Research in Transportation Economics 30 (2010) 23–28

Contents lists available at ScienceDirect

Research in Transportation Economics

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

Social marginal cost pricing and second best alternatives in partnerships for transport infrastructures

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Keywords:
Pricing
Social marginal costs
Transport infrastructures
Public private partnership

A B S T R A C T

According to the economic theory, if all the first-best conditions are met, social optimality involves the prices to be set equal to social marginal costs. When it is not possible to set prices equal to social marginal costs, due to the presence of constraints within the transport sector or distortions elsewhere in the economy, the theory suggests corrections to the SMC principle (second-best alternatives). But the implementation of second best alternatives can give rise to serious problems when transferred from theory to practice. This chapter will discuss in particular the problems that might rise when investment cost are included (totally or partially) in the social marginal costs rules, and in particular when private operators are involved.

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1. Relevant principles

Welfare economics looks upon price as a method of resource allocation, which maximises social welfare rather than simply the welfare of the supplier. The price that maximises the social welfare in absence of a break-even constraint is the price at which marginal cost is equated with willingness to pay. In other words social welfare is maximised when price is set equal to Social Marginal Cost (SMC).

SMC pricing makes sure that all external costs are internalised (the Pigouvian tax) and that at the same time the amount of congestion on a transport infrastructure is reduced to an optimum. Fig. 1 shows how, due to the presence of external costs, the level of traffic could exceed the optimal level. Equilibrium is established in N^o where the demand curve meets the private cost curve (perceived cost). Actually, the social costs generated by the transport activities are in general higher that perceived costs. From the social welfare point of view, the optimal use of the infrastructure would be N^*. The optimal charge that would secure the realization of the optimal mobility is depicted by *t*. After imposition of the optimal *t* charge, users between N^* and N^o – whose infrastructure usage is excessive from a social perspective since the social benefits are lower than the social costs – will not find it attractive to use the infrastructure anymore, since the benefits derived from its use fall short of the sum of the private cost *c* plus the price charge *t*.

In the case of transport infrastructures, the vehicles generate four types of cost that do not fall on those individuals whose choice has caused them: congestion and scarcity costs[1], infrastructure wear and tear, part of accident externalities and emissions. All these costs could be included in the definition of the optimal tariffs.

However, there are some conditions that should be met in order to validate the SMC pricing. These conditions in reality are never met completely. Second-best policies are considered for when it is not possible to set prices equal to social marginal costs due to the presence of constraints within the transport sector or distortions elsewhere in the economy. A substantial technical literature has emerged over the last decade, that addresses various types of second-best pricing, and considers questions towards the optimal design of second-best pricing schemes and towards the relative efficiency of these schemes (much of this literature is reviewed in Lindsey & Verhoef, 2001 and in Rouwendal et al., 2002). Nevertheless, in the real world it is not only difficult to find out practical solutions, but results deriving from the applications of second best solutions could be extremely variable from the impossibility of increasing welfare gains to some examples where second-best pricing schemes realize the first-best welfare levels (Rouwendal et al., 2002).

Another property that SMC pricing might assure (even if limited to the infrastructure wear and tear and congestion costs only) is that, according to the equilibrium approach based on the Mohring and Harwitz (1962) model, under suitable technical conditions generates exactly the revenues which are needed to finance the

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[1] Scarcity is significant in the rail and aviation sectors. It happens when demand exceeds capacity. Possible solutions for allocating scarce capacity are slot trading and auctioning: when selling slots on a spot market, scarcity value is the cost of pushing another service off the tracks or into an inferior slot.

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doi:10.1016/j.retrec.2010.10.004

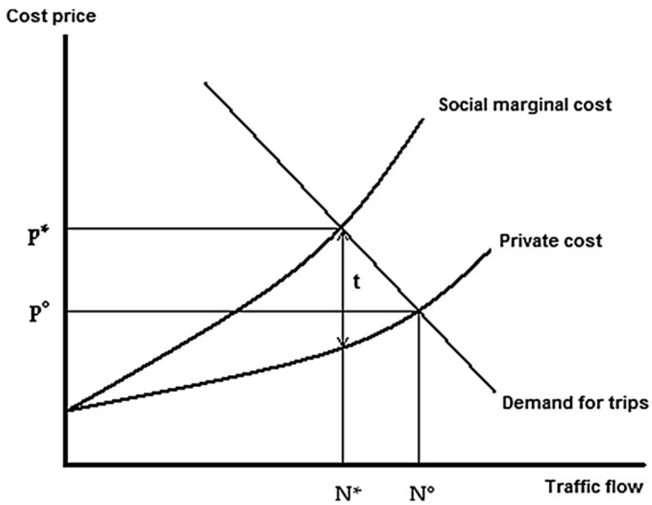

Fig. 1. Marginal costs – current and efficient.

network (Cost Recovery Theorem – CRT). The most important conditions are that 1) capacity is perfectly divisible and can be expanded at constant marginal cost, and that 2) user costs are homogeneous of degree zero in capacity and usage[2]. Mohring concludes "setting marginal cost prices for highway trips and, more generally, transportation services is not necessarily incompatible with having a self-supporting system" (Mohring, 1976).

