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Does Competition for the Field Improve Cost Efficiency? Evidence from the London Bus Tendering Model *

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Abstract

In this paper we investigate the relationship between cost and number of bidders for local transportation contracts in London. Using an original database on 806 calls for tender on local bus transportation routes we find that a higher number of bidders is associated with a lower cost of service. This finding, in addition of being one of the few empirical tests of a crucial theoretical issue, has important policy implications, especially for countries in which bids are organized such that only few bidders are allowed to participate (e.g. France). More precisely, our results point out that the allotment of an urban transport network may be a source of significant costs reductions.

Key Words: public transportation, competitive tendering, auctions.

JEL Codes: H0, H7, K00, L33.

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1. Introduction

In many countries, governments are pushing for the introduction of competition in the organization of public services and more broadly in public procurement (Armstrong and Sappington 2006). The development of competitive tendering throughout the world is a good illustration of this trend. In Europe in particular, several recent directives are to be implemented to make the use of competitive tendering in local public services compulsory (e.g. Regulation (EC) N°1370/2007).

The use of auction procedures aims at replacing competition in the field by competition for the field. The intuition is that an increase in competition (*i.e.* the number of bidders) should encourage more aggressive bidding, so that, in the limit, as the number of bidders becomes large, prices[1] decrease toward efficiency prices. This is called the *competition effect*.

However, recent theoretical developments taught us that the impact of the number of bidders on prices is not systematically negative and it is not an easy tack to empirically assess it.

First, competition may not negatively impact on prices when auctions are common-value auctions, in which the competing bidders are differentially and incompletely informed about the value of what is auctioned. Indeed, in such situations where the buyer's estimate of an asset's value is affected by the perceptions of others, the winner's curse pushes toward conservative bids (*i.e.* lower expected prices). This *winner's curse effect* even increases with competition so that when this effect is greater than the competition effect, prices are likely to increase with the number of competitors. Consequently, it often appears difficult to isolate the competition effect and estimate the impact of the number of bidders on prices.

Second, even if competition among bidders leads them to reduce their price, the winning bidder may, *ex post*, renege on her initial commitments. Recent empirical works indeed point out that it may be misleading to consider public private contracts as renegotiation-proof agreements. Indeed, in a study of more than 1,000 concession contracts in Latin America, Guasch (2004) shows that more than 50% of them are renegotiated only two years after being started. Athias and Saussier (2005) obtain the

[1] As we deal with public utilities services, prices refer here to the amount required by bidders to operate the service. This represents expenses for public authorities. Hence their objective might be to minimize it.

same result with contracts signed in Europe. This empirical fact is crucial for studying the impact of the number of bidders on prices and might lead us to reconsider the relevance of the traditional arguments on competitive tendering. Indeed, the potential for renegotiation might lead bidders to make very aggressive bids, even in common-value auctions. From an empirical perspective, this implies that the assessment of the impact of the number of bidders on price requires to control for potential contractual renegotiations. As far as we know, it has not been done in previous empirical studies.

At last, opportunities for empirical works are restricted by the lack of suitable data on bidding behavior and the non-homogeneity of the tendered products although some empirical tests exist and provide estimations of the effect of the number of bidders on prices (Thiel 1988; Brannman *et al.* 1987; Gómez-Lobo and Szymanski 2001; Hong and Shum 2002; Bajari and Hortaçsu 2003; Athias and Nunez 2006), or of the effect of information disclosure on prices (De Silva *et al.* 2005).

In this paper we investigate empirically the relationship between costs of service and number of bidders in the London bus market. This case is of particular interest because it allows us to control for the potential for contracts renegotiations. Indeed, London buses' contracts are short-term contracts, which are severely regulated. In addition, following Cantillon and Pesendorfer (2006a and 2006b), we can reasonably support the hypothesis that auctions in the London bus market are private value auctions, that is to say that cost forecasts by competitors do not lead bidders to revise their own cost estimates. Thus, we should observe only a competition effect in our data.

Using an original database on 806 calls for tender on London bus contracts we find that a higher number of bidders is associated with a lower cost of service. This result holds even when taking into account the potential endogeneity of the number of bidders. This finding, in addition of being one of the few empirical tests of a crucial theoretical issue has important policy implications, especially for countries in which bids are organized such as only few bidders can answer (e.g. France). Our results indeed point out the cost reductions that may accrue from the allotment of urban transport networks and the regulator's ability to commit.

2. Auctions, number of bidders and prices: Propositions

a. *Number of bidders and winning bids in common-value auctions*

Auction theory predicts that an increased number of bidders might not always increase winning bids depending of the type of auction and the characteristics of the good being sold. More precisely, common-value auctions are characterized by the winner's curse effect, an adverse selection problem that arises because the winner tends to be the bidder with the most overly optimistic information concerning the object's value. If a bidder bids naively, with a bid based only on his private information, this would lead to negative expected profits. Consequently, in equilibrium, we might expect a rational bidder to internalize the winner's curse problem by bidding less aggressively (Milgrom 1989).

