DUBLIN ROAD USE CHARGING PILOT-ACTION

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1. INTRODUCTION

Traffic congestion in Dublin has reached relatively high levels despite the existence of a concentrated plan to improve public transport and offer reliable and feasible alternatives to motorists. The difficulty is primarily due to the slow and piecemeal introduction of the public transport alternatives proposed by the Dublin Transportation Initiative (DTI, 1994) teamed with an unprecedented rise in car ownership and usage levels related to increased economic activity in Ireland in recent years.

It is against this background that road use pricing has recently been the subject of a scoping study commissioned by one of the Irish government departments, the aim of which is to examine the potential for road use pricing in controlling traffic congestion in the city. Needless to say the integration of such a measure with the integrated package of measures already recommended for Dublin would be a fundamental issue to be examined by such a study.

Other Dublin based research on road use pricing has been the subject of a two-year EU funded project entitled EUROPRICE (O'Mahony et al, 1999), funded under the DGXVII SAVE II Programme. It aimed to evaluate the potential user response through a small pilot-action, to estimate the impact on the use of energy and the impact on traffic congestion.

The means by which user response was measured in Dublin was through participation of a sample of individuals in a road use pricing field trial. In addition to the field trial, modelling runs using the DTO transportation network model were conducted to estimate the potential energy savings likely to accrue. Below is a description of the work conducted in Dublin for the EUROPRICE project. Firstly, the specific objectives of the work are outlined followed by descriptions of the pricing regime and the participants involved in the pilot-action. A summary of the results of the field trial and the modelling runs to estimate energy savings are then presented.

2. OBJECTIVES

The Dublin field trial involved twenty-three participants, who were given real money budgets and charged for using their car in the peak period at rates equivalent to the marginal external costs of car use. The equipment used was an in-vehicle charging meter (ICU) developed specifically for the purpose. Attendant to the field trial were modelling exercises to estimate the impact of road use pricing on energy savings

The objectives were to:

- Evaluate user response to road use pricing
- Evaluate the impacts of road use pricing on energy usage
- Measure the resulting changes in private transport travel demand
- Establish the effectiveness of in-vehicle meters for road use pricing
- Investigate if the pricing levels used, which correspond to the marginal external costs, are effective.

3. ROAD USE PRICING METHOD

The charge applied in the peak period was much higher than that in the off-peak period reflecting the higher marginal external costs associated with peak period car travel. The aim was to apply a charge equivalent to the marginal external costs which, in theory, road use pricing internalises. The rates applied, 6.4 Euro per peak period trip for Dublin (Proost et al 1998), are relatively high and concerns over acceptability may be an issue if these rates were to be applied in a full-scale implementation.

Road use pricing was applied in the trial as a combination of distance and time based pricing similar to taxi metering. The charges applied to each individual were selected such that the total peak period trip was 6.4 Euro with the predominant part of the charge related to distance based pricing to eliminate the potential dangerous driving habits associated with time based pricing (Bonsall and Palmer, 1997). The LCD of the unit displayed the running cost of the trip on a real time basis so that the car driver was aware at all times of the amount spent. A running budget total was also displayed.

4. IN-VEHICLE CHARGING METER (ICU)

The ICU is a programmable display and data logging instrument specifically for use in logging 'trip data' and displaying road use costs. The ICU used in the EUROPRICE project was designed by Geraghty and Humphreys, Mechanical Engineering Department, TCD. It is an 'in-car' instrument and can be retrofitted to almost all models of car. There are some variations in the installation procedure such as, for instance, in retrofitting to diesel engines.

The output from digital tachometers may be connected directly to the ICU with only the calibration procedure to be performed. Calibration is done by driving a standard mile/kilometre or if the number of pulses per mile/kilometre is known it can be programmed into the ICU. Other models may use an entirely mechanical tachometer. These require the addition of a Hall-effect interface.

The ICU records details of a driver's car usage, such as number of trips, distance and duration of the trip, speed data relating to each trip, over an extended period (up to 3 months). In addition, it can calculate a cost for each trip according to a predetermined formula. The cost may include components related to congestion pricing as well as the conventional cost elements such as fuel, wear and tear, and depreciation. The

particular pricing mechanism may be chosen by the researcher. Feedback on cost may be provided to the drivers by means of an LCD display.

The trip data are stored in chronological order and indexed so that, under certain circumstances, the data may be viewed by the researcher. Information on costs, trip lengths, budget remaining and charge rates are presented to the driver on a real-time basis by means of the LCD display.

