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"Bidding For Tendered Bus Routes In London"

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BIDDING FOR TENDERED BUS ROUTES IN LONDON

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Our primary aim is to learn what we can about the nature of the costs of bus operation in the London area under competitive conditions. Since 1933 licensing systems have effectively granted the monopoly right to offer bus service to London Regional Transport and its predecessors. The services have been produced by the enterprise on its own account, latterly with the benefit of block (or 'network') subsidy. The assertion has been made that what is presently done could be done to a similar standard at lower cost under a different administrative regime. The present British Government is committed to deregulation - the promotion of free competition - at some future date, which it has already achieved outside London. This creates a need to forecast the outcome under London conditions. In particular, it is necessary to estimate the extent of the commercially viable network under competitive conditions and, by subtraction, the liability of the public purse implied by any commitment to preserve current (or any other) service patterns.

Recent contributions to the theory of auctions (Milgrom and Weber, 1982, Bernheim and Whinston, 1986) have provided a formulation of the inherent strategic nature of bidding. They provide a foundation for empirical investigation. Comprehensive data on bids and on the payoffs to buyers and sellers are rather difficult to find. So some authors, such as Kagel, Levin and Harstad (1987) have used idealised, experimental approach to testing the theory. In this paper the theory underpins our analysis of observed behaviour in <u>real</u> bidding for contracts to supply bus services on behalf of London Regional Transport.

Full deregulation is a future prospect. In the meantime London Regional Transport has, in accordance with the legislation which created it in 1984, been offering certain of its bus routes for competitive tender. By the end of 1988 we had data on approximately 520 bids for 135 individual bus routes comprising about 25% of the current bus mileage in London. There are plans to increase this proportion to over 50% during the next six years.

Procurement of goods and services by competitive tender - or auction - raises general issues of practical importance which are of relevance in the present context. They are essentially questions of what procedures will produce the 'best deal' for the client. Where the client is a public body with an in-house production facility bidding in competition with outside suppliers, the procedures must be even-handed, and be seen to be so. We comment on the following issues. What are the effects of uncertainty and strategic bidding on outcomes? Is the 'winner's curse' a problem and what are its implications for an authority committed to continuity of service? What do bidders learn from experience, from each other's bids or in other ways? Can undue preference for particular bidders by the client be detected? When tendering is to be a process continuing over a period of years,

what strategies on the part of the client will keep potential bidders interested and in the market? What are the best ways of bundling together individual routes into 'tranches' for auction?

The tendering process

In outline the procedure has been as follows (more detail and sample documentation can be found in Newton and Rigby, 1985). London Regional Transport officials decide upon which routes, or sets of routes to put out to tender. In the early stages these were small, outer London routes, with lower than average loadings and requiring a relatively small number of vehicles to operate. One reason for this was so as to leave the field open to the smaller independent operators. More recently there have been tenders for quite large local networks of routes (one with an annual value of over £7m pa). Although it was open to all companies to bid for parts of these networks - and some did so - the experience was that they were taken as a piece by large companies (notably London Buses Limited, the London Regional Transport subsidiary). Recently there have been tenders for some larger and more central, individual routes. One contact is for a central route at an annual cost of over £2.5m involving the commitment of over 25 vehicles.

London Regional Transport officials specify minimum service level by time of day and day of week, frequency, regularity and exact route. Vehicle age or type is not specified but specified capacity must be provided and it is usual that all bidders treat a particular route as a 'big bus' route or a 'small bus' route. (Recently a maximum vehicle age limit has been imposed.) Providing that a tenderer puts in one tender that conforms with the specification he can also suggest variants. Tenders are made in the form of sealed bids. There is no public declaration of any of the bids.

The contract is a cost contract: London Regional Transport pays the company to operate the service and the operator remits revenues to London Regional Transport. The alternative of 'bottom line' contracts, where the operator keeps revenues and thus bears the revenue risks has been rejected so far. Bottom line contracts have been commonly used outside London for securing subsidised services in the commercial, deregulated environment (see Meadowcroft, 1988 for a discussion of these).

London Regional Transport provides ticketing equipment to control revenues and contracted services are subject to London Regional Transport revenue inspection. Initially, London Regional Transport also insisted on the installation of mileage recording devices (tachographs) as an aid to enforcing the contracted bus mileage. But this has been discontinued because of the impracticality of making sensible use of the information. Service frequency and regularity is also subject to London Regional Transport inspection. Persistent failure to meet specification leads to a system of formal warnings and ultimately to contract termination. This has in fact occurred on occasion.

Contracts were for three years and the contract price is reviewed annually in the light of movements of input prices. (More recently two year contracts have been bid for and are accepted if there is no cost penalty.) Nothing is laid down concerning the terms and conditions of employment of labour used by tenderers, although London Regional Transport do take these into consideration when assessing whether they think a tenderer has been realistic in his view of whether he will be able to secure sufficient labour to operate a regular service.

It is important to note that the client for the services is London Regional Transport. London Buses Limited is a wholly owned subsidiary (as is London Underground Limited). The intention is that London Buses Limited should compete for contracts on an equal basis against other, outside contractors. A particular problem concerns the 'rules of engagement' for London Buses Limited because they are an in-house contractor, because they are almost always the incumbent operator and because they get substantial block subsidy which is only loosely tied to output decisions. The rules are intended to ensure that London Buses Limited bids are constructed on a subsidy-free basis. The managing director of London Buses Limited is a member of the London Regional Transport Board but he is excluded from proceedings concerning tendering.

Our data relate to two kinds of auction. In most cases the auction is for a single, indivisible item, a route. In a few cases (the local area networks) it is a 'menu auction', where bidders can offer a set of prices for different combinations of items of their own selection.

We shall use the following terminology. Where a company makes a bid for a single route and does not also bid for it as part of a combination of routes we shall refer to it as a 'bid for an individual route'. When a company quotes a single price for more than one route this is a 'combination bid'. In making a combination bid a company must always also give a separate price for each of the routes in the package if it were to be awarded as a free standing contract. We refer to these as 'stand-alone bids'. As we shall see, strategic considerations can mean that a bid for an individual route is different in nature from a stand-alone bid.

Theoretical background

There are two alternative models one might use to characterise the industry generating our bidding data. At one extreme it might be an industry in disequilibrium. Most firms would make bids on the basis of the equipment and facilities they happen to have available or think they can get if they win the contract; bound by different agreements with labour - in the case of London Buses Limited encumbered by existing custom and practice. Alternatively the industry might be in long run competitive equilibrium. Then all bidders would have access to similar information and would put forward the same technical solutions, except to the extent that equally profitable forms of specialisation had developed. Or possibly different kinds of bid would occur because different operators were able to take advantage of particular situations peripheral to their core businesses.

