Competitive Tendering of Public Transport

Estimating Effects of Competition

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Abstract

In this paper I study the tendering of bus routes in the Swedish county Västernorrland. The research of bus tendering has got some attention since the public transport reform in 1989 and this is a contribution analysing how the actual competition in auctions affects costs per kilometer. The main conclusions are that more competition reduces costs and that data is scarce.
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1 Introduction

Since about a quarter of a century the public transport authorities in Sweden use competitive tendering to decide which company should operate specific routes or set of routes in a region. This paper studies the tendering of bus services in a Swedish region and investigates factors determining the cost per kilometer. The data used comes from the latest tender by the public transport authority in county Västernorrland. The method draws on the work by Amaral et. al. (2013) who studied the impact on costs per mile by the number of bidders and the expected number of bidders, using data from London. The purpose in this paper is to make a similar analysis on Swedish data. Hong and Shum (2002) argue that there are two contradicting effects on enhanced competition (i.e. more competitors). The first is the competition effect which works according to the Walrasian logic, namely that more bidders leads to more aggressive bidding. The second effect is the winner’s curse which means that the winner overestimates the value of the auctioned object, an effect that may lead to less aggressive bidding.

The total value of the procured goods and services in Sweden in 2013 weighed in on 741 billion SEK and accounts for roughly 20 per cent of the Swedish Gross Domestic Product (GDP) according to the Swedish Competition Authority (2015) and the total cost of public transport the same year was 39.3 billion SEK (Transport Analysis, 2014).

There is a large body of literature analysing effects of competitive tendering around Europe but in my experience there is a lack of studies regarding bus tendering in Sweden and with recent data. According to Nilsson (2011) the public transport sector must be better to follow up its activities in order to learn from past experiences. Ultimately it is a democratic concern that data points are so hard to obtain. Beck (2010) argues that data constraints and lack of economic research in Germany makes it hard to analyse the market for subsidised public transport. This might be due to the fact that only four regions had used competitive tendering to a larger extent.

The general idea of procuring the operation of bus services compared to a fully deregulated regime is that competition for the market is hoped to be better than competition in the market (Amaral et. al., 2009). Jansson and Wallin (1991) stated that a transport system is valued higher than the sum of the single routes. Travelers often need to transfer between routes in order to reach their destination, why an integrated system and a uniform fare is essential. A fear of this type of planned, centralised, system is that it disregards innovations from private operators (Jansson and Wallin, 1991). However, the operator’s view is taken into account in some cases, for instance in developing the new network.
of bus routes in Stockholm city the French company Keolis was involved together with the public transport authority and the city council (Sundström, 2015).

The paper will begin with a background of public transport and in section 3 outline auction theory briefly along with previous studies. In section 4 the data and empirical model is presented, section 5 contains the results and lastly, section 6, will include comments and conclusions.

2 Public Transport

The transport sector is a vital function for a modern society. According to data from the Swedish authority Transport Analysis (2014), presented in figure 1, the total distance travelled per year in Sweden (all modes) has sharply increased since 1950 with only a few jumps in the curve that seems to coincide with macroeconomic events such as the oil crisis in 1973 and the crisis in the early 1990s. It is of course expected to observe that total transportation has increased (because of population growth), but a correction for the population each year tells that the traveled kilometers per person and day has increased from about 8 in 1950 to a little less than 40 in 2013. Thus, in times of climate change and congested cities, this is an important field to study.

Figure 1: Kilometers traveled in Sweden
The market share of public transport modes was in the 1950s about 50 per cent, however due to higher living standards and increase of private cars the public transport share fell to about 20 per cent and has stayed there the last decades (Transport Analysis, 2014). The number of trips per person in Västernorrland was 45 in 2003 and 42 in 2013 compared to the average in Sweden which was about 150 in 2013 (SIKA 2004; Transport Analysis 2014). The revenues for the bus service are far below the total costs for the service. Numbers from 2013 tells that fare revenues made on average up to a little less than 50 per cent of the total costs in Sweden in general and to about 30 percent in Västernorrland. The reason is that production costs have increased by 86 per cent, since the year 2000, while the revenues have increased by 65 per cent (Transport Analysis, 2014). Alexandersson and Pyddoke (2003) saw this pattern early, but their general observation was that tendering had reduced costs, since costs per kilometer actually decreased in the 1990s. They reason that the cost reduction in the early stages may be due to routes being tendered for the first time and suggest studies are made comparing costs when routes are re-tendered. This notion is supported by Hensher and Wallis (2005) who observe that cost reduction was much larger between 1987 and 1993 than between 1993 and 2001.1

