Road pricing
Predicting the responses of drivers to road pricing

Road pricing has emerged as one of the most prominent policy measures for managing traffic congestion. While the theory behind road pricing is well established, only more recently has the theory been implemented in practice in cities as diverse as London, Singapore and Stockholm.

The increasing prominence of road pricing in the transport debate comes from the continued growth in traffic and the accompanying congestion in many cities and countries, as well as increasing awareness of the impact that traffic is having on the environment. Pricing for road use based on when and where one chooses to drive has become more feasible with the rapid development of technologies suitable for area-wide road pricing schemes.

If road pricing is to achieve its potential, then careful modelling is essential to ensure that schemes are the most appropriate for each particular location and meet the specific policy objectives. Traditional traffic modelling and forecasting approaches may be found wanting in investigating road pricing schemes because of the complex behavioural responses that may occur. However, there exist techniques, which are both feasible and proven, to address some of these issues and which we outline in the next sections.

Disaggregate modelling
Disaggregate models segment the population into a large number of groups, each of which may exhibit different characteristics. Disaggregate approaches are key to capturing the variation in responses to charging that may occur across the population. For example, it may be expected that people from lower income households would be more sensitive to pricing than those from higher income households. Understanding the way such households respond to road pricing schemes is important not only in the near term, but also in the longer term for forecasting purposes, as average incomes change and the distribution of income within the population alters.

Abstract
Road pricing is moving up the policy agenda as an option to relieve traffic congestion and to reduce the environmental impact of traffic. While the effectiveness of road pricing in relieving congestion has long been demonstrated, both in theory and now in practice in a number of cities, policymakers need reliable, flexible transport models to forecast the impact of road pricing schemes. Road pricing schemes place additional demands on our modelling techniques, which require specialist expertise and experience. In this REsource we describe some of the work that RAND Europe has been undertaking with UK clients to investigate road pricing.

Positive and negative impacts of road pricing will vary across the various population groups. An understanding of these implications is critical to addressing any potential inequities of a scheme and in developing policies to ameliorate these impacts.

Stated preferences
Where available, data based on existing choices provide the best indicator of future choices. However, in many cases such data do not exist for proposed policies such as road pricing. Stated preference (SP) techniques provide a means of quantifying choices based on hypothetical choice data when no existing revealed preference (RP) data are available. Typically, surveys are undertaken in which respondents are presented with a series of hypothetical alternatives and asked to choose which they prefer. Discrete choice models are estimated from such data in order to be able to quantify likely behavioural responses.

SP choice experiments are one of the most flexible and robust methods for analysing choices in complex choice contexts such as road pricing. The charge may well differ depending on when
and where a journey is made, making a host of responses possible, including:

- switching to other modes of travel;
- making fewer trips;
- switching the time of travel; and
- choosing to travel to another destination.

SP techniques can be used to quantify these likely responses. Discrete choice models estimated from SP data can be fed into disaggregate model systems so that the responses across population segments, as well as in aggregate, can be predicted.

Theory into practice: London congestion charging

RAND Europe has worked intensively with Transport for London (TfL) to develop a disaggregate model capable of examining a wide range of potential congestion charging scheme enhancements, including cordon charging, time-of-day-based charging and emissions-related charging. A spreadsheet-based forecasting system, developed by RAND Europe, allows rapid evaluation of the potential impact of congestion charging policies on traffic flows in the charging zone.

SP experiments were undertaken to examine driver responses to these future policies. Specifically, we designed and tested three SP experiments examining the following:

1. drivers’ values of time across travel purposes and socio-economic groups;
2. time-of-day-based charging to determine drivers’ willingness to shift journey departure times to avoid higher charges for peak hour travel;
3. interest in a cordon charging scheme, which would be offered in addition to the current area licence-based charge. In a cordon charging scheme, drivers would pay every time they cross the cordon.

Findings

The resulting values of time varied by household income, journey purpose and journey length. Journeys made for employer’s business had significantly higher values of time than for other purposes. Drivers from higher income households valued their time more highly (in other words, they were less price sensitive) than drivers from lower income households. We also found that values of time tended to decrease as journey times increased.

A preference for the existing area charge was evident, perhaps in part due to a degree of familiarity with the current scheme. We found that for a cordon charge to be equally attractive to an area charge, the cordon charge would need to be substantially cheaper; how much cheaper would depend on the individual and journey purpose.

For time-of-day-based charging to be effective, the charge differential would need to be significant in order to encourage travellers to alter the timing of their journeys. In particular, we found that travellers would be more willing to alter the timing of the return leg of their journey rather than that of the outward leg. Furthermore, changes that had implications for the duration of stay at the destination were valued very negatively.

Emissions-related charging

In a related study, TfL commissioned a team including RAND Europe to forecast the impact of road user charges that would be linked to vehicle carbon dioxide (CO2) emissions. TfL was specifically interested in the impact that emissions-related charges would have on the choice of car used by household members already having a variety to choose from, and on longer-term car purchasing decisions.

As before, we used SP techniques to present respondents with hypothetical scenarios in which they could: continue to use their current vehicle at the specified charge; use another vehicle in the household (if they have one); or buy another car with lower emissions to reduce the impact of an emissions-related charge. The experiment was tailored to each individual. An example showcard is provided below.

Findings

A forecasting system was developed to test the impact of different emissions-based charging scenarios. The models predicted a small decrease in trips by the most polluting cars, charged at £25 and a more substantial increase in trips by the least polluting cars, where there was either no charge for the lowest CO2 emission cars or £8 for average-emitting ones. These effects were partly a result of drivers choosing less polluting cars in their household, if available, and if not, then purchasing new cars. Our findings suggest that an emissions-related charge may be effective in altering the vehicle composition, but that care will be required to ensure that congestion benefits are not reduced.