In such common value auctions, the increase of the number of bidders has two counteracting effects on equilibrium bidding behavior. On the one side, we might expect a competition effect leading to more aggressive bids: the more the bidders, the more aggressive one bidder should be to maintain his chance of winning. On the other side, we might expect the winner's curse effect to become more severe as the number of bidders increases. Depending of the relative size of these two effects, the impact of the number of bidders on the winning bid might be positive or negative.

b. *Number of bidders and winning bids in private-value auctions*

Recent developments in the literature on auctions point out that even without any common-value dimension but considering the possibility for bidders to make prediction errors[2], competition induces a selection bias in favor of optimistic bidders, even in the case of pure private-value auctions (Compte 2004). The winner's curse phenomenon is thus not specific to common-value setting. The more bidders, the higher the probability of the winner's expected profit to be negative. To be immune from the winner's curse effect, bidders should then mark-up the estimation of their costs (mark-down their estimation of the value of what is auctioned), the size of this mark-up increasing with the level of competition (i.e. the number of bidders).

[2] For example because bidders might be overconfident in the signal they receive about their costs or valuation of the auctioned good.

c. Number of bidders and winning bids in renegotiated contracts

As already mentioned, auctions may be a way to introduce competition in public utilities industries. However, as pointed out by Guasch (2004), it is sometimes hard to "sanctify" the bid. Many (long term) auctioned contracts are renegotiated shortly after their signature. Depending on the bidders' beliefs concerning the probability of a future renegotiation, competition and winner's curse effects may be affected or even inexistent, simply because bidders are not committed with auction's results.

d. Proposition

The type of auction (private-value or common-value auctions) is clearly linked with 1/ the characteristics of the goods or services to be provided and with 2/ the type of tendered contract that supports the provision of such goods or services. Indeed, a private-value auction is characterized by the fact that all bidders perfectly know the value for them[3] of what is auctioned (*i.e.* they perfectly know the cost they will support to operate the service and the gains that will be generated). On the contrary, a common-value auction is characterized by the fact that the value of what is auctioned is the same for all bidders but is unknown to them.[4] It is thus straightforward that auctions concerning goods or services for which bidders are equally efficient (same costs) but differ in their valuation of what is auctioned are specific ones, characterized by uncertainties about costs and future gains (i.e. future demand). Those uncertainties are not independent from the kind of contract signed by the winner. This leads us to the following proposition:

[3] Another way to put it is that if bidders' gains (G) are depending on an external signal x_i, we have $G_i = x_i \;\forall i$. Valuations or costs are drawn from independent distribution.

[4] Another way to put it is that if bidders' gains (G) are depending on an external signal x_i, we have $G_i = G \;\forall i$

Proposition: The winning bids should increase with the number of bidders if

(1) The bidders know perfectly the value of what is auctioned (i.e. private-value auctions),

(2) The bidders do not make any errors concerning their costs (i.e. no winner's curse effect due to prediction errors),

(3) The bidders know that contracts will not be renegotiated (i.e. bidders commit to their bids).

In other words, if conditions (1), (2) and (3) are respected, we should observe only a competition effect, that is to say a negative impact of competition on prices.

Surprisingly, although this issue is central in auction theory, the ratio of empirical tests over theoretical developments remains too low to conclude or even highlight the debate on the impact of the number of bidders on the price of public services. As mentioned before, the confrontation of auction theory to facts has been limited by the lack of suitable data on bidding behavior and the non-homogeneity of the tendered goods. However, bus transport services in London are relatively homogeneous and the compulsory use of competitive tendering since 1994 provides a natural experiment to assess the effect of bidding on prices. Furthermore, we believe that in this case the three necessary conditions for our proposition to hold are respected, allowing us to estimate a pure competition effect.

3. The London Bus Tendering Model – Description and Data

London's population, currently 7.9 million, and population density, currently 4,900 persons per square kilometre[5], are considerably greater than those for each of the other metropolitan areas in the UK and are greater than in most of the big European cities. With approximately 700 routes serving an area of 1630 square kilometres and more than 6 millions passengers every weekday[6], the bus network is an essential element to support economic and social activities in the city. As a consequence, the

[5] Source: Office of National Statistics.
[6] Source: Transport for London (2008).

functioning of the London bus routes market, which received 700 millions Pounds of subsidies in 2008/2009[7], has deserved particular attention, especially since the reform of 1984.

a. The 1984 reform

The regulatory framework, the contracting mode and the form of ownership within the London bus market have all evolved over the past 20 years as a consequence of the London Regional Transport Act 1984. Prior to the reform launched by the Act, bus operations in London were provided by a publicly-owned and subsidised company, London Transport (LT), which was not exposed to competition. In the mid 1980s however it was decided that, in London, the industry should remain regulated but that competitive forces should be introduced *via* a regime of bus route tendering[8] in order to increase efficiency and reduce financial assistance from public funds. Consequently, in 1985, LT created an operational subsidiary known as London Buses Limited (LBL), which was then split into 13 locally based subsidiary companies. In the same year, LT also set up the Tendered Bus Division to begin the process of competitive tendering. This required LBL's subsidiaries to compete against operators in the private sector for the opportunity to run individual bus routes. As a step towards the reform of the sector, LBL subsidiaries were privatised in 1994. The introduction of competition for the market and the involvement of the private sector have therefore been gradual. Indeed, the first tenders took place in 1985 and, until 1994, competition for the right to serve the market was between the public sector subsidiaries of LBL and an emerging group of private bus operators[9]. In the early stages the routes put out to tender were very small, peripheral routes requiring few vehicles to operate so as to facilitate the entry of small independent operators (Glaister and Beesley 1991). Progressively, more and more routes were put out to tender such that, by the end of 1995, half of the network had been tendered at least once[10] and, in the beginning of 2001, all the bus miles operated were supplied under tendered contracts.

