Assessing standard costs in local public bus transport: evidence from Italy

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Abstract

We estimate a piecewise regression model for the determination of standard costs in the Italian local public bus transport system. We consider quantitative and qualitative characteristics, which contribute to explain the variability of the cost structure of services provided. Economic and transport data have been collected from companies producing more than 500 millions of service-kilometers. We find that commercial speed is the most important cost driver, while economies of scale are low and only present in the case of small basins. Results highlight a positive correlation between investments in bus fleet and the cost incurred for the provision of the service. Finally, the model aims at introducing policy constraints in order to impose regulatory requirements in the use of the results for the allocation of public funds earmarked to the local public transit sector among Italian regions.

Keywords: standard costs, local public transport, fiscal federalism, cost proxy models

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1. Introduction

In recent years, many EU-member countries (e.g., Sweden, Finland, Germany, France and United Kingdom) have introduced new industry reforms and a competitive tendering procedure (competition for the market) in the assignment of franchised monopolies in the local public transport (LPT) industry, in order to introduce more efficiency, enhance productivity and reduce huge deficits. This process, regulated by the European Directive 1370/07/EU, requires the member countries to use competitive tenders in cases where the providers are not owned by home states. As summarised by Hensher and Wallis (2005), in fifteen years competitive
tendering brought about a 50-55% reduction in real unit costs in London, whilst in Scandinavia there were savings ranging from 5 to 34%, but most in the range of 20-30%. Amaral et al. (2009) show that the introduction of auction procedures lead to very different results in France and London: few competitors, collusion, and cost increases in the French model, compared with more transparency, competition, and better performance in London. In Italy, some competitive tendering took place after 1998 (Boitani and Cambini, 2006). However, large cities were not affected by the tendering process, but for one fifth of the bus services in Rome in 2001 (Boitani et al., 2013).

In this scenario, the paper develops a model for the determination of standard costs in the Italian local bus transport system. We contribute to the literature and to the policy debate on two counts. First, at a macro level, the model is a suitable tool for policy makers useful to introduce regulatory constraints for the allocation of public funds earmarked to the LPT sector among Italian regions. Second, at a micro-level, results might be used in the definition of the economic compensation earmarked to LPT firms in competitive tendering procedures. LPT firms are encouraged to promote their efficiency on the principle of yardstick competition (Shleifer, 1985), since the standard cost reflects the cost of the service regardless of the particular provider. Local Authorities might then acknowledge to service providers a compensation that cover the costs of a (hypothetical but realistic) reasonably efficient operator and not the specific costs of the firm supplying the service.

2. Data and variables

Disaggregated information about costs (e.g., labour, energy, materials and services, capital) and about technical and environmental characteristics (e.g., average fleet age, average commercial speed, network size) have been obtained through questionnaires sent to firms’ managers and engineers. The questionnaire has been later adopted by the national Observatory on Local Public Transport Policies (Law n. 244/07), which has the responsibility of collecting economic and transport data from firms proving local public bus transport (LPBT) services in order to create an information system for the evaluation of the sector’s evolution and of the regulatory reforms’ completion status.

Our dataset consists of a balanced panel of 45 Italian private- and publicly-owned companies, providing LPBT services in 13 Italian regions. Our sample firms, which on aggregate are responsible for about 500 millions of service-kilometers, have been observed in 2011 and are fairly representative of the universe of large and medium-sized Italian LPBT operators.
In fact, 20 firms are enrolled in ANAV (Italian Association for Passengers Road Transport), the nationwide trade organization of private-owned LPT companies. The remaining 25 firms provide LPT services in Italian regions operating within the round table based at the Italian premiership in range of the field test agreed between the Italian Ministry of Transport and Infrastructure and the Regions, for the regulatory and financial reorganization of the LPT sector (Lazio, Friuli Venezia Giulia, Piemonte, Veneto, Marche and Campania).

3. Methodology

We consider quantitative and qualitative characteristics, which contribute to explain the variability of the cost structure of services provided, that are:

- \( VC (km/h) \), the commercial speed. This is a qualitative (hedonic) characteristic of the service, which can be barely controlled by the LBPT firm providing the service.

- \( KM (m\textnormal{ln} \textnormal{of} \ km) \), the millions of service-kilometers.

