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Do Public Sector Reforms Get Rusty? Local Privatization in Spain

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ABSTRACT Recent evidence on the savings from private production of local public services has become increasingly ambiguous. Here we specify and estimate a model to explain municipal costs for solid waste collection. As we find no effect of the mode of production on costs, we put forward two hypotheses. First, progressive concentration and decreases in bidding competition may come to outweigh gains from privatization. Second, the threat of privatization may have stimulated public unit managers to search for alternative reforms. The results suggest that both inter-municipal cooperation and recent privatization are associated with lower costs, while old privatization is not.

KEY WORDS: Privatization, contracting-out, local government

JEL CODES: L33, R51, H72

1. Introduction

Recent empirical evidence on costs savings from the privatization¹ of local public services is increasingly ambiguous. When surveys like Savas (1987), Domberger and Rimmer (1994) and Domberger and Jensen (1997) appeared, there was some consensus that most robust empirical works on the

1. Transferring firms or services to the private sector and contracting out differ in many aspects. Nonetheless, Vickers and Yarrow (1991) consider the contracting out of services previously provided by the public sector as another type of privatization. Although it does not imply the sale of physical assets, it consists of the sale of a franchise contract. The contractor appropriates any financial surplus derived from the service, and the appropriation of this profit is central to the idea of property.

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issue found a positive relation between privatization and cost savings. However, more recent works (e.g. Boyne, 1998; Hodge, 2000; Sclar, 2000) emphasize that the evidence is mixed and cost savings vary from one service area to another.

Kodrzycki (1994) and Ballard and Warner (2000) have suggested that initial savings from privatization tend to disappear over time, and this seems to be particularly true for small municipalities. Perhaps, privatization, while potentially beneficial when first implemented, is a kind of reform that is not a permanent optimum. Indeed, in his analysis on economic reform processes, Hirschman (1971) has pointed out that there are no permanent optimal measures, and dynamic interaction between market and government continues after reform. Hence, Hirschman has suggested focusing on finding a good periodical policy-switching pattern, rather than on searching for a permanent optimal policy.

This paper studies the relation between costs of local public services and the mode of their production, either public or private. In order to assess this relation we specify a model and run multivariate regressions using a sample of Spanish municipalities. This case is interesting because of the *comarca*, the equivalent of county level service districts in Catalonia, allows smaller municipal governments to pool resources and achieve economies of scale for services like refuse collection. The study is conducted on refuse collection, because this service is, initially, among the most suitable for contracting out. In addition, it is relatively rich in the data needed for cost analysis.

Results of the empirical analysis indicate that the mode of production has no significant effects on costs of refuse collection paid by municipalities.² In order to explain these results, we analyze alternative management reforms and post-privatization market dynamics. The economic theories of organization have long identified the importance of a competitive market place. In fact, transaction cost theory centers around the risks of contracting for services in the absence of a competitive marketplace or where services are likely to become monopolized. The paper shows that, on one hand, a high degree of market concentration may weaken competition for contracts and make it difficult for governments to obtain actual benefits from contracting-out. On the other hand, a cost comparison between cases of inter-municipal cooperation and instances of isolated municipal production suggest that cooperation is an effective tool for realizing potential scale economies and

2. From the results of this kind of cross-section analysis, many authors conclude that privatization does (or does not) reduce costs depending on their empirical results. However, a cross-section analysis cannot tell us whether privatization reduces costs or not. The analysis of the particular effects of privatization should take into account the first year in which every single municipality contracted out, thus studying the change in the service costs from pre- to post-privatization. Owing to lack of data over time, multivariate analysis is not suitable for this type of study. Hence, what we find in our analysis has nothing to do with what happened when privatization took place. What our empirical evidence actually shows is that the mode of production does not appear to influence the differences in costs paid by municipalities for the refuse collection service.

reducing costs in low-population municipalities. Since inter-municipal cooperation is more frequent where production is public, we can conclude that inter-municipal cooperation can be used as an alternative to privatization when reforms are advanced.

The research strategy is as follows. After beginning with a summary of previous theoretical and empirical work on the effects of privatization on costs, we develop a model to estimate and explain solid waste collection costs. Within this context, we assess the effect of the mode of production on costs. Third, we analyze inter-municipal cooperation and post-privatization market dynamics to explain our results. Finally, we draw the main conclusions and implications for public policy.

2. Background

As mentioned, consensus on the positive relation between privatization and cost savings prevailed for a long time. Despite this, many governments have been reluctant to privatize, and continue to use public production. Why should they forego the potential cost savings from privatization?

Literature published in the eighties offered evidence of political considerations influencing the decision to privatize (Boyne 1998). Nonetheless, more recent research indicates that privatization has entered a more pragmatic and less ideological phase. In recent years, many political-economy studies have looked for an empirical accounting of the factors that induce or deter privatization: McGuire *et al.* (1987; 1990); Dubin and Navarro (1988); Lopez-de-Silanes *et al.* (1997); and Warner and Hebdon (2001) in the USA; Bel and Miralles (2003) in Spain; Dijkgraaf *et al.* (2003) in The Netherlands; Christoffersen and Paldam (2003) in Denmark, and Ohlsson (2003) in Sweden.

Empirical evidence offers little support to those who explain the decision not to privatize as a government failure. Although some studies find that the strength or weakness of trade unions and voter preferences are relevant to the privatization decision (e.g. McGuire *et al.*, 1987; 1990; and Lopez-de-Silanes *et al.*, 1997), a more general finding is that ideological biases have not played a large role in politicians' decision in this area. Thus, this decision appears to be pragmatic rather than ideological.

The theoretical analysis of privatization and contracting-out explains some of the decisions by using the wide concept of transaction costs, which include administration costs as well as incomplete contract costs. Sappington and Stiglitz (1987) theoretically analyze the choice between public and private production to understand the effect of transaction costs. They argue that the main factor in choosing the production mode is a function of the transaction costs level derived from authority delegation under asymmetric information. Paroush and Prager (1999) extend the theoretical analysis on the choice of production mode with transaction costs by allowing contractor deception.

