Competitive tendering and cross-shareholding in public passenger transport

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Abstract

Competitive tendering is a widespread procurement strategy for increasing efficiency in the passenger transport industry. Motivated by the structural changes following the increased use of competitive tendering observed in the Norwegian local bus industry, this paper uses first-price single-bid auction theory to demonstrate that rational firms can respond strategically with cross-ownership when exposed to the uncertainty entailed to competitive tendering. This could raise the equilibrium bid implying that the subsidy reduction rationale for introducing competitive tendering is partly invalidated. Transport authorities should be aware of such possible structural changes when considering further implementation of competitive tendering.

Keywords: Auction theory, competitive tendering, cross-ownership, equilibrium subsidy bid, public transport

1. Introduction

The market for public passenger transport is characterized by governmental interventions to ensure that services are provided in a way that is considered satisfactory by the society with respect to factors such as area planning, congestion, fares or quality (see e.g. Button, 2010). As a consequence, transport authorities often allocate subsidies to this industry which can be assigned to the transport companies in several ways. The subsidies can take the form of procurement contracts for exclusive operation in a region which is awarded by auctions on subsidy bids referred to as competitive tendering (Hensher and Wallis, 2005; Preston, 2005). The use of competitive tendering has proven to be popular in procurement of transport services the last few decades and there is a growing literature on the experiences (e.g. Beck, 2012; Hensher and Stanley, 2010; Ida and Talit, 2015; Kain, 2009; Lidestam, 2013).

A consequence of exposure to competitive tendering, which is perhaps an unintended effect, is the possible incentives for rational profit maximizing firms to increase cross-ownership. The influence of partial ownership between firms on bids has been addressed to some degree in the auction literature, see e.g. Dasgupta and Tsui (2004) and Reynolds and Snapp (1986), but the results have rarely been related to the transport industry. Some empirical evidence does, however, exist on this topic. Mathisen and Solvoll (2008) presented empirical evidence on how the increased competitive exposure in the Norwegian subsidised local bus industry has led to substantial structural changes towards larger groups of companies and higher market concentration.[1]

More recent evidence from the Norwegian express coach industry by Aarhaug and Fearnley (2016) shows that the number of independent active firms was reduced from 30 when the market was deregulated in 2003 to 12 in 2015. Much of the reduction is due to mergers and increased cross-shareholding, and the local bus and express coach markets are currently served mostly by the same

[1] Until 1991, the county councils in Norway used either direct negotiations, standardized cost norms or a combination of the two to determine the size of the subsidy allocated to a bus operator. Transport legislation was changed in 1991 allowing county councils to use competitive tendering as an alternative to negotiations and cost norms from 1. April 1994. Today, the county councils have the opportunity to combine or choose between direct negotiations, cost norms and tendering when distributing subsidies among bus operators (Mathisen and Solvoll, 2008).

companies. Aarhaug and Fearnley (2016) further argues that the market response to deregulation and competitive tendering in Norway is similar to what has been observed in Sweden and the UK. In the review of impacts of competitive tendering in Germany, Beck (2012) finds evidence of both reduction in the number of bidders and situations where the number of bidders are unchanged. Evidence from Israel shows, in contrast, that tendering encouraged entry of new firms in addition to the two incumbent firms (Sharaby and Shiftan, 2008). Consequently, the impact of competitive tendering on market structure is not unambiguous.

The overall trend towards market concentration following exposure to tendering is not limited to the bus industry. For example, the number of active companies in the Norwegian car ferry industry was also reduced when negotiations were replaced by full implementation of competitive tendering. When evaluating the early stages of implementation, Bråthen et al. (2004) expected five owner groups to take part in future tendering processes and pointed specifically at structural changes as a major challenge for full scale implementation of competitive tendering in this industry. By 2010 the norm was two bids (Oslo economics, 2012). Today, all ferry services are procured by tendering and there are four active groups, of which a takeover is in process reducing the number of independent groups to three if allowed to proceed.

The change in market structure with partial ownership arrangements could potentially lead to collusive behaviour firms among the competing firms and is subject to policies regulating competition (see e.g. Motta, 2004). Hence, the structural changes frequently observed when competition increases would not be desirable for the market in the long run because it prepares for local monopolies and reduced efficiency gains from the regulatory mechanism of competitive tendering.

