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Effects of time-varying toll pattern on social welfare. The case of the Metropolitan Area of Barcelona, Spain.

ABSTRACT

This paper analyzes the second best time-varying toll pattern design issue, with a focus on parameters such as the degree of toll variation between time intervals, the minimum toll fare and the gap with the peak period fare. We study the impact of those parameters on a study case for a two parallel route, an idealized two route alternative in the north-eastern region of Barcelona Metropolitan Area. A model that properly joins DTA commercial software to a time-swapping algorithm that accounts for users' departure-time choice is proposed, allowing the achievement of a departure-time steady-state assignment (DT-DUE).

The results show that toll pattern design has a more than fine tuning effect on optimal toll design problem. Some complex interactions between route and departure-time choices and the network characteristics have been pointed out. Peak hour time-varying toll pattern yields the minimum total generalized cost, but different toll patterns can reach better results for non optimal toll levels. This suggest that, if social welfare is ought to be maximized the better option will be to set a peak hour time-varying toll. In case minimum revenue constraint has to be taken into account, it should be better to set a uniform toll or a bounded time-varying scheme depending on the necessary toll level, as long as those strategies rise private travel costs far less than the revenue collected allowing reinvestment.