As mentioned above, empirical studies on the decision to privatize since the nineties suggest that politicians are rather pragmatic. Hence, it may well

happen that many of them are reluctant to privatization simply because they do not foresee cost savings. Contracting out involves relevant transaction costs; Brown and Potoski (2003) offer evidence on monitoring frequency that governments take when risk of contract failure is high. Moreover, governments have available a menu of other management reform alternatives. Indeed, recent literature on public services reform (e.g. Warner and Hebdon, 2001) points out that analysis of privatization often fails to take into account policies other than privatization itself. These authors emphasize that privatization is just one of the tools politicians may employ in the face of a growing quality demand. No privatization is not the same as no reform. Several alternatives can contribute to improving efficiency in publicly produced services: increasing flexibility in public organization structure, inter-municipal cooperation, contracting back in, entrepreneurial behavior, and cessation of services. Increasingly, attention has been paid to the possibility of reforming public units that produce services given a competitive threat from the private sector.

Empirical studies on privatization usually show that, from an efficiency point of view, effective competition *in* the field is more important than a firm's ownership structure (e.g. Vickers and Yarrow, 1998; Hodge, 2000). Positive effects from ownership change are heavily dependent on a good competition framework. This paper focuses on a kind of service that is monopolistic, so competition *for* the field is a central issue. In this context, the existence of competition failures in bidding for contracts may be a serious obstacle to both technical efficiency improvements (Antonioli and Filippini 2002), as reflected in firms' costs and allocative efficiency, reflected in costs borne by municipalities. On this issue, Gomez-Lobo and Szymanski (2001) find that the number of firms bidding for refuse collection contract relates negatively to service costs.

Contracting out is a dynamic process that typically converges from a competitive market structure toward monopoly (Sclar, 2000). Although bidding processes may have been competitive enough, the market becomes a bilateral monopoly just after a contract is awarded. The contracted firm has incentives to try to keep control over the contract by means of anti-competitive behavior against public and private firms. Foreseeing these threats, firms are likely to try to secure contacts with politicians and even arrive at collusive agreements. Vickers and Yarrow (1991) point out the possibility of collusive behavior and progressive market concentration. In a recent theoretical development, Miralles (2004a) shows that when there is the expectation of successive bids for a contract, a variety of bidders are more likely to participate in the first auction and to bid more aggressively in the first auction, in anticipation of future earnings. To sum up, competition may become more important than ownership.

3. Solid Waste Collection

Many empirical studies have analyzed the relation between privatization and costs in the service area of solid waste collection. Table 1 summarizes a wide

Table 1. Empirical evidence on solid waste collection privatization and costs

Study	Country	Evidence
Kemper & Quigley, 1976	USA	Private individual collection is 30% more expensive than local monopoly. Within local monopoly, contracting out is 20% cheaper than in-house production.
Kitchen, 1976	Canada	In-house production is more expensive than contracting out.
Collins & Downes, 1977	USA	No significant difference between public and private production.
Pommerehne & Frey, 1977	Switzerland	Private production is cheaper than public production.
Stevens, 1978	USA	Comparison between public and private production does not generally yield significant differences. In large cities private production is cheaper.
McDavid, 1985	Canada	Cost reduction when private sector obtains the contract is larger than public-private mix.
Domberger, Meadowcroft & Thompson, 1986	UK	Contracting out reduces costs by 20%, with no change in services quality.
Tickner & McDavid, 1986	Canada	Contracting out reduces costs.
Berenyi & Stevens, 1988	USA	Contracting out reduces costs between 0 and 48%.
Dubin & Navarro, 1988	USA	Monopoly, public or private, is cheaper than market. Private monopoly is the cost minimizing option.
Buck & Chaundy, 1992	UK	Contracting out reduces costs by 33%.
Szymansky & Wilkins, 1993	UK	Contracting out reduces costs.
Szymanski, 1996	UK	Contracting out reduces costs. Cost reduction by 20% with private firms and by 10% when contracts awarded to in-house teams.
Reeves & Barrow, 2000	Ireland	Cost reduction with private firms.
Callan & Thomas, 2001	USA	No significant difference between public and private production
Dijkgraaf & Gradus, 2003	Netherlands	Contracting out reduces costs, but there is no significant difference between public and private production.
Ohlsson, 2003	Sweden	Public production is 6 percent cheaper than private production.

Source: Authors. Information on Buck and Chaundy (1992) has been obtained from Hodge (2000).

sample of econometric regression results.³ It is quite clear that up to the late nineties, evidence overwhelmingly supported a positive relation between contracting-out and private production, and service cost reduction. Only Collins and Downes (1977), and in some sense Stevens (1978) and Dubin and Navarro (1988), cast doubt on this almost-unanimous conclusion.

Nevertheless, the most recent papers (in bold type, Table 1) find much more diverse results: (1) cost improvements with private production in Ireland (Reeves and Barrow, 2000); (2) non-significant differences between public and private production in Massachusetts (Callan and Thomas, 2001) and the Netherlands (Dijkgraaf and Gradus, 2003); (3), and public production proving cheaper in Sweden (Ohlsson, 2003). It is worth noticing that national and local contexts may affect results. Studies in Table 1 published prior to 2000 dealt with privatization in Canada, Switzerland, the UK and the USA. Those that have appeared since 2000 deal with Ireland, the Netherlands, Sweden and the USA. In these countries, legislative frameworks and public/private dealings vary significantly from those in Canada, Switzerland and the UK. Although the USA appears in both categories, all the cited studies prior to 2000 that cast doubt about the benefits of contracting-out waste collection deal with the USA.

This has brought ambiguity to the comparison between private and public production costs and induces discussion of the possibility that reduced competition for concessions and reforms in public service production may have led differences in costs to municipalities to vanish.