Intuitively we would expect the industry to be somewhere between these extremes, initially rather close to the disequilibrium end of the spectrum and moving in the direction of the other end over the four year period of adjustment to which our data relate.

If the bids we are analysing reflect an industry which is in disequilibrium, then it is difficult to construct a suitable formal model with which to interpret our data. But firms might be expected to estimate the costs implied by their particular circumstances and to convert this into a bid by adding a margin. The profits thus anticipated would be the rents to the good fortune of happening to own the lowest cost way of fulfilling the particular contract. Bids for routes of given characteristics would vary systematically by operator (because of differing labour contracts and, possibly, because of differing corporate objectives in the recent past), by kind of vehicle proposed (because of imperfections in the new and second hand vehicle markets) and by geographical location (because the particular firms that happen to be around will be influential, there being insufficient pan-London firms to eliminate the unessential differences). One might not expect strategic bidding factors to be dominant.

If we were analysing an industry in full equilibrium the common values model of bidding behaviour would be appropriate (Milgrom and Weber, 1982). It is assumed that the inherent value of the contract (ie contract price net of costs) to all bidders is the same ex post. However, ex ante the bidders are uncertain of this value. Each bidder makes an estimate which is an independently distributed random variable. If the distributions of these random variables are known, then, in principle, it is possible to work out the bids, as a function of the payoffs, the number of bidders etc., which would constitute a Nash equilibrium set of strategies - ie a set of bidding strategies in which no bidder has a better strategy taking the strategies of the others as given.

An important feature of the Nash equilibrium is that it must take proper account of the "winner's curse". Suppose that several are bidding for an object of fixed, but unknown value. All have estimates of the value which are independent random variables, with mean values equal to the true value. If each bidder naively bids his estimate then the one who happens, by chance, to have the highest estimate will win and will probably have bid more than the object is worth. This is the winner's curse. The optimal response is to shade one's bid below the estimated value. The optimal degree of shading will be greater, the greater the number of bidders and the greater the degree of variability (ie the unreliability) of the estimates.[1] These are features we shall look for in the estimated bid functions.

Note that one implication of this is that if bidders do behave according to a strategic bidding model then we cannot naively identify observed bids with payoffs. For the purposes of predicting the procurement cost of services in a deregulated environment this may not matter, since one is then interested in bids rather than payoffs. However, this will involve predicting the number of bidders if it turns out that this affects the level of bids.

Unfortunately the dependence of bids on the number of bidders does present an econometric difficulty. We shall proceed as if the number of bidders is a predetermined variable whose value is common knowledge to the bidders. To the extent that the number of bidders is in fact jointly determined we shall introduce simultaneity bias. Hendricks and Porter (1988) discuss auctions for drainage leases on the US Outer Continental Shelf where there is an asymmetry of information: holders of neighbouring tracts are likely to have better information on the value of the lot for sale than are others. They develop a bidding model with the important feature that the bid functions for the neighbour firms is independent of the number of bidders. In principle, this model might be quite appropriate to our own context, with London Buses Limited, the incumbent firm, being the analogue of the well informed, neighbour firm. But we do not have sufficient information to implement that model, since we have no independent measure of contract profitability.

In summary we have a difficulty, which we shall not satisfactorily resolve, of distinguishing between two possible sources of variation in our bid data: one is because we may be observing an ad hoc series of samples from an industry in short run disequilibrium and the other is residual variation due to strategic bidding from members of an industry in long run equilibrium in the face of inherent uncertainty. Our method is regression analysis to

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[1]Kagel and Levin (1986) derive explicit bid functions in an experimental common value, first price auction. They found that their subjects did learn about the winner's curse with experience, but they failed to account for it fully, especially as the number of rivals increased.

explain the bids, looking for evidence of the influences of strategic behaviour predicted by the common values model. By good fortune we are also able to deduce avoidable costs of certain routes directly from the structure of a set of composite bids. This provides us with a 'cross check' of our statistical results and lends support to our conjecture that our data pertain to bids that have more to do with underlying estimated costs plus a margin than to bidding strategy.

Bids for non-combinatorial routes

We now consider the bids for single routes. In the years 1985 to 1988 London Regional Transport had put about 135 single routes out to tender. Our data is as follows: for each route

- the start date

- the value of each bid expressed in £ per bus mile and deflated using the index of average earnings for all industries (April 1985 = 100)

- The number of annual bus miles, as estimated by London Buses Limited[2]

- The ownership type of the bidder: London Buses Limited; National Bus Company or ex - National Bus Company; Municipal; or other private

- The type of vehicle proposed: new or old; double or single decker or small vehicle (ie between 15 and 40 seats; all of them new); coach.

- Some of the route characteristics: the number of vehicles required in the peak; the service frequencies on a weekday, a weekday evening, Saturday and Sunday.

Of the 135 routes in our data with either bids for individual routes or stand-alone bids, we dropped 13 because of inadequacies of ambiguities in the data. Some bids related to minor variations of specifications and were excluded. This left 480 bids for 122 routes.

Figure 1 shows a histogram of the bids. Bids exceeding £3.50 per bus mile (7 of them) were excluded from our analysis: we were advised by the assessors of the bids that the very high bids were not 'serious'; they often came from operators who had little experience of 'proper costing techniques'.

In the event only 76 of the routes were awarded to any bidder as free standing contracts. The remaining 46 were awarded as part of a combination contract for more than one route. Table 1 shows the distributions of bids made and contracts awarded by type of operator for the 76 routes. The table also shows the success rate by operator type, measured as contracts won per bid, and bus miles won per bus mile bid for.

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[2] Note that this will differ from the (unknown) figure used by non-LBL bidders. The officials notice that inexperienced operators are not good at making realistic estimates of mileages, speeds and vehicle requirements.

In interpreting these success rates it must be borne in mind that London Buses Limited made one bid for each of these routes (with one exception when it made two bids), whereas there were several contenders from the other sectors for some routes and none for others.

London Buses Limited had a relatively high success rate, although its average bid was higher than the other sectors. This does not necessarily indicate any undue preference for London Buses Limited, because, amongst other things, of the tendency of the other sectors to concentrate their interest on the routes which are cheaper to run. Notice that the success rate of the non-London Buses Limited sectors is higher on a bus mileage basis than a route basis, because of their higher average bus miles per successful bid.

