

The Impact of Contracting Out on the Costs of Refuse Collection Services: The Case of Ireland*

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Abstract: This paper examines the impact of contracting out on the costs incurred by local authorities in providing refuse collection services. Using original survey data for the Republic of Ireland, three methods of estimating the impact of tendering are adopted. Crude comparisons of costs before and after tendering and the costs of local authorities versus private contractors indicate that tendering can yield savings of between 34 and 45 per cent. Using multivariate regression analysis to enable us to control for service characteristics confirms cost savings of around 45 per cent. The bulk of these cost savings are attributed to real efficiency gains as a result of contracting out.

I INTRODUCTION

Over the last two decades, governments throughout the world have searched for a new approach to public sector management. The traditional arms of public administration have been subjected to a variety of measures of reform in an attempt to promote the efficiency and effectiveness of public service delivery. These include the privatisation of public enterprises, deregulation of markets and the marketisation of public services such as health, education and community care. In local government there has been a discernible shift towards the promotion of competition (through the use of competitive tendering) to provide services traditionally provided directly by the local authorities. Since 1988 local

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authorities in England, Scotland, and Wales have been compelled to put certain defined activities (such as refuse collection and cleaning of buildings) out to public tender. There has been a resultant upsurge in the extent of contracting out of services to the private sector. A more pragmatic approach has been adopted in countries such as Holland (Snape, 1994), Sweden (Walsh *et al.*, 1997) and Australia (Domberger and Hall, 1996) where local authorities have been encouraged rather than compelled to make use of competitive tendering and contracting as a means of organising service delivery.

There is international evidence to suggest that the use of competitive tendering can yield considerable cost savings (see Domberger and Jensen, 1997, for a review of evidence). The potential for cost savings however, varies across services and efficiency gains can be reduced by the costs of contracting. There is also the possibility that cost savings are accrued through a deterioration in working conditions rather than genuine efficiency gains (Milne and Michie, 1997).

Local authorities in Ireland have for long made extensive use of external sources for service provision. Some examples include major capital projects such as roads, housing and water/sewerage. Another service that has been increasingly privatised or contracted out in recent years is refuse collection (Reeves, 1995, Coughlan and de Buitlir, 1996). However, despite accounting for the highest cost element of solid waste management, refuse collection generally attracts less attention than final disposal (Barrett and Lawlor, 1995, p. 33). This paper aims to address the evident need for information on the cost of providing refuse collection services in Ireland. In particular, the paper focuses on the cost-effects of privatising refuse collection services by contracting out, following the use of competitive tendering. The analysis presented, is part of a wider study of the experience of local authorities with contracting out the service. On the basis of original survey data it examines whether the use of private contractors has led to significant cost reductions and the degree to which any reductions represent genuine efficiency gains.

II EXTENT AND FORMS OF PRIVATISATION OF REFUSE COLLECTION SERVICES IN IRELAND

The first stage of the research presented in this paper involved the determination of the different arrangements for providing refuse collection services in Ireland. A brief questionnaire-based survey, covering each of the 88 local authorities was conducted. The brevity of the questionnaire combined with follow-up telephone calls ensured a 100 per cent response rate. The survey revealed that three basic arrangements for providing refuse collection services were adopted by Irish local authorities in 1995 (see Table 1). The majority (61 per cent) of local authorities provided refuse collection services in their areas through

their own direct labour (public provision).¹ In almost 15 per cent of cases, private service providers were contracted to provide refuse collection services by local authorities following a competitive tendering process. Under this arrangement, private contractors provided the service in accordance with the terms of an agreed contract and there was no financial arrangement between the private collector and customers. In the remaining 24 per cent of cases, local authorities fully privatised the provision and finance of refuse collection services. In such circumstances, the consumer selects and pays the private producer for the service.

Table 1: *Refuse Collection Arrangements in Irish Local Authorities 1995*

<i>Arrangement</i>	<i>Co. Borough Corporations</i>	<i>County Councils</i>	<i>Borough Corporations</i>	<i>Urban District Councils</i>	<i>Total</i>
Public	5	12	5	32	54
Contract Out	0	3	0	10	13
Full Privatisation	0	14	0	7	21
Total	5	29	5	49	88

Note: Two County Councils (CCs) and two Urban District Councils (UDCs) contract out between 45-70 per cent of their local authority areas. All other contracting authorities contract out 100 per cent.

As local authorities that fully privatise their services no longer incur expenditures, the examination of the impact of privatisation on refuse collection costs conducted in this paper is confined to an analysis of the impact of contracting out after competitive tendering.

III COMPETITIVE TENDERING — THEORY AND EVIDENCE

Domberger (1986) summarises the nature of franchising. The best known method is the Chadwick/Demsetz auction, which according to Demsetz (1968) provides an appealing alternative to regulation and state monopoly. By putting the right to be a monopoly provider of a service up to auction and awarding that right to the bidder offering the lowest consumer price, competition *for* the market replaces competition *in* the market. Variants of the Chadwick/Demsetz auction include: awarding the contract to the bidder offering the most attractive price/quality combination; or to the bidder who offers to pay the most for it; or to the bidder willing to receive the lowest contract price (i.e. contracting out). The

1. It is noteworthy that retaining public provision does not necessarily coincide with public finance of the service. A number of local authorities that retain public provision levy user-charges on end users.

attraction of this model was stressed by Demsetz who argued that *ex post* monopoly in the supply of goods and services is now consistent with *ex ante* competition for the right to be the sole supplier for a given period of time.

Morgan (1992) distinguishes between franchising and contracting out. Under a franchise agreement “the user pays the provider directly for the service and the public authority may or may not control prices or service levels” (Morgan, 1992, p. 254). Furthermore, the franchise may be exclusive or non-exclusive. Under contracting out, the public authority retains ownership but awards a competitive bid to a private vendor for operation and maintenance.