The aim of this paper is to apply a first-price auction model with asymmetric information and symmetric cross-ownership to demonstrate possible structural effects of introducing competitive tendering in a transport market. What distinguishes tendering from negotiated contracts is the higher insecurity for the participating firms because no firm knows who will win the contract. Consequently, an auction model is introduced as framework for understanding the general effect of firms taking strategic actions to handle the possible outcome of zero profit if they lose the tendering competition. The discussion of the model results relates to the Norwegian evidence of cross-ownership in competitive tendering for public passenger transport by bus.

The structure of the paper is as follows: Section 2 discusses the strategy of increasing the level of cross-ownership. In section 3 the auction model is presented and the equilibrium subsidy bid is solved with respect to cross-shareholding. Finally, the main conclusions and implications are given in section 4.

2. The strategy of increasing cross-ownership

It is argued by Reitman (1994) that even though mergers and partial ownership arrangements are primarily argued by efficiency gains, it can be questioned whether the real motivation is to increase market power. A corporate strategy to achieve reduced competition is to acquire shares in competing companies, and thereby taking part in the rivals' profit and strategy plans (Fu and Lu, 2013). Hence, for a firm there are several reasonable motives for engaging ownership links or taking over a rival, e.g. economies of scale, reduced competition, share of profit and reduced risk.

When discussing ownership shares in a rival company, distinction is made between ownership links and cross-ownership. While ownership links simply means that a company has an ownership share in another company, the term cross-ownership, or cross-shareholding, deals with two companies owning a share of each other. Dasgupta and Tsui (2004) define the degree of cross-ownership as the ratio of ownership share in another firm to the ownership share in its own firm. So, if a firm experience increased degree of cross-ownership, the firm either increases ownership share in the other firm or decrease ownership share in itself. If symmetry is assumed, cross-ownership can be defined as the ownership share each firm has in the other firm (Ettinger, 2002).

Auction theory will be used to demonstrate that it could be rational for a transport company to acquire shares in its competitors. Theoretical studies of auctions conclude that ownership links between two bidders damage both seller and society (Chillemi, 2005). Ownership links arranges for possible benevolent behaviour among the firms encouraging collaborative agreements that weaken the potential efficiency gains of competitive tendering. These effects are, in a general Cournot model, proven to be substantial even with relatively small ownership shares (Reynolds and Snapp, 1986). Dasgupta and Tsui (2004) concludes that the bidder with the higher cross-shareholding will bid less aggressively than its rival in first-price auctions.

The literature examining cross-ownership among more than two bidders is not extensive. Clark et al. (2007) study cross-shareholding in an all-pay auction with incomplete information and compares the results with first-price auctions in order to explain the more aggressive bidding in the latter

approach. Studies on this topic mostly debate which form of auction is best to minimize the benevolent behaviour related to cross-ownership. Generally, first-price auctions are more efficient than both second-price auctions (Ettinger, 2002) and English auctions (Greenlee and Waehrer, 2004) in markets with private values and cross-ownership. The introduction of cross-ownership makes the models more complex. In order to overcome the problems, ownership-shares are either assumed to be equal among firms or given prior to the game.

The auction models in the literature are relevant for the tendering procedures taking place in the transport industry and the results are transferable when assuming that, due to the authorities' goal of selecting the operator with lowest subsidies for a predefined service standard, the lowest bid rather than highest bid wins the contract. Tendering, at least in the Norwegian local bus industry, is typically an auction consisting of few bidders with relatively high level of ownership links. Because the "seller" is the local transport authority, there are only horizontal ownership links. When applying auction theory in the context of tendering of transport services, the focus is purely on classic gross contracts, also known as the Scandinavian model (Preston, 2005). Since authorities defines the route standard, revenues are assumed to be equal for all bidders. In this form of competitive tendering firms compete by minimizing operation costs on tendered routes and have little, if any, revenue incentives. Bekken et al. (2006) shows that the majority of new tendered contracts in the Norwegian bus industry are gross contracts.

3. The auction model

The applied model is based on a first-price sealed-bid auction with private information and symmetric share crossholding. The firms do not know each other's cost functions and this private information must be included in the auction model.[2] This is similar to the problem formulated for the Bayesian-Nash equilibrium: *Each player's strategy is a function of her own information, and maximizes her expected payoff given other players' strategies and given her beliefs about other players' information* (Klemperer, 1999).