Adding in routes won as part of a network contract, London Buses Limited was awarded 77 and other operators 58. The table shows the others as winning 53 routes freestanding. London Buses Limited was overwhelmingly successful in winning routes as part of a network; it won 77% by value of the contracts.

Table 2 shows the result of a binary probit analysis of the determinants of whether a bid was successful or not, using only data on tenders that were in fact awarded. If awarding on the basis of the lowest bid had been the choice mechanism then whether a bid was the lowest would have been the only statistically significant factor. The table confirms that it was a highly significant factor. But there was one other; if a bid was from London Buses Limited and using small vehicles this improved its chances of acceptance (relative to the omitted class, new London Buses Limited double deckers) even though it may not have represented the lowest bid. Conversely, there is a suggestion that a private sector small vehicle proposal had a poorer chance of acceptance, notwithstanding that it may be the lowest bid.

This does not necessarily provide evidence of undue discrimination. London Regional Transport are not bound to accept the lowest tender and often do not do so. There were several instances of very low bids being made by private companies which the London Regional Transport assessors judged to be unrealistic. That is, they took the view that the bidder would not, in fact, be able to survive at the prices bid. Having regard to the requirement for continuity of service the contract was not awarded to the low bidder. On the other hand, London Buses Limited were regarded as experienced operators who had been required to carry out its costing according to rules laid down by London Regional Transport. There was therefore more confidence that London Buses Limited would be able to 'deliver' on the individual routes. This raises questions concerning the degree to which bids should be taken at face value, and the extent to which bidders should be held liable to fulfil their bid if they win the contract.

Costs

We assume that in constructing their bids operators adopt the following procedure. It is capable of estimation with the limited information at our disposal.

The week is divided into four types of period: weekdays (Wd), evenings (Ev), Saturdays (Sa) and Sundays (Su). Annual costs of operating a given route have three distinct components:- costs per bus hour operated (eg drivers), costs per bus owned (eg capital and depreciation) and costs per bus mile (eg fuel, tyres). Thus

Cost per year = (cost per bus hour in Wd)(bus hours in Wd)
+ .
+ .
+ (cost per bus hour on Su)(bus hours on Su)
+ (cost per bus year)(number of buses allocated to route)
+ (cost per bus mile)(bus miles per year)

Dividing by bus miles per year gives

Cost per bus mile = $\underline{b}_{Wd}$(bus hours in Wd/bus miles per year)
+ .
+ .
+ $\underline{b}_{Su}$(bus hours on Su/bus miles per year)
+ $\underline{a}$ (buses/bus miles per year)
+ $\underline{d}$

But

bus hours in Wd = (hours of year in Wd)(buses allocated to route)
x (service frequency in Wd/peak service frequency)

etc.

We have sufficient information on the variables to enable us to estimate $\underline{b}_{Wd}$, $\underline{b}_{Ev}$, $\underline{b}_{Sa}$, $\underline{b}_{Su}$, $\underline{a}$ and $\underline{d}$, that is, the cost per bus hour in each kind of period, the cost per bus year and the cost per bus mile. In principle we allow each of these coefficients to vary by type of operator and by type of vehicle.

Other factors were expected to influence the bids. First the number of bidders for the route. Second, a measure of the degree of uncertainty about the returns from the route. For this we used the coefficient of variation of the bids received on the route. We were interested to know if bidders became more aware of the problem of the winner's curse with experience. If so then we would expect bids to become more responsive to uncertainty (ie to the coefficient of variation) as time passes. For this reason the coefficient of variation was 'interacted' with the time variable (the number of months since January 1985) - so that the estimated coefficient on the coefficient of variation itself depends upon time.

Several of the early contractors failed to deliver a satisfactory service; the contracts were terminated and retendered. A dummy variable was included for these routes to see whether the winning bids were lower than would have been expected - if so then the failures might have been capable of being predicted. Many of these failures (12 routes) were in fact routes originally won by London Buses Limited. (Three of the other failures were routes won by ex-National Bus Companies and one by a private company.) They were retendered by London Regional Transport because it was considered that London Buses Limited were failing to escape costs on the routes in the way that had been assumed when the winning bids were composed. To prevent a recurrence new rules were imposed on London Buses Limited after about two years of the process. A dummy variable was

included to see if this made a detectable difference to London Buses Limited's bids.

Finally, it was generally thought that there had been an upward drift in bids over time - and hence pessimism has been expressed that the initial low bids would not be likely to be repeated over a long period. Rather than include a simple time trend we used a dummy for each of the 14 tranches (bar the first) of contracts. We would expect to find larger coefficients on the dummies corresponding to the later tranches, unless there happen to be offsetting and unexplained characteristics in these tranches.

We assume that bidders are risk neutral and that in getting from costs to bids, bidders make an additive adjustment. This is a feature of some of the optimum bid functions worked out explicitly in the literature.

Results

The bid functions were estimated using maximum likelihood estimation of a lognormal model (Amemiya, 1973, as implemented in LIMDEP). The histogram of the bids (figure 1) suggests that they have the general form of the lognormal distribution. A formal test shows that the data conform to the lognormal model well; the value of the chi-squared statistic for a test that the logarithms of the bids are normally distributed is 6.49, when the 5% critical value with 9 degrees of freedom is 16.92. (In fact we found that we obtained similar estimates of both coefficients and t statistics by simply regressing the logarithm of the bid on the same independent variables.)

Table 3 shows a typical example of our results.

We expected stand-alone bids to be systematically different form the others for strategic reasons. But excluding them made no noticeable differences to our results and would have lost 130 degrees of freedom, so we included them. There were 473 useable observations on a total of 122 routes. The mean value of the dependent variable, the bid in 1985 prices, was £1.60 per bus mile.

After some considerable experimentation we were not able to find any strong relationship between bid and number of bidders. The omitted class is the case where there was only a single bid (four routes). There is a mild suggestion that bids were higher in all other cases and that bids declined very slightly as the number of bidders increased - but none of these effects is of statistical significance. So we do not find evidence of the optimal adjustment that would be predicted by the Nash equilibrium bidding model, which would predict that bids should increase as the number of bidders increased so as to avoid the winners curse (note that a "bid" in this context is the absolute value of a negative bid).

The fact that a route subsequently failed and had to be retendered did not appear to be associated with significantly low or high bids. This is, perhaps, not surprising since as already noted, the officials had already taken care to eliminate low bids that they thought likely to fail.

The new rules imposed upon London Buses Limited for calculating costs did have a discernable effect on London Buses Limited's bids. On average they increased by £0.20 per bus mile; about 12%.

