Helsinki
Center
of
Economic
Research

Discussion Papers

The Determinants of Entry in an Auction with both Private and Common Value Bidders

Janne Tukiainen
University of Helsinki, RUESG and HECER

The Determinants of Entry in an Auction with both Private and Common Value Bidders*

Abstract

I compare the determinants of entry between a bidder to whom common value components are more important and a bidder to whom private value components are more important in the City of Helsinki Bus Transit Auctions. I find that these bidders do not react any differently to changes in the amount of expected competition. I also find that the City should shorten the contract lengths because that would simultaneously induce more entry and decrease the importance of common value components.

Janne Tukiainen

Department of Economics
University of Helsinki
P.O. Box 17 (Arkadiankatu 7)
FI-00014 University of Helsinki
FINLAND

e-mail: janne.tukiainen@helsinki.fi

1   Introduction

A vast majority of studies on auctions assume that bidders always know the number of actual bidders. This exogenous entry assumption is valid in cases where there is no binding reservation price and entry costs[1] are very small. In those cases, we would expect every potential bidder to always submit a bid. However, in a typical procurement auction data, we observe that the amount of bids submitted changes from one auction to another. Entry could still be exogenous if there were some exogenous and commonly observed shocks that make some bidders too disadvantaged to be willing to pay the entry cost. Then all the bidders would know which bidders enter in the equilibrium. Also in some cases the actual participants are publicly announced. In many cases the assumption of exogenous entry is not plausible. Endogenous entry has been one of the main research questions in the literature on auctions in the recent years.

This paper has two objectives. First, I study the determinants of entry in the City of Helsinki bus transit market. Knowing which contract and bidder characteristics affect the bid submission decisions helps the procurement agency to plan the contracts to minimize the procurement costs. My paper thus has a policy objective. Second, I contribute to the literature on endogenous entry in auctions by studying whether bidders for whom private value aspects are relatively more important make different entry choices than those bidders for whom common value aspects are more important.

In an auction setting, the second question is central. Common values refer to a situation where the information about the value of the auctioned object is dispersed among the bidders. In such an environment, bidders would update their beliefs about the value of the object if they learned their competitors' signals on this value. Private values refer to a situation where the bidders care only about their own signals. This distinction is called the information paradigm. I use procurement auction data to construct a set up that enables me to study how the information paradigm affects the entry choices.

Due to a phenomenon known as the winner's curse, the effects of competition may change with the information paradigm. The winner's curse arises in situations where bidders bid in a common value environment only according to their own value estimate. With unbiased estimates and symmetric bidders, the bidder who underestimates his valuation most, wins the auctions and may receive a negative payoff. The expected amount of underestimation increases with the number of bidders. Rational bidders take

---

[1]Typical entry costs consist of entry fees and/or information acquisition costs.

this into account and thus bid less aggressively as competition increases. On the other hand, strategic behavior implies that bidders bid more aggressively when the number of bidders increases. With private values, only this strategic component is in play, whereas in the common values setting both of these factors matter and thus the overall effect of competition on bids is uncertain. It is yet to be asked whether the information paradigm makes a difference when bidders make entry decisions. If bidders face some entry costs, they might not want to submit a bid to every auction. For strategic reasons all the bidders would prefer bidding to less competed contracts over more competed contracts. However, the additional effect of having common values on the entry decisions is unclear. In cases when the entry cost is an information acquisition cost, the bidders base their entry decisions on their expected profits of entry. Since these differ for private and common value bidders, one would expect the entry decisions to differ as well. It is however difficult to say to which direction. Here I study whether common value bidders make different entry choices than private value bidders when the amount of expected competition changes.

I am able to address this question because in Tukiainen (2008), I find that some bidders are more influenced by common value elements than others in the City of Helsinki bus transit auctions. Bidders that have garages close to the contracted bus routes are more influenced by the common value elements than bidders with garages further away. So far there are no theoretical results that analyze this form of bidder asymmetry. It could complicate the theoretical analysis beyond tractability. Therefore an empirical approach to answer whether the information paradigm affects the entry choice is important. I utilize the particular form of asymmetry found in these bus transit auctions. I compare the participation behavior of one bidder, for whom the private value components are more important than to its rival in every auction, with another bidder for whom the common value components are always more important than to its rival. I test whether these bidders react to the amount of competition they expect to face differently. The possible difference could then be attributed to the different information paradigm in this set up.

According to the endogenous entry model that Levin and Smith (1994) (denoted LS) study, the auctioneer does not want to deter entry when values are private but could want to set reservation prices to deter entry when values are common. This would suggest that in markets with both private and common valued bidders, the auctioneer would wish to attract more private value bidders and maybe restrict the participation of common value bidders. If common value bidders were more reluctant to enter heavily competed auctions than private value bidders, attracting more private value bidders would

achieve both of the goals. Goeree and Offerman (2003) study a model with symmetric bidders where the objects for sale possess both private and common values. They show that then both efficiency and revenue increase when more bidders enter the auction, and also when the auctioneer can reduce the uncertainty about the common value component. Therefore it is very policy relevant to study whether there are some contract characteristics that either increase entry or reduce the importance of uncertainty about the common value component or both. We know that common values typically arise from common future uncertainty. As Tukiainen (2008) discussed, in the auctions analyzed here, the main uncertainty is about getting enough bus drivers in the future and about the development of land rents. Reducing contract lengths would therefore reduce the uncertainty about the common elements. If reducing contract lengths would also increase entry, there would be two reasons to reduce them. To test for both the effect of the information paradigm and the effect of contract and bidder characteristics on entry, I use a recent method by Bajari et al. (2007a) (denoted BHKN) that allows for an empirical analysis of static entry game with strategic interactions.

In the next Section, I analyze the relation of my work to the existing literature more closely. In Section 3, present the Helsinki bus transit market and describe the data. In Section 4, I shortly discuss the estimation method, how it fits the data and how I set up my estimations. Section 5 presents the results and Section 6 concludes.