4. Empirical Study: the Model and Data

(a) *The Model*

The basic function for solid waste collection costs for the municipality can be represented as:

$$C = f(Q, P, X, Z) \quad (1)$$

C is the costs of the service for the municipality. They are mainly determined by the output Q , input prices P , some other characteristics X of the output and non-controllable characteristics Z already affecting the service. Explanatory variables considered here are Q = Output generated by the municipality; PR = Percentage of recycling on total waste; W = Labor costs;

3. There exist other assessments using DEA techniques. In the UK, Cubbin *et al.* (1987) conclude that physical productivity growth explain most of cost reduction both in private production and in public production retained by means of a tendering process. Bosch *et al.* (2000) do not find any significant productivity difference between public and private production, using DEA with a 75 -Spanish-municipality sample. Finally, other studies just compare costs directly, not taking into account control variables (e.g. Savas, 1977a; 1977b; 1981; Berenyi, 1981; Fitzgerald and Lyons, 1986; and McDavid, 2000; 2001).

F = Frequency of service; D = Population density; T = Tourism intensity; L = Existence of landfill in the municipality; PROD = Mode of production (public/private).

The analysis is based on the most relevant previous works: Hirsch (1965), Kitchen (1976), Stevens (1978), Domberger *et al.* (1986), Dubin and Navarro (1988), Callan and Thomas (2001), Dijkgraaf and Gradus (2003) and Ohlsson (2003). Besides cost function determination and specific assessments of scale economies, this study considers general waste and recycling separately, a task only carried out to this date in Callan and Thomas (2001) and Dijkgraaf and Gradus (2003). Moreover, unlike all the cited papers, particular attention is paid to the ‘seasonality’ implied by tourism activity, a particularly relevant geographical context of this study. Finally, a multivariate analysis is done in order to assess the extent (if any) to which mode of production affects costs.

The Dependent Variable

The dependent variable is the cost of refuse collection paid by the municipality. This includes collection, transportation, and disposal and elimination. Total cost of the service, *TC*, is specified as the dependent variable, as in most works in the literature (Stevens, 1978; Domberger *et al.*, 1986; Callan and Thomas, 2001; and Dijkgraaf and Gradus, 2003).

Explanatory variables

1. *Output (Q)* The first explanatory variable is the quantity of waste generated in the municipality, expressed in kilos. Results in the literature mostly indicate low-populated municipalities saw scale economies that were either slight (Stevens, 1978; Dubin and Navarro, 1988) or non-existent (Hirsch, 1965; Callan and Thomas, 2001), and hardly any work reported scale economies for highly populated municipalities. Since previous results on scale economies are mixed, there is not a precise hypothesis drawn from the results.

2. *Percentage of recycling (PR)* Data allows for distinguishing between waste for elimination and recycled waste. This enables us to analyze the impact of the latter on total costs. We expect that costs increase with the percentage of recycling (*PR*), according to existing evidence (McDavid, 2000; 2001).

3. *Wage level (WL)* Wage variability among territories may have an influence on costs paid by the municipalities. Non-aggregated information on wages in this service is not available, but it is very likely that workers in a given province (Catalonia has four provinces: Barcelona, Girona, Lleida and Tarragona) live in that province, and it is plausible to think that sector-specific territorial wage differences are quite similar to general territorial

wage differences. In his analysis on local public services in the United States, Ladd (1992) uses the state wage level as an explanatory variable. For the Spanish case, Alcaide and Alcaide (2003) offer estimates of labor costs at the province level. We use these estimates to specify the variable wage level (*WL*). This variable takes the average provincial value for each municipality within a province. As in Stevens (1978) and Domberger *et al.* (1986), we expect that labor costs and service costs are directly related. Therefore, the variable will have a significant and positive effect on costs.

4. *Frequency (FREQ)* Number of days per week refuse is collected from each location. Quality of the service can vary between municipalities and this could be an important source of variation of costs. Even if quality is hard to appraise in a multivariate cross-section analysis, variables such as the frequency of the service and the percentage of recycling (see above) are closely related to the overall quality of the service. We expect a significant positive effect on costs following previous results (Stevens, 1978; Domberger *et al.*, 1986; Dubin and Navarro, 1988; Callan and Thomas, 2001).

5. *Population density (DENS)* We take population density, measured in inhabitants per square kilometer, as a municipality density indicator. This variable has also been used in demand studies for this service (i.e. Kinnaman and Fullerton, 2000). The expected effect of this variable is ambiguous. On the one hand, a higher population density offers the opportunity to collect more solid waste per dustbin. On the other hand, waste collection is mainly a transportation activity. Transportation time is quite sensitive to congestion and traffic-light regulation, usually common in densely populated areas. Bodkin and Conklin (1971) did already suggest this duality in the effects of density on local services costs, and Kitchen's (1976) empirical work considered it. However, subsequent literature has obviated this issue. We consider this, so we have no strong prediction of what the density effect on costs will be. This is consistent with the ambiguity evident in the empirical literature: no density economies (Stevens, 1978); diseconomies of density (Kitchen, 1976); economies of density (Domberger *et al.*, 1986); mixed results (Dubin and Navarro, 1988; Callan and Thomas, 2001).

6. *Tourism (TO)* There are no preceding examples of the use of this variable. However, the importance of this activity in the geographical context of this empirical analysis makes its inclusion advisable. Tourism activity in Catalonia (Spain) has a pronounced seasonal component in both summer and winter. Generated solid waste data reflects this tourism effect but fails to reflect the instability of the production structure that follows from tourism's seasonality. Peak seasons require additional efforts, i.e. changes in frequency, using more inputs, etc. Thus, the effect of tourism intensity on costs may be positive and significant. We take as a measure the 'tourism index' for the year 2000, published by La Caixa (the main savings bank in Spain).

7. *Landfill in the municipality (LAND)* Transportation costs between the municipality where collection takes place and the disposal place, represents an important part of the service's costs. As in Callan and Thomas (2001), we consider a dummy variable showing the existence of a landfill in the municipality. It takes value 1 if the landfill is in the municipality and 0 otherwise. We expect the effect of this variable on costs to be negative.

