



## **Implementing Pricing Reform in Transport – Effective Use of Research on Pricing in Europe**

### **Deliverable Four**

#### **Phasing and Packaging**

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Authors: Batool Menaz, Bryan Matthews and Chris Nash (ITS) with comments and contributions from other IMPRINT-EUROPE partners

Project Partners:

Institute for Transport Studies (ITS), Leeds

Forschungs- und Anwendungsverbund Verkehrssystemtechnik (FAV), Berlin

Istituto di Studi per l'Integrazione dei Sistemi (ISIS), Rome

Netherlands Organization for Applied Scientific Research (TNO), Delft

Budapest University of Technology and Economics (BUTE), Budapest

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## Executive Summary

This report provides a summary of the proceedings of the fourth seminar in the IMPRINT-EUROPE series of events. IMPRINT-EUROPE is a thematic network on the implementation of pricing reform in transport and its objectives are to:

- facilitate the exchange of experience and transfer of knowledge among scientists and practitioners in the field of pricing;
- draw together the results of previous and ongoing research in the field of pricing and to make them accessible to policy-makers, practitioners, industry and other professionals in a series of seminars and deliverables designed to assist them in developing and responding to pricing policy reform;
- identify, through critical comparative work, the prerequisites for the development of an integrated approach to implementing the European Commission's proposed pricing reforms.

This fourth seminar focused on phasing and packaging of pricing reform and concentrated heavily on the results of the MC-ICAM project. Several key contributors to MC-ICAM gave presentations of their findings and these were supplemented by a number of presentations of other pieces of relevant research. In addition, a number of important policy developments were presented and a series of wide-ranging discussions took place.

Day one began with an update of the European Commission's policy, which re-emphasised the priority given to pricing reform as a means of promoting efficiency and generating finance within Europe. The seminar then heard a presentation from the Swiss government on the implementation of their Heavy Vehicle Fee and the latest information on what impacts it is having. The first of the MC-ICAM-related presentations gave an overview of the project, introduced the distinction between barriers to and constraints on the implementation of marginal cost based pricing, highlighted the key barriers and constraints and introduced the concept of the 'implementation path'.

The workshop on key barriers to implementing pricing reform in rail, air and water transport heard the findings of some of the MC-ICAM modal analyses and an exposition of the specific case of rail infrastructure charging in Hungary. In general, it was found that charging for rail infrastructure maintenance and renewal should be implemented immediately, whilst charging for congestion, scarcity and environmental costs will be medium to long run developments. Further progress depends on research to improve cost estimates, particularly for congestion and scarcity costs, and progress with the implementation of marginal social cost pricing on other modes. If privatisation is pursued, then it is necessary for regulation or franchising to ensure marginal social cost pricing is used. For air and water, the appropriate initial policy steps would be to encourage free competition for end users and to promote greater transparency amongst the state-owned airports and ports in order to move towards tariffs based on marginal social cost, or to privatise ports and airports with price capping or regulation setting infrastructure charges through an independent administrative body.

The workshop on key barriers to implementing pricing reform in urban transport and on inter-urban roads heard the findings of the other MC-ICAM modal analyses and a review of

experiences in the US and Canada. The MC-ICAM findings set out proposed implementation paths for pricing reform, which involved simple short term measures - such as cordon pricing in urban areas or simple kilometre based charges for heavy goods vehicles - which could be gradually refined over time to lead towards full marginal social cost pricing. Lessons from the US and Canada show that there has been a dominance of facility-based pricing, that private sector participation has been important and that there is a need for packaging road pricing with travel demand management policies and transit investment to facilitate capacity for modal shifts from private vehicles. Interoperability of technology was also regarded as being important.

The workshop on inter-urban modeling results again contained a paper from MC-ICAM and another on acceptability, which looked at acceptability in terms of the welfare effects on different income groups. The MC-ICAM RESULTS found marginal social cost pricing led to a positive welfare effect and that pricing road was a good first step in an implementation path, because of its dominance of the market. The welfare analysis found that the efficiency, equity and acceptability of a pricing reform depend both on the level of transport pricing and on the use of revenue.

The workshop on urban modelling results discussed the findings of MC-ICAM modelling relating to Brussels, Helsinki, Oslo and Paris, and some related modelling work for Stockholm. The MC-ICAM WORK found that efficiency gains resulting from pricing rise with the priced proportion of transport networks and that greater efficiency gains were found to be derived from more finely tuned measures with respect to mode, time, location, vehicle characteristics etc.

It was found that an implementation path may not progress monotonically; prices can first rise and fall later or vice versa; and users could gain in the early stages and lose later or vice versa. Lack of coordination between levels of government controlling different policy instruments may lead to welfare losses. The Helsinki study found that investment in additional transport infrastructure capacity may help to gain acceptability for pricing but may not be justifiable on efficiency grounds unless there was adequate demand to use the capacity. The Stockholm work showed that zone and cordon charging could achieve similar results to optimal link-based charging, and that relocation impacts tended to be minor.

