efficiency than municipal under contract (MUC).*

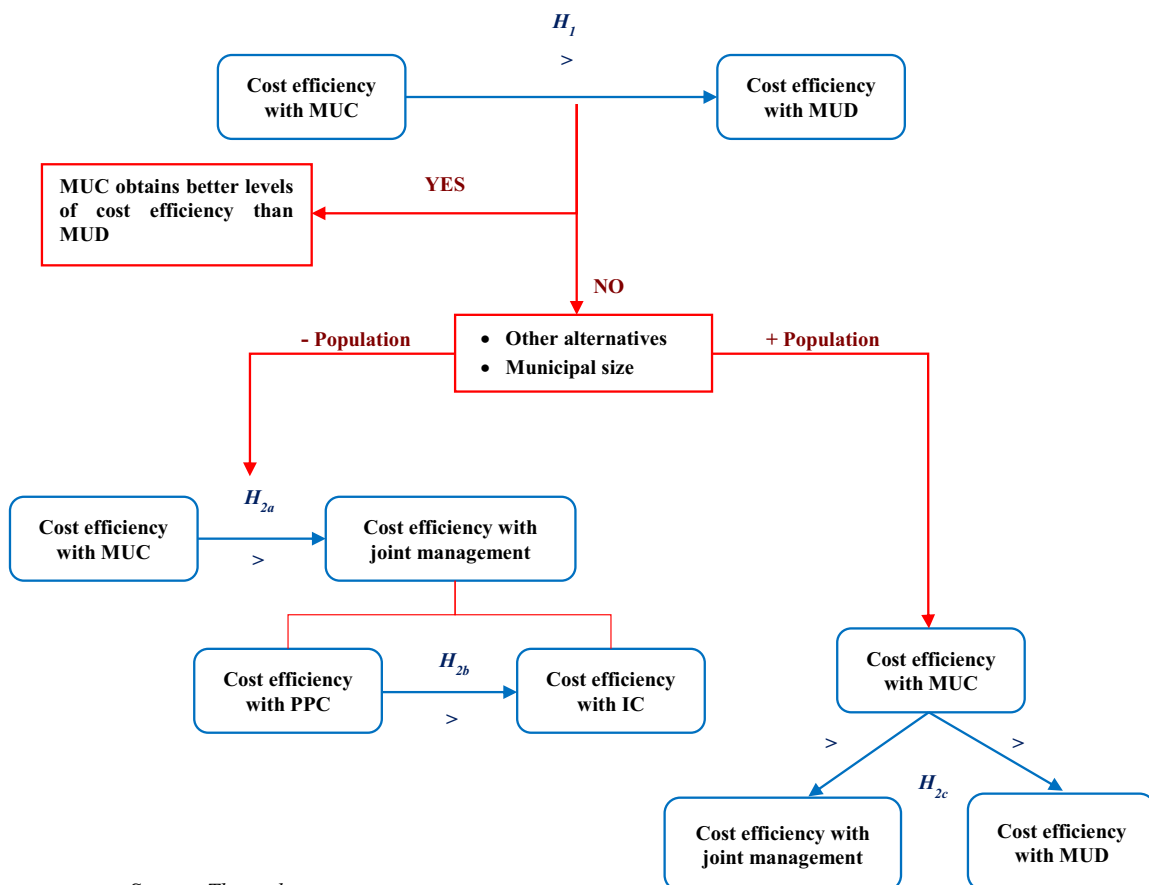
*H<sub>2b</sub>: In smaller municipalities, private production with cooperation (PPC) provides higher levels of efficiency than inter-municipal cooperation (IC).*

*H<sub>2c</sub>: In larger municipalities, municipal under contract (MUC) provides the highest levels of efficiency.*

Figure 3 illustrates the relationships among the different hypotheses proposed in this study. The main objective of this study is to contribute to the analysis of the cost efficiency of different alternatives for MSW service, and this is addressed by considering, first, the differences among the various alternatives, and then by observing

which management form obtains the best efficiency levels. Finally, we determine which form is most suitable taking into account the population size of the municipality.

Figure 3. Relation between cost efficiency and service delivery forms: hypotheses



Source: The author

### 3. MSW DELIVERY FORMS AND EFFICIENCY: THE USE OF THE METAFRONTIER

To address the above hypotheses, we chose to apply the concept of metafrontier or frontier separation, developed by Battese and Rao (2002) and Battese et al. (2004), according to which the efficiency of DMUs operating under a particular technology cannot be compared with that of other units operating under other forms of service provision. Previous studies have concluded that there are differences in efficiency levels

between municipalities that use different operational designs (Balaguer-Coll et al. 2012; Simões et al. 2012). Therefore, certain differences are intrinsic to each delivery form and these differences make it difficult to compare the efficiency of individual management of the MSW service from that obtained in cooperation with other municipalities. Similarly, it is very difficult to compare the results obtained from public versus private management forms.

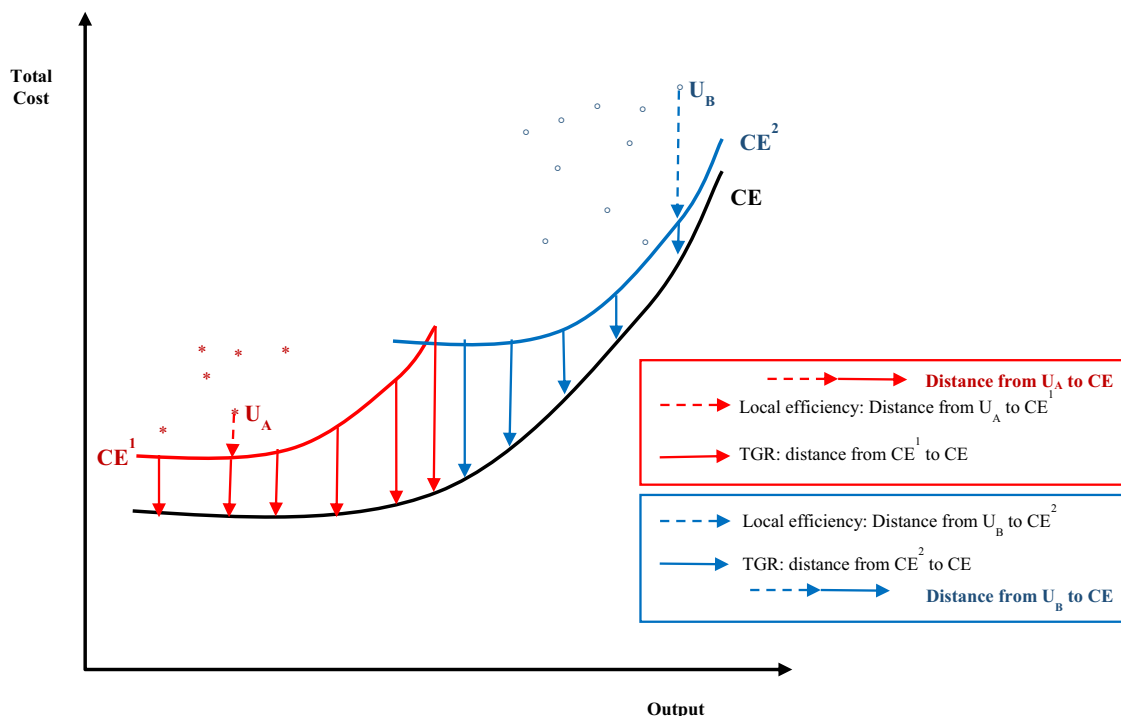
Figure 4 shows an example of applying the concept of frontier separation for the specific case of minimising the total cost for a single output. It is apparent that when the metafrontier concept is applied, different efficiency frontiers are obtained for each of the groups considered (local frontiers,  $CE^k$ ). Thus, the cost efficiency values are estimated for each DMU corresponding to each local frontier, and hence the DMUs operating under the same operating characteristics will be comparable.

In addition, a homogeneous frontier (metafrontier, CE) is obtained for each unit. The metafrontier can be considered an ‘umbrella’ term that includes the various frontiers of each technology (Rao et al. 2003) and functions as a reference point to obtain the technology gap ratio ( $TGR^k$ ) (Battese and Rao 2002; Battese et al. 2004; O’Donnell et al. 2008), i.e., the lowest possible cost for each DMU given a certain output<sup>14</sup>.

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<sup>14</sup> For a given level of output, TGR is defined as the lowest possible cost of the metafrontier divided by the lowest total cost of the local frontier.

Figure 4. Frontier separation and the Metafrontier



Source: The author

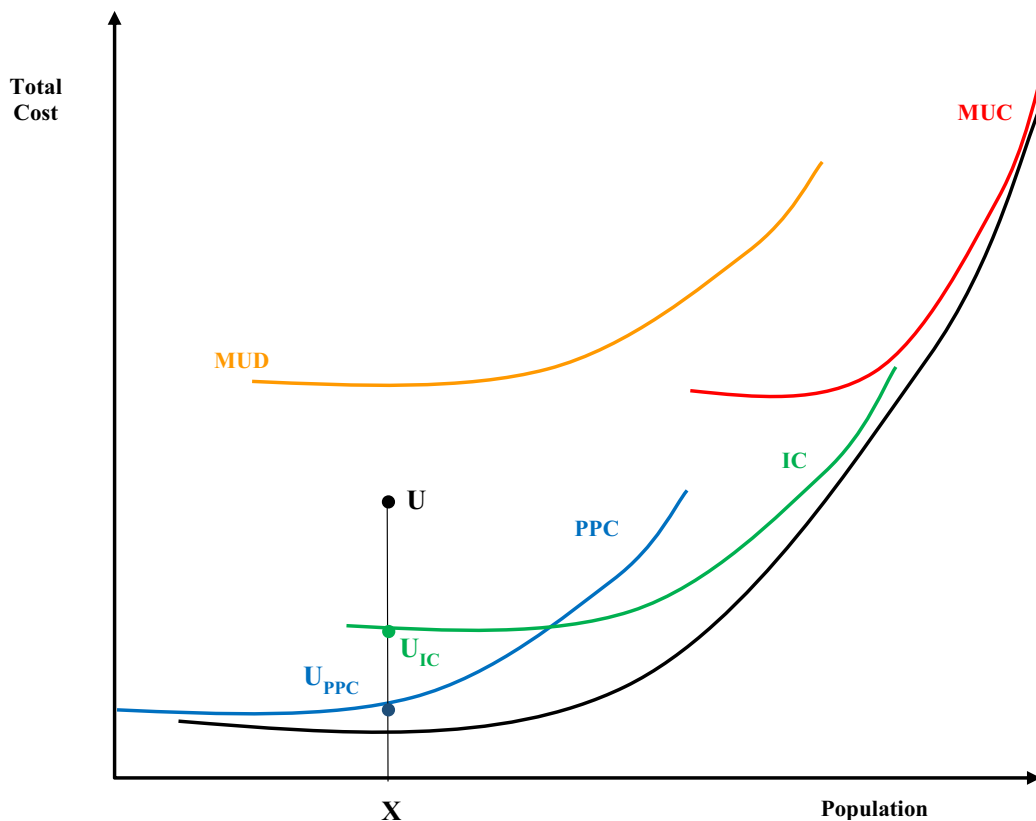
By analysing the technology gap ratio, therefore, we can determine which delivery form is closest to the metafrontier and is therefore most likely to reduce costs and raise levels of efficiency (Figure 4). This figure shows that the units corresponding to a particular technology may be more or less distant from their local frontier ( $CE^k$ ); this factor determines the cost savings that units can achieve with respect to their own service delivery form, that is, as a result of local efficiency.

Thus, if unit  $U_A$  belongs to group  $CE^1$ , the ratio that measures the distance from  $U_A$  to  $CE^1$  reflects the cost efficiency within this group; similarly, the distance from  $CE^1$  to  $CE$  determines the cost efficiency derived from membership of group  $CE^1$  ( $TGR^1$ ). Together, these two distances represent the total distance to the metafrontier of unit  $U_A$ .

Breaking down the overall efficiency value at the metafrontier as the product of the local efficiency ratio and the technology gap ratio reveals the efficiency derived from the internal municipal management (local efficiency) and that derived from the delivery form ( $TGR^k$ ). Thus, as shown in Figure 4, unit  $U_B$ , despite its short distance from its local frontier ( $CE^2$ ) to the metafrontier (CE), will find it more difficult to improve its position with respect to its local frontier (from  $U_B$  to  $CE^2$ ) than will unit  $U_A$  with respect to its own local frontier ( $CE^1$ ). Accordingly, the inefficiency of unit  $U_B$  is mainly due to the internal management form of the municipality, and not to the service delivery form, as is the case of unit  $U_A$ , as other municipalities use this same delivery form and achieve higher levels of efficiency through the same production process.

From the above information, it is possible to identify which delivery form would be most suitable for each type of municipality, in order to achieve improvements in MSW service cost efficiency by changing the way in which the service is provided. Thus, as shown in Figure 5, a municipality with X inhabitants which adopted inter-municipal cooperation (IC) would achieve better results if it switched to private production with cooperation (PPC). The minimum level of costs that the municipality could achieve is determined by the local frontier for inter-municipal cooperation (the distance from U to  $U_{IC}$ ), which is the minimum level of costs that municipality U could achieve by optimising its own management. However, if it operated under an alternative delivery form – in the case in question, PPC – it could attain the efficiency level corresponding to the frontier for this technology; in other words, it could reduce its costs to  $U_{PPC}$  and substantially improve its efficiency (from  $U_{IC}$  to  $U_{PPC}$ ).

Figure 5. Theoretical differences in the efficiency levels of alternative service delivery forms



Source: The author

To calculate the cost efficiency values, both at the metafrontier and at the local frontier, we propose to use the order- $m$  frontier application (Cazals et al. 2002; Daouia and Simar 2007). One of the main advantages of frontier evaluation, compared with previous studies that have estimated the total cost of the MSW service, is that it does not depend on an a priori production function to determine the output with respect to a certain input (Simões et al. 2012; Rogge and De Jaeger 2013).

Several different techniques can be used to calculate nonparametric frontiers. For metafrontier models, the method traditionally applied is that of DEA. However, this technique may not provide satisfactory results, due to its deterministic nature (De Witte and Marques 2010) and to problems of dimensionality that can affect the results thus

obtained (Balaguer-Coll et al. 2012; Simões et al. 2012). Specifically, by including all possible combinations of inputs and outputs, the estimates provided by DEA are extremely sensitive to the presence of outliers (Daouia and Simar 2007). Moreover, this method assumes the absence of statistical errors (De Witte and Marques 2010; Rogge and De Jaeger 2013). As an alternative, which overcomes these limitations, the robust partial frontier approach allows us to consider observations beyond the efficiency frontier being estimated, which makes it a suitable technique to control for the possible presence of outliers (Simar and Wilson 2008). Specifically, the order- $m$  frontier calculates the efficiency values of a DMU by comparing it with a sub-sample of  $m$  pairs, unlike DEA, which compares a DMU with the best unit from the whole sample.

In addition, order- $m$  frontiers can be calculated with respect to input, output, costs or revenue. Given the nature of the units under study in the present case, we chose the cost orientation, as in the previous chapter, since it is more appropriate to assess the efficiency of municipalities in terms of minimising costs, fundamentally because outputs are determined, in most cases, externally to the municipality, and because it is difficult to price inputs and outputs in local government (Cherchye et al. 2014).

The algorithm used to estimate the efficiency coefficients for the order- $m$  frontier considers a fixed positive integer  $m$ ; thus, for a given input ( $x_0$ ) and output ( $y_0$ ), the estimation considers  $m$  random DMUs with output variables ( $Y_1, \dots, Y_m$ ) derived from the distribution of the output matrix that satisfies the condition  $Y_m \geq y_0$ . Following Daraio and Simar (2007), we apply the following steps:

1. For a given level of  $y_0$ , a sub-sample of size  $m$  with replacement is created, among the  $y_{sm}$  that satisfy the following condition  $y_{sm} \geq y_0$ .



2. The efficiency coefficient  $\tilde{\alpha}_S$  is calculated from this random sub-sample and by solving FDH nonconvex integer programming problems.
3. The first two steps are repeated  $B$  times, and the coefficient of FDH efficiency is estimated for each round, so that by the end of the process we have obtained  $B$  efficiency coefficients  $\tilde{\alpha}_S^b$  ( $b = 1, 2, \dots, B$ ).
4. Finally, a central value<sup>15</sup> (the arithmetic mean) of the  $B$  efficiency coefficients is calculated, as:

$$\alpha_S^m = \frac{1}{B} \sum_{b=1}^B \tilde{\alpha}_S^b$$

Thus, by applying order- $m$  frontiers, we estimate both the metafrontier and a robust frontier for each technology considered, by calculating the efficiency coefficients of the municipalities ( $\alpha_S^{m,S_1}, \alpha_S^{m,S_2}, \alpha_S^{m,S_3}, \alpha_S^{m,S_4}$ ) included in each of the groups considered ( $S_1, S_2, S_3, S_4$ ), thus obtaining four local frontiers, one for each of the service delivery forms considered in the study: municipal direct, municipal under contract, inter-municipal cooperation and private production with cooperation.

We now estimate the efficiency coefficients for the metafrontier ( $\alpha_S^m$ ) and the technology gap ratios (TGR<sup>k</sup>):  $\frac{\alpha_S^m}{\alpha_S^{m,S_1}}, \frac{\alpha_S^m}{\alpha_S^{m,S_2}}, \frac{\alpha_S^m}{\alpha_S^{m,S_3}}, \frac{\alpha_S^m}{\alpha_S^{m,S_4}}$ .

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<sup>15</sup> Due to the random replacement, the order- $m$  frontiers may obtain efficiency coefficients beyond the estimated frontier, and so as well as applying a cost orientation, an observation will be super-efficient when it reaches  $\alpha_S^m > 1$ . Furthermore,  $\tilde{\alpha}_S^b$  depends on the value of  $m$ , and so the larger the  $m$ , the more observations are taken into consideration in the estimation and therefore the more DMUs will meet the condition  $y_{sm} \geq y_0$ . Thus, when  $m \rightarrow \infty$  the efficiency coefficients obtained by applying the order- $m$  methodology converge with the FDH coefficients. In addition, the quality of the approximation can be adjusted by increasing  $B$ . Although in most applications it is reasonable to use  $B = 200$  (Balaguera-Coll et al. 2012) in this paper, we take  $B = 2000$ , as suggested by De Witte and Geys (2013).

In order to facilitate comparison of results, to avoid problems of dimensionality and to neutralise the influence of outliers, we assigned the same value of  $m$  to all estimates, regardless of the number of units included in each of the groups considered. According to Daraio and Simar (2005),  $m$  is the value at which the percentage of super-efficient DMUs decreases marginally with an increase in  $m$ ; however, using the same value of  $m$  when the group sizes are different has the drawback that groups with higher numbers of units will obtain more super-efficient units. Using a variable value for  $m$  would overcome this limitation, but even so the estimates obtained would not be comparable because the basis for comparing the different groups would not be the same. For this reason, after conducting a sensitivity analysis with different values of  $m$  (50, 60 and 70) we observed some convergence in the results for  $m = 50$  and decided to make all estimates at this parameter setting, as the percentage of super-efficient observations declined only marginally with  $m$ . However, because the total number of units had been used in obtaining the metafrontier estimate, another sensitivity analysis was performed for  $m = 50, 60, 70 \dots 250$ , from which a certain degree of convergence in the results was obtained from  $m = 200$ . Accordingly, this value was applied in our estimation of the metafrontier.

Finally, to complete the calculations made and to further study the different levels of efficiency for each service delivery form, various statistical tests were applied: first, the Kruskal-Wallis test, to determine the existence of differences in the efficiency calculated for the different groups created (coincident with each of the local frontiers representing different management forms). The Kruskal-Wallis test is a nonparametric method that does not assume a normal distribution of the variables analysed. It is used to determine whether two or more samples are independent (unrelated). However, this test does not state what are the differences between samples. For this reason, we also

applied the Mann-Whitney U test, another nonparametric test that tests the independence of two samples, with the null hypothesis that the difference between two samples is zero. Finally, we compared the distributions of the different groups using the Li test, which measures the distance between two density functions through the integrated mean square error of the functions (Li 1996; Balaguer-Coll et al. 2010; Zafra-Gómez and Muñiz 2010).

#### **4. MEASURING THE EFFICIENCY OF MSW SERVICE DELIVERY FORMS IN SPANISH PRACTICE**

##### ***A. DATA DESCRIPTION***

In Spain, MSW service is a local public service that all municipalities are required to provide<sup>16</sup>, although for this purpose they can establish the delivery form that they see fit. The following delivery formulas are analysed in this study and are applicable to the Spanish context: direct provision by the municipality, municipal under contract, inter-municipal cooperation, and cooperation with private production (Warner and Bel 2008; Plata-Díaz et al. 2014).

To achieve the study goals, we examined a large database, and extracted the data for the years 2004, 2006, 2008 and 2010, with respect to 771 Spanish municipalities each with a population of 1,000-50,000<sup>17</sup>. These municipalities represent 25% of all Spanish municipalities in this population group. This restriction with respect to the population size of the municipality arose from the non-availability of data for municipalities with fewer than 1,000 inhabitants, and from a parallel absence of data on the MSW service (outputs) for municipalities with over 50,000 inhabitants. The

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<sup>16</sup> This obligation is specified in Article 26 of *Ley 7/1985, de 2 de abril, Reguladora de las Bases del Régimen Local*, as amended *Ley 27/2013, de 27 de diciembre, de racionalización y sostenibilidad de la Administración Local*

<sup>17</sup> Population data were obtained from the Statistical Yearbook published by 'La Caixa'.

reduction in sample size from the 1,058 municipalities described in the second chapter to the 771 municipalities in the present study was necessary due to the non-availability of budgetary data, in the remaining cases, on the cost of the MSW service.