[7] Source: Greater London Authority (2010).
[8] The reform was more radical outside the greater London since bus operations throughout Great Britain were completely privatised and deregulated.
[9] National Bus Company operators, municipal operators and other private operators.
[10] Non-tendered routes remained operated by the subsidiaries of LBL under a negotiated block grant.

b. The tendering process and the auction format

Since 1995, an invitation to tender is issued by the regulator (Transport for London –TfL-, the former London Regional Transport) every two or three weeks so that about 20% of the London bus network is tendered each year. The tenders are open to all licensed operators and the invitation may cover several routes, usually in the same area of London, and provides a detailed description of the service to deliver (e.g. service frequency, vehicle type, network routes). The contract to operate each bus route is generally for five years, with a possible 2 years extension (TfL 2006). Since most of the contracts are gross cost contracts[11], the bids consist of an annual price at which the bidder accepts to provide the service. The criterion for selection of a winning bid is the "best economic value" that is to say that the contract is awarded to the lowest bidder but that other qualitative factors may also be considered at the margin. Thus, for instance, promises of extra off-peak or Sunday services or promises of new vehicles may be considered and lead to the selection of a bidder who is not the lowest one.

As already suggested, the auction format adopted in the London bus routes market is a variant of a combinatorial first price auction. Indeed, bidders can submit bids on any number of routes and route packages. Thus, for instance, a bidder can submit a bid on a package without submitting a bid on the individual routes included in the package. But bidders are not allowed to bid more for a package than the sum of the stand-alone bids of that package. The auction format therefore implies that bidders are committed by their route bids, that is to say that stand-alone route bids define implicitly a package bid with value equal to the sum of the route bids. This rule was motivated by the regulator's wish to detect and exploit economies of scale despite the fragmentation of the network. The auction system adopted in London is therefore an attempt to reach two contradictory objectives. On the one hand, the unbundling of the network is expected to encourage the participation of small bus operators, and consequently to foster competition. On the other hand, the possibility to bid for packages of routes is supposed to allow benefiting from coordination synergies and economies of scale.

[11] That is to say that the operator receives a fixed fee for the service and the revenues from fares accrue to the regulator.

At last, in accordance with Cantillon and Pesendorfer (2006a, 2006b), we argue that auctions in the London bus market are auctions with private values. A first reason is that there is little uncertainty among bidders regarding the expected costs of most of the inputs incurred in carrying out the contract, particularly labour and fuel, which have well-functioning markets. Moreover, considering that a vast majority of the operators come from the bus industry and given that the current system is in place since more than 20 years, we can reasonably think that bidders are experienced enough to be able to forecast accurately their costs and not to be influenced by their competitors' cost forecasts.

c. Data and summary statistics

We collected data on all the auctions for London bus service contracts that were conducted between August 1999 and May 2008. Over this period, 806 individual routes were put out to tender. The awarding procedures and their result are well documented. Indeed, the regulator publishes on his website many data related to the auctions[12]. Thanks to this source we have at our disposal data on:

- The number of bidders per individual route;
- The lowest and the highest individual compliant bids;
- The accepted bid in current £ and the corresponding cost per mile of the awarded contract;
- The identity of the successful bidder;
- The type of bid submitted by the winner, i.e. whether the ultimate award was for a package of routes, that is to say for a joint bid;
- The package bid proposed by the winner;
- The number of routes attributed in a same package;
- The annual scheduled mileage.

Descriptive summary statistics on the evolution of the number of bidders per route are reported in Table 1 and illustrated in Figure 1.

[12] (http://www.tfl.gov.uk/buses/bus-tender/default.asp).

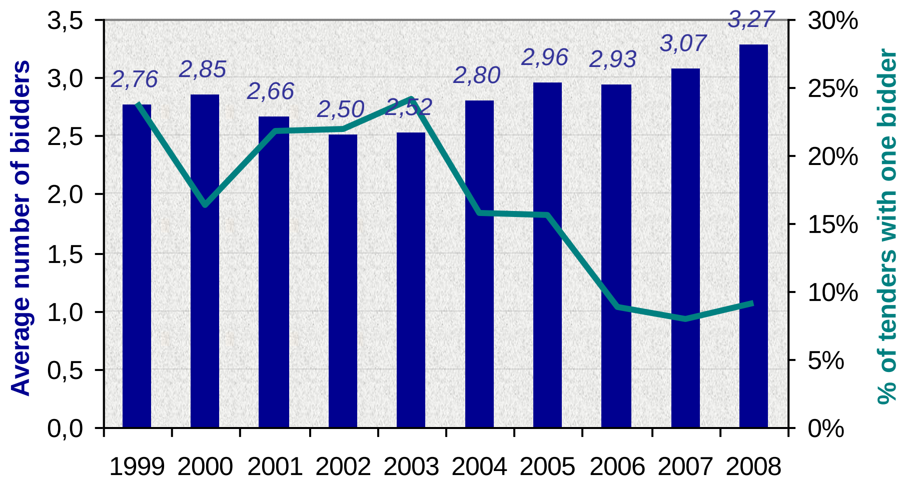
Table 1: Evolution of the average number of bidders

