The effectiveness of the Spanish urban transport contracts in terms of incentives

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Abstract

We consider a principal-agent model in which the regulator faces a moral hazard problem, since he cannot observe the effort exerted by public transit operators. In this context, we analyze the effectiveness of the different urban transport contracts signed by the Spanish Central Government since 1990 in terms of incentives. The main result is that none of these contracts provides the appropriate incentives to public transit operators. Thus, we propose a fixed-quantity contract as an alternative financing mechanism. The fixed-quantity contract is a high-powered incentive contract that allows the regulator to perfectly forecast the amount of public funds to be used in the urban transport system. Moreover, the fixed-quantity contract can be adjusted to attain the equilibrium between incentives and optimal allocation of risk.

Keywords: contracts, incentives, asymmetric information

JEL Classification: D82, L51, L92

1 Introduction

The urban transport system is organized in Spain in the same manner than in most European countries: urban transport services are regulated by a public agency. In general, transport service operators are better informed about their own operating costs and market conditions than the public regulator. In this context the regulator should carefully choose the financing scheme, since some public financing systems may have adverse effects on the efficiency of public transit operators.

The Spanish urban transport system is not exempt from the typical asymmetric information problems. In fact, some authors argue that there are significant differences between the efficiency of private and public transport operators (see De Rus, 1989; De Rus and Nombela, 1997; Matas and Raymond, 1998). However, there is not so far any paper analyzing the effects of the different Spanish financing systems on the incentives of public transit operators.

The main purpose of this paper is to analyze the effects that the different financing policies applied by the Spanish Central Government since 1990 have on public transit operators' incentives. To this purpose, we consider a principal-agent model in which the public regulator faces an asymmetric information problem since it cannot observe the effort exerted by public transit operators.

The rest of the paper is organized as follows. In section 2 we analyze the main elements of the different urban transport contracts used by the Spanish Central Government since 1990. The effectiveness of the Spanish urban transport contracts in terms of incentives is discussed in section 3. Finally, in section 4 we suggest an alternative financing mechanism.

2 The Spanish urban transport contracts from 1990

Urban transport contracts were initially conceived as an instrument to support the urban transport system. The main objectives of such contracts are the promotion of the public urban transit, the encouragement of public transit operators' efficiency, and the establishment of a stable financing system for public transit operators. This financing

system must be compatible with the public funds available to the different public authorities concerned. We can mainly distinguish three different agents: The Spanish Central Government (SCG); the urban transport operators in the Spanish regions with urban transport contracts; and the Spanish Local Governments (SLG) that cooperate with the SCG in financing the urban transport system.

The SCG has applied different criteria in order to finance the operating needs of public transport operators. We can mainly distinguish two different periods: from 1990 to 1997, and from 1999 to 2004.

During the first period, the SCG financed public transport operators through a subsidy per passenger and a subsidy per passenger-km.[1] Moreover, the SLG promised to finance all the operating deficits that were not covered with the Central Government's subsidies.

During the second period, from 1999 to 2004, the financing criteria of the SCG completely changed. Instead of paying a passenger or a passenger-km subsidy, the SCG decided to pay a percentage of public transit operators' losses. As usual, the SLG promised to finance all the operating deficits that were not covered by the SCG.

3 The effectiveness of the Spanish urban transport contracts in terms of incentives

The model

Let us denote by Q_S the frequency offered by the transport service provider, and by $C^*(Q_S)$ the efficient cost function, that is, the minimum cost paid for offering Q_S.

The real cost function that is observed by SCG and SLG, $C(Q_S)$, may not coincide with the efficient cost function. In fact, being efficient requires the operator to make an effort. Thus, the way in which managers organize timetables for drivers or the effort exerted in correctly maintaining and repairing the vehicles may substantially affect the

[1] The term passenger-km refers to the amount of kilometres run by passengers.

costs of offering a certain level of service. Moreover, the fuel consumption of the vehicles or the need of reparations may highly depend on drivers' effort.

