



A Law of Large Numbers: Bidding and Compulsory Competitive Tendering for Refuse Collection Contracts *

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Abstract. In this paper we investigate the relationship between costs and number of bidders for U.K. local authorities' refuse collection contracts. We find that a higher number of bids is associated with a lower cost of service. This finding, as well as being an important empirical verification of standard proposition in auction theory, has important policy implications. The U.K. Labour government elected in 1997 has abolished Compulsory Competitive Tendering (CCT). Our findings indicate that this would increase local authorities' expenditure in refuse collection.

Key words: Econometrics of auctions, refuse collection, tendering.

I. Introduction

This paper concerns the relationship between the number of bidders for refuse collection contracts and their selling price for a sample of English local authorities. In a survey of the empirical auctions literature, Laffont (1997) has pointed out that in all but a limited number of cases (the major exceptions mentioned were oil drilling rights in the U.S., and timber in the U.S. and Canada), the application of auction theory to data has been quite limited. Opportunities for empirical work are restricted by the lack of suitable data on bidding behaviour and the non-homogeneity of the products tendered. However, domestic refuse collection services are relatively homogeneous and the imposition of Compulsory Competitive Tendering (CCT)

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by the central government in 1988 generated a natural experiment in the effect of bidding on costs.

In this paper we find that a higher number of bids is associated with a lower cost of service, providing an empirical verification of a standard proposition in auction theory. This finding still holds when account is taken of possible endogeneity problems in the number of bids variable and the presence of non-observable local authority effects, such as political bias.

The results have important policy implications. The U.K. government has recently all but eliminated CCT. Our results would indicate that this policy change – by reducing competitive pressures – may increase the future refuse collection expenditures of local authorities.

II. Econometrics of Auctions

The econometrics of auctions literature comes in two strands, the structural approach and the reduced form approaches.¹

In broad terms the structural approach starts by postulating a theoretical auction model that is deemed to fit the characteristics of the situation at hand (say, a first price sealed bid symmetric auction). It then assumes that observed bids are the outcome of equilibrium play in this game and estimates the underlying parameters by imposing the restrictions of the model.

The advantage of the structural approach is that it can be used to recover “deep” structural parameters, such as bidders’ underlying valuation distributions. Therefore, results can be used to make predictions regarding the effects of changes in the auction environment (for example, by raising the reserve price or changing the tendering mechanism).

However, the structural approach is not so useful to test the theoretical models in themselves.² The theoretical model is assumed to hold and the restrictions implied by this assumption are then used to identify and estimate the underlying parameters.

The reduced form approach is more flexible. It usually examines the relation between variables using regression techniques and then tries to determine whether the observed correlations accord with the predictions of the theory. The drawback of reduced form models is that they cannot be used to make predictions regarding the effects of changing the “rules of the game”, since the underlying structural parameters are not estimated.

The current paper is in the reduced form tradition, since our main interest is to explore the relationship between variables. We attempt to test a general proposition in auction theory – namely that more bidders will increase competition and there-

¹ Hendricks and Paarsch (1995) present a useful survey. See also Laffont (1997).

² An exception is the test developed by Elyakime et al. (1994) in the context of their non-parametric structural estimation procedure.

fore benefit the owner of the object being tendered.³ This proposition is crucial in order to justify popular policy recommendations such as tendering, outsourcing and franchising. However, it has not received much attention in the applied literature.⁴

The proposition that more bidders increase the selling price of an object (or reduces the procurement cost of a service) may seem trivial to economists. However, confirming this with actual data is a useful first test to detect whether a given auction mechanism is functioning as it should. The absence of the expected relationship may be an indication of collusion, biases in the auction mechanism or some other undesirable effect.

The advantage of the present paper is that a relatively large data set on the tendering of refuse collection contract has been assembled. Refuse collection is an attractive service to study mainly because of its simplicity. Inputs are basically unskilled labour and trucks, output is measured simply by the volume of waste collected and quality of service does not tend to vary widely because: either the garbage is taken away or it isn't. In recent years recycling of waste has complicated the service somewhat, but it still remains an economic activity where the effects of different organisational structures can profitably be studied given the broad homogeneity of the service.

