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Factors influencing privatization of urban solid waste collection: some evidence from Spain

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Abstract:

In this paper we analyse some of the organisational aspects of the urban solid waste collection and, in particular, the privatization modality of contracting out. We start by discussing some of the theoretical aspects of contracting out. We then specify and estimate an explanatory model on a sample of municipalities that we surveyed. Our purpose is twofold: on the one hand, we identify the economic factors at work when deciding to contract out the service and, on the other hand, we analyse the role of ideological factors in choosing between the public production of the service or contracting it out. The results show a significant effect of the demand for waste collection on contracting out. There also appears to be a neighbouring effect as the municipalities close to other cities that contract out are also more prone to do so. Finally, the decisions to contract seem to have been motivated by pragmatic rather than ideological reasons.

Key words: privatization, contracting-out, local government, public services.

INTRODUCTION

The literature on privatization has increased enormously in the last years. Many theoretical and empirical papers are devoted to the study of the objectives and the effects of privatization of public companies that operated in competitive markets where no market failures were present and those that operated in non-competitive markets and thus enjoyed considerable market power. Vickers and Yarrow (1991) refer to these transfers from the public to the private sector as type 1 and type 2 privatizations, and add a third type of privatization that has been much less studied: the contracting out of services previously provided by the public sector.

Even though it does not imply the sale of physical assets, contracting out is another type of privatization, as it consists of the sale of a service or franchise contract. The contractor, public or private, appropriates any financial surplus derived from the service and the appropriation of this benefit is central to the idea of property.

Contracting out has particularly increased in the UK and US in the last two decades. In the US, the local governments have faced tax revolts since the late 1970s, cuts in federal and state programs and other financial difficulties. These factors forced them to rethink the way local services were provided and financed.¹ In addition to the decrease in the financial resources, the taxpayers' demand for better services without increasing in taxes increased (Savas, 1998). This put pressure to increase the productivity in the provision of local services.² Altogether these factors contributed to the spread of contracting the provision of local services in the US.³

During the 1980s the British government was interested in reducing the size of the public sector and cutting back the power of trade unions. Thus it was favourable to contracting.⁴ Ascher (1988) argues that the likelihood to contract out was larger if it appeared as a natural response than if it was imposed politically. Yet, the British government passed the Local Government Act in 1988, where competitive bidding was made compulsory. Taxpayers who wanted cheaper

services and business groups which saw in the bidding for services the possibility for potential economic benefits supported the Act. The opposition to privatization came from government employees and trade unions.⁵

Reimer (1999) has studied the expansion of contracting after the obligation established by the Local Government Act of 1988. He concludes that the spread of this formula followed a sequential process. During the first years after the law was passed, there was a clear relationship between the ruling party in the local administration and the winner of the bid. However this relationship vanishes as time goes on. In the last years, economic or geographic factors, such as closeness to one of the establishments of a private provider, have been more powerful explanations than ideological reasons. More precisely, contracting out seems to spread in a network way; the likelihood to contract increases as more municipalities in the same area use this formula.

Spain is one of the pioneering countries in this type of privatization, especially in urban solid waste collection. In some cities -such as Barcelona- contracting stems back to the XIX century. In recent times, since the 1960s there have been many cases of contracting which is now used in an increasing fashion. Surprisingly enough, there is no tradition in the study of this phenomenon and the studies in Spain, in particular the economic analysis, are scarce. In Spain – as in US- competitive tendering is not compulsory, opposite to UK. Since the decision of contracting out is entirely up to each local government, what are the factors that influence this decision?

In this paper we try to somehow fill in this gap by studying the determinants of contracting out urban solid waste collection in Spain. In the first section we survey the theoretical literature on contracting from which we derive the hypothesis for our empirical test. In the second section we specify a model that explains the decision to contract out. We then test some

hypothesis determining such a decision, like for example the need to undertake organisational reforms and the importance of political factors. Finally we summarise the most important results.

THE ECONOMICS OF CONTRACTING OUT.

Even though contracting has not received as much attention in the literature as other aspects related to the public sector and public services, this is not a new concern either. Back in 1859 Edwin Chadwick defined the concept of *competition for the sector*, as opposed to the better known *competition within the sector*. Chadwick (1859) argued that in some services with decreasing average cost, such as water distribution, the competition resulted in inefficiencies and thus he recommended to auction all the service.