Table 4 describes and states the source of the variables included in the calculation of cost efficiency for the MSW service, the descriptive statistics for which are given in Appendix 6.

**Table 4. MSW service: inputs and outputs**

<b>Variable</b>	<b>Definition</b>	<b>Source</b>
<b>Total Cost</b>	Municipal budget expenditure, obtained from the functional budget classification, <i>Category 442 – MSW removal and street cleaning</i> , for each of the municipalities included in the sample, for the years 2004, 2006 and 2008. This classification has been used in several previous studies (Benito-López et al. 2011; Zafra-Gómez et al. 2013). Due to the implementation of a new classification system (O. EHA / 3565/2008, de 3 de diciembre), with respect to the year 2010 we used the equivalent, composed of <i>Category 162 – Waste collection, disposal and treatment</i> and <i>Category 163 – Street cleaning</i>	Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury
<b>MSW tons</b>	Annual production of waste, in tons/year	Survey of Local Infrastructure and Equipment
<b>MSW tons*quality</b>	Annual production of waste, in tons/year, corrected by the index of service quality	(EIEL), from the Ministry of Public Administration's website
<b>Containers</b>	Number of containers recorded as installed on public roads in the municipalities, for each type of MSW collection	

*Source: The author, based on data supplied by the Virtual Office of Local Government Financial Coordination and on the Survey of Local Infrastructure and Equipment.*

To analyse the efficiency of the MSW service according to the service delivery form applied, the municipalities were classified into four categories, following Zafra-Gómez et al. (2013), Bel et al. (2014) and Plata-Díaz et al. (2014): municipal direct (MUD), municipal under contract (MUC), inter-municipal cooperation (IC) and private production with cooperation (PPC). To do so, the relevant information was obtained from the Virtual Office of Financial Coordination with Local Entities of the Ministry of

Public Administration, the official provincial gazettes and the websites of the municipalities concerned. Table 5 describes each of the categories.

**Table 5. Delivery forms for the MSW service**

<b>Category</b>	<b>Concept</b>
<b>Municipal direct (MUD)</b>	The service is managed by the municipality itself or through a public agency or public enterprise controlled by the municipality
<b>Municipal under contract (MUC)</b>	Management is contracted out to a single private company
<b>Inter-municipal cooperation (IC)</b>	Joint management by various municipalities, through a public entity created for this specific purpose (consortium or association) or through the transfer of management to a supra-local public entity (regional council)
<b>Private production with cooperation (PPC)</b>	Joint management among two or more municipalities, contracted out to a private company

*Source: The author, based on Zafra-Gómez et al. (2013), Bel et al. (2014) and Plata-Díaz et al. (2014).*

## **B. RESULTS**

To test the first of the hypotheses proposed, regarding all of the municipalities in the sample, we estimated the cost efficiency scores for each municipality, both for the local frontier ( $CE^k$ ) and for the metafrontier (CE), and ascertained the technology gap ratio. The Kruskal-Wallis test was then applied to determine whether the efficiency levels of the different categories of services delivery forms differed from each other, with the null hypothesis being that the median efficiency of the  $k$  groups was equal in every case. This test was applied to the cost efficiency coefficients of the municipalities, for the local frontier ( $CE^k$ ) (Table 6). Analysis of these results led us to reject the null hypothesis, at a significance level of 99% for every year considered except 2010. Thus, the cost efficiency of each of the categories considered varied from that of the others, except for the last year considered.

**Table 6. Kruskal-Wallis test for the local frontier, by service delivery form and year**

<b>Management forms: MUD – MUC – IC – PPC</b>				
	<b>2004</b>	<b>2006</b>	<b>2008</b>	<b>2010</b>
<b>Chi-squared</b>	101.211	111.949	198.050	3.386
<b>Degrees of freedom</b>	3	3	3	3
<b>p-value</b>	0.0001	0.0001	0.0001	0.3359

*Results obtained using Stata 12*

*MUD: Municipal direct MUC: Municipal under contract*

*IC: Inter-municipal cooperation PPC: Private production with cooperation*

In the next phase of the analysis, the Mann-Whitney U test (also called the Wilcoxon-Mann-Whitney test) and the Li test were performed, because the Kruskal-Wallis test does not identify the differences between the different categories. The results of these tests are shown in Appendix 7. The results of both tests were very consistent, thus indicating the existence of differences between the efficiency levels of the different management forms, with only two exceptions. For the year 2010, as previously obtained with the Kruskal-Wallis test, there were no significant differences among the different service delivery forms.

Accordingly, we conclude there are significant differences between different delivery forms, and so potential cost savings in providing the MSW service will depend on the form of service delivery.

Having established the existence of differences in the efficiency levels of each service delivery form, we then analysed the results obtained for each of the delivery forms considered, to determine which is most efficient for the MSW service. Table 7 shows, for each year, the main results of the estimates of the order- $m$  frontiers for each of the local frontiers ( $CE^k$ ), representing different forms of MSW service delivery, and

the metafrontier (CE) and the technology gap ratio (TGR<sup>k</sup>) for each service delivery form.

Initial analysis of the results for the metafrontier (CE) and the local frontiers (CE<sup>k</sup>) shows that the average cost efficiency values are relatively low for all management forms. The percentage of efficient units (municipalities whose efficiency is equal to 1) is also low. However, application of the order-*m* frontiers allows us to obtain super-efficient units, as shown by the maximum values<sup>18</sup> (see Table 7), which are far removed from the minimum values, implying the existence of differences between municipalities that employ the same service delivery form.

**Table 7. Cost efficiency of service delivery forms for the MSW service, each year**

Service delivery form		N	Mean	Min.	Max.	% Eff. Obs <sup>5</sup>
<b>Year: 2004***</b>						
<b>MUD</b>	CE	153	0.126	0.003	1.175	1.96
	CE <sup>k</sup>		0.314	0.007	1.324	3.92
	TGR		0.526	0.020	1.003	
<b>MUC</b>	CE	282	0.114	0.007	1.000	4.61
	CE <sup>k</sup>		0.204	0.007	1.302	4.26
	TGR		0.605	0.074	1.000	
<b>IC</b>	CE	259	0.137	0.007	1.223	2.32
	CE <sup>k</sup>		0.300	0.009	1.621	5.02
	TGR		0.525	0.016	1.000	
<b>PPC</b>	CE	77	0.198	0.013	1.916	2.6
	CE <sup>k</sup>		0.599	0.051	1.509	16.88
	TGR		0.398	0.018	1.317	
<b>Year: 2006***</b>						

<sup>18</sup> Unlike stochastic frontier analysis, according to which the metafrontier includes the most efficient points at each of the local frontiers (Battese and Rao 2002), the metafrontier values obtained by applying order-*m* frontiers need not coincide with the most efficient values at each local frontier, and so there may be super-efficient points beyond the metafrontier and the local frontiers.

<b>MUD</b>	CE	144	0.092	0.001	1.003	4.17
	CE <sup>k</sup>		0.440	0.015	1.292	6.94
	TGR		0.175	0.013	1.003	
<b>MUC</b>	CE	282	0.089	0.002	1.021	3.19
	CE <sup>k</sup>		0.205	0.004	2.673	4.61
	TGR		0.477	0.060	1.000	
<b>IC</b>	CE	260	0.135	0.002	2.147	4.23
	CE <sup>k</sup>		0.259	0.002	2.730	4.62
	TGR		0.593	0.010	1.000	
<b>PPC</b>	CE	85	0.109	0.002	1.385	2.35
	CE <sup>k</sup>		0.487	0.002	1.140	7.06
	TGR		0.379	0.015	1.319	
<b>Year: 2008***</b>						
<b>MUD</b>	CE	132	0.081	0.002	1.000	3.03
	CE <sup>k</sup>		0.668	0.015	1.828	6.82
	TGR		0.109	0.013	1.000	
<b>MUC</b>	CE	299	0.091	0.002	1.045	3.34
	CE <sup>k</sup>		0.209	0.006	1.924	5.02
	TGR		0.480	0.018	1.000	
<b>IC</b>	CE	253	0.131	0.001	1.477	3.16
	CE <sup>k</sup>		0.240	0.001	1.682	5.93
	TGR		0.686	0.013	1.000	
<b>PPC</b>	CE	87	0.124	0.002	3.088	1.15
	CE <sup>k</sup>		0.484	0.006	1.806	10.03
	TGR		0.213	0.011	1.710	

\*\*\*Only reported results with mean independence of service delivery forms at 99% significance, according to the Kruskal Wallis test

CE: Metafrontier                      CE<sup>k</sup>: Local frontier                      TGR: Technology gap ratio

MUD: Municipal direct                      MUC: Municipal under contract

IC: Inter-municipal cooperation                      PPC: Private production with cooperation

As a first approximation to determine which service delivery form is most appropriate for MSW service, we analysed the technology gap ratio, which is obtained for each municipality as the ratio of the efficiency value at the metafrontier to the



corresponding value at the local frontier ( $\frac{\alpha_S^m}{\alpha_S^{m,S_k}}$ ). For values close to 1, the distance from the frontier of the specific service delivery form (local frontier) to the metafrontier is minimal, while values below 1 represent a greater distance between these frontiers. Therefore, the delivery form that is closest to the metafrontier will usually present the highest TGR.

The highest TGR values were found for inter-municipal cooperation (IC) and municipal under contract (MUC): MUC<sub>2004</sub>: 0.605; IC<sub>2006, 2008</sub>: 0.593 and 0.686. By contrast, when we determined which management form was furthest from the metafrontier, we found that in 2004, private production with cooperation (PPC) obtained the lowest mean TGR values (PPC<sub>2004</sub>: 0.398), while in 2006 and 2008, the lowest mean TGR value corresponded to municipal direct (MUD<sub>2006, 2008</sub>: 0.175, 0.109). These results are also illustrated in the graphs included in Appendix 8, to reflect the evolution of the mean distance of each service delivery form from its local frontier to the metafrontier (TGR). In this case, in the white-shaded area, from the origin to TGR = 1, it can be seen that, on average for all years observed, private production with cooperation (PPC) and municipal direct (MUD) are the least efficient delivery forms (hence the area is larger), while inter-municipal cooperation (IC) is closest to the metafrontier. These graphs also reflect the presence of units that are super-efficient when the technology gap ratio presents values above 1.

However, with respect to the mean values for the local frontiers (CE<sup>k</sup>), we found that the municipalities that implement private production with cooperation (PPC) and municipal direct (MUD) outperform the other service delivery forms (PPC<sub>2004, 2006</sub>: 0.599, 0.487; MUD<sub>2008</sub>: 0.678). It follows, hence, that for each of these alternatives, the

efficiency values for each municipality are closer, on average, to their local frontier than is the case with the other service delivery forms.

The opposite case is that of municipal under contract (MUC), for which the local average efficiency ( $CE^k$ ) in the years 2004, 2006 and 2008 was about 20%. Thus, the efficiency of the municipalities implementing this delivery form is further from the respective local frontiers, and there is more dispersion among the group elements. In consequence, only a few manage the service efficiently. Similar results were obtained for inter-municipal cooperation (IC: 0.300, 0.259, 0.240), thus indicating that although TGR analysis showed this service delivery form to be closest to the metafrontier, the cost efficiency scores of the municipalities implementing it are more distant from their respective local frontiers.

In summary, the municipalities that implement private production with cooperation (PPC) and municipal direct (MUD) achieve more homogeneous levels of efficiency, close to their local frontier. Nevertheless, these management forms fail to achieve the highest levels of efficiency in MSW service delivery, as our TGR analysis shows that some municipalities would achieve better results with a different delivery form.

The TGR analysis, therefore, leads us to reject the hypothesis that contracting out produces higher levels of efficiency than public service delivery formulas ( $H_I$ ), since the results show that municipal under contract (MUC) obtained a mean cost efficiency that was slightly higher than that of inter-municipal cooperation (IC) in only one year; in the other years, IC was the most efficient formulation.

As the first hypothesis cannot be accepted, and in accordance with the study structure shown in Figure 3, we now analyse which MSW service delivery form is most appropriate according to the population size of the municipality. The variability of the above results, together with the fact that previous studies have suggested that inter-municipal cooperation is more commonly adopted by smaller municipalities, constitutes empirical evidence that this type of study is influenced by the population size. For this reason, we now test hypotheses  $H_{2a}$ ,  $H_{2b}$  and  $H_{2c}$ ; thus, Table 8 (see Appendix 9) presents – for all the study years – a summary of the results obtained.

Table 8 shows the mean TGR for each delivery form, distinguishing three population tranches<sup>19</sup>: 1,000-5,000, 5,001-20,000 and 20,001-50,000 inhabitants<sup>20</sup>, ordered according to the mean value obtained. Thus, for each year, each service delivery form receives a grade from A to D, according to the average TGR value obtained (the numerical values are given in Appendix 9b).

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<sup>19</sup> The study focused on municipalities with a population between 1,000 and 50,000 inhabitants. The population tranches examined were adopted taking into account the requirements of *Real Decreto Ley 2/2004, de 5 de marzo, por el que se aprueba el Texto Refundido de la Ley Reguladora de las Haciendas Locales*.

<sup>20</sup> The population data used in classifying the municipalities were obtained from the Spanish National Institute of Statistics (INE) and from the Economic Yearbook published by La Caixa.

**Table 8. TGR for each service delivery form, according to population size**

Size / Year***	1,000≤Population ≤5,000			5,001≤Population ≤20,000			20,001≤Population ≤50,000		
	2004	2006	2008	2004	2006	2008	2004	2006	2008
<b>MUD</b>	C	D	D	C	D	D	B	C	C
<b>MUC</b>	D	C	C	A	B	B	A	A	A
<b>IC</b>	B	B	A	B	A	A	C	B	B
<b>PPC</b>	A	A	B	D	C	C	D	D	D

\*\*\* Only reported results with mean independence of service delivery forms at 99% significance according to the Kruskal Wallis test (results for the test reported in Appendix 9a)

MUD: Municipal direct MUC: Municipal under contract

IC: Inter-municipal cooperation PPC: Private production with cooperation

A: The highest technology gap ratio (TGR)

D: The lowest technology gap ratio (TGR)

In the case of the municipalities belonging to the first population tranche, the shortest distance between the local frontiers and the metafrontier is obtained by the formula of inter-municipal cooperation. Specifically, the TGR for private production with cooperation (PPC) obtained the highest values in 2004 and 2006 (0.848 and 0.747) and the second highest value in 2008, after inter-municipal cooperation (IC) which recorded a TGR value of 0.83 in that year. Moreover, PPC obtained the highest metafrontier value in all three periods considered (Appendix 9b: 0.374, 0.107 and 0.220), which shows that on average these municipalities are more efficient than the others. In addition, for this population tranche, the results suggest that the municipal direct (MUD) and municipality under contract (MUC) formulas are less suitable for MSW service delivery management.

The two service delivery forms that obtain the highest TGR values for municipalities with a population size of 5,001-20,000 are municipal under contract (MUC) and inter-municipal cooperation (IC). A slightly higher TGR value was obtained by MUC in 2004 ( $MUC_{2004}$ : 0.572), while for 2006 and 2008, IC was the most cost

efficient (IC<sub>2006, 2008</sub>: 0.581 and 0.676). In this case, the lowest efficiency levels corresponded to MUD and PPC.

Finally, for the larger municipalities – with 20,001-50,000 inhabitants – the delivery form that came closest to the metafrontier was MUC, which achieved the highest TGR values (0.893, 0.829 and 0.822). In this case, therefore, we conclude that contracting out obtains greater cost efficiency, although the municipalities implementing this service delivery form are more distant from their own local frontiers, with lower levels of cost efficiency at the local frontier ( $CE^k$ ). In other words, in municipalities with a population between 20,001 and 50,000 inhabitants that provide the MSW service using the MUC alternative, there are large differences in efficiency between those which achieve the best efficiency values (i.e., the municipalities that constitute the local frontier) and the rest. On the other hand, although inter-municipal cooperation (IC) is the delivery form that comes second closest to the metafrontier, it obtains a mean TGR value that is well below that for municipal under contract (MUC). Finally, for municipalities of this population size, the formula that obtains the lowest level of efficiency is that of private production with cooperation (PPC), followed by municipal direct (MUD).

In summary, these results show that the efficiency of each form of MSW service depends on the size of the municipality in which it is applied. Although the inter-municipal cooperation (IC) formula is relatively good for all population sizes, for municipalities in the first and last population tranches, private production with cooperation (PPC) and municipal under contract (MUC), respectively, outperform IC.

In this respect, and as suggested by Bel and Mur (2009), Zafra et al. (2013) and Bel et al. (2014), smaller municipalities can obtain cost savings, and thus improve the

efficiency of their MSW service, when they adopt joint management formulas, in accordance with hypothesis  $H_{2a}$ . Specifically, in the smaller municipalities (with up to 20,000 inhabitants), joint management is a highly recommended alternative to contracting out, as it provides higher levels of efficiency.

However, in contrast to previous studies, we find that municipalities with smaller populations may achieve greater cost savings through a combination of joint management with contracting out, as this approach provides, on the one hand, the cost savings derived from cooperation and, on the other, the increased efficiency offered by a private operator. Accordingly, hypothesis  $H_{2b}$  is accepted.

Finally, for the municipalities with the highest populations in our sample (20,001-50,000 inhabitants), contracting out the MSW service provides better levels of efficiency, and therefore the last hypothesis ( $H_{2c}$ ) is accepted. Hence, municipal size determines which service delivery form is the most appropriate, and therefore municipalities of a certain size can take advantage of the benefits offered by contracting out their MSW service, and if they do not reach this size, enjoy these benefits by combining contracting out with inter-municipal cooperation.

Previous studies, too, have observed that formulas of inter-municipal cooperation are more frequently found among small municipalities, while contracting out is more common in larger ones (Bel et al. 2010a). To illustrate this question, Table 9 shows the percentage of municipalities included in the study that apply each of the delivery forms, according to municipal size and year, highlighting whether municipalities actually make use of the formulas that maximise their cost efficiency.

**Table 9. Service delivery forms by population size: percentage in each case**

Size / Year***	1,000≤Population ≤5,000			5,001≤Population ≤20,000			20,001≤Population ≤50,000		
	2004	2006	2008	2004	2006	2008	2004	2006	2008
<b>MUD</b>	17.39	15.58	15.54	21.22	19.79	18.07	17.50	18.25	15.65
<b>MUC</b>	29.19	27.27	27.70	35.71	36.25	37.61	50.00	48.18	53.74
<b>IC</b>	38.51	41.56	40.54	33.88	33.33	33.19	25.83	26.28	23.81
<b>PPC</b>	14.91	15.58	16.22	9.18	10.63	11.13	6.67	7.30	6.80
<b>Total</b>	100	100	100	100	100	100	100	100	100

Source: The author, based on data supplied by the Virtual Office of Financial Coordination with Local Entities of the Ministry of Public Administration, official provincial gazettes and the websites of the municipalities concerned.

\*\*\*Data reported for years in which the Kruskal Wallis test, the Mann-Whitney U test and the Li test obtain significant differences.

MUD: Municipal direct MUC: Municipal under contract

IC: Inter-municipal cooperation PPC: Private production with cooperation

It can be seen that the most commonly adopted service delivery forms are inter-municipal cooperation (IC) and municipal under contract (MUC), with a higher percentage of the latter in larger municipalities (over 20,000 inhabitants) and more cases of inter-municipal cooperation in the other population tranches. In contrast, private production with cooperation (PPC), the least commonly used delivery form, is more common among smaller than larger municipalities.

The joint analysis of Tables 8 and 9 shows that municipalities with a population of 1,000-5,000 inhabitants are less likely to adopt private production with cooperation (PPC) despite the greater efficiency it provides. However, the larger municipalities more commonly apply the form that offer the best efficiency levels according to their size, i.e., inter-municipal cooperation (IC) in municipalities with 5,001-20,000 inhabitants and municipal under contract (MUC) for those with a population size of 20,001-50,000.

Finally, and with respect to the current economic crisis, it can be seen that in the initial years the cost efficiency of the different service delivery forms remains unchanged. However, in 2010, according to the results of the various tests performed, there were no significant differences between the different delivery forms, and so for this year it is not possible to distinguish which is the most appropriate alternative for MSW service. These results suggest that the analysis of municipal cost efficiency cannot be performed in isolation from the economic context, and that we must distinguish periods of economic recession from those of economic expansion.

## **5. CONCLUSIONS AND DISCUSSION**

This chapter presents an analysis of the cost efficiency achieved by different forms of MSW service delivery. Research in this field has traditionally focused on the debate between public and private provision. However, recent studies have examined other options, one of which is inter-municipal cooperation. In the present study, therefore, the service delivery forms analysed are municipal direct, municipal under contract, inter-municipal cooperation and private production under contract.

To determine which alternative achieves the highest levels of MSW service cost efficiency, the concept of metafrontier (Battese and Rao 2002; Battese et al. 2004) was applied to a sample of 771 Spanish municipalities each with a population of 1,000-50,000 inhabitants, for the years 2004, 2006, 2008 and 2010. The efficiency of each municipality was calculated according to the service delivery form adopted for its MSW service. In addition, we determined the cost efficiency that would be obtained if there were no delivery form differences. Order- $m$  frontiers were used to calculate cost efficiency coefficients, thus obtaining more robust results than is the case with other non-parametric techniques.