Day two of the seminar began with an overview of conclusions from MC-ICAM. The key issue of pricing and its link with investment was then addressed, drawing on work undertaken for the Dutch Ministry of Transport which highlighted the importance of road pricing in the form of congestion charges as a price for road space scarcity. It found that road pricing has to include a fee for capacity expansion in order for it to be effective in implementing the user pays principle.

There were then three papers on the theme of acceptability. The first, drawing on findings from MC-ICAM, concluded that pricing measures could only be implemented if people could get value for money but that the use to which the revenue was put to could be a key measure to alleviate some of the acceptability barriers. The second paper considered policy reversibility and acceptability. Its main conclusions were that it is harder to implement a policy than to ensure its continuation, and policies that require firms or consumers to make investments are harder to implement in the first place, but once implemented, they are difficult to reverse and are usually continued. The third paper considered a psychological

model of responses to pricing and other travel demand management measures. It concluded that households set car use reduction goals when travel demand management measures impair their travel options, and options that achieved the goal at minimum costs were preferred.

The final presentation reported on the remarkable political debate at the ECMT committee of minister's deputies and the council of ministers, at which 34 of the 43 member countries were represented by their ministers. Three final conclusions were drawn. Much success was found getting across the principle of local charges needed for local costs. Also that local conditions determine charge levels, therefore different remedies were expected in urban and non-urban areas. It was believed that pricing changes should always move in the direction of the first-best and changes running opposite to greater efficiency and improved internalisation should be avoided. Technology was now finally available to implement charges. On the evidence put forward to the ministers, estimates of the changes in costs for users were found to be extremely useful. The other estimates of changes in revenues, welfare and external costs were useful, but the trick was to attach the welfare gains to something that was politically attractive such as revenues or votes. This is due to welfare gains being a vague concept and will only be pursued by politicians if something more politically concrete such as revenues was linked to them. Another point put across was that the results from pilot systems in London and Switzerland were rated positively. In terms of implementation, top civil servants were very good at devising inventive second best pricing philosophies and special exemptions from pricing systems to overcome acceptability problems. On the quantitative results, it was very important to make explicit the limitations to applicability and transferability. Politicians were found to be real experts on acceptance. They seemed rather more relaxed than the advisors, and required transparency, simplicity and balance.

Thus, the seminar successfully introduced the idea of an implementation path as a sequence of second best optima, resulting from constraints on the implementation of marginal social cost pricing. It found that starting with simple pricing reforms was likely to be the best first step, paving the way for more sophisticated systems later. However second best policies should be treated with caution; wherever possible it was better to remove the barriers that were causing the constraints rather than accept them. Moreover pure second best pricing could lead prices to move in the opposite direction to that ultimately intended, which could certainly cause implementation problems.

Acceptability was considered to be the real barrier to implementation, but there were both theoretical and empirical reasons to believe that acceptability would increase as reforms were implemented. Open, transparent and appropriate use of revenue was very important for acceptability as well as for efficiency and equity. The point was made that politicians might welcome the revenue raising implications of transport pricing reform but would not necessarily use the revenue in an effective way.

A number of important issues were identified for further research. Institutional issues were important, and evidence was provided that inappropriate allocation of pricing decisions between levels of government could cause problems. Although the results of MC-ICAM suggested that well designed transport pricing schemes would have beneficial effect on land use, more evidence on this, on equity issues and on the broader economic effects of transport pricing reform were still needed.

A few comments were made to close the seminar. It was commented that we are currently at a stage where, in terms of charging, things are looking very encouraging. The London experience has been more positive than expected and many countries are getting interested in doing something better in terms of charging heavy goods vehicles. However the negative side is that things are moving more slowly at the Commission than many people at the seminar wished, in particular regarding the continued absence of a framework Directive and methodology paper covering all modes of transport. The way forward was not to try to persuade people of the theoretical case for marginal cost pricing but to quantify the benefits. Selling the theoretical case for marginal cost pricing had been tried for many years with little or no success. In London, the Mayor was interested in reducing congestion, improving the environment and improving public transport. Under his leadership London has taken the first step towards a more efficient transport pricing system, whether it is explicitly based on social cost pricing or not, and this first step in the implementation path may gradually lead on to extending the area covered by pricing and moving to more sophisticated systems.

# **1. Introduction**

## **1.1. The IMPRINT-EUROPE Thematic Network**

This is the fourth report of the IMPRINT-EUROPE thematic network. It reports on the proceedings and outcomes of the fourth of a series of six seminars being held under the auspices of IMPRINT-EUROPE over a three year period.

The IMPRINT-EUROPE thematic network brings together researchers, professionals, policy-makers and operators in order to promote the implementation of transport pricing reform based on marginal cost principles. The network encompasses both urban and inter-urban transport and all of the main passenger and freight modes. The specific objectives are:

- 1) To facilitate the exchange of experience and transfer of knowledge among scientists and practitioners in the field of pricing;
- 2) To draw together the results of previous and ongoing research in the field of pricing and to make them accessible to policy-makers, practitioners, industry and other professionals in a series of seminars and deliverables designed to assist them in developing and responding to pricing policy reform;
- 3) To identify, through critical comparative work, the prerequisites for the development of an integrated approach to implementing the European Commission's proposed pricing reforms.