Source: Authors' own calculations

Period	*Number of routes put out to tender*	*% of route tenders with one bidder*	*Average number of bidders*
1999 (May-December)	*21*	*24*	*2.76*
2000	*86*	*16*	*2.85*
2001	*133*	*22*	*2.66*
2002	*91*	*22*	*2.50*
2003	*91*	*24*	*2.52*
2004	*89*	*16*	*2.80*
2005	*96*	*16*	*2.96*
2006	*102*	*9*	*2.93*
2007	*75*	*8*	*3.07*
2008 (January-May)	*22*	*9*	*3.27*
Average	***81 (Total = 806)***	***17***	***2.83***

Figure 1 : Evolution of the average number of bidders

Source: Authors' own calculations



On average, over the period covered by our database (August 1999- May 2008), 2.83 tenderers submitted a bid for an individual route and 17% of the routes put out to tender received only one bid. In addition, the average number of bidders appears to be increasing. This contrasts with the competition intensity observed in other countries like France where local authorities organize larger size auctions. As reported by illustrated by Amaral *et al.* (2009), the French case is indeed characterized by few bidders (1.8 in average over the period 1995-2005), a decreasing number of bidders through time and a high proportion of route tender bids which attract only one bidder (53.5% in average over the period 1995-2005).

Regarding the market structure, Figure 2 indicates that the London bus market is fairly competitive. Although the number of operators has consolidated in recent years, from twenty operators in 2000 to ten by the end of 2009, no single group has yet achieved a total scheduled kilometres that exceeds twenty five percent of the total market. The Herfindahl index equals 1523, which corresponds to a moderate concentration. It is to be noted that a public company (East Thames Buses) is still operating bus routes in London. It allows the regulator (TfL) to benchmark private operators with their public competitor. Furthermore, bidders can be automatically disqualified if, should they win the bid, their market share exceeds 25% of the total scheduled vehicle kilometres.

Figure 2 : The market structure in 2009

Source : TfL

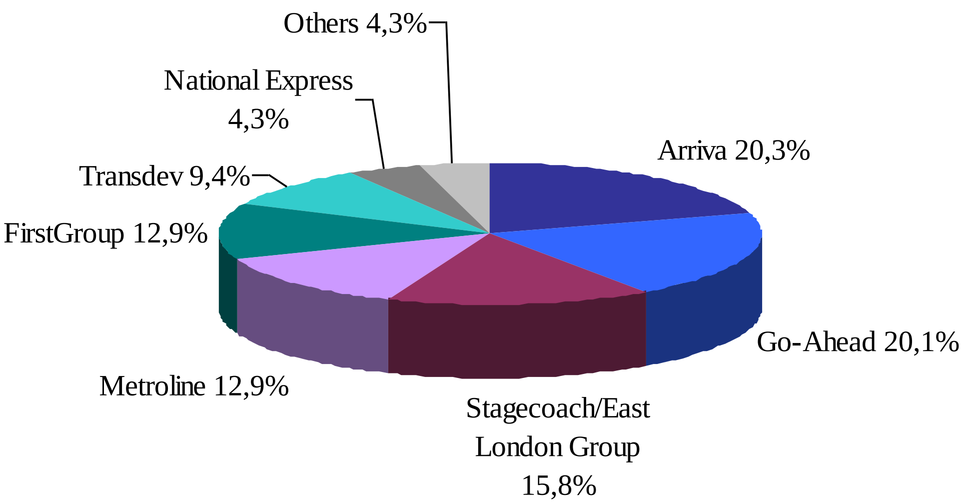


Table 2 focuses on the period covered by our database (May 1999-May 2008) and presents statistics on the observed bids broken down according to the number of actual bidders who participated in the auction.

Table 2: Number of effective bidders and cost per mile
Source: Authors' own calculations

Number of effective bidders per route	Number of auctions	Average bus.miles (10,000)	Average winning bid (£)	Average cost per mile of the awarded contract (£)
1	128	46.99	2,217,554	8.63
2	213	47.24	1,933,647	6.20
3	232	38.20	1,522,683	4.82
4	140	44.14	1,727,877	4.56
5	58	41.84	1,647,772	4.01
6	10	34.15	1,452,628	5.43
7	5	32.25	1,044,786	3.61
8	1	57.97	1,797,000	3.10
9	1	21.53	645,878	3.00
>5	*17*	*36.47*	*1,105,743*	*3.78*

The evidence presented in this table supports the view that, in the London bus market, auctions are with private values, hence the increased competition effect (which leads to less cautious, i.e. lower bids) dominates the winner's curse effect (which leads to less aggressive, i.e. higher bids). Indeed, as opposed to what was found by Hong and Shum (2002), we do not observe a positive correlation between the number of bidders and the winning bids. On the contrary, the average winning bid decreases from about £2.2 million (8.63 £ per mile) in 1-bidder auctions to less than £0.7 million (3 £ per mile) in 9-bidder auctions.

What we also observe is that the number of bidders decreases with the size of the contracts put out to tender, that is, with the number of bus miles (column 3). This suggests the existence of asymmetries among bidders, some bidders being unable to participate to large auctions. Despite the moderate concentration of the market (see Figure 2 above), only few operators are likely to be interested in bidding for large routes requiring a lot of vehicles to operate. In other words, winning bids and number of bidders are likely to be endogenous variables. This means that investigating the determinants of winning bids by regressing the operating costs proposed by the winner on the number of bidders might be misleading unless this endogeneity problem is solved.