[2] It could be argued that firms with ownership share in another company would have some information about the costs of this firm. In that case competition would be treated as an auction with complete information (see e.g. Fu and Lu, 2013).

Figure 1 illustrates this game in two stages. First, the strategic structural changes take place as the companies realise the threat of competitive tendering. Second, the auction takes place and the winner starts production. Based on this framework we can discuss the optimal strategic behaviour of the firms in stage 1 assuming profit maximization.

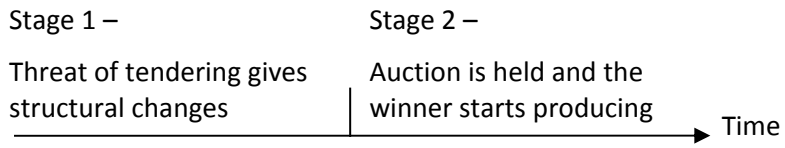

Figure 1 – Framework: the two stage model of structural changes in auctions.

Let $i = \{1,2\}$ denote two risk-neutral and rationally profit maximising firms bidding on a tendered network of routes. The firms bid on a subsidy granted to the winning operator for meeting operating costs and profit. The firm with the lowest subsidy requirement, which also fulfil the specifications, wins exclusive rights to operate the area for several years. The expected payoff for the winning firm, $\pi_i(S_i, C_i, \theta)$, is the difference between the winning subsidy bid, S_i, and the costs, C_i. It is assumed that both firms control a share of the capital of the other firm, θ. The share of the capital, or cross-ownership share, is symmetric among the two firms and valid for the interval $\theta \in [0, 1/2]$.

The operating costs for firm i, C_i, is private information and drawn from a strictly increasing cumulative independent probability distribution $F(C_i)$ with density $f(C)$ on the interval $[0,1]$. That is, each bidder knows its own value but views the rival's value as an independent and identically distributed draw from the distribution function F with density f over the support $\in [\underline{C}, \overline{C}]$. $F(X)$ is the cumulative probability that C_i is equal or lower than X, $F(X) = Prob(C_i < X)$. We assume that the subsidy bid, S_i, is symmetric and a strictly increasing function of the costs. Thus, the bid for firm i can be written as $S_i = s(C_i)$, or inversed $C_i = s^{-1}(S_i)$.

From the assumptions it is evident that the results are symmetric for the two firms, so let us start by looking at firm 1. Since the lowest bid wins the auction, firm 1 will win if it places a bid lower than its competitors, $S_1 \leq s(C_2)$. The probability that firm 1 bid lower than 2 is then $Prob(s^{-1}(S_1) \leq C_2)$. The probability that firm 1 has the lowest bid can be written as $[1 - F(s^{-1}(S_1))]$ given symmetric strategy in equilibrium.

The ownership links complicates the expected payoff in this auction. If bidder 1 wins the auction he derives the profit $S_1 - C_1$. This increases the value of the other firm's share of the profit, θ, by $\theta(S_1 - C_1)$, consequently reducing firm 1's profit to $(1-\theta)(S_1 - C_1)$. Thus, the expected payoff, π, for firm 1 is the remaining profit if it wins plus the share of firm 2's profit if it loses expressed by $\pi_1(S_1, C_1, \theta) = Prob(S_1 < S_1)(1-\theta)S_1 - C_1) + Prob(S_2 < S_1)\theta(S_2 - C_2)$. A rephrasing of this profit function is given in equation (1).

(1) $$\pi_1 = (1-\theta)\int_{s^{-1}(S_1)}^{\overline{C}}(S_1 - C_1)f(t)dt + \theta\int_{\underline{C}}^{s^{-1}(S_1)}(s(t) - t)f(t)dt$$

Firm 1 then maximizes the profit with respect to the bid. Let us look at firm i's profit maximisation problem. In order to find the best strategy (i.e. bid) for firm i we differentiate (1) with respect to S_1 using the Leibniz formula (see e.g. Sydsæter et al., 2005).