The results reveal significant differences between cost efficiency levels for the different forms of MSW delivery. As was the case with previous studies (Bel and Mur 2009; Zafra et al. 2013; Bel et al. 2014), we found that, in general, inter-municipal cooperation is the most efficient service delivery form for the MSW service.

However, unlike these earlier studies, we found that the optimum alternative for this service depends on the size of the municipal population. Our results suggest that joint management formulas are more appropriate in municipalities with a population of up to 20,000. Specifically, the formula of private production with cooperation is the most appropriate for smaller municipalities. In practice, however, these local governments are more likely to adopt inter-municipal cooperation or contracting out. If the PPC formula were adopted, both the municipality and the private operator could benefit from the economies of scale offered by collaboration in service delivery and by the presence of a private operator, thereby improving service efficiency.

For medium-sized municipalities, the most appropriate formula is that of inter-municipal cooperation, while the largest ones (over 20,000 inhabitants) should opt for contracting out. Thus, our findings suggest that private operators obtain higher levels of efficiency in MSW service delivery when the town reaches a certain population size.

The present study highlights the existence of cost differences arising from different approaches to providing MSW services and from population size. The latter factor is shown to be of particular importance in this analysis of cost efficiency, and so studies examining the relationship between cost efficiency and service delivery forms for the municipal waste collection service should take into account the size of the municipality.

One limitation of the present study is that the non-availability of data for larger municipalities (more than 50,000 inhabitants) prevented us from determining which delivery form for MSW service would be most appropriate for these municipalities.

Furthermore, this study is merely an initial approach to the analysis of cost efficiency in the context of the MSW service in which the concepts of frontier separation and metafrontier are used to determine which delivery formula would be most appropriate, conducting a cross-sectional analysis over four years. In view of the results obtained, a further analysis should be made of the issue, from a dynamic standpoint.



**CHAPTER 4: MUNICIPAL SOLID WASTE SERVICE:  
CONTRACTING OUT, COST EFFICIENCY,  
TRANSACTION COSTS AND THE LEARNING CURVE  
FOR LOCAL GOVERNMENTS IN SPAIN**



## **1. INTRODUCTION**

In the previous two chapters, we analysed the relationship between different delivery forms for the provision of local public services and the cost efficiency thus achieved, from an overall standpoint for the municipality, and from a specific one as regards the municipal solid waste (MSW) service. The next step is to analyse, from a dynamic standpoint, how a change in the delivery form applied to a specific service affects its efficiency.

The results presented in Chapter 3 suggest that, in general, the inter-municipal cooperation achieves the highest levels of cost efficiency for MSW service delivery. In addition, we obtained evidence that private formulas – in larger municipalities, applied in the form of contracting out, and in smaller ones, in combination with inter-municipal cooperation – allow the municipality to maximise its cost savings. However, these results were obtained with respect to a certain period of time. The methodology employed determines whether a given service delivery form produces better results, but it cannot establish the cause-effect relationship between the adoption of a particular delivery form for the MSW service and the resultant cost efficiency of this service.

Accordingly, in this fourth chapter we conduct a dynamic study of cost efficiency in the context of the MSW service.

Among the different service delivery forms, this study focuses specifically on the contracting out of the MSW service, in the understanding that when service efficiency is analysed taking into account the size of the municipality, formulas based on contracting out (i.e., municipal under contract and private production with cooperation) obtain greater cost savings, as explained in the previous chapter.

The contracting out of local public services has been defended as a mechanism to improve efficiency (Brown and Potoski 2005), and various theories have proposed contracting out as a means of increasing cost efficiency (Brudney et al. 2005) in the provision of local public services. Some studies have focused on the relation between contracting out and the costs of local services, with the main aim of determining whether contracting out is an appropriate service delivery form (Kitchen 1976; Callan and Thomas 2001; Reeves and Barrow 2000; Dijkgraaf and Gradus 2003; Bel and Costas 2006; Bel and Warner 2008b; Bae 2010). Nevertheless, empirical evidence is contradictory with respect to the reality of such cost savings (Dijkgraaf and Gradus 2003; Brudney et al. 2005; Bel et al. 2010c), and in some cases higher costs have been reported (Girth et al. 2012), especially in individual case studies (Domberger and Rimmer 1994; Hodge 1996; Sclar 1997, 2000).

The trend toward the contracting out of local public services has been spurred by the recent economic crisis, which has encouraged local authorities to seek cost savings, hoping to achieve increased efficiency and valuable innovation by means of this formula for service delivery (Greene 1996a; Warner and Hedbon 2001; Brown and Potoski 2005). In consequence, there has been a considerable increase in the contracting

out of public services in recent years, coinciding with the impact of the international economic crisis.

The question that remains to be answered is whether this contracting out achieves lasting cost savings or whether, to the contrary, it reduces long-term cost efficiency. Clearly, this is a question of vital importance to the managers of local public services (Boardman and Hewitt 2004). Therefore, it is important to conduct an in-depth analysis of the results obtained from contracting out, to establish whether the cost efficiency of local public services improves after contracting out, and if so, how long it takes the municipality to achieve tangibly better results.

The time dimension in such an analysis is important (Bel and Fageda 2007), as a local government that implements a contracting out process can acquire new knowledge over time (i.e., there are potential benefits from the learning process) and thus achieve improved management performance (Amirkhanyan 2007; Rashman and Randor 2005; Rashman et al. 2009; Warner and Hefetz 2008, 2012). Organisational learning has become a central point in the process of public service improvement (Rashman et al. 2009), since the experience gained over time will probably result in better cost control (Argote 1999).

For these reasons, the main objective of this chapter is to employ a dynamic perspective to examine the long-term effect of contracting out, to see whether this delivery form leads to cost savings, as held by advocates of the managerialist tradition, or to cost increases, as suggested under the transaction cost theory. Moreover, the dynamism of the study will allow us to study the effect produced over several years, and thus we shall establish whether there is a learning effect with the implementation of contracting out that could favour the achievement of cost savings.



Taking into account these study goals, we analyse the variation in MSW service cost efficiency using matching techniques, as has been done in previous research in related areas (Heckman et al. 1997; Girma et al. 2004; Manjón et al. 2012; Máñez-Castillejo et al. 2010; Máñez et al. 2013). However, to the best of our knowledge, this is the first study in which this technique is applied to investigate the effect of contracting out on the cost efficiency of MSW service delivery. In our specific context, this matching technique is applied by pairing local governments that contract out the MSW service with observations in the control group (non-contracting-out municipalities) that have similar observed characteristics, and then estimating the effect of contracting out by subtracting the mean efficiency improvement of non-contracting municipalities from that achieved by contracting ones.

For this purpose, we studied a sample of 422 Spanish municipalities for the period 2002-2010, to determine whether contracting out enhances cost efficiency, and examining whether there was a time lag during the change of service delivery form that might affect MSW cost efficiency, such that cost efficiency decreased during the early years after the change and later increased, due to the learning effect produced by the change of service delivery form, thus reducing any transaction costs arising from the change. For the purpose of this analysis, we previously obtained the MSW cost efficiency scores for each local government in the sample, by applying robust partial frontiers (Daraio and Simar 2007; De Witte and Marques 2010). Moreover, to apply the matching techniques it was necessary to calculate the year-on-year rate of change of cost efficiency for each local government. This was done by using the concept of intertemporal frontier (Tulkens and Vanden Eeckaut 1995a), considering a single production set that included all the observations for the period being considered.

The results obtained reveal the importance of considering the time dimension in the analysis of management organisation in local public services, and highlight the existence of a time lag between the implementation of contracting out and the materialisation of cost efficiency improvements. It appears, therefore, that local governments that contract out the MSW service need to adapt to the peculiarities of contracted-out management, and that short-term cost increases are incurred. However, there is a learning effect that counteracts these initially higher costs and increases cost efficiency after three years' experience with this form of service delivery.

The rest of this chapter is organised as follows. In the second section we review prior literature into the practice of contracting out, with respect to cost efficiency in MSW service, and then introduce a new concept in the specific analysis of MSW cost efficiency: the learning curve effect. In the third and fourth sections we present the methodology applied, the data used and the results obtained. Finally, we summarise the main conclusions drawn and point out some limitations to this study.

## **2. CONTRACTING OUT AND COST EFFICIENCY IN MSW SERVICE. DIFFERENT EXPLANATIONS FOR DIFFERENT RESULTS: THE TRANSACTION COST FRAMEWORK AND THE LEARNING CURVE**

As mentioned above, various authors have proposed contracting out as a way to improve cost efficiency in local public services. However, the potential for cost reduction depends largely on the characteristics (Reeves and Barrow 2000) and nature of the service (Ferris and Graddy 1986; Brown and Potoski 2005).

Specifically, as highlighted in Chapter 3, the MSW service is affected by economies of scale (Bel and Fageda 2006) that can be exploited by private operators to obtain cost savings by sharing the fixed costs of delivering this service to different local governments (Donahue 1989; Wassenaar et al. 2013). At the same time, MSW is an

asset-specific service, and so high levels of investment are required; for this reason, local governments often prefer to contract out the service and thus obtain cost savings (Carr et al. 2008).

Additionally, ownership of the asset is an important factor, since public managers do not have property rights over local services assets, which prevents the municipality from benefiting from cost reductions (Grossman and Hart 1986; Hart and Moore 1990); thus, contracting out the MSW service will enable the municipality to benefit from cost efficiency improvements. However, according to the theory of incomplete contracts and property rights, the private operator has no incentive to maintain service quality (Hart et al. 1997).

At the same time, from a theoretical perspective, contracting out will introduce competition into MSW service delivery, which will raise levels of cost efficiency. In this sense, a monopoly market in local services is associated with low efficiency, since public managers seek to maximise their own interests (Savas 1987). The promotion of competition through contracting out tends to limit the excessive supply of public services and thus lowers costs (Bel et al. 2010c). However, competition can be introduced by local governments (Warner and Hebdon 2001; Warner and Hefetz 2008). In this sense, local governments have introduced the auction/concession system as a means of contracting out the MSW service and promoting competition. In consequence, the decision to contract out public services lies within a principal-agent framework (Sappington and Stiglitz 1987) in which transaction costs may be higher than the benefits of contracting out, thus resulting in lower cost efficiency (Bel and Fageda 2008).

### ***A. THE TRANSACTION COST THEORY WITH RESPECT TO MSW SERVICE***

The transaction cost framework has been extensively studied with respect to the contracting out of municipal services (Bel and Fageda 2006; Brown and Potoski 2005; Brown et al. 2006; Carr et al. 2008; Wassenaar et al. 2013). This theory suggests that contracting out costs are often underestimated because transaction costs are excluded from the analysis (Sclar 2000) and that these costs may reduce the cost efficiency obtained.

Transaction costs are those related to the administrative process of implementing and monitoring the contracting out process. Specifically, they include “the administrative resources needed to manage the solicitation and bidding and award processes, implement the contract, and perform adequate oversight” (Girth et al. 2012: 888), as well as those derived from the information asymmetry arising from rational, opportunistic behaviour by the agents (Williamson 1981). These costs thus, are the outcome of uncertainty, limited information and agents’ opportunistic behaviour (Coase 1937; Williamson 1981, 1996, 1997) and are especially likely when the contract is weakly specified (Brown and Potoski 2005). It is apparent, thus, that local governments may incur higher costs when private operators must be monitored, and the higher the transaction costs, the lower the cost efficiency gains to be obtained from contracting out (Bel and Fageda 2008; Rodrigues et al. 2012).

In the specific context of MSW service, the presence of transaction costs in the management of the contract may be caused by the asset specificity, by the state of competition in the market and by the complexity of the service (Brown and Potoski 2005; Bel et al. 2010c). Asset specificity may result in an absence of competition, since the private operator that first delivered the MSW service has considerable advantages

over its competitors, having already made the necessary investments, and thus be in a position to behave opportunistically (Brown and Potoski 2005). Furthermore, contracting out non-competitive, complex services such as MSW service could entail higher transaction costs, since contracting out is usually more appropriate for the delivery of competitive, lightly-regulated services (Vickers and Yarrow 1988), when local governments can benefit from the low-cost monitoring of a private operator. Thus, when a non-competitive, complex service such as MSW is contracted out, the service delivery cost may actually rise after this change of service delivery form (Rodrigues et al. 2012).

***B. THE LEARNING EFFECT WHEN THE MSW SERVICE IS CONTRACTED OUT***

The goal of reducing MSW service delivery costs is acknowledged by all the different theories put forward favouring the contracting out this service. But from an empirical perspective, there is no clear evidence of cost efficiency benefits obtained from this change (Dijkgraaf and Gradus 2003; Bel et al. 2010c). For various reasons, empirical studies have presented widely varying results. In this context, the transaction cost theory is often accepted as a solid framework with which to explain the limits of contracting out (Brown and Potoski 2005; Dijkgraaf and Gradus 2013).

Bel et al. (2010c) analysed the empirical literature on this question using the meta-regression technique, with the aim of verifying whether contracting out leads to cost savings in refuse collection and water distribution. These authors reported a negative relationship between costs and contracting out. However, they also found that the differences between public and private production depend largely on the sample size and the time period of the studies conducted. Hence, studies including cross-section and time-series data are more likely to obtain differences between the two forms of service

delivery. Nevertheless, as the above authors observed, these previous studies “did not measure the before and after effects of privatisation but rather changes over time across localities” (Bel et al. 2010c: 570).

We see, thus, that contracting out is a dynamic process in which it is important to consider the time effect (Bel and Fageda 2007; González-Gómez and Guardiola 2008), since organisations acquire new knowledge over time. Generally, higher costs are incurred when a new management technique is implemented, but at the same time the organisation doing so can learn from experience of the new context. When this new knowledge and experience are maintained over time, they are translated into organisational learning (Argote 2011).

In particular, organisational learning refers to changes in knowledge provoked by the experience of an organisation (Fiol and Lyles 1985; Argote 2011). It is a dynamic process affected by cognitive, behavioural and social factors (Crossan et al. 1999; Rashman et al. 2009). Although organisational learning has been extensively studied in the management field (March and Simon 1958; Levitt and March 1988; Argyris and Schön 1996; Crossan and Guatto 1996), since it is a key factor in management improvement, our literature review shows that this issue is under-researched in the specific context of public service (Rashman et al. 2009).

Initial studies of the experience effect found that the time required to complete a task and the number and severity of errors made decrease in line with the experience gained; in the specific framework of organisations, this may result in productivity gains (Argote 1999). In this respect, the learning curve theory suggests that costs change as a function of experience (Dutton and Thomas 1984). Thus, the learning (or experience) curve reflects the rate of improvement in performing a task as a function of time or the

rate of change in average cost as a function of cumulative output (Wright 1936; Hirsch 1952; Spence 1981).

Learning by doing has been analysed in both sectorial and macro studies and in micro and firm studies (Malerba 1992). Since the pioneering study by Wright (1936), empirical research has demonstrated the relationship between cumulative experience and performance improvement (Hirsch 1952, 1956; Baloff 1966; Lieberman 1984). However, the outcome of learning by experience varies across organisations (Dutton and Thomas 1984; Argote 1999) because it is a dynamic process that it is not automatic and depends on a range of factors (Malerba 1992), such as the context in which learning occurs and on the specific capabilities of the organisation (Fiol and Lyles 1985; Argote 2011).

Taking into account the experience curve concept, we believe that in the contracting out process the local government obtains experience over time that enables it to better control for possible transaction costs. Brown and Potoski (2003b) consider contract management to be efficient when it mitigates the specific problems that emerge in the contract process. Under the transaction costs theory, contracting out takes place within a principal-agent relation that may result in greater costs being incurred (Fernandez 2009). However, we seek to show that such cost increases are not permanent and that, therefore, the local government may ultimately obtain cost efficiency gains. The dynamism of contracting out can be seen as an organisational learning process in which the cost increase derived from new administrative and monitoring tasks is eliminated over time, due to the learning effect and the local government's improved management capabilities with respect to contracting out.

In the light of this review, we believe that contracting out the MSW service will

present different results in relation to cost efficiency depending on the stage of the contracting out examined, and that two phases can be distinguished: in the first one, there may be cost increases due to the effect of transaction costs, while in the second one, the local government may derive cost savings due to the learning curve effect.

Figure 6 illustrates the effects of transaction costs and of the learning curve when the MSW service is contracted out. Two cost frontiers are represented, for the municipalities that contract out the MSW service and for those that do not, and it can be seen that, as reported by the literature, municipalities that contract out achieve lower costs than non-contracting-out ones. Accordingly, the average cost incurred by the contracting out municipalities is expected to be lower, as shown in the figure. For this reason, a non-contracting municipality may decide to contract out its MSW service at  $t_1$ . However, during the first years of implementation, transaction costs may arise (in accordance with the theory in this respect), resulting in higher average costs than if the municipality had made no such change. Notwithstanding, we hypothesise that after this first phase, the municipality would benefit from a learning effect in contract management, leading to greater cost efficiency, and thus decreased overall costs.

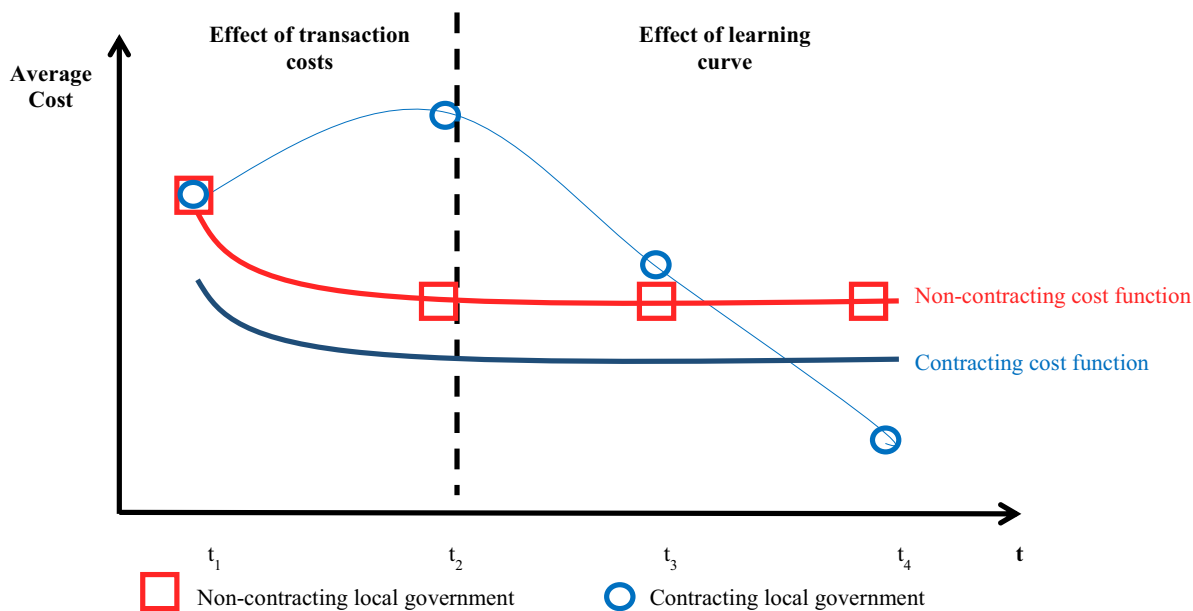
Thus, the main hypotheses of this chapter are:

*H<sub>1</sub>: Taking into account the transaction cost framework, MSW cost efficiency will decrease during the initial implementation of contracting out.*

*H<sub>2</sub>: After an initial period in which cost efficiency decreases, contracting out the MSW service produces higher levels of cost efficiency.*



Figure 6. Transaction costs and the learning effect when the MSW service is contracted out



Source: The author

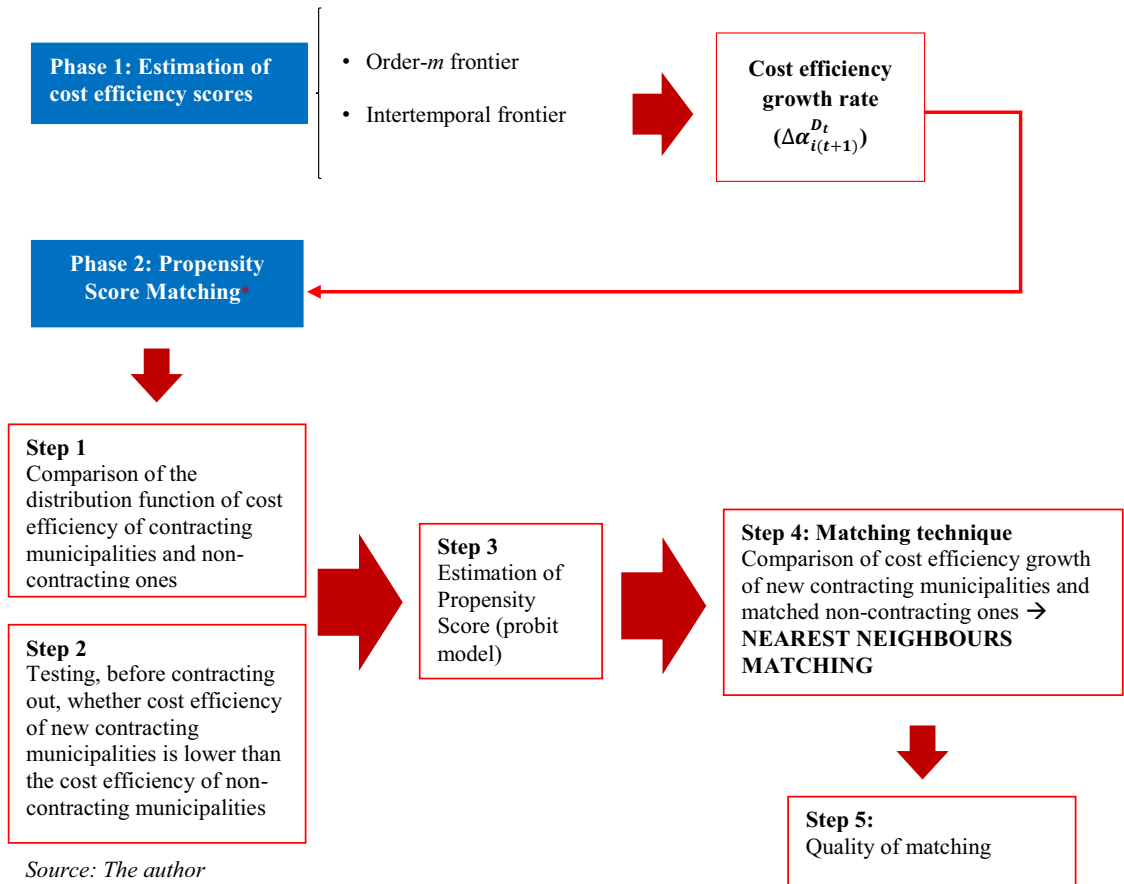
### 3. DYNAMIC ANALYSIS OF THE IMPLEMENTATION OF CONTRACTING OUT AND ITS EFFECT ON COST EFFICIENCY IN MSW SERVICE

To obtain empirical evidence to test the hypotheses presented in the previous section, a two-step methodology was applied to a sample of 422 Spanish municipalities for the period 2002-2010 (Figure 7). The panel nature of the data allows us to classify local governments into those that contract out the MSW service over time (identifying the year in which this decision was implemented) and those that do not.