The advantages and limitations of the contracting-out model were formally described by Sappington and Stiglitz (1987). Using a principal-agent framework, these writers devised a “privatisation theorem” which set out conditions under which government objectives can be attained by an appropriately designed auction of the rights to produce a given product or service.

Given government objectives of productive efficiency, allocative efficiency and rent extraction, the ideal setting is that two or more risk-neutral firms bid for the right to produce the good/service. Actual costs are only learned by the successful bidder just prior to production. Bidders do not collude and have symmetric beliefs about the state of technology. They bid for the right to receive payment according to the government’s valuation of output. According to Sappington and Stiglitz the firm submitting the highest bid is chosen. It will select the production level most desired by the government, conditional on actual costs being realised. As bidding firms shared symmetric beliefs about costs, the competitive tendering process ensures that no rents accrue to the winner.

The conditions are however strict and the ideal setting may not be attained. This can lead to “privatisation failure”, which according to the writers can arise for a number of reasons. For example, the government may fail to extract rents due to collusion between bidders at the bidding stage or because information problems mean the government lacks precise information of its social valuation function. Despite the real potential for “privatisation failure” Sappington and Stiglitz (1987) contend that the ideal setting is conceivably attainable where:

- (a) product specification is simple;
- (b) technology is well known;
- (c) significant demand fluctuations are unlikely within the terms of the arrangement;
- (d) the incumbent or any bidder does not possess advantageous information;
- (e) entry costs are not high and transfer of the firm’s assets to the private producer is not difficult.

As refuse collection generally satisfies these conditions it is commonly contracted out to the private sector. Furthermore, as the service is a relatively simple

service to analyse, a number of published studies have examined the impact of privatising refuse collection services on service costs. Some earlier (late 1970s, 1980s) analyses of the privatisation of refuse collection services in the USA were summarised by Savas (1987, p. 128). Nine major studies over a ten year period were reviewed and Savas concluded that municipal collection was roughly 35 per cent more costly than contract collection although a range of 14 to 124 per cent was reported.²

Walsh (1991) and Walsh and Davis (1993) conducted comprehensive studies of the impact of the *Local Government Act 1988* and compulsory competitive tendering (CCT) in the UK. The first study involved following the experiences of a panel of 40 local authorities over the initial stages of introducing competition across all services covered by the Act. Two approaches were taken to estimating the financial impact of contracting out refuse collection services. First, local authorities were asked to compare the costs of providing the service with estimated costs in the first full year after contracting out. On the basis of data returned by seven authorities, average cost savings were estimated at 8 per cent of pre-competition costs. In order to deal with some of the limitations of this initial approach (e.g. the non-inclusion of costs such as redundancy payments or income from the sale of equipment) local authorities were asked to estimate cost savings/losses by taking all continuing additional costs and revenues into account. The average result for refuse collection was cost savings of 12.4 per cent. The second study of the experiences of local authorities under CCT was published in 1993. The authors remarked that it “proved increasingly difficult to gather financial information through questionnaires” (Walsh and Davis, 1993, p. 141). Information was therefore supplemented by interviews with the best result often only an estimate of costs. Refuse collection was found to be one of the three services in which the greatest savings were found. On the basis of 22 observations, cost savings over the first three years of competition were estimated at 11.3 per cent.

More sophisticated methods of estimating cost savings have been adopted McDavid (1985), Domberger *et al.* (1986), Szymanski and Wilkins (1993) and Bello and Szymanski (1996). In a sample of 205 Canadian cities, McDavid (1985) reported that exclusive public collection was 50.9 per cent more expensive than private collection. In order to control for factors such as environmental differences, regression analysis was used to predict costs per household. It was reported that public collection was 41 per cent more expensive than private collection. These savings were attributed to improved technical efficiency, somewhat lower pay, better incentives and use of larger trucks. Domberger

2. It should be noted that Savas expresses cost savings as a percentage of the lower private costs which inflate the savings relative to those in other studies.

et al. (1986) conducted the most thorough analysis of contracting out before the introduction of CCT in the UK. Using data for England and Wales, from an annual survey conducted by the Chartered Institute of Public Finance and Accountancy (CIPFA), they estimated the cost of waste collection services using 16 variables. After controlling for factors such as economies of scale and regional variation they found that costs incurred by private contractors were on average 22 per cent less than costs of public collectors. Successful in-house contractors were on average 17 per cent less costly. These findings were supported by Data-Envelopment Analysis conducted by Cubbin *et al.* (1987) and by time-series/cross section analysis by Szymanski and Wilkins (1993).

Bello and Szymanski (1996) published the first detailed analysis of contracting under CCT. They found that refuse collection costs fell by 22 per cent on average, comparing the last full year before introducing competitive tendering with the first full year afterwards. After controlling for variations in service characteristics they found that the size of cost savings directly attributable to the competitive tender was between 27 and 34 per cent.

Overall there is strong evidence to support the case for contracting out as a means of reducing service expenditure. Controversy remains however with regard to the source of these cost reductions. Whereas Cubbin *et al.* (1987) found that the cost savings estimated by Domberger *et al.* (1986) were attributable to "improvements in physical productivity of men and vehicles" (Cubbin *et al.*, 1987, p. 53) these were disputed by Ganley and Grahl (1988). The latter questioned some of the assumptions underpinning the original study and argued that the savings were more attributable to reductions in quality, large scale redundancies and deterioration in working conditions. What most studies do demonstrate, however, is the significance of service characteristics as determinants of costs. In particular, one of the key determinants of cost is the point from which household refuse is collected. Bello and Szymanski (1996) cite previous studies that show authorities can reduce costs by 25 per cent if they change their method of collection from backdoor to kerbside collection. However, in their own study the same authors found that there was no evidence that CCT brought about any radical shift in characteristics of the specification of the services delivered to consumers. Hence the bulk of cost savings are attributed to competition.