## **1.2. Results from the previous seminars and implications for Seminar Four**

Seminar one dealt with key requirements for implementing transport pricing reform across the different modes of transport [Matthews & Nash, 2002], whilst the second seminar tried to identify mode-specific issues for pricing reform [Ricci & Fagiani, 2003]. Seminar three concentrated more definitely on implementation issues (Kendzia and Korver, 2003) and Seminar 4, that reported here, continued in this vein.

Much of the seminar focused on the provisional results of the MC-ICAM project. This project has undertaken significant research into the phasing and packaging of transport pricing reforms and its final conference, reporting on the emerging conclusions, was planned as an integrated event with this fourth IMPRINT-EUROPE seminar. In addition, policy-makers presented the latest EU policy developments, the latest experience of heavy goods vehicle charging in Switzerland and new proposals for urban road pricing in Stockholm.

A session was dedicated to the issue of acceptability issues and the final presentation reported on the process and outcome of political discussions amongst the European Conference of Ministers of Transport. A roundtable discussion then sought to summarise the proceedings and draw conclusions.

The report considers in turn the sessions on policy development and the approach to phasing and packaging, key issues for rail, air and water, key issues for urban transport and interurban roads, interurban modelling results, urban modelling results, policy conclusions, acceptability and use of research to inform policy. In each section the papers presented are reviewed and the discussion summarised.

## **2. Policy Developments and the Approach to Phasing and Packaging**

### **2.1. Introduction**

This section summarises the contributions to the introductory session of the seminar, including presentations by Hugh Rees from the European Commission on EU policy, by Ueli Balmer from the Swiss government on the Swiss Heavy Goods Vehicles Fee, and by Erik Verhoef et al who is the scientific coordinator of MC-ICAM on MC-ICAM's approach to the phasing and packaging of pricing reform.

### **2.2. Developments in EU Policy**

Rees's presentation summarised recent developments in EU policy and, in particular, considered issues relating to financing the building of the Trans European Network (TEN). The new infrastructure financing needs, as well as limited public resources, the issue of accession countries and rail problems due to high costs and poor profitability, were highlighted by the White Paper (CEC, 2001) and financing issues were the subject of a recently launched Communication from the commission (CEC, 2003).

To complete the TENs, an estimated 350 billion Euros was still required. 130 billion Euros were needed for the Essen project alone, 100 billion Euros were needed for the newly associated states and currently, 15-20 billion Euros were invested by the EU.

Major financing needs still remain and sources of revenue need to be found. Rees argued that roads are easier to finance than rail as there are more people wanting to use roads and so greater sources of potential revenue exist. If the policy was to prioritise railways though, then railway financing remains a major challenge. He suggested that public-private partnerships would be the way forward but that there are problems with organisation and with who bears the risks. He commented that he could not see the private sector tackling major projects, as financially only the government was able to do so. However, the private sector could fund less major projects and take the pressure off the government so that the government could fund major projects. Other ways forward would be to stimulate research for solutions for new infrastructure financing and to allow cross financing and favour inter-modal transport.

Rees explained that whilst a great deal of work had been undertaken since the pricing Green paper in 1995 (CEC, 1995), further research and policy action is needed. In particular, further research is needed on infrastructure pricing, on the impact on peripheral regions and on demand elasticity. On the policy side, new tolling systems are being proposed and, specifically in Germany, being implemented and the Commission's road charging policy needs to be revised to keep pace with these changes. Hence, the next step would be the move to a road-charging directive which would be a revision of the current legislation, Directive 1999/62/EC on the charging of heavy goods vehicles, to introduce distance-related charges and provide for system interoperability and the harmonisation of excise duties on fuel for commercial use.

Rees argued that a move forward to a sustainable transport structure will be important to provide a coherent and stable guideline for TEN financing in an enlarged Europe which is consistent with the objectives of the White paper. The consequences for peripheral countries have to be considered and pricing reform needs to be continued.

### **2.3. Practice and Experience in Switzerland**

This paper explains the background to the Swiss Heavy Vehicle Fee (HVF) and how it was implemented. The features of the system and the impacts so far as described, as well as highlighting the lessons learnt.

Balmer began by describing the 20-year process which led to the implementation of the HVF in 2001. Prior to 1984 use of the Swiss road network was free of charge and construction, maintenance and operation were financed primarily from fuel excise duties, vehicle licenses and public contributions. In the early 1980s arguments were put forward in favour of a user fee on the basis of the high uncovered costs of goods transport by road, though it was believed that a distance or performance related fee was not technically feasible. In 1984, people agreed in a public referendum to the introduction of a motorway user permit (a flat fee for private cars for the use of the motorway network) and of a weight-dependent flat fee for heavy vehicles, and these were introduced. The fixed fee was conceived from the outset as a transitional solution until a distance related fee could be introduced and the arguments for introducing a distance related fee became stronger as exhaustive studies proved the substantial external costs of heavy goods traffic and as the technology for the electronic collection of the fee became available. Then, in 1998, people agreed in a referendum to replace the flat fee for heavy vehicles by a distance related (performance related) fee. The fee was agreed to be introduced in several steps and in parallel to the increase of the weight limit.