2   Related literature

Entry has been studied widely in empirical industrial organisation literature (e.g. Bresnahan and Reiss 1990 and 1991, Berry 1992). Berry and Tamer (2007) provide a survey on the traditional entry literature. Empirical models of entry in auctions have been considered by Athey et al. (2004), Bajari and Hortacsu (2003), Bajari et al. (2007b), Krasnokutskaya and Seim (2005), Li (2005) and Li and Zheng (2006). Athey et al. (2004) form a structural model of bidding coupled with a reduced form model of entry that allows for heterogenous bidders and unobserved auction heterogeneity under independent private values (IPV) paradigm. They compare open and sealed bid U.S. Forest Service auctions. Bajari and Hortacsu (2003) use a parametric structural model to study winner's curse and the effects of a reserve price on seller revenue when entry is endogenous in eBay coin auctions. They consider a pure common value

setting with the Poisson arrival of bidders. Bajari et al. (2007b) propose an identification method for discrete games of complete information with an application to auctions. They estimate the probabilities for each of the possible equilibria, including mixed equilibria. First they estimate an auction model similar to Athey et al. (2004) and then use simulations to calculate all the equilibria. Krasnokutskaya and Seim (2005) analyze the effects of bid preference programs on participation in highway procurement. They estimate jointly a model of participation and bidding in a similar manner as Athey et al. (2004). Li (2005) considers the structural estimation of first-price auctions with entry and binding reservation prices when bidders are symmetric. He suggests a method of simulated moments estimator that can be used to test whether the reservation prices are binding, and to test the mixed-strategy of entry. Li and Zheng (2006) form a fully structural auction model with endogenous entry, an uncertain number of actual bidders, unobserved heterogeneity and mixed strategy entry equilibrium under IPV paradigm with symmetric bidders. They form counterfactuals on the effects of the number of bidders on procurement costs in highway mowing auctions. The common econometric goal of all these structural auction papers is to estimate the distribution of bidder's private values and the distribution of entry costs. I apply the method proposed by BHKN for estimating static games of incomplete information. They generalize the discrete choice models to allow for the actions of a group of agents to be interdependent. This method allows a reduced form analysis of a situation where there is no existing equilibrium behavior structure.

LS presented the theoretical auction model with endogenous entry that is the basis of most of the above empirical work. They characterise a symmetric mixed strategy equilibrium that leads to a stochastic number of entrants. A fixed and known number of identical potential bidders have to incur an entry cost to be able to submit a bid. In equilibrium each bidder enters with the same probability. Previously, McAfee and MCMillan (1987) and Engelbrecht-Wiggans (1993) studied models of entry where bidders have entry costs but both assumed pure strategies. Smith (1982 and 1984), Samuelsson (1985) and Engelbrecht-Wiggans (1987) were the first to examine endogenous entry. They were interested in the efficiency and optimality of reserve prices. Also Harstad (1990) and Hausch (1993) treated entry stochastically in a simpler setting than LS do. Chakraborty and Kosmopolou (2001) extend the LS framework so that bidders are asymmetrically informed about their valuations when making the entry decision. With asymmetry they mean that, unlike in LS they observe their signals before paying the entry cost. This reverses the LS predictions that the optimal reserve price is zero and entry fee positive (zero) in a common (private) value framework. Also Menezes and Monteiro (2000) change the LS setting so that bidders learn their

valuations before paying the entry cost. Ye (2004) generalises the LS model so that bidders can update their beliefs after entry. In an ongoing work Harstad (2005) extends the endogenous entry model further by introducing affiliation and generalizing the information flows. Cox et al. (2001) test experimentally a model of endogenous entry, exit and bidding in common value auctions. They find that observed entry is lower than predicted by the model and that winner's curse occurs among inexperienced bidders. Gal et al. (2007) extend the LS model by allowing the entry costs to differ across bidders. The resulting game is bi-dimensional, because bidders receive signals on both the value and the entry cost. They find that partially reimbursing the entry costs of high entry cost types increases revenue.

Auctions where bidders have both private and common components in their valuations have drawn some attention in the recent literature. More generally they belong to a class of auctions where the essential feature is that signals on valuations are multidimensional, because there is a signal for both the private and common component. Maskin (1992), Dasgupta and Maskin (2000) and Jehiel and Moldovanu (2001) have studied these auctions. The main feature is that no auction format is efficient when signals are multidimensional although Pesendorfer and Swinkels (2000) are able to derive some conditions for restoring efficiency in a uniform price auction with many bidders. These auctions are inefficient because a bidder with an overly optimistic conjecture about the common component may outbid a bidder with a higher private valuation. Jackson (2005) shows that equilibrium fails to exist when valuations have both components in second price and English auctions. Goeree and Offerman (2003) are able to derive the equilibrium by aggregating the multidimensional signals into a sigle statistic by relying on the indepence assumption. They study the effects of competition and information disclosure in this set up and find that increasing both reduce the inefficiency. Goeree and Offerman (2002) use an experimental setup to study efficiency in these auctions and find observed efficiencies close to the predicted ones. Compte and Jehiel (2002) propose a model where bidders know their private component and are differently informed about the common component. They study the welfare effect of adding one bidder to one-object sealed-bid second price and ascending auctions. They find that with symmetric bidders, an extra bidder is good for welfare whereas with asymmetric information about the common element this is not the case. Compte and Jehiel (2002) tackle bidder asymmetry in their model, but that particular asymmetry is different from what I am interested in. They assume that bidders draw their signals from different distributions. In my auction data, the bidders are asymmetric also in the sense that they put different weights on the private and common value component. In the extreme case, one bidder could be a pure common value bidder

6

and another have independent private values. Asymmetry in this dimension has not been addressed in the literature before. The theoretical analysis of a model with both common and private values that allows for this particular form of asymmetric and endogenous entry is beyond the scope of this paper and possibly beyond the reach of existing analytical tools. I focus on an empirical analysis on how differences in the information paradigm affect the entry choices. Although I do not impose this complex information structure on the estimations explicitly, this is still the first empirical analysis of auctions that studies bidder behavior when values have both private and common component.

