Adapting the Dutch 'mobility explorer' program to investigate possible car taxation futures in the UK

Conference or Workshop Item

Adapting the Dutch '*Mobility Explorer*' program to investigate possible car taxation futures for the UK

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Abstract

This paper reports work being conducted as part of the only transport project in the current ESRC programme on the Environment and Human Behaviour. The concept of generalised road user changes eventually replacing existing Fuel Duties and Vehicle Excise Duty (VED) is in the ascendant, with several studies concentrating upon the eventual adoption of a GPS-based congestion charging system.

The Dutch and Swiss have also been exploring such schemes. In particular the Dutch have looked at a more quickly and easily implemented option of *distance charging* rather than *congestion charging* that is favoured in the UK. This project seeks to explore a wider range of new taxation options, particularly seeking more pragmatic paths towards early implementation rather than the 10 – 20 year timescale currently envisaged. Indeed, the Dutch studies have suggested that distance charging might yield most of the traffic management and emission reduction benefits of congestion charging, with a modelled reduction in car kilometres travelled of between 18 and 35 per cent compared with a 'business as usual' base case.

In this project, the Dutch *Mobility Explorer* program that was used to estimate the effects of a national distance charge, is being adapted using UK data to investigate a series of possible car taxation futures. These range from a low-key introduction of a distance charge to replace VED, through to a distance charging system replacing fuel tax and VED and a GPS congestion charging system. This will permit a comparison of the traffic, congestion and emission reductions between such options and also a cross-country comparison on a comparable basis with the existing Dutch work.

The adaptation of the Dutch model to the UK has not been straightforward, and possibly the greatest lessons have been in helping to understand the differences in context in which a seemingly similar transport policy measure is being proposed.

The paper concludes with a reflection upon the rapid rise in favour by the UK government for of generalised road user changes to replace Fuel Duties and VED. It is suggested that this is not a way to avoid hard decisions in transport policy that it may at first seem.

The drive towards national road user charging

With remarkably speed and relatively little attention in the media, the idea that area-wide road charging should substantially or entirely replace Britain's long-established road transport taxation regime has progressed from marginalised obscurity into the centre of government thought. Last June, at a road demand management seminar, Transport Secretary of State, Alistair Darling, declared that replacing Road Fuel Duty and Vehicle Excise Duty (VED) with an area-wide road user charging was a key policy tool to deal with 'pressures over the next 20-30 years'. The introduction of something like a national GPS-based congestion charge is at least a decade away, but a DfT working party has been set up to explore the form of the new system, timescales and implementation.

However for heavy goods vehicles (HGVs) the process of introducing road user charging has already begun. This has largely been accepted on the principle of 'taxing foreigners living abroad':

lorries registered outside the UK pay nothing for using British roads, so in 2002 a new HGV system was announced to cover them as well as UK operators. VED on HGVs is due to be replaced by a new tax that will vary by the weight of the lorry and the distance driven, with foreign lorries paying as well. Implementation is due in 2006, but could be delayed to ensure compliance to the recent European Commission directive on payment systems.

The idea of a national (or 'area-based') road user featured as a possible development in the February 2002 a report by the Commission for Integrated Transport, (Dodgson, Young, and Van der Veer, 2002). They suggested a charging scheme balanced by a 21 per cent cut in fuel duties and VED. The House of Commons Transport Select Committee picked up the idea. and then, coinciding neatly with Alistair Darling's road demand management seminar, came the Independent Transport Commission's report, *Transport Pricing* (Glaister and Graham, 2003). This in-depth study modelled how a congestion road user charge could produce substantial user benefits and significant cuts to congestion. However the report also raised the issue that a fiscally-neutral redistribution of VED and Road Fuel Duty could have detrimental results. The October 2003 IPPR study, (Foley and Fergusson, 2003), partly based on research commissioned from Glaister and Graham and using their model, explored this aspect further and concluded that national road user changing would need to be combined with an increase of £16bn per annum to achieve an environmental gain. Finally, in November 2003, came the All Party Parliamentary Rail Group's report (Goodwin, 2003;) that highlighted the implications to rail of a national road user charging scheme.