A major transformation of public transport in Sweden began in 1978 with a new regulatory framework. It entailed that each county had the responsibility to arrange the planning and operation of public transport services in order to ensure an integrated and co-ordinated system (Jansson and Wallin, 1991).

Public transport in Sweden was reformed again in 1989 when competitive tendering was introduced, until then the regional authorities had issued licenses to operators who could act as monopolies in specific areas (Alexandersson et. al. 1998). The procurement regime in Sweden from 1989 resembles that of other countries such as France, Germany and New Zealand. Public transport in the UK gives another interesting case. Here bus routes are tendered competitively in London but the rest of the country is totally deregulated. Hence, in London there is competition for the market and in the rest of the UK there is competition in the market.

A new Act in 2012 reformed public transport once again when it became possible for commercial bus companies to start a new service without following the usual way to win an item put up for tender. The purpose was to enhance the services, increase traveling and achieve lower prices. This can be referred to as the “Mohring” effect;2 better service is beneficial for all public transport users and new

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1 Competitive tendering was introduced in 1989 but some routes were tendered in 1987.
2 Named after Herbert Mohring (1972).
users who will increase demand leading to even better service and so on. However, it has turned out to be less attractive to start new routes compared to what was being anticipated. 59 new routes were introduced from the start of the new regulation until the autumn of 2014, but several have already shut down (Transport Analysis, 2014).

The general idea behind competitive tendering is, as stated above, to reduce costs for the regional authorities and lower prices as a consequence of competition while still enjoying the stability and predictability of a centralised system. On what premises should a contract be awarded? Both lowest price (LP) and economically most advantageous tender (EMAT) are common alternatives to award the contract. EMAT takes into consideration not just the price but also offered quality and other relevant factors that distinguish operators.3

The auction format used in Västernorrland is a combinatorial first-price auction. The idea is that bidders simultaneously submit bids on individual items or a package of items and the contract is awarded to the tenderer that gives the lowest costs, i.e. the award regime is LP. Important to note is that to submit a package bid the bidder must also submit a stand-alone bid on each item in the package. This makes it possible to analyse how much the procurer gains from the design. However, Lundander and Lundberg (2011) shows that stand-alone bids in combinatorial auctions are significantly higher than the bids in standard auctions. Thus, the inflated stand-alone bids may offset the discount expressed in the package bids.

Comparing the winning bids to the winner’s best single bid for each contract shows the discount that the procurer gained thanks to the combinatorial auction design. The result is that the costs have been on average 10.55 per cent lower than without the possibility to place package bids. The highest discount was about 20 per cent and the lowest 0 per cent. Again, these figures should be analysed with caution.

3 Theoretical Machinery and Previous Work

The very foundation of public procurement is basic auction theory. Pioneering works were made by Vickrey (1961) who developed a private value model, and Wilson (1967) who built a common value model. The difference between common value and private value auctions is that in the former the bidders value the item identically although they have different information of its value, in the latter

3 Bergman and Lundberg (2013) discuss tender evaluation and award mechanisms.
they value the item different than the other bidders (Cramton, 2006). The type of auction discussed in this paper is not the type where a seller sells an object and potential buyers announce their interest until there is only one left.\(^4\) Instead, the first-price sealed-bid auction is the underlying machinery, i.e. where companies bids to buy through sealed bids. Intuitively, as the bidders increase the equilibrium bids and procurement costs are reduced (Holt, 1979; McAfee and McMillan, 1987). Much of what is being discussed in the mentioned papers concerns auctions or procurements of goods/services with an unknown value both to the procurer and the bidder, such as an auction of oil-rights. In the case of bus services it is often clear what the value is in terms of produced vehicle kilometers and patronage.