3   The market and the data

The City of Helsinki arranges tenders for its intra-city bus traffic. The first tender was arranged in 1997. The intra-city market served 100 million passengers and was valued at 177 million euro in 2000 (YTV Transport Department 2001). The data used in this study consists only of these intra-city tenders, and include 55 auctions. I include all auctions up to 1st January 2005, the date when Suomen Turistiauto Oy (STA), a company owned by the City of Helsinki, and the Helsinki City Transport's (HKL) bus transport unit merged. Since STA is one of the two firms that I analyze here, it is not possible to include any newer data. I cannot use the data from the entire metropolitan area[2] either, because of differences in the market characteristics, auction rules, the set of participants and bidder behavior. The planning unit of HKL decides routing, timetables, vehicle requirements and fleet schedules. The amount of bus kilometers in a contract can change by a maximum of ten percent per year. The City of Helsinki Supplies Department invites the tenders. The tenders are open to all licensed contractors. Also a financial analysis on the contractors' ability to fulfill the tender specifications is conducted. The bus transport unit of HKL participates as one of the bidders.

In bids, the operators state the unit costs of the service (cost per kilometer, per hour and per vehicle day). The tendering authority uses these costs to calculate the total cost of service provision given the announced amount of traffic. This total cost is the actual monetary bid. The City receives all ticket

---

[2]The Helsinki Metropolitan area consists of the Cities of Espoo (237968 inhabitants 31st December 2007), Helsinki (568361 inhabitants), Kauniainen (8511 inhabitants) and Vantaa (192399 inhabitants). YTV organizes the regional and the intra-city bus traffic tenders in Espoo and Vantaa.

revenues. Similar, so-called gross cost contracts, are used in many cities, for example in London. The contract period varies from three to six years and is most often five years. The invitation to tender simultaneously covers many contracts and a single contract can cover one or more routes. The intra-city market consists of 86 routes on average, with some changes in the network from year to year. The set of contracts that correspond to an invitation is called a tranche, following Cantillon and Pesendorfer (2006). Combination bidding within a tranche is allowed. I do not make a distinction whether a given bidder included a given contract in some combination or submitted a single bid to it or both, all of these possibilities count simply as an entry to that auction. Combination bidding violates the assumption of independent auctions needed for the econometric analysis. I hope that this is an innocuous violation for two reasons. First, submitting combination bids is rare. Second, it is reasonable to assume that bidders would have submitted bids to the same contracts even if combinations were not allowed. Then auctions are independent with respect to entry choices and the combination bidding only changes the bidding strategies. The principle of awarding tenders is the best economic value, calculated by a scoring rule based on monetary bids and vehicle quality. I collected the data from the City of Helsinki Supplies Department (Saarelainen 2004). It is summarized in Table 1. There are 11 tranches and 55 contracts in the data. 215 single bids and 14 combination bids were submitted. The number of actual bidders varies from two to eight. The amount of auctions in a given trance varies from one to nine. No combination bids were submitted after the entire traffic was procured once nor are they in tenders following this data collection.

[Table 1. about here]

Table 2. presents some descriptive statistics on contract characteristics and bidding decisions for each bidder. There are 10 potential bidders of which five are fringe firms. Bidder HKL submitted bids to all the 55 auctions and won 38 % of them. CX submitted bids to 52 of the 55 auctions and won 8 auctions. The third and fourth most active firms STA and CR submitted bids on and won about the same amount of auctions. PKL submitted bids to 29 % of the auctions and won 31 % of those. The five fringe bidders did not win any of the auctions. There are some differences between the bidders on what type of contracts they on average submitted bids on. The fringe bidders never participated in contracts that required the use of articulated/bogie buses. PKL participated on average in smaller auctions that the other four large bidders and was more reluctant to bid when articulated/bogie buses were used. HKL and STA have the garages nearest on average and three of fringe firms do not have a garage at all.

8

[Table 2. about here]

In the empirical analysis, I will concentrate on the bidders STA, CR and PKL because these firms have sufficient variation in their entry decisions. STA stands for Suomen Turistiauto Oy, a City owned private company. CR stands for Concordia Bus Finland Oy, a Finnish subsidiary of Concordia Bus, one of the ten largest European public transportation groups. It is also the leading Nordic bus transportation group. PKL denotes Pohjolan Kaupunkiliikenne Oy. It is a subsidiary of Pohjolan Liikenne Oy, the largest domestic road transportation company. That in turn is a subsidiary of VR-group, the rail monopoly and transportation company owned by the Finnish state.

In these bus transit auctions, bidder asymmetry arises mainly from the different garage locations. The closer the route to the garage, the less transfer kilometers the buses need to drive. A transfer is the driving of an empty bus from garage to route at the start of a shift and driving the bus back at the end of a shift. Asymmetry may also arise for other reasons such as different collective labor agreements or capacity constraints. More free capacity increases incentives to bid more aggressively. Cantillon and Pesendorfer (2006a) argue that capacity effects may not be important for London bus route auctions, because firms have time to adjust their capacity between the auctions and the start of contract traffic. Similar time lags obtain in Helsinki. If indeed capacity is not important, the assumption of independent auctions is more plausible. Figure 1. presents the distances from the garage to the route(s) for the three bidders that will be the object of the empirical analysis. The distances were calculated using an internet service (http://kartat.eniro.fi/) that gives road distances between street addresses in Helsinki. I used the average distance from the nearest garage of a given firm to both end points of the route, weighted by the amount of traffic for contracts consisting of many routes. The main purpose of this figure is to show that the garages of STA are always nearer to the route(s) under contract than the garages of PKL. Therefore the common value components are always more important to STA than PKL. I compare how these two bidders will react to their expectation of Concordia's (CR) participation.

[Figure 1. about here]

9

4 Estimation

BHKN propose a method for estimating static games of incomplete information. They generalize a discrete choice model to allow the actions of agents to be interdependent. The main difference with the previous models is that this method allows more than two players and more than two actions, and that instead of having the actual decision of the other players in the model, they utilize choice probabilities. I present here their simplest entry example (BHKN, p. 5-8).