8. *Mode of production (PROD)* In order to assess the influence of the different ways of producing the service on its costs we use the variable *PROD* as a dummy that takes value 1 if a private firm produces the service and 0 if a public unit or firm does so. The expected effect is ambiguous. As was pointed out, some multivariate studies find a negative relation between private production and costs, while others do not find conclusive evidence at all.

(b) Data and Sources

All data employed in the empirical analysis refers to the year 2000. Information on solid waste generated by each municipality was obtained from the Catalan Government web page (<http://www.gencat.es>), which contains data on quantities of waste disposed of and recycled. Data for existing landfills and their locations come from the same source. Information on municipal population and area is from the Spanish National Statistic Institute web page (<http://www.ine.es>) and the Catalonia Statistic Institute (<http://www.idescat.es>). We have used Alcaide and Alcaide (2003) estimates for labor costs. The savings bank La Caixa has published tourism indicator data for the year 2000 in the *Economic Yearbook 2002* (<http://www.lacaixa.es>).

Data concerning municipal costs, weekly collection frequency, and mode of production (public/private) has been obtained from the *Survey on local service production*, designed by University of Barcelona researchers, supervised by the School of Catalanian Public Administration (Government of Catalonia), and completed by municipalities. The enquiry had two phases. In the first stage, between May and October 2000, data was obtained about mode of production, frequency, and inter-municipal cooperation, along with other minor issues. In the second stage, developed between February and October 2002, additional queries were sent to municipalities with populations over 1000 that had replied to a previous survey. At this stage, the survey asked for data on settled waste collection costs in 2000. Meanwhile, a complete survey asking for all the information was sent to those municipalities that had not completed the first survey. By the close of the survey, 186 municipalities had sent answers with enough reliable information to be included in the study.

The sample contains 44% of those municipalities in Catalonia with a population over 1000, and 80% of municipalities with a population over 20 000. It also includes half of the medium size municipalities, which have a

population between 5000 and 20 000 inhabitants. Finally, the sample has 35% of Catalonian municipalities that have a population between 1000 and 5000 inhabitants, a percentage that is quite high for this type of municipality. The actual population covered by the sample is higher than the ‘number of municipalities’ level. Since the response frequency increases with municipality population, the population included in the sample represents almost 79% of all inhabitants of Catalonia.⁴ In addition, the 186 municipalities included in the sample produce 2.49 million waste tones in total, almost 75% of the total refuse generated in Catalonia in 2000. Recycling in the sample municipalities’ amounts to 12.6% of their total waste. For the whole of Catalonia, this percentage is 12.5. Table 2 presents a brief depiction of most relevant variables.

(c) *The Estimated Equation*

From the cost function [1] a model for total refuse collection costs paid for by the municipality is specified as follows:

$$TC_i = \beta_0 Q_i^{\beta_1} PR_i^{\beta_2} DENS_i^{\beta_3} FREQ_i^{\beta_4} WL_i^{\beta_5} e^{(\beta_6 TO_i + \beta_7 LAND_i + \beta_8 PROD_i + ui)} \tag{2}$$

All the variables are defined above. As in Stevens (1978) and Domberger *et al.* (1986), we have estimated the double logarithmic form of the following equation:

Table 2. Basic statistics [average (and standard deviation)] for relevant variables

Inhabitants	Municipalities (Euros)	Cost (kilos)	Refuse of recycling	Percent (times per week)	Density	Frequency	Tourism
Whole sample	186	955 665 (4 544 265)	13 402 459 (56 945 641)	11.17 (7.67)	1170.22 (2791.61)	6.05 (1.20)	64.65 (439.58)
1000 to 19999	147	221 582 (281 863)	3 503 225 (3 712 996)	10.79 (8.35)	305.25 (396.74)	5.88 (1.27)	20.93 (91.42)
≥ 20000	39	3 722 593 (9 501 965)	50 714 959 (118 010 421)	12.59 (4.01)	4430.47 (4850.97)	6.69 (0.47)	229.41 (934.53)

Source: Authors.

4. Potential non-response bias is a usual concern in this kind of survey. It could be the case that the municipalities with more successful reforms are more prone to reply surveys on reforms. Due to this concern, Szymanski and Wilkins (1993) test the existence of this kind of bias, and they cannot reject their corrected model. Throughout the development of our survey, we have not had any indication of systematic differences between municipalities affecting their reply to the survey, with the unique exception of population size. Thus, we do not expect to have a relevant non-response bias.

$$\begin{aligned} \log TC_i = & \beta_0 + \beta_1 \log Q_i + \beta_2 \log PR_i + \beta_3 \log DENS_i + \beta_4 \log FREQ_i \\ & + \beta_5 \log WL_i + \beta_6 TO_i + \beta_7 LAND_i + \beta_8 PROD_i + u_i \end{aligned} \quad (3)$$

Finally, and from previous experience evident in the literature, we think that there may be some concern with questions related to municipality size. In cases where scale economies have been recognized (Stevens, 1978; Dubin and Navarro, 1988), the eventual disappearance of the effect has been observed at some critical municipality size. Additionally, Stevens (1978) and Dubin and Navarro (1988) opened a debate on the structural stability of the cost equation or on the eventual changes as they relate to population size. In order to study these issues, the sample has been split into three subgroups (municipalities up to 10 000 inhabitants, municipalities up to 20 000 inhabitants and municipalities with more than 20 000), and separate equations for each of them have been estimated. We have done Chow's test for structural change from the obtained results.

5. Empirical Results

The results have been obtained from the estimation of the equations by using Intercooler Stata 6.0 statistical software. Robust White error estimation has been calculated to account for a possible problem of heteroscedasticity, to the extent that there are systematic differences in the scale of the variables considered for each municipality. Table 3 shows obtained results for the aggregate sample as well as for the different subgroups.