Matching techniques were used to study the effect produced on cost efficiency when the MSW service was contracted out. However, it was first necessary to estimate the corresponding cost efficiency scores. As shown in Figure 7, in the first stage of this process we applied robust partial frontiers within the concept of intertemporal frontier and then implemented propensity score matching by applying the nearest neighbour option. In this section, we explain the methodology and the data used in the empirical

model presented.

**Figure 7. Research methodology: phases and steps**



### A. RESEARCH METHODOLOGY

Matching techniques are used to analyse the effect of a treatment or policy. In this process, the individuals that have implemented the treatment/policy are paired with those that have not but which have similar characteristics. The analyst then estimates the treatment impact by comparing the results of the treatment/policy between the two groups of individuals. In the present case, we wish to determine whether the contracting out of the MSW service affects cost efficiency, and therefore the first requirement is to obtain a measure of changes in MSW cost efficiency (Phase 1, Figure 7). Hence, before explaining the econometric model of the matching technique, let us examine the method

used to obtain cost efficiency scores.

As we need a measure representing the inter-year variation in MSW cost efficiency for each municipality in the sample in order to apply matching techniques, we apply the concept of intertemporal frontier (Tulkens and Vanden Eeckaut 1995a), which facilitates temporal comparisons (Avkiran 2009).

In frontier analyses, there are three types of frontiers: *contemporaneous*, *sequential* and *intertemporal* (Tulkens and Vanden Eeckaut 1995a, 1995b; Mukherjee, 2008). A *contemporaneous frontier* is built from the cross-section data for a given period of time; a frontier is constructed for each period because it is assumed that each frontier can only be constructed from the data observed at that time (Tulkens and Vanden Eeckaut 1995b). A *sequential frontier* allows different frontiers to be assigned to each period, but it includes all current and past observations (Tulkens and Vanden Eeckaut 1995b). Finally, an *intertemporal frontier* is constructed with all the observations contained in the panel data (Tulkens and Vanden Eeckaut 1995a, 1995b).

The main disadvantage of *contemporaneous frontiers* is that the efficiency scores of these frontiers cannot be used to measure whether efficiency has improved or not over time, since these frontiers vary from year to year (Mukherjee 2008). On the other hand, an *intertemporal frontier* makes it possible to compare the efficiency scores obtained under a single frontier, since it captures the overall efficiency change (Mukherjee 2008; Avkiran 2009). *Sequential frontiers* do not obtain efficiency scores that are comparable over time and, moreover, have only limited degrees of freedom for the earlier years, artificially estimating observations with an efficiency equal to 1 (Mukherjee 2008). Taking into account that we wish to compare cost efficiency measures over time in order to evaluate whether contracting out improves or

deteriorates cost efficiency, we decided to use the *intertemporal frontier*. This was calculated by constructing a single reference set for the whole period  $[1, T]$ , incorporating all the decision-making units (DMUs) in  $Y(1, T)$  (Tulkens and Vanden Eeckaut 1995a, 1995b). Hence, we consider a simple production frontier that incorporates all local governments for the complete period: 2002-2010, but in which we can differentiate subsamples of local governments for each year and thus calculate the change in cost efficiency.

The second step in phase 1 was to apply robust partial frontiers (Daraio and Simar 2007; De Witte and Marques 2010) to compute the cost efficiency measure for each local government for the MSW service, using the order- $m$  approach, which estimates the cost efficiency score as a central value of repeated estimations of the cost efficiency scores with replacement obtained from the outputs of  $m$  subsamples (Daraio and Simar 2007). As this partial approach benchmarks a DMU within a subsample of  $m$  peers, its estimations are more robust than those of other estimators obtained through the application of nonparametric approaches such as DEA and FDH, which are extremely sensitive to outliers – because these approaches envelop all data points (Daouia and Simar 2007). Furthermore, they are susceptible to measurement errors, because they assume the absence of statistical noise (De Witte and Marques 2010). Robust partial frontiers overcome these limitations and allow the presence of superefficient units (observations beyond the estimated efficiency frontier), as this technique does not envelop all the data (Simar and Wilson 2008).

Formally, the algorithm estimating the order- $m$  efficiency coefficients considers for a specific level of input ( $x_0$ ) and output ( $y_0$ ),  $m$  random DMUs with output variables

$(Y_1, \dots, Y_m)$ , drawn from the distribution of the output matrix  $Y$  observing the condition  $Y_m \geq Y_0$ . Therefore, and following Daraio and Simar (2007), we apply four steps:

1. For a given level of output ( $y_0$ ), a random sample of size  $m$  is created with replacement among those  $y_{sm}$ , such that  $y_{sm} \geq y_0$ .
2. The efficiency coefficient  $\tilde{\alpha}_s$  is estimated using this random sample.
3. Steps 1 and 2 are repeated  $B$  times, so that for each round an efficiency coefficient is estimated, having  $B$  efficiency coefficients  $\tilde{\alpha}_s^b$  ( $b = 1; 2; \dots; B$ ).
4. Finally, the efficiency score is computed as a central value (the arithmetic mean) of the estimated  $B$  efficiency coefficients:

$$\alpha_s^m = \frac{1}{B} \sum_{b=1}^B \tilde{\alpha}_s^b$$

As explained in the previous chapters, the order- $m$  approach can be oriented toward inputs, outputs, costs or revenues. In this specific context of local government, we opted for the cost orientation, since outputs are either totally or partially determined externally and sometimes output prices are not available, and so it is more appropriate to seek to minimise the municipal cost (Cherchye et al. 2014). Considering the cost orientation and random replacement, the order- $m$  approach obtains efficiency scores beyond the efficiency frontier (superefficient units) when a DMU ( $s$ ) reaches  $\alpha_s^m > 1$ .

In order to determine the value of  $m^{21}$ , the efficiency scores are computed for different values of  $m$ , as this represents the value at which the percentage of superefficient DMUs decreases marginally with an increase in  $m$  (Daraio and Simar 2005). After performing various estimations ( $m = 100, 200 \dots 500$ ), we observed that the results were very stable from  $m=300$ , as the percentage of super-efficient units declined only marginally with  $m$ .

Additionally, to increase the quality of the estimation, the order- $m$  methodology was applied assuming  $B = 2,000$  (De Witte and Geys 2013).

The final step in phase 1 (Figure 7) is to obtain the change in cost efficiency, which is calculated as the difference between the cost efficiency scores of each local government for each year.

In the second phase (Figure 7), we would need to compare the actual variation in cost efficiency for new contractors with the cost efficiency variation that would have been presented by the same local governments if they had not contracted out, to control for the direction of causality from contracting out to cost efficiency variation. The problem is that we lack information about the counterfactual situation, i.e., the variation in the cost efficiency of new contractors if they had never undertaken contracting out. Matching techniques provide a way to construct this counterfactual.

More formally, we denote  $\Delta \alpha_{i(t+1)}^{D_t}$  as the rate of change of cost efficiency from  $t$  to  $t + 1$  and  $D_{it} \in \{0,1\}$  as the indicator of whether local government  $i$  is a new

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<sup>21</sup> Note that  $\tilde{\alpha}_S^b$  depends on the level of  $m$ : the higher the value of  $m$ , the more observations are considered in the estimation and the more units will meet the condition  $y_{sm} \geq y_0$ . Therefore, when  $m \rightarrow \infty$  the order- $m$  efficiency score will converge with FDH scores.

contractor (a local government that starts contracting out the MSW service during the study period) at period  $t$ , as opposed to a non-contractor.

Thus, we can use  $\Delta\alpha_{i(t+s)}^1$  to define the change in cost efficiency between  $(t + s - 1)$  and  $(t + s)$ ,  $s \geq 0$  for local government  $i$  classified as a new contractor in  $t$  and  $\Delta\alpha_{i(t+s)}^0$  as the change in cost efficiency that local government  $i$  would have had if it had not contracted out the service. Using this notation, the causal effect of contracting out, in terms of change in cost efficiency from period  $(t + s - 1)$  to  $(t + s)$  for local government  $i$  that starts contracting out in  $t$ , can be defined as:

$$\Delta\alpha_{i(t+s)}^1 - \Delta\alpha_{i(t+s)}^0 \quad (3)$$

In accordance with previous literature on policy/treatment evaluation, we defined the average causal effect on local governments of starting to contract out, in  $t$ , as (Heckman et al. 1997):

$$E(\Delta\alpha_{i(t+s)}^1 - \Delta\alpha_{i(t+s)}^0 | D_{it} = 1) = E(\Delta\alpha_{i(t+s)}^1 | D_{it} = 1) - E \quad (4)$$

However, using this formulation (4) to make a causal inference faces the problem that in observational studies the counterfactual for a new contractor ( $\Delta\alpha_{i(t+s)}^0$ ) is not observed and, therefore, must be generated<sup>22</sup>.

This problem is overcome by using matching techniques to identify among the pool of non-contractors in  $t$  those local governments with a distribution of observable variables ( $X$  in  $t - 1$ ) affecting cost efficiency change and a probability of contracting out that is as similar as possible to the corresponding aspects of new contractors. In this

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<sup>22</sup> Note that  $\Delta\alpha_{i(t+s)}^0$  is the average cost efficiency growth that new contractors would have experienced if they had not started to contract out.

sense, it is assumed that based on  $X$ , local governments with the same characteristics are randomly exposed to the contracting/not-contracting decision. Thus, expression (4) can be rewritten as follows:

$$E(\Delta\alpha_{i(t+s)}^1|X_{it-1}, D_{it} = 1) - E(\Delta\alpha_{i(t+s)}^0|X_{it-1}, D_{it} = 0) \quad (5)$$

However, there is a limitation, since there are several observable variables that may potentially affect a local government's probability of contracting out and the resulting change in cost efficiency. Therefore, it is necessary to determine the appropriate variable to match the municipalities, and if more than one variable is used, to determine the appropriate weights. Furthermore, in order to guarantee that the second term in (5) is a good counterfactual for the final term in (4), we need to assume that all relevant differences between new contractors and the control group of non-contractors are properly captured by the vector of observables  $X$ . This is the conditional independence assumption (CIA), which also means that the potential change in cost efficiency for local governments that do not contract out is independent of the treatment assignment between being a new-contractor or a non-contractor, in accordance with  $X$ .

Rosenbaum and Rubin (1985) proposed using the propensity score technique to deal with this limitation. This method makes it possible to combine the complete information from a vector of variables, specifically driving the probability of initiating contracting out into a scalar that is the predicted probability of becoming a new contractor. A further benefit is that the propensity score method preserves the same properties as when the vector of variables is matched directly: thus, municipalities with the same probability of becoming a new contractor are randomly exposed to contracting out. Thus, we will match local governments on the basis of their probability of contracting out for the first time.



As Figure 7 shows, before performing the matching analysis, we determined the probability of a local government becoming a new contractor (i.e., the propensity score) in terms of the predicted probability, using a probit model. Following existing literature on contracting out the MSW service<sup>23</sup>, the model specified below includes variables measuring municipal fiscal stress, the political and socioeconomic factors facing the local government and the effect of the economic crisis (Great Recession)<sup>24</sup>:

$$P(D_t = 1) = \Phi \{cost\ efficiency_{t-1}, cash\ index_{it-1}, taxable\ value\ over\ financial\ charge\ index_{it-1}, budget\ result\ index_{it-1}, independec\ index_{it-1}, political\ orientation_{it-1}, political\ strength_{it-1}, Great\ Recession_t, population_{it-1}, tourism\ index_{it-1}, population\ centres_{it-1}\}(6)^{25}$$

where  $\Phi(\cdot)$  is the normal cumulative distribution function.

Propensity score matching includes different estimators (algorithms), which vary according to how the control group of individuals is defined and according to the weights assigned to the different individuals (Stuart 2010). The main matching methods are *nearest neighbour*, *caliper and radius matching*, *subclassification* (stratification and interval matching) and *weighting adjustments matching* (Caliendo and Kopeinig 2008; Stuart 2010). The *nearest neighbour* method matches the contracting municipality with the non-contracting one that has the closest propensity score. *Caliper matching* imposes a tolerance level on the maximum propensity score distance (caliper) in addition to the closest propensity score. On the other hand, its variant *radius matching* matches contracting municipalities with an average of the non-contracting ones within a given radius. *Subclassification and weighting matching* use all the individuals included in the sample, in contrast to the one nearest neighbour matching technique, which discards

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<sup>23</sup> The selection of this set of variables is explained in the next section.

<sup>24</sup> Appendix 10 includes the description and descriptive statistics of the variables included in the probit model.

<sup>25</sup> This probit model also includes dummy variables for each year of the sample, in order to control for the year in which local governments start to contract out the MSW service.

some of the individuals from the control group (Stuart 2010). *Subclassification* (stratification and interval matching) creates groups of individuals that are similar, dividing the common support of the propensity score into a set of intervals (strata) and calculating the impact within each interval by taking the mean difference in outcomes between contracting municipalities and non-contracting ones. The *kernel approach*, which is the most common *weighting matching* in economics (Stuart 2010), matches contracting municipalities with a weighted average of all non-contracting municipalities, with weights inversely proportional to the distance between the propensity score of the contracting municipalities and the non-contracting ones. All of these different approaches would obtain the same results, especially with larger samples (Smith 2000). Previous studies have obtained robust results by applying different methods (Máñez et al. 2013). However, there is no single methodology that is valid for all situations, and so the choice of estimator depends on the specific circumstances of the study (Stuart 2010).

In the present case, we opted for *nearest neighbours matching* (oversampling) in order to construct the counterfactual (Becker and Ichino 2002), this being one of the most common and understandable methods (Rubin 1973) as well as being the most effective approach when the researchers' goal is to select individuals for follow-up (Stuart 2010). In contrast to the one nearest neighbour (one to one) technique, nearest neighbours is less sensitive to the presence of outliers, as it matches the contracting municipality with a group of non-contracting ones with the closest propensity score. We applied this approach by grouping the four closest non-contracting municipalities. Matching was performed using the Stata *psmatch2* command (Leuven and Sianesi 2003). Since we had previously estimated the propensity scores, the usual procedure would be to calculate the *p*-values corresponding to the extra-efficiency growth (EEG,

hereafter) of new contractors using bootstrapping techniques. However, Abadie and Imbens (2008) showed that due to the extreme non-smoothness of nearest neighbours matching, the standard conditions for bootstrapping are not met, and so the bootstrap variance diverges from the actual variance. Subsampling was applied to overcome this problem (Politis et al. 1999), together with the Stata *nmmatch* command (Abadie et al. 2004).

## ***B. DATA DESCRIPTION***

To address the main study hypotheses, we analysed a large database of Spanish local governments with populations between 1,000 and 50,000 inhabitants. As explained in the previous chapters, the sample was restricted to municipalities within this population range due to the lack of relevant information for those with smaller or larger populations.

Our initial database was composed of 771 municipalities for the period 2002 – 2010, which corresponds to the sample described in Chapter 2. However, in order to apply matching techniques, the sample had to be filtered, as the starting point must contain only local governments that have not contracted out the MSW service. Accordingly, we excluded the local governments that in the initial period (year 2002) already contracted out their MSW service delivery, thus reducing our initial sample to 422 local governments<sup>26</sup>, representing 14% of the total Spanish municipalities within the stipulated population range.

Firstly, we present the data used in the computation of the local governments' cost efficiency score. In this regard, as explained in the previous section, we applied

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<sup>26</sup> Another criterion for inclusion was that the contracting out should be maintained over time; therefore, local governments that contracted out the MSW and then decided to internalise the service were excluded.

robust partial frontiers via the order- $m$  approach with a cost orientation. Taking into account the considerations presented in Chapter 2, we included the total cost of MSW service delivery, in accordance with Benito-López et al. (2011) and Zafra-Gómez et al. (2013). This cost comprises the budget expenditure of the municipal function classification. As output variables, we considered the total tons of waste per year, the total tons per year corrected by the quality of the MSW service, described by an index measuring the adequacy of the service and the number of containers on public roads in the municipality (Zafra-Gómez et al. 2013). Table 10 summarises the variables included in computing the cost efficiency scores, the descriptive statistics for which are presented in Appendix 11a.

**Table 10. Variables included in the computation of cost efficiency scores**

Variable	Definition	Source
<b>Total Cost</b>	Municipal budget expenditure, obtained from the functional budget classification, <i>Category 442 – MSW removal and street cleaning</i> , for each of the municipalities included in the sample. This classification has been used in several previous studies (Benito-López et al. 2011; Zafra-Gómez et al. 2013). Due to the implementation of a new classification system (O. EHA / 3565/2008, de 3 de diciembre), with respect to the year 2010 we used the equivalent, composed of <i>Category 162 – Waste collection, disposal and treatment</i> and <i>Category 163 – Street cleaning</i>	Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury
<b>MSW tons</b>	Annual production of waste, in tons/year	Survey of Local
<b>MSW tons*quality</b>	Annual production of waste, in tons/year, corrected by the index of service quality	Infrastructure and Equipment (EIEL), from the Ministry of Public Administration's website
<b>Containers</b>	Number of containers recorded as installed on public roads in the municipalities, for each type of MSW collection	

*Source: The author, based on data supplied by the Virtual Office of Local Government Financial Coordination and on the Survey of Local Infrastructure and Equipment.*

Application of order- $m$  frontiers provided a measure of MSW cost efficiency for each local government in the sample, per year. In addition, the concept of intertemporal

frontier was applied to obtain a measure of the change in cost efficiency between years, these data being necessary in order to apply the matching techniques, defined as  $\Delta\alpha_{i(t+s)}^1$ .

The municipalities were classified into two groups: contractors and non-contractors (counterfactual group). Contracting municipalities are those that began contracting out MSW service delivery at any point during the period 2003-2010 (the first year was not included as it was a condition for this study that no municipalities should have previously contracted out the service), and so non-contractors are the municipalities that did not contract out the service during the whole period considered (2002-2010). To create this classification, a variable was constructed, taking the value 1 if the municipality contracted out the MSW service and maintained this delivery form during the whole period, and 0 otherwise<sup>27</sup>. Appendix 11b contains the descriptive statistics for the change in cost efficiency for the contracting and non-contracting municipalities.

Table 11, below, presents a summary of the contracting out variable<sup>28</sup>, showing both the number of municipalities that contract out each year and the percentage they represent with respect to the non-contracting municipalities in the previous year. As can be seen, by the end of the sample period (year 2010), 95 municipalities (22.51%) had contracted out the MSW service. This table also shows that the current economic crisis accelerated the contracting out process; whereas the average contracting out rate (defined as the ratio of new contractors to non-contractors in the previous year) before

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<sup>27</sup> Municipalities that in 2002 had not contracted out and contracted out during the study period.

<sup>28</sup> The municipalities were classified as contractors or non-contractors on the basis of the information supplied by the Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury, and that published in Official Provincial Gazettes (BOP) and in municipal web pages.

the beginning of the crisis (2003-2007) was 1.97%, this ratio subsequently rose to 5.05%.

*Table 11. Annual number of new contractors*

<b>Year</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>Total</b>
<b>New contractors</b>	8	7	8	11	6	15	23	17	95
<b>Contracting out rate<sup>a</sup></b>	1.90	1.69	1.97	2.76	1.55	3.93	6.27	4.94	

<sup>a</sup> The outsourcing rate is defined as the percentage of new contractors with respect to the number of non-contractors in the previous year.

#### **4. RESULTS**

This section presents the principal results obtained. Following the steps shown in Figure 7 in the previous section, we first performed a series of tests, in order to confirm the validity of our analysis, and then the matching technique was applied. The first test was intended to identify whether contracting out increased MSW cost efficiency; to do so, we compared the distributions of non-contracting and of contracting municipalities in the first and last years of the sample. Secondly, we expected the municipalities with lower levels of cost efficiency to be those that would contract out the MSW service in the future, and so a test of this outcome was performed. Thirdly, a probit model was created to estimate the propensity score of a non-contracting municipality becoming a contracting one, in order to obtain a series of factors and weights to match the municipalities. Finally, we performed the matching model and analysed its quality.