The rate of the fee was the subject of lengthy negotiation between the EU and Swiss government. The first step was to calculate the uncovered costs of heavy traffic, including uncovered road costs and external costs of air pollution, noise and accidents caused by heavy vehicles (congestion and the greenhouse effect were not considered). Research showed that these external costs totalled 650 million Euros. To this total, the uncovered road costs (10 million Euros) and the amount to replace the flat fee, which was dropped due to the introduction of the performance related fee (90 million Euros) were added, giving an overall total of 750 million Euros.

Then, the total transport performance (measured in tonne-kilometres) was calculated. The corresponding performance for each weight category was calculated and these figures were then multiplied by the average admissible weight in each category. For all classes combined, this gave the figure of 47 billion tonne-kilometres.

The rate was arrived at by dividing the uncovered costs of 750 million Euros by the total transport performance of 47 billion tonne-kilometres, giving the value of 1.6 cents per tkm. The fee varies according to three factors: distance (kilometres travelled on Swiss territory), weight (admissible weight of vehicle and trailer) and the emissions of the vehicle and applies to all heavy goods vehicles with total admissible weight of more than 3.5 tons. The approach chosen for setting the charge level may not correspond to many requirements of marginal cost principles. However it was argued that the HVF achieved some of the policy goals of internalisation and showed advantages compared to fuel taxation.

Two systems were developed to gather the relevant data; one for domestic and one for foreign vehicles. Each domestic vehicle has to be fitted with an on board unit (OBU) which is connected with a tachograph, that enables the OBU to register the kilometres driven. The admissible weight and the emission category are stored in the OBU as well as in the

background system. At the beginning of each calendar month, the data stored in the OBU has to be transmitted to the Swiss Customs Authority (SCA) which is within the Department of Finance, responsible for the administration and collection of the HVF. The data is checked and forms the basis for the calculation of the fee and the billing. For foreign vehicles, an OBU is not mandatory but is available on request. For an unequipped vehicle, the fee is registered by using an identification card at the special terminals for HVF clearance. This identification card is provided upon entering Switzerland for the first time and contains the relevant data such as admission weight and emission class. In order to obtain the distance needed for calculating the fee, the driver has to enter on a form the actual mileage on the tachograph when entering and leaving the country. The fee is paid when leaving the country by cash, fuel credit cards or through an account with the Customs Authority.

The technical side is recognised to have worked very well. The well functioning of the OBU and the lack of delays at the border have been especially critical. Balmer believed that the following factors were important for the successful implementation; the long experience and knowledge of the Swiss Customs Authority on how to implement operational and data processing projects nationwide, the use of a technology that has been used successfully for road user charging before (DSRC) and good project organisation.

Three factors that have been decisive for the political implementation of the HVF are:

- The political deal of introducing the HVF to outbalance the negative effects of the higher weight limit.
- The agreement that up to 2/3 of the revenue from the HVF should be used for projects in public transport, with the remaining 1/3 going to the cantons where it is used mainly for road purposes.
- The link to the polluter pays principle.

The author suggested bearing some facts in mind when considering the impacts of the HVF. These are that the HVF was applied to the whole road network in Switzerland; on average, the HVF is five times higher than the flat fee it replaced; and the fee was introduced simultaneously with an increase in the weight limit, which raises the productivity of road transport which leads to less heavy vehicle traffic on the roads, but it also more or less balances out the higher competitiveness conferred on railways by the HVF.

Balmer explained that the introduction of the HVF led to remarkable changes within road transport. There was a change in fleet composition because in the year before the introduction of the HVF, sales of heavy goods vehicles increased by 45%. Truck owners saved money as new vehicles belong to the lowest and therefore cheapest emission class and the admissible weight of the trucks in the fleet could be better matched to the actual needs of the market. The HVF system led to a concentration in the haulier industry, either through mergers or close of smaller firms. Larger firms were able to manage their vehicles more efficiently and avoid empty runs. In terms of road performance, nationally there was a change to the growth trend as annual increases of vehicles on motorways were replaced by a fall after the change from a flat fee to a performance related fee. In transit traffic across the Alps, the higher weight limit led to an increase in articulated lorries, which was almost outbalanced by a decrease in lighter lorries. This meant that the total number of lorries crossing the Swiss Alps in 2001 was stable and is currently about equal to the level before the HVF. Balmer found that no significant impact could be measured so far on the performance of rail transport. This may have been due to fact that the competitiveness of rail due to the HVF was outbalanced by increased productivity in road transport because of the higher weight limit.

The author showed that before the HVF, the annual net proceeds for the period 2001-2004 had been estimated to be approximately 500 million Euros and to 1000 million Euros after 2005. The actual net income according to the federal account in 2002 was 525 million Euros so the estimates were fairly precise.