IV ORGANISATION OF REFUSE COLLECTION SERVICES IN IRELAND AND DATA ASSEMBLY

The *Waste Management Act 1996* provides the current legal framework for governance of the waste management sector in Ireland. The Act restates the traditional responsibility of major local authorities for waste management in

relation to non-hazardous wastes and for ensuring adequate domestic waste collection and disposal arrangements in their areas. Authorities must decide on the level of service and whether the service is provided by the public or private sector.³ Aspects of the service to be decided include: frequency and method of collection, type of container and the provision of recycling facilities and collection of non-standard items. As the provisions of the Act have only recently been implemented this study focuses on the impact of contracting out on local authority expenditures prior to 1996.

To gather data on the costs and other characteristics of the refuse collection two complementary approaches were adopted. First, as part of a wider programme of research, structured interviews were conducted with contracting authorities.⁴ These interviews covered most aspects of the contracting experience of relevant authorities including a comparison of costs before and after contracting.

Second, a single questionnaire was sent to all local authorities (excluding those who had fully privatised their service as these councils no longer incur any expenditures). As local authorities are generally prepared to respond to a limited range of questions a three-page questionnaire was designed asking twelve questions. Responses to 51 of the 74 questionnaires were received – a response rate of 68.9 per cent.⁵ The questionnaire covered the years 1993, 1994 and 1995 and details concerning the following issues were requested:

- *Costs:* Each authority was requested to provide the gross cost of providing refuse collection services in their area for the years 1993, 1994 and 1995;
- *Quantity:* As the cost data provided can cover “domestic” or “domestic and commercial” collection, respondents were requested to provide information on the number of households and the number of premises from which refuse is collected. Respondents were also requested to provide details regarding

3. The Act recognises that waste collection services are increasingly being provided by commercial concerns. In order to ensure that these operations are carried out in an environmentally sound manner, it provides that commercial collectors of waste will require a permit from the relevant local authority. Waste collection of both hazardous and non-hazardous waste will be subject to the granting of permits from the local authority, provided the persons involved fulfil certain regulatory and fiscal requirements. The *Waste Management Act 1996* therefore provides the legal framework for governance of the Waste Management sector in Ireland including the regulation of privatised refuse collection services.

4. Seven of the 13 authorities that were contracting out during our survey period (1993-1995) provided cost data during structured interviews.

5. As Cork County Council is divided into North, West and South for administrative purposes, they were treated as separate local authorities in this survey. Hence the initial total number of local authorities was 90. This survey was undertaken as part of a wider programme of research. An earlier phase of the research identified that 16 local authorities had fully privatised arrangements for refuse collection services in *each* of the three years 1993-95 and consequently did not incur any service expenditures. The total number of questionnaires sent was therefore 74.

the number of wheel bins issued by the local authority. This question served a number of purposes. First, it served as a proxy for the number of units collected from. Second, as the wheel bin method is generally accepted as providing a better level of service than traditional bins, the data assisted in controlling for service quality. Third, because the costs figures provided may include the costs of introducing the wheel bin method, the question served to reveal if this occurred over the three years covered;

- *Service Characteristics:* Authorities were requested to provide various indicators of service quality. These included:
 - (a) collection frequency;
 - (b) the percentage of gross expenditure paid to private collectors;
 - (c) the percentage of gross expenditure paid to provide recycling facilities;
 - (d) the percentage of waste collected kerbside, backdoor and by any other method of collection.

V DATA ANALYSIS AND RESULTS

We first examine how costs have changed before and after contracting in a number of authorities. This serves as a useful preliminary analysis as costs can be expected to be fairly stable before and after contracting out (Boyne, 1997).

Contracting authorities that agreed to be interviewed, were asked to provide the costs of providing refuse collection services in the full year before contracting with the contract costs in the first full year of contracting. The results for the seven respondents are displayed in Table 2. Contract costs include transaction costs incurred in the introduction of contracting. On the basis of the five cases where contracting did not coincide with the introduction of the wheel bin method, average cost savings amounted to 33.5 per cent.⁶

We also demonstrate the crude difference in costs between contracting and non-contracting authorities without accounting for explanatory factors such as size of authority. Table 3 provides unit⁷ costs and standard deviations for contracting and non-contracting local authorities for the years 1993, 1994 and 1995. Comparing the average cost per unit for contracting and non-contracting authorities reveals that costs were lower for contracting authorities by 49.0 per cent in 1993, 46.5 per cent in 1994 and 43.4 per cent in 1995.⁸

6. In the cases of Authority 1 and Authority 4, contracting coincided with the introduction of the wheel bin method of collection.

7. Unit cost is used instead of household cost as 43 per cent of respondents failed to separate the costs of domestic and commercial refuse collection.

8. While this approach fails to control for authority-specific factors besides the number of units, it should be noted that the following section supports the findings of previous studies which show that much of the variation in total cost can be explained by the size of the service.

Table 2: *Gross Cost Savings (Comparing Pre-Contract Cost with Contract Price)*

<i>Authority</i>	<i>Year Before CT</i>	<i>Costs Year Before</i>	<i>Costs Year After</i>	<i>Saving/ Loss (%)</i>
Authority 1 (UDC)	1993	205,920	264,000	-28.21
Authority 2 (CC)	1987	436,400	246,400	43.54
Authority 3 (CC)	1987	75,000	66,000	12.00
Authority 4 (UDC)	1992	42,489	33,150	21.98
Authority 5 (UDC)	1986	22,424	14,300	36.23
Authority 6 (CC)	1984	83,000	55,000	33.73
Authority 7 (UDC)	1992	58,130	33,648	42.12

Notes: (1) In the case of Authority 1 post-contracting costs were higher as they included the purchase of wheel bins.