The *Transport Taxation Futures* project

Overall 2003 has seen a frenzy of action around the issue of national road user charging (recent studies are usefully summarised in a *Local Transport Today* review, Anon 2003). Another group in the fray is one including the authors of this paper[1], who are undertaking a project under the ESRC's *Environment and Human Behaviour New Opportunity Programme*, co-ordinated by Professor Paul Ekins[2]. The aim of projects in the EHB Programme is to synthesis research on a topic area and aims include identifying what public policy approaches might persuade people to change their behaviour to mitigate environmental impacts. The project, *Transport Taxation Futures*, which began work in January 2003, is the only transport project in this programme.

The Transport Taxation Futures project follows the approach of the EHB Programme in that it seeks to synthesise existing research by a number of people who have explored ways in which the taxation and charging regime could be structurally altered. The plethora of research and policy activity during 2003 has only sought to highlight the appropriateness of this work.

A particular aspect of the Transport Taxation Futures project is that we are linking research on the concept of developing national road user charging in the UK to a similar appraisal study in the Netherlands. Ubbels, Rietveld and Peeters (2002) explored the car use and environmental impacts of the Netherlands replacing car purchase, annual and fuel taxes with four variations of a fiscally-neutral kilometre charge. The Dutch government of the time were actively interested in this idea, although the subsequent election of a more right-wing coalition has resulted in the idea being shelved. It should be noted that the Dutch have focused upon a distance rather than a congestion charge.

The Dutch study used a dynamic model called Scenario Verkenner (Scenario Explorer). This allowed scenario variations to be entered not only of car cost distribution, but of a variety of factors that have a crucial impact on car use and any environmental impacts arising from changes in travel behaviour. These include demography, technology, prices and regulations, infrastructure and spatial development. The Scenario Explorer outputs for 2008 produced results with important policy implications. In the Dutch context, redistributing existing taxes to a kilometre charge resulted in a modelled reduction in car kilometres travelled for the four alternative charging systems of between 18% and 35% compared to the base case. CO_2 emissions from cars were cut by 22-40% and NOx by 40-50%. Total travel declined by only 5-10%, but interestingly public transport travel

[1] See appendix for full list of the ESRC project team

[2] For details see www.psi.org.uk/ehb

increased by only a maximum of 5%. The main impact of the kilometre charge was to increase walk and cycle use by 5-10% and increase car occupancy and car trip linking.

These results raise some important issues. One observation made in the UK is that, using conventional behavioural change policies, a large rise in public transport is needed to produce a small drop in car use. The cost of expanding public transport to this level is very large indeed (the rail expansion programme alone costing over £10 billion, excluding the cost of any new high-speed lines. This study opens the possibility of a transport measure that does not require a massive and expensive rise in public transport use to effect a significant reduction in car use. The main impact of a road user charge could well be to shift short trips to walk and bike and a better utilisation of the car for longer trips and only a marginal need to expand public transport capacity. Compared to other demand management policies this looks very cost effective and politically attractive.

Members of the Dutch study are taking part in the ESRC study. With UK modelling by Glaister and Graham suggesting that a fiscally neutral redistribution of transport taxes would not cut traffic and emissions, whereas the Dutch study did, there has been an opportunity to compare the different policy and modelling contexts. The ESRC Transport Taxation Futures study is therefore developing a series of scenarios that are being assessed for their tax income and ability to deliver effective environmental signals to car users. A version of the Dutch '*Mobility Explorer*' model is being used with UK data entered in order to provide a comparison to the Dutch runs of the model and to also compare with the results coming from other research work in the UK.

The research is still underway and so this paper is essentially of a 'work in progress' nature.

The Mobility Explorer Model

Earlier Dutch work had been undertaken using a model called *Scenario Explorer*, which was used for the study on the effects of a Dutch kilometre charge. However, a more recent and comparable model became available at the end of 2002. This is the *Mobility Explorer* model, which includes special features to define a mobility charge. It is also more focussed on the impact of economic developments on mobility, whereas the Scenario Explorer is strongly based on the spatial characteristics of several parts of The Netherlands, making it more difficult to adjust the model to the UK. In consequence the version 5.0R5 of the Mobility Explorer model was used.