Balmer summarised that the main objectives of the HVF were the implementation of the Polluter Pays Principle, promoting the shift to rail and catalyst for Bilateral Treaties. The move from the flat to the performance related fee may give an incentive to drive less, to use lorries not heavier than necessary and with modern emission standards complies with the Polluter Pays Principle. Research by the Swiss Agency for Environment estimated before the introduction of the fee in 1997, that CO<sub>2</sub> and NO<sub>2</sub> caused by heavy goods vehicles would be about 30% lower in 2007 with the new regime. No considerable shift to rail was noticed so far. A considerable shift to rail is not expected until 2005. There has been an increase in efficiency of road transport which moved towards the direction of making goods transport more sustainable. The HVF played a large role in finding out ways of negotiating between Switzerland and the EU about the bilateral treaties. It proved to be on solid ground; two years after the HVF had been accepted, a large majority of the Swiss population agreed to the bilateral treaties, which were also accepted by the EU.

The author believes that the Swiss pricing reform in heavy goods transport was considered to be a success. Successful implementation was due to the solid scientific work to define the level of the fee, and the separation of political and technical implementation. For political implementation, it was necessary to set out clear and understandable targets such as the Polluter Pays Principle, the shift from road to rail and the use of the revenue. For technical implementation, it was necessary to have a simple system, high competence of the authority in charge and cooperation with transport lobbies.

#### **2.4. Phasing and Packaging of Pricing Reform: The MC-ICAM Approach**

Verhoef et al's paper gave an overview of the MC-ICAM project, which has looked at the possible motivations for phased implementation of marginal cost based pricing via a sequence of steps along an implementation path rather than big bang implementation. In particular, they focused on the economic theory relevant for the design of implementation paths and translation of the conceptual ideas developed for practical policy making.

The EC White Paper (1998) proposed the phased implementation of marginal cost based pricing, yet there was little research relating to the design, evaluation and implications of phasing on which to base detailed policy. The goal of MC-ICAM was to develop principles and guidelines related to implementation paths, defining the desired end state by identifying and investigating a broad range of theoretical and practical issues involved. The project encompassed four areas of work: 'Methodological Development'; in-depth analysis of barriers to implementation in urban transport, interurban road, rail, air and water sectors; 'Intermodal Perspective and Welfare Estimation', which aimed to combine the insights from the previous two blocks and develop general principles, actual applications and evaluations of practical implementation paths; and 'Policy Conclusions'.

He first explained that optimal prices will generally change over time independent of phasing. Firstly, due to short run marginal costs – on which prices should be based – converging

towards long run marginal costs, and secondly due to changes in exogenous factors such as inflation.

Phasing is required because there are barriers and constraints on 'big bang' implementation. MC-ICAM has defined barriers as typically exogenous factors that limit the regulator's possibilities to perform the most desired policy. A barrier is relevant when it causes a 'constraint' on the policy options for the regulator. In transport pricing, it prevents the regulator from being able to set all the prices at the levels it would like to set them at. There is a causal relationship between barriers and constraints. One barrier may cause multiple constraints and one constraint may result from multiple barriers.

MC-ICAM considered the main barriers to be:

- 1) Institutional and legal barriers.
- 2) Technological barriers; and
- 3) Acceptability barriers.

Barriers are relevant if they cause constraints on pricing and MC-ICAM distinguishes between constraints on coverage and scope of the pricing system, composition and level of pricing measures, degree of differentiation of pricing measures, rules and principles governing revenue use and use of supplementary non-price measures. Verhoef et al explained that the existence of constraints on pricing means that welfare is maximised by the regulator using second-best policies in such a way that the constraints are satisfied in the least distortive way. It is then possible to identify an implementation path, defined as a sequence of second-best equilibria, along which constraints change over time as the underlying barriers gradually erode or are removed in discrete steps. A phase is defined as the time period during which there is no change in constraints.

The authors explained that the theory of second-best transport regulation can be used to design the optimal policy, given the constraints applying during each phase. The difference between first-best marginal cost pricing and second-best marginal cost based pricing is highly dependent on the nature of the constraints applying. In any event, a strong case for 'policy packaging' arises, as in isolation, the second best pricing instruments may lead to efficiency losses, but in combination they may be capable of achieving a full set of incentives given by a first-best pricing scheme. However, the rules and information requirements for optimal second-best pricing are more complicated than those valid under first-best conditions.

The authors explained that MC-ICAM constructed a cost-benefit analysis framework that was capable of assessing second-best pricing reforms proposed by the theory, included efficiency as well as equity concerns, was implementable for the models that were to be used in the case studies of MC-ICAM and was able to assess implementation paths. The main principles underlying the use of the assessment framework are: define the time horizon and geographic scope of alternative pricing proposals, construct a reference and an alternative pricing equilibrium that are feasible, construct an optimal pricing alternative (first-best benchmark) and test the reliability of the conclusions of the assessment.

The effects of pricing reform to be included in the framework are the user benefits, producer surpluses, public revenues and expenditures, external costs, effects on other markets and investment and implementation costs.

The authors state that a transport pricing reform project leads to a change in the utilities of current and future generations that should be assessed through a social welfare function. The social welfare function is the objective function used for the ranking of alternative pricing policies by the decision maker.