The fact that the local government is required to guarantee the service does not mean that it also needs to provide it itself. Donahue (1989) points out that sometimes the municipality is not the optimal geographical unit to produce the service. The private companies enjoy some advantages over the public administration: (1) more flexible labour, incentives and accountability, (2) less restrictions in the procedures and a higher orientation towards results.

An especial advantage is the economies of scale. That is, the private companies can efficiently distribute the fixed costs over several geographical units, as they are not necessarily constrained to a single municipality. Thus, some welfare gains are to be realised. Graph 1 shows that if the total market demand is larger than that of the municipality, the company can offer a lower price. The shaded area depicts the welfare gains to the municipality. *Figure 1: Economies of scale realised by contracting out the services. (pag. 20)*

The contractor can also use a wide incentive scheme for its employees, such as the top positions in different locations. Furthermore, the contractor enjoys more incentives for innovation and organisational improvement. Hart, Schleifer and Vishny (1997) argue that, unlike the

government, the private sector has more incentives to pursue innovations to improve quality or reduce costs because they can claim property rights over the innovations. In short, opening up to competition by a bidding process can result in cost minimisation and thus technical efficiency. Graph 2 shows the welfare gains due to scale economies together with technical efficiency.

Figure 2: Welfare gains realised by contracting out the services. (pag. 21)

Contracting does not come without problems though, the most important being the transaction costs (Domberger and Jensen, 1997). Transaction costs include administrative costs and those of incomplete contracts, because it is impossible to write a contract that foresees all contingencies. Bailey and Davidson (1999) find out that even ten years after contracting, the local governments still incur in costs of monitoring inputs and performance of the service. In fact, the emphasis on procedures, one of the most stressed pitfall in the public provision of services, does not disappear when the service is contracted but it only takes another form. Sclar (1997) argues that one needs to take into account the theory of the organisational dimension and the distinction between spot and contract markets. The former deal with standardised products, where a high degree of competition is possible and quality can be monitored. However, the contract markets are different. For example, they refer to continued services.

In addition to the importance that the contract be well-specified, Domberger and Jensen (1997) explain that contracting will be more successful: (1) the less the magnitude and specificity of the actives; (2) the more negligible the non contractable quality characteristics –i.e., those difficult to be specified and monitored-; and (3) the higher the real or potential competition in supply. In other words, the theory suggests that the higher the uncertainty, the higher the risks of failure of contracting. It also suggests that the public provision will be more efficient than contracting the larger the active specificity is.

In the case of solid waste collection, there is little magnitude and specificity of actives, quality can easily be monitored and there might be substantial competition on the supply side.⁶ Therefore, it is an adequate service to contract.

The pure market formula, where every household contracts its own service to a private provider, has clear disadvantages. It is usually more expensive because no economies of scope can be realised. There are also additional costs of individual billing, i.e., because the contractor must bear the cost of unpaid bills, it might charge higher service fees. These are reasons why a unique provider has generally carried out solid waste collection⁷, and the payment consists of a mandatory local fee. Depending on the formula specified in the contract, the fees fund either the direct provision of the service or are used to make a global payment agreed upon in the contract. The existing empirical studies on the effects of contracting out urban solid waste collection refer mostly to the US and the UK. The results indicate that in general there have been cost reductions derived from contracting out the service.⁸

I. A model for deciding to contract out solid waste collection in urban areas.

Our hypothesis is that the local governments use contracting as a response to the need to improve on the organisation and flexibility of the service. This is motivated by the efficiency gains derived from economies of scale and the reduction of X-inefficiencies. These benefits must be compared with (1) the possible gains from improving the internal organisation of direct public provision and (2) the costs of monitoring associated to contracting. On the other hand, contracting is favoured in those areas where there have been previous experiences with this formula. Finally, we hypothesise that local politicians follow pragmatic rather than ideological criteria to take decisions.

We use a binomial discrete choice model to test our hypothesis. Our dependent variable is the method of production of the service –Y- and it takes value zero in case of direct public production and one if the service is contracted. We regress the dependent variable on a number of explanatory variables. The statistical inference is performed for two different periods: first, for the period 1979-98, that is, since the first year of democratic local governments and second, for the period 1991-98, for which information on all the explanatory variables is available.

a. Data and sources.