Our measure of the uncertainty ascribed by bidders to a route was the coefficient of variation of the bids offered for the route. The mean value of the coefficient of variation was 0.18. The effect on bids was estimated to be

(1.72 - 0.036 x Month) x coefficient of variation
(t statistic) (4.80) (3.08)

The value of "Month" increases from 7 to 47 over our observations. Therefore, at the beginning of the tendering process an 0.1 increase in the coefficient of variation would increase the average bid by (1.72 - 0.036 x 7) x 0.1 = £0.47 per bus mile, whereas the effect would be negligible by the end of the period (since 0.036 x 47 = 1.692). It seems that over time bidders became less inclined to shade their bids conservatively in the face of increasing uncertainty.[3]

Our model of bidder behaviour is not sufficiently precisely specified for us to say to what extent we would expect uncertainty to influence bids, but we would certainly expect increasing uncertainty to increase bids, as apparently it did. We have found that the market learned to discount a given level of uncertainty less and less as time went on. (Too much weight should not be given to the fact that the effect declined to zero at the end of the period: this may be an artefact resulting from the use of a simple straight line formula for the coefficient. This must cut the horizontal axis somewhere. A quadratic formulation gave insignificant coefficients.)

We come now to the estimates of the costs per bus hour, per bus year and per bus mile; ie the coefficients b, a and d above. In principle it would be possible to estimate different costs per bus hour by time of week, size of vehicle and by type of operator. Not surprisingly, there is not enough variation in our data to allow this. We found it impossible to distinguish between different times of the week for London Buses Limited or (ex)National Bus Company operators. This may reflect the way in which labour was rostered for these operators, with an averaging of rest day and Sunday working. There was a suggestion of a difference between Private hours on Sundays and the rest of the week, although it was not statistically significant. The estimates are, in £ per bus hour (with standard errors):- London Buses Limited £4.28 (0.79); National Bus Company £3.3 (0.96); Private not Sundays £2.8 (0.77); Private on Sunday £3.91 (2.97). Alternatively, dividing private hours into weekdays and weekends gave the figures: Private in week £2.43 (1.06); Private at weekends £4.42 (2.22). Note that these are average costs per bus hour; to the extent that there are variations from the average by vehicle type (for instance because hourly pay rates are lower for the drivers of smaller vehicles) these will be picked up by the vehicle-

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[3]The question arises as to how the coefficient of variation itself has changed over time. Figure 2 shows a plot of the residuals against the starting month of the route. These represent variation in the bid unexplained by factors included in the model. There is no obvious trend in the variability of the residuals. They fall naturally into the groups indicated. The standard deviations of the residuals within these groups are 0.481, 0.309, 0.296, 0.241 and 0.306. However, this diagram shows both within-route and between-route variation. A regression of the coefficient of variation of the bids against the starting month gives

coefficient of variation = 0.15 + 0.00085 Month
(t statistic) (5.54) (0.98)

There is therefore no significant evidence of any change over time.

specific coefficients, see below.

We found it impossible to distinguish sensibly between the a coefficients and the d coefficients: the costs per bus year and the costs per bus mile. The explanatory variables had too much intercorrelation to alow them to be used together, and each alone gave a similar degree of explanation. We decided to use costs per bus mile on the grounds that is gave a slightly better fit and that operators are more likely to think in terms of costs per bus mile.

The estimates by vehicle by ownership are shown in the table. Note that they are measured relative to the omitted class, which is a new London Buses Limited owned double decker. Thus, for example, an London Buses Limited small vehicle is estimated to cost £0.52 (standard error £0.09) per bus mile less than a new London Buses Limited double decker. This figure represents expenditure on interest, depreciation, as well as fuel, tyres etc. (Old London Buses Limited single deckers and old National Bus Company single deckers do not appear in the list because there was insufficient information in the data to identify their effects sensibly).

The notable features of the costs per bus mile are (a) the considerable saving shown by small vehicles by all three kinds of owner. This will be partly due to lower rates paid to their drivers and partly to lower ownership and running costs; (b) old single deckers in private ownership have similar costs per bus mile as the small vehicles; (c) new double deckers in National Bus Company ownership show signs of being much cheaper than those in London Buses Limited ownership (although they are only represented by four bids).

Finally, we have the effects specific to each of the 14 different tranches of tendering, measured relative to the first tranche. Only one of these is statistically different from the first: the Surrey cross-border services were bid about £0.20 per bus mile higher. Whilst there are significant differences between one tranche and another, there is no obvious pattern over time. Replacing the set of tranche dummies by a simple trend variable gave an estimated exogenous growth corresponding to 4.1% pa real with a t statistic of 2.01. But it is possible that this is due to changes in the unexplained characteristics of the routes included in the tranches. If there is a genuine upward trend this may be due to a crude response to the 'winner's curse', simply perceived as an unacceptably low return on the early contracts.

Savings from tendering

Each time a set of contracts is awarded London Regional Transport makes an estimate of how much has been saved at the contract price, compared with the fully allocated costs of continuing to run the service as part of the London Regional Transport network. An allowance is subtracted for the administrative costs of the tendering operation and additional management and supervision costs of the contract, to give a net saving. Estimates for some of the tranches were, in sequence, 22%, 22%, 20%, 19%, 12%, 11%, 30%, 8%, 20%, 0%. The average, weighted by the total contract costs, is 16%.

There is some impression in these figures that the saving is declining over time. However, this conclusion needs to be regarded with caution. As figure 3 shows, London Buses Limited's real unit costs have been declining at a remarkable rate (about 22% over five years) and it is highly likely that this has only been possible, in large part, because of the competitive pressure exerted by the tendering process. In other words there is a considerable and

increasing benefit attributable to tendering. Further, as we noted above, there is no conclusive evidence that bids have been rising any faster than industrial earnings generally once the characteristics of the routes are controlled for. Therefore, a reasonable interpretation is that "competitive minimum" costs showed up in bids for tenders at an early stage, whilst the costs of London Buses Limited's regular bus network progressively fell towards this minimum. Superficially, the gains from tendering may have appeared to fall, but that has only been because the tendering process itself has been instrumental (amongst other things) in reducing the cost base against which the comparison is being made.

London Regional Transport collects two quality of service measures. An "input" measure is the proportion of the scheduled bus miles that are actually run. An "output" measure is the average waiting times actually experienced at stops by passengers. As a generalisation tendered services have shown a slight improvement on both of these measures - although there have been some cases of severe disruption to services and some of remarkable improvements. It is, perhaps to be expected that there would be an improvement overall, because of the increased level of supervision and general attention as a result of managing a contract; the cost of which is counted against the estimated financial savings.