Column 1 in Table 3 presents results for the aggregate sample. These indicate that the explanatory power of the model is quite high, above 95%. This result is common in studies taking the total cost as the endogenous variable, as Stevens (1978), Domberger *et al.* (1988), and Dijkgraaf and Gradus (2003). The F-test indicates that all variables are jointly significant at the 1% level.

Quantity of waste has a very significant relation to costs, over a 99% confidence level, and its coefficient is slightly below 1. Nonetheless, rejecting the hypothesis of *no* scale economies, i.e. $\beta_1 \geq 1$, is not possible (a more detailed analysis is shown in Table 4 below). The percentage of recycling and the frequency of service increase service cost and show a significant relation with the total cost, above the 99% confidence level. Wage level has a significant and positive relation with costs, above the 95% confidence level. Tourism also has a positive relation to costs, above the 90% confidence level. Having a landfill within the municipality has cost-reducing effects and is significant, above the 99% confidence level. Finally, population density does not show a significant relation to costs. Neither does the mode of production (private/public).

Table 3 also shows results obtained from the estimation of the equations for different population size subgroups: up to 10 000 inhabitants (column 2) and up to 20 000 inhabitants (column 3). In both cases, the explanatory

Table 3. Empirical results from the estimation of total cost equation

Variable	Column 1	Column 2 (population <10000)	Column 3 (population <20000)	Column 4 (population >20000)
	Coefficient	Coefficient	Coefficient	Coefficient
Constant	-21.398** (-2.931)	-29.604*** (-3.770)	-22.960*** (-3.058)	5.089 (0.819)
Log quantity	0.995*** (37.829)	0.900*** (21.450)	0.940*** (24.309)	0.942*** (21.167)
Log percent of recycled	0.110*** (3.899)	0.126*** (3.482)	0.109*** (3.876)	0.134*** (2.730)
Log density	0.125 (0.614)	0.029 (1.146)	0.009 (0.364)	-0.021 (-0.885)
Log frequency	0.365*** (4.229)	0.356*** (3.958)	0.391*** (4.241)	1.619*** (4.835)
Log wage level	1.759** (2.407)	2.693*** (3.414)	1.988*** (2.633)	-0.999* (-1.727)
Tourism	0.00005* (1.659)	0.003*** (6.885)	0.0006 (1.554)	0.00004** (2.240)
Landfill	-0.405*** (-3.171)	-0.802*** (-4.725)	-0.609*** (-3.855)	-0.211*** (-4.819)
Production	-0.025 (-0.499)	0.041 (0.694)	-0.004 (-0.951)	0.094 (1.159)
R ²	0.972	0.928	0.942	0.981
Adjust R ²	0.971	0.923	0.940	0.976
F-test	1041.74***	208.99***	264.81***	6144.43***
N	186	121	147	39

In parentheses z-statistic with White estimation.

Significantly different from zero at the 99% (***), 95% (**), and 90% (*) confidence level.

power is high and the whole equation is significant at the 1 percent level. Results are quite similar to one another and to the aggregate-sample estimation. Quantity of solid waste, percentage of recycling, frequency of service, and wage level increase service cost and are significant at the 99% confidence level. Tourism also increases cost, at the 99% confidence level in the up-to-10 000-inhabitant subgroup, while the confidence level is lower in the up-to-20 000 subgroup. Landfill in the municipality reduces costs significantly, at the 99% confidence level. Furthermore, population density and mode of production do not show significant relation with the cost in any subgroup.

Finally, column 4 in Table 3 shows estimation results for highly populated municipalities (more than 20 000 inhabitants). The table reveals differences in one variable compared to the other estimations: The wage level has a negative effect in this sub-sample, although the confidence level is relatively low. This may be because there is low variability in the sub-sample, since 31 out

Table 4. Scale economies analysis

Equation	N	Coefficient	z-statistic
All municipalities	186	0.995	-0.185
Municipalities over 20 000 inhabitants	39	0.942	-1.203
Municipalities below 20 000 inhabitants	147	0.940*	-1.552
Municipalities below 10 000 inhabitants	121	0.900***	-2.371

z-statistic from the robust estimation. Confidence levels for rejecting the hypothesis ($H_0: \beta_1 \geq 1$) are: 99% (***) , 95% (**) and 90% (*).

of the 39 municipalities of population above 20 000 inhabitants belong to the province of Barcelona. In addition, it may be plausible that inter-provincial variation among cities is very low at this population level.

If average costs (unit cost per tone) are taken alternatively as the explained variable, the explanatory power becomes more moderate. R-squared are 0.335 (aggregate sample), 0.480 (municipalities up to 10 000 inhabitants), 0.377 (up to 20 000 inhabitants) and 0.544 (over 20 000 inhabitants). This result is similar to that of Dubin and Navarro (1988) and higher than the one in Ohlsson (2003). In all cases, model adjustment is quite high, following the respective F-tests, and, logically, the coefficients and the statistic signification of the variables except for the quantity of generated waste are identical to the ones shown in Table 3.

Results obtained from the equation estimation reveal significant differences between highly populated municipalities and low populated ones. This suggests the existence of two equations. Chow's proof can be used to assess this possibility. After proper calculation, the obtained F is 3.10. According to this result, we can reject the null hypothesis of no structural change at the 1% level, and the alternative hypothesis is assumed true: the equations are different for high population and low population municipalities. Hence, it is advisable to analyze solid waste collection costs taking into account different municipality population levels, as has been done in this paper.

Analysis of Scale Economies Existence

Table 4 presents results for the absence of scale economies ($H_0: \beta_1 \geq 1$) test. The analysis of a hypothesis of this kind calls for a one-tail test (Greene, 2000), as the alternative hypothesis is $H_1: \beta_1 < 1$, corresponding to scale economies. We do not find evidence of scale economies for either the aggregate sample or the high-population subgroup estimations, and the null hypothesis cannot be rejected. However, the estimations for low population municipalities present several differences. First, the coefficients on the quantity of waste are lower than in the other estimations. Second, it is possible to reject the null hypothesis of non-existence of economies of scale at the 99% confidence level (up to 10 000 inhabitants) and the 90% level (up to 20 000 inhabitants).