(2) In the case of Authority 2 the data refers to the privatisation of some of the routes served by the council.

(3) In the case of Authority 4, contracting commenced in 1986. The costs compared here are the costs of two different contractors.

(4) CC = County Council, UDC = Urban District Council.

The statistical significance of the difference between the sample variances and means were also tested. The tests revealed that the variance was significantly lower for contracting authorities in years 1993 and 1994.⁹ Sample means were significantly lower for contracting authorities in all years.¹⁰ A full set of statistical outputs is available on request from the authors.

Table 3: *Average Cost Per Unit, Standard Deviation and Coefficient of Variation for Sample Non-Contracting and Contracting Local Authorities*

	<i>1993</i>	<i>1994</i>	<i>1995</i>
<i>Non-Contracting Local Authorities</i>	(n=36)	(n=37)	(n=37)
Average Unit Cost	£54.72	£55.77	£55.93
Standard Deviation	£37.96	£34.89	£34.33
Coefficient of Variation	0.69	0.63	0.61
<i>Contracting Local Authorities</i>	(n=12)	(n=11)	(n=11)
Average Unit Cost	£28.07	£29.79	£31.64
Standard Deviation	£13.22	£15.05	£23.64
Coefficient of Variation	0.47	0.50	0.74

9. The difference between variances for 1995 is statistically significant if the outlier in the contracting authorities is not included.

10. The difference in means is statistically significant at 5 and 1 per cent for each year except 1995 when the hypothesis that the means were equal cannot be rejected at 1 per cent.

Overall, these comparisons point to significantly lower costs for contracting authorities. Furthermore, because sample variances are significantly lower for contracting authorities this could be interpreted as indicating greater attention to cost savings across the contracting sample.¹¹

Multivariate Cross-Sectional Analysis – Theory and Data

The most comprehensive approach to examining the impact of contracting out on local authority costs involves the estimation of the relevant cost function using regression analysis. Most of the previous studies conducting this form of analysis adopt the model proposed by Stevens (1978) which is based on the assumption that the production function for refuse collection can be represented by Cobb-Douglas technology such that output (Q) is a function of drivers and loaders (L), trucks (K) and authority-specific characteristics (A).

Authorities are assumed to minimise costs subject to their production function and under this assumption the following log-linear cost function can be estimated.

$$\ln(C_i) = \Sigma \gamma A_i + a_0 + a_1 \ln(Q_i) + u_i \quad (1)$$

where C_i is the cost of refuse collection, A_i is a vector of authority specific service characteristics, a_0 is a constant term, and Q_i is a measure of output in the service. The value assumed by a_1 is an indicator of the presence of economies of scale and u_i is a disturbance term.

The precise description of the model estimated is as follows:

$$\begin{aligned} \ln C = & \alpha + \beta_1 \ln \text{Unit} + \beta_2 \ln \text{Den} + \beta_3 \text{Con} + \beta_4 \text{Wheel} + \beta_5 \text{Intwheel} \\ & + \beta_6 \text{More} + \beta_7 \text{Less} + \beta_8 \text{Recyc} + U \end{aligned} \quad (2)$$

Note: These variables are described in Table 4.

This description was decided on the basis of previous empirical studies, the data provided by the survey and advice from persons responsible for refuse collection in some local authorities. Hence, the model did not include some of the variables used in studies conducted in the UK. For example, although input prices should theoretically be included they are unlikely to vary much in the cross section. This would not permit estimation of the equation. Another noteworthy exclusion in the model is “method of collection” which previous

11. As the difference in sample variances is related to the difference in sample means, Table 3 also provides the coefficient of variation for both samples. This weights the sample standard deviations by the sample means. The summary statistics indicate a large difference in coefficient of variation for 1993 and 1994. The coefficient of variation for the contracting sample is 0.30 in 1995 (50 per cent lower than the coefficient for non-contracting authorities) when the outlier is omitted.

studies found was a significant determinant of costs. Although the survey questionnaire included questions based on the method of collection the responses received showed little variation with an overwhelming majority of authorities indicating that 100 per cent of waste was collected kerbside. Method of collection was, therefore, not included as an explanatory variable.

Table 4: *Description of Variables*

<i>Variables</i>	<i>Description</i>	<i>Log / Level</i>
C	Total gross expenditure on refuse collection services including: employees, premises, transport, materials, supply of bins, apportionment of central administration costs.	Log
Unit	Number of domestic and commercial units.	Log
Den	Density of units per hectare	Log
More	Percentage of units collected from more than once a week.	Level
Less	Percentage of units collected from less than once a week.	Level
Con	Dummy Variable = 1 if privately contracted more than 10%; 0 if otherwise.	Level
Wheel	Dummy Variable = 1 if wheel bin method of collection used; 0 if otherwise.	Level
Intwhl	Dummy Variable = 1 if wheel bin method of collection introduced; 0 if otherwise	Level
Recyc	Percentage of total costs expended on recycling	Level

As the cost amounts provided by local authorities covered domestic collection in some cases and domestic and commercial collection in others, output is measured as the number of units that the relevant cost figure refers to.

Authority-specific factors specified in the model include density of the collection area and frequency of collection. The model also includes a variable covering the provision of recycling activities. Both Domberger *et al.* (1986) and Bello and Szymanski (1996) included three variables¹² accounting for waste reclamation activities in their models. Government policy on recycling in Ireland was outlined in its strategy document *Recycling for Ireland* in 1994. This reflected the requirements of the EU packaging directive which sets targets for the recovery and recycling of packaging waste. The target rates are 25 per cent for most material types and 55 per cent for glass for over five years. The role of local authorities in providing a recycling dimension to refuse collection is low.

