



Do contractual practices affect technical efficiency? Evidence from public transport operators in China



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ABSTRACT

This paper presents a discussion on the causal effect of contractual practices on the technical efficiency of Chinese public transport operators. To test this proposition, an original panel data set covering 47 operators over the period 2008–2013 is used, we firstly estimate the technical efficiency based on the stochastic frontier approach in a time-varying form of the trans-log production function, and then consider a propensity score matching approach to assess the causal effect between them. The econometric results corroborate this proposition that gross cost contracts offer more incentives to technical efficiency than net cost contracts and management contracts.

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1. Introduction

Under Chinese background, public transport services are the important infrastructure of urban public services, which also are the social public welfare related to people's livelihood. Improving the public transport services is the responsibility of Chinese municipal governments. Since the reform and opening up policy was introduced, some of Chinese municipal governments have reversed the privatization of market-oriented reform in the public transport field (Wang et al., 2014). It usually involves contractual practices. These reforms aim at improving the technical efficiency and the service level of public transport services in a context of severe public budget constraints by changing the organizational and regulatory of public transport services (Roy and Yvrande-Billon, 2007). These reforms attempt to balance government, market and social groups. The government plays a lead role to organize the stakeholders to achieve common goals, the perfect government supervision mechanism is necessary for public transport services are the quasi-public goods. However, the type of regulatory contract is mainly the expression form of the government supervision mechanism for public transport services. The privatization reform policy is implemented on the premise of a theoretical hypothesis, that is, that the contractual practices affect the performance of public transport operators. Therefore, our main objective in this paper is to test this hypothesis by investigating to what extent the type of regulatory contract influence the performance of public transport operators. More precisely, the aim of this study is to assess the impact of the contractual practices on the performance of the Chinese public transport operators.

In China, government-oriented and market-oriented are two fundamental modes of public transport governance. The local authorities in charge of regulating the procurement of public transport services mainly can choose between the

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following two modes (Wang et al., 2014). Direct administration is one possibility. In this mode, public transport services are directly delivered by the local government departments. The authorities also contract out the operation of public transport services either to semi-public firms or to fully private firms. In the Chinese public transport service market, public firms or private firms or semi-public firms can deliver the public transport services. Moreover, once local authorities have decided to delegate, a major problem authorities have to deal with then is the choice of an appropriate contractual practice. Three main categories of contractual practices are traditionally and distinguished in the Chinese public transport service market, according to the type and proportion of the risks that are shouldered by each contracting party, namely the management contract, net cost contract and gross cost contract. Hence, the diversity of contractual practices in the public transport service sector in China provides a favorable condition to test the core hypothesis of the contract theory according to which the type of contractual practices is a key factor affecting the performance (Quinet and Vickerman, 2004). To our knowledge, no other empirical studies of the Chinese public transport sector have already addressed this issue thus far.

The panel data set of the operation cost covering 47 different Chinese public transport operators over the period 2008–2013 has been studied in order to test the hypotheses and assess an indicator of the efficiency. The data that we use is one of our contributions. In the studies of transport economics, there have been scholars who applied the frontier production function method to measure the efficiency of transport systems (Cowie and Asenova, 1999; De Borger et al., 2002; Roy and Yvrande-Billon, 2007; Karlaftis, 2010; Boitani et al., 2013). The previous studies did not attach much importance to the effect of contractual practices on the efficiency of public transport operators. For this reason, we shall first of all build a stochastic frontier approach (SFA) in a time-varying form of the trans-log production function to obtain the efficiency of public transport operators. Although, SFA can be used to assess the effect of contractual practices on the efficiency. However, the relationship between them is confused by other observed covariates; it is also difficult to directly explore the causal effects between them based on SFA. In order to overcome this problem, an alternative method is the method of propensity score matching (PSM) developed in Rosenbaum and Rubin (1983), which is by far a much more compelling strategy compared to the one currently being applied. Under this strategy, we firstly estimate the efficiency based on the SFA in a time-varying form of the trans-log production function, and then consider as a second step running a propensity score matching approach to estimate the impact of the type of contractual practices on the efficiency. This is an area of innovation in research methodology contributed by this paper.

The structure of this paper is as follows. In Section 2, the available literature is reviewed and two research hypotheses are proposed. Section 3 describes the research methodology. In Section 4, the definitions of some variables are introduced along with data specifications and processing. An empirical analysis of the contractual practices influencing the efficiency of Chinese public transport operators, the core content of this paper, is elaborated in Section 5. Finally, the main conclusions are summarized, and an outlook for future research is presented.

2. Literature review and research hypotheses

In micro economics, the efficiency is divided mainly into economic efficiency and technical efficiency. The former is represented by cost benefit ratio, while the latter by the input–output ratio. The efficiency of public transit operators is measured by technical efficiency instead of economic efficiency because technical efficiency measures the vertical gap of the boundaries between the actual output of public transport operators and its maximum possible output on the production possibility in a fixed technical standard and the scale of the investment of critical elements. The bigger the gap is, the higher the technical efficiency is. Therefore, the use of technical efficiency as a measure standard for the efficiency of public transport services spares us the worry of operators having too many goals or sometimes conflicting goals. Moreover, the chosen measure standard is restricted by the availability and reliability of the data. In contrast to the data needed for the measurement of economic efficiency (for example, profit or cost), the data essential to the measurement of technical efficiency (for example, vehicle-kilometres, number of vehicles, and number of employees) is more accessible and reliable.

In the previous studies, some scholars applied contractual practices to analyse the technical efficiency of public transport operators. Quinet and Vickerman (2004) proposed the criteria of classification for contractual practices in the *Principles of Transport Economics* and outlined the classification of contractual practices. In accordance with quient's criteria, the formal contracts governing public transport services in China may be of three different types, namely the management contract, net cost contract and gross cost contract. The three types of contractual practices are classified according to the types of risks they shoulder (the risks include the production risk and the profit risk). Net cost contract and gross cost contract are two variants of fixed-price contracts, whereas management contracts are a variant of cost-plus contracts.

The basic argument of the contract theory is that cost-plus contracts produce fewer incentives than fixed-price contracts (Beesley, 1989; Cowie and Asenova, 1999; Bajari, 2001; Van de Velde and Preston, 2012; Smirnova and Leland, 2013). Under cost-plus contracts, the production cost of operators is fully borne by the local government, and operators have less incentive to reduce production cost. Therefore, cost-plus contracts lead to lower technical efficiency. The empirical literature concerning contractual practices influencing the technical efficiency of public transport operators are limited. Roy and Yvrande-Billon (2007) has found through empirical research of the effect of contractual practices on the technical efficiency that operators regulated by cost-plus contracts are less efficient technically than those regulated by fixed-price ones. Albalade et al. (2012) has derived from the case studies a conclusion that is consistent with that of Roy. For this reason, the following hypothesis is proposed in this paper:

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