The operator may reduce its operating costs if he exerts enough effort.[2] In other words, the higher the effort exerted by the operator, the closer the efficient and the observed cost functions are. For the sake of simplicity, we assume that both cost functions are related by the following expression:

$$C(Q_S) = C^*(Q_S) + \theta - e_c \,, \tag{1}$$

where e_c denotes the effort exerted by public transit operators in order to operate with efficiency. The parameter θ can be understood as an inefficient measure, implying that efficiency can never be achieved if the operator exerts no effort. In order to have the model well defined, we assume θ to be always higher or equal than e_c.

Notice that the observed cost function $C(Q_S)$ tends to the efficient cost function $C^*(Q_S)$ as the operator exerts a higher effort, that is, as the term $\theta - e_c$ tends to zero.

In general, public transit operators are better informed about the most efficient way of offering the urban transport service than public agencies. Thus, we assume that the SCG and the SLG cannot observe (or verify) either the efficient cost function or the effort exerted by public transit operators in order to be efficient. The SCG and the SLG can only observe (and verify) real cost functions, that is, $C(Q_S)$.

In transport models it is common to distinguish between the offered quantity (or frequency) and the real level of service demanded by consumers (see Small, 1990; Berechman, 1993; Gagnepain and Ivaldi, 2002). Both concepts can be related by the following expression:

$$Q_d = \alpha \; Q_S \,, \tag{2}$$

where Q_d denotes the real level of service demanded by consumers, and α represents the proportion of the offered capacity that is indeed demanded by consumers. The

[2] If public transit operators exert enough effort, the reduction in costs can be substantial. As an example we can look at the British case, in which, following the deregulation in the eighties, public transit operators reduced their costs up to 40 per cent (see Heseltine and Silcock, 1990; Jansson and Wallin, 1991; Mackie *et al.*, 1995; Nash, 1993).

parameter α is assumed to belong to the closed interval $[0,1]$ and it is a function of two variables:

$$\alpha = \alpha(x, e_d), \tag{3}$$

where x denotes a set of exogenous and random variables that affect the final demand but are neither observed neither controlled by public transit operators. The variable e_d denotes the effort exerted by public transit operators in order to attract new users to the urban transport system, which cannot be observable either by the SCG or the SLG. Thus, on the one hand, the effort exerted by public transit operators in order to minimize access and waiting times of passengers clearly affects the demand of the urban transport system. On the other hand, the behavior of drivers, especially in terms of punctuality and kindness, may also affect the quality of the urban transport service and, hence, passengers' willingness to use such a service.

The effort e_d allows public transit operators to increase the proportion of the total offered capacity that is indeed demanded by consumers. For the sake of simplicity, we assume that both α and e_d are positively and linearly correlated.

The effort exerted by public transit operators in order to be efficient or attract consumers is not costless. As it is usual in the Economics of Information literature, we assume quadratic costs for effort, $\frac{e_d^2}{2} + \frac{e_c^2}{2}$, implying either an increasing marginal disutility of effort or decreasing returns to scale.[3]

The public transit operators' profits are then given by:

$$\Pi = pQ_d - C(Q_S) - \frac{e_d^2}{2} - \frac{e_c^2}{2} = p\alpha(x, e_d)Q_s - C^*(Q_S) - \theta + e_c - \frac{e_d^2}{2} - \frac{e_c^2}{2}, \tag{4}$$

where p denotes the price charged for the urban transport service. Prices and frequencies are regulated, so none of these variables can be chosen by public transit operators. In this framework, the operator can only choose the effort levels e_c and e_d.

[3] The assumption of quadratic costs for effort is quite common in the Economics of Information literature. Some examples are Arrow and Radner (1979), Gibbons (1998), or Socorro (2007).

Assumption 1: Given that prices and frequency are regulated, operating costs are never covered. Thus, public financing is needed.

Neither the effort e_d nor the effort e_c is observed by the SCG and the SLG, so they cannot be part of any urban transport contract. On the contrary, urban transport contracts should provide the proper incentives to public transit operators in order to exert the socially optimal efforts. In what follows we analyze the effects of the different urban transport contracts used in Spain since 1990 on public transit operators' incentives.

