Endogenising demand for information in road transport

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Abstract. In this paper, the impact of endogenous information provision to drivers in road transport is investigated. A static economic equilibrium model is used, which allows potential road users to buy information on the prevailing (stochastic) traffic situation. It takes for granted that an individual will try to acquire proper information when the private benefits of doing so exceed the private costs. By using an information model for road users, the interesting result is found that the provision of endogenous information leads to a strict Pareto improvement. Furthermore, the model shows that — depending on the price of information — it can be efficiency improving to subsidise or tax the motorist information to the user. Finally, there is a relationship between fine congestion pricing and subsidising motorist information. It turns out that the social welfare maximising subsidy under first-best congestion pricing is equal to zero. However, subsidising information may be an attractive policy instrument when a flat congestion pricing scheme is preferred.

1. Introduction

Traffic congestion is one of the most pressing transportation problems, particular in urban areas. The negative impacts of congestion are not strictly confined to the transportation sector, but are affecting the economy as a whole. Various ways to resolve (part of) the congestion problem in the transport sector have been addressed in the literature. In the present paper we will focus on one of these solu-

1 There is a large body of literature on congestion in transport networks. For useful references see Arnott et al. (1993), and Johansson and Mattsson (1995).
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tion strategies: the provision of information to improve the efficiency of road usage. This tool is becoming increasingly more important as more traditional ways of resolving the congestion problem (such as expansion of the existing road network) are viewed as infeasible, due to the negative social and environmental consequences (Boyce 1988).

Research assessing the effects of these new information technologies has usually focused on (1) the technical feasibility (witness the many technical projects within the European Community DRIVE I and II programme); (2) the impact on driver behaviour using a wide variety of methodologies (Bonsall (1992); Emmerink et al. (1996); Kobayashi (1994); Lotan and Koutsopoulos (1993); Yang et al. (1993)); and (3) the impact on the efficiency of road usage (see, for example, Emmerink et al. (1995a), and Mahmassani and Jayakrishnan (1991)).

In the present paper, the latter issue using a static economic equilibrium model, in which individual decisions are interdependent due to a congestion externality, is investigated. To model the large and often unpredictable random fluctuations in levels of congestion, the link travel cost functions are assumed to be random variables. Two types of actors are being considered: informed and uninformed ones. Informed actors are assumed to have perfect knowledge on the realisation of these random variables, and are therefore basing their trip-making decision on actual costs. Uninformed actors, in contrast, do not have this information, and hence base their behaviour on expected costs. However, in contrast to previous work (Emmerink et al. 1994a, 1995b), we assume that there are costs associated with information provision which reflect, for instance, the costs of the necessary information technology equipment. In this manner, the choice of being informed is modelled endogenously, whereas in previous papers this process was modelled as an exogenous input. Hence, an actor in the present model does not only decide on whether or not to use the transport network, but also decides upon whether to buy information on the traffic situation. Clearly, an actor will buy the information only if the private benefits of being informed at least exceed the private costs of doing so.

This model will also be used to examine the efficiency improving properties of two types of government regulation. First, we will consider the possible implications of subsidising the costs of information for social welfare. The idea is that owing to the external benefits generated by the information to uninformed actors, it may be attractive for the government (or an infrastructure authority) to subsidise information (Emmerink et al. 1994b) and we will analyse under which conditions it is socially desirable for the government to do so. Next, we will investigate the link between fine congestion pricing and endogenous provision of information. Fine congestion pricing will yield its first-best characteristic, only if the users of the system are perfectly aware of the prevailing fine congestion toll. Without perfect information on actual levels of congestion and tolls, users would base their behaviour on expected costs rather than on actual costs. Therefore, it seems logical to consider the efficiency of first-best congestion tolling in combination with the endogenous provision of perfect information. With respect to the second point, we will elaborate the analysis of El Sanhouri (1994) and Verhoef et al. (1994), who assumed that information is available for free, both for all actors and for the government.