There is a third, implicit measure - and the most important - how revenues from passengers have changed. Since cash revenues are remitted in full to London Regional Transport they are accurately known. There is something of a problem in allocating card and concessionary revenues to routes, which typically constitute more than half. However, the estimates are that as a result of the tendering exercise schedule coverage is better, reliability has improved and revenues have indeed responded positively to both of these factors. In one central London case, operated by a private company, early estimates are that revenues have increased by 15 - 20% because of the better regularity of the service.

The combination bids

We turn now to a discussion of some of the bids that were made for combinations of more than one route. In all cases it has been possible to bid for single routes. But many tranches of tendering were a consequence of local network restructuring exercises by London Regional Transport (which would have happened in any case). They involved sets of geographically inter-related routes and it was natural to expect that "combination" bids would be made. The tranches where this occurred are listed in chronological order in table 4.

When we first analyzed these bids, data up to and including the Bexleyheath tranches were available. It was apparent that London Regional Transport was adopting a policy of offering larger and larger local networks for tender. London Buses had learned that it had a good chance of winning a large proportion of these networks as a piece. There were indications that competitors were becoming discouraged in that the number of bids per route was declining[4]. We also found that relatively few operators were willing to bid for large numbers of routes; only London Buses Limited made composite bids for six or more routes. London Buses Limited and only one other offered contingent bids (£x for route a if route b also awarded).

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[4] The figure for the number of bids per route in the case of Bexley is not strictly comparable. Although LBL did put in individually priced bids, they were clearly priced so that they would be highly unlikely to be selected. We return to this below.

London Regional Transport found a further difficulty with the large networks which it awarded to London Buses Limited. The bids had been made on the basis that new operating units would be set up within London Buses Limited with different terms and conditions of employment. In the event considerable labour relations difficulties were experienced with the result that the contracts were severely delayed in starting and when they did start, the quality of service was poor because of disruption.

After Bexleyheath there were five tranches and as the table indicates, only three of these were conducive to composite bids. The trend towards increasing size was reversed. London Regional Transport began to follow a policy of finding a balance, with some tranches allowing networks and some not. Then different operators, with advantages in bidding for different kinds of tranche, would each have their opportunities. Interest from competitors revived and London Buses Limited was the dominant winner in only one of the three. It is also noteworthy that several private sector enterprises saw the possibilities for composite bidding: there were four companies who bid for six or more routes in a single bid, in addition to London Buses Limited.

The bids put in by London Buses Limited in the cases of Harrow and Bexleyheath are sufficiently rich to reveal useful information about their bidding strategy and their underlying costs.

Harrow

London Buses Limited made a bid for all the routes offered (which was accepted). It also offered prices for all the routes but with one dropped, in turn. The difference made to the total bid by dropping each route in turn must reflect the differences in total costs with and without the routes. This is one way to derive an estimate of the avoidable costs associated with each route. The avoidable costs would be chiefly concerned with the extra fuel, extra wages, greater bus use etc. associated with adding or subtracting the route, together with the return needed to remunerate the bidder's effort.

Table 5 sets out information about London Buses Limited's bids for the Harrow routes. Routes P - V were bid as double decker vehicles and W - Z as small vehicles. Row A sets out the estimated avoidable cost expressed in £ per bus mile. Row B is the bid predicted by the statistical model estimated in the previous sections.

The statistical predictions are much closer to the estimated avoidable costs than are the stand-alone bids (not shown). This gives us some comfort that our statistically estimated bid functions do relate to underlying costs and are not dominated by strategic considerations.

Row C shows the mark-up of the stand-alone bid over the estimated avoidable cost expressed as a% of the avoidable cost. Row D is the avoidable cost as a % of the stand-alone bid. Row E shows the vehicle requirements for each route.

The ratios in row D behave as one might reasonably expect. As the scale of the route added to the system grows, as evidenced by the number of buses involved, the avoidable costs rise as a proportion. This is simply, it could be argued, because the smaller the add-on, the more likely it is to be accommodated within the existing slacks in the system. Thus route R has a ratio of 72% and is nearly six times as big in terms of buses as route Q which has a ratio of 22%.

The puzzle arises when we consider the mark-ups(not shown) and these as a proportion of the avoidable costs. As a proportion of avoidable costs the mark-ups vary greatly. But the absolute figures show surprising similarities. The W - Z figures are all within £11,000 of each other. Among the other routes a particular figure appears three times and a look-alike also appears. The natural interpretation of this is that we have encountered a rule governing mark-ups - for example that any separate bid, of whatever scale, must have a minimum built in. If so then this would be a grave handicap to London Buses Limited in individual bids for routes.

Looked at another way, these mark-ups are high - high enough to raise the question of whether they were ever intended as bids to be accepted. Rather, it might be argued that the intention was to make sure the individual bids were too high, so as to say to the tenderer, in effect, "accept all or nothing". This is supported by the comparison of London Buses Limited's stand-alone bids with those of other bidders, which were much closer to the avoidable cost bids in row A.

This is a legitimate bidding tactic, intended guard against winning combinations which might have included only part of London Buses Limited's offerings. As it turned out London Buses Limited happened to be a sole bidder on three of the contracts. If London Buses Limited was indeed following the tactic it got an unanticipated bonus by inflating alternatives to its 'serious' total bid.

Further study of the complete set of combinatorial bids made by London Buses Limited confirms the importance of the avoidable cost calculations. Using these we can reconstruct each combinatorial bid as a set of routes to be provided, each route valued at its own avoidable cost plus a mark-up to reach the actual bid. The avoidable cost proportion rises systematically with the scale of the bid, apparently reflecting judgements about what could be done to scale down the operation as routes were excluded from the package.

An alternative to viewing the bid structure merely as a tactic to ensure that smaller packages were not selected is to say that the bids truly do represent how London Buses Limited adjust avoidable costs, or overheads, according to the rules set by London Regional Transport. If so the figures reinforce the earlier point that London Buses Limited's ability to bid for small packages is severely constrained. The implied elasticity of adjustment of the mark-up element to scale is 0.375.

Whether or not the tactical interpretation is correct, a concern must arise that the bid for all the routes (the wining bid) was not commercially realistic in view of the costs additional to avoidable costs which are involved for that scale of operation: the mark-up was less than 15%, which seems low.

Finally, London Buses Limited did not bid for all the combinations. It is possible to show that there could have been London Buses Limited bids which, if constructed as it appears the rest were, would have enabled London Regional Transport to have selected a lower price total combination, involving some of the bids on offer from other companies. London Buses Limited was fortunate! Had there been a rule that all combinations must be covered by bidders if combined bids are submitted at all the outcome might well have been different. Such a rule might be a useful safeguard.