McAfee and McMillan (1987) establish the Revenue-Equivalence Theorem which says that for a benchmark model the four types of auctions, English (or ascending-bid auction), Dutch (or descending-bid auction), first-price sealed-bid and second-price sealed-bid, on average yields the same price. The benchmark model consists of four simplifying assumptions; (1) the bidders are risk neutral, (2) the bidders’ valuation is independent of each other, (3) the bidders are symmetric and (4) the payment is a function of bids alone.

Cantillon and Pesendorfer (2006) anaylsed bidding behaviour in combinatorial auctions of bus routes in London and investigated motivations for businesses to submit package bid and implications on welfare and efficiency. They found that the auction size did not affect bidding behaviour and did not find positive synergies across routes, contrary to the motive for the auction design. However, the London experience is seen as a success that has improved quality and increased the vehicle kilometers supplied (Transport for London, 2008). Amaral et. al. (2013) conducted a study on data from London and analysed how the expected number of bidders and actual competition affected costs per mile. They found that competition leads to lower costs and that expected competition has a greater effect than actual competition. They also concluded that significant cost reduction has been achieved since an unbundled network attracts bids from small operators. Higginson (1991) studied the London case a few years after the reform (in 1984) and compared it with the rest of the UK which was completely deregulated in 1986. The conclusion was that the London buses had performed much better and the author questioned the plans to deregulate the London buses as well.

Amaral et.al. (2009) compared the London model with the French model of procuring bus operations. The London model is a multiple-unit-auction meaning that tenderers can bid on single routes or a package of routes if they wish, whereas in France the tenderers instead bid on entire networks

\(^4\)This type of auction is called “English auction”.

5
of bus routes. Amaral et. al. (2009) concluded that the London model has proved to be the better model in fostering competition and reducing costs. The model used in Västernorrland is more similar to the one in France meaning that contracts typically cover a town or municipality (school bus routes in Västernorrland are however procured as single units).

Jansson and Wallin (1991) analysed public transport in the foregoing decade and they concluded that, so far, the deregulation did not have very much impact. Alexandersson et. al (1998) stated that the reform had led to improvements of the local and regional bus services. They claimed that competitive tendering had reduced the costs significantly, controlling for vehicle kilometers. As mentioned in the previous section the costs have increased since 1999 (Alexandersson and Pyddoke, 2003). Vigren (2014) makes an attempt to identify factors in the contracts affecting costs using cross sectional data from 2012. The results show that public operators have significantly higher costs than private operators and that the costs are inelastic with respect to vehicle kilometers which indicates economies of scale.

Beck (2010) investigated tendering of public transport in some regions in Germany. The results show that there had been better efficiency and lower subsidy payments over the years but recent data revealed that unit costs were in fact increasing. More studies are obviously needed.

4 Data and Empirical Model

The data used in this study comes from county Västernorrland in Sweden which procured all of its bus services in 2013 (except the town of Örnsköldsvik which was awarded separately). The county is one of the largest in Sweden geographically but is sparsely populated with a density of 11 people per square kilometer, compared to Sweden’s average of 23 people per square kilometer. Figure 2 shows the map of Västernorrland and the contract areas. As we can see there are relatively few areas but the data includes school buses as well, in fact most of the contracts are for school buses. The school buses are not presented in the map.

There were a total of 17 different bidders but only two bidders won all routes, Mittbuss AB and Nobina Sverige AB. Mittbuss AB is a company owned jointly by six smaller and larger regional bus service operators and Nobina is a major company that operates all over Scandinavia. One can discuss the case of Mittbuss which has one dominant firm and five smaller. They were the only bidder on several school bus routes and faced limited competition in the rural areas. This question is out of the
scope for this paper but they arguably have a dominant position in the region and that may affect the bids.

The total cost of all traffic procured is almost 400 million SEK. The contracts issued span over eight years with options to extend and are mostly without incentives for the operator. The contracts in and around the city of Sundsvall (the largest city) contain incentive schemes.