Our sample consists of municipalities in Catalonia that filled out the Survey on Production of Local Services, a survey designed and carried out by our research group. The survey was sent to all municipalities in Catalonia.⁹ We have data on the nature of the provision of the service (i.e., whether it is publicly or privately produced), the level (local or supra-local) at which the service is produced and the year when the service was contracted, if it was. The information on the demand side was obtained from two different sources: (1) for the period 1979-98, we use the total population as a proxy for the demand of the service and it was obtained from the statistics of **the Catalonian Statistical Institute**, (2) from 1991 on, we have direct data on the demand of the service provided by the **Catalonian Council of Waste**. The latter allowed us to create an indicator for **daily generation of waste**. The data on the local electoral results were obtained from the **Catalonian Statistical Institute**.¹⁰ The data on the structure and dispersion of the municipalities was obtained from the **Information System of the Local Government**. Finally, the data on financial burden was provided by the **Catalonian Auditing Agency**, the information being available since 1990.

b. The explanatory variables.

The demand for solid waste collection (Q) is the first explanatory variable we consider. As the demand increases the management of the service becomes more complex so that organisational improvements and more flexibility are required. The increase in the demand implies an increase in the expected profits due to the reduction of inefficiencies through contracting out, while the supervision costs associated to contracting out become relatively less important with dimension. These factors might have a positive impact on the decision to contract. However, there might be a limit to the exploitation of economies of scale.¹¹ On the other hand, high levels of urban solid waste collection are associated to large cities, which in turn are most capable to undergo organisational reforms, hire the best managers and introduce elements of flexibility in the provision of the service.

It is plausible to think that the relation between the level of solid waste and the decision to contract out has an inverse-U shape. This suggests that in relatively small cities the obstacles to contract out are higher, due to high supervision costs, little benefits to be enjoyed from reducing inefficiencies, and less of a tendency to organisational changes. As demand increases, the supervision costs become relatively less important, the advantages from reducing inefficiencies increase and so does the probability to contract out. However, when demand is too high the exhaustion of economies of scale and the higher capacity to undertake organisational improvements in the public production of the service could put a halt to the decision of contracting.

In the analysis for the period 1979-98, we use the population variable (POP) as the proxy for the demand for the service. This variable is constructed from the local population from the Census of Population. We take the population from the Census nearest to the year when the service was contracted. For those cities where the service has always been provided directly by

the local government we take the population from the 1996 Census, the last year available. We also include the square of the population (POP^2) to test for the inverse U-shape hypothesis.¹² For the period 1991-98 we use the variable Daily Generation of Waste (DGW) that directly measures the demand for the service. For those cities where the service was contracted, we take the value of this variable in the year when the decision of contracting was taken. For the other cities, we use the value of Daily Generation of Waste in 1998, the last year available. As with the population, we also include the square of this variable (DGW^2) to test for the inverse U-shape hypothesis.

Our second explanatory variable is the municipality dispersion (D), which includes the number of population units in the city. The higher the dispersion, the higher the costs of the service and thus the higher the complexity. This factor would favour contracting.

The third explanatory variable tries to capture the neighbouring effects that might play a role, positively influencing the choice to contract out. One of these indicators is the use of contracting in the municipalities nearby or in a given area of reference. Following Reimer (1999) our hypothesis is that the neighbouring effect positively influences the decision to contract out for two reasons. First, the closeness to cities where the service is contracted enables the private providers to offer attractive plans to the municipality that is considering to contract, due to economies of scale.¹³ Second, the local government can compare the management of the service with that of the neighbouring cities or reference cities, which in turn favours contracting out. To pick up the neighbouring effect we use a variable called (NE). This variable is the percentage of the municipalities in a reference area that had contracted out the service by the beginning of the period considered.¹⁴ For the period 1979-98 we use the benchmarking in 1979 (NE79); for the period 1991-98, we use that in 1991 (NE91).