In addition, it seems more realistic to use the number of potential bidders as a covariate instead of the number of effective bidders. Indeed, as mentioned by De Silva *et al.* (2008) or Tukiainen (2008), although a vast majority of studies on auctions assume that bidders always know the number of actual bidders, in many procurement auctions bidders do not know how many rivals they face at the time they incur the cost of preparing their bids so that the assumption of exogenous entry is not plausible. The degree of competition bidders anticipate is therefore more likely to be a determinant of their bidding strategy. More precisely, as suggested by Tableau 3, in which the number of potential bidders is defined as the number of bidders at the previous route tender, bidders seem to be even more aggressive that the number of rivals they anticipate is high. Descriptive statistics provided in Tableau 3 indeed clearly indicate that the operating costs proposed by the winners are decreasing with the number of potential bidders. .

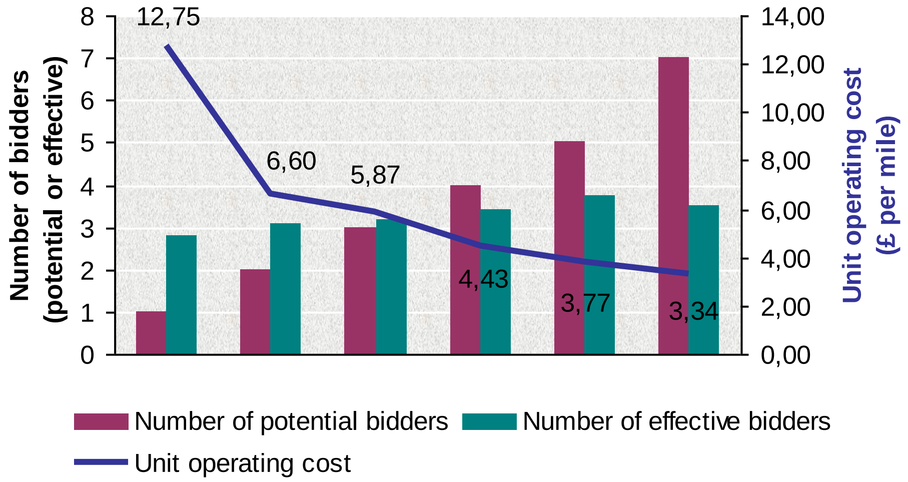
Tableau 3 : Number of potential bidders and cost per mile

Number of potential bidders par route	Number of auctions	Average bus.miles (10,000)	Average cost per mile of the awarded contract (£)
1	44	28.16	12.75
2	59	38.68	6.60
3	56	45.28	5.87
4	25	46.18	4.43
5	8	30.40	3.77
>5	2	63.01	3.34

What is even more interesting and reinforces our conviction that the number of potential bidders is a more relevant explanatory variable than the number of effective bidders is what Figure 3 reveals. Indeed, when we compare the number of potential bidders with the number of effective participants to auctions and then link this ratio with the winning bids, it first appears that the number of effective bidders does not coincide with the number of potential bidders. More precisely, the number of effective bidders seems to exceed the number of potential bidders when the former is low. On the contrary, the number of effective bidders seems to be systematically inferior to the number of expected candidates when the former is high. In addition, we observe that winning bids are less aggressive when the number of effective bidders exceeds the number of potential ones, but are very low when the number of effective bidders is inferior to the number of expected competitors. This suggests that bidders are prone to participate in auctions that received few bids in the past but, as they know competition was not fierce at that time, they expect to win with a relatively high bid. Conversely, bidders seem to be discouraged to enter auctions that were highly competed in the past but those who eventually decide to participate place very aggressive bids. These interpretations of the empirical evidence provided in Figure 3 are consistent with the theoretical results obtained by De Silva *et al*. (2008). Indeed, they show that in pure private value settings an increase in the number of potential bidders has a direct beneficial effect on bidding, leading to lower cost to the procuring agency (this is the competition effect). However, as a result of lower profit margins for the winners of the auctions, the incentive to go through the costly bid preparation process is diminished, which depressed the number of bids submitted (this is the entry effect). As the latter effect can offset the initial beneficial effect of an increased number of potential bidders, the net effect of an increase in the number of potential bidders is uncertain.

What we intend to do in the next section is to disentangle between these two effects -the competitive effect and the entry effect- to assess whether potential entry has an overall positive or negative impact on costs.

Figure 3: Number of potential and effective bidders and corresponding unit operating costs



4. Tests and Results

a. Empirical strategy

What we are interested in is the relationship between the observed bids and the level of competition (i.e. the number of bidders). However, in many auctions, the winning bids and the number of bidders may increase together because they are both correlated to a third variable – for example, the characteristics of what bidders are bidding for (e.g. the size of the contract). One way to take care of this is to adjust for this correlation by including variables, which, for instance, control for the size of the contract the candidates are bidding for.

In order to estimate the impact of the number of potential bidders on auction's results, we estimate the following model:

$$C_{itn} = \beta N_{it} + \delta R_{it} + \upsilon_t + \sigma_n + \varepsilon_{itn} \quad (1)$$

Where C_{itn} is the cost bid submitted for route i at data t by the winning operator n, N_{it} is the number of bidders that submitted a bid for route i at date t, R_{it} is a vector of variables which account for the characteristics of the bus route firms are bidding for, υ_t is a year fixed effect which accounts for events in a particular year that may impact on observed bids, independently of the number of bidders, σ_n is a term that captures operator specific control variables, and ε_{itn} is a potentially heteroskedastic regression error term. We assume that $\varepsilon_{itn} \sim (0, \Sigma)$.

b. Endogeneity issue

One issue that may arise is the possibility that N_{it} is endogenous. In particular, there may be individual heterogeneity across operators, time periods and bus routes that is unobserved by the econometrician and that is correlated with both the decision to bid and the observed winning bids. Failure to account for this possibility may lead to an inconsistent estimate of β. If the unobservable individual heterogeneity that results in the endogeneity of the number of bidders is time invariant, then, to the extend that we account for time invariant operators fixed effects in equation (1) as well as for year fixed effects, we may be confident in the fact that these heterogeneity biases are taken into account in our estimates. However, the decision to bid may also be motivated by some unobservable time varying heterogeneity. To account for this potential source of endogeneity we follow two paths.