- \( Akm (€/km) \), the degree of modernization of the bus fleet. This variable is defined as the monetary value – per service-kilometer – of the sum of all amortizations of owned vehicles and rents/leasing for non-owned vehicles. In particular, it identifies a qualitative characteristic which can be controlled by the LBPT firm providing the service.

The standard cost per service-kilometers \((CS_{km})\) is obtained through the estimation of a piecewise regression (i.e., segmented regression or broken-stick regression). In other words, a nonlinear relationships between \(CS_{km}\) and the explanatory variables, \(VC, KM\) and \(Akm\), has been modelled using a linear (multiple) regression and the cost per service-kilometers has different slopes for certain ranges of the covariates.

The proposed model is the following:

\[
CS_{km} = \alpha_0 + \beta \times VC + \gamma_{KM} \times KM + \sigma \times Akm
\]  

where, for the intercept \(\alpha\), it results

\[
\alpha = \begin{cases} 
\alpha_0 & VC < 17 \text{ km/h} \\
\alpha_0 - 17\beta_{VC1} & 17 \text{ km/h} \leq VC < 32 \text{ km/h} \\
\alpha_0 - 17\beta_{VC1} - 32\beta_{VC2} & VC \geq 32 \text{ km/h}
\end{cases}
\]

while for the partial coefficients it results
\[ \beta = \begin{cases} \beta_{VC} & VC < 17 \text{ km/h} \\ \beta_{VC} + \beta_{VC1} & 17 \text{ km/h} \leq VC < 32 \text{ km/h} \\ \beta_{VC} + \beta_{VC1} + \beta_{VC2} & VC \geq 32 \text{ km/h} \end{cases} \] (3)

\[ \gamma = \begin{cases} \gamma_{KM1} & KM < 4 \text{ mln km} \\ \gamma_{KM2} & KM \geq 4 \text{ mln km} \end{cases} \] (4)

The coefficients are all statistically significant and the goodness of fit of the model is substantial, as testified by a high coefficient of determination, $R^2$ and corrected-$R^2$. The choice of the covariates included in the regression model, as well as the breakpoints interpretable as critical thresholds value beyond or below which (un)desired effects occur, is intended to highlight the crucial role of a limited number of variables, considered essential in order to explain the cost differences among several operators and describe the operational aspects that characterize the offer of LPBT services. We remark that the model presented in equation (2), or equivalently in equation (3), highly complies with the requirements of the 2013 Budget Stability Law (Law n.147/2013), which defines the criteria for the determination of the standard cost in the Italian local public transport system (art.1, clause 84).

4. Results

The most important effect is the impact of commercial speed, $VC(km/h)$, as confirmed by literature (Cambini et al., 2007; De Rus and Nombela, 1997; Fraquelli et al., 2004; Gagnepain, 1998; Gathon, 1989; Levaggi, 1994; Buzzo Margari et al., 2007; Miller, 1970; Nolan, 1996; Petretto e Viviani, 1984; Piacenza, 2006; Viton, 1992; Windle, 1988; Wunsch, 1996). However, as opposite to earlier studies, we find that the marginal effect of the commercial speed on the standard cost per service-kilometers reduces when the commercial speed increases, that is it is not linear. Some test examples conducted on the basis of our model show that the standard cost per service-kilometers may even reduce by 0.60 €/km when the commercial speed reduces by 1 km/h.

The millions of service-kilometers provided to users within the service contract in a management basin also affects the standard cost per service-kilometers. In particular, the model reveals that economies of scale run out when the dimension of the network is small and transform into diseconomies of scale when it is higher than 4 millions of service-kilometers. Results obtained in this work are consistent with the findings of some papers focusing on the estimation of long-run cot function (Bhattacharyya et al., 1995; Jha and Singh, 2001; Levaggi
1994; Matas and Raymond, 1998;). Diseconomies of scales have also been found in Boitani et al. (2013). Finally, Fraquelli et al. (2001) find that the average cost per seat-kilometers is U-shaped, which is consistent with our conclusions.

The degree of modernization of the bus fleet, may be considered as a proxy of service quality perceived by users. The amortization of owned vehicles (gross of non-repayable public funds) and rents/leasing for non-owned vehicles represent some of the most onerous cost components of the quality of services provided. The model reveals that, when the degree of modernization of the bus fleet increases, the standard cost per service-kilometers increases.

References