The fourth explanatory variable is the ideological stand of the local government, given by the variable called Political Indicator (PI). This is a qualitative variable that takes value 1 if in the year the service was contracted the municipality had a right-wing or center-right government, and it takes value 0 if the political stand of the local government was left or center-left. In those cities where the service had not been contracted the variable takes value 1 if the right or center-right governments had been predominant during the period considered, and it takes value 0 otherwise. If the ideological position of the local government plays a role in the decision to contract, we would expect this variable to be significant. On the contrary, if the decision has a pragmatic motivation this variable would not be significant.

Finally, for the period 1991-98, we include two additional variables: the Index of Global Financial Burden (IGFB) that captures the financial burden for each municipality, and the supra-local association of the service (SLA). As for the variable IGFB, we would expect the organisational reform to be more likely as the budget restrictions of the municipality are higher, because there is a need to cut on expenditures then. The data for this variable is only available since 1990, so we can only use it for the period 1991-98. For the municipalities that contracted the service we take the financial burden of the year prior to the decision of contracting, as the debt burden should have had an effect prior to the decision. For those municipalities that directly produced the service during the period we use the fiscal burden in 1997.

Our last variable is the supra-local association of the service (SLA), which implies the transfer of the service to a public body of a higher geographical dimension. In the case of Catalonia, new administrative units were defined in 1987: the ‘comarcas’ (counties) which constituted a geographical unit larger than the municipality, especially appropriate to share the provision of the service. The supra-local association could have favoured the decision to contract because it increases the volume of waste collection and thus the dispersion in the area then

covered. Therefore, it introduces complexity in the service and economies of scale advantages that can induce to contract. Moreover, the transfer of the service to a higher body involves an organisational change that might favour the political decision to contract. To be sure, as the distance between the citizens and the decision-making body increases, the political risk of privatization for the local government reduces. On the other hand, aggregating the service at a superior geographical level could be seen as an alternative way to contracting out in order to achieve economies of scale. The variable SLA is qualitative and takes value 1 if the municipality has the service transferred to this superior administrative unit and it takes value 0 otherwise.

c. The model.

The function for the increase in the expected utility of the local government takes the following form: $\Delta U_{0,1} = f(Q, D, NE, PI, IGFB, SLA)$, where 0,1 indicates the change from direct production of the service to contracting, and the arguments in the utility function have already been discussed above.

As we also explained, the model we use is a binomial discrete choice model, where the dependent variable takes value 1 if the municipality contracted out the service during the period analysed and it takes value 0 if the service continued being publicly produced. That is, for each municipality i :

$$Y_i = \begin{cases} \text{Period 1979-1998} & \text{Period 1991-1998} \\ 1 \text{ if } \Delta U_{0,1}^i = f(Q, D, NE, PI)_i > 0 & 1 \text{ if } \Delta U_{0,1}^i = f(Q, D, NE, PI; IGFB, SLA)_i > 0 \\ 0 \text{ if } \Delta U_{0,1}^i = f(Q, D, NE, PI)_i \leq 0 & 0 \text{ if } \Delta U_{0,1}^i = f(Q, D, NE, PI; IGFB, SLA)_i \leq 0 \end{cases}$$

We run two estimations. The first one comprises the period 1979-98, for which we use the population as a proxy for the demand for waste collection and we do not include the budget restriction and the supra-local association variables. In the second estimation, period 1991-98, we have information on all the variables; in addition, the demand variable directly measures the demand for the service.

The models estimated are the following:

$$(1) \text{ 1979-1998: } Y_i = \Phi(\beta_0 + \beta_1 POP_i + \beta_2 POP_i^2 + \beta_3 D_i + \beta_4 NE79_i + \beta_5 PI_i) + \varepsilon_i$$

$$(2) \text{ 1991-1998: } Y_i = \Phi(\beta_0 + \beta_1 DGW_i + \beta_2 DGW_i^2 + \beta_3 D_i + \beta_4 NE91_i + \beta_5 PI_i + \beta_6 IGFB_i + \beta_7 SLA_i) + \varepsilon_i$$

Where Φ is the cumulative distribution function for a standard normally distributed variable and ε is the disturbance term. This is a probit model.¹⁵ Finally, for each period we estimate the model without including the political indicator (PI) and including it. The reason for this is that we think it is interesting to see how the estimation with only economic variables does.

