

ABSTRACT

Pricing policy and its complementary measures are part of a strategy to reduce the external costs that road mobility causes upon society. From the point of view of sustainability in developed countries, pricing becomes a useful tool in order to make the road system efficient, to raise funds for its maintenance and to improve and innovate the public transportation system. Its application is progressively expanding, though it is not free from neither conceptual determining factors (a mixture of pricing and restriction is the optimum balance), nor technological determinants (pricing by road network vs. parking lot, license plate recognition vs. GPS or DSRC), nor cultural determinants (aversion to pay for road usage or public network), nor social (system credibility, funds raised use, etc.), nor it is free from implications on the social equity.

This thesis presents a methodology based on the economical principle of the social short run marginal cost and it uses a *second-best* approach in order to quantify the optimal toll to determine the demand level that offers the highest increase in social welfare. The proposed methodology is developed for a metropolitan road network and it allows a comparison between multiple pricing schemes by means of quantitatively analyzing the different operation, economic and social indicators.

The evaluated alternatives are made up of five pricing systems that can at the same time be grouped into two simple alternatives (flat pricing and linear kilometric) and three complex alternatives (concave kilometric, access toll plus kilometric charge and cordon plus kilometric charge); these latter alternatives favor the *commuters*, they help balancing the weaknesses and strengths of the conventional structures and they adapt themselves to the current road topology. In order to contrast and select the better pricing system to be established, a multicriterial analysis based on the hierarchization analytical process has been used.

This system has been applied to expressways of the Metropolitan Area of Barcelona, modeled with TransCAD. The base scenario is defined and the future scenario is simulated by means of implementing each of the studied structures during the rush hour traffic congestion. The results measure the negative effects (user's surplus loss) and the positive ones (revenues and reduction of congestion costs) grouped within the net social welfare change.

Modeling and its sensitivity analysis allow the obtaining of a design guide to transportation planning and to implement a pricing strategy in congested metropolitan or urban areas. The appropriate use of the revenues positively influences the equity and shows that the mixed scheme cordon toll plus linear kilometric is the most appropriate for the city of Barcelona: with 1.55 €/vehicle per access plus 0.09 €/vehicle the demand is reduced a 10% in vehicles·km; the maximum increase in social welfare exceeds 93,000 €/h for a 11.8% reduction in vehicles·km. Finally, extensions of this research and developed model are suggested.