The BHKN model goes as follows. Finite number of players $i = 1, ..n$ simultaneously choose an action $a_i = 0, 1$, where $a_i = 1$ denotes entry. State variables x_i are common knowledge and observed by the econometrician. There are also state variables which are private information to the bidders. These are denoted by $\epsilon_i(a_i)$. BHKN assume that they are distributed i.i.d. across agents and actions. The periodic utility for player i is then

$$(1) \quad u_i(a, x, \epsilon_i; \theta) = \Pi_i(a_i, a_{-i}, x; \theta) + \epsilon_i(a_i).$$

The difference of the BHKN model from standard discrete choice models is that the actions a_{-i} of other players enter into i's utility. When the decision rule of BHKN model is a function $a_i = \delta_i(x, \epsilon_i)$, they define $\sigma_i(a_i|x)$ as:

$$(2) \quad \sigma_i(a_i = k|x) = \int 1\{\delta_i(x, \epsilon_i) = k\} f(\epsilon_i) d\epsilon_i.$$

This is the probability that i chooses action k conditional on the state variables that are public information. $1\{\}$ is an indicator function and f denotes the density function of ϵ. BHKN define player i's expected utility π_i from choosing action a_i when the vector of parameters is θ and the vector of bidder and contract characteristic is x as

$$(3) \quad \pi_i(a_i, x, \epsilon_i; \theta) = \sum_{a_{-i}} \Pi_i(a_i, a_{-i}, x; \theta) \sigma_{-i}(a_{-i}|x) + \epsilon_i(a_i), \text{ where}$$
$\sigma_{-i}(a_{-i}|x) = \Pi_{j \neq i} \sigma_j(a_j|x)$ denotes i's beliefs about other agent's actions.

BHKN define the deterministic part of the expected payoff as

$$(4) \quad \Pi_i(a_i, x; \theta) = \sum_{a_{-i}} \Pi_i(a_i, a_{-i}, x; \theta) \sigma_{-i}(a_{-i}|x).$$

They state that it follows immediately that the optimal action for player i satisfies the equation (5).

(5) $\sigma_i(a_i|x) = \Pr\{\epsilon_i|\Pi_i(a_i, x; \theta) + \epsilon_i(a_i) > \Pi_i(a_j, x; \theta) + \epsilon_i(a_j) \text{ for } i \neq j.\}.$

When the utility is assumed to take a linear form, equation (6) presents the payoff structure in a static entry game when the outside option is assumed to be zero. This payoffs structure is typically assumed in the static enty game literature (e.g. Bresnahan and Reiss, 1990 and 1991 and Berry, 1992).

(6) $\Pi_i(a_i, a_{-i}, x; \theta) = \begin{cases} x'\beta + \delta\sum_{j\neq i} 1\{a_j=1\} & \text{if } a_i=1 \\ 0 & \text{if } a_i=0 \end{cases}$

Combining this payoff structure with equation (5), we get

(7) $\sigma_i(a_i = 1|x) = \Pr\{\epsilon_i|x'\beta + \delta\sum_{j\neq i} 1\{a_j = 1\} > 0\}$
$= \Phi(x'\beta + \delta\sum_{j\neq i} 1\{a_j = 1\})$
$= \frac{\exp(x'\beta + \delta\sum_{j\neq i}\sigma_j(a_j=1|x))}{1+\exp(x'\beta + \delta\sum_{j\neq i}\sigma_j(a_j=1|x))}$, for $i = 1, ..., n.$

Now Φ is some cumulative distribution function. The last equality holds assuming that the error terms that capture the private shocks to the profitability of submitting a bid, are distributed extreme value.

According to BHKN, observing a large number of entry decisions we can estimate $\sigma_i(a_i = 1|x)$ by any one of a number of standard techniques. They state that this simply boils down to estimating the probability that a binary response a_i is equal to one conditional on a given set of covariates x. BHKN argue that knowing these first stage estimates $\hat{\sigma}_i(a_i = 1|x)$ for all i, we can then estimate the structural parameters of interest β and δ in the second stage. They propose a linear probability model to estimate the first stage. In the second stage they propose a logit model (assuming extreme value distribution for error terms) to estimate a following pseudo-likelihood function:

$L(\beta, \delta) = \Pi_{t=1}^{T}\Pi_{i=1}^{n} \left(\frac{\exp(x'\beta + \delta\sum_{j\neq i}\hat{\sigma}_j(a_j=1|x))}{1+\exp(x'\beta + \delta\sum_{j\neq i}\hat{\sigma}_j(a_j=1|x))} \right)^{1\{a_{i,t}=1\}} \left(1 - \frac{\exp(x'\beta + \delta\sum_{j\neq i}\hat{\sigma}_j(a_j=1|x))}{1+\exp(x'\beta + \delta\sum_{j\neq i}\hat{\sigma}_j(a_j=1|x))} \right)^{1\{a_{i,t}=0\}}$

where $t = 1, ..., T$ denotes a given auction. BHKN argue that to be able to separately identify the effects of β and δ on the entry choice, we need an exclusion restriction. We need a variable that is included in the first stage but can be excluded from the second stage. In other words, we need to assume that at least one the competitors' characteristics affect a given bidder's revenue only indirectly. It is plausible

to assume that this holds for the distance variable in the auctions here. It is also important that the distance variable is exogenous. Since the bidders made their location decisions before the auctions started and there have not been important changes in garage locations, this is a plausible assumption.

BHKN argue that "if the error term has atomless distribution, then player i's optimal action is unique with probability one. This is an extremely convenient property and eliminates the need to consider mixed strategies as in a standard normal form game". They show that their model has a unique equilibrium in the two firm case, given a linearity assumption. For more players, they use a homotopy method to calculate all the equilibria of the game. I assume that the equilibrium is unique in my data.

BHKN propose a nonparametric generalization of this estimation method but that would require much larger data set than I have. However, it is possible to add some flexibility to the estimation by using a semiparametric approach that BHKN also propose. They suggest a two stage least squares estimation with nonparametric first stage. For practical purposes, they show that STATA "ivreg" command with robust standard errors can be used to obtain consistent estimates. The first stage is now some non-parametric approximation like sieve or orthogonal polynomial regression and the second stage is linear regression. I use orthogonal polynomials in the first stage. These polynomial transformations of the contract characteristics are inserted as instruments for the endogenous variables, which are the participation decisions of competitors.

The BHKN method is very useful for my analysis, because it can be used with only a small amount of observations. A structural approach based on equilibrium bidding behavior would require more from the data both with respect to the amount of observations and the nature of the data generating process. Because we would need to conduct the estimation of the bidding stage as well, the combination bidding would have to be addressed more carefully. If dealt in the same way as in (Tukiainen 2008), the data set would become even smaller than it is now. Moreover, an equilibrium bidding condition that would capture all the elements of interest does not exist.