III. CCT and Data Collection

Compulsory Competitive Tendering (CCT) of blue collar services such as refuse collection and street cleaning was introduced in the U.K. by the Local Government Act 1988. This law, imposed by central government, obliged elected local authorities to expose specific services to competitive tendering at fixed intervals and subject to national guidelines. Prior to 1988 most local authorities operated refuse collection services through what is now known as the Direct Service Organisation (DSO), basically a department of the local authority operating under exclusivity conditions.

Although the details are naturally more complex, CCT can be characterised by the following process.⁵ Firms and the incumbent DSO present bids that reflect the price at which they are willing to provide the services stipulated in the contract, usually for a duration of 3 to 7 years. The lowest bid wins and the successful

³ Some readers may note that in a common value auction equilibrium bidding behaviour may result in a U-shaped relationship between bids and the number of bidders. However, we are analyzing the relation between the *winning* bid and the number of bidders.

⁴ Other authors that have analysed somewhat similar issues are Gilley and Karels (1981), Brannman et al. (1987) and Giliberto and Varaiya (1989).

⁵ More details concerning CCT can be found in Szymanski (1996) and the references therein. Other authors have examined the effect of competitive tendering on local authority expenditure for refuse collection services (see Domberger et al. (1986) and Szymanski (1996)). However, as far as we are aware, this is the first study that uses information on the number of bids for each contract.

contractor is paid each year according to the terms of his bid.⁶ The process is basically a first price sealed bid auction with no reservation price.

It is important to make the distinction between the cost to the firm (or DSO) of providing the service, and the bid, which most probably includes a mark-up over costs. Actual bids are not observed. However, we do observe the expenditure of each local authority on refuse collection. We focus here on the ex-post net expenditure by each local authority the first full year after the contract was tendered. This is the level of resources paid to the contractor. This variable, we assume, directly reflects the characteristics of the winning bid in the tendering process and will be considered as the “winning bid”.

An important stylized fact of the CCT garbage collection experience is that the expenditure by local authorities has decreased substantially as a result of the tendering process (Szymanski, 1996). Another important fact is that the incumbent DSO organizations have won a disproportionate number of contracts. This last point would seem to imply that either DSO’s have an informational advantage over private bidders, that the tendering mechanism is biased towards these organizations or that DSO’s have intrinsically lower costs.

The data on bidding numbers were collected by telephone questionnaire at the end of 1996. The timetable to be followed by local authorities was imposed by central government and the first round of tendering under CCT rules took place between 1989 and 1993, so that in many cases contracts have now been re-tendered. Responses were obtained for 175 contracts in England.⁷ Of these, 113 were contracts tendered in the first round after CCT was introduced while the remaining 62 observations related to second round contracts. Expenditure on refuse collection services as well as other local authority characteristics were obtained from the Department of the Environment. The data also included information on whether the contract was won by the in-house DSO and the contract start date taken from the CDC Contracts Handbook. The competitors to the DSO are usually private contractors, although there have been cases, albeit rare, where a DSO from a bordering authority has competed for a contract.

IV. Empirical Specification

We specify the following function to examine the effects of the number of bids on expenditure:

$$\ln(E_{it}) = x'_{it}\beta + \alpha \ln(n_{it}) + \varepsilon_{it}, \quad (1)$$

where $\ln(E_{it})$ is the logarithm of net expenditure on refuse collection in authority i in the first full year after the contract has been tendered (in April 1996 prices),

⁶ CCT rules were very strict in relation to choosing the lowest value bid. Local authorities would be hard pressed to explain why they did not chose the lowest tender.

⁷ One additional observation, the City of London, was not included in the data set given its highly peculiar structure and characteristics.

x_{it} is a $k \times 1$ vector of conditioning variables that might affect bids, $\ln(n_{it})$ is the logarithm of the number of bidders for the contract in local authority i in the year t , β is a $k \times 1$ parameter vector, α is a scalar parameter and ε_{it} is a stochastic residual.⁸ We expect α to be negative.

