Assessing standard costs in local public bus transport: A hybrid cost model

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\textbf{ABSTRACT}

We develop a hybrid cost model for the determination of unit standard costs in the Italian local public bus transport sector. Detailed economic and transport data have been collected from companies producing more than 500 million of bus-kilometers in Italy observed in 2011. We draw upon the Bottom-Up approach for the estimation of the cost of the driving personnel and the economic cost of the rolling stock which usually cover more than 50% of the total economic cost. We thus adjust for efficiency the number of bus-kilometers per vehicle and the number of net driving hours per driver, which are characterized by very different levels of efficiency across Italian Regions. We resort to the Top-Down approach for the estimation of other costs. We find that an increase in the number of net driving hours per driver produces higher savings in urban services than intercity services. Conversely, the impact of an increase in the number of bus-kilometers per vehicle in the case of urban services is almost equal to that in the case of intercity services. The applied model allows us to tune the required level of efficiency according to regional desiderata. Our results might then be useful in order to define the maximum economic compensation that can be required by any local public transport firm which takes part in competitive tendering procedures for the allotment of service concessions or which is entitled with monopoly rights by political choice and/or local public ownership.

\textbf{1. Introduction}

In recent years, many EU-member countries (e.g., Sweden, Finland, Germany, France and United Kingdom) have introduced competitive tendering procedures for the assignment of local public transport (LPT) services, in order to improve efficiency, enhance productivity and reduce the present large amount of subsidies to the inefficient LPT companies. As summarised by Hensher and Wallis (2005), competitive tendering in London brought about a 50-55% reduction in real unit costs in fifteen years, 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 few competitors, collusion, and cost increases in the French case, compared with more transparency, competition, and better performance in London. In Italy, the industry reform bill (1997) touched upon two dimensions: the allocation of public funds to Regions - and, in turn, to Local Authorities (LAs) - as well as the definition of a roof to public compensations payable to LPT firms. Although reform bill stated that by January 2004 all subsidized LPT services should have been tendered off, later legislative interventions left discretion to local governments about whether tendering out concessions or adopting in-house provision. Some competitive tendering took place after 1998 (Boitani and Cambini, 2006), except in large cities where in house provision prevailed (Boitani et al., 2013). In recent years, a stream of parliamentary acts reaffirmed the willingness to create a more market-oriented LPT industry and established that the maximum economic compensation to LPT firms should be based on standard costs (Law n. 135/2012). The standard cost reflects the cost of a LPT service provided by a reasonably efficient operator given a pre-specified service quality. However, a standardized methodology for the determination of unit standard costs has not been adopted by the Transport Ministry.

In this scenario, our paper develops a model for the determination of unit standard costs as for the Italian local bus transport sector. Detailed economic and transport data have been collected from companies producing more than 500 million of bus-kilometers in Italy. In depth information about costs has been gathered in order to fairly compute the total economic costs of the LPT bus service observed in 2011.

The model employed is as simple as possible and it might be easily used in order to appropriately define auction bases in competitive...
tendering procedures, providing incentives to LPT operators as well as LAs. LPT operators might improve their cost-efficiency on the principle of yardstick competition (Shleifer, 1985), since they are residual claimant of the profits accruing from the difference between the industry yardstick and their costs, if lower. Local Authorities have an incentive to design contracts to be auctioned in such a way that bidders have in turns an incentive to “beat” the standard which (by the law) must be available to potential competitors prior to any competitive tendering procedure. The yardstick competition principle is at work also where contracts are not tendered out, as Local Authorities may either increase the quantity/quality of the service or put resources to alternative uses if the local monopolistic LPT operator is able to reduce its actual cost below the standard level.

The present paper is related to a burgeoning empirical research (see Daraio et al., 2016 for a critical review). A first bunch of papers deals with the LPT companies’ cost structure, with a recent focus on the estimation of variable and total costs (e.g., among others, Obeng and Sakano, 2002; Fraquelli et al., 2004; Cambini et al., 2007; Ottoz and Di Giacomo, 2012). The appropriate output measure has been debated (Berechman and Giuliano, 1985; De Borger and Kerstens, 2000; De Borger et al., 2002). Supply-side indicators have been suggested – such as vehicle-kilometer (Cambini and Filippini, 2003), seat-kilometer (Farsi et al., 2007) or total-seat-kilometer (Gagnepain and Ivaldi, 2002) – as well as demand-side measures, such as passenger-trips or passenger-kilometer (Bhattacharyya et al., 1995). Quite a few papers include hedonic characteristics among the explanatory variables: service frequency and average commercial speed are commonly employed (e.g., among others, Cambini et al., 2007; De Rus and Nombela, 1997; Fraquelli et al., 2004; Piacenza, 2006; Shaw-Er et al., 2005). The service size and the average fleet age are also frequently considered. Different characteristics of LPT operators as for scale and density economies have also been discussed. As for the Italian case, Cambini et al. (2007) suggests the presence of economies of network density and scale economies, especially for urban LPT services. Fraquelli et al. (2004) finds evidence supporting the existence of scale and scope economies. In the same vein, Filippini and Prioni (2003) finds the presence of considerable economies of scale for all size classes, comparing Italian and Swiss companies. Modest economies of scale have also been found in Bhattacharyya et al. (1995), Jha and Singh (2001), Matas and Raymond (1998). To the contrary, Boitani et al. (2013) concludes that diseconomies of scales result in a cross-country analysis of 77 LPT companies operating in large European cities, while Fraquelli et al. (2001) finds that the average cost per seat-kilometer is U-shaped, which is consistent with the conclusions of Avenali et al. (2014a), (2016).