The paper explains that an imaginary implementation path goes through three intermediate phases before an optimal end state is achieved. At each phase, a specific set of barriers exists, that creates specific constraints on the pricing and revenue use policies that can be implemented; the barriers and constraints will be removed over time. At each stage, the regulator tries to apply optimal second-best policies that respect the exogenous constraints, implying a certain equilibrium with an associated social welfare level which can be interpreted by comparing it to the welfare that would apply in the absence of the policy and the welfare that would apply under first-best policies during that phase. For the optimal design of an implementation path, an important issue is the determination for each phase, of the best policies among other possibilities that would satisfy the constraints applied during that phase.

Verhoef et al concluded the paper by stating that implementing marginal cost based pricing in transport is a difficult matter. There was little literature on the design and consequences of implementation paths, and MC-ICAM was an innovative attempt to examine these issues.

## **2.5. Discussion**

The discussion quickly turned to the recently implemented London congestion pricing scheme and whether this could be seen as an appropriate step on the implementation path. The end goal should be economic, but in reality it may actually be political. The design of the current scheme could have drawn from second best theory, but it was not clear that it was. Issues that need to be considered are what is the optimal area? What is the optimal price? Why £5.00 rather than £5.50? If the scheme was successful, it opened up the possibilities for extension and refinement.

It was argued that movements along the implementation path, which went in the wrong direction at a particular step, had to be avoided. A useful benchmark would be the first-best situation as the end state. This would help to evaluate whether you are moving in the right direction.

The question was raised as to how do you know that a constraint is a constraint, rather than something you should be changing? How do you know when the constraint is ready to be moved or whether it should have been moved earlier?

In summary, the strength of the second best approach to design of implementation paths was recognised, but naïve application was to be avoided. Constraints should not be accepted unless it was clear that they could not be overcome, and moves which took prices in the wrong direction relative to the desired end-state had to be carefully considered.

### **3. Implementation in practice – key issues for rail, air and water**

#### **3.1. Introduction**

This session is dedicated to infrastructure charging in transport modes other than road. This section is organised by looking at the two papers presented and will be concluded with a discussion. The first paper covered work undertaken by MC-ICAM and looks at marginal cost pricing in rail, air and water. The second paper looks at the Hungarian railway infrastructure charging system.

#### **3.2. Barriers to reform**

In this paper, the authors Adler, Nash and Niskanen (key members of the MC-ICAM consortium) explore the appropriateness of marginal cost pricing in rail, air and water. They look at the views found in the literature, the current status of these three modes and the barriers, which may stand in the way of implementing marginal cost pricing (MCP).

The major drivers behind the pricing policies in transport are to improve efficiency and to generate revenues. It is important to ensure that although price levels can be different across countries, they should be computed by similar methods across countries and modes. The three modes are at different stages of implementation of MCP of infrastructure. Rail is probably the most advanced and waterborne transport is the furthest away from potential implementation. Significant barriers and constraints exist that may prevent or delay the implementation of MCP. These barriers include institutional, legal, technological and acceptability related issues.

The authors explain that the economics literature has led to two approaches in achieving MCP; through a competitive equilibrium given constant returns to scale and through state ownership and control or regulation given a natural monopoly. However neither may be realistic as the range of output over which technology exhibits increasing returns to scale can fall short of total industry output, resulting in an oligopoly. On the other hand, it is possible for governments to attempt to implement MCP regardless of the technology and nature of returns to scale, but acceptability may be an issue.

An argument in the literature is between short run and long run MCP. The two are equivalent at optimum capacity but issues arise when capacity is non-optimal. Short run MCP is seen as offering optimal use of existing capacity, whereas long run MCP offers appropriate incentives to invest, although it may require regulatory action to ensure that the investment takes place.

The authors found that there was little literature discussing efficient pricing in rail, air and waterborne transport compared to road. The issues relating to the implementation of pricing for these modes are very different from road pricing as they are network-based, with stations, airports or ports, and may consist of a hub-and-spoke network. Furthermore, transport services are provided by a limited number of specific firms, which differs from the road sector with atomistic infrastructure users.

It is often believed that the infrastructure construction and maintenance are the natural monopoly elements of transport networks, whilst the competitive equilibrium model may be applicable to transport operators using the network. However this may be too simplistic, as

whilst there is potential for competition between shipping lines and airlines the promotion of on-track competition between rail operators remains problematic.

The literature on rail pricing is more extensive than air and water. And in recent years there has been a closer focus specifically on rail infrastructure pricing. Important areas that were considered were the conflicting objectives of infrastructure charges including the efficient use and appropriate incentives for development, promotion of competition, cost recovery and measurement of marginal social costs including wear and tear costs, accident and environmental externalities as well as noise, congestion and scarcity charges. Various second-best pricing approaches were considered which seek to reconcile these objectives, including Ramsey pricing and two-part tariffs. For air transport, a lot of research has focused on congestion based charges for airports to replace the weight based charges. However, none of the ideas have really been implemented as administrative allocation techniques were introduced instead. There has been greater interest over the past five years by the EC, which has fuelled research on both pricing and externality charges in this area. There is not much literature about pricing let alone MCP in waterborne transport and the general consensus appears to be that this is a very under-researched area.