The results concerning scale economies agree with the results from Dubin and Navarro (1988) Callan and Thomas (2001); and Dijkgraaf and Gradus (2003) in the sense that no economies of scale are found in the aggregate sample. They are also in line with the results from Stevens (1978) and Dubin and Navarro (1988) in finding scale economies in less-populated municipalities, economies that become weaker as population increases, essentially disappearing as population passes 20 000 inhabitants. Moreover, they agree with Stevens (1978) in the sense that, inside the relevant scale economies existence rank, its intensity decreases with respect to municipality size. It is observed in Table 4 that the β_1 coefficient gets closer to one when higher populated municipalities are included in the estimation.

In less populated municipalities, scale economies are still very small, as in Dubin and Navarro (1988). They are lower and less significant than those obtained in Stevens (1978). The explanation may be that the potential for alternative reforms exploiting scale economies has increased in our context and moment. We have already pointed out that inter-municipal cooperation is frequent, particularly in small municipalities that have preserved public production. These reforms may have had a substantial effect on the exploitation of scale economies. This would explain why economies of scales, although real, are moderate and only slightly significant.

6. Alternative Reforms, Privatization and Competition: an Extension of the Basic Model

Results obtained in our analysis show that the mode of production (public/private) does not have any effect on observed differences in costs paid by the municipalities. This would have been a quite singular result had it been found among the empirical papers published between the mid seventies and the late nineties. However, this result appears more and more frequently among the most recent empirical works. It is possible that privatization decision had cost-reduction effects just after implementation, but some dynamic factors may be reducing these effects in the long term.

(a) Inter-municipal Cooperation as an Alternative Form of Reform

Many municipalities are of a size smaller than optimal for service production, and contracting-out is a way to exploit scale economies (Donahue, 1989). Contracting out allows a private firm to produce the service over several municipalities in the same zone, taking advantage of any scale economies. However, aggregating the service through inter-municipal cooperation also allows for exploiting scale economies, with either private production or public.

Inter-municipal cooperation in refuse collection is present all over Catalonia. Its most usual district delimitation is the '*comarca*' (roughly Spanish for county). In other cases, some municipalities create 'communities' in order to aggregate the service in an optimal extension other than the county. Municipalities that cooperate have three options: (a) strictly public production; (b) a public-private partnership through a mixed-firm; or (c)

contracting-out of the service on an aggregated basis. Inter-municipal cooperation frequency varies depending on municipality size, following the pattern of rural-urban differences already identified in Warner and Hefetz (2003): frequency of inter-municipal cooperation is a lot higher in low-populated municipalities than in highly populated ones.

From the information available on service cost for each municipality, we can compare average costs (Euros per kilo) among municipalities depending on whether inter-municipal cooperation is used or not. Table 5 presents cost comparisons. In the whole sample, average costs in cooperating municipalities are 19.5% lower than average costs in municipalities that do not cooperate. This cost difference is significant at the 1 percent level.

When dealing with municipalities of a population over 20 000 there are no significant average cost differences related to cooperation. This has to do with the decline of scale economies in this type of municipality. Nevertheless, inter-municipal cooperation in less populated municipalities does have a significant relation with lower average costs. In the whole set of municipalities below 20 000 inhabitants, the average cost when co-operating is 19.6% lower than where inter-municipal cooperation does not exist, and this difference is significant at the 1 percent signification level. In the set of municipalities with a population under 10 000, average costs in cooperating municipalities are 21.9% lower, and the difference is statistically different from zero, at the 1% level.

Based on the above analysis, cooperation can be defined as a new variable in the model specified in (2). We can define the variable *InterCoop* as a dummy variable that takes value 1 if the municipality is significantly involved in inter-municipal cooperation and 0 otherwise. We expect the effect of this variable to be significantly negative for the municipalities of low population, and non-significant for the highly populated municipalities. Now we specify

Table 5. Average costs according to existence or absence of inter-municipal cooperation

Population	Inter-municipal cooperation		Municipality		<i>t</i> -student
	Average cost (Euro/ton)	Cases	Average cost (Euro/ton)	Cases	
All municipalities	54.13 (15.33)	73	67.21 (19.51)	113	-5.096***
Population ≥ 20 000	73.42 (13.75)	4	70.00 (13.26)	35	0.473
Population < 20 000	53.01 (14.74)	69	65.96 (21.79)	78	-4.261***
Population < 10 000	53.19 (14.97)	66	68.09 (23.75)	55	-4.033***

Standard deviation in parentheses.

t-student significant at 1% level (***); significant at 5% level (**)

the model for total refuse collection costs paid for by the municipality as follows:

$$TC_i = \beta_0 Q_i^{\beta_1} PR_i^{\beta_2} DENS_i^{\beta_3} FREQ_i^{\beta_4} WL_i^{\beta_5} e^{(\beta_6 TO_i + \beta_7 LAND_i + \beta_8 PROD_i + \beta_9 INTERCOOP_i + ui)} \quad (4)$$

Table 6 presents the results obtained from the estimation of the new model. The results do not significantly alter the results already obtained (see Table 3). To avoid redundancies we will discuss only the new information obtained by introducing the new variable. We find the coefficient for inter-municipal cooperation (*InterCoop*) to be negatively related to costs

Table 6. Empirical results from the estimation of total cost equation including the inter-municipal cooperation variable