A second bunch of papers focusses on the impact of alternative contract schemes within one country, e.g., Norway (Dalen and Lobo, 1996, 2003); France (Gagnepain and Ivaldi, 2002; Roy and Yrrande-Billon (2007); Gautier and Yrrande-Billon (2003); Italy (Piacenza, 2006; Buzzo Margari et al., 2007). These studies confirm that firms operating under high-powered incentive schemes, such as a fixed-price contract, are more efficient than firms operating under low-powered incentive schemes, such as a cost-plus contract. Dalen and Lobo (1996) points out that, by 1992–1993, the standard cost model had become the most popular contract in 9 out of 19 Norwegian counties. They use a linear model that links driver costs, fuel costs, and maintenance costs (excluding the cost of capital) to the number of bus-kilometers produced for different categories of routes (from low-speed inner-city routes to high-speed long-distance routes). Overall, their results suggest that firms regulated under the yardstick type contract exhibit less than half the cost inefficiency compared to those firms regulated under the subsidy-cap type contract. Moreover, the firms regulated with a yardstick type contract reduce cost inefficiency faster. In order to define LPT firms’ compensation, Hensher et al. (2013) introduces a simplified performance-linked payment (SPLP) model that can be used as a benchmark in assessing the subsidies that an authority should recognize to a LPT operator. Their model internalizes the effects of exogenous variables (not under the control of operators), such as commercial speed, on the cost of LPT services. However, the parameter estimates used are not representative of any specific operating context, but are based on reasonable assumptions over the Australian metropolitan areas.

Many of the above mentioned studies focus on the causes of inefficiencies and the cost structure of firms in order to identify the proper configuration of the operating network, or they investigate how the standard cost model compares with other regulatory schemes in affecting the efficiency performance of operators. However, they do not focus on the definition and measurement of the standard cost. To the best of our knowledge, Avenali et al. (2014a), (2016) build a Top-Down model for the determination of unit standard costs for the provision of LPT bus services. They find that commercial speed is the most important cost driver, while economies of scale are low and limited to small sized service banches. Results also highlight a positive correlation between investments in the bus fleet and the cost incurred in service provision. Our paper builds on the approach of Avenali et al. (2014a), (2016) from which it departs on two counts. First, the model proposed by Avenali et al. (2014a), (2016) is conceived as a suitable tool for policy makers in the allocation of public funds (i.e., macro-level). Our purpose in the present paper is to provide a useful alternative to define the maximum economic compensation that can be required by any LPT operator – which takes part in competitive tendering procedures for the allotment of service concessions or which is entitled with monopoly rights by political choice and/or local public ownership (i.e., micro-level). To this purpose, our research develops a hybrid cost model, which will follow a combined Bottom-Up and Top-Down approach and allows a fine tuning of the required level of efficiency according to regional desiderata. The main shortcomings of the two approaches are the incorporation of historical inefficiencies on crucial industrial cost categories (typical of the Bottom-Up approach), and the underplaying of firm-specific features (typical of the Top-Down approach). The combined standard cost model estimated in the present paper overcomes these shortcomings and makes for a handy policy-tool to be applied in contracting between LAs and LPT firms.

The paper is organised as follows. Section 2 describes the methodology. Section 3 presents the dataset, while Section 4 describes the hybrid cost model. Section 5 contains results and a toy example, in order to illustrate some policy implications. Finally, Section 6 concludes concluding remarks.2

2. Methodology

The use of an appropriate mixture of the Bottom-Up and the Top-Down approach to cost estimation is common in utility (network) industries, such as water services or telecommunications (e.g., Gasmi et al., 2002; Post-och telestyrelsen, 2007).

On the one hand, Bottom-Up models rely on detailed engineering analysis of the production process and determine an estimate of the cost that takes into account all technological standards characterizing the provision of the service. On the other hand, Top-Down models involve parametric or non-parametric estimates based on historical data provided by firms. For instance, in parametric estimates, a specific functional form is assumed relating cost to selected, independent, cost-driving variables.

Cost estimates obtained by Bottom-Up models may be different from those obtained from historical data provided by firms. In other words, the ideal efficient operator is represented, which, in turn, might

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1 See Avenali (2009) and Avenali et al. (2013b) for efficient allocation mechanisms to be applied in competitive tendering where complementary service concessions are simultaneously allocated.

2 For the sake of notation, in the rest of the manuscript we simply refer to LPT as to indicate the local public bus transport.
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