Figure 2: Map of Västernorrland showing the contract areas, excluding school bus routes (Din Tur, 2012).

The purpose is to investigate what effect the number of bidders, i.e. actual competition, have on costs. The variables at hand are the winning bid, the number of bus kilometers to be delivered (called “volume”) and number of bidders. Two dummy (binary) variables are created to account for effects of the contract being in a dense area and if it is a school bus route. The dummy for density has been constructed according to Glesbygdsverket’s (The Rural Authority) definition of dense areas. An observation is assigned the value 1 if it is a contract in a dense area and 0 otherwise. A dense area
must have at least 3000 inhabitants (Glesbygdsverket, 2007).

The dummy variable for school bus takes the value 1 if it is a school bus and 0 otherwise.

In order to make the observations comparable I have standardised the cost variable to represent costs per kilometer and use this as the dependent variable in the models. The covariates included in the model are the number of bidders, the contract volume and the two dummy variables to control the effects of the contract being in a dense area or a school bus service. Also the volume squared is included as a covariate to check for nonlinearities. A dummy variable for incentives is not included since only a very small number of contracts have an incentive scheme.

Table 1 displays the descriptive statistics. As we can see the mean number of bidders is 1.6 which means that most contracts only had one bidder. This observation is made more evident in figure 3 which shows the distribution of the number of bidders. By visual inspection of the figure we can see that 30 contracts only had one bidder while one contract had four bidders. These 30 contracts are mostly school bus routes won by Mittbuss.

Further, we can see that costs per kilometer has a big spread between the maximum and minimum values. The maximum value is a rather short school bus route with a winning bid that was relatively high. We can also see that there are more contracts in rural areas than in dense areas and that there are more school bus contracts than not.

To get a good picture of the relation between the winning bid and the volume in each contract, table 2 depicts two regressions of winning bids on volume, one linear and one logarithmic. The results show that the volume can explain the variance in costs to a very large degree, the computed $R^2$ is 0.98 and 0.94 respectively and the estimated slopes are significantly different from zero. This is a rather

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5Glesbygdsverket is now part of Growth Analysis (Tillväxtanalys) and the Swedish Agency for Economic and Regional Growth (Tillväxtverket).

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Table 1: Descriptive statistics (sample size $n = 53$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Standard deviation</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winning bid (thousands)</td>
<td>7528</td>
<td>1739</td>
<td>17953.01</td>
<td>302.1</td>
<td>119500</td>
</tr>
<tr>
<td>Volume (thousands)</td>
<td>220.4</td>
<td>26.83</td>
<td>500.35</td>
<td>1.061</td>
<td>3133</td>
</tr>
<tr>
<td>Cost/km</td>
<td>59.19</td>
<td>49.8</td>
<td>41.34</td>
<td>22.08</td>
<td>284.7</td>
</tr>
<tr>
<td>Bidders</td>
<td>1.623</td>
<td>1</td>
<td>0.81</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Populated area (binary)</td>
<td>0.2453</td>
<td>0</td>
<td>0.43</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>School bus (binary)</td>
<td>0.6981</td>
<td>1</td>
<td>0.46</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

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Figure 3: Distribution of number of bidders per contract

expected observation and thus worth to mention as a description of the data. Figure 3 displays volume on the horizontal axis and winning bid on the vertical axis. The four sub-figures are zoomed versions of each other where the sub-figure in the top left corner is the “largest”. One can see that in the two top figures there is a big cluster of observations near the origin, why the two bottom figures zoom in further on that area.