This theoretical conclusion opens up a set of empirical questions about economies of scale in transport, and about continuous capacity. Many studies have tried to verify the applicability of the CRT. Empirical evidence on economies of scale in infrastructure varies by transport mode. As far as roads are concerned, the issue is still controversial, but there is a wide agreement in transport engineering that infrastructure yields increasing returns to scale, not only in the construction costs, but also because with increased capacity disturbances stemming from the mix of vehicles can be treated more efficiently (Kraus, 1981, Rothengatter, 2005), and because of substantial scale economies in durability with respect to pavement thickness. Railways exhibit economies of density and the average cost curve is U-shaped with respect to network size (Preston, 1996). There is evidence of scale economies for traffic volumes up to 3–4 million passengers/year in airports (Doganis, 1992). Furthermore, due to investment indivisibility (road capacity is discrete because of traffic lanes, indivisibilities are important for runway capacity, for seaports and railways), capacity could never reach the optimum level.

It is possible to conclude that while the CRT represents a useful theoretical instrument, it cannot be considered as a rule to be universally applied (de Palma & Lindsey, 2005): under second-best conditions (inability to toll a whole network, competing modes priced above or below SMC, impossibility to readjust capacity according to traffic volumes because of indivisibilities, past investment sub-optimal, etc.) the implications of SMC pricing for cost recovery are not clear-cut (Laird et al., 2003). If social marginal cost pricing will lead to deficit, it can be funded by taxes; otherwise, a constraint must be imposed on the infrastructure manager in order to finance part of the construction costs. Both these situations require second-best prices.

[2] This means that if usage and capacity are both doubled, private user costs are unchanged.

2. Pricing problems in the PPP

Which are the main specificities of the PPP in comparison with a public infrastructure?

1) It is a case of private subjects build and operate a stretch of a network or a node and both revenue (commercial) and industrial risks are substantially transferred to the concessionaire;
2) Tariffs and capacity are determined on a project-by-project basis;
3) They should at least cover the private component of the investment (at least partially) and operating costs.
4) The distribution of revenues among facilities operators does matter.

As a consequence:

1) PPP may suffer from decisions taken by other actors that manage other parts of the networks, in particular the ones regarding the investment and pricing.
2) If the infrastructure manager (IM) is not regulated, prices will generally diverge from efficient prices. This divergence will take place because the manager will add a mark up above its total cost in proportion to its market power up to the point its net profits are maximised. Furthermore, some IM may have a discriminatory power, and maximise their rents extracting all the user's surplus. In this case, social efficiency is optimised anyway, even if equity suffers badly.
3) Private tolls are typically established by contracts with some public authority. Given the relatively long lasting of the transport infrastructure concessions, the uncertainties linked to the future demand are of a major concern. Competitive tendering can establish the initial level of tariffs, and sometimes price cap methods are applied as a mode of regulation. However, in some cases the contract leaves open the possibility to renegotiate the level of tariffs given the financial difficulties that private new infrastructures may face. In any case, given that the investment cost should be, at least partially, covered by the tariff revenues, tariffs should be designed to include also amortisation and capital interests. In the case of railways negotiations for infrastructure cost sharing will turn out extremely complex given the unbundling of rail infrastructure and operation: they should consider the financing capabilities of the infrastructure manager directly linked to the level of infrastructure pricing, but that level should be established taking into account the user's reaction modified through the rail operator(s)' own commercial and technical reaction (Meunier, 2007).

The following paragraphs discuss some specific problems due to the presence of private operators in the provision of transport infrastructure, such as deficit due to the impossibility to pricing competing links, investment cost recovery, revenues allocation etc.

2.1. Mispriced substitutes

First-best optimal pricing requires that all the network links be priced according to SMC. If first-best pricing is not applied throughout the whole network considered, the imposition of marginal cost pricing only on a few key links or sections in a network is not welfare maximizing. For instance private roads will typically face competition from other roads simply because alternative routes often exist between given origins and destinations: a non tolled competing route can generate an excess of demand on the free road, with increasing congestion while at the same time the tolled links will remain underutilised.

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