The current pricing practices in the three modes are very different between themselves and across other countries in Europe, partly due to different institutional arrangements regarding ownership and regulation. The EC's existing directives on rail focus on MCP whilst the directives on air and water transport seem to emphasise total cost recovery rather than marginal social cost pricing, perhaps due to the issue of preventing the use of state aid to give unfair competitive advantage. Waves of major reforms have occurred in the 1990s in the rail sector, including actions and measures both on EU and national levels.

A key issue relevant to all three modes is the involvement of the private sector versus the responsibilities of the public sector in the provision of transport infrastructure and services. The case for privatisation of airports, ports and rail track infrastructure are to avoid x-inefficiency and to provide private funding of investment. However privatisation may lead to monopoly power. The role of privatisation is a very controversial issue. Matthews and Nash (2002) argued that MCP would be easier to implement where rail infrastructure was in public ownership, as in Sweden. However Adler and Berechman (2002) argue that airports should be privatised.

Rail infrastructure pricing was found to be very variable. Charges were based on a variety of different schemes in different countries. Only Sweden explicitly includes environmental costs within its tariffs and only Britain estimates and includes congestion costs in its tariffs. No country includes pure scarcity costs.

To make train operating companies pay for some of the costs of infrastructure, the authors believed that two solutions were popular; two-part tariffs and Ramsey pricing.

Airport pricing currently includes many types of fees such as landing fees, passenger departing fees, air traffic control tariffs, parking fees and freight loading/unloading charges. Some airports implement additional peak charges which are currently very low, some have implemented additional night tariffs and noise related tariffs. Switzerland and Sweden have implemented aircraft engine emission charges. However no congestion or scarcity charges have been put into practice. A potential method for promoting the efficient use of airport capacity was suggested to be through the pricing of slots which are currently allocated for free

via 'grandfather rights'. As most airports in Europe were publicly owned, there are often significant political issues influencing any proposals relating to pricing.

The authors consider that current port pricing in the shipping industry is based mainly on empirical intuition and past trends. Port pricing today differentiates between the following criteria; vessel types and destination, location of operations in the port territory, total time of service use and season. However it is believed that these tariff levels do not reflect the actual costs levied by the port operations and they do not recover costs, thus creating severe inefficiencies such as congestion as well as sources of financial loss. Due to the different conditions under which major and short sea shipping ports are working, some ports suffer from over capacity whilst others are lacking in infrastructure.

The key barriers to implementing efficient cost-based pricing are different in rail from air and waterborne transport. This may be because directives already exist requiring MC based pricing for rail infrastructure and a start has hence been made in most countries. The other modes have not yet implemented such policies and are pushing towards long rather than short run MCP.

The common key barriers to the implementation of marginal social cost pricing in the rail sector are:

- governments are unwilling or unable to provide necessary subsidies
- failure to provide correct incentives for investment
- anti-trust problems related to small new entrants
- absence of strategy at European level to encourage and secure efficient pricing and competition across modes
- problems of measurement

The key barriers in air and water transport appear to be:

- lack of transparency involved in the entire charge-setting approach
- lack of harmonisation of pricing principles across different countries within the EU
- the power of monolithic countries to prevent change
- the lack of interest of airports and ports in collecting additional data that will be required to accurately charge new tariffs
- current difficulty of computing delay data, and scarcity data is not considered at all.

The authors suggest the following ways forward for the different modes of transport. For rail, further progress depends on research to improve cost estimates, particularly for congestion and scarcity costs, and progress with the implementation of marginal social cost pricing on other modes. Immediate charging for infrastructure maintenance and renewal should be implemented, but charging for congestion, scarcity and environmental costs will be medium to long run developments. If privatisation is pursued, then it is necessary for regulation or franchising to ensure marginal social cost pricing is used.

For air and water, the appropriate policy steps would be:

- To encourage free competition for end users
- Either continuation of state or regional-owned ports and airports, with greater transparency in order to set tariffs at marginal social cost levels, or privatisation of ports and airports with

price capping or regulation setting infrastructure charges through an independent administrative body.

- Imposition of taxes, e.g. on fuel, to reflect other externalities such as noise and air pollution. Privatisation may be a possibility for airport infrastructure in the medium or long term. Market mechanisms for slot allocation to account for scarcity and congestion require more theoretical analysis, data collection and agreement at the EU and national levels, therefore will be decided in the longer term.

### **3.3 Railway infrastructure charging in Hungary – Key implementation issues**

The main part of the paper by Tanczos and Farkas (Budapest University of Technology and Economics) presents the structure of the infrastructure charging system implemented in the Hungarian Railways. The directives of the EU have to be taken into account when making decisions about the Hungarian railway reform. The infrastructure charging system should comply with the directives of the EU (2001/12, 2001/14 EC) of non discrimination, marginal cost coverage and international comparability. The charge will become effective on the day the law pronouncing the international contract on the accession of the Hungarian Republic to EU comes into force.

The infrastructure charging system entails reshaping the financing model of railway companies and Infrastructure-Managers (IM) to establish a new system of budget funds that allowed railway operators to pay for infrastructure charges. When deciding the level of the charge, it has to be considered what is being charged in the neighbouring countries. Estimation of the costs needed for a certain level of quality under given circumstances in transport policy is needed. The different needs of passenger and freight transport towards infrastructure need to be considered.