I am interested in estimating the determinants of entry decisions for bidders STA and PKL. The main question is whether they behave differently with respect to the expected participation of CR. Because of the small number of observations and the participation patterns evident in Table1, I need to make some assumptions in the econometric modelling. The five fringe bidders have too few and bidders HKL and

CX too many bids for reasonable discrete choice analysis. First, I assume that STA, PKL and CR do not care about the participation of the fringe bidders. This allows me to limit the number of explanatory variables. Second, I assume that STA, PKL and CR treat the distances of HKL and CX as exogenous contract characteristics. Therefore I conduct the analysis for the bidders STA, PKL and CR and then test whether the estimated coefficients of how STA and PKL react to the expected participation of CR differ from each other.

BHKN make two essential assumptions. First, the game is static. This is a plausible assumption in my auction data. Each single auction and auctions within the same tranche are simultaneous games and therefore static. However, these individual auctions are held sequentially. This could induce dynamics through changes in capacity. However, as argued in Section 3, capacity is probably not important since time lags between the auctions and the actual service production are large enough to allow capacity adjustments with low enough costs. Second, the information is assumed to be incomplete, that is the shock are private. In a complete information game, the error term would be written $\epsilon_i(a)$. It now depends on the actions of all the players, not just i's. Then it would present information known by all the players, but not the econometrician. It is hard to say which assumption fits this market better. The less players there are and the longer they have been in the same market, the more plausible the complete information assumption becomes. It can also be the case that the nature of information changes as firms learn more about each other. Bajari et al. (2007b) have proposed an estimation method for such games where they also utilize structural auction econometrics. They state that parameters estimated assuming private information, when information is common, are not generally consistent, but "they will be roughly in the correct neighborhood". Therefore even if the assumption of incomplete information is not correct, we should obtain results that give roughly a correct picture on the determinants of entry in this market.

5 Results

I conduct two different estimations suggested by BHKN. First is the linear model using ordinary least squares in the first stage and logit in the second stage. Second is the semiparametric method that maintains the linearity assumption, but the first stage is made more flexible by orthogonal polynomial transformations. Otherwise it is a standard two stage least squares estimation. The results from the

first stage of the first estimation are presented in Table 3. These also provide information on how bidder and contract characteristics influence participation decisions. All the three analyzed bidders seem to bid more on contracts that are near their garages as one would suspect. STA and PKL seem to operate under decreasing returns to scale since they bid more on larger contracts and have a negative sign on the square of the contract size variable. Time when the auction was held matters for CR and PKL. CR was more active in the early years and PKL in the later years. STA and PKL seem to favor short contracts. PKL avoids the use of articulated/bogie buses. STA avoids contracts where HKL has an advantage in the sense that they are near to HKL's garages and CR avoids CX in a similar manner. All of these preliminary results are in line with what one would expect. The explanatory power of the models is fairly good. These results encourage to use the chosen estimation approach even with only 55 data points.

[Table 3. about here]

The results from the second stage of the first estimations are presented in Table 4. Including the strategic component in the estimations changes the results of this logit analysis compared with those of the OLS first stage. In the first model specification, the contract characteristics are not important for STA. It only cares for the distance from its own garages to the routes and about the participation probability of PKL. This "prop. s. PKL" variable affects STA in the opposite direction than one would expect under normal competition. One explanation is collusion with a phony bidding scheme. This is however unlikely since then also the "prop. s. STA" variable should have positive effect on PKL's participation. This is however negative. A more plausible explanation is that the model suffers from multicollinearity. Now the participation likelihood of PKL captures the effects of contract characteristics for STA. To check this, I estimate the model STA2 where "prop. s. PKL" is dropped. The results of the second model specification give credibility to the multicollinearity suspicion, because STA again cares for the same variables as in the linear first stage. The only exception being the use of articulated/bogie buses that it seems to avoid now. The main variable of interest, how STA reacts to the expected participation of CR, "prop. s. CR" is robust to the different model specifications. PKL gets very similar results to the first stage in both specifications and these results are the same in both specifications. The only difference is that its own distance and the contract length are no longer significant when the strategic elements are taken into account, but they still have the expected sign. For neither PKL nor STA, the expected participation of CR seems to matter. Based on this estimation, common value bidders do not behave any differently than private value bidders when making the entry decisions. Since neither is significantly

different from zero, no explicit test is needed to test their difference. One possible explanation for this result is that entry is exogenous in this market, bidders know who are going to submit a bid before the auction.

[Table 4. about here]

The results of the semiparametric estimation are presented in Table 5. The main result of these estimations is the same as in the parametric estimation. For neither PKL nor STA, the expected participation of CR seems to matter. The common value bidders do not seem to behave any differently than private value bidders when making the entry decisions. For PKL, the effect of contract characteristics are very similar to the first estimation. The only difference is in the model PKL2. It also seems to care about the distance of CX and in a surprising direction. PKL bids more to those contracts that are near to CX. STA seems only to care about its own distance. In the model STA2, it also wants to avoid long contract periods.

[Table 5. about here]

6   Conclusions

I have constructed a set up from a data set on the City of Helsinki bus transit auctions to test whether common value and private value bidders make different entry decisions. More specifically, I have tested whether one bidder that is always more influenced by common value components reacts to the amount of expected competition differently than another bidder who always puts more weight on the private value components. Tukiainen (2008) shows that bidders that have garages close to the contracted bus routes are more influenced by the common value elements than bidders with garages further away. I find that the near bidder and the far bidder do not react to changes in the expected amount of competition any differently.

The analysis was conducted using estimations developed by BHKN. Besides measuring the effects of strategic interactions, the analysis provided information on how the different contract and bidder characteristics affect the entry choices of the bidders. I estimated two different two stage models. Three

main results arise from the more flexible estimations: First, there are no strategic interactions, the expected participation of other bidders does not affect the entry decisions. Second, the bidder's own distance from the garage to the route matters for the common value bidder STA but not for the private value bidder PKL. Third, the contract length matters for the common value bidder but not for the private value bidder. In addition, there was evidence of decreasing economies of scale with respect to the size of the contracts for PKL. PKL also avoided contracts where special buses were required. In addition to these results, the parametric estimations show that there is reason to suspect that actually both the bidders operate under decreasing economies of scale with respect to the size of the contracts and that both the bidders avoid contracts where special buses were required. Moreover, according to the first stage of the parametric approach, also the private value bidder seems to care for its own distance and avoids long contracts.