(2) $$\frac{\partial \pi_1}{\partial S_1} = (1-\theta)\left[\int_{s^{-1}(S_1)}^{\overline{C}} f(t)dt - (S_1 - C_1)f\big(s^{-1}(S_1)\big)s^{-1\prime}(S_1)\right]$$
$$+\theta\big[s[s^{-1}(S_1) - s^{-1}(S_1)]f\big(s^{-1}(S_1)\big)s^{-1\prime}(S_1)\big] = 0$$

This is expected profit if the firm win plus the expected profit if the other firm win. Equation (2) can be rewritten as $\frac{\partial \pi_1}{\partial S_1} = s(C_1)f(C_1) - C_1 f(C_1) - \frac{s'(C_1)(1-F(C_1))(1-\theta)}{1-2\theta}$ using the relationships that $s^{-1\prime}(S_1) = \frac{1}{s'(s^{-1}(S_1))} = \frac{1}{s'(C_1)}$ and $S_1 = s(C_1)$. This leads to equation (3) where $\alpha \equiv \frac{1-\theta}{1-2\theta}$.

(3) $$\frac{\partial \pi_1}{\partial S_1} = s(C_1)f(C_1) - C_1 f(C_1) - s'(C_1)(1-F(C_1))\alpha = 0$$

The derivative of (3) with respect to the earlier defined X is solved in (4).

(4) $$\left[s(X)(1-F(X))^{\frac{1}{\alpha}}\right]' = \left[\frac{\alpha s'(X)\big(1-F(X)\big) - f(X)s(X)}{\alpha}\right](1-F(X))^{\frac{1}{\alpha}-1}$$

The relationship $\alpha s'(X)\big(1-F(X)\big) - s(X)f(X) = -Xf(X)$ that can be derived from equation (3) is used in equation (4) and gives equation (5).

(5) $$\left[s(X)(1-F(X))^{\frac{1}{\alpha}}\right]' = -\frac{Xf(X)}{\alpha}(1-F(X))^{\frac{1-\alpha}{\alpha}}$$

We then integrate both sides of equation (5). Because the firm with the highest costs never will win and both sides of equation (5) thus can be 0, it can be deduced that the constant of integration, k, in equation (6) is 0.

(6) $$-s(C_1)(1-F(C_1))^{\frac{1}{\alpha}} = \int_{C_1}^{\overline{C}} -\frac{Xf(X)(1-F(X))^{\frac{1-\alpha}{\alpha}}}{\alpha}dX + k$$

Then the first term on the right hand side of equation (6) is integrated by parts.

(7) $$\int_{C_1}^{\overline{C}} -\frac{Xf(X)(1-F(X))^{\frac{1-\alpha}{\alpha}}}{\alpha}\,dX = -(1-F(C_1))^{\frac{1}{\alpha}}C_1 - \int_{C_1}^{\overline{C}}(1-F(X))^{\frac{1}{\alpha}}\,dX$$

By inserting equation (7) in equation (6), we are able to derive the equilibrium bidding strategy in (8).

(8) $$s(C_1) = C_1 + \frac{\int_{C_1}^{\overline{C}}(1-F(X))^{\frac{1}{\alpha}}dX}{(1-F(C_1))^{\frac{1}{\alpha}}} \Rightarrow s(C_1) = C_1 + \frac{\int_{C_1}^{\overline{C}}(1-F(X))^{\frac{1-2\theta}{1-\theta}}dX}{(1-F(C_1))^{\frac{1-2\theta}{1-\theta}}}$$

Equation (8) shows that the symmetric equilibrium subsidy demand for firm 1 is based on costs plus a term depending on the degree of cross-ownership. The derivative of the term under the integral in equation (8) with respect to θ show how increased cross-ownership influences the equilibrium bid.

(9) $$\frac{d}{d\theta}\left[(1-F(X))^{\frac{1-2\theta}{1-\theta}}\right] = -\frac{ln\left[\frac{1-F(X)}{1-F(C_1)}\right]}{(1-\theta)^2}\cdot\left[\frac{1-F(X)}{1-F(C_1)}\right]^{\frac{1-2\theta}{1-\theta}} > 0$$

Since $0 < \theta < 1/2$ and $1 \geq \frac{1-F(X)}{1-F(C_1)} > 0$, the derivative in equation (9) is positive.

The equilibrium subsidy bid is thus increasing in the level of cross-ownership. This means that the loss of revenue to the other firm if winning is more than compensated by the expected value of an equal proportion of the other firm's revenue derived from a higher bid. In other words, if firms seek to increase profit by raising their bids, they should encourage cross-ownership. Hence, the result is higher subsidy bids where cross-ownership is present, implying that the efficiency rationale for introducing competitive tendering is partly invalidated.