12. The three variables were: tonnes of paper collected, number of abandoned cars collected and number of bottle banks operated by the authority.

According to Barrett and Lawlor (1995) there are two main approaches to recycling - "bring" and "collect". With the "bring" system, recyclables are brought by the waste generator to a point of collection e.g. a bottlebank. The main system is the glass bottlebank system organised by the voluntary organisation REHAB. Local authority involvement is confined to assistance in preparation of the bottlebank sites and payment of a lump sum subsidy to REHAB. The "collect" system involves the recycler collecting from the waste generator's premises and bringing the recyclables to the Materials Recovery Facility. According to Barrett and Lawlor (1995) the only example of a "collect" system is a private enterprise based in Dublin. As recycling activity by Irish local authorities over the period 1993-95 appears to have been appreciably low, the specified model includes just a single recycling variable measured in terms of the percentage of costs accounted for by the provision of recycling facilities.

The single most significant aspect of the organisation of refuse collection services since the mid-1990s has been the introduction of the wheel bin service. The introduction of wheel bins can generally lead to reduction in crew size and increases in the number of houses that can be serviced in the same time-span. On this basis the model includes a dummy variable accounting for the use of the wheel bin method of collection with the relationship between this factor and cost expected to be negative.

Estimation

The regression defined by Equation (1) was estimated by adopting two main approaches.

- (1) *Cross-Sections by Year*: Individual cross sections for each year in the data set were estimated in order to establish the relative level of costs for local authorities. Although the composition of authorities changed from year to year the number of observations per year was 48. In addition, the entire data set was combined with the cost amounts deflated using the consumer price index (*CPI*). This simply involved stacking the three cross sections and estimating the cost function using the combined data.
- (2) *Panel Data Model*: According to Gujarati (1995) combining time series and cross-sectional data is common in situations where there are a limited number of observations. Combining the data may provide more efficient estimation, and inference¹³ but if the original model is estimated using ordinary least squares after simply stacking the cross-sections this implicitly assumes both temporal stability (i.e. the regression parameters do not change over time) and cross-sectional stability (i.e. the regression

13. According to Vinod and Ullah quoted in Gujarati (1995, p.524).

parameters do not differ between cross-sectional units). These assumptions are relaxed and the regressions are re-estimated using panel data modelling. Due to a technical problem this gave inappropriate results as we explain below.

Some of the authorities provided data for one or two of the years covered so the sample was restricted to 48 observations for each of the cross-sections and 144 for the combined data.

Interpreting the Coefficients

(1) *Cross-Sections*: The coefficients in the basic cost equation estimated for three separate years; 1993-95 are shown in Table 5. Most are of the expected size and are statistically significant. The adjusted R^2 for the three years is 0.817 for 1993, 0.865 for 1994, and 0.868 for 1995. These indicate that most of the variation in costs between authorities is determined by factors included in the specified equation. It is notable that most coefficients are very stable across the three years.

Domberger *et al.* (1986) report that most of the variation in total cost can be explained by differences in the size of the refuse collection service. If number of units is included as the only explanatory variable in this study, the estimated R^2 is 0.729 for 1993, 0.818 for 1994 and 0.817 for 1995. The estimated coefficients for "number of units" in the specified cost function can be interpreted as elasticity values and the estimates are similar over the three years. The results strongly suggest a unit elasticity without evidence of economies of scale (similar to Domberger *et al.* (1986) but unlike Szymanski and Wilkins (1993)).¹⁴ The "number of units per hectare" (density) was statistically significant and stable across the three years.

The coefficient on the dummy variable for private contracting is significant in each of the years examined. The results indicate that the introduction of private contracting yields substantial cost savings. These amounted to 41 per cent in 1993, 48 per cent in 1994 and 47 per cent in 1995.¹⁵

14. Given the absence of economies of scale the model was re-estimated with the cost per unit as the dependent variable and the number of units omitted. The results for the combined regression are not markedly different from the results from the original model.

15. Note on interpretation: The estimated coefficient is interpreted as private contractors costs as a proportion of other authorities costs, given by e^b . So for 1993, $b = -0.537$. Contractor's costs = $e^{-0.537} = 0.59$, indicating a 41 per cent cost saving.

Table 5: *Summary of Regression Results – Cross-Sections by Year and Stacked*

Variable	Description	1993	1994	1995	Stacked
		Coeff (T-Ratio)	Coeff (T-Ratio)	Coeff (T-Ratio)	Coeff (T-Ratio)
Constant		3.800 (5.440)	3.636 (6.002)	3.458 (5.862)	3.530 (10.465)
Lnunt	Number of units	0.978 (11.607)	1.024 (14.229)	1.032 (15.192)	1.024 (25.728)
Lnden	Density of units	-0.1214 (-3.105)	-0.140 (-3.445)	-0.102 (-2.663)	-0.116 (-5.406)
Con	Privately Contracted	-0.537 (-2.687)	-0.661 (-3.320)	-0.633 (-3.153)	-0.585 (-5.412)
Wheel	Wheel-bin method used	0.695 (3.312)	0.391 (2.114)	0.379 (2.210)	0.452 (4.501)
Intwhl	Wheel-bin introduced	-0.124 (-0.370)	-0.378 (-1.471)	0.129 (0.480)	-0.118 (-0.786)
More	More than once a week	0.003 (0.055)	0.003 (0.500)	0.002 (0.433)	0.003 (-1.085)
Less	Less than once a week	-0.005 (-0.950)	-0.003 (-0.286)	0.009 (0.755)	-0.004 (-0.891)
Recyc	Percentage of expenditure on Recycling	0.430 (1.341)	-0.025 (-0.228)	-0.027 (-0.676)	-0.019 (-0.536)
Adj R²		0.817 n = 48	0.865 n = 48	0.868 n = 48	0.862 n=144