The Mobility Explorer (ME) has been produced by TNO-INRO in Delft and financed by the Dutch Ministry of Transport. The latest version is ME 5.0R5. The model has been described in a (Dutch) report Eijkelenbergh, P.L.C., Droppert-Zilver, M.N., Korver, W. et al, (2002) The Executive Summary of this report is translated as follows:

The Mobility Explorer is a strategic, medium term (2 till 15 years) transport forecasting model that can be used on a national and a regional scale in the Netherlands. It is a so-called quick response and can be bought by other organisations. The user communicates with the model by using a dedicated interface.

In total twelve main influencing factors have been distinguished which are understood to determine mobility developments in the Netherlands. These factors are: demography (including the number of students using the student public transport pass), car ownership, employment, national income, private incomes, variable car costs (including Road Pricing, fuel taxes and direct km fee), the length of the motorway network, average journey time for both car and public transport, public transport fares, fiscal policy (company cars, home-to-work travel, etc.) and fixed car taxes (purchase tax, road tax, etc.).

For passenger transport the output is the average daily transport demand of the total Dutch population for the following modes: car driver, car passenger, train, rural transport urban transport and slow transport (walk and bicycle). An additional feature is to make selections for trip purpose, working and non-working day, peak and non-peak hours and the average traffic volumes per road type. For freight transport the output is limited to the average yearly volume of ton kilometres on the Dutch road network.

In version 5.0 a new user interface has been developed and the base year is updated towards 1997. A main innovation is that it is now possible to evaluate mobility developments and transport policy on its impact on financial expenditures and income for the central government.

The Mobility Explorer includes a 'Base Scenario', describing the incremental mobility development between 1997 and 2002. The model may create values for every intermediate year between 1997 and 2020. 1997 is the Base-year of the model for which it has been tuned to real-life data on person and goods transport.

The Mobility Explorer model has clearly been designed for application in the Netherlands, including Dutch data on transport elasticities, mode choice, public transport quality etc. Consequently there is clearly an issue of the validity of attempting to enter UK data into Mobility Explorer. However the ESRC project had low resources and so developing a new UK model was not possible or part of the EHB Programme remit. In any case others were developing a dedicated UK model (i.e. Glaister and Graham). The use of the Dutch Mobility Explorer allowed us to examine whether a model could be adapted to provide useful results outside of its national context and to provide a comparison to Glaister and Graham's results. In working through the adaptations to the UK, it also helped to highlight the crucial differences between the policy context of the Netherlands and the UK. This has provided important insights into how the UK and the Netherlands can learn from each other as we both explore the use of a similar road user charging proposals.

The tax change scenarios

Besides a ***Business as Usual*** base scenario, five tax change scenarios were identified. Our intention was to purposefully study a wide range of tax reform options and not just simply a GPS road user congestion charging system. This is possibly one of the distinctive aspects of the ESRC project. These scenarios developed were:

1) Company Car Distance Charging

The idea for this scenario emerged as a possibility for a sectoral introduction (as is the case for the road user distance charges for HGVs). It also involves an important fixed transport tax that no other studies on road user charging have considered. The proposal would be that Company Car Tax (both vehicle and fuel) is replaced by an annual distance-based charge weighted by CO_2 emissions. This would retain the CO_2 element of the current Company Car taxation system but crucially turn a fixed tax into one that varies with use.

2) VED replacement

The proposal is that there would be an annual charge replacing VED. This would be based on the distance driven weighted by CO_2 and fuel type for the car model type (bandings as per current VED system). It would be possible to widen the charging bands while retaining fiscal neutrality. The resultant probable charge would be in the range of 0.3p - 3.0p a kilometre (average 0.9p km). This scenario could allow for users opting into this or continue to pay conventional VED.

3) Car Distance Charging

An annual charge replacing VED and fuel duty based on distance driven weighted by CO_2, NOx and particulates for the car model type. Measured by an annual read-out of distance travelled. Average charge of 4.8p a kilometre (VED replacement would be 0.9p km and 3.9p km for fuel). This might produce a charge range of 3p - 12p per km.

This is a system that is designed around varying charge by distance driven and emissions performance of the car. This is close to the proposed (though now shelved) Dutch policy proposal. Congestion is not taken into account as it would need more complex charging technology.