The recorded data is stored in non-volatile memory and may be uploaded to a spreadsheet package via a serial interface at any time. Windows '95 based software is provided to configure the ICU and to retrieve the experimental data.

5. WORK PROGRAMME

The field trial work programme lasted four months. Firstly, the in-vehicle meters were installed in the cars and calibrated. During Phase 1, which lasted three weeks, no information was displayed on the LCD to the car drivers. The purpose of this phase was to log baseline travel behaviour. On completion of Phase 1, Phase 2 was initiated and during the three weeks of Phase 2, road use charging was applied in line with the pricing regime described above. After Phase 2, the ICUs were removed from the vehicles.

6. SAMPLE

The sample was made up of university based volunteers. Although a random sample of the population may have generated more reliable results, the level of interference with the vehicles for installation of the instrumentation necessitated dependence on a volunteer sample.

57% of the individuals spend between 12.7 – 19.05 Euro on fuel each week, 36% spend between 19.05 – 25.4 Euro and 7% spends between 25.4 – 31.75 Euro. 79% consider their journey to work to be congested whereas 21% consider that congestion is not a problem. All individuals have free parking places at the university but the demand for parking is quite high and some of the sample experience difficulties if they arrive much later than 9.00am.

86% of the sample drive alone to work whereas 14% drop family members to other destinations en route. 85% select the fastest route to work whereas 8% choose the shortest and 7% have more detailed constraints. If they had changed their route to work on any occasion they were asked to specify why from the following: to avoid congestion, to save time, to save fuel or boredom. The reasons consistently receiving a 1 or 2 rating from the participants were 'to avoid congestion' or 'to save time'. 'Saving fuel' and 'boredom' received ratings 3 or 4 from most individuals. This finding reinforces the importance of avoiding congestion and time savings over money savings.

86% of the sample live within 10 minutes walk of a bus stop and in fact 83% of these had less than 5 minutes of a walk. 64% require no bus change for their work trip from home whereas 21% require one change en route. 57% indicated that the bus or DART

(urban rail service on the east side of the city) has a stop within 5 minutes walk of their work place and for 43% the walk to their work place from the public transport stop is 5 – 10 minutes.

14% indicated that they take public transport for their trips to work more than twice per week with a similar proportion using it 1-2 times per week. 50% suggest they take it 1-2 times per month and 43% never use public transport for their trip to work. The latter group of individuals was questioned further to investigate the reasons for this choice. The reasons rated high in importance were 'slower than car', 'unreliable', 'uncomfortable' and 'weather'. The bus service in Dublin, for many years, has been poor in terms of travel times and reliability although serious attempts are at present being made to improve it by the establishment of eleven quality bus corridors. However, it can be assumed that such innovations were not in place to influence the opinion of the participants in the pilot-action.

To give an indication of the cost of a work trip by public transport the individuals were asked to price a typical trip. The cost of the trip to work for 57% would be less than 1.27 Euro each way and 79% indicated it would be less than 1.9 Euro. 50% said that the waiting time for public transport was usually 5-10 minutes whereas 57% suggested waiting times of 10-20 minutes. 12% rated public transport to be faster in getting them to work than if they went by car, 24% rated both modes to be similar in terms of travel times, 46% rated the public transport service as twice as slow, 6% three times as slow and 12% more than three times as slow.

The sample were asked some questions about road use pricing before commencing the trial such as: if road use pricing were to be introduced, at what charge/week would they consider changing mode for some trips. 32% suggested at 12.7 Euro / week, 9% said at 19 Euro / week, 17% said 25.4 Euro /week, 17% said 32 Euro /week, 9% said 45 Euro / week and 16% were strongly against road use pricing as a measure and did not answer the question. When asked to identify the likely difficulties of introducing road use pricing 'the lack of alternative modes of transport' featured highest followed by 'public acceptability'. The difficulties rated not that important were 'technical difficulties of tolling' and 'businesses unwilling to support it'.

7. RESULTS

7 individuals increased the number of trips made during Phase 2 during which time they were charged for road use, 2 maintained the same level of trip making as in the baseline period and 14 individuals reduced the number of trips made. 4 individuals increased the number of trips made in the peak period, 4 maintained the same level of trip making and 15 reduced the number of trips made. In the case of off peak period trips, 13 increased the number of trips made, 1 maintained the same level of trip making and 9 decreased the number of trips made. The overall decrease in peak period trips for the sample was 22% and off peak period trips increased by 10%. One could be 99.5% confident (by means of paired t-test) that road pricing was influencing the decrease in peak period trips but not the increase in off peak period trips.