The Spanish urban transport contracts from 1990 to 1997

During this period, the SCG's financing system was based on a passenger or passenger-km subsidy. In the urban transport contracts signed, the SLG promised to finance the operating deficits that were not covered with the SCG's subsidies. In other words, the SLG financed the difference between the real (observed) operating revenues and the real (observed) operating costs whenever this difference were negative. In all cases, the SCG's subsidies were insufficient to cover the operating costs, so the SLG's additional financing was needed.

In this case, the SLG only financed the difference between observed operating revenues and observed operating costs (recall neither the efficient cost function neither the efforts exerted by the operator are observable). Thus, once the SLG covered the observed deficits, the profits of public transit operators were:

$$\Pi = -\frac{e_d^2}{2} - \frac{e_c^2}{2}. \tag{5}$$

Clearly, public transit operators would choose the effort levels that minimize their losses, which are given by $e_c = e_d = 0$.

The Spanish urban transport contracts from 1999 to 2004

During this period, the SCG's financial system completely changed. Instead of paying a passenger or a passenger-km subsidy, the SCG decided to pay a percentage of public

transit operators' losses. The other part was financed by the SLG. Thus, the 100 per cent of operating deficits was financed by some public entity

Given *Assumption 1*, operating costs are never covered. Thus, financial support from the SCG and the SLG is needed. As a consequence, even though during this period the public financing scheme completely changed, the result in terms of incentives is the same that in the previous period: public transit operators would exert no effort at all, that is $e_d = e_c = 0$.

4 An alternative financing system

Basically, all urban transport contracts signed in Spain since 1990 cover firms' operating deficits. Clearly, as we conclude in the previous section, with contracts in which public transit operators only receive financial support if they obtain negative operating profits, operators have no incentives to exert any effort.

We suggest an alternative financing mechanism consisting of giving public transit operators an *ex-ante* fixed amount of money in order to finance their possible losses. The fixed-quantity contract is a very high-powered incentive scheme, as operators are now responsible for insufficient revenues and cost overruns, that is, operators are the residual claimants for effort.[4]

Traditionally, passenger or passenger-km subsidies have been considered as an optimal device to increase public transit operators' effort in the literature (Glaister and Collings, 1978; Nash, 1978). However, the fixed- quantity contract has some advantages over subsidies. The first advantage is that with a fixed-quantity contract the SCG can exactly predict the amount of money assigned to finance the urban transport system. On the contrary, the total amount of money to be paid by the SCG with subsidies depends on the total number of passengers.

[4] There is some empirical evidence supporting the argument that firms with fixed-price contracts (either subsidies or fixed-quantity contracts) have lower operating costs. See, for example, Gagnepain and Ivaldi (2002) for an analysis of the public transit systems in France, and Dalen and Gomez-Lobo (1996, 1997) or Jorgensen *et al.* (1997) for an analysis of the Norwegian case.

The second advantage of the fixed- quantity contract over subsidies is that the amount of public funds used to finance the urban transport system with the latter may be excessive High levels of demand do not necessarily imply high levels of effort and therefore using a passenger or passenger-km subsidy may be inefficient.. In general, optimal payments should be higher if the SCG has a stronger signal of high effort. However, high levels of demand are not necessarily a signal of high efforts, so the operator should not receive additional funding.

The fixed-quantity should be *ex-post* adjusted throughout taking into account the trade-off between incentives and the optimal allocation of risk. In particular, it should be adjusted *ex-post* in order to use the operating deficits and other verifiable variables, such as the input prices, as a source of information on the operators' behaviour. Thus, operators' efforts cannot affect, for example, some input prices (such as fuel prices) but input prices may affect the operating deficits. Low operating deficits are generally a much stronger signal of high effort if the input prices are high than when input prices are low. Thus, the fixed-quantity to be granted to an operator with low deficits should be greater if input prices are high than if input prices are low.

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