The Hungarian infrastructure charging system is based on a two-tier, two-part model. The essence of the two-tier system is that the infrastructure charge is the total sum of the basic charge and the charge for the services utilized. The charging system consists of two parts because the basic charge includes a fixed and variable charge. The fixed charge considers the number of trains or train paths and depends on the train type (long distance passenger, short distance passenger and freight.) The variable charge considers the provision of running the train and depends on line category (advanced line, normal line and local line.) The authors believe that the implementation of this charging system is seen to promote a social sharing of burdens between the actual users of the infrastructure and taxpayers when reimbursing the costs of the infrastructure manager.

The basic infrastructure charge considers the direct costs; access charge (fixed part) and the charge for the running of the train (variable part.) Besides the fixed and variable parts (first tier), charges for additional services and ancillary services are calculated in the second tier. The two-tier system also contains mark-ups, discount and compensations. The fixed charge covers the general costs, which are not directly related to traffic or performance. This element of the charge is to cover the costs incurred by providing the train path and amounts to the cancellation fee. The variable part is calculated from the costs related to traffic control, maintenance and wear and tear elements.

Other costs, which are drivers for the charging system, include costs of catenary and substations, costs of passenger trains stops, costs of passenger trains at stations where trains reverse directions, marshalling costs, costs of serving of trains and routing (running) costs.

New bodies will need to be set up in order to implement the infrastructure charging system. An allocating body independent of the railway undertakings will handle requests for capacity, allocation of capacity and train paths. This body or a charging unit will carry out the development and calculation of the charges. A separate authority has to be created for issuing permissions and safety certificates for railway operators. The authority responsible for regulation and appeals will handle operator's complaints regarding the allocation of infrastructure capacity and the charging system.

The authors believe that this new infrastructure capacity market may lead to the railway sector operating in a more transparent way, a more efficient use of budget resources and a growth in competitiveness with other modes.

The capacity allocating body has to ensure the optimal use of train paths. The infrastructure charge as a market regulating instrument enables the railway operators to operate on a market basis and makes the calculation of profitability of passenger and freight transport an objective. The charging system is said to help locate bottlenecks and weak points on the infrastructure and justifies the decisions about rationalization, modernization, development and closure. In order to achieve effective operation on an international level, harmonization of capacity allocation and charging systems and the establishment of a transparent and uniform process is needed.

The authors state that the existing cost calculation methods of the Hungarian Railways could be improved with using the marginal cost theory. But the 'pure' usage of the marginal cost approach may not be a good idea due to its barriers and practical difficulties. However the construction of a new 'account based marginal cost approach' is aimed to use all the possible benefits of the marginal cost theory while eliminating its drawbacks.

The charges are imposed on state railways but the question is who would get the revenue. The authors believe that the infrastructure company should get the revenue and use it to maintain and operate the infrastructure. Naturally the government may decide to obtain this revenue.

### **3.4. Discussion**

Following the presentations of the papers, there were two discussants; David Niven-Reed from UIC and Lars Hellswik from the Swedish Ministry of Transport.

David Niven-Reed began by discussing the appropriateness of the use of the concept of barriers, as this implies that we could go forward if only we could overcome these barriers. He questioned whether marginal cost pricing is actually appropriate in rail, air and water modes and, hence, whether we need to be concerned about supposed barriers. He also challenged the existence of scarcity in the railway sector, arguing that since rail was a network system, scarcity could be kept at bay at the timetabling stage if the system could handle the pressure correctly. However, it was highlighted by others that the scarcity issue relates to identifying the best way of handling that pressure - resolving competing demands for timetable slots – and that there is not an agreed correct way of ensuring that the system

does this. It was also highlighted that even if scarcity is dealt with at timetabling stage, there may still be the possibility of congestion later on (defined as expected delays resulting from the transmission of delays from one train to another).

Questions were raised as to whether the organisation implementing rail infrastructure pricing should be commercial or non-commercial, what should the nature of the charges be and what should they include? Part of the answer to these questions was a further question as to how much funding governments are prepared to put into the rail industry given that marginal cost pricing would not fully cover infrastructure costs. In Sweden, the approach has been to charge very low charges based on short run marginal cost, though this is politically unacceptable in many countries as it leaves a large chunk of infrastructure costs which have to be covered by the government.

A clear view of the objectives for rail is needed in order to develop a charging regime but Lars Hellsvik discussed that there were a range of conflicting objectives. He suggested that the only way to overcome this would be to set up a comprehensive framework covering all modes, as done in the Nordic countries. This includes what the role of society should be when deciding upon infrastructure charging. Initially the Nordic countries tend to take the view that the mix of infrastructure is a decision taken by society. He believed that even if there were private organisations, they could work within such a framework but there was no escape from public sector responsibility and political influence.

To address scarcity issues in the allocation process, Hellsvik said that the willingness to pay should be measured as well as possible, and the charge should be at a level that was the closest to the operator's willingness to pay. Auctions were highlighted as a possible means of identifying willingness to pay but the questions of how you optimise the use of existing infrastructure and what the right level of infrastructure is were left open.

Three issues seemed to generate some confusion: firstly, the term marginal cost pricing seemed to be