4) GPS-based congestion charging

This is the central concept being explored in the UK. The charge would be varied by area, road, time of travel. Average charge is also around 4.8p, but with a wider range (which could be as low as zero in some circumstances). Weighting is by behaviour (driving or not in congested situations) rather than emissions performance of vehicle. Possible range 0p - 100p a kilometre

5) GPS-based congestion and emission charging

This combines scenarios (3) and (4). The charge would be varied by area/time/road and also weighted by car model emissions. By weighting by *both* emissions profile of vehicle and behaviour (driving or not in congested situations) would produce both a behavioural effect of replacing fixed charge by a distance charge *and* varying that charge by whether car is driven in a congested situation. Consequently, highly polluting cars would always pay a charge (never pay zero), but low emission vehicles in low congestion areas would pay least. Possible range 0.5p - 100p per kilometre.

Adapting Mobility Explorer for the UK

To use the Mobility Explorer for the UK the following steps were involved:

- Modifying the input parameters for a base year of 2000 to the UK values.
- Tuning the model, using for real-life mobility data in 2000 for the UK.
- Development of the base scenario: Implementing growth and change parameters per year between 2000 and 2020
- Fine-tuning the Base-scenario for scenario data available in the UK.

Using this model to forecast UK effects required a redefinition of many of the data fields and inputs. For a number of inputs it was simply a matter of inputting data using the appropriate unit. For example fuel costs for petrol, diesel and LPG were entered as Euros per litre or getting from the British National Travel Survey information on distances travelled, which are gathered in broadly comparable ways to the Dutch National Travel Survey. The figures for mean speeds were enlightening (again derived from respective National Travel Surveys). In the Netherlands, mean car travel speed is 44km/h and in the UK it is 41km/h. For rail it is almost identical (UK 33 km/h and 34km/h in the Netherlands), despite the UK having more long distance rail. It was possible to enter other information with little adaptation (the categories for government income from transport taxation being broadly comparable to those used in Britain). In a few cases we simply used the Dutch figures for factors unlikely to change between Britain and the Netherlands. This included, for example, the service life of cars.

However, many of the input fields were structured according to uniquely Dutch definitions. In some cases these were simply left blank as they did not apply to the UK. For example, Dutch commuters can claim tax relief on commuting, whereas this does not apply in the UK. However in a number of cases there were Dutch definitions that simply did not map on to UK data. For example, for Dutch annual car ownership taxes (equivalent to UK VED) the Dutch charge according to weight and fuel bands (up to 850kg, >850-1150kg and over 1150kg) whereas the UK has its new CO_2 emissions-based charging categories. We therefore took a sample of British cars categorised by our emissions bands and allocated them to the Dutch weight categories to estimate an average VED charge for the each type. This appeared to produce reasonable figures (e.g. a petrol car under 850kg came out at €172).

Transport use data produced a similar problem. The Dutch have categories of rail, urban public transport and regional public transport that do not map easily onto how Britain categories its public transport operations. Information on patronage, grants and operating characteristics are all broken down by these categories. The rail definition was transferable, but in the end we used London and the PTEs as a proxy for ‘Urban’ and local public transport in other areas as a proxy for ‘Regional’. This is not entirely satisfactory, but in the verification of the model produced acceptable results. We also had to enter in the mean speed of urban and regional public transport. Again there is no centralised sources, the best being the *Benchmarking* section in the CFiT European Best Practice in the Delivery of Integrated Transport Report on Stage 1. This indicated a mean speed for regional public transport of 22km/h in Britain compared to 28km/h in the Netherlands.

Fares were also entered by these categories. The difference in rail fare costs came out less than expected (an average of €0.9/km in the Netherlands and €0.14 in Britain), though this may be due to discounted longer distance fares reducing the British figure. For regional public transport the

difference was more marked (UK €0.26/km and the Netherlands €0.05-0.12) and for urban public transport (UK €0.22-23/km and the Netherlands €0.07-0.12).

