

## ABSTRACT

The literature on the economics of road congestion has not resolved issues about the correct basis for understanding and measuring the related externalities and there does not appear to be an accepted theory of hypercongestion. Thus, the ambition of this thesis has been to develop an economic model that attempts to resolve these issues and provide a basis on which to estimate marginal external congestion time costs.

The new model is based on the view that it is density of road users that causes congestion and a multiperiod model is required to analyse the implied dynamic behaviour. It is shown how the theory relates to the standard speed-flow analysis. Importantly, the conventional speed flow model does deal correctly with a stationary state condition where speeds and flows are constant over time. However, when speed and density vary across time, the conventional model can be reworked in a density multiperiod framework to give an appropriate and correct analysis of the congestion externality costs.

This model is applied to the case of a single vehicle type during ordinary congestion and hypercongestion. In the case of ordinary congestion with constant density speed and density, the marginal external congestion time cost is the same in the new density and conventional models. In the case of hypercongestion, the new model predicts the marginal external congestion cost to be high and the single period conventional speed flow model has difficulty in predicting the externality cost. Additionally, it is shown that all hypercongestion equilibria are unstable and, in general, it is suggested that hypercongestion equilibria outcomes are not efficient. The final development of density based model is for the marginal

external congestion time costs caused by different vehicle types. The elasticities of speed with respect to density are important in determining the extent of these externalities and the analysis is complex. The data requirements for appropriate estimation of the external congestion costs are high and presently not available. However, it is suggested that the impact on congestion of large and special vehicles is likely to be in excess of the commonly used factor of two to three passenger car equivalents.

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