##### ***A. CONTRACTING OUT AND THE CHANGE IN COST EFFICIENCY: AN INITIAL APPROACH***

The main goal of this chapter is to analyse the effect of contracting out on the change in cost efficiency in MSW service. Therefore, the first step was to compare, for

the first and last years of the sample, the cost efficiency distribution of the local governments that had not contracted out this service (non-contractors) with that of those which had done so during the study period (contractors). This procedure provided an overview of the contracting out-efficiency relation.

For this purpose, we used the Kolmogorov-Smirnov one-and-two-sided tests of stochastic dominance (KS, hereafter). Therefore, we compared:

$$F_t(\text{cost efficiency}) \text{ vs. } G_t(\text{cost efficiency}) \quad t = 2002, 2010$$

where  $F$  is the distribution function of the contractors' cost efficiency and  $G$  is the corresponding distribution function for the non-contractors.

As can be seen in Table 12, the results for the first year of the study period (2002) suggest that there are no differences between the cost efficiency distributions of the non-contractors and the future contractors, and so we do not reject the null hypothesis of equality of cost efficiency distributions of the two-sided KS test at any conventional level of significance. However, for the last year of the sample (2010), the cost efficiency distribution of the contractors exceeds that of the non-contractors, and so we reject the null hypothesis of equality of the distributions but not the null hypothesis of favourable differences for contractors. This outcome implies that the contracting municipalities achieve higher rates of cost efficiency than do the non-contracting ones.

**Table 12. Comparison of the cost efficiency distributions of municipalities that became contractors during the study period and municipalities that never contracted out**

Year	Number of observations		Cost efficiency differences <sup>a</sup>	Equality of distributions		Favourable differences to contracting municipalities	
	Contracting	Non-contracting		Statistic	P-value	Statistic	P-value
<b>2002</b>	95	327	0.000	0.634	0.111	1.153	0.070
<b>2010</b>	95	327	0.001	1.301	0.051	0.745	0.329

<sup>a</sup> Cost efficiency differences (between the two groups of municipalities) are calculated at the median of the distributions.

This preliminary analysis suggests that contracting out increases cost efficiency, but we cannot yet confirm this as a causal link, because in order to establish a causal relation between contracting out and cost efficiency, it is necessary to compare the change in cost efficiency among municipalities after contracting out the MSW service with its counterfactual. i.e., the change in cost efficiency that would have been achieved by the contractors if they had not contracted out the service.

#### ***B. EX-ANTE DIFFERENCES BETWEEN CONTRACTING AND NON-CONTRACTING MUNICIPALITIES***

We then tested whether, among the non-contracting municipalities, those that will contract out the MSW service in the future are those currently achieving the lowest levels of cost efficiency. Considering that one of the factors favouring the decision to adopt contracting out is the expectation of obtaining cost savings (Brudney et al. 2005), we would expect that one of the main reasons for contracting out the service would be to obtain greater cost efficiency, and therefore the least cost efficient municipalities would have the strongest incentive to introduce contracting out.

In view of these considerations, we tested whether prior to contracting out the service, the cost efficiency of the municipalities in question was lower than that of the



municipalities that did not contract out. This comparison was carried out by examining the cost efficiency presented before contracting out was implemented by newly-contracting municipalities and the corresponding cost efficiency of the non-contracting municipalities. To classify a municipality as a new contractor in year  $t$ , it should not have contracted out the MSW service previously. And to classify a municipality as a non-contractor in year  $t$ , it should not have contracted out the MSW service in year  $t$  or in previous years of the study period.

Table 13 shows the results of the KS tests of stochastic dominance for the whole sample period. The small size of the new contractors' cohorts between 2003 and 2010 (see Table 11) suggests that year-by-year stochastic dominance tests should not be performed, as their results would be unreliable. To overcome this limitation, the test was performed jointly for the whole study period, as follows:

$$F_{NEW}(\text{cost efficiency}) \text{ vs. } F_{NON}(\text{cost efficiency})$$

where  $F_{NEW}$  is the cost efficiency distribution in year  $t - 1$  of the eight cohorts of new-contractors (for  $t = 2003 - 2010$ ), and  $F_{NON}$  is the yearly average cost efficiency distribution over the period 2003-2008 for non-contractors, which are re-defined as municipalities that did not contract out the MSW service during the whole study period.

**Table 13. Comparison of previous cost efficiency of new-contractors and non-contractors**

Number of observations		Equality of distributions		Favourable differences to non-contractors	
New contractors	Non-contractors	Statistic	P-value	Statistic	P-value
95	327	1.715	0.004	0.347	0.785

Regarding the results of the formal KS tests of stochastic dominance, we reject the null hypothesis of equality of the cost efficiency distributions of contracting and non-contracting municipalities, but we cannot reject the null hypothesis of favourable differences to non-contractors. Therefore, before contracting out, the cost efficiency for non-contracting municipalities was higher than that of the new-contracting ones, suggesting that one of the main reasons for contracting out the MSW service is to increase cost efficiency.

### ***C. RESULTS OBTAINED BY THE NEAREST MATCHING TECHNIQUE***

In order to apply the matching methodology, we must calculate the probability of a municipality becoming a new contractor (the propensity score), which is obtained in terms of predicted probability. For this purpose, it is necessary to create a probit model, in which the dependent variable is a dummy variable representing the contracting out of the MSW service.

Many studies have been conducted to identify factors that influence the decision to contract out local public services (Ferris 1986; Greene 1996b; Dijkgraaf et al. 2003; Bel and Fageda 2007; González-Gómez and Guardiola 2008; Warner and Hefetz 2008; Levin and Tadelis 2010; Wassenaar et al. 2013). We summarise below the most important research work that justifies our selection of this set of variables<sup>29</sup>.

Firstly, as explained in Chapter 2, one of the explanatory factors that has been most often studied in relation with contracting out is that of fiscal stress (Bel and Fageda 2007), since a municipality suffering fiscal stress because of reduced income, and not wishing to increase the tax burden (Tiebout 1956; Bel and Fageda 2007), would

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<sup>29</sup> Appendix 10 includes the description of the variables and their descriptive statistics.

consider contracting out costly public services (Savas 2000; Greene 2002) in order to alleviate its financial condition. On the other hand, authors such as Pallesen (2004) and Rodrigues et al. (2012) have supported the contrary relation, such that a healthy financial condition would favour the contracting out of public services, as these would then be more attractive to private contractors.

In this study, four variables – cash solvency, flexibility, budgetary sustainability and financial independence (Groves et al. 2003; Plata-Díaz et al. 2014) – are used as a measure of municipal fiscal stress, since the concept of fiscal stress is multidimensional, and cannot be defined by a single measure alone (Greenberg and Hillier 1995; CICA 1997). Cash solvency (*Cash Index*) measures the municipality's ability to generate the necessary liquidity to pay its short-term debts (Groves et al. 2003). Flexibility (*Taxable value over financial charge Index*) is the municipality's capability to respond to economic or financial changes within the limits of its fiscal capacity (Zafra-Gómez et al. 2009a, 2009b). Budgetary sustainability (*Budget Result Index*) refers to a municipality's ability to maintain, promote and protect the social welfare of the population, employing the resources at its disposal (Greenberg and Hillier 1995; CICA 1997; Groves et al. 2003). Finally, financial independence (*Independence Index*) captures the level of dependence on external funding received by means of transfers and grants (Zafra-Gómez et al. 2009a, 2009b; Zafra-Gómez et al. 2012).

In addition, empirical studies have considered political factors in their analysis of the contracting out decision (Dubin and Navarro 1988; Dijkgraaf et al. 2003; Bel and Fageda 2007; Zullo 2009). Accordingly, we include the *political orientation* of the governing party and *political strength* as factors underlying the contracting out decision. In the first case, a negative relation is expected between government by a left-wing

party and the decision to contract out municipal services (Bel and Fageda 2007; Plata-Díaz et al. 2014). On the other hand, the relation between contracting out and the existence of political fragmentation or coalition governments is unclear. On the one hand, a positive relation would be expected, due to the higher cost of service provision derived from the concessions made to minority parties (Salinas and Alvarez 2002; León et al. 2010). But on the other hand, it has been suggested that political fragmentation could lead to political instability, discouraging private operators from contracting with such municipalities (Rodrigues et al. 2012).

Moreover, in the current economic crisis, local governments would seek to control their fiscal stress and would be more likely to introduce cutback measures, which favours the contracting out of local public services (Funkhouser 2012). Therefore, we include the variable *Great Recession*.

Finally, socioeconomic factors within municipal characteristics also influence the contracting out decision. The *population* of the municipality is expected to have a positive effect, since the larger the population, the more services are needed, which may increase the likelihood of contracting out (Bel et al. 2010b). Likewise, the largest municipalities are likely to find more private operators wishing to provide municipal services (Kodrzycki 1994). Furthermore, touristic areas (*Tourism Index*) are more likely to contract out as the existence of an incremental population provokes higher costs (Bel and Mur 2009). In addition, we include a specific variable measuring the number of *population centres* in the municipality as a proxy of the complexity of the MSW service. The main reason for this is the belief that the municipality would contract out the MSW service when it is more complex, as such a situation would call for a higher level of investment (Bel and Miralles 2003; Bel et al. 2010b).

The results from our implementation of the probit model are shown in Table 14. Only the variable *Independence Index* presents a significant relation with the likelihood of contracting out; this relation is positive, showing that the greater the municipal independence on transfers, the greater the probability of the municipality contracting out the MSW service. In line with our initial hypothesis, it was found that conservative parties in government are more likely to contract out municipal services. The positive and significant relation between contracting out and the *Great Recession* suggests that in periods of crisis, local governments are more likely to contract out. Finally, both *Population* and the *Tourism Index* are positively related with contracting out, and so an increase in this variable would favour the contracting out of the MSW service.

**Table 14. Probit estimates to calculate the propensity score (probability of a municipality becoming a new contractor)**

Variables	Marginal effect	Standard error
<i>Cost efficiency</i> $_{t-1}$	-0.0008	(0.0010)
<i>Cash Index</i> $_{t-1}$	-0.0002	(0.0003)
<i>Taxable value over Financial Charge Index</i> $_{t-1}$	-0.0001	(0.0001)
<i>Budget Result Index</i> $_{t-1}$	-0.0019	(0.0168)
<i>Independence Index</i> $_{t-1}$	0.0330**	(0.0148)
<i>Political Orientation</i> $_{t-1}$	-0.0090*	(0.0057)
<i>Political Strength</i> $_{t-1}$	-0.0073	(0.0055)
<i>Great Recession</i> $_t$	0.0326***	(0.0088)
<i>Population (ipop)</i> $_{t-1}$	0.0122***	(0.0039)
<i>Tourism Index</i> $_{t-1}$	0.0004*	(0.0003)
<i>Population centres</i> $_{t-1}$	-0.0001	(0.0001)
<b>Observations</b>	3,123	

Standard errors in parentheses. \* Significant at 10 %, \*\* significant at 5 %, and \*\*\* significant at 1%

Finally, matching techniques were used to compare the change in cost efficiency among new contractors and matched non-contractors for the periods  $(t - 1)$  to  $t$ ,  $t$  to  $(t + 1)$ ,  $(t + 1)$  to  $(t + 2)$  and  $(t + 2)$  to  $(t + 3)$ . The choice of the period  $(t - 1)$  to

$(t + 3)$  is a compromise between allowing a sufficient length of time for possible learning effects to emerge and observing a reasonable number of new contractors.<sup>30</sup> In addition, the application of the matching technique takes into account the specific year in which municipalities contract out the MSW. Thus, we have information for the period  $(t - 1)$  to  $t$  for all 95 municipalities that contracted out the MSW service during the study period, but the information for the following periods to  $(t + 1)$ ,  $(t + 1)$  to  $(t + 2)$  and  $(t + 2)$  to  $(t + 3)$  depends on the year in which local governments contracted out the MSW, i.e. if a municipality did so in 2010, we would only have information for  $(t - 1)$  to  $t$  but if it had done so in 2003, we would have information for the whole period  $(t - 1)$  to  $(t + 3)$ .

Table 15 presents the results of this comparison. As explained in the methodology section, nearest neighbours matching is used to construct the counterfactual (Becker and Ichino, 2002). To evaluate the quality of the matching, Appendix 12 shows the results for the balancing of the observable variables within the matched samples.

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<sup>30</sup> As the length of time considered increases, the number of new contractors considered, per unit of time, decreases.

**Table 15. Estimates of extra-efficiency growth for contracting municipalities<sup>31</sup>**

Period	Nearest Neighbours	Observations	EEG	SE
$t - 1/t$	SS	95 (2616)	-0.014*	0.008
	A&I		-0.014*	0.008
$t/t + 1$	SS	78 (2616)	0.004	0.009
	A&I		0.004	0.007
$t + 1/t + 2$	SS	55 (2616)	-0.002	0.010
	A&I		-0.002	0.011
$t + 2/t + 3$	SS	40 (2616)	0.032*	0.017
	A&I		0.032**	0.016

EEG: Extra-efficiency growth of contractors with respect to non-contractors.

A&I: Standard errors were calculated using the Abadie and Imbens (2008) correction.

SS: Following Politis et al. (1999), standard errors were calculated by sub-sampling (2000 data extractions).

The observations column shows the number of contracting municipalities, with the number of control observations in parentheses, imposing common support.

SE: Standard error

\*\* and \*\*\* indicate significance at 5% and 1%, respectively.

Contractors are the municipalities that contracted out the MSW service during the study period. Non-contractors are municipalities that did not contract out in any year during the study period.

From the results obtained, it can be seen that the improvement in cost efficiency among new contractors is 1.4% lower than that achieved by matched non-contractors, and that the estimated EEG of new contractors is negative and significant. It is important to highlight the robustness of the results, which are practically identical with both of the methods used to calculate standard error. Thus, our results suggest the existence of certain transition/switching costs from a municipality that does not contract out the MSW service to one that does. In other words, local governments that contract out the MSW service do not immediately obtain the expected cost savings, but they do suffer from decreased cost efficiency, due to the need to adapt to the peculiarities of contracting out management, which has a negative impact on cost efficiency.

In the same line, the fact that the EEG estimates for new contractors with respect to matched non-contractors are non-significant for the periods  $t/t + 1$ ,  $t + 1/t + 2$

<sup>31</sup> Matching was performed using the Stata *psmatch2* command (Leuven and Sianesi 2003), but in order to overcome the limitations inherent in the calculation of *p*-values corresponding to the EEG of new contractors by bootstrapping techniques, we calculated the *p*-values using subsampling with 2,000 replications (Politis et al. 1999) and the Stata *nmmatch* command (Abadie et al. 2004).

suggests that local governments overcome the initial transition costs after one year operating the MSW service, but also that contracting out does not result in higher rates of cost efficiency during periods  $t/t + 1$  and  $t + 1/t + 2$ .

However, for the period  $t + 2/t + 3$ , we find evidence of a positive EEG of new contractors, to 3.2% above the corresponding figure for matched non-contractors. This result could be interpreted as evidence of a learning process, which lasts no less than three years: thus, municipalities that contract out the MSW service should allow at least three years before expecting to achieve increased cost efficiency.

To sum up, our results reflect the impact of contracting out on the cumulative variation in cost efficiency during the whole study period from  $(t - 1)$  to  $(t + 3)$  (Table 16). Because of the disadvantage of new contractors over non-contractors during the period of transition from a non-contracted service to a contracted service, the cumulative EEG of new contracting municipalities is negative during the period  $t - 1/t + 2$  (-1.4%). However, the positive and significant EEG of new contractors over non-contracting municipalities in the period  $t + 2/t + 3$  (3.2%) outweighs the initial disadvantage, with the final result of a cumulative EEG for new contractors of 1.8% for the whole period from  $(t - 1)$  to  $(t + 3)$ . Consequently, our results suggest that contracting out the MSW service has positive effects on cost efficiency when this relation is analysed over sufficient time.

**Table 16. Cumulative EEG for the period  $t - 1/t + s$  (for  $s = 1 \dots 3$ )**

Cumulative cost efficiency variation			
$t - 1/t$	$t - 1/t + 1$	$t - 1/t + 2$	$t - 1/t + 3$
-1.4%	-1.4%	-1.4%	1.8%

Therefore, our results indicate that a temporal analysis should be carried out to verify the results obtained with respect to the impact of contracting out on cost



efficiency. This finding represents a significant advance on previous studies (Bel and Costas 2006). Our study overcomes the limit of not considering the first year in which the MSW service is contracted out, obtaining evidence of initial transition costs that result in lower levels of cost efficiency. In consequence, our first hypothesis is accepted. This decrease in cost efficiency after contracting out could be explained by the appearance of new management costs in the contracting out process (Bae 2010; Bel and Costas 2006; Brown et al. 2006). However, our results also indicate that the deterioration of cost efficiency after contracting out the MSW service is not permanent, and that within three years, cost efficiency has improved, counteracting the initial loss of cost efficiency. In summary, our results highlight the existence of a learning effect within municipal government which eventually benefits cost efficiency, and therefore our second hypothesis is also accepted. Learning by doing and from experience are positively related to performance improvement (Hirsch 1952, 1956; Baloff 1966; Lieberman 1984). The initial higher cost of contracting out is reduced with experience, as contract management capabilities improve. Apart from decreased monitoring and administrative costs, the benefits offered by this delivery service form ultimately result in enhanced cost efficiency.

## **5. CONCLUSIONS AND DISCUSSION**

Previous research work has paid great attention to the contracting out of local public services, especially in the context of MSW, and its relation with cost savings (Reeves and Barrow 2000; Dijkgraaf and Gradus 2003; Bel and Warner 2008b; Bae 2010). However, contracting out the MSW service does not guarantee that cost efficiency will improve (Bel and Warner 2008b), as prior empirical evidence in this respect has produced conflicting results (Bel and Warner 2008b; Bel et al. 2010c).

The present study analyses the relation between cost efficiency in MSW service and contracting out, but from a different perspective, in which we consider the dynamism of the contracting out implementation. Hence, unlike previous empirical research (Bel and Costas 2006), we take into account the year in which the municipality contracts out the MSW service and analyse the variation in cost efficiency over time.

For this purpose, matching techniques were applied to a sample of Spanish municipalities, in order to determine whether contracting out increased or decreased cost efficiency over time. In implementing this model, the cost efficiency scores were estimated by means of intertemporal frontier analysis and the application of robust partial frontiers.

Empirical results suggest that transaction costs are generated when the MSW service is contracted out, thus causing an initial decrease in cost efficiency that is counteracted as time passes. In the specific context of contracting out local public services, the presence of these costs can be explained by the transaction costs framework, according to which transaction costs are excluded from the cost analysis of contracting out (Sclar 2000) resulting in worsened levels of cost efficiency. Thus, it was found that after a cost efficiency decrease of 1.4% in the initial phase of contracting out, this delivery form was associated with an increase of 3.2% in cost efficiency after three years, resulting in a net cumulative efficiency gain of 1.8% for new contractors. Thus, our results highlight the existence of a learning effect over time in the contracting out process, which may eventually produce better contract management and overcome the initial cost efficiency decrease.

The main contribution of the present study is its conclusion that the results obtained from contracting out the MSW service may vary over time, but that cost

efficiency is ultimately enhanced. In contrast with previous studies, we analysed the long-term effect of contracting out the MSW service cost efficiency, and found that its consequences vary depending on the implementation stage considered. Therefore, it is necessary to analyse contracting out as a process, taking into account that the effects of its implementation may be subject to a time lag.

Finally we acknowledge some limitations to this study. Considering that the time lag analysed in the present study was four years, it would be desirable to extend this analysis to a broader period of time, for greater precision. Additionally, it should be extended to other local public services in order to determine whether the results

## **CHAPTER 5: CONCLUSIONS, LIMITATIONS AND AREAS FOR FUTURE RESEARCH**



## **1. CONCLUSIONS, LIMITATIONS AND AREAS FOR FUTURE RESEARCH**

In recent years, local governments have had to meet increasing demands, while coping with severe budget cuts, due to the current economic recession. In this context, it is considered of fundamental importance to manage local public services in such a way as to achieve higher levels of efficiency (Andrews and Entwistle 2013). In consequence, local public services have been widely reformed, resulting in a proliferation of different entities and management processes, presenting a large variety of organisational structures.

In view of these considerations, we have analysed the cost efficiency of different forms of management, from different standpoints in order to obtain more information about the effectiveness of these service delivery alternatives with respect to the efficiency of local public services, and bearing in mind the theories underlying them. Our aim is both to contribute to existing knowledge of this question, by providing new empirical evidence, and to provide support for decision making by the managers of local public services.

The perceived impact of these delivery forms on the cost efficiency of local public services may differ depending on whether overall municipal efficiency or that of a specific service is analysed. According to Fox (1999), one entity may be more efficient than another in each specific output, but have lower overall efficiency. Thus, in our case, each of the different organisational structures, derived from a different form of service provision, may affect overall municipal efficiency in the contrary sense to its effect on a particular service. Therefore, taking into account the distinction existing in the literature between studies examining the overall efficiency of local public services and those focusing on the efficiency of a particular service (De Borger and Kerstens 2000), we believe these two realities should not be considered in isolation. Accordingly, one of the main contributions of the present thesis is that it analyses the cost efficiency of forms of local public services delivery from this dual perspective: overall and service-specific.