In other cases there was information that appears to be readily available in the Netherlands, but not in the UK. Very precise figures had been entered in the Dutch version on the average parking fee paid for commuting, business and education trips, which are not easily obtained from British sources (the NTS being used in the end). The Dutch also appear to have good figures on the total number of car parking spaces and how many of these are paid spaces and how many are free. We had to undertake pretty creative assumptions on these as no national source or estimate appears to exist.

Finally there has been difficulty in creating a congestion charging scenario. The model is designed to explore distance charging and cordon charging – not a congestion charge. Consequently we are having to mimic indirectly a congestion charge using what variables are available within the model. This is best achieved using urban cordons with separate peak and off peak charges to differentiate charges between rural, suburban areas and city centres.

In undertaking a validation of the model by comparing results to actual 2000 data (particularly distance travel by each mode) reasonable correlations were obtained. But once we started to change the tax measures it was clear that some variables in the model responded in a strange way and others were fixed to reflect Dutch conditions. This is the stage we have reached at the time of writing and enquiries are in hand with the model's authors at TNO about some of the difficulties in adapting the model for UK data.

Conclusions

The work on adapting the Mobility Explorer model is still underway. Clearly the results will not be as satisfactory as a dedicated UK model, but it does look like a rough and ready adaptation will be possible. Furthermore, in our detailed work and intensive discussions on adapting the Mobility Explorer model we have come to realise what are key differences between the Dutch and UK situation that affect the performance of a seemingly similar transport taxation reform. The first thing is that, contrary to popular belief, we seem to have less transport taxation to play with than in the Netherlands. The Dutch were looking at shifting purchase measures across to a distance charge. The UK has (apart from standard-rate VAT) no purchase measures, whereas the Dutch have a 45.2% purchase tax on cars (as well as comparable levels to the UK of fuel taxes and VED). UK purchase tax (at a mere 10%) was abolished in the 1980s to be replaced by the fuel duty escalator. The Dutch have kept high purchase tax in addition to expensive fuel. The presence of purchase tax helps to explain the conclusion from the Ubbels et al (2002) study that a fiscally neutral shift of existing purchase, registration and fuel taxation to a distance charge would cut traffic, whereas the Glaister and Graham model suggests in the UK it would not. The only fixed tax shifted in Britain would be the relatively small VED, plus fuel duty (which is already a variable tax). This reinforces the conclusion that a higher overall rate of tax (as is reflected by the Netherlands high purchase tax) is needed to achieve congestion reduction and environmental benefits.

The other important reflection concerns Britain's Company Car taxation system. This is a fixed tax that is very substantial and influential. In discussions about introducing a national road user charging system Company Car taxation has been all but ignored. Perhaps we need start exploring how this might be incorporated into a tax regime change.

National Road User Charging and Transport Policy

Although the detailed modelling work is still underway, perhaps it is worth having a final reflection at a more strategic level. It appears that, at the heart of the sudden rise to favour of the concept of national road user charging are four key factors that have combined to produce a sudden policy shift. The first is the ongoing failure of transport policy, particularly the recognition that even a revised 10 year Transport Plan will not cut congestion, reduce emissions or provide Britain with the sort of transport system that it electorate demands. The professional, research-based argument that Britain cannot build its way out of congestion has never been refuted. But progress has been painfully slow. With a few local exceptions, effective mobility management has not filled the transport policy gap. Above all there is little acceptance among the general public and media that

'car bashing' mobility management is needed at all. In consequence a politically pragmatic fudge between mobility management and roadbuilding has emerged. Yet this can only be a short term holding position before reality asserts itself. Before long effective mobility management has got to happen. There is no other way, however politically unpleasant this truth may be.

The second key factor is cost. The debacle of rail privatisation has been followed by the quadrupling of revenue subsidies plus the need for multi-billion state investment to do little more than simply keeping our railways going. Added to this, bus subsidies are on the rise, let alone the cost of a return to a roadbuilding programme which appears to be underway. And all this delivers little mobility management effects. In the last year the politicians have realised that current transport policies are not only failing but that it is going to cost a lot more to fail than it did before.