Table 2: Explaining winning bid with contract volume

<table>
<thead>
<tr>
<th></th>
<th>Linear</th>
<th>Log linear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t</td>
</tr>
<tr>
<td>Intercept</td>
<td>-299.6775</td>
<td>-0.771</td>
</tr>
<tr>
<td></td>
<td>(388.8360)</td>
<td>(0.28596)</td>
</tr>
<tr>
<td>Volume</td>
<td>35.5135***</td>
<td>49.540</td>
</tr>
<tr>
<td></td>
<td>(0.7169)</td>
<td>(0.02628)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.98</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Significance codes: ***0.01, standard errors in parentheses
The empirical equation used as a foundation for the analysis can be expressed as

\[ c_i = \alpha + \beta z_i + \theta x_i + \epsilon_i \]

Where \( c_i \) is costs per kilometer, \( z_i \) is the number of bidders, \( x_i \) is a vector of contract specific variables and the \( \epsilon_i \) are assumed to be independent and identically distributed error terms with zero mean and constant variance (homoskedasticity). \( \alpha, \beta \) and \( \theta \) are parameters to be estimated and \( i = 1, ..., 53 \) are the contracts. Several functional forms will be tested, including linear, semi-log (where dependent variable is logarithmic) and quadratic. The method of estimation used is Ordinary Least Squares (OLS), that under given assumptions is the best linear unbiased estimator (Greene, 2012, pp. 55-64).
5 Results

A model with the intended variables is tested and a glance at the diagnostics plots (figure 5 in appendix) display that two observations deviate from the rest. These two are the largest in terms of costs per kilometers. A Bonferroni test for outliers is conducted which shows that these two are significant outliers. An outlier is an observation that appears to be “outside the reach of the model” (Greene, 2012, p. 141). Meanwhile, a Shapiro-Wilk test for normality indicates non-normal residuals with the original dataset but normal residuals when outliers are deleted (Shapiro and Wilk, 1965). Based on the outlier tests these two observations are excluded (representing 3.8 % of the data) and further analysis is therefore made with a dataset of 51 observations.

Now turning to the model estimates, table 3 presents the results of the linear model and table 4 presents the results of the semi-log model where the dependent variable is logarithmic. Below each table I interpret the estimated coefficients and briefly discuss the models.

<table>
<thead>
<tr>
<th>Cost/km</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>60.170***</td>
<td>71.750***</td>
<td>73.020***</td>
<td>70.49***</td>
<td>72.070***</td>
</tr>
<tr>
<td></td>
<td>(9.480)</td>
<td>(5.453)</td>
<td>(5.595)</td>
<td>(6.257)</td>
<td>(6.312)</td>
</tr>
<tr>
<td></td>
<td>(3.160)</td>
<td>(3.172)</td>
<td>(3.272)</td>
<td>(3.663)</td>
<td>(2.587)</td>
</tr>
<tr>
<td>Volume</td>
<td>-0.000*</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.000*</td>
<td>(0.000)</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
</tr>
<tr>
<td>Volume^2</td>
<td>0.000*</td>
<td>0.000***</td>
<td>0.000***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dense</td>
<td>11.380*</td>
<td>12.550**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6.141)</td>
<td>(6.169)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School bus</td>
<td>13.430</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(9.052)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adjusted $R^2$ | 0.436 | 0.421 | 0.383 | 0.216 | 0.174

Significance codes: ***0.01 **0.05 *0.1, standard errors in parentheses

Table 3 indicates that the estimated coefficients for the volume variables are extremely small but significant and we can also see that the adjusted $R^2$ drops when the volume variables are omitted.

6The outliers are two school bus routes. For more on Bonferroni see Ellenberg (1976).
As mentioned in the theoretical section the intuition tells that more bidders should push in the direction of more aggressive bidding and as we can see the estimate is negative for all models and significantly different from zero on at least the 5 per cent level.

The estimate for the variable density is significant and means that if the contract is in a populated area the costs per kilometer is 11.38 or 12.55 SEK higher depending on which model one is looking at. Further, estimated coefficient for the variable controlling for whether the bus route is a school bus is not significant. However, it becomes significant when using as covariate with the variables Bidders and Volume and an estimate similar or larger than the one presented above. In addition, there can be a correlation between the school bus variable and density variable and controlling for an interaction effect in model 4 and 5 gives highly significant estimates and positive coefficients. For the other models the interaction effect is insignificant.