II. The results.

Table 1 shows the results for the period 1979-98 (equations 1 and 1bis). Table 2 presents the results for the period 1991-98. The overall significance of the model is quite high, especially for the best specifications of the model, equations 1 (overall significance > 99%) and equation 2OK (overall significance > 97.5%). The explanatory power of the model is moderate but by no means unimportant. The R^2 ranges between 0.205 and 0.259 (which is not a bad range being a

binomial discrete choice model) and it is slightly higher for the period 1991-98. This might be due to the higher accuracy of the variable DGW as an indicator for the demand and the inclusion of the supra-local association variable even though it does not appear to be significant. The demand variable, either proxied by the population (POP) or by the generation of waste (DGW), is the most significant, around 1% significance level. The fact that the signs are positive for POP and DGW and negative for POP^2 and DGW^2 validates the hypothesis that the relation between the demand and the tendency to contract out displays an inverse-U shape. That is, the decision to contract is more likely as population increases up to a point where this tendency reverses.

The other variable that seems to explain the decision to contract is the existence of neighbouring municipalities where contracting is used (NE); this variables is always significant at significance level inferior to 5%. The higher the percentage of neighbouring municipalities that already contract out, the more likely that the municipality will decide to contract out the service.

The dispersion of population in the city and the supra-local association do not appear significant. Neither does the financial burden. The variable IGFB,¹⁶ that we use for the period 1991-98, has a positive sign, as expected, but its coefficient is not significantly different from zero. The financial situation of the municipalities does not seem to have an effect on the decision to contract.

Finally, the variable PI, that represents the ideological stand of the local government, is not significant. This suggests that the local politicians take a pragmatic rather than ideological position when considering these issues.

Table 1. Factors explaining the decision to contract solid waste collection, 1979-98. (pag. 22)

Table 2. Factors explaining the decision to contract solid waste collection, 1991-98. (pag. 23)

IV. Conclusions.

Spain is one of the pioneer countries as far as contracting urban solid waste collection is concerned. The use of this formula has increased in the last years. In this paper we analyse the determinants of the decision to contract out this service. The existing literature suggests a number of hypotheses to explain this decision so we set up an explanatory model where we test for these alternative hypotheses.

Our results indicate that there is a significant relationship between the demand for waste collection and the decision to contract. Moreover, this relationship is inverse-U shaped. We interpret this as follows. The cities with relatively small population, and thus small demand, can take little advantage of reducing inefficiencies while they face relatively large supervision costs if they contract. These factors, together with the fact that they are less able to undertake organisational reforms to improve the service, explain the small probability to contract in this type of municipalities. As the population increases, the supervision costs decrease relatively and the expected benefits from contracting out increase, which in turn make the cities more prone to contract. However, economies of scale might be exhausted after some city size is reached. Similarly, very large cities might be more capable to undergo internal reforms in the direct production of the service. Thus, when the cities are too large the probability to contract out decreases.

The municipalities show a higher probability to contract the more spread this formula is in the neighbouring cities. There are two reasons for this. First, the politician has more available information on the results of contracting, which reduces the uncertainty and risk associated to the change in the management of this service that has high social sensitivity. Second, the contractors

operating in the municipalities close to the one considering this formula can exploit economies of scale and therefore offer attractive contracts to the city.

We do not find evidence of the municipality budget restrictions having an effect on the decision to contract. The financial reasons, which have motivated the privatization of public companies, play a small role in this case because this type of privatization does not generate any receipts to the administration. The objective of improving efficiency might have played a more important role. Our results are supportive of the hypothesis that the local governments were led by pragmatic rather than ideological reasons.

There are other interesting aspects in the process of organisational reform in the management of local services that we do not analyse here. In particular, the issues related to the effects on efficiency and effectiveness of the services contracted out, the tendency to concentration in this type of services and the consequences for the competition are central to the discussion. We leave these issues for a future research agenda.

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Figure 1: Economies of scale realised by contracting out the services.

