

Distance and time based pricing in Dublin

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Traffic management in Dublin to date has concentrated primarily on increasing public transport capacity with secondary measures such as reducing the number of on-street car parking also playing a part. Although there is strong commitment to such measures at a policy level there have been delays in the implementation of public transport solutions. In parallel with the slowness of implementation has been an unprecedented increase in car ownership and usage levels, exacerbating the traffic congestion problems on all corridors to the city centre during, in particular, the peak periods.

Another phenomenon adding to the congestion levels is the increasing price of property in Dublin city which is encouraging long distance commuting. Road use pricing is one of the measures that has recently been the subject of a scoping study (Oscar Faber, Goodbody, TCD and TORG, 1999) to establish its potential in addressing the likely shortfall between transport demand and supply in the short to medium term. Another project, entitled EUROPRICE, funded by EU DGXVII, the aim of which was to examine the potential user response to distance and time based pricing in Dublin, has recently been completed and forms the subject of this paper. Both projects have raised the profile of restrictive transport demand management measures on the transport agenda in Dublin.

The EUROPRICE project involved both demonstration and modelling to evaluate user response to road use pricing, to establish the impact on traffic demand and in addition the likely impact on energy usage. This paper will concentrate on the Dublin work and in particular the method used in a mini road use pricing trial involving a small number of volunteers. The road use pricing charges applied were equivalent to the marginal external costs of transport, including congestion, noise, pollution and accidents.

Some reference will be made to a sister trial conducted in Athens as part of the EUROPRICE project. The findings were useful in that some indications of lower private transport demand in the peak periods as a result of road use pricing were evident although these findings would require validation on a larger sample.

An ICU was designed specifically for the project and not only is it capable of applying distance and time based pricing but it also has the capability to log 3 months of travel data in one logging period. The pricing method is innovative in that the charge levels were selected so that the average marginal external costs of transport are paid by the user. The aim of the project was to evaluate the response of individuals if they were required to pay all transport costs and not just private costs. The relatively high charge levels would clearly raise acceptability issues. These issues are not addressed here other than to suggest that they require further review.

IN-CAR UNIT (ICU)

The ICU is a programmable display and data logging instrument and for this project was specifically programmed to log 'trip data' and display road use costs. It is an 'in-car' instrument and in most respects is a 'one-fits-all' solution in that it can be retrofitted to almost all models of car. One of its primary inputs is a connection to the odometer for distance measurement. There are some variations in the installation procedure depending on odometer type. The ICU is capable of recording details of a driver's car usage. 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 conventional cost elements, such as fuel, wear and tear and depreciation.

The particular road use pricing formula may, with some restrictions, be chosen by the researcher. Feedback on cost is provided to the driver by means of an 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.

Functionality

The basic functionality of the ICU is that of a trip-meter. For each trip it records the following information:

- time and date of the start of the trip;
- duration of the trip;
- distance travelled;
- the computed cost of the trip;
- the number of stops during a trip (i.e. when the car is idling - this gives an indication of congested conditions where necessary).

The trip data are stored in chronological order and indexed so that the data may be viewed and analysed on a spreadsheet 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 an LCD display.

Programmability

The ICU programmability is three-tiered. The most basic level, Tier 1, is that available to the installation engineer and provides for:

- (1) calibration of the ICU for different tachometer types; and
- (2) simple proofing and fault finding. Tier I operations are ICU front panel operations.

At the next level, the ICU may be programmed with details of:

- (a) the costing regime to be applied;
- (b) initial value parameters for the selected costing regime.

- (c) currency option;
- (d) display parameters, such as font, language, currencies, etc;
- (e) unit of distance to be used i.e. miles or kilometres;
- (f) date and time of daylight savings changes to be made to the real time clock;
- (g) vehicle identification information e.g. registration number, participant details; and
- (h) tachometer details for some models. Also at this level, the researcher may:
 - (a) retrieve the data at any time; and
 - (b) re-initialise the ICU, thus erasing any accumulated data.

Tier II programmable options use the PC interface and should be done prior to installation. Since the ICU normally uses the car battery/charging system as the power source, a separate power supply is provided to power the instrument on the bench.

Tier III operations are only available to the developer. As such they include such functionality as:

- (a) addition of a new costing function; and
- (b) addition of a new display option.

Tachometer Interface

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

Data Storage

The ICU stores the trip data and configuration data in nonvolatile memory. Enough memory to record up to 3 months of trip data is provided. The amount of memory required is based on an average number of trips per day per vehicle.

