Regulation of road accident externalities by insurance companies with market power: an analytical model with endogenous speed and safety technology choice

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Abstract:

Accident externalities are among the most important external costs of road transport, [3]. The negative impact of the road accidents is multiple of that of congestion externalities; yet, it remains under-investigated in the economic literature. In this work we study the regulation of road safety, when insurance companies have market power, and can influence road users’ strategy choices in terms of mileage, investment in car safety for the driver, and speed. The government, in turn, has control over both insurance providers and the drivers.

Our model describes a two-stage game between car insurance providers and road users. First, insurance companies maximize their profit with respect to insurance premiums, subject to equilibrium constraints. Then, each atomistic road user opts for a safety technology and speed in order to minimize its generalized costs. This includes time costs, investments into own safety technology, insurance premiums, and a possibly immaterial part of the expected accident costs not covered by the insurance. We assume that an individual’s speed choice does affect both one’s own and other road users’ safety, while the technology affects only the former. Possibly, technology chosen by a driver would partly influence the safety level of all the road users, but distinguishing between a strictly internal safety measures (technology investment) and a combined internal-external safety measure (speed) is helpful for the interpretation of our results.

Following the reasoning provided in the papers [1] and [4], we obtain marginal conditions of the first- and second-best solutions. In our model we assume that companies can influence drivers’ behavior via insurance programs. Government then can impose taxes, subsidies on companies and/or road users, fines for speeding over a certain speed limit, and other regulations. We consider social and private profit-maximizing monopolies, and competitive markets of the firms playing Nash in Cournot fashion.

In line with the earlier literature on airport congestion and private road operation, we find that market power is of key importance when insurance markets are regulated. The discussion on private internalization of externalities is therefore not only relevant for airport congestion or the operation of private roads, but also impacts optimal road transport pricing when regulating the accident externalities related to road use, speeding, and the level of safety technologies, [1].
Among the main results, we have concluded the following: For each type of market structure, the insurance schedule consists of an insurance premium, and marginal dependence of that premium on speed and technology, given by what we will call optimal “slopes” of the premium function with respect to speed and technology. Although such a sophisticated, continuous design of insurance premiums may appear unrealistic, we model it in such a way in order to identify whether and how the company would prefer to affect speed and technology choices of its insurees, in an analytical setting that does not introduce additional second-best distortions arising from imperfect instruments. The insurance premiums imply that monopolists fully internalize the accident externalities imposed by the drivers upon one another, and competitive firms provide only partial internalization. The same is true for the optimal “slopes” of the premium with respect to the speed and technology choices of the road users. A safer technology may only influence driver’s own accident costs, and does not directly affect the chance to be guilty of an accident. The speed choice, on the other hand, decreases the risk to cause a collision, and this fact is reflected in the optimal control over the marginal change of the premium in case of competitive insurance market. In that case, the social regulator might have to balance inequalities by introducing appropriate limits and/or supplementary fines or bonuses as the first-best slopes do not depend directly on the risk of being guilty of an accident.

Our results may guide empirical research that aims to estimate accident externalities from data on insurance premiums (see for example [2]). On top of that, the analysis results are relevant for policy makers and engineers (subsidies for safer vehicles, speed limits, even influence of the results to the road quality as roads have to correspond to the speed of vehicles).

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References