First, we added in our regressions the number of auctions organized during the month (*NB_MONTH)*. The number of auctions organized during one month is known by the participants and may alter their willingness to bid aggressively for every auction. Furthermore, the more numerous the auctions, the higher the likelihood of collusion among bidders. We also add the number of auctions already won by the winner during the month (NB_MONTH_WIN) that might indicate specific strategy from operators during specific periods. Those two variables help capturing time varying heterogeneity.

Second, we used N_{it-1} that is the number of bidders observed for route *i* during the previous call for tender concerning this route *i*. This obliged us to make our estimates on the subsample of renewed contracts. Nevertheless, using the lagged variable is interesting for two reasons. First, it helps dealing with potential endogeneity of N_{it}. Second, and more interestingly, we believe that, when operators bid, they may not know how many bidders are involved in the bid (they may have only an imprecise idea) but they know for sure the number of bidders that participated to the previous bid. It is then more natural to consider the impact of the number of participants to previous auctions on the actual observed bids.

c. Data

Table 4 presents the variables we used in our econometric test.

Table 4: Checklist of our variables-

Variable	Description	Obs.	Mean	Std	Min.	Max.
C_{itn}	Unit operating cost in £/mile proposed by the winner *n* at date *t* for route *i*	786	6.30	7.05	1.4	51.31
N_{it}	Number of bidders for route *i* at date *t*	786	2.80	1.26	1	9
N_{it-1}	Number of bidders for renewed route *i* in the previous auction concerning this route.	194	2.49	1.19	1	7
$MILES_{it}$	Number of bus.miles to be supplied each year on route *i* at date *t* / 100 000	786	4.34	3.24	0.000014	17.13
$MILES^2_{it}$	Sq(Number of bus.miles to be supplied each year on route *i* at date *t* / 100 000)	786	29.44	37.02	$1.9e^{-10}$	293.60
$JOINT_{it}$	Dummy variable taking the value 1 if the winning bid for route *i* at date *t* is a joint bid	786	0.55	0.49	0	1
$PACKAGE_{it}$	Number of routes attributed at the same time as route *i* at date *t* (route *i* included)	786	3.01	2.60	0	11
$INCUMBENT_{it}$	Dummy variable taking the value 1 if the winning bidder of route *i* at date *t* is the incumbent	786	0.04	0.20	0	1
$NB\_MONTH\_WIN_{itn}$	Number of auctions won by the winning bidder *n* of route *i* at date *t* during the previous month	786	2.93	2.03	1	10
NB_MONTH_{it}	Number of auctions organized during the same month as the aution for route *i* at date *t* was organized	786	14.13	7.79	1	31
$TREND_{it}$	Number of months elapsed since January 1995	786	106.12	29.03	55	160

We are interested in assessing the impact of the number of potential bidders (*NB_BIDDERS*) on the unit operating cost submitted by the auction's winner. More precisely, we expect β, the coefficient of the variable *NB_BIDDERS*, to be negative due to the competition effect.

Vector *R* includes several route specific variables, namely the number of bus-miles to be supplied on the route (*MILES*), the variables *JOINT*, which controls for the fact that the winning bid is a joint bid and *PACKAGE,* which controls or the size of the joint bid. In the presence of economies of scale, the unit operating costs should decrease as the volume of service to supply, that is the number of vehicle miles to deliver, increases. We therefore expect the coefficient of the variable *MILES* to be negative.

We also expect *JOINT* and *PACKAGE* to have a negative impact on *C*. Indeed, as already mentioned, a central motivation of the London Transportation authority for encouraging combination bids was to allow bidders to pass on some of the cost savings resulting from cost synergies between routes through lower bids. And indeed, when we compare, for each package of routes, the winners' joint bids and the sum of the best stand-alone bids, we observe that bidders offer discount for combinations of routes. More precisely, consistently with results obtained in other studies (Cantillon and Pesendorfer 2006a) and b)), the discount of a combination bid relative to the sum of stand-alone bids equals 4.9% on average in our sample. That is why we expect joint bids to allow bidders to lower costs due to cost synergies.

In addition, we control for the fact that the winner of the auction is the incumbent. The theoretical auction literature suggests that the incumbent should be in a favourable situation during contract renewal with a higher probability to win the bid[13]. In addition, the regulator in London (TfL) clearly favours the incumbents as incumbents' renewal ensures continuity for passengers and reduces the risks associated with the transition of route operation between depot locations. For these reasons, we included the variable *INCUMBENT*, expecting this variable to have a positive effect on *C*.

We also control for the fact that the winner already won several routes during the previous month (NB_MONTH_WIN) and for the number of routes auctioned during the month (NB_MONTH).