Variable	Column 1 Coefficient	Column 2 (population <10000) Coefficient	Column 3 (population <20000) Coefficient	Column 4 (population >20000) Coefficient
Constant	-15.388** (-2.193)	-22.485*** (-2.963)	-15.997** (-2.192)	-5.598 (-0.933)
Log quantity	0.974*** (38.574)	0.876*** (22.419)	0.908*** (24.843)	0.935*** (20.177)
Log percent of recycled	0.119*** (4.526)	0.135*** (4.333)	0.118*** (4.761)	0.149*** (2.778)
Log density	0.006 (0.295)	0.018 (0.790)	-0.004 (-0.165)	-0.025 (-1.030)
Log frequency	0.323*** (3.698)	0.314*** (3.333)	0.350*** (3.666)	1.667*** (4.945)
Log wage level	1.214* (1.737)	2.050*** (2.719)	1.371* (1.882)	-1.048* (-1.895)
Tourism	0.00006** (2.155)	0.003*** (6.103)	0.0006* (1.703)	0.00005** (2.277)
Landfill	-0.409*** (-3.224)	-0.821*** (-5.783)	-0.591*** (-3.586)	-0.225*** (-4.649)
Production	-0.071 (-1.482)	-0.037 (-0.652)	-0.066 (-1.239)	0.102 (1.235)
InterCoop	-0.185*** (-3.856)	-0.236*** (-4.620)	-0.226*** (-4.475)	-0.075 (-1.107)
R ²	0.974	0.939	0.949	0.982
Adjust R ²	0.973	0.934	0.945	0.976
F-Test	1068.76***	207.63***	268.49***	5073.14***
N	186	121	147	39

In parentheses z-statistic with White estimation.

Significantly different from zero at the 99% (***), 95% (**), and 90% (*) confidence level.

and highly significant, above the 99% confidence level, for the aggregated sample.

When estimating the equation for the municipalities with low population (up to 10 000, column 2; up to 20 000, column 3) we find again that the coefficient for *InterCoop* is negative and highly significant, above the 99% confidence level. However, when estimating the model for the sub-sample of municipalities of population above 20 000 we find a negative sign for *InterCoop*, as expected, but the coefficient does not significantly differ from 0.

To conclude, inter-municipal cooperation appears to be an effective formula for addressing scale economies and reducing costs in municipalities with population below 20 000. This kind of service aggregation is generalized (87%) among municipalities of below 20 000 inhabitants that have kept public production. Its frequency in municipalities below 20 000 inhabitants that have contracted out services is only 37%. One can conclude that inter-municipal cooperation is often used as an alternative to privatization when seeking cost-reductions.⁵

(b) Contracting Out, Collusion and Competition Conditions

The *Survey* used in this research does not provide information on the number of firms bidding for every single contract. Nonetheless, it includes information on the identity of the firms holding contracts in those municipalities that have contracted out the service. In all these cases contracts were awarded to private firms, as public firms do not participate in bidding processes in the context of our study. Hence, we can assess the distribution of firms in the 152 municipalities in which production is private. Since the city of Barcelona was split into four refuse collection districts before the last bidding process, the total number of concessions is 155.

A first look at the data on concessions structure (available upon request) shows a high degree of concentration on both a number-of-concessions criterion as well as a quantity-of-collected-waste criterion. One firm, FCC, holds almost 30% of concessions and collects almost 50% of the solid waste in the contracting-out municipalities. CESP, the second firm in this sector, has 12% of concessions and 16% of collected refuse. At the other extreme, one quarter of the concessions are allocated to single-contract-holder firms, and 13% to two-contract-holding firms. This suggests a highly concentrated sector, with the major contracts in the hands of the leading firms at one extreme, and a high degree of small firms and contracts at the other. This

5. It must be noted that inter-municipal cooperation does not preclude privatization; both are sometimes used simultaneously. This is the case of 43 municipalities in the sample with fewer than 20 000 inhabitants, which have the service both supra-municipally aggregated and contracted out. This combination is also observed in four municipalities with population over 20 000. Warner and Hebdon (2001) examined the mix of restructuring services and found that a mix of strategies is usually used to reform. Bel and Miralles (2003) and Miralles (2004b) do not find a univocal relation between inter-municipal cooperation and privatization.

impression is confirmed by a concentration analysis performed with concentration indicators widely used in economic research:

Concentration rate is defined as the cumulative market share of the first k firms:

$CR_k = \sum_{i=1}^k X_i / X = \sum_{i=1}^k Q_i$, where X_i is the i^{th} -firm's size, X is the total market size, and Q_i is the i^{th} -firm's market share. This rate can be calculated either for the leading firm (CR_1), or it can be taken as a 'marginal concentration rate,' combining a given number of firms. In the latter case, the most usual indicator used in the literature is the one that includes the first four firms (CR_4).

Hirschman-Herfindahl Index (HH). It is defined as the sum of squared market shares: $HH = \sum_{i=1}^n Q_i^2$, where Q_i is defined as above and n is the total number of firms in the field. Its advantage over simple concentration rates consists in its ability to take into account both the number of firms and the differences among them, as big firms are weighted high and small firms weighted low. Thus, the Hirschman-Herfindahl index has become the standard concentration measure for antitrust enforcement purposes (Yoo, 2002).

Table 7 presents results calculated for (a) the number of concessions and (b) the quantity of waste collected. CR_1 and CR_4 rates show a very high degree of concentration. As mentioned above, the market shares of the leading firm are almost 30% (concessions) and 50% (waste collected). Aggregating the first four firms' market shares gives 50% concessions and 75% of collected refuse. Following the four main types of market structure often used when analyzing the CR_4 index, concentration reaches level one (very high, above 60%) with respect to the quantity of waste, and level two (high, between 40 and 60%) with respect to the number of concessions.

The Hirschman-Herfindahl Index is greater than 0.10 for concessions and is clearly above 0.20 for quantity of collected waste. Within the four types of market structure characterized in Besanko *et al.* (2000), the market structure of refuse collection in our sample is one of monopolistic competition (competition depends on product differentiation) for concessions and an oligopoly with respect to the quantity of waste (competition depends on firms' rivalry). Taking into account the limits in product differentiation in this sector, one can conclude from the observed structure that competition intensity is low and crucially depends on rivalry between firms.