- Notes: (1) Statistically significant results in bold.
 (2) Ramsey's RESET test for functional form (square of fitted values):
1993: $F = 0.11481$; **1994:** $F = 0.19078$; **1995:** $F = 0.86661$; **Pool:** $F = 0.0001$
 $F_{1,38}(5\%) = 4.08$, $F_{1,38}(1\%) = 7.31$; $F_{1,134}(5\%) = 43.92$, $F_{1,134}(1\%) = 6.85$.
 (3) Heteroscedasticity (regression of squared residuals on square of fitted values):
1993: $F = 1.3000$; **1994:** $F = 0.86726$; **1995:** $F = 0.4492$; **Pool:** $F = 0.0078$
 $F_{1,46}(5\%) = 4.08$, $F_{1,46}(1\%) = 7.31$, $F_{1,134}(5\%) = 43.92$, $F_{1,134}(1\%) = 6.85$.

Table 6: *Comparison of Cost Savings Under Bivariate Cross-Sectionaal and Regression Analysis*

Year	Bivariate C-S	Regression
1993	49.0	41.0
1994	46.5	48.0
1995	43.4	47.0
	<i>Average</i>	<i>Average</i>
1993-95	46.4	45.3

Table 6 shows how the estimated savings are large and broadly similar to savings calculated earlier (see Table 3).¹⁶ This suggests that contracting and non-contracting authorities are not too dissimilar in their characteristics. Moreover the degree of savings is similar to the findings of McDavid (1985) who estimated savings of 41 per cent in a Canadian-based study. However, the magnitude of these savings is notably higher than those estimated in comparable UK studies where savings were consistently estimated at around 20 per cent.¹⁷

Although frontier efficiency models offer means of examining the efficiency of contracting and non-contracting authorities, these are not adopted because there are relatively few observations in the cross-section. Accurate measurement of any deviations from symmetry of residuals is therefore difficult. Instead the question of efficiency is examined by comparing the residuals of the regression equation, estimated with the dummy variable related to competitive tendering omitted, for both categories of authority. The residuals measure how much higher or lower actual costs are, compared to the predictions of the cost function. Authorities with efficiency measures below zero are more efficient and vice versa. Between 77 and 85 per cent of contracting authorities have actual costs below the level predicted by the specified function over the three years examined, compared to between 26 and 31 per cent of non-contracting authorities. This indicates that the incidence of efficiency is much higher amongst contracting authorities (see Figures 1-2 for 1994 data). It is worth noting, however, that the best of the non-contracting authorities perform as well as the best contracting ones. However, the long tail of poor performers in the non-contracting sub-sample differentiates the two groups. This pattern of results is similar to those found by Domberger *et al.* (1986) in their analysis of contracting out of refuse collection service in the UK sample. In addition, Figure 3 shows that the dispersion of residuals is smaller for contracting authorities thereby indicating greater attention to efficiency across the contracting sub-sample.

16. It is anecdotally acknowledged that work practices in the bigger Borough Corporations can give rise to inefficiencies in these authorities. In order to examine this issue the original regressions were re-run with these bigger authorities omitted. However, no marked change was found in the coefficient on contracting which is the key independent variable.

17. The estimated savings were:
Domberger *et al.* (1986): 22 per cent 1983-85 (pooled regression, contracting voluntary);
Szymanski and Wilkins (1993): 20 per cent (descriptive cross-sections by year), around 20 per cent 1984-86 (regression, cross-section by year, contracting voluntary); 21 per cent 1984-88 (pooled regression, contracting voluntary).
Bello and Szymanski (1996): 19 per cent, 1984-88, (pooled regression, contracting voluntary), between 27 per cent and 34 per cent for post-CCT years using 1984-93 data (pooled regression, contracting voluntary and compulsory).