Bexleyheath

The London Buses Limited bids for this tranche confirm the bid construction inferred above. This time London Buses Limited made a specific distinction between the 'avoidable cost' bids, called 'overhead paid' bids, and stand-alone, bids. The tenderer was invited to select any combination of the 'overhead paid' bids subject to two constraints - a fixed overhead to be paid on any selection and a peak requirement of 74 big buses, which related to the capacity of the local garage.

The big bus requirement over all routes was 86. Hence the tenderer had to drop routes involving 12 buses or more if London Buses Limited's low bids were to be taken. Small buses were not subject to the garage constraint but the fixed overhead applied to them. London Buses Limited also made combinatorial bids subject to the overhead being paid.

As in Harrow London Buses Limited's individual route bids were very high. This had the effect of driving the tenderer to accept the largest number of London Buses Limited bids subject to the 74 bus garage constraint. An extra inducement to do so was to ignore any requirement for garage space for small buses by making the overhead cover them too.

Because, in this case, London Buses Limited was offering any combination of routes, its combinatorial bids totalled 2^{20} - 1 or about 1.05 million bids for the 'overhead paid' routes alone. It also put in 20 specific combination tenders, although it is not clear why it did so. Some did in fact offer the tenderer savings over the individual overhead paid routes as one would expect. But some combinations offered totalled more than the sum of the individual overhead paid bids.

No other bidder attempted anything so complex. Only one company bid for all the routes. One other offered one combination.

London Buses Limited's offering of prohibitively expensive stand alone bids plus low overhead bids was successful. The tenderer's choice was in effect reduced to seeking the cheapest way to meet London Buses Limited's garage constraint.

Conclusions

This paper is a report on work in progress: there is more to be done with this data and new data is being generated as time passes. London Regional Transport now have the job of reletting contracts which have run their initial three year course which will create new problems and new data. We hope to test some of the principles of optimum bidding in menu auctions, worked out by Bernheim and Whinston (1986).

Effects of tendering

Tendering has been a key element in reducing costs of operations and, in particular, the costs of London Buses Limited, to which it gives a bargaining focus. Service levels and revenues have generally improved. These conclusions are similar to those drawn by Domberger, Meadowcroft and Thompson (1986, 1987) in the contexts of refuse collection and hospital domestic services.

Bids for individual routes

Our feeling is that our results are consistent with observations taken from an industry in a state of disequilibrium. We can identify statistically significant, systematic differences between bids from different kinds of operator and associated with different kinds of vehicle. One would not expect this in long run

equilibrium. In the case of the bids for individual routes strategic bidding is therefore likely to have been less important than it would be in industry equilibrium. We think it not unreasonable to regard bids as being reasonably closely related to avoidable costs, with bidders hoping to cash in the rents they may enjoy by virtue of their particular circumstances. Dissection of combination bids has allowed us to deduce avoidable costs directly for certain routes and these match the predictions of the statistical model reasonably well.

There is some evidence of the kind of strategic bidding behaviour that would be necessary in order to make money in long run industry equilibrium, as predicted by Nash equilibrium in a common values model with uncertainty. Bids do not appear to be more conservative when there are many bidders - as they ought to be to avoid the 'winner's curse'. But they are more conservative if the degree of uncertainty rises - although the sensitivity to uncertainty appears to have fallen over time.

Combination bids for networks

The opportunities to bid for large networks appear to have given more scope for strategic or 'manipulative' bids. The two case studies suggest the following misgivings (which seem to be confirmed by further work on the Wimbledon case).

Under the rules London Buses Limited's bids were both permissable and well judged. From London Regional Transport's point of view the dangers would seem to be these:-

a) there was no effective comprehensive alternative bidder in the market. The other companies' efforts were puny compared to London Buses Limited's.

b) London Regional Transport may have had a cumulating problem of credibility via a vis big companies wishing to take on substantial local network operations. As already noted, there are now signs that other companies are becoming willing to match London Buses Limited on the more recent and smaller tranches. London Buses Limited has not dominated in all recent cases (table 4). But it is still the case that no large network bid has been won by any operator other than London Buses Limited although attractive offers have been on the table.

c) smaller operators may have gained the impression that they cannot hope to succeed in tranches where the opportunity exists to group routes. In fact it would have been possible to have included more operators at relatively little increased cost. Would this have been worthwhile in the interests of keeping their interest alive?

d) London Buses Limited's successful bids contain low aggregate mark-ups over avoidable costs. These are consistent with the rules set by London Regional Transport. But can it really adjust its overheads to this degree, or are costs being absorbed in the other, core operations? Without comparable combined bids from outsiders this is difficult to judge.

Two of the lessons to be learned have already been implemented, at least in part. They are that the tranches should not be too big and that at least some of the tranches should not be for sets of routes which could be claimed as a unitary network. We think that another useful lesson may be that it would be wise to insist that if a company makes a combination bid then it must make bids for all combinations. Finally, no revision of bids is allowed. This results in quite disparate reactions from bidders which London Regional Transport cannot adjust. Such inflexibility is characteristic of public sector bidding, but not of the private sector. Giving

London Regional Transport the right to negotiate should be considered.