We included operators and years' dummies in order to capture fixed effects and we also included a trend variable in our regressions (*TREND*).

d. Results

i. Impact of the number of bidders on costs

The log-log regression has the advantage of directly giving elasticities between independent and dependent variables. It also helps reducing heteroscedasticity problems. Thus we performed the following model:

[13] As indicated in a report to Transport for London (2009), the incumbent success rate in the London bus market is estimated at 78.4%.

$$\ln(C_{itn}) = \beta \ln(N_{it-1}) + \delta \ln(R_{it}) + \upsilon_t + \sigma_n + \varepsilon_{itn} \quad (2)$$

In order to check the robustness of our results, we also provide OLS results by estimating equation 1 and also the following equation 3 that captures in more details the impact of the number of bidders on cost:

$$C_{itn} = \beta_2 N\_2_{it} + \beta_3 N\_3_{it} + \beta_4 N\_4_{it} + \beta_5 N\_5_{it} + \beta_6 N\_Sup_{it} + \delta R_{it} + \upsilon_t + \sigma_n + \varepsilon_{itn} \quad (3)$$

where the *N_X* variables are dummies taking value 1 if the number of bidders is equal to X for auction *i* at date *t* and *N_Sup* is a dummy taking value 1 when the number of bidders is superior to 5.

Results are presented in Table 5.

Table 5: Econometric Results

	ln (Cost per Mile) Model 1 *Robust OLS*	ln (Cost per Mile) Model 2 *Robust OLS*	Cost per Mile Model 3 *Robust OLS*	Cost per Mile Model 4 *Robust OLS*	Cost per Mile Model 5 *Robust OLS*
Ln N_{it}	-0.167***	-0.132***			
	(0.035)	(0.037)			
N_{it}			-0.679***	-0.555***	
			(0.153)	(0.155)	
N_2					-0.956
					(0.756)
N_3					-1.110
					(0.847)
N_4					-2.087**
					(0.768)
N_5					-2.066*
					(0.820)
N_Sup					-3.363***
					(1.009)
Ln $MILES_{it}$	-0.168***	-0.166***			
	(0.012)	(0.011)			
$MILES_{it}$			-2.801***	-2.775***	-2.757***
			(0.264)	(0.254)	(0.255)
$MILES^2_{it}$			0.181***	0.179***	0.178***
			(0.022)	(0.021)	(0.022)
$TREND_{it}$	0.003***	0.005	0.019*	-0.053	-0.057
	(0.001)	(0.005)	(0.007)	(0.062)	(0.062)
$INCUMBENT_{it}$	0.049	0.025	-0.035	-0.355	-0.364
	(0.078)	(0.079)	(1.044)	(1.021)	(1.023)
$PACKAGE_{it}^{a}$	-0.006	-0.009	0.034	0.014	0.011
	(0.007)	(0.008)	(0.089)	(0.096)	(0.097)
$JOINTBID_{it}$	0.007	-0.003	-0.578	-0.600	-0.576
	(0.044)	(0.047)	(0.533)	(0.549)	(0.550)
$NB\_MONTH_{it}^{a}$	-0.003	-0.005^{+}	0.006	-0.013	-0.012
	(0.003)	(0.003)	(0.032)	(0.033)	(0.033)
$NB\_MONTH\text{-}WIN_{it}^{a}$	0.012	0.015	0.040	0.046	0.037
	(0.010)	(0.010)	(0.123)	(0.126)	(0.127)
OPERATOR Dummies		*Yes***		*Yes***	*Yes***
YEAR Dummies		*Yes***		*Yes***	*Yes***
INTERCEPT	3.481***	3.471***	13.072***	18.757***	18.537***
	(0.166)	(0.329)	(1.206)	(3.939)	(3.983)
R^2	0.470	0.501	0.345	0.391	0.392
Obs.	786	786	786	786	786

a: the logarithm of the variable is used in models 1 and 2

Huber/White/Sandwich standard errors within parentheses

*Significance levels: + 10% *5% ** 1% *** 0.1%.*

The first interesting result concerns the impact of the number of bidders on costs. As in De Silva *et al.* (2008), in these private value auctions, the positive cost reducing overall effect of entry is present meaning that the unit operating cost proposed by the winner of the auction is decreasing with the number of bidders. This result holds whatever the specification we retain, introducing or not fixed effect for each operator and using linear or log-log specifications. Hence, in the London bus market, the "discouraging" effect of additional entry seems to be more than compensated by the competitive effect of an increase number of potential bidders. This competitive effect is important as reflected in Table 6.

Table 6: Estimation of the cost reducing effect of competition

Specification	Model 2	Model 4	Model 5
Impact in % on average cost per miles of having 6 bidders instead of 2	-26 %	-35%	-50%

Secondly, our results suggest non-linear economies of scale. Unit-operating costs decrease with *MILES* (the number of vehicle miles) but increase with $MILES^2$ in our linear specifications (Models 3, 4 and 5). We obtain the same results in our log-log specifications (Models 1 and 2).