Figure 1: *Residuals for Contracting Authorities 1994*

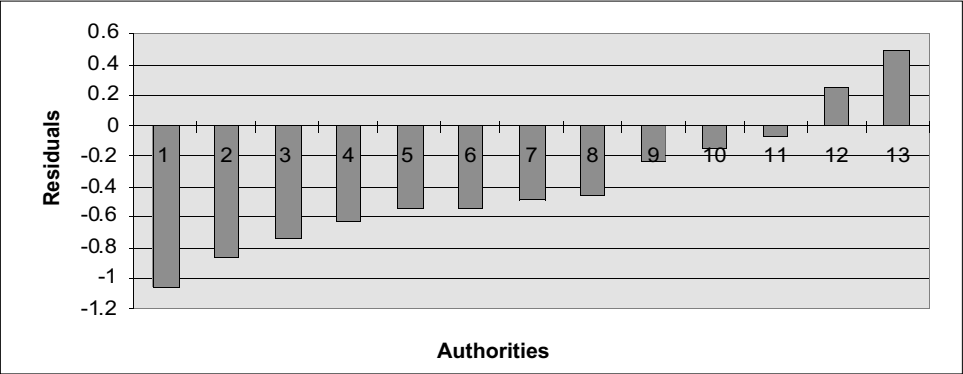


Figure 2: *Residuals for Non Contracting Authorities 1994*

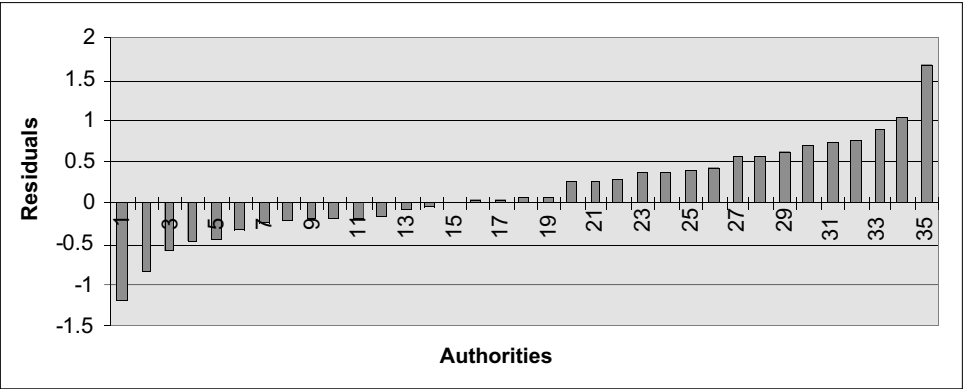
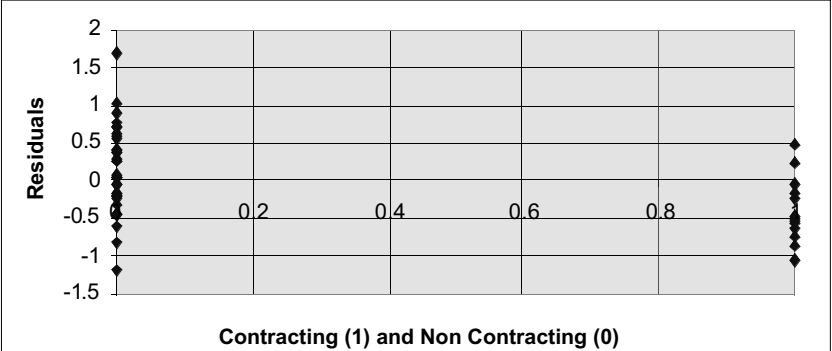


Figure 3: *Residuals for Contracting and Non Contracting Authorities 1994*



The coefficient on the variable for use of the wheel bin method indicates that this method of collection is more expensive. Given the perceived advantages of the wheel bin method the estimates appear to be counter-intuitive. The result may be explained by the phasing-in of the wheel bin system in a number of authorities¹⁸ during the years covered by the study. If the amortisation of the related investment is included in the costs figures provided this would increase costs in the short term.

The remaining explanatory variables (the independent variables to capture any effect on costs in that year caused by the introduction of the wheel bin method,¹⁹ percentage of units collected more and less than once per week and percentage of expenditure incurred for provision of recycling facilities) were not statistically significant at the 5 and 10 per cent levels.

The regression parameters estimated by stacking the individual cross-sections are also shown in Table 5. These are similar to those in the individual cross-sections in terms of magnitude and statistical significance. This confirms the temporal stability apparent in the separate cross-sections for the three years.

(2) *Panel Data Modelling*: In order to examine the issue of differences between cross-sections which are implicitly assumed away in the stacked regression, further regressions were run based on panel data modelling. Initially, group dummy variables were included to capture intrinsic differences between authorities. The results from this (fixed effects) regression are reported in Appendix 1.²⁰ The tests do indicate differences between authorities but most variables are statistically insignificant. This is not unexpected because some of the variables are time invariant.²¹ A generalised least squares regression (random effects model) was subsequently employed and the results from this regression are presented in Appendix 2. Both the fixed and random effects models estimated the coefficient for the contracting variable as positive. This result is counter-intuitive and is explained by the single council in the sample that moved from public provision to contracting out during the period examined. In this case service costs increased resulting in a positive coefficient. Therefore, the regression results from the original cross-sections are preferred.

18. The wheel bin method was introduced by 16 authorities over the period 1993-95.

19. The variables *Wheel* and *Intwhl* were tested for possible correlation. The impact of omitting the variables, on the R^2 was also tested. These tests indicated that the explanatory power of the model was not compromised by inclusion of the variables.

20. The regression results shown in Appendix 1 were estimated using a so-called *within estimator* which treats the U_i as fixed — that is, it estimates a separate intercept for every firm. This can be done by suppressing the constant term and adding a dummy variable for each N firms or, equivalently, by keeping the constant term and adding $(N - 1)$ dummies (Schmidt and Sickles, 1984, p. 369).

21. This is discussed in Schmidt and Sickles (1984, p. 369).

Overall, this cost function analysis shows that Irish local authorities have accrued substantial cost savings by contracting out refuse collection services. One question that naturally arises, however, is whether these savings represent genuine gains in productivity or efficiency? This issue has been addressed in a number of studies of the contracting experience in the UK and some writers (e.g. Ganley and Grahl (1988), Jackson (1994), Milne (1997)) have questioned the overall welfare effects of contracting out, given the (mainly case-based) evidence of reductions in wages, longer working hours and poorer conditions.

The evidence gathered from structured interviews with Irish local authorities for this study indicates that savings were derived from a number of sources. In all contracting authorities examined, interviewees suggested that lower costs incurred by private contractors were partly attributable to more flexible work practices (e.g. smaller crew sizes). While these do represent real productivity gains, some cases reported the existence of poorer working conditions in the private sector (e.g. lower health and safety standards and the employment of underage labour). The latter sources of cost savings have obvious redistributive consequences and reduce the extent to which measured cost savings improve overall economic welfare.

It is important to note that cost savings arising from contracting refuse collection services did not necessarily lead to a reduction in *overall* local government expenditure. In most cases, contracting authorities re-deployed all the relevant direct labour following contracting.²² For example, when one Urban District Council contracted out its service in 1994, it re-deployed all 10 members of its refuse collection crews. In the late 1980s, trade union opposition to partial privatisation led to one County Council creating four new positions within the local authority. The bulk of cost savings on the refuse collection service were therefore retained within local authorities rather than contributing to a reduction in *overall* local authority expenditure. However, assuming that labour has a positive marginal product after re-deployment the efficiency gains recorded above are real.