The main policy result is based on the finding that all of the analyzed firms seemed to dislike long contracts. Whether this was statistically significant for all the bidders depends on the estimated model. Longer contract period increases the common future uncertainty and therefore the common value component becomes more important. If the contract period is shortened, it decreases the importance of common costs. According to Goeree and Offerman (2003) already this should increase the auctioneer's revenue. In addition, a decreased contract period should increase entry in this market. With less uncertainty about the common components, the possible increased entry should be more profitable for the auctioneer than with longer contract periods. Thus two separate effects arise from shortening the contract length that would both increase the auctioneer's revenue. Even if the entry is not increased with shorter contracts, we know that at least entry should not decrease and thus the information effect should work unhindered. Therefore the City of Helsinki should experiment by shortening the average contract length from five to for example four years.

7 References

Athey S, Levin J, Seira E (2004). Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions. Working Paper.

Bajari P, Hortacsu A (2003). The Winner's Curse, Reserve Prices and Endogenous Entry: Empirical Insights from eBay Auctions. The Rand Journal of Economics 34(2), 329-355.

Bajari P, Hong H, Krainer J, Nekipelov D (2007a). Estimating Static Models of Strategic Interactions. Working Paper.

Bajari P, Hong H, Ryan S (2007b). Identification and Estimation of a Discrete Game of Complete Information. Working Paper.

Berry S (1992). Estimation of a Model of Entry in the Airline Industry. Econometrica 60, 889–917.

Berry S, Tamer E (2007). Identification in Models of Oligopoly Entry. In Advances in Economics and Econometrics: Theory and Applications, Ninth World Congress, vol. 2, Blundell R, Newey W ,Persson T, eds., Cambridge University Press.

Bresnahan T, Reiss P (1990). Entry in Monopoly Markets. Review of Economic Studies 57, 531-553.

Bresnahan T, Reiss P (1991). Empirical Models of Discrete Games. Journal of Econometrics 48, 57-81.

Cantillon E, Pesendorfer M (2006). Combination Bidding in Multi-Unit Auctions. CEPR Discussion Paper 6083.

Compte O, Jehiel P (2002). On the Value of Competition in Procurement Auctions. Econometrica 70(1). 343-355.

Chakraborty I, Kosmopolou G (2001). Auctions with Endogenous Entry. Economic Letters 72, 195-200.

Cox J, Dinkin S, Swarthout, J (2001). Enodenous Entry and Exit in a Common Value Auctions. Experimental Economics 4, 163-181.

Dasgupta P, Maskin E (2000). Efficient Auctions. Quarterly Journal of Economics 115, 341-388.

Engelbrecht-Wiggans, R (1987). On Optimal Reservation Prices in Auctions. Management Science 33(6), 763-770.

Engelbrecht-Wiggans, R (1993). Optimal Auctions Revisited. Games and Economic Behavior 5, 227-239.

Gal S, Landsberger M, Nemirovski, A (2007): Participation in Auctions. Games and Economic Behavior 60, 75-103.

Goeree J, Offerman T (2002). Efficiency in Auctions with Private and Common Values: An Experimental Study. The American Economic Review 92(3), 625-643.

Goeree and Offerman (2003). Competitive Bidding in Auctions with Private and Common Values. The Economic Journal 113, 598-613.

Harstad R (1990). Alternative Common Value Auctions Procedures: Revenue Comparison with Free Entry. Journal of Political Economy 98(2), 421-429.

Harstad R (2005). Rational Participation Revolutionizes Auction Theory. Working paper.

Hausch D (1993). A Common Value Auction Model with Endogenous Entry and Information Acquisition. Economic Theory 3(2), 315-334.

Jackson M (2005). Non-Existence of Equilibrium in Vickrey, Second-Price, and English Auctions. Mimeo, Caltech.

Jehiel P, Moldovanu B (2001). Efficient Design with Interdependent Valuations. Econometrica 69, 1237-1259.

Krasnokutskaya E, Seim, K (2005). Bid Preference Programs and Participation in Highway Procurement Auctions. Working paper.

Levin D, Smith J (1994). Equilibrium in Auctions with Entry. The American Economic Review 84(3), 585-599.

Li T (2005). Econometrics of First-Price Auctions with Entry and Binding Reserve Prices. Journal of Econometrics 126, 173-200.

Li T, Zheng, X (2006). Entry and Competition Effects in First-Price Auctions: Theory and Evidence from Procurement Auctions. Cemmap working paper 13/06.

Maskin E (1992). Auctions and Privatization. In Privatization, Siebert H, ed., Institut fur Weltwirtsschaften der Universitat Kiel, 115-136.

McAfee P, MCMillan J (1987). Auctions with Stochastic Number of Bidders. Journal of Economic Theory 43(1), 1-19.

Menezes F, Monteiro P (2000). Auctions with Endogenous Participation. Review of Economic Design 5, 71-89.

Pesendorfer W, Swinkels J (2000). Efficiency and Information Aggregation in Auctions. American Economic Review 90, 499-525.

Saarelainen K 2004. Helsingin kaupungin bussiliikenteen kilpailutuksen tarjouspyyntö- ja tarjousvertailuaineisto vuosilta 1997-2004. City of Helsinki Supplies Department. (A summary of bidding in the City of Helsinki bus transit auctions, in Finnish only.)

Samuelsson W (1985). Competitive Bidding with Entry Costs. Economic Letters 17, 53-57.

Smith J (1982). Equilibrium Patterns of Bidding in OCS Lease Sales. Economic Inquiry 20(2), 180-190.

Smith J (1984). Further Results on Equilibrium Patterns of Bidding in OCS Lease Sales. Economic Inquiry 22(1), 142-146.

Ye L. (2004). Optimal Auctions with Engoneus Entry. Contributions to Theoretical Economics 4(1), Article 8.