How do we interpret ε in Equation (1)? It could represent random shocks that influence expenditure, but it will also include unobservable (to the econometrician) variables that are correlated with bids. One example could be the local authority's attitude to competitive tendering and private provision of refuse collection services.⁹

Furthermore, informal discussions with participants reveals that private refuse collection companies are aware of these attitudes, and their decision to participate in a particular tendering process will depend on the perceived willingness of a local authority to allow private provision of the service.¹⁰ This implies that the number of bidders for a particular contract may be endogenous and correlated with the residual ε , leading to biases in the estimated parameters. Besides attitudes to CCT, there may be other characteristics of a local authority that influences both expenditures and the number of bidders but which are not accounted for by the observable variables contained in our data set. For example, geographical characteristics, distances and availability of refuse disposal sites, or any other authority specific effect.

For the above reasons, we assume that the disturbance term ε has an error component structure given by,

$$\varepsilon_{it} = \tau_i + v_{it}, \quad (2)$$

where τ_i is an authority specific effect and v_{it} is random disturbance uncorrelated across time and across authorities.

The assumed error structures implies that standard OLS estimates of Equation (1) will be biased if there is some correlation between the authority specific effect, τ_i , and any of the regressors, including the number of bids. A more robust estimating strategy is to first difference Equation (1),

$$\ln(E_{it}/E_{it-1}) = (x_{it} - x_{it-1})'\beta + \alpha(\ln(n_{it}) - \ln(n_{it-1})) + \varepsilon_{it} - \varepsilon_{it-1}, \quad (3)$$

which will eliminate the authority specific effect τ_i (as well as any other time invariant variable). In the above first differenced model, lagged variables are defined

⁸ The relation between the winning bid and n will probably be highly non-linear. In the empirical implementation we experimented with powers of $\ln(n)$ to capture possible non-linearities.

⁹ Some commentators believe that local authorities can influence the outcome of the bidding process by designing the contract in such a way that it favours the DSO. On the other hand, others have mentioned that private companies show an unfounded lack of interest in bidding for contracts in authorities controlled by a particular political party.

¹⁰ Evidence from the BRMB (1995) survey states that "Most firms had been selective about the contracts for which they bid, choosing contracts on the basis of geographical location, size of contracts and mix of work".

as the values in the year before the particular contract was tendered. For those observations that correspond to the first wave of contracts tendered under CCT, the lagged variables are for a year when the service was provided by the DSO under monopoly conditions. Therefore, n_{it-1} could be assumed to be 1 for these authorities, making the logarithm zero. For second round observations, n_{it-1} should be the number of bids that each authority received for the first round contract. We do not have information on the past number of bids for second round contracts, therefore, this is proxied by a dummy variable that takes a value of one if the observation is a second round contract. Notice that because α is expected to be negative, the coefficient on the second round dummy should be positive. Expenditure reductions for second round contracts should be smaller than for first round contracts since part of the monopoly rents would already have been eroded when the first contract was tendered.

V. Results

Table I presents the estimation results. Columns 1 and 2 are OLS estimates while the last column contains the results of the first differenced model. Conditioning variables included the logarithm of the real wage rate (regional wage from the New Earnings Survey), the logarithm of the number of domestic units in the local authority's jurisdiction, the logarithm of the number of non-domestic units, and the logarithm of bids received. Other potential regressors such as size of the local authority, motoring expenses (subindex of the RPI), a trend, and the metropolitan and London dummy variables were found to be insignificant and were dropped.

The second column includes political variables as regressors. The variables are the fraction of seats controlled by the Conservative Party and the Labour Party in the local government, respectively. The justification for including these variables is to control for unobserved attitudes towards competition that might affect costs.

For the first differenced model reported results correspond to the parameters on the first difference of the respective variable. Consequently, parameters associated with time invariant variables, such as domestic and non-domestic units, cannot be estimated.

The wage rate coefficient is positive, as expected, in all regressions but it is not estimated very precisely. The most important determinant of costs in the OLS estimates is the number of domestic units served.¹¹ The null hypothesis of no economies of scale in domestic units served cannot be rejected.