The third key factor is that the eco-reforms to the current tax regime and policies to promote cleaner vehicle technologies are starting to cut Treasury income. In the wake of the September 2000 fuel duty protests, policy has essentially been to provide a series of tax concessions to cleaner-fuel vehicles, without any compensating tax increases for the most polluting vehicles. Consequently, rather than stealth tax rises, we have ended up with stealth tax cuts. Graham Parkhurst's work as part of our ESRC study (Parkhurst 2003) has shown that within the next two years, tax yield is set to drop by at least £1.5billion per annum and decline steadily thereafter (Fig. 1). With the Government getting increasingly desperate for revenue sources without raising income tax, the bleeding away of road transport revenues cannot be tolerated for long.

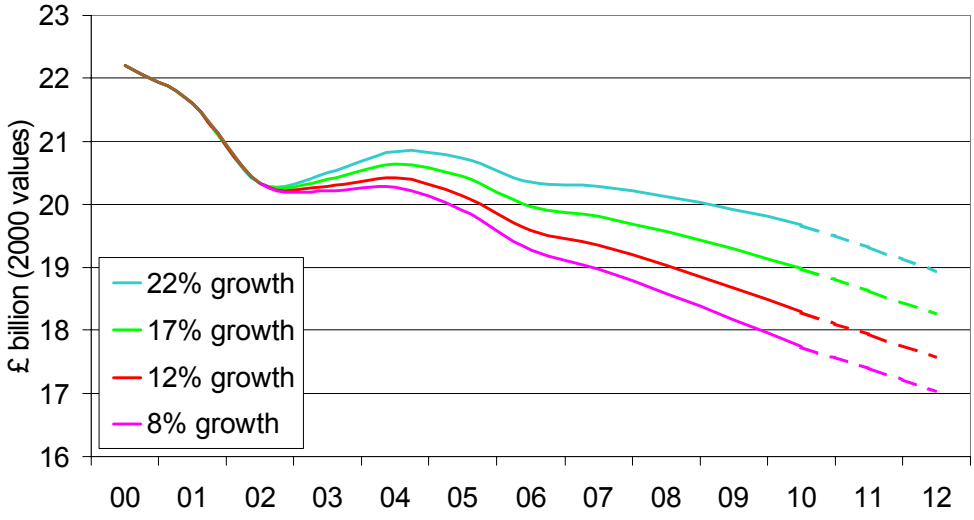

Figure 1: Effect of existing policies on UK car tax revenue 2000-2012
(Four projections varied by traffic growth rates)

Finally there are practical tax problems of new transport technologies. Were hydrogen or electricity to become a major road fuel how could these be taxed at a different rate for transport as opposed to domestic or industrial use? What's to stop people charging up at home and paying no road fuel duty and half rate VAT? Traditional road fuel taxation is going to get harder and costlier to collect and enforce.

What seems to have happened is that all these four factors were particularly heightened this year. Transport policy failure has become abundantly clear and there seemed to be no heavyweight, long term, solution that could win widespread support. At the same time the sheer cost of major transport projects was hitting home just as the Treasury was facing a funding crisis. Furthermore part of that funding crisis is the loss of transport revenues due to eco-taxation reforms.

A possible explanation is that, particularly in the wake of the success of the London Congestion Charge, national road user charging was suddenly picked up as the dream solution that would deliver effective mobility management and, by changing the basis of taxation, road tax revenues can be maintained and will not be depleted by the advent of new transport technologies.

Is this so? A radical change in the taxation regime to road user charges appears to be more appropriate for modern policy needs than the current structure of ownership and fuel taxes. It would

also support cost-effecitive local 'soft' policy measures. But, there are big unanswered questions. For example, should you charge more for places and times that are actually more congested (largely urban areas) or which are not congested but where traffic growth is highest (largely rural areas). If the former, would it not simply transfer traffic growth to the low charge areas? So could this form of mobility management also fail to manage congestion and emissions without strong complementary land use policies? Furthermore, if (as seems the case) road transport taxation needs raising significantly to cut congestion and control traffic. In other words, we are back to the issues behind the original breakdown of the fuel duty escalator in September 2000. Whatever the taxation regime, car travel needs to be priced higher than at present. Area-based road user charging may provide a better structure, but it does not permit us to duck the politically difficult questions that have always dogged transport policy development.

Project Workshop

Note: A workshop on this project is planned in early February. Please contact Stephen Potter or Ben Lane if you wish to attend.

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Appendix:
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