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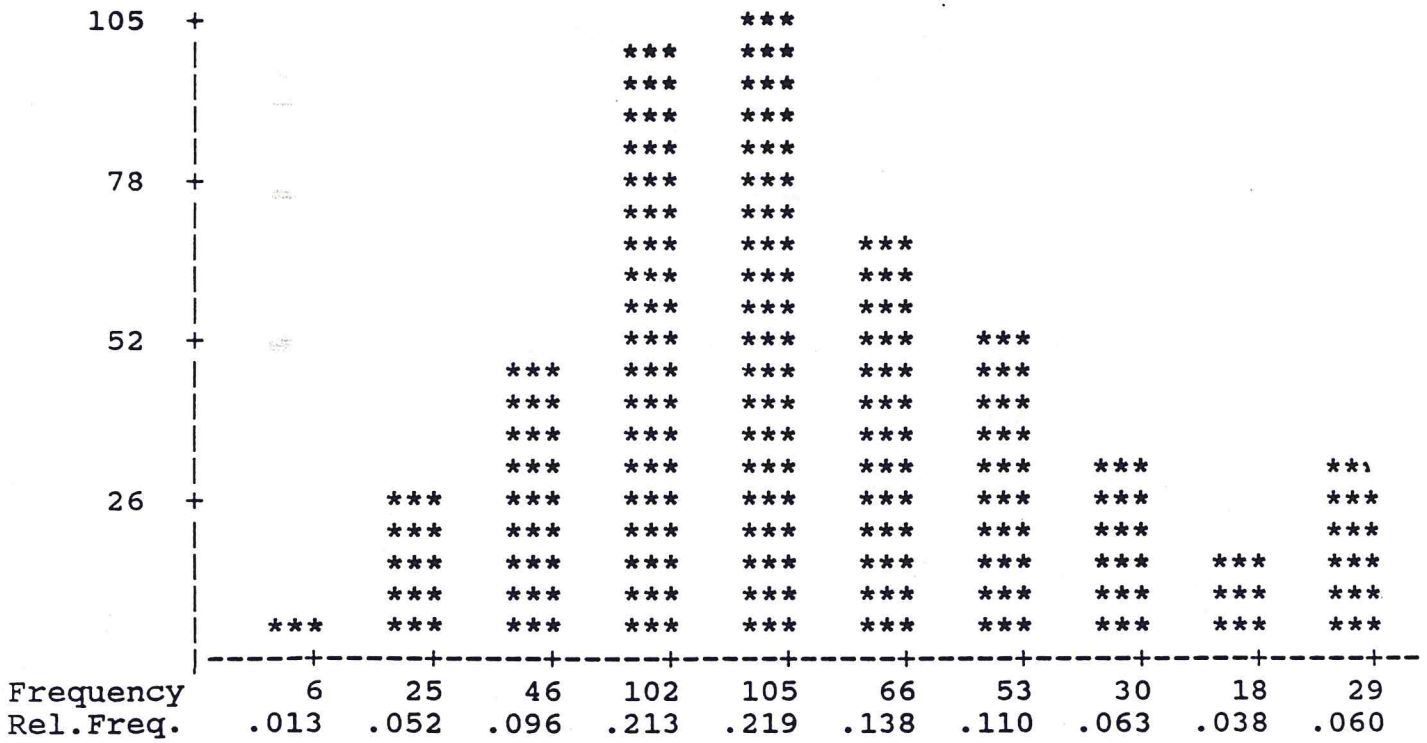
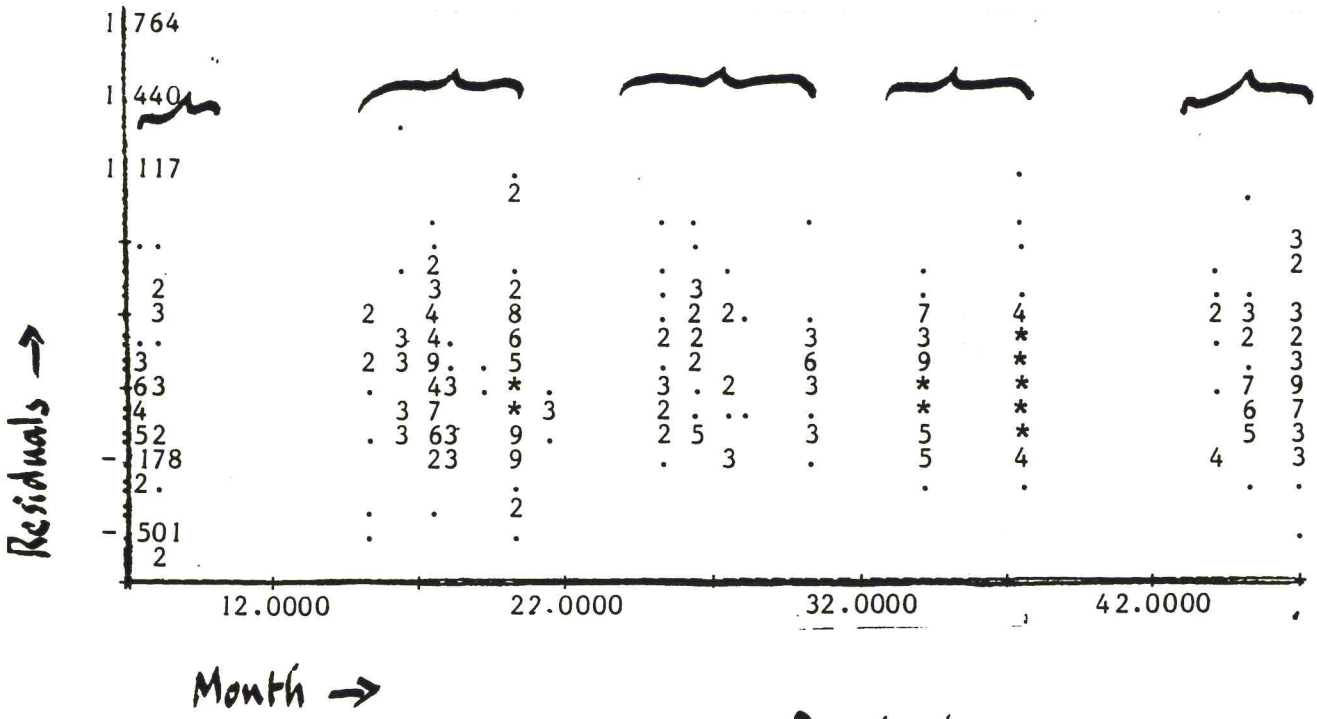
Lower limit	Upper Limit	Frequency
**********	.8417	6
.8417	1.0374	25
1.0374	1.2330	46
1.2330	1.4286	102
1.4286	1.6242	105
1.6242	1.8198	66
1.8198	2.0154	53
2.0154	2.2110	30
2.2110	2.4066	18
2.4066	**********	29