Consequently, when relating the result to the framework presented in Figure 1, it is clear that the uncertainty related to the threat of tendering in a future stage 2 could lead to strategic structural changes in stage 1. The auction increases competition and imposes the possibility for firms making no profit if the tendered contract is lost. A strategy to reduce the risk of receiving no profit is to reduce the competition by acquiring shares in the competitor and take part in the strategic plans and possible profit. Based on our model and literature on auctions it can be argued that cross-ownership leads to higher subsidy demands and less aggressive bidding behaviour. It is thus demonstrated that rational bus companies can respond strategically to the threat of competitive tendering with structural changes such as take-overs or increased cross-ownership.

4. Conclusions and implications

Competitive tendering is frequently used for governmental procurement of subsidised services in the public passenger transport industry. The competition between transport firms to be awarded the subsidised contracts can take many forms, and is in this article modelled by a first-price auction with symmetric ownership links where cost is private information. This model, following the traditions of competitive tendering of transport services in Scandinavia, demonstrates that the exposure to competitive tendering could make rational firms increase cross-ownership in its competitors. This is, however, not a causal relationship, but could contribute to explain the phenomenon observed by empirical studies that following the introduction of competitive tendering the number of companies has decreased considerably and leaving a set of very large remaining groups of companies. It is emphasized that the experiences forming the basis for the conclusions relates to the Norwegian local bus industry. Evidence from other countries and industries has shown that competition could encourage entry of new firms. This could be the case for example if the initial number of providers is very low, the rent is high and barriers to market entry are low.

Transport authorities should be aware of the possible structural changes when considering further implementation of competitive tendering. Assuming that illegal collusive behaviour is taken care of by law and that the competition authority deals with undesired takeovers, the transport regulator should not ban cross-owned firms from participating as this will reduce competition further. In the long run it could give undesirable local monopolies which will weaken the competitive element and partly invalidate the efficiency rationale of tendering. Nevertheless, a high number of bidders is not a goal in itself but merely an indicator for authorities to be aware of possible collusive behaviour.[3] Relevant goals should rather be efficient operations and improvements in consumer surplus. Authorities can influence the efficiency of the process by regulating for example contract type, contract duration and renegotiation possibilities (see e.g. Ida and Talit, 2015).

[3] Athias and Nunez (2008) discuss how the fear of the “winners curse” in principle could in fact raise the winning bid when the number of bidders increases. Hence, the influence on bids by introducing more firms in the tendering process is the total of the two opposing effects of increased competition and increased fear of the “winners curse”.

If the number of active bidders are few and competition is low, price competition by tendering may not be the best way to arrange for procurement of public transport from a welfare point of view. By including incentives, authorities can guide the transport company to deviate from the monopolistic behaviour of an uncompeted bidder towards the desired market outcome. An alternative to competitive tendering addressed by Hensher and Stanley (2003) is performance- and output based contracting. Moreover, by giving incentives to quality enhancements, it is quite possible to increase attractiveness the public transport services with the result of reduced subsidies (e.g. Rojo et al., 2015). For lots with very few bidders, the use of incentive strategies in direct negotiations could be preferable. The relevance of negotiations is supported by the review of experiences with competitive tendering by Hensher and Stanley (2010). Consequently, by combining different forms of procurement strategies, the incentive to engage in cross-ownership will be reduced and local authorities can maintain both the long-run basis for competition and the overall objective of maximising the social surplus of public transport services. Still, competitive tendering has a disciplining effect on negotiations and should be part of the procurement strategy to avoid excessive rents (e.g. Filippini et al., 2015).

Even though several studies address the number of bidders in tendering rounds, there exists little evidence on cross-ownership conditions between bidders. Future research should expand the empirical body on cross-ownership so that conclusions drawn from the case of the Norwegian local bus industry can be contrasted by other contexts. In order to get a deeper understanding of the effects of cross-ownership on the equilibrium bid future research could aim to reveal the information necessary to calculate the equilibriums using empirical data. However, an empirical test would require data on company sensitive information such as costs and it is perhaps more appropriate to approach this by using numerical examples and assumptions on the key information.

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