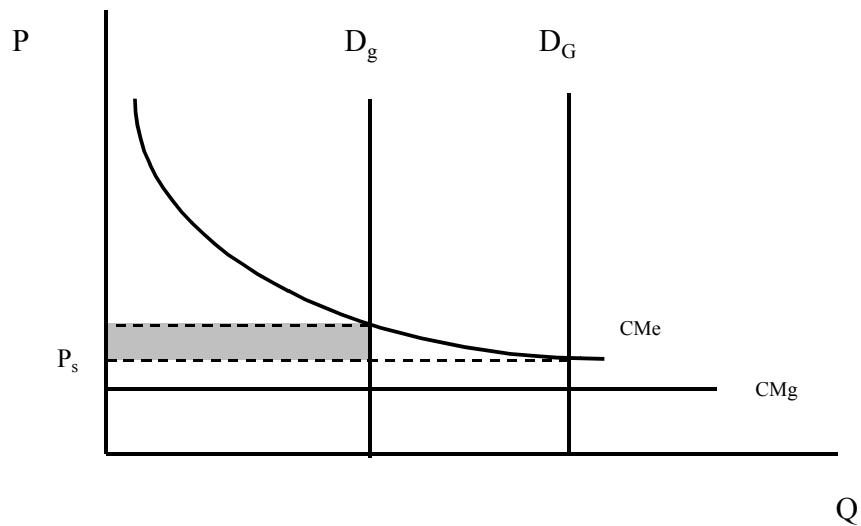
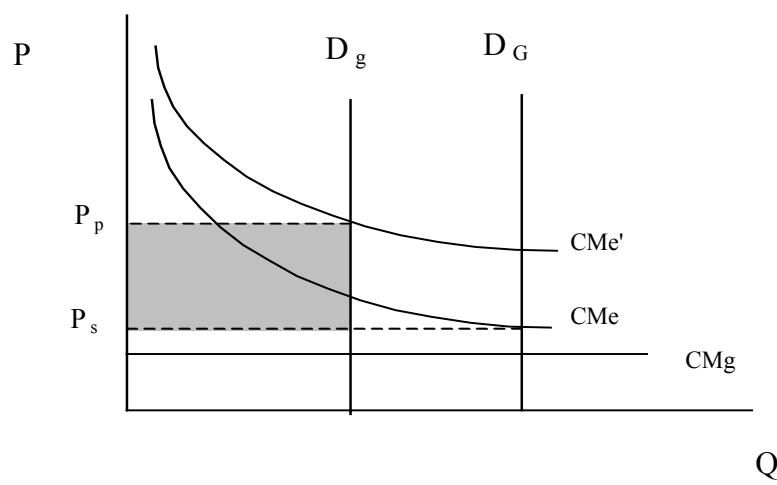


Gráfico 1: Economías de escala en la contratación externa de servicios.

Figure 2: Welfare gains realised by contracting out the services.



**Gráfico 2: Ganancias de bienestar
mediante la contratación externa de servicios**

Table 1. Factors explaining the contracting-out of solid waste refuse collection, 1979-1998.

Variable	Equation 1 Coefficient	Equation 1bis Coefficient
Constant	- 0,1328 (0,668)	-0,0489 (0,922)
POP	0,0001 (0,014)b	0,0001 (0,009)a
POP2	-1,96 · 10-9 (0,006)a	-2,02 · 10-9 (0,004)a
D	-0,0201 (0,565)	-0,0249 (0,469)
NE79	0,0259 (0,048)c	0,0252 (0,050)c
PI	-	0,2382 (0,594)
Test Wald Test of joint significance*	0,0037a	0,0079a
R2 aproximado	0,2045	0,2074
N	90	90

Notes: In parenthesis, probabilities that the coefficient be zero, using White's robust estimation.

- Here and also in table 2, the superscripts indicate the following significance levels: a=1%, b=2.5% and c=5%.
- *=Probability of non-significance of the model (also for table 2).

The likelihood test confirms equation 1 as the best one. In particular, chi-squared takes value 0.178972, which lies on the range of non-rejection of the null hypothesis, the null hypothesis being that PI should not be included.

Tabla 2. Factores determinantes de la contratación externa de recogida de residuos sólidos, 1991-1998.