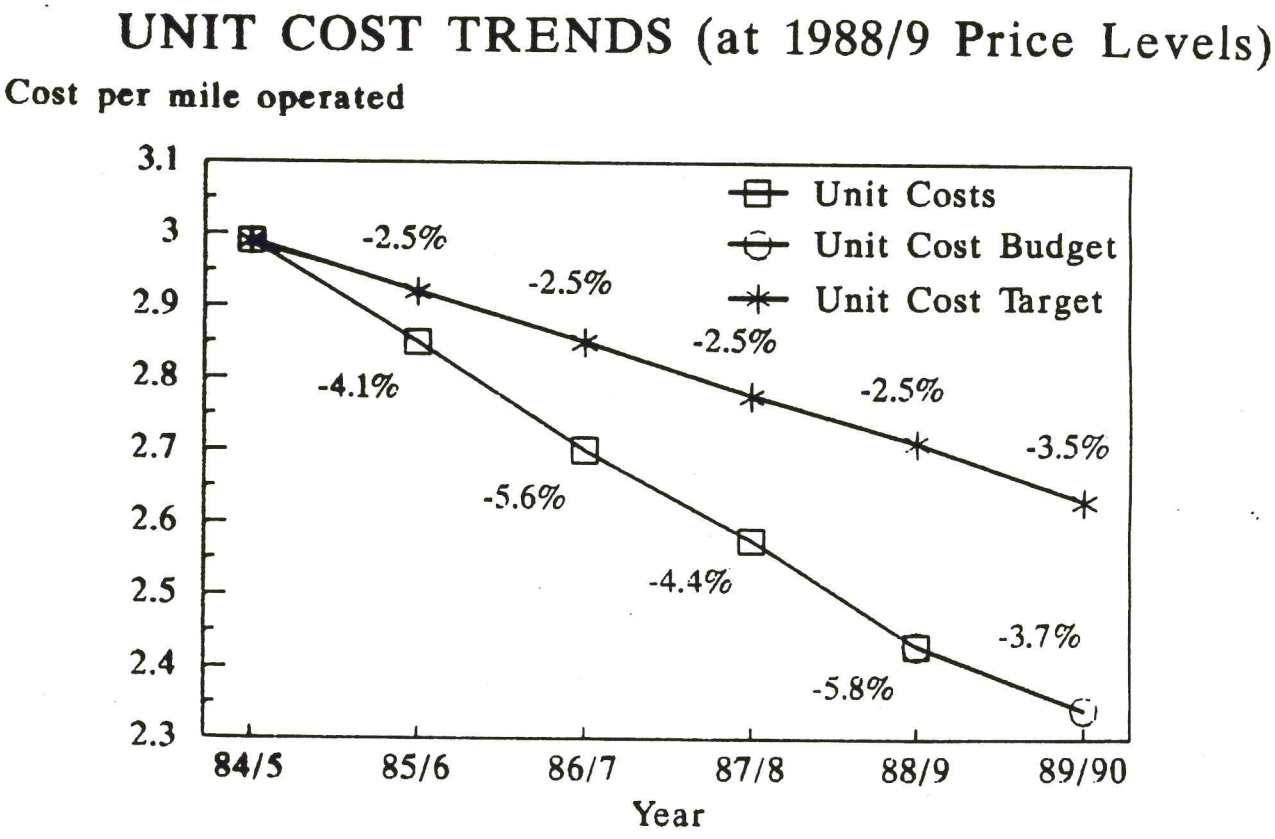
Histogram of bids in sample.

Figure 1.



Regression Residuals

Figure 2



London Buses Ltd. Unit Costs

Figure 3

	All	%	LBL	%	NAT	%	PRIVATE	%	MUNICIPAL	%
Winning bids (no.)	76	25	23	30	28	29	21	20	4	17
Bids made (no.)	300		77		96		104		23	
Miles won (thousands)	21,817	27	5,582	26	8,712	32	6,372	25	1,152	23
Miles bid for (thousands)	79,512		21,750		27,203		25,451		5,107	
Mean miles won (thousands per route)	287.1		242.7		311.1		303.4		287.9	
Mean miles bid for (thousands per route)	265.0		282.5		283.4		244.7		222.0	
Mean bid (£ per bus mile)	1.625		1.70		1.61		1.60		1.55	

TABLE 1

Probit analysis of determinants of a bid winning

	Coefficient	t-ratio
Constant	-0.99	-2.56
Lowest bid for route	1.65	8.12
Old LBL double	0.24	0.67
Old LBL single	0.38	0.75
LBL small	1.41	3.07
Old NBC double	0.22	0.63
Old NBC single	-0.03	-0.06
NBC small	0.28	0.57
New private double	-0.28	-0.53
Old private double	0.31	0.84
Private small	-1.17	-1.79
Municipal	-0.09	-0.20
Number of bids for route	-0.10	-1.54

Log-likelihood	-116.82
Restricted log-likelihood	-169.79

TABLE 2

Lognormal regression

Dependent variable is the bid (at constant prices)

	Coefficient	t-ratio
Constant	0.95	3.47
2,3 or 4 bids	0.22	0.88
5 bids	0.19	0.76
6 or 7 bids	0.18	0.72
Contract subsequently failed	-0.11	-1.08
New rules for LBL bids	0.20	2.79
Coef. of variation	1.72	4.80
Coef. of variation x month	-0.04	-3.08
LBL hours	4.28	5.45
NBC hours	3.33	3.45
Private non-Sunday hours	2.85	3.69
Private Sunday hours	3.91	1.32
Municipal hours	-0.18	-0.25
LBL old double	-0.18	-1.62
LBL old single	-0.20	-1.34
LBL small	-0.53	-5.33
NBC new double	-0.40	-1.76
NBC old double	0.11	-0.72
NBC old single	-0.14	-0.77
NBC small	-0.47	-2.88
Private new double	0.01	0.06
Private old double	-0.10	-0.80
Private new single	-0.06	-0.44
Private old single	-0.32	-2.18
Private small	-0.32	-2.61

TABLE 3

cont/d over

	Coefficient	t-ratio
Coach	0.05	0.14
Second tranche	0.12	1.75
Herts/Essex	0.07	0.69
Surrey	0.20	2.24
Orpington	-0.05	-0.52
Third tranche	0.02	0.30
Kingston	-0.12	-1.08
Retendered routes	0.12	0.98
Harrow	-0.13	-1.21
Bexleyheath	-0.11	-0.98
Fourth tranche	0.22	1.49
Wimbledon	0.14	0.87
London Country NE retender	0.16	0.95
Surrey Docks	0.16	1.33
Log-likelihood	-128.64	
Restricted log likelihood	-259.62	

TABLE 3 (cont'd)

	Bids per individual Route	Proportion of contract value won by LBL (%)
Surrey	3.5	36
Orpington	2.25	83
Kingston	2.43	87
Harrow	2.09	100
Bexley	3.20*	87
Hornchurch	6.33	12
Wimbledon	4.50	100
Surrey Docks	2.40	47

TABLE 4

* See footnote 4.

TABLE 5

Routes:-	P	Q	R	S	T	U	V	W	X	Y	Z
A	1.56	2.62	1.50	1.52	1.39	1.88	1.78	1.25	1.14	2.21	1.30
B	1.79	2.31	1.56	1.52	1.47	1.61	1.71	1.71	1.58	2.06	1.71
C	59	339	39	80	138	66	55	134	78	176	128
D	63	22	72	56	42	60	63	43	56	36	44
E	12	3	17	11	4	8	10	6	10	5	6