Table 7. Concentration indices in solid waste sector

Variable	RC1	RC4	HH
Concessions (155)	0.2968	0.5097	0.1120
Waste collected	0.4686	0.7563	0.2583

Source: Authors

As mentioned in the theoretical framework section, contracting out is a dynamic process that typically converges from a competitive market to monopolistic structure (Sclar, 2000). No matter how competitive the bidding processes, a market becomes a bilateral monopoly just after a contract is awarded. Moreover, there is wide room for the possibility of collusive behavior and progressive market concentration (Vickers and Yarrow, 1991).

Following the hypothesis above, we should expect that the older the first process of contracting out, the higher the probability that competition for the contract has decreased. Contrariwise, the more recent the first experience of contracting out in a municipality, the higher the degree of competition and, because of this, the better the negative effect on costs paid for the service.

To check this hypothesis, we can define two new variables to extend the model specified in (4). We can define the variables (a) *OldPriv* as a dummy variable that takes value one if the municipality had its first privatization experience before 1990 and zero otherwise, and (b) *NewPriv* as a dummy variable that takes value one if the municipality had her first privatization experience in 1990 or after, and zero otherwise. Logically, we must take the variable *Prod* out of the model. When comparing the new variables with public production, we do not expect a negative relation between *OldPriv* and costs, but we do expect such a relation between *NewPriv* and costs. In addition, we expect a negative relation between *NewPriv* and costs when compared with *Oldpriv*. Now we specify the model for total refuse collection costs paid for by the municipality as follows:

$$TC_i = \beta_0 Q_i^{\beta_1} PR_i^{\beta_2} DENS_i^{\beta_3} FREQ_i^{\beta_4} WL_i^{\beta_5} e^{(\beta_6 TO_i + \beta_7 LAND_i + \beta_8 OLDPRIV_i + \beta_9 NEWPRIV_i + \beta_{10} INTERCOOP_i + ui)} \quad (5)$$

Table 8 presents the results obtained from the estimation of the new model. The sample has been reduced to 125 municipalities, since we do not have any information on the first contracting for 61 municipalities with private production. Owing to the reduction of the sample size here, we do not break down the results by size of municipality.

The results are quite similar to those obtained above (Table 6). Concerning the new variables, we find that costs in municipalities with private production and recent reform (*NewPriv*: first contract in 1990 or later) are lower than costs in municipalities with public production (negative sign). This difference is significant at the 5% level. On the other side, costs in municipalities with private production and old reform (*OldPriv*: first contract before 1990) are higher than costs with public production (positive sign). However, in this case the difference is not statistically significant. Finally, when comparing old with new privatization (last row in Table 8), we find that costs with old privatization are higher than costs with new privatization, and this difference is significant at the 5% level.

Learning from experience in contract design cannot be a source of difference between the municipalities with old and new privatization. In our

Table 8. Empirical results from the estimation considering the time of first privatization

Variable	Coefficient	z-statistic with White estimation
Constant	-18.405**	(-2.302)
Log quantity	0.981***	(30.695)
Log percent of recycled	0.132***	(3.378)
Log density	-0.012	(-0.517)
Log frequency	0.385***	(3.503)
Log wage level	1.490*	(1.880)
Tourism	0.00005**	(2.257)
Landfill	-0.234***	(-3.197)
PrivOld	0.007	(0.099)
PrivNew	-0.133**	(-2.417)
InterCoop	-0.141**	(-2.191)
R ²	0.980	
Adjust R ²	0.979	
F-Test	1324.91***	
N	125	
Coef PrivOld-Coef PrivNew	0.140**	(2.164)

Significantly different from zero at 99% (***), 95% (**), and 90% (*) confidence level

sample, the average length of contract is 6.67 years, and less than 2% of contracts have a length over 10 years. This means that all municipalities with old privatization have recently run new competitions for the contract, so that they could eventually take advantage of recent knowledge about contract design.

Our results clearly show the weakness of competition in the sector, and they suggest that competition failures can be particularly important in the municipalities where the first contract was made long ago. Such failures help to explain why contracting out has no significant effects on the payments borne by municipalities across the whole sample.

7. Conclusions

This paper studies the effects of contracting out on local public services. Results obtained in the estimation indicate that the mode of production has no significant effects on costs borne by municipalities. Since we do not find any significant effect of the mode of production (public/private) on costs, we put forward two hypotheses. On one hand, the threat that privatization represents for public unit managers may have stimulated them to search for alternative management reforms, including inter-municipal cooperation and transformation of service agencies into more flexible publicly-owned private-law corporations. On the other hand, progressive concentration and

decreased bidding competition in the privatized sector may have outweighed potential initial gains from privatization.

Results from the cost comparison between the case with inter-municipal cooperation and the case without it, reveal that this tool may be effective in exploiting scale economies and, hence, reducing costs in municipalities with populations of fewer than 20 000 inhabitants. Regression analysis confirms these results for inter-municipal cooperation. Given that this kind of service aggregation is much more usual in non-privatizing municipalities, one can conclude that inter-municipal cooperation is often used as an alternative to privatization.

Market concentration in the solid waste collection sector is quite intensive. The analysis shows a clear weakness of competition in the sector and gives support to the hypothesis that lack of competition explains the non-existence of privatization-induced cost advantage. Analysis of the time of first privatization suggests that the more recent the reform the better its effect on costs. When privatization began long ago, the costs tend to be higher than for similar, more recent contracting out. That may help to explain why the mode of production has no significant effect on costs paid by municipalities when we analyze the whole sample of municipalities.

The empirical results carry some important implications for refuse collection management. Reforms already implemented may have almost completely exploited scale economies, by contracting out or by inter-municipal cooperation. Further, the dynamics of contracting out may present serious competition failures. Local governments engaged in contracting out should consider shorter-term contracts and other measures to stimulate competition. Promotion of antitrust policies might redirect efficiency gains and cost reductions to municipalities. Those advancing pro-competition political agendas, who hardly ever attend to public service concessions, should begin to take note of them.

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