VI DISCUSSION

This paper presents the first analysis of the impact of privatising the provision of refuse collection services on costs in Ireland through competitive tendering. The study focuses entirely on local authorities that have privatised by contracting out service provision and is therefore comparable with a number of similar studies from other countries.

22. Six of the 9 authorities, interviewed as part of a wider programme of research, revealed that trade union opposition to privatisation resulted in the re-deployment of the entire refuse collection crews within the authorities.

Three separate approaches to estimating the impact on costs were adopted.

- (a) A basic comparison of the costs for contracting councils in years before and after contracting indicated that average cost savings of 33.5 per cent were accrued by contracting authorities and that these savings varied from 12 per cent to 44 per cent.
- (b) The second method compared the average unit cost of contracting authorities versus authorities still engaged in public provision of the service. The comparisons were made for the three years 1993-95 and statistically significant differences were found for all three years. Contracting authorities were found to have lower costs of around 46 per cent on average.
- (c) Multivariate statistical analysis enabling control of relevant service characteristics also revealed significant savings for contracting authorities in the region of 45 per cent on average. Furthermore, it was found that the incidence of efficiency was much greater amongst authorities that contracted out the service.

These results provide evidence of the cost savings that can be accrued by local authorities contracting out their refuse collection services through competitive tendering. The estimated cost savings are more than double the savings estimated in similar studies in the UK. Although the survey data used in the latter two methods do not permit analysis of the sources of these savings, structured interviews with contracting authorities indicate that contractors provide a cheaper service due to more flexible work practices. In some cases however, these gains are offset by the existence of poorer working conditions. Overall efficiency gains are more probable in cases where there is strong competition for the contract and the evaluation of tenders is rigorous without an over-emphasis on contract price.

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APPENDIX 1

Least Squares with Group Dummy Variables: Results

Ordinary least squares regression.	Dep. Variable = LNCOST
Observations = 144	Weights= ONE
Mean of LHS = 0.1181431E+02	Std.Dev of LHS = 0.1363607E+01
Std Dev of residuals = 0.8234416E-01	Sum of squares =0.5763477E+00
R-squared = 0.9978324E+00	Adjusted R-squared = 0.9963534E+00
F[58, 85] = 0.6746499E+03	Prob value 0.2036704E-93
Log-likelihood = 0.1931746E+03	Restr.(á=0) Log-l = -0.2484846E+03
Amemiya Pr. Criter.= -0.1863536E+01	Akaike Info. Crit. = 0.9558708E-02

ANOVA Source	Variation	Degrees of Freedom	Mean Square
Regression	0.2653213E+03	58	0.4574505E+01
Residual	0.5763477E+00	85	0.6780561E-02
Total	0.2658977E+03	143	0.1859424E+01

Variable	Coefficient	Std. Error	t-ratio	Prob t > t _{0.5}	Mean of X	Std. Dev. of X
LNUNIT	1.8738	1.373	1.365	0.17465	8.1056	1.1407
LNDENS	-1.9239	1.370	-1.404	0.16257	-0.22659E-01	2.3536
CON	0.32227	0.1074	3.002	0.00319	0.27083	0.44594
WHEEL	-0.98105E-02	0.4538E-01	-0.216	0.82918	0.32639	0.47053
INTWHL	0.69820E-01	0.3916E-01	1.783	0.07682	0.97222E-01	0.29729
MORE	-0.37869E-02	0.3815E-01	-0.099	0.92107	7.4965	15.484
LESS	-0.16182E-03	0.1382E-02	-0.117	0.90694	2.5556	11.248
RECY	0.28213E-01	0.7872E-02	3.584	0.00047	0.33819	1.2597

Estd. Autocorrelation of e(i,t) -0.239682.

APPENDIX 2

Random Effects Model: Results

Random Effects Model: $v(i,t) = e(i,t) + u(i)$

2 estimates of $\text{Var}[u] + Q * \text{Var}[e]$

Based on Means OLS

0.28665E+00 0.29016E+00

(Used Means. $Q = 0.3824$)

Estimates:

$\text{Var}[e] = 0.678056\text{E-}02$

$\text{Var}[u] = 0.284054\text{E+}00$

$\text{Corr}[v(i,t), v(i,s)] = 0.976686$

Lagrange Multiplier Test vs. Model (3) = 108.01992

(1 df, prob value = 0.000000)

Fixed vs. Random Effects (Hausman) = 57.08576 (8 df, prob value = 0.000000)

Estd. Autocorrelation of $e(i,t)$ —0.203331

Re-estimated using GLS coefficients:

Estimates:

$\text{Var}[e] = 0.943176\text{E-}02$

$\text{Var}[u] = 0.446442\text{E+}00$

Sum of Squares 0.522667E+02

R-squared 0.803433E+00

N[0,1] used for significance levels.

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>Prob t > x</i>	<i>Mean of X</i>	<i>Std. Dev. of X</i>
LNUNIT	0.90685	0.5931E-01	15.291	0.00000	8.1056	1.1407
LNDENS	-0.11500	0.3243E-01	-3.546	0.00039	0.22659E-01	-2.3536
CON	0.44721E-01	0.9293E-01	0.481	0.63035	0.27083	0.44594
WHEEL	0.20935E-01	0.4360E-01	0.480	0.63108	0.32639	0.47053
INTWHL	0.10955	0.3708E-01	2.954	0.00314	0.97222E-01	0.29729
LESS	-0.16022E-02	0.1319E-02	-1.215	0.22436	2.5556	11.248
MORE	0.89583E-02	0.5101E-02	1.756	0.07906	7.4965	15.484
RECY	0.25980E-01	0.7803E-02	3.329	0.00087	0.33819	1.2597
Constant	4.3373	0.4959	8.746	0.00000		