As opposed to our expectations, our other variables do not seem to play a crucial role in the determination of the cost per mile.

ii. Impact of the past number of bidders on costs

One problem with the regressions presented in Table 5 is that the number of bidders who participate in an auction may be correlated with attributes of the auction that are observable to the bidders, but not to the econometrician. The best way to proceed to solve possible endogeneity issues regarding the number of bidders would be to find instruments. Unfortunately, it is hard to think of a natural instrumental variable strategy in this situation, since factors correlated with the number of bidders should also enter into the distribution of valuations. Another possibility is to use a lagged variable to attenuate this problem. This obliges us to focus on the subsample of renewed contracts for which we have information on previous bids. Results are provided in Table 7

Table 7: Econometric Results

	Ln (Cost per Mile) Model 6 *Robust OLS*	Ln (Cost per Mile) Model7 *Robust OLS*	Ln (Cost per Mile) Model 8 *Robust OLS*	Cost per Mile Model 9 *Robust OLS*	Cost per Mile Model 10 *Robust OLS*	Cost per Mile Model 11 *Robust OLS*	Cost per Mile Model 12 *Robust OLS*
$Ln\ N_{it}$	-0.125*						
	(0.060)						
$Ln\ N_{it-1}$		-0.148**	-0.143*				
		(0.053)	(0.055)				
N_{it}				-0.499^{+}			
				(0.298)			
N_{it-1}					-0.933**	-0.623^{+}	
					(0.325)	(0.326)	
N_2							-2.382^{+}
							(1.391)
N_3							-2.008
							(1.430)
N_4							-2.342^{+}
							(1.338)
N_5							-3.634^{+}
							(1.848)
N_Sup							-3.001
							(2.328)
$Ln\ MILES_{it}$	-0.276***	-0.276***	-0.273***				
	(0.027)	(0.028)	(0.027)				
$MILES_{it}$				-3.800***	-3.866***	-3.799***	-3.698***
				(0.531)	(0.521)	(0.508)	(0.517)
$MILES_{it}^{2}$				0.278***	0.275***	0.278***	0.268***
				(0.049)	(0.051)	(0.047)	(0.048)
$TREND_{it}$	0.001	-0.000	0.000	0.015	0.000	0.010	0.006
	(0.009)	(0.002)	(0.009)	(0.135)	(0.025)	(0.138)	(0.140)
$INCUMBENT_{it}$	0.007	0.007	0.000	-0.452	-0.349	-0.549	-0.384
	(0.067)	(0.066)	(0.067)	(1.033)	(1.056)	(1.041)	(1.040)
$PACKAGE_{it}^{a}$	0.087	0.075	0.1047	0.158	0.126	0.215	0.187
	(0.068)	(0.059)	(0.065)	(0.290)	(0.231)	(0.283)	(0.291)
$JOINTBID_{it}$	-0.035	-0.051	-0.078	-0.029	-0.839	-0.414	-0.396
	(0.106)	(0.094)	(0.102)	(1.392)	(1.220)	(1.378)	(1.416)
$NB\_MONTH_{it}^{a}$	-0.003	0.004	-0.010	-0.107	-0.030	-0.109	-0.103
	(0.045)	(0.042)	(0.046)	(0.066)	(0.060)	(0.067)	(0.067)
$NB\_MONTH\_WIN_{itn}^{a}$	-0.004	-0.003	0.002	0.180	-0.056	0.187	0.189
	(0.046)	(0.047)	(0.047)	(0.217)	(0.229)	(0.226)	(0.229)
OPERATOR Dummies	*Yes***		*Yes***	*Yes***		*Yes***	*Yes***
YEAR Dummies	*Yes*		*Yes*	*Yes*		*Yes*	*Yes*
INTERCEPT	4.848***	5.125***	4.971***	12.328	18.859***	13.222	14.189
	(1.339)	(0.395)	(1.347)	(21.250)	(3.871)	(21.582)	(21.888)
R^2	0.732	0.726	0.737	0.543	0.493	0.546	0.552
Obs.	194	194	194	194	194	194	194

[a]: *the logarithm of the variable is used in models 6, 7 and 8*

Huber/White/Sandwich standard errors within parentheses

*Significance levels: + 10% *5% ** 1% *** 0.1%.*

Our main findings remain unchanged giving us confidence in our results. Model 6 and model 9 provide results for the same specifications as Model 2 and Model 4 but focusing on our subsample. The impact of the number of bidders on costs does not change dramatically. Specifications using a lagged variable for the number of bidders involved in the auction gives results in line with previous specifications on our whole sample.

5. Conclusion

The introduction of competitive tendering in utilities industries is the subject of large debates among theoreticians and practitioners. In the London bus market it is claimed to have induced a dramatic improvement in the value for money achieved (London Transport Buses 2009). In this article, our aim was to confront this assertion with recent data. Thus, we have analysed bids for operation contracts in the London Regional Transport bus market between 1999 and 2008 to test hypotheses about bidding under competition. More precisely, our econometric strategy has consisted in estimating the impact of the number of potential bidders on the winner's cost bid. Whereas a vast majority of studies on auctions assume that bidders always know the number of actual bidders, in many procurement auctions, and in the London bus market auction in particular, bidders do not know how many rivals they face at the time they incur the cost of preparing their bids so that the assumption of exogenous entry is not plausible. By using the number of expected competitors as a potential determinant of bids, we have been able to relax this hypothesis and to highlight interesting behaviours. Indeed, not only do we obtain the "classical" result that tendering reduces bid prices as the number of potential bidders increases but we also provide empirical evidence suggesting that bidders' strategies are more influenced by the number of potential bidders than by the number of effective rivals.

Such results, in addition of supporting a traditional and yet under-investigated argument in economic theory, highlight the role played by allotment of urban transport networks. The choice made by the London decision makers to unbundle the bus network so as to enhance competition for the market indeed appears as relevant. It might inspire for instance French local transport authorities who are deeply concerned about the huge increase of operating costs and at the same time about the lack of competition.

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