¹¹ Previous studies of refuse collection costs have found similar results. Domberger et al. (1986), find that other output characteristics such as frequency of service and method of collection do affect costs. However, the added explanatory power provided by these other variables is very low. Most of the variation in costs across authorities seems to be explained by units served.

Table I. Expenditure of refuse collection regressions

Variable	Coefficient		
	1 OLS	2 OLS	3 FD
Constant	-3.1602 (-2.45)	-4.3202 (-3.23)	-0.0931 (-2.11)
Ln(wage)	0.1376 (0.57)	0.2843 (1.18)	0.5229 (0.93)
Ln(domestic)	0.9379 (12.21)	1.0271 (11.98)	-
Ln(non-domestic)	-0.0469 (-0.65)	-0.1088 (-1.43)	-
Ln(n)	-0.1988 (-6.69)	-0.1794 (-5.69)	-0.1003 (-3.18)
Pol. control conservative	-	-0.3015 (-3.10)	-
Pol. Control Labour	-	-0.0989 (-1.18)	-
Second Round	-	-	0.1077 (2.87)
Adjusted R^2	0.84	0.85	0.07
Number of observations	174	174	169

Columns 1 and 2 are OLS estimates. Columns 3 are first differenced estimates. For this last column, parameters of time invariant variables cannot be estimated. t -ratios are in parentheses. The dependent variable in the first two columns was the logarithm of net expenditure on refuse collection the first full year after the contract started (in April 1996 prices). In the last column it was the difference between the net expenditure in the first full year after the contract started and the net expenditure the year before the contract started.

The number of bids in the OLS regressions has a significant and negative impact on expenditure.¹² Including the political variables does diminish the coefficient on bids but it still remains significant and negative.

Based on the OLS results, the presence of two bidders reduces expenditure by about 12% to 13% compared with the single bidder case. The average saving from CCT over the sample is between 20% to 22%, consistent with previous studies on the subject (Domberger et al., 1986; Szymanski, 1996).

¹² Higher order terms in this variable were found to be jointly insignificant in all regressions. Therefore, non-linearities between expenditure and the number of bids variable do not seem to be present.

In all, it would seem that the CCT tendering of refuse collection contracts has generated competitive pressures that serve to lower expenditure. However, as was discussed above, the number of bids may not be exogenous. Nonetheless, the results from the first differenced model shows that the number of bids did affect the change in expenditure achieved through tendering, although the parameter is reduced by 50% from the undifferenced model. This implies that the number of bids and expenditure may have been both influenced by local authority specific effects. However, controlling for this potential endogeneity still results in a significant and negative effect of the number of bids on expenditure. Also, as expected, second round contracts achieved less expenditure savings than first round contracts.

We have not controlled for changes in the political composition of local authorities in the first differenced model. However, this omission is probably not very important. First, for most authorities swings in political control are unlikely to be very large in the space of one or two years. Furthermore, additional estimation using instrumental variable techniques has confirmed that the results shown in column 3 are valid.

VI. Conclusions

The introduction of Compulsory Competitive Tendering in the U.K. has generated a natural experiment for testing the relationship between bidding and expenditures on refuse collection services. We find that a greater number of bids submitted is associated with lower expenditure levels on refuse collection by local authorities. If we control for authority specific fixed effects that may be correlated with the number of bids, the impact of bidding is still significant, although smaller in magnitude.

For the case of 4 bids, the cost saving would be about 13% of the original level. Although significant, it is below the 22–24% range implied by the OLS results. An explanation for this difference is that some local authorities have lower costs due, perhaps, to some special characteristic of the authority or an attitude towards the efficiency with which local government services should be provided. In turn, these special characteristics may have induced a higher number of firms to bid for the refuse collection contract. The bottom line, however, is that even correcting for the potential endogeneity of the number of bids, competition seems to have a significant impact in reducing expenditures by local authorities.

These results are consistent with what we would expect from auction theory. In addition, they also have significant policy implications. Given that the Labour Party has abolished the compulsory element of CCT, in the future it is likely that many less tenders will be held, and fewer firms will bid for contracts. Our results suggest that this will lead to an increase in service costs.

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