The next variable examined was distance travelled. In the case of total distance travelled each week, 8 increased the distance travelled in Phase 2 whereas 15 decreased the distance travelled. In the case of the peak period, 5 increased, 1 maintained the same distance travelled and 17 decreased the distance travelled during peak periods. For distance travelled in the off peak period, 12 increased, 2 maintained the distance travelled and 9 travelled less The impact of road use pricing on the total distance travelled by the sample, a reduction of 23%, has a confidence level of 95% and in the case of the distance travelled during the peak period the level of confidence rises to 99.5%.

The last variable examined was the amount of money spent relating to the road use charge applied. 7 increased the total amount spent on road use pricing and 16 decreased the amount spent in Phase 2. For peak period travel, 6 increased the amount spent and 17 decreased the amount spent and in the off peak period 12 increased the amount spent and 11 spent less than in Phase 1. The reductions in peak and total amount spent were found to be related directly to the imposition of road use pricing.

8. ENERGY IMPACT ASSESSMENT

An assessment of the energy savings likely to accrue from road use pricing was conducted as part of the EUROPRICE project. It involved modelling exercises using the Dublin Transportation Office Model (DTI, 1994). The model covers Dublin city and county and parts of Kildare, Meath, Wicklow and Louth; in other words the area which is within commuting distance of the city. The supply of transport infrastructure in this area is represented by a series of networks. Each mechanised mode has its own network - one representing the road system for use by cars and commercial vehicles, one representing the bus routes and their associated operating frequencies and one representing the rail services and associated operating frequencies. The average values of time used were IRL£6.76 (8.6 Euro) per hour for the peak period and IRL£7.63 (9.7 Euro) for the off peak period. An elasticity of -0.2 was used for the model runs.

The software platform adopted for the Dublin Network Model is SATURN and SATCHMO - the SATURN Travel CHoice Model. The model used for the EUROPRICE project runs is the DTO Transportation Model containing zone to zone private vehicle demands and trip costs for a representative future year, 2006. In other words the modelled networks reflect the completion of major road and public transport infrastructure schemes such as:

Roads

- - the final sections of the C-ring (a motorway joining the Euroroute from Belfast to Rosslare)
- Tallaght Bypass Extension;
- South Eastern Motorway;
- Dublin Port Tunnel;

Public Transport:

- Luas (light rail transit on two corridors);

- Quality bus corridors; and
- DART improvement (urban heavy rail on coast).

The model also takes account of the existing East and West Link toll facilities and the proposed tolling of the Dublin Port Tunnel.

8.1 Model Test Description

Two tests were conducted:

Test 1: Inner cordon only on canal ring with a cordon charge of IRL£3 (3.8 Euro)
Test 2: Inner and outer (M50) cordon with a cordon charge of IRL £3 (3.8 Euro) at each cordon

8.2 Energy Assessment

Out of a total of 133,378 trips within the Greater Dublin area, 33,134 (25%) incur the charge (£3 - 3.8 Euro) in Test 1 resulting in a 35% reduction in fuel consumed.

Test 2 indicates that congestion is not just a problem in the centre of Dublin but extends much further out. A reduction in 7.1% in the number of trips resulted from this policy with a 5.6% in the number of vehicle-kilometres and a 40% reduction in fuel consumed.

9. CONCLUSIONS

The conclusions are as follows:

- A 22% reduction in trips was realised during the peak period as a result of road use pricing. When tested statistically one can be greater than 99.5% certain that the changes in behaviour of the sample in Phase 2 are specifically as a result of road use pricing.

- There were also some impacts on total car travel demand of the order of a 3.4% reduction. Although there was a sizeable increase in the sample total of off peak period trips, when tested with a paired t-test one could not be confident that this was as a result of road use pricing. This is understandable in that the pricing levels assigned to the off peak period were relatively low.

- The modelling exercises suggest there would be 3% reduction in trips if an inner cordon were applied to Dublin with a charge of 3.8 ∈ for crossing the cordon. The reduction rises to 7 % if a second cordon with a similar charge is applied on the outskirts of the city.

- A 35% - 40% decrease in fuel consumed was estimated by the model if road use pricing were to be introduced in Dublin. The highest level of reduction was associated with the double cordon test.

- The in-vehicle units used in the project were very effective in applying distance and time based charging. The data logging ability of the units were also useful and eliminated the requirement for travel diary keeping.

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