In addition, we assess a broad range of alternative forms of providing of local public services. Previous studies of the relationship between service delivery forms and public service cost efficiency have focused mainly on the distinction between public and private management, but in recent years there have been other initiatives, such as forms of cooperation, either with private entities, for example by means of mixed firms (Marra 2007), or with other municipalities through inter-municipal cooperation (Bel and Mur 2009; Mohr et al. 2010). However, empirical evidence in this respect remains limited and most studies address only one or two alternatives. In our opinion, the issue should also be considered from a broader and more comprehensive viewpoint, taking into account all these different formulas.

Therefore, we have analysed the following forms of local public service management: local horizontal decentralisation (the creation of agencies), contracting out, mixed firms and inter-municipal cooperation (in its two variants, inter-municipal cooperation via a public agency, and private production with cooperation).

Furthermore, the analysis of the cost efficiency of the MSW service is addressed from a new dimension, to establish which service deliver form is the most cost-efficient according to the population size of the municipality. Although previous research has highlighted the exemplarity of small and medium-sized towns for a particular formula, no previous study has been carried out to determine whether the cost efficiency of different service delivery forms for the MSW service varies according to the size of the municipality.

Among the various delivery forms considered, we examine in detail the impact of contracting out on the cost efficiency of the MSW service and consider how transaction costs resulting from the change in management form may affect this efficiency. Specifically, this relationship is addressed from a new perspective, in which we propose the concept of organisational learning and make use of the learning curve as a theoretical framework to analyse effects on efficiency and on the transaction costs arising from the implementation of a contracting out system. For this purpose, we examine the temporal dimension involved; this approach represents an improvement over previous studies in this field, which have limited their analysis of this relationship to a particular moment in time. Thus, we consider the cause-effect relationship between contracting out and the cost efficiency of the MSW service over a broad time horizon, using matching methodology, a technique that has not previously been applied in studies of the efficiency of local public services. By means of this approach, it is



possible to determine the effects of contracting out and of the learning curve on service cost efficiency.

From the methodological standpoint, this thesis considers various innovative methods for studying the cost efficiency obtained by different management forms for local public services. Thus, robust partial frontiers are used to calculate the efficiency values of the municipalities included in the sample. This method offers several advantages over the traditional nonparametric models, DEA and FDH, obtaining results that are more robust and not affected by the presence of extreme values. Thus, it is possible to assess units with an efficiency greater than one, i.e., super-efficient units.

In addition, other methodologies are used to address the aims of each of the studies that comprise this thesis. Thus, the second chapter describes the use of bootstrapped truncated regression, proposed by Simar and Wilson (2007), in the third we apply the metafrontier concept developed by Battese and Rao (2002) and by Battese et al. (2004), and finally, in the fourth chapter, we present the concept of intertemporal frontier (Tulkens and Vanden Eeckaut 1995a) and the propensity score matching method (Rosenbaum and Rubin 1985).

The following main findings are reported: first, under stable economic conditions, the creation of agencies, contracting out and inter-municipal cooperation all worsen the overall level of cost efficiency. However, during periods of adverse economic and financial conditions, inter-municipal cooperation and contracting out produce a slight improvement in municipal cost efficiency. The creation of mixed firms is the only service delivery form to significantly increase overall municipal cost efficiency both in times of crisis and under stable economic conditions.

Thus, as a first result, this study reports evidence that the relationship between overall efficiency and the delivery form for local public services favours the development of policies aimed at recentralisation – in accordance with post-NPM postulates – when economic conditions are stable. On the other hand, the management methods proposed by NPM, in terms of municipal restructuring via contracting out, inter-municipal cooperation or mixed firms can make a positive contribution to overall cost efficiency when the economic situation is less stable. In summary, this thesis provides a new perspective to the debate on NPM vs post-NPM by considering the different types of economic-financial situation that may be applicable to the municipalities in question.

However, further studies should be conducted of the relations between overall efficiency and delivery forms, in order to corroborate the results obtained in an international context, because the implementation of NPM policies may vary depending on the country considered. In this respect, we must distinguish between two main groups of countries: those of the Anglo-Saxon tradition, represented by the UK, New Zealand, Australia and the USA, and those of the continental tradition, such as France, Italy and Germany (Kuhlmann 2010b).

As an example, in Spain, a country characterised by a strong administrative-legal culture and the presence of a strong bureaucratic administration (Carvalho et al. 2006), NPM has been implemented selectively (Rhodes et al. 2012), with these reforms being adopted individually and sometimes only in part. This form of implementation has been termed “NPM with doctrine” (Khulman 2010a) and contrasts with that found in countries like New Zealand, Australia, the USA and the UK. Therefore, the application of the approach presented in this thesis to the situation found in other countries would

enable us to determine whether differences in the implementation of NPM affect the relationship between NPM delivery forms and cost efficiency.

Apart from assessing overall efficiency, it is also necessary to conduct a more detailed examination of the effect produced by these delivery forms on the efficiency of specific services and by the process of changing from one form to another. Regarding the first aspect, the specific efficiency of the MSW service is analysed in order to determine which delivery form minimises the service cost. The results obtained show that for municipalities in general, as an alternative to contracting out, inter-municipal cooperation generally obtains better cost-efficiency results.

However, a more profound examination of this relationship makes it clear that the efficiency derived from the choice of delivery form also depends on the population size; thus, for smaller municipalities (1,000-5,000 inhabitants) it is more advisable to adopt private production with cooperation, while those with a population of 5,001-20,000 inhabitants should opt for the contracted out form of inter-municipal cooperation. However, municipalities with a population of 20,001-50,000 would achieve higher levels of cost efficiency by fully contracting out the service.

The results obtained advance our understanding of how to determine the most efficient delivery form of MSW service, taking into account the size of the municipality, and thus facilitate decision making by public managers. Furthermore, these results reflect the existence of a certain population size above which it is more advisable for municipal managers to adopt the contracting out recommended by some studies, and corroborates theoretical postulates according to which contracting out is effective when the private operator can obtain economies of scale, thanks to the size of the municipal population.

Similarly, although comparative studies have been made with specific regard to the MSW service (Warner and Bel 2008; Bel et al. 2010a), it would be useful to examine whether in other countries the size of the municipality determines the most appropriate deliver form in terms of cost efficiency.

Although our previous study evaluates the situation in four different years (2004, 2006, 2008 and 2010), it does not identify the service cost efficiency achieved when changes are made from one management form to another. Accordingly, and as one of the management forms that has been most intensively studied is that of the contracting out of local services, we propose that in addition a dynamic efficiency analysis of service costs should be carried out, for the period from the previous year until three years after the change.

This approach contributes to the literature on the effectiveness of contracting out the MSW service by specifically considering the time when this change takes place and analysing the consequences once it has become consolidated. On the one hand, it is shown that municipalities that contract out this service experience reduced efficiency, which suggests the presence of transaction costs in the management of such contracts following their introduction. On the other hand, it is apparent that, over time, the cost efficiency achieved by these municipalities improves, and ultimately overcomes the initial loss of efficiency. This outcome can be explained as the learning effect obtained in the management of the contract. This finding highlights the need to conduct dynamic studies, addressing the cause and effect of contracting out local public services, by applying intertemporal frontiers and using the matching technique.

This methodological process for the analysis of public service contracting out by municipalities is validated for the Spanish context in the present study, but still requires

validation in an international context, characterised by different types of contracting out and where the legal and economic characteristics of such contracts may be different (Warner and Bel 2008). This contracting out might promote competition within the same field, as is the case in the USA, where the private and public sectors coincide in providing the MSW service, while in other countries such as Spain, the competition takes place during the selection of the private operator. In this regard, it would be useful for future research to corroborate our results by applying methodologies enabling the dynamic analysis of the effects of contracting out on the cost efficiency of local public services in other countries, with different administrative cultures and systems.

Despite their virtues, the studies presented in this thesis suffer a number of limitations. First, the absence of the necessary data made it impossible to include municipalities with fewer than 1,000 inhabitants and those with more than 50,000 inhabitants. The study should be extended to include these municipalities, especially the larger ones, which have greater financial resources and are obliged to provide a wider range of services.

Furthermore, taking into account the data availability, the sample of municipalities included in the three studies covers a broad period of time, including the onset of the current economic recession. However, the conclusions drawn with respect to this period cannot be extended to that of the whole crisis. This is because periods of economic crisis are composed of cycles presenting different phases, which are characterised by the different policies adopted by economic agents, and therefore the results may differ depending on the phase in which they were obtained.

Accordingly, in future research we intend to expand the sample, both in terms of the municipalities included, to make it representative of all types, and from the temporal

standpoint, to analyse in greater depth the current economic recession and the difference between periods in the economic cycle.

New techniques are now being developed to obtain dynamic estimates of efficiency, and so an interesting future line of research would be to apply dynamic nonparametric frontiers. This approach, moreover, would facilitate the dynamic analysis of how changes in deliver forms affect individual efficiency and produce variations in the metafrontier, thus facilitating evaluation and enabling the management of municipal services to be improved.

Another issue of interest would be to extend the study of the contracting out of the MSW service. Our evidence shows that after the third year of its implementation, this management form produces service cost efficiency gains. But it remains to be determined how long such an improvement would last. As we show, the adoption of a new procedure produces a learning effect, which in the present case results in the improved management of the MSW service. However, this improvement is not necessarily permanent, and so at a later stage this gain in efficiency might be constrained. Therefore, we intend to expand our analysis of the effects of contracting out on MSW service efficiency, examining in greater detail the dynamics of this process and extending the study beyond the first three years after its introduction.

## **2. CONCLUSIONES, LIMITACIONES Y FUTURAS LÍNEAS DE INVESTIGACIÓN**

En los últimos años, los gobiernos locales han tenido que atender a unas demandas ciudadanas cada vez mayores, a la vez que hacer frente a importantes restricciones presupuestarias. En este contexto, se considera un aspecto fundamental la búsqueda de formas de gestión de los servicios públicos locales que permitan obtener mayores niveles de eficiencia (Andrews y Entwistle 2013), especialmente a raíz de la actual recesión económica. Así, los gobiernos locales han llevado a cabo una reforma de los servicios públicos, que se ha traducido en una proliferación de diferentes entidades y procesos de gestión que ha configurado una amplia variedad de estructuras organizativas en el ámbito municipal.

Por este motivo, se ha llevado a cabo un análisis de la eficiencia en costes de las distintas formas de gestión, abordando su estudio desde diferentes perspectivas, con el propósito de aportar más información sobre la efectividad de dichas alternativas de gestión sobre la eficiencia de los servicios públicos locales, y de las teorías que las sustentan, pretendiendo de esta forma contribuir a la literatura existente aportando nueva evidencia empírica, así como, apoyar la toma de decisiones de los gestores públicos locales.

En este sentido, el impacto de estas formas de gestión en la eficiencia en costes de los servicios públicos locales puede diferir según si se analiza la eficiencia conjunta del municipio o la eficiencia específica de un servicio. De acuerdo con Fox (1999), una entidad puede ser más eficiente que otra en cada output específico, pero tener menor eficiencia global. Así, en nuestro caso, cada una de las diferentes estructuras organizativas, derivadas de la prestación del servicio de distinta forma, que posee un municipio puede afectar a la eficiencia municipal en sentido contrario a cómo lo hace

respecto a un servicio concreto. Por tanto, atendiendo a la distinción existente en la literatura respecto a los estudios que analizan la eficiencia conjunta de los servicios públicos locales de los que, por el contrario, analizan la eficiencia de un servicio concreto (De Borger y Kerstens 2000), entendemos que no resulta conveniente aislar estas dos realidades. Por lo que, una de las principales aportaciones consiste en analizar la relación de la eficiencia en costes de los servicios públicos locales con las formas de gestión desde esta doble perspectiva: a nivel global y específico.

Por otro lado, se ha pretendido evaluar un amplio abanico de alternativas en cuanto a formas de gestión de los servicios públicos locales se refiere. El estudio de la relación entre formas de gestión y eficiencia en costes de los servicios públicos se ha centrado mayoritariamente en la distinción entre gestión pública o privada, aunque en los últimos años, además, se ha abierto a fórmulas de cooperación tanto con entidades privadas, formando, por ejemplo, empresas mixtas (Marra 2007), como con otros municipios a través de la cooperación intermunicipal (Bel y Mur 2009; Mohr et al. 2010). Sin embargo, la evidencia empírica es aún limitada y los estudios realizados en su mayoría solamente contemplan una o dos alternativas, por lo que resulta necesario contribuir al análisis de esta cuestión desde una visión más amplia e integradora entre las diferentes fórmulas alternativas.

En este sentido, se han analizado diversas formas de gestión de los servicios públicos locales, como la descentralización horizontal local o creación de agencias, la externalización de los servicios públicos, las empresas mixtas y la cooperación intermunicipal, que tiene dos variantes: cooperación intermunicipal a través de agencia pública o cooperación intermunicipal externalizada.



Asimismo, se aborda el análisis de la eficiencia en costes del MSW desde una nueva dimensión: qué forma de gestión del MSW es más adecuada en términos de costes según el tamaño poblacional del municipio. Aunque en estudios previos se haya puesto de manifiesto la preferencia de los pequeños y medianos municipios por una determinada forma de gestión, no se había hecho un estudio en el que se determinara que, la eficiencia en costes de las distintas formas de gestión del MSW, varía según la dimensión del municipio.

Además, de entre las distintas formas de gestión consideradas, se profundiza en el impacto que la externalización de servicios presenta en la eficiencia en costes para el servicio de recogida de residuos y cómo los costes de transacción derivados del cambio de la forma de gestión puede afectar a la eficiencia. Concretamente, se aborda esta relación desde una nueva perspectiva, proponiendo el concepto de aprendizaje organizacional y utilizando a su vez la curva de aprendizaje como marco teórico para analizar sus efectos sobre la eficiencia y los costes de transacción derivados de la gestión del contrato de externalización del servicio. Para ello, se considera metodológicamente la dimensión temporal de la externalización del servicio, de manera que supone una mejora de los estudios realizados hasta la fecha, centrados en el análisis de esta relación en un momento concreto del tiempo. Así, se analiza la relación causa-efecto de la externalización y la eficiencia en costes del servicio de recogida de basura a lo largo de un amplio horizonte temporal, a través de la metodología del matching, que hasta la fecha no había sido aplicada en los estudios sobre eficiencia de los servicios públicos locales. De este modo, resulta posible estudiar el efecto que la implantación de la externalización tiene sobre la eficiencia en costes del servicio y el efecto que el proceso de aprendizaje tiene sobre ésta.

Desde el punto de vista metodológico, la presente tesis considera diferentes e innovadores procedimientos para abordar el estudio de la eficiencia en costes que producen las formas de gestión de los servicios públicos locales. Así, se propone el uso de fronteras parciales no paramétricas para el cálculo de los valores de eficiencia de los municipios incluidos en la muestra, dadas las ventajas que presenta frente a los tradicionales modelos no paramétricos: DEA y FDH. Con ello se obtienen resultados más robustos y no condicionados a la presencia de valores extremos, al permitir valorar aquellas unidades cuya eficiencia es superior a la unidad, conocidas como “supereficientes”.

Por otro lado, se hace uso de otras metodologías para dar respuesta a los objetivos planteados en cada uno de los estudios de los que consta esta tesis doctoral. En concreto, en el segundo capítulo se propone el uso de la regresión truncada propuesta por Simar y Wilson (2007); en el tercero se aplica el concepto de metafrontera desarrollado por Battese y Rao (2002) y Battese et al. (2004) y, por último, en el cuarto capítulo, se emplea el concepto de frontera intertemporal (Tulkens y Vanden Eeckaut 1995a) y la metodología del *propensity score matching* (Rosenbaum y Rubin 1985).

En relación con los principales resultados obtenidos en la tesis destaca, en primer lugar que, bajo condiciones económicas estables, la creación de agencias, la externalización y la cooperación intermunicipal, originan peores niveles de eficiencia global en costes. No obstante, durante períodos con condiciones económico-financieras adversas la cooperación intermunicipal y la externalización de servicios públicos permiten obtener leves mejoras en la eficiencia en costes municipal. Únicamente, la creación de empresas mixtas resulta una forma de gestión eficiente que contribuye a

augmentar la eficiencia en costes global de los ayuntamientos tanto en períodos de crisis como en condiciones económicas estables.

En este sentido, un primer resultado del presente trabajo muestra evidencia de que la relación entre eficiencia global y las formas de gestión de los servicios públicos consideradas favorece el desarrollo de políticas públicas orientadas hacia la recentralización de la administración – postulados de la Post-NGP –, cuando las condiciones económicas son estables; mientras que, las formas de gestión propuestas por la NGP, basados en la reestructuración de la administración a través de la descentralización, la externalización, la cooperación intermunicipal o la creación de empresas mixtas, contribuyen positivamente sobre la eficiencia global durante períodos en los que la situación económica es más inestable. Así, la presente tesis contribuye al debate de la NGP vs Post-NGP desde una nueva perspectiva considerando la distinta situación económico-financiera bajo la que prestan sus servicios los municipios.

No obstante, resulta necesario llevar a cabo más estudios que relacionen eficiencia global y formas de gestión que permitan corroborar los resultados obtenidos en un contexto internacional. Esto es así debido a que las políticas de implantación de la NGP varían en función del país en el que desarrollan. En este sentido, se distinguen dos grandes grupos de países: de tradición anglosajona representados por Reino Unido, Nueva Zelanda, Australia y EE.UU. y, de tradición continental, como Francia, Italia o Alemania (Kuhlmann 2010b).

En concreto, el proceso de implantación de la NGP en España, caracterizada por a una fuerte cultura basada en la ley administrativa y la presencia de una estructura marcadamente burocrática (Carvalho et al. 2006), se ha llevado a cabo de forma selectiva (Rhodes et al. 2012), de manera que las reformas propuestas por la NGP se han ido adaptando de forma individualizada y parcial. Este proceso de implantación que

ha sido denominado como “NGP con doctrina” (Khulman 2010a) es diferente del adoptado en países como Nueva Zelanda, Australia, EEUU o Reino Unido. Por tanto, la aplicación de este trabajo a otros países permitiría contrastar si las diferencias en la implantación de la NGP afectan a la relación entre formas de gestión de los servicios públicos locales y eficiencia en costes municipal.

Por otro lado, dejando a un lado la evaluación de la eficiencia global, también, es necesario profundizar de manera más pormenorizada en el efecto que producen estas formas de gestión sobre la eficiencia de determinados servicios específicos y sobre el proceso de cambio de una forma de gestión a otra. En relación con este primer aspecto, se analiza la eficiencia específica del servicio de recogida de basura con la finalidad de determinar qué forma de gestión permite minimizar su coste. Los resultados obtenidos ponen de manifiesto que, para la totalidad de ayuntamientos, en general, además de la externalización del servicio de recogida de residuos como forma de minimizar el coste, existen otras alternativas como la cooperación intermunicipal la cual consigue obtener, por términos generales, mejores resultados.

Sin embargo, cuando se profundiza en esta relación se evidencia que la elección de la fórmula de gestión más eficiente depende igualmente del tamaño poblacional del municipio, por lo que para aquellos municipios de menor tamaño resulta más aconsejable el uso de la cooperación intermunicipal: externalizada, en el caso de los municipios con una población comprendida entre 1.000 y 5.000 habitantes y, a través de ente público para los municipios con una población entre 5.001 y 20.000 habitantes. En el caso de los municipios con una población superior a 20.000 habitantes e inferior a 50.000, la externalización alcanza mayores niveles de eficiencia en costes.

En este sentido, los resultados obtenidos suponen un avance en el conocimiento al determinar la forma de gestión del servicio de recogida de residuos más eficiente según la dimensión del municipio, lo que favorece la toma de decisiones de los gestores públicos. Además, de los resultados se desprende la existencia de un determinado tamaño poblacional a partir del cual resulta más aconsejable acudir a la externalización del servicio, tal y como sugiere cierto sector de la literatura, contribuyéndose de esta forma a los postulados teóricos que apuestan porque la externalización alcanza sus objetivos cuando el operador privado aprovecha economías de escala gracias al tamaño del municipio.

Del mismo modo, aunque existen estudios comparativos en el servicio concreto de servicio de recogida de residuos (Warner y Bel 2008; Bel et al. 2010a), sería necesario corroborar en otros países cómo la dimensión del municipio determina la forma de gestión más adecuada en términos de eficiencia en costes.

Sin embargo, a pesar de que el estudio anterior abarca la evaluación de cuatro ejercicios diferentes (2004, 2006, 2008 y 2010), no identifica la eficiencia en costes del servicio cuando se producen cambios de una forma de gestión a otra. En este sentido, y dado que una de las formas más estudiadas en la literatura es la externalización de los servicios locales, se propone el análisis dinámico de la eficiencia en costes desde el año anterior al cambio hasta tres años después del mismo.

Así, se contribuye a la literatura que trata de analizar la efectividad de la externalización del servicio de recogida de residuos, al considerar específicamente el momento en el que se externaliza el servicio y analizar los efectos que durante los años subsiguientes tiene la externalización, pudiéndose identificar a través de los resultados obtenidos dos fases una vez que la externalización ha sido implantada en el servicio. Por un lado, se evidencia que los municipios que adoptan la externalización ven reducida su

eficiencia, lo que sugiere la presencia de costes de transacción en la gestión de los contratos una vez implantada la externalización. Por otro lado, es posible apreciar cómo a lo largo del tiempo, la eficiencia en costes de dichos municipios mejora, llegando a sobrepasar la pérdida de eficiencia inicial, lo que puede ser explicado por el efecto aprendizaje en la gestión del contrato. En este sentido, se demuestra la necesidad de realizar estudios dinámicos para abordar el análisis de la relación causa-efecto de la externalización de servicios públicos locales mediante la aplicación de fronteras intertemporales y de la técnica del matching.