Tukiainen J (2008). Testing for Common Costs in the City of Helsinki Bus Transit Auctions. Forthcoming in International Journal of Industrial Organization (2008), doi:10.1016/j.ijindorg.2007.12.006.

Table 1. Bus transit tenders included in the data set.

Tranche	# auctions	# single bids	# comb. bids	# bidders
1/I (97-98)	7	34	5	3-8
1/IA (98)	1	4	0	4
1/II (98)	7	23	1	2-6
1/III (98-99)	1	8	0	8
1/IV (99)	9	33	4	2-6
1/V (00)	8	25	3	2-5
1/VI (01)	5	18	1	2-4
2/I (01)	3	11	0	3-5
2/II (02)	5	21	0	3-5
2/III (03)	5	20	0	3-5
2/IV (03)	4	18	0	3-5
Total	55	215	14	2-8

A "Tranche" refers to the set of contracts that correspond to a single invitation to tender. The year the auction was held is in parentheses. "2/III" means the third tranche of the second round of the tendering of the entire traffic. "# auctions" refers to the number of auctions in a given tranche. "# single bids" means the total number of single bids in a given tranche. "# comb. bids" means the total number of combination bids in a given tranche. "# bidders" denotes to the spread (min - max) of the number of bidders per auction in a given tranche.

Table 2. Participation, its success and the mean of contract characteristic when actual bidder for each bidder separately.

	HKL	CX	STA	CR	PKL	AAS	OLA	LLR	LSL	ESL
Bids	55	52	39	38	16	7	6	6	2	2
% submitted	100	95	71	69	29	13	11	11	4	4
Wins	21	8	10	11	5	0	0	0	0	0
% won	38	15	26	29	31	0	0	0	0	0
Mean distance	5.8	13.8	8.2	14.4	20.9	7.7	15.1	NA	NA	NA
C mean line hrs	42.3	43.3	37.1	41	30.1	18.2	38.9	40.8	27.2	47.5
C mean rush%	0.4	0.41	0.41	0.35	0.42	0.24	0.33	0.52	0.43	0.28
C mean a/b bus d	0.38	0.37	0.36	0.42	0.19	0	0	0	0	0
C mean c. length	4.9	4.9	4.8	4.9	4.7	5	4	4.5	3.5	5

"Bids" denotes the number of bids submitted. "% submitted" is "Bids" divided by 55, the total number of auctions in the data. "Wins" denotes the number of auctions that the given bidder has won. "% won" is "Wins" divided by "Bids". "Mean distance" presents the mean distance from the garage to the route for each bidder and all auctions in the data. The last four rows present the means of contract

characteristics conditional on the given bidder submitting a bid, therefore the notation "C mean". "line hrs" stands for thousands of line hours in a year, i.e the size of the contract. "rush%" is the share of rush hour traffic. "a/b bus d" is a dummy for whether the contract requires articulated/bogie buses and "c. length" denotes the contract length in years. HKL = Helsingin Kaupungin Bussiliikenne. STA = Suomen Turistiauto Oy. CX = Connex Oy. CR = Concordia Oy. PKL = Pohjolan Kaupunkiliikenne. OLA = Oy Liikenne Ab. LLR = Linjaliikenne Randell. AAS = Askaisten Auto or Auto Andersson Oy. LSL = LS-Liikennelinjat Oy. ESL = Etelä-Suomen Linjaliikenne.

Figure 1. Distance from the garage to the route for bidders STA, CR and PKL.
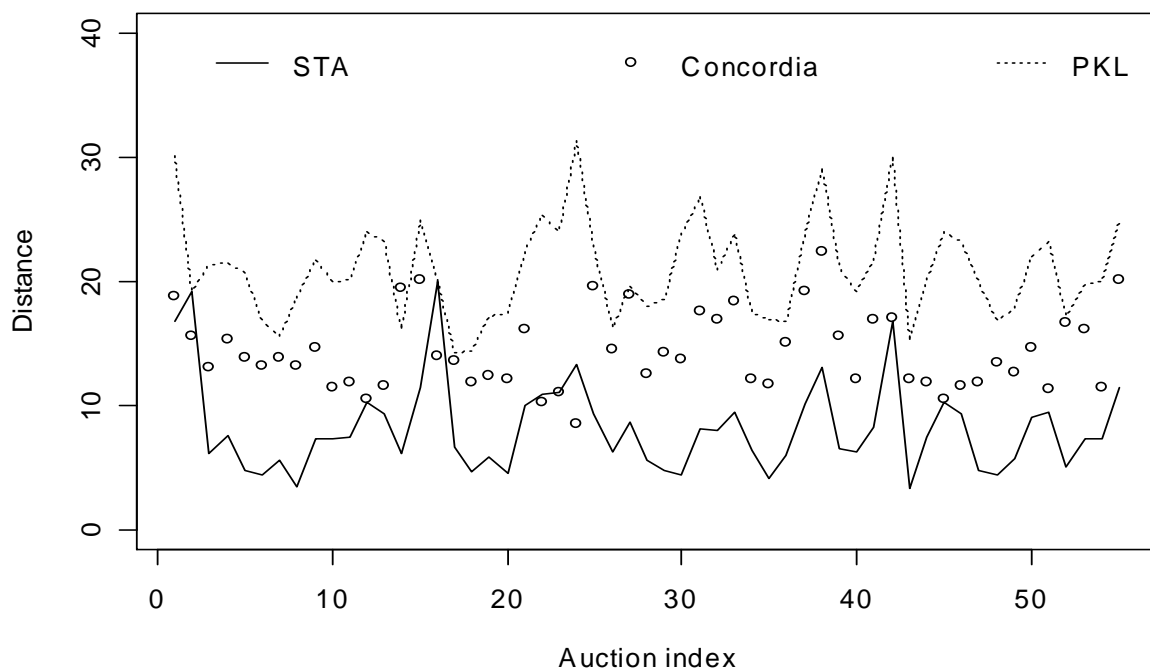
The auctions are indexed in the x-axis with 1 being the first auction and 55 the last auction. The distance is in kilometers in the y-axis.

Table 3. Results of the first stage linear probability estimations.