Costing Functions

Two costing functions were used for the Dublin and Athens trials in the EUROPRICE project. The costing regimes for each are detailed below:

Dublin - The proposed cost function for Dublin is as follows:

$$C = aD + bT$$

where: C = Generalised cost, D = Trip distance, T = Trip time, a, b = coefficients (or weights) effectively charge rates

The charge level is therefore a function of the distance (primary) and time (secondary) of the trip and the charge rates. As all of the parameters are known (or can be estimated in the case of trip time), the cost of the trip is generally known prior to departure.

Athens -The costing function applied in Athens is a 'carrot & stick' regime (O'Mahony et al, 1999). Each trip has a baseline charge e.g. DK400, which is applied every time the car is started between the hours of 7.00 am and 11.00 am. This charge is applied regardless of whether or not the car actually travels any distance. In addition there is a sliding scale of charges which is applied on a per-mile basis. The per-mile charge is incremented for every consecutive day of car usage and decremented every day the car is not in use. This implies that the cost of driving on a particular day is influenced by the recent driving history. The scheme is therefore based on three elements:

- (1) a starting charge (S)
- (2) a per mile minimum charge (M)
- (3) penalty charge (P)

A penalty charge is incurred every day the car is used, so if the car is used on two consecutive days, a penalty charge of 2P will be applied on the third day of consecutive use. If the car is idle for a day one penalty unit is recovered.

The charging scheme is given by the equation:

$$C = S + (M + nP)x$$

where: x = miles travelled, n = number of penalty charges, S = starting charge, M = minimum per mile charge, P = penalty charge, C = calculated charge. Each of the parameters S, M, and P are programmed at Tier II.

WORK PROGRAMME

Twenty-three university based volunteers participated in the Dublin trial. Their baseline travel behaviour was logged for three weeks by the ICU before the distance and time based road use pricing phase was initiated. Each participant was then given a real money budget from which they could pay the road use charges or if they found alternative methods of transport they were allowed to retain any remaining budget.

The road charges applied in the peak period were closely aligned to the average marginal external cost of transport for a peak period car trip in Dublin; 6.4 euro / trip. Charges applied in the off-peak period were set at a nominal rate of 0.12 euro per mile and 0.02 euro per minute. The marginal external costs of transport had been previously calculated for Dublin as part of the EU TRENEN II STRAN project (Proost et al, 1998). The distance and time rates were selected so that the total cost of the trip would be 6.4 euro. The advantages of distance and time based pricing are twofold. It internalises more closely the marginal external costs so that if congestion is present on the route the car driver pays for adding to that congestion. It also allows the driver to

find alternative routes to lessen the charge; a response that is not an option in cordon tolling methods. The road use charging phase lasted for three weeks after which the data was downloaded and analysed.

RESULTS

There was a 6% reduction in the average total weekly trips by the participants with a much larger reduction of 23% in the peak period. Both of these results had high significance when tested statistically but the 6% increase in the number of trips made in the off-peak period was not significant. Similar trends in results were evident when the data on distance travelled and time spent travelling in the vehicle were analysed.

As well as the positive impacts there were some individuals who did not react to road use pricing. Seven individuals actually increased the total number of trips they made when compared to the baseline and 4 increased the number of peak period trips made. The amount of money spent on road use pricing was also examined. When compared to the baseline, 7 individuals increased the amount spent on road use pricing and 16 decreased the amount spent during the road use pricing phase.

In the peak period, six increased the amount of money spent and 17 spent less than in Phase 1 (notional charges for Phase 1). In the off-peak period, 12 increased the amount spent compared with the baseline. Although there was some transfer of trips from the peak to the off-peak period, it was clear from interviews with the participants that some were making an effort not to use their car for work trips for a couple of days per week. More detailed information on the sample characteristics and user response results are presented in the EUROPRICE final report (O'Mahony, et al 1999).

CONCLUSIONS

The conclusions of the work are as follows:

- (1) One of the aims of the EUROPRICE project was to evaluate user response to road use pricing. The pilot-action in Dublin analysed the response of 23 individuals. Clearly this is a small sample and further validation of the findings would be required on a larger group of individuals.
- (2) The specialised equipment used in the pilot-action allowed detailed logging of travel data and accurate accounts of trips to be kept. This obviated the necessity for the participants to fill out travel diaries.
- (3) The equipment proved useful in applying time differentiated distance and time based pricing where the charges in the peak period were set at a higher level than those in the peak period. For a full-scale demonstration integration of the equipment with GPS would be required so that travel in non-congested areas outside the city could be priced at a different level or not at all.

- (4) Road use charging was found to have an impact on the private transport demand of individuals, particularly in the peak period where the average number of trips decreased by 23%.
- (5) On the basis of this project, there is considerable scope to evaluate the impact of internalising the marginal external costs more closely such as by distance and time based pricing, a method that has distinct advantages over the more commonly proposed cordon charging.

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