Este proceso metodológico desarrollado para el análisis de los procesos de externalización se ha validado para el contexto español con el desarrollo del presente trabajo, pero requiere a su vez de su validación en un contexto internacional caracterizado por diferentes tipologías de externalización y donde las características legales y económicas de los contratos pueden ser distintas (Warner y Bel 2008). Así, la externalización del servicio puede favorecer la existencia de competencia en el propio servicio local, como sucede en EE.UU. donde los sectores privado y público concurren en la prestación del servicio, mientras que en otros países, como el caso español, la competencia se produce durante la elección del operador privado. En este sentido, sería oportuno que futuras investigaciones pudieran corroborar los resultados obtenidos aplicando metodologías que permitan el análisis dinámico de los efectos que la externalización tiene sobre la eficiencia en costes de los servicios públicos locales en otros países con culturas administrativas y regímenes administrativos diferentes.

No obstante lo anterior, los estudios incluidos en la tesis presentan una serie de limitaciones que pasamos a comentar a continuación. En primer lugar, la falta de disponibilidad de datos hace imposible incluir los municipios con una población inferior a 1.000 habitantes y superior a 50.000 habitantes. En este sentido, resulta necesario

extender el estudio realizado a estos municipios, especialmente a los de mayor tamaño que poseen mayores recursos económicos y que deben ofrecer mayor número de servicios.

Asimismo, considerando la disponibilidad de los datos, la muestra de municipios incluida en los estudios abarca un amplio período de tiempo que incluye el inicio de la actual recesión económica. Sin embargo, las conclusiones relativas a este período no pueden extenderse al conjunto de la crisis. En este sentido, los períodos de crisis económica son ciclos en los que se puede distinguir diferentes fases que se caracterizan por las distintas políticas adoptadas por los agentes económicos, motivo por el cual los resultados pueden diferir según la fase en la que se encuentre.

Así pues, para futuras investigaciones se pretende ampliar la muestra tanto, desde el punto de vista de los municipios incluidos en ella, con el fin de que ésta sea representativa de todos los tipos de municipios, como desde el punto de vista temporal, de manera que pueda ser analizada en mayor profundidad la actual recesión económica y la diferencia entre períodos en el ciclo económico.

Por otro lado, recientemente se están desarrollando nuevas técnicas que permiten realizar estimaciones dinámicas de la eficiencia, por lo que como futura línea de investigación se pretende aplicar las fronteras no paramétricas dinámicas. Con lo que además, se facilitaría el análisis desde un punto de vista dinámico de cómo los cambios de formas de gestión afectan a la variación de la eficiencia individual y la variación respecto a la metafrontera, con el fin de facilitar la evaluación de la gestión municipal de los servicios para que los municipios puedan llevar a cabo mejoras en la gestión de sus recursos.

Otra cuestión a considerar sería ampliar el estudio que se realiza de la externalización del servicio de recogida de residuos. En este sentido, obtenemos evidencia de que tras el tercer año de implantación de dicha forma de gestión, el municipio obtiene mejoras en la eficiencia en costes del servicio. Pero queda sin respuesta el tiempo durante el cual el municipio podrá aprovecharse de esa mejora en la eficiencia. Tal y como se propone, a lo largo del tiempo, después de adoptar una nueva medida se produce un efecto aprendizaje, que en nuestro caso concreto se traduce en una mejora de la gestión de los contratos. Sin embargo, dicha mejora no tiene por qué perdurar en el tiempo, por lo que sería posible que en una fase posterior la ganancia en eficiencia se viera limitada. Por ello, pretendemos ampliar el análisis de los efectos que la externalización del servicio de recogida de residuos tiene sobre la eficiencia, profundizando en la dinámica de este proceso, y ampliar el estudio en los ejercicios siguientes a los tres primeros después de su implantación.





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## **APPENDIX**



**APPENDIX 1. DISAGGREGATION OF NPM DELIVERY FORMS BY SERVICES**

<b>Service group</b>	<b>Services included in the group</b>
Water ( <i>Water</i> )	Water cycle: water treatment and distribution
Urban waste ( <i>Urban Waste</i> )	Comprehensive management of municipal waste, road cleaning, urban environment (parks, gardens)
Culture, sports and education ( <i>Culture</i> )	Management education, training centres, cultural activities, sports, cultural and sports facilities
Social and health care ( <i>Social</i> )	Hospitals, social services, funeral services
Promotion ( <i>Promotion</i> )	Business support, promotion of economic activity, promotion of employment, subsidies, tourism promotion, markets and slaughterhouses
Transportation ( <i>Transportation</i> )	Urban transport, bus stations, maritime and railway transport
Urban ( <i>Urban</i> )	Public works, land development, parking, architecture, housing management, lighting
Other ( <i>Other</i> )	Protection services (police, firefighting and civil protection), administration, infrastructure maintenance, energy management

Source: Cuadrado-Ballesteros et al. (2012)

**APPENDIX 2. DESCRIPTIVE STATISTICS: INPUT AND OUTPUT VARIABLES**

<b>Variable</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Minimum</b>	<b>Maximum</b>
Total Cost	8,153,654.46	9,092.262.09	198,793.55	111,726,186
Water network length	58,928.175	107,395.484	14	2,887,810
Number of street lights	1,837.55567	5,303.3337	2	277,032
Cemetery area	12,681.9215	46,781.1591	0	1,719,300
Urban area	57,184.8497	68,064.4821	45	796,468
Area of public parks	101,761.544	84,4671.048	40	25,019,311
Tons of waste disposal	27,380.6753	82,5916.371	1	46,955,660.7
Population	9,160.35652	8,927.66879	851	51,774



**APPENDIX 3. DESCRIPTIVE STATISTICS OF TWO-STEP VARIABLES, VARIANCE INFLATION FACTOR (VIF) AND CORRELATION MATRIX OF TWO-STEP VARIABLES**

<b>Variable</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Minimum</b>	<b>Maximum</b>	<b>VIF</b>
Efficiency	.8561006	.2256298	.0912329	1.858703	
Unemployment	4.926541	3.320402	.4	26.8	1.76
Tourism	2.151414	7.655166	0	135.3855	1.18
Size	1.697732	.6724246	1	3	1.50
Income Tax Index	.5804846	.143699	.213728	.8602183	1.09
Budgetary Result	1.020457	.1512396	.6651739	1.603301	1.08
Cash Index	.8974518	1.17241	-.1738455	6.918322	1.11
Transfers Index	.4661005	.1653535	.0445812	.9640027	1.47
Municipal Debt	2.354687	.5323434	-7	3.810627	1.07
Political Orientation	.5867675	.4924371	0	1	1.09
Political Strength	.610775	.4875975	0	1	1.14
Great Recession	.3	.4582792	0	1	1.67
<b>Agencification</b>					
Water	.0316635	.1804283	0	2	1.13
Urban waste	.0095463	.0972424	0	1	1.04
Culture	.2774102	.7439329	0	7	1.36
Social	.071172	.2789877	0	2	1.16
Promotion	.1208885	.3710356	0	3	1.25
Transportation	.005293	.0725637	0	1	1.03
Urban	.144518	.3987446	0	3	1.21
Others	.0266541	.1679724	0	2	1.07
<b>Contracting out</b>					
Water	.0520794	.243704	0	3	1.06
Urban waste	.0995274	.3564587	0	5	1.18
Culture	.0759924	.3541581	0	6	1.30
Social	.026465	.1789018	0	3	1.14
Promotion	.0150284	.1349328	0	3	1.10
Transportation	.0083176	.0928832	0	2	1.09
Urban	.0537807	.2975145	0	5	1.28
Others	.0337429	.2403155	0	5	1.32
<b>Mixed Firms</b>					
Water	.0081285	.0897955	0	1	1.07
Urban waste	.0037807	.0613741	0	1	1.07
Culture	.0202268	.1530085	0	2	1.12
Social	.0066163	.0810747	0	1	1.09
Promotion	.0953686	.3838567	0	5	1.26
Transportation	.0055766	.0744714	0	1	1.05
Urban	.0215501	.145216	0	1	1.06
Others	.0413043	.1990026	0	1	1.11
<b>Inter-municipal Cooperation</b>					
Water	.3558601	.5461227	0	3	1.08
Urban waste	.5432892	.6032001	0	3	1.12
Culture	.4507561	.86543	0	7	1.41
Social	.1808129	.4169471	0	2	1.08
Promotion	.6312854	.800005	0	5	1.30
Transportation	.0462193	.2338252	0	2	1.09

Urban	.1749527	.4198905	0	3	1.15
Others	.455293	.6156614	0	3	1.24
<b>Mean VIF</b>					<b>1.19</b>

Service delivery forms and cost efficiency in Spanish local government

**Correlation matrix**

Variables	Unemp	Tourism	Size	ITI	BR	CI	TI	MD	Sign	Strength	GR	Agenc	Contract	Mixed	Coop
Unemp	1.0000														
Tourism	-0.1005***	1.0000													
Size	0.1531***	0.1028***	1.0000												
ITI	-0.0110	0.0645***	-0.0430***	1.0000											
BR	-0.0254***	0.0076	-0.0131	-0.0116	1.0000										
CI	-0.0333***	0.0130	0.0394***	-0.0203**	0.2362***	1.0000									
TI	0.2687***	-0.2094***	-0.2639***	-0.0011	-0.0326***	-0.1334***	1.0000								
MD	-0.0023	0.0369***	-0.0006	0.2348***	0.0139	-0.0016	-0.0185*	1.0000							
Sign	0.0282***	-0.0519***	0.0353***	-0.0188*	0.0053	-0.0466***	0.0314***	-0.0119	1.0000						
Strength	0.0187*	-0.0783***	-0.1989***	-0.0271***	-0.0098	-0.0269***	0.1658***	-0.0125	-0.1636***	1.0000					
GR	0.5924***	-0.0336***	0.0345***	-0.0047	-0.0975***	-0.0029	0.2282***	0.0106	0.0040	-0.0294***	1.0000				
Agenc	0.0483***	0.1445***	0.3916***	-0.0119	0.0015	-0.0473***	-0.1951***	0.0239**	0.0426***	-0.1058***	0.0380***	1.0000			
Contract	0.1278***	0.1088***	0.2543***	0.0031	-0.0304***	0.0344***	-0.1536***	0.0172	-0.0198**	-0.0661***	0.1614***	0.0809***	1.0000		
Mixed	0.0432***	0.0461***	0.1714***	-0.0031	-0.0028	0.0093	0.0473***	0.0007	0.0858***	-0.0254***	0.0098	0.2080***	0.0373***	1.0000	
Coop	0.0610***	0.0103	0.2481***	-0.0339***	-0.0185*	-0.0447***	-0.2373***	-0.0147	0.1100***	-0.1018***	0.0899***	0.2799***	0.0768***	0.1014***	1.0000

\* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Unemp.: Unemployment  
 Sign: Political Orientation  
 Agenc: Agencification

ITI: Income Tax Index  
 Strength: Political Strength  
 Contract: Contracting out

BR: Budgetary Result  
 GR: Great Recession  
 Mixed: Mixed firms

CI: Cash Index  
 TI: Transfers Index  
 MD: Municipal Debt

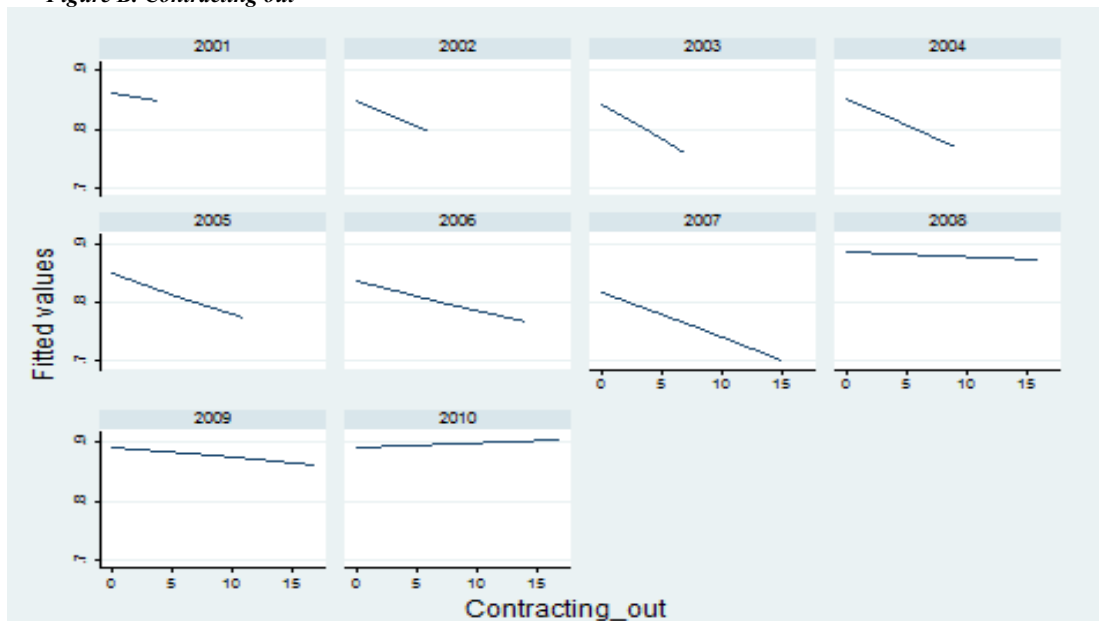
Coop: Inter-municipal cooperation

**APPENDIX 4. PREDICTED EFFICIENCY SCORES BY NPM DELIVERY FORMS, PER YEAR<sup>32</sup>**

*Figure A. Agencies*



*Figure B. Contracting out*



<sup>32</sup> Figures obtained from Stata 12 with the predicted values obtained by the post estimation command

Figure C. Mixed firms

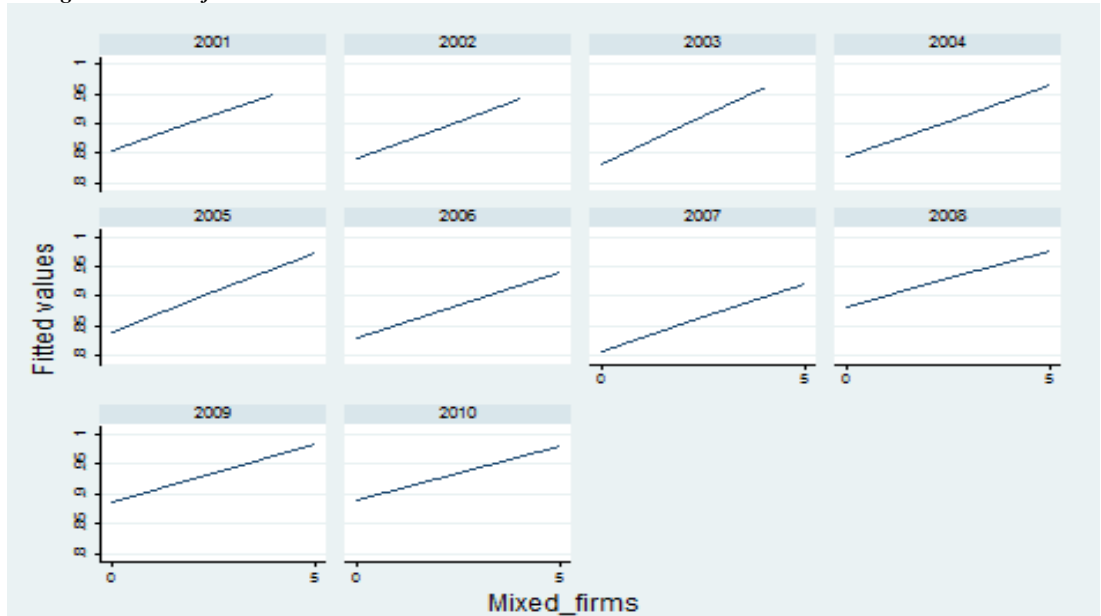
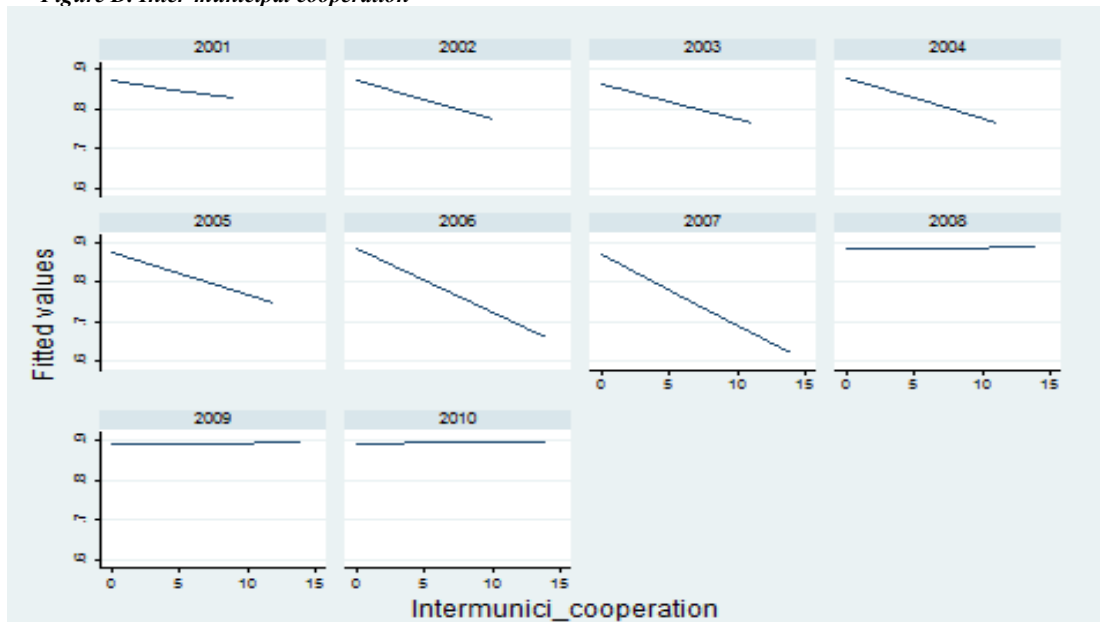
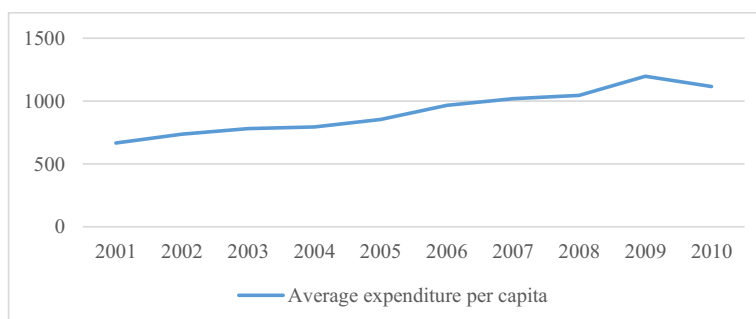


Figure D. Inter-municipal cooperation



## APPENDIX 5. AVERAGE EXPENDITURE PER CAPITA



Source: The author, based on data from the Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and the Treasury

## APPENDIX 6. DESCRIPTIVE STATISTICS OF COSTS AND OUTPUTS IN THE MSW SERVICE

Year	Cost/Outputs	Mean	Median	Minimum	Maximum	SD
<b>2004</b>	Total Cost	649582.3	325524.1	3623.1	1.31e+07	928082.1
	MSW tons	86895.6	4632.67	9	4.70e+07	1709418
	MSW tons*quality	172856.9	9064	18	9.39e+07	3418743
	Containers	559.7613	357	0	19835	914.4888
<b>2006</b>	Total Cost	816412.3	444515.5	912.8	1.34e+07	1119577
	MSW tons	15401.87	4394.6	21.8	1941128	93598.13
	MSW tons*quality	30483.17	8603.4	42	3882257	186868
	Containers	543.4968	374	0	6611	594.0456
<b>2008</b>	Total Cost	963390	531062.3	355.88	1.60e+07	1276967
	MSW tons	15401.87	4394.6	21.8	1941128	93598.13
	MSW tons*quality	30483.17	8603.4	42	3882257	186868
	Containers	543.4968	374	0	6611	594.0456
<b>2010</b>	Total Cost	1074366	557918.4	700	2.06e+07	1592148
	MSW tons	8975.759	4321.76	202.5	786180.9	35674.46
	MSW tons*quality	17668.83	8272.2	405	1542186	70410.42
	Containers	577.8988	408	9	4929	560.8631

APPENDIX 7. MANN-WHITNEY U TEST AND LI TEST

Null hypothesis ( $H_0$ )	Mann-Whitney U test			Li test		
	10% significance	5% significance	1% significance	10% significance	5% significance	1% significance
<b>Year: 2004</b>						
$CE^k(\text{MUD})= CE^k(\text{MUC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUD})= CE^k(\text{IC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected
$CE^k(\text{MUD})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUC})= CE^k(\text{IC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUC})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{IC})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
<b>Year: 2006</b>						
$CE^k(\text{MUD})= CE^k(\text{MUC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUD})= CE^k(\text{IC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUD})= CE^k(\text{PPC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUC})= CE^k(\text{IC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUC})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{IC})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
<b>Year: 2008</b>						
$CE^k(\text{MUD})= CE^k(\text{MUC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUD})= CE^k(\text{IC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUD})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUC})= CE^k(\text{IC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ not rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{MUC})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{IC})= CE^k(\text{PPC})$	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
<b>Year: 2010</b>						
$CE^k(\text{MUD})= CE^k(\text{MUC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected
$CE^k(\text{MUD})= CE^k(\text{IC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected
$CE^k(\text{MUD})= CE^k(\text{PPC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected
$CE^k(\text{MUC})= CE^k(\text{IC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected
$CE^k(\text{MUC})= CE^k(\text{PPC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ rejected	$H_0$ rejected	$H_0$ rejected
$CE^k(\text{IC})= CE^k(\text{PPC})$	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected	$H_0$ not rejected