Variable	STA		CR		PKL	
	coef.	s.e.	coef.	s.e.	coef.	s.e.
constant	-4.10	3.56	4.96	3.12	-9.84	3.63***
log line hrs	1.34	0.74*	-0.85	0.64	2.54	0.74***
log line hrs^2	-0.07	0.03*	0.04	0.03	-0.13	0.04***
rush%	-0.20	0.27	-0.30	0.25	-0.23	0.25
a/b bus d	-0.15	0.12	-0.04	0.10	-0.29	0.11**
c. length	-0.30	0.11***	-0.04	0.09	-0.18	0.10*
time1	0.15	0.17	-0.51	0.15***	-0.08	0.17
time3	0.13	0.12	0.09	0.10	0.33	0.12***
dist. HKL	0.09	0.04**	0.03	0.03	-0.0006	0.03
dist. CX	-0.02	0.02	0.06	0.02***	-0.03	0.02
dist. Own	-0.07	0.02****	-0.08	0.02****	-0.04	0.02**
R^2	0.42		0.62		0.48	

"log line hrs" denotes the logarithm of line hours in a year and "log line hrs^2" its square. "rush%" stands for the share of rush hour traffic. "a/b bus d" is a dummy for the contract requiring the use of articulated/bogie buses. "c. length" denotes the contract length in years. "time1" is the time dummy for the very first tranche and "time3" is the time dummy for the last four tranches in the data, the time period after the entire traffic was tendered once. "dist. HKL" is the distance from the nearest HKL garage to the route(s) in a given contract and "dist. CX" in the same for the bidder Connex. "dist. Own" is the distance of the bidder for whom we conduct the estimation. N=55 for each bidder. "*" means 10 % significance level, "**" means 5 % significance level, "***" means 1 % significance level and "****" means 0,1 % significance level for two-sided tests.

Table 4. Results of the second stage logit estimations.

Variable	STA1 coef.	STA1 s.e.	STA2 coef.	STA2 s.e.	PKL1 coef.	PKL1 s.e.	PKL2 coef.	PKL2 s.e.
constant	98.8	77.8	-51.2	41.9	-876	463*	-644	263**
log line hrs	-19.7	18.5	17.8	10.3*	184	94.6*	134	54.1**
log line hrs^2	1.02	0.96	-0.91	0.54*	-8.96	4.54**	-6.56	2.66**
rush%	2.64	4.63	-0.12	3.42	-9.74	7.77	-4.82	5.90
a/b bus d	-0.10	2.18	-3.78	1.76**	-6.35	3.14**	-4.72	2.81*
c. length	-2.03	2.52	-5.66	2.31**	-6.72	4.12	-3.22	2.26
time1	6.59	7.73	7.23	4.45	-1.16	3.92	-1.40	3.11
time3	-0.89	2.08	2.48	1.58	10.4	4.84**	8.11	4.33*
dist. HKL	1.00	0.62	0.85	0.56	1.26	1.16	0.69	0.82
dist. CX	0.18	0.24	0.05	0.21	-0.58	0.43	-0.44	0.42
dist. Own	-0.84	0.46*	-1.24	0.47***	-1.15	0.71	-0.75	0.49
prop. s. CR	**0.54**	**3.34**	**0.91**	**2.55**	**-0.99**	**4.33**	**-0.57**	**4.02**
prop. s. PKL	12.7	6.30**	-	-	-	-	-	-
prop. s. STA	-	-	-	-	-8.95	9.03	-	-
AIC	51.2		54.4		42.6		43.2	

Variables are explained in the caption of Table 2. In addition "prop. s. CR", "prop. s. PKL" and "prop. s. STA" denote the propensity scores or choice probabilities , i.e. the fitted values, of these three bidders calculated from the first stage estimations. The variable "prop. s. CR" is in bold because that is the main variable of interest. N=55 for both bidders. "*" means 10 % significance level, "**" means 5 % significance level, "***" means 1 % significance level and "****" means 0,1 % significance level for two-sided tests.

Table 5. Results of the semiparametric two stage least squares estimations.

Variable	STA1 coef.	STA1 s.e.	STA2 coef.	STA2 s.e.	PKL1 coef.	PKL1 s.e.	PKL2 coef.	PKL2 s.e.
constant	1.46	6.48	-4.20	4.00	-11.3	3.05****	-11.0	2.92****
log line hrs	0.13	1.45	1.34	0.85	2.79	0.61****	2.71	0.58****
log line hrs^2	-0.00	0.08	-0.07	0.04	-0.14	0.03****	-0.14	0.03****
rush%	0.08	0.37	0.05	0.42	0.16	0.34	0.08	0.82
a/b bus d	-0.06	0.18	-0.16	0.14	-0.30	0.14**	-0.29	0.11***
c. length	-0.16	0.12	-0.23	0.12*	-0.10	0.13	-0.11	0.27
time1	0.31	0.21	0.30	0.19	0.16	0.25	0.09	0.20
time3	-0.04	0.15	0.07	0.14	0.23	0.13*	0.25	0.13*
dist. HKL	0.07	0.06	0.05	0.05	-0.05	0.05	-0.04	0.35
dist. CX	-0.02	0.04	-0.03	0.03	-0.05	0.03	-0.04	0.02*
dist. Own	-0.06	0.01****	-0.06	0.02****	-0.03	0.03	-0.03	0.02
entry CR	**0.24**	**0.36**	**0.32**	**0.26**	**0.50**	**0.30**	**0.38**	**0.27**
entry PKL	0.43	0.38	-	-	-	-	-	-
entry STA	-	-	-	-	-0.06	0.33	-	-
R^2	0.44		0.43		0.49		0.52	

Variables are explained in the caption of Table 2. In addition "entry CR", "entry PKL" and "entry STA" denote the endogenous variables, i.e. the participation dummy, of these three bidders. The results are obtained with STATA "ivreg" command with robust standard errors. As instrumental variables, I used two orthogonal polynomial transformations of the contract characteristics. These were calculated with R "poly" command. The variable "entry CR" is in bold because that is the main variable of interest. N=55 for both bidders. "*" means 10 % significance level, "**" means 5 % significance level, "***" means 1 % significance level and "****" means 0,1 % significance level for two-sided tests.