Transportation Research Part A 75 (2015) 51–60

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

An analysis of the performance of public bus transport in Tunisian cities

Ahmed Ayadi *, Sami Hammami

Faculty of Economics and Management of Sfax, Laboratory URED, University of Sfax, Tunisia

ARTICLE INFO

Article history:
Received 5 March 2014
Received in revised form 15 January 2015
Accepted 5 March 2015
Available online 31 March 2015

Keywords:
Public transport
Bus
Cost-efficiency
SFA

ABSTRACT

The purpose of this paper is to assess the efficiency cost of the Tunisian public bus transport system using six stochastic frontier models to see which one would the most robust. This analysis is based on a sample of 12 Tunisian regional bus transport companies for the period 2000/2010. To achieve this, we chose, as an dependent variable, the "variable cost" and, as an independent variable, the output "seats per kilometer", the prices of the input, labor and energy as well as a control variable represented by the network length. The main results show that the regional bus transport companies are economically inefficient with an almost similar magnitude regardless of the estimated model except for Green's True model (2002). This inefficiency is explained by the existence of an outdated regulation characterized by an administered wage policy where financial risk is incurred by the authorities and not by the company.

1. Introduction

The Tunisia urban public transport sector is a public service made up of 12 regional bus transport companies[1] (*RTC*). This service suffers from several problems such-as: the difficulty of meeting the demand and keeping the costs under control. It should be noted that it is also characterized by a budget deficit weighing heavily on the State budget, especially as the decision-making is managed by the organizing authority (the Ministry of Transport).

Actually, in such a complex situation, the sector is called upon, first, to review its policy of cost reduction through a cost frontier to identify the individual measures of "inefficiency-costs".

For this reason, we chose the econometric technique of the stochastic frontier in this analysis. Compared to the deterministic frontier, this technique has an advantage in terms of the deviation from the frontier that could be caused by the noise in the data, or by specification errors, and not necessarily by inefficiencies. Hence, the term "inefficiency" differs from one model to another depending on its orientation in time (constant or variable time) and its specification.

Therefore, our objective is multifold. We will assess the cost efficiency of the *RTC* by making a comparison between three groups of parametric models to identify the best one that can achieve a good correlation between the two models with constant and variable time. Each model group differs from the others depending on its orientation over time (constant or variable) and its specification of the term "inefficiency-cost".

* Corresponding author at: Faculty of Economics and Management of Sfax, Laboratory URED, University of Sfax, Street of airport, km 4.5, LP 1088, Sfax 3018, Tunisia.
E-mail address: ahmedayadifseg@gmail.com (A. Ayadi).

[1] Throughout this article the abbreviation *RTC* is used, which denotes of regional transport companies.

http://dx.doi.org/10.1016/j.tra.2015.03.009
0965-8564/

Our paper is organized as follows; we will present a literature review on the application of the stochastic frontier in the public bus transport sector (Section 2). Then, in the third section, we present the methodology of the study in which we talk about the choice of the 'cost' function for the estimation, the efficiency measurement through a stochastic frontier and the shape of the model chosen. The fourth section is the subject of an empirical study in which we present the used variables and the estimated results.

2. Cost-effectiveness of the public transport industry: literature review

Several studies have been conducted to analyze the efficiency of the transport services using the stochastic frontier as it was applied for maritime transport (e.g. Cullinane et al., 2006; González and Trujillo, 2008), for railways (e.g. Coelli and Perelman, 1999; Farsi et al., 2005; Cantos et al., 2012), and airlines (e.g. Oum et al., 2008; Scotti et al., 2012) and some studies about public transport, such as those of Farsi et al. (2006), Wang et al. (2014), Barros and Peypoch (2010) and Obeng (2013).

Farsi et al. (2006) identified the efficiency scores of the public transport system in Switzerland for the period 1986–1997. They used a sample of panel data for a Translog cost function. Therefore, they took as an input, the price of capital (residual cost/total number of seats), the labor cost (employees' annual salary costs/total number of employees), and as a control variable, they chose the network length. As an output, they took the seats/kilometre. They could show that unexploited economies of scale are more important for those who have better opportunities of redistribution over the large networks. These effects may be hidden by the unobserved network factors.

Ottoz et al. (2009) evaluated the impact of ownership structure on the cost of the bus services using a sample of 65 Italian private bus operators and 12 local public transport companies (LPT) for the 1998/2002 period. To achieve that, they used the overall cost, as a dependent variable, but three independent variables, such as the price of labor, materials and quasi-fixed capital (K). Therefore, they estimated a translog cost frontier using Battese and Coelli's model (1995). Ottoz et al., (2009), found that the inefficiency cost is higher in public bus transport operators than in the private ones.

Karlaftis et al. (2010) measured the performance of 15 different European public transport systems according to the operator's size and the ownership structure. The selected sample covers a period of ten years going from 1990 to 2000. To do so, the authors used three inputs, such as, labour (number of employees), energy (annual fuel charge) and capital (the total number of vehicles operated by the system). Moreover, the used two outputs, namely, the number of vehicles per kilometer, which is considered a measure of the output when estimating efficiency, and the number of passengers per kilometer concerning efficiency. Results suggest the existence of considerable efficiencies in European transit systems, but markedly lower effectiveness.

Jarboui et al. (2013) evaluated the technical efficiency of 54 public road transport operators in 18 different countries for the 2000/2011 period. They applied the stochastic parametric approach in their analysis. They actually used the "Thomson Financial" database to calculate the inputs, the outputs and the explanatory variables of inefficiency. They found that the level of technical efficiency of the public road transport operators ranges from 0.458 to 0.95. They also showed that large operators with good investment capacity tend to be technically more efficient than the small ones. Moreover, they found that the operators of the developed countries are technically more efficient than those of developing countries.

3. Methodology

3.1. Estimation of a frontier using a cost function

The cost function is a reliable instrument for the analysis of the efficiency of an industry. For this reason, several empirical studies, through an attempt to model the behavior of an industry or business, have used cost function-based econometric approaches.

The firm's program is to maximize production according to the costs. Distortion in relation to the maximum production levels is a synonym of technical inefficiency. The dual program consists in minimizing the costs due to the level of production. The distortions that appeared at the total cost level originate from those observed at the level of the requests of the factors. The recorded difference between the current cost level and that on the boundary deviation is a measure of cost-inefficiency which can be decomposed into technical and allocative inefficiency.

The public transport sector in Tunisia is in the hands of the regional bus transport companies. These have experienced budgetary difficulties, besides; the decision-making power[2] is managed by the organizing authority (Ministry of Transport). For these reasons, we have chosen a cost frontier to identify individual measures of cost-inefficiencies. This choice helps to assess the capabilities of reducing the costs which differ from one operator to another. Moreover, this choice depends on the availability of input prices and the output levels for the whole period of analysis. The distortions, which appear at the cost, level are explained by those that characterize the demands of the production factors. As a result, the demand frontiers and the associated inefficiencies are the causes of the cost frontiers and inefficiencies.

[2] We generally choose to represent the technology as a cost frontier, when the producer has no power to decide on the level of production.