The plots of the residuals versus the fitted values suggest that there are signs of heteroskedasticity (see figure 6 in appendix). Despite that Beusch-Pagan tests shows that the null hypothesis of homoskedasticity cannot be rejected for none of the models except the last (Breusch and Pagan, 1979). Thus, the standard errors reported for this model are the heteroskedasticity-consistent standard errors (HCSE). Tests for multicollinearity indicate that volume and volume squared are severely correlated but the rest shows very little or none multicollinearity at all.\(^7\)

Lastly, it should be noted that the variable volume may cause endogeneity since there may be some simultaneity between that variable and the dependent variable. This can be addressed by using an instrumental variable (IV) that is uncorrelated with the error term but correlated with volume. However, no IVs are at hand so the variables will be transformed in logarithms.

\(^7\)The test used is VIF (Variance Inflation Factor).
In table 4 the semi-log models are presented as well as an extra model, Model F, where the covariates Volume and Bidders are in logarithms as well. Model F is presented because it is the “best” model that could be found in terms of model fit.

First, looking at model A to E we can see that, again, the estimated coefficients for Volume and Volume squared are significantly different from zero but they are extremely small. The first nonzero digit appears in the fifth decimal for the estimation of volume and even further away for the coefficient of volume squared. Similar to Model 1 to 5 in table 3 the estimated coefficient for Bidders are significant and negative. Now, since this is a semi-logarithmic function the coefficient will be interpreted as follows: for a units’ increase in the number of bidders the costs per kilometer are reduced by 23 per cent or less, depending on the model.

The interpretation of the estimated coefficients for the dummy variables are as we will see not as straightforward as the other variables (Halvorsen and Palmquist, 1980). If the variable Dense is changed from 0 to 1 (the value 1 is assigned to dense areas) the costs are 22 per cent higher for Model

<table>
<thead>
<tr>
<th></th>
<th>Model A</th>
<th>Model B</th>
<th>Model C</th>
<th>Model D</th>
<th>Model E</th>
<th>Model F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0.164)</td>
<td>(0.096)</td>
<td>(0.098)</td>
<td>(0.117)</td>
<td>(0.120)</td>
<td>(0.267)</td>
</tr>
<tr>
<td>Bidders</td>
<td>-0.163***</td>
<td>-0.148**</td>
<td>-0.143**</td>
<td>-0.175**</td>
<td>-0.230***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.055</td>
<td>(0.056)</td>
<td>(0.057)</td>
<td>(0.069)</td>
<td>(0.066)</td>
<td></td>
</tr>
<tr>
<td>ln(Bidders)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.204**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.090)</td>
<td></td>
</tr>
<tr>
<td>Volume</td>
<td>-0.000**</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.000**</td>
<td></td>
<td></td>
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<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln(Volume)</td>
<td></td>
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<td></td>
<td>-0.184***</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.026)</td>
<td></td>
</tr>
<tr>
<td>Volume$^2$</td>
<td>0.000**</td>
<td>0.000***</td>
<td>0.000***</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Dense</td>
<td>0.728</td>
<td>0.200*</td>
<td></td>
<td>0.164*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.106)</td>
<td>(0.109)</td>
<td></td>
<td>(0.095)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School bus</td>
<td>0.308*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.156)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.531</td>
<td>0.502</td>
<td>0.476</td>
<td>0.237</td>
<td>0.180</td>
<td>0.582</td>
</tr>
</tbody>
</table>

Significance codes: ***0.01 **0.05 *0.1, standard errors in parentheses
B, which is significant on the ten per cent level. The estimated effect for Model A would have been 107 per cent had the estimation been significantly different from zero.\textsuperscript{8} The estimated coefficient for the variable school bus is 0.3 and using the same calculations as above the costs will be 36 per cent higher if it is a school bus.

Model F, the log-log model has a higher adjusted $R^2$ than the rest of the models, indicating that this model fits the data better than the other models. The estimated coefficients when having both the covariates and the dependent variable in logs are interpreted as elasticities, i.e. when increasing the number of bidders by one per cent the costs per kilometer are increased by 0.2 per cent. However, increasing the number of bidders by a percentage is a dubious and theoretical exercise.