Variable	Ecuación 2 Coeficiente	Ecuación 2bis Coeficiente	Ecuación 2OK Coeficiente
Constante	- 0,9525 (0,128)	-1,1338 (0,110)	-0,9099 (0,129)
DGW	0,1451 (0,013) b	0,1494 (0,009) a	0,1438 (0,012)b
DGW2	-0,0018 (0,006) a	-0,0018 (0,004) a	-0,0018 (0,005) a
D	-0,0284 (0,498)	-0,0348 (0,405)	-0,0297 (0,473)
B91	0,0190 (0,037) c	0,0186 (0,039) c	0,0189 (0,040) c
PI	- (0,635)	0,2021	-
IGFB	0,0019 (0,837)	0,0017 (0,852)	-
SLA	0,7281 (0,164)	0,6714 (0,218)	0,7231 (0,169)
Test Wald de significación conjunta*	0,0410 c	0,0364 c	0,0233 b
R2 aproximado	0,2594	0,2631	0,2588
N	41	41	41

Notes:

- In parenthesis, probabilities that the coefficient be zero, using White's robust estimation.
- The likelihood test for the coefficients on IGFB and PI being equal to zero (chi-squared with 3 degrees of freedom) takes value 5.5747 (critical value=7.82).

Notes:

¹ For instance, Proposition 13 passed in California in 1978 implied cuts in the property local tax, which in turn forced the local governments to either cut on the services or increase the receipts from the provision of services or both.

² According to the City Management Association survey (ICMA, 1989), by 1989 23.9% of the local governments had contracted out once or more. The easiest services to contract out were those which clearly be standardized, which require of a large number of employees/providers and skills or specialized equipment.

³ Donahue (1989) offers a wide look into the issue. Lopez-de-Silanes, Sheleifer and Vishny (1997) carry out an empirical study on the determinants of contracting out in the US.

⁴ In the case of the UK, the notion of contracting out implies that a private company won the bid for the service.

⁵ According to Porter and Dewey (1998) the contracting out spread faster in the UK than in the US because the British government transferred the benefits to favourable sectors, maximising this way the support for privatization, while the same selective compensation was not all that common in the US.

⁶ However, Reimer (1999) finds out some tendency to concentration in this service in the UK. The largest companies concentrated about 60% of the contracts of solid waste collection granted to private providers.

⁷ In big metropolitan areas, it is an increasing practice to split up the city into districts and contract the service in each district according to different procedures. The reasons for this are the exhaustion of economies of scale and the possibility of competition between different districts within the metropolitan area. ICMA (1989) gives account of this procedure in Phoenix, Arizona. More recently, in 2000, the city of Barcelona was divided into four districts for the concession of the service.

⁸ See Savas (1987) and Hodge (2000) for a survey on empirical works.

⁹ The percentage of answers is high as far as population is concerned (the answers cover about 60% of the total population) and somehow lower as far as the number of municipalities is concerned (13,3%). The significance of the responses is low in the municipalities with population below 1,000 inhabitants but it increases rapidly thereafter; 37% of the cities with population between 5,000 and 20,000 people are covered; 50% of those between 20,000 and 50,000 and 2/3 of the cities above 50,000 inhabitants. The sample is random and representative of the municipalities of Catalonia, even though the results are less representative for those municipalities under 1,000 inhabitants.

¹⁰ For those cases where the electoral results did not yield absolute majority of any political party in the year the service was contracted, individual queries were carried out to identify the political party in office that year.

¹¹ This could be the reason why large cities such as Phoenix and Barcelona tend to divide the city into districts and independently contract the service for each of these districts.

¹² The inclusion of this variable does not pose a problem of co-linearity. This would only be an issue if the sample size were within a very small interval, which is not the case.

¹³ See Donahue (1989) for a more detailed explanation.

¹⁴ Catalonia is divided into six administrative areas, some of which are smaller than the province.

¹⁵ We also tried with a logit model. However, the probit model is more suitable for the periods considered, and it also allows for the estimation of heteroscedastic models. Since the literature up to now is silent on the superiority of one model over the other (see Green, 1999), we choose the probit model.

¹⁶ The inclusion of the variable IGFB introduces heteroscedasticity problems. Thus the OLS estimators in equations 2 and 2bis might not be consistent (Yatchew and Griliches, 1985). We re-estimated the model of equation 2bis using Harvey (1976) estimation to take care of the heteroscedasticity problem and we compared it with the correct model, 2OK, which does not include IGFB and PI. The coefficients have the same sign, are also significant and are of about the same magnitude.