$CE^k$ : Local frontier

MUD: municipal direct

IC: inter-municipal cooperation

MUC: municipal under contract

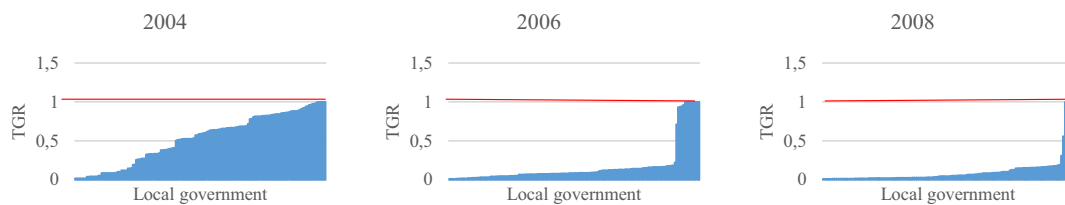
PPC: private production with cooperation (PPC)

Results of the Mann-Whitney U test obtained using Stata 12

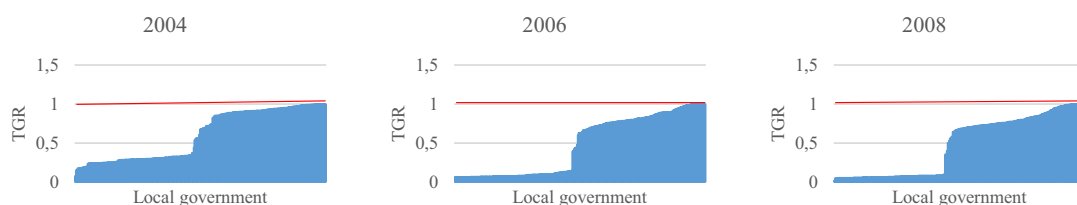
Results of the Li test obtained using "The R Project for Statistical Computing"

## APPENDIX 8. EVOLUTION OF THE TECHNOLOGY GAP RATIO (TGR)<sup>33</sup>

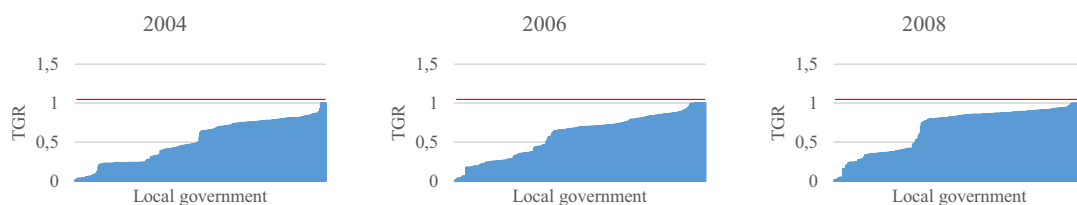
### *Municipal Direct (MUD)*



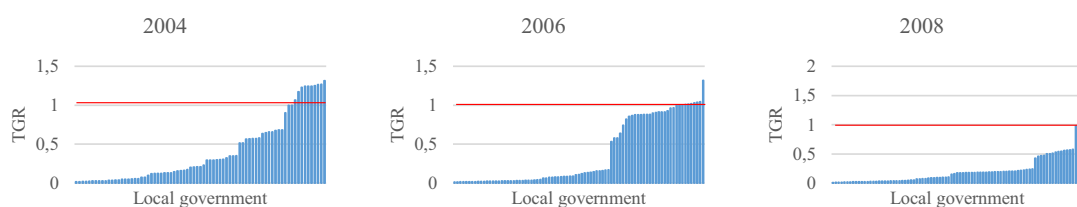
### *Municipal under contract (MUC)*



### *Inter-municipal cooperation (IC)*



### *Private production with cooperation (PPC)*



Source: The author

<sup>33</sup> Graphs for years in which the Kruskal-Wallis test, the Mann-Whitney U test and the Li test obtain significant differences.



## APPENDIX 9. RESULTS BY MANAGEMENT FORM, POPULATION SIZE AND YEAR

### a. Kruskal-Wallis test for TGR, by management form, year and population size

Groups compared: MUD – MUC – IC – PPC									
Municipal Size	1,000≤Population≤5,000			5,001≤Population≤20,000			20,001≤Populatio≤50,000		
Year	2004	2006	2008	2004	2006	2008	2004	2006	2008
<b>Chi-squared</b>	52.86	92.19	107.98	55.28	169.46	241.62	69.91	54.13	65.03
<b>Degrees of freedom</b>	3	3	3	3	3	3	3	3	3
<b>p-value</b>	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Results obtained using Stata 12

MUD: Municipal direct MUC: Municipal under contract

IC: Inter-municipal cooperation PPC: Private production with cooperation

### b. Cost efficiency of the different management forms for MSW service delivery, by municipal population size and year

Size		1,000≤Pop.≤5,000			5,001≤Pop.≤20,000			20,001≤Pop.≤50,000		
Service delivery form		Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.
<b>Year: 2004***</b>										
MUD	CE	0.206	0.035	1.133	0.085	0.006	1.175	0.224	0.003	1.000
	CE <sup>k</sup>	0.313	0.073	1.205	0.275	0.009	1.324	0.509	0.007	1.064
	TGR	0.637	0.043	1.001	0.521	0.020	1.003	0.401	0.020	1.000
MUC	CE	0.125	0.013	0.383	0.072	0.007	1.000	0.225	0.007	1.000
	CE <sup>k</sup>	0.414	0.042	1.195	0.132	0.011	1.302	0.251	0.007	1.013
	TGR	0.362	0.150	0.920	0.572	0.174	1.000	0.893	0.074	1.000
IC	CE	0.169	0.034	0.702	0.112	0.007	1.223	0.205	0.007	1.000
	CE <sup>k</sup>	0.274	0.044	0.972	0.261	0.009	1.621	0.563	0.060	1.021
	TGR	0.643	0.230	0.861	0.526	0.016	1.000	0.284	0.029	1.000
PPC	CE	0.374	0.029	1.916	0.135	0.013	1.000	0.024	0.017	0.036
	CE <sup>k</sup>	0.421	0.051	1.509	0.634	0.088	1.123	0.934	0.469	1.000
	TGR	0.848	0.162	1.317	0.224	0.020	1.000	0.026	0.018	0.036
<b>Year: 2006***</b>										
MUD	CE	0.090	0.010	1.003	0.049	0.004	1.000	0.258	0.001	1.000
	CE <sup>k</sup>	0.477	0.152	1.292	0.397	0.060	1.132	0.569	0.015	1.059
	TGR	0.146	0.044	1.003	0.135	0.014	1.000	0.357	0.013	1.000
MUC	CE	0.054	0.005	0.328	0.060	0.002	1.021	0.186	0.004	1.000

	<b>CE<sup>k</sup></b>	0.388	0.052	2.673	0.142	0.008	1.137	0.253	0.004	1.009
	<b>TGR</b>	0.177	0.060	0.854	0.416	0.061	1.000	0.829	0.070	1.000
<b>IC</b>	<b>CE</b>	0.101	0.005	2.147	0.116	0.002	1.455	0.279	0.002	1.000
	<b>CE<sup>k</sup></b>	0.156	0.008	2.730	0.239	0.003	1.692	0.529	0.002	1.006
	<b>TGR</b>	0.691	0.252	0.930	0.581	0.063	1.000	0.470	0.010	1.000
<b>PPC</b>	<b>CE</b>	0.107	0.007	1.191	0.127	0.002	1.385	0.020	0.003	0.035
	<b>CE<sup>k</sup></b>	0.235	0.008	1.140	0.552	0.002	1.078	0.755	0.003	1.000
	<b>TGR</b>	0.747	0.020	1.045	0.255	0.015	1.319	0.125	0.016	1.022
<b>Year: 2008***</b>										
<b>MUD</b>	<b>CE</b>	0.069	0.004	0.606	0.058	0.004	1.000	0.177	0.002	1.000
	<b>CE<sup>k</sup></b>	0.775	0.093	1.828	0.684	0.126	1.302	0.498	0.015	1.000
	<b>TGR</b>	0.082	0.027	0.559	0.078	0.013	1.000	0.251	0.015	1.000
<b>MUC</b>	<b>CE</b>	0.047	0.005	0.267	0.064	0.003	1.045	0.174	0.002	1.000
	<b>CE<sup>k</sup></b>	0.408	0.061	1.924	0.152	0.015	1.242	0.235	0.006	1.016
	<b>TGR</b>	0.155	0.053	0.799	0.404	0.018	1.000	0.822	0.056	1.000
<b>IC</b>	<b>CE</b>	0.108	0.004	1.184	0.112	0.001	1.477	0.257	0.003	1.000
	<b>CE<sup>k</sup></b>	0.133	0.007	1.349	0.214	0.001	1.682	0.543	0.003	1.005
	<b>TGR</b>	0.830	0.228	0.999	0.676	0.160	1.000	0.484	0.013	1.000
<b>PPC</b>	<b>CE</b>	0.220	0.007	3.088	0.100	0.004	1.000	0.023	0.002	0.047
	<b>CE<sup>k</sup></b>	0.384	0.055	1.806	0.492	0.033	1.031	0.677	0.006	1.000
	<b>TGR</b>	0.354	0.035	1.710	0.170	0.016	1.000	0.101	0.011	0.530

\*\*\* Only reported results with mean independence of service delivery forms at 99% significance according to the Kruskal Wallis test

CE: Metafrontier

CE<sup>k</sup>: Local frontier

TGR: Technology gap ratio

MUD: Municipal direct

MUC: Municipal under contract

IC: Inter-municipal cooperation

PPC: Private production with cooperation

## APPENDIX 10: FACTORS DETERMINING THE CONTRACTING OUT OF LOCAL PUBLIC SERVICES

### *a. Definition of variables included in the probit model*

Variable	Expected sign	Definition	Source
<b>Contracting out</b>	(Dependent variable)	Dummy variable taking value 1 if at the end of the period 2002-2010 the local government has contracted out the MSW service and 0 otherwise	The author, based on the Survey of Infrastructure and Equipment (EIEL, from Ministry of Public Administration and Treasury), Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury, Official Provincial Gazettes (BOP) and municipal web pages
<b>Cost efficiency</b> ( $\alpha_{S,it-1}^m$ ) <sup>34</sup>	-	Ratio that measures the relationship between municipal spending in relation to the outputs achieved (score obtained through order-m methodology)	<u>Municipal spending</u> : Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury <u>Output variables</u> : Survey of Local Infrastructure and Equipment (EIEL), from the Ministry of Public Administration's website
<b>Cash Index</b>	+/-	Percentage of cash over liquidated obligations	
<b>Taxable value divided by Financial Charge Index</b>	+/-	Fiscal receivables divided by annual amortisation payment – interest and principal	
<b>Non-financial Current Budgetary Result Index (Budget Result Index)</b>	+/-	Current budgetary payables and non-financial capital budgetary payables divided by non-financial current budgetary receivables and non-financial capital budgetary receivables	Virtual Office of Local Government Financial Coordination of the Ministry of Public Administration and Treasury
<b>Independence Index</b>	+/-	Percentage of total income excluding transfers received over total expenditure	
<b>Political Orientation</b>	-	Dummy variable that takes the value 0 if the municipal government	The author, based on the website of the Ministry of the Interior

<sup>34</sup> We include this variable in order to assess whether the cost efficiency obtained in the previous year would affect to the likelihood of contracting out MSW service. In this sense, it is expected a negative relation as the decrease of cost efficiency would favor the contracting out decision.

		has a conservative ideology and 1 if it is left-leaning	
<b>Political Strength</b>	+/-	Dummy variable that takes the value 0 if the municipal government shares power with other parties and 1 if it has an absolute majority	
<b>Great Recession</b>	+	Dummy variable that takes the value 1 for the years of the Great Recession (2008-2010) and 0 for the other years of the period considered	Elaborated by the author
<b>Population</b>	+	Logarithm of the number of inhabitants corresponding to each local government for each year of the period 2002 and 2010	National Institute of Statistics (INE) and the Economic Yearbook of 'La Caixa'
<b>Tourism Index</b>	+	Index that measure the tourism-oriented activities of the municipality	The Economic Yearbook of 'La Caixa'
<b>Population centres</b>	+	Number of population units within the municipal area	Continuous register, National Institute of Statistics (INE)

**b. Descriptive statistics of the variables included in the probit model**

Variable	Mean	Minimum	Maximum	SD
<i>Cost efficiency</i>	.0768693	.0000373	2.058116	.19083
<i>Cash Index</i>	3.859339	-192.8108	1176.286	32.47208
<i>Taxable value over financial charge Index</i>	22.62513	.2498085	14739.43	268.2594
<i>Budget Result Index</i>	1.023976	.4269567	3.292641	.1721207
<i>Independence Index</i>	.5783543	.1213181	2.765167	.2075042
<i>Political Orientation</i>	.6288507	0	1	.4831839
<i>Political Strength</i>	.5859005	0	1	.4926388
<i>Great Recession</i>	.25	0	1	.4330768
<i>Population</i>	9.069115	6.96602	11.0469	.7712259
<i>Tourism Index</i>	1.973702	0	115.8107	7.221282
<i>Population centres</i>	12.39336	0	224	25.28506

SD: Standard deviation

## APPENDIX 11: DESCRIPTIVE STATISTICS

*a. Descriptive statistics: variables included in the computation of the cost efficiency scores*

<b>Year</b>	<b>Cost/Outputs</b>	<b>Mean</b>	<b>Median</b>	<b>Minimum</b>	<b>Maximum</b>	<b>SD</b>
<b>2002</b>	Total Cost	443565.5	224233.2	443.35	7753480	676405.1
	MSW tons	26277.44	4410.985	9	6077887	309747.6
	MSW tons*quality	52249.05	8748.1	18	1.22e+07	619512.8
	Containers	567.6114	367.5	0	19835	1097.068
<b>2003</b>	Total Cost	511258.2	254069.9	60.69	7914726	779541.7
	MSW tons	26277.44	4410.985	9	6077887	309747.6
	MSW tons*quality	52249.05	8748.1	18	1.22e+07	619512.8
	Containers	567.6114	367.5	0	19835	1097.068
<b>2004</b>	Total Cost	568652.6	274453.5	8264.53	8031755	844674.8
	MSW tons	26277.44	4410.985	9	6077887	309747.6
	MSW tons*quality	52249.05	8748.1	18	1.22e+07	619512.8
	Containers	567.6114	367.5	0	19835	1097.068
<b>2005</b>	Total Cost	639734.4	315227.1	3550	1.01e+07	965806.2
	MSW tons	26277.44	4410.985	9	6077887	309747.6
	MSW tons*quality	52249.05	8748.1	18	1.22e+07	619512.8
	Containers	567.6114	367.5	0	19835	1097.068
<b>2006</b>	Total Cost	716935	345860.8	912.8	8515038	1014044
	MSW tons	19129.09	4119.9	31.1	1941128	116737.2
	MSW tons*quality	37969.36	8163.038	56.6	3882257	233027.1
	Containers	547.9408	389.5	0	6611	600.0957
<b>2007</b>	Total Cost	769710.7	397842	583.51	1.00e+07	1024811
	MSW tons	19129.09	4119.9	31.1	1941128	116737.2
	MSW tons*quality	37969.36	8163.038	56.6	3882257	233027.1
	Containers	547.9408	389.5	0	6611	600.0957
<b>2008</b>	Total Cost	838656.5	449418.8	2598.04	9082999	1095121
	MSW tons	19129.09	4119.9	31.1	1941128	116737.2
	MSW tons*quality	37969.36	8163.038	56.6	3882257	233027.1
	Containers	547.9408	389.5	0	6611	600.0957
<b>2009</b>	Total Cost	922979.4	444970.3	300	1.15e+07	1271402
	MSW tons	9584.429	4305.005	126.53	786045.3	43818.79
	MSW tons*quality	18854.65	8525.306	165.03	1541915	86376.17
	Containers	546.1588	406.5	9	3526	493.738
<b>2010</b>	Total Cost	984479.5	445025.9	868.85	1.72e+07	1579779
	MSW tons	9875.644	3925.95	202.5	786180.9	47344.01
	MSW tons*quality	19489.15	7822.269	405	1542186	93524.58
	Containers	583.9645	426	9	3476	533.0506

*SD: Standard deviation*

*b. Descriptive statistics: variation in cost efficiency*

<b>Year</b>	<b>Municipality</b>	<b>Obs.</b>	<b>Mean</b>	<b>Minimum</b>	<b>Maximum</b>	<b>SD</b>
<b>2002</b>	Non-contracting	422	0	0	0	0
	Contracting	-	-	-	-	-
<b>2003</b>	Non-contracting	414	-.0107683	-1.560381	2.057847	.1815395
	Contracting	8	-.0144451	-.084164	.0011151	.029346
<b>2004</b>	Non-contracting	407	-.0154334	-2.057956	.7717245	.1319294
	Contracting	15	-.0250306	-.1592655	.0000214	.049474
<b>2005</b>	Non-contracting	399	-.0109131	-.9470752	.220079	.0672379
	Contracting	23	-.0034925	-.0389816	.0072776	.0091634
<b>2006</b>	Non-contracting	388	.0078489	-.7494582	.9997973	.1583372
	Contracting	34	.0013103	-.304226	.1990875	.0748855
<b>2007</b>	Non-contracting	382	-.003496	-.30033	.9130174	.0676135
	Contracting	40	-.0058664	-.0635999	.000993	.0143546
<b>2008</b>	Non-contracting	367	-.0076713	-.8927622	.7475233	.0924674
	Contracting	55	-.0071185	-.4427732	.1256962	.0637509
<b>2009</b>	Non-contracting	344	-.0066874	-.9223195	1.005759	.1377441
	Contracting	78	-.0264867	-.9635553	.1271822	.1296859
<b>2010</b>	Non-contracting	327	.0170505	-.8559671	1.7242	.2043455
	Contracting	95	.0064636	-.4961455	.5881901	.1024709

*SD: Standard deviation*

**APPENDIX 12: QUALITY OF THE MATCHING**

Various approaches may be taken to evaluate whether the matching procedure employed is capable of balancing the distribution of the relevant variables both for new contractors and for matched non-contractors, when one variable influences the propensity score.

Following Sianesi (2004), the following table (Appendix 12a) shows a pseudo  $R^2$  test and a joint significance test, used as matching quality indicators. Sianesi (2004) suggested the propensity score should be re-estimated on the matched sample, that is, only on new contractors and matched non-contractors, and that the probit pseudo  $R^2$  should be compared before and after the matching.

The probit pseudo  $R^2$  value indicates how well the regressors  $X$  explain the probability of a municipality initiating contracting out. After matching, there should be no systematic differences in the distribution of the regressors between the two groups, and therefore the pseudo  $R^2$  value should be fairly low for the matched sample. As reported in the table, we obtained small values for the pseudo  $R^2$  after matching. Sianesi (2004) also proposed that an  $F$  test should

be conducted on the joint significance of all the probit regressors before and after matching. The interpretation of this test is that the joint significance of the regressors should be rejected after matching but not before. We obtained this result for the different time periods considered.

Another indicator used to assess the distance in marginal distributions of the  $X$  variables is the median bias, as suggested by Rosenbaum and Rubin (1985). Median bias refers to the median absolute standardised bias before and after matching. The median is calculated over all regressors. Following Rosenbaum and Rubin (1985), for a given regressor the standardised difference before matching is the difference of the sample means between new contractors and non-contractors as a percentage of the square root of the average of the sample variances from the two sub-samples (new contractors and non-contractors, respectively). The standardised difference after matching is calculated analogously, using the corresponding values for the matched samples. A potential problem in this approach to interpreting the standardised bias is that there is no clear indicator of the success of the matching procedure. In our study, a substantial reduction was obtained in the standardised bias, which seems to be consistent with the results obtained in previous empirical studies.

a. *Quality of the matching*

	Before	After
<b>(a) Median bias in the probit regression</b>		
$t - 1/t$	21.010	2.218
$t / t + 1$	20.397	5.285
$t + 1/t + 2$	21.894	13.305
$t + 2/t + 3$	22.782	10.277
<b>(b) Probit pseudo R<sup>2</sup></b>		
$t - 1/t$	0.074	0.008
$t / t + 1$	0.066	0.025
$t + 1/t + 2$	0.073	0.043
$t + 2/t + 3$	0.068	0.057
<b>(c) <math>p &gt; \chi^2</math> (LR test of joint significance of coefficients in the probit regression)</b>		
$t - 1/t$	0.000	0.996
$t / t + 1$	0.000	0.870
$t + 1/t + 2$	0.000	0.413
$t + 2/t + 3$	0.002	0.878

(a) Median bias refers to the median absolute standardised bias before and after matching.

(b) Probit pseudo R<sup>2</sup> for contracting starters on covariates before matching and in matched samples (after matching).

(c)  $p > \chi^2$  is the p-value of the likelihood-ratio test after matching. This is a test of the hypothesis that the regressors are jointly insignificant, i.e., that they are well balanced in the two samples.





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