The elasticity for volume is -0.184 implying that a percentage increase in volume leads to a decrease in costs per kilometer by 0.184, or 10 per cents increase in volume leads to a decrease in costs per kilometer by 1.84 per cent.

The estimation for Dense tells that if the contract is in a densely populated area the costs per kilometer are increased by almost 18 per cent, according to the same interpretation of dummy variables as above.

Breush-Pagan tests for heteroskedasticity fail to reject the null hypothesis for all models so no further actions are taken. Diagnostics plots for model A and F are presented in appendix.

6 Conclusions

The introduction of competitive tendering of public transport has attracted much attention in several countries. It seems to be a consensus that regulation with competition for the market has so far been a success. Recent data in Sweden has shown that costs are increasing more rapidly than revenues but it is hard to tell whether it is due to competitive tendering or not.

The results in this paper are in line with those of Amaral et. al. (2013). The number of bidders has a negative impact on costs, negative in the sense that more bidders decrease costs. The competition effect outlined in the introduction seems to be larger than the winner’s curse. Regarding the positive signs of the estimations for density one can reason that driving in towns and cities demands more breaking and accelerating and is more expensive than driving in the countryside.

I will not draw any conclusions about potential discounts from the package bids. It seems like

\textsuperscript{8}The formula is $100 \cdot (\exp(b) - 1)$, where $b$ is the estimated coefficient (see Halvorsen and Palmquist, 1980).
the combinatorial bidding gives a discount to the procurer but as Lunander and Lundberg (2011) argue the stand-alone bids may be inflated. The level of competition in Västernorrland in general is questionable. The estimates for school bus routes shows a positive sign (although only the estimate for model A is significant) which may be due to low competition on those routes. As mentioned in section 4 Mittbuss was the only bidder on many of the school bus routes and if they were expecting to face limited competition they might have relaxed their bidding.

The question of which type of contract to use (incentive scheme or no incentive scheme) is of course relevant but could not be addressed in this paper due to poor sample size.

The main lesson drawn from this study is however that follow-up statistics from procurement of public transport is problematic. Several public transport authorities were contacted while looking for data to analyse but the general experience is that it takes a long time to get the documents or even worse, that information such as the losing bids are not kept at all. However, I should mention that the public transport authority in Västernorrland replied promptly and delivered documents from the last tendering of bus routes without hesitation.

The problematic situation in general puts severe restrictions on researchers wishing to understand and investigate the market. A more serious concern regards the value that is being procured and the importance of a well functioning transport system in the society. I mentioned in the beginning that the total cost of public transport was just about 40 billion SEK in 2013 and that revenues are only a little more than half of that. This implies that the rest has to be funded by taxes or other public funds. Transparency is essential to avoid issues of corruption. Nilsson (2011) stated that the scrutiny of the use of resources in the public sector is insufficient which is a democratic concern.

In section 2, I argued that the transport system is vital for the welfare of people and that it is essential that the infrastructure is coherent and predictable. The pros with competitive tendering is that it provides the procurer with the tools to choose the design which maximises social welfare and at the same time rely on competition between companies to reduce costs. The problem of choosing the best design is discussed in Cantillon and Pesendorfer (2006) in the London context. This should be of interest for the Swedish public transport authorities as well since the production costs have been increasing more than revenues in the last decade and a half.
References


### A Appendix: Regression Diagnostics Plots

Figure 5 shows the two outlying observations, number 1 and 49.

![Residuals vs Fitted](residuals_vs_fitted.png)

![Scale-Location](scale_location.png)

![Normal Q-Q](normal_qq.png)

![Residuals vs Leverage](residuals_vs_leverage.png)

Figure 5: Initial model with all observations
Model 1 is the first linear model and Model A is the first semi-log model. Both indicate that there is an observation, number 20, with high leverage. This means that the observation is deviating from the rest in one or more of the independent variables. No actions are taken to address that and we can see that in figure 8 this observation does not show any high leverage due to the logarithms that scale down the values.

Figure 6: Model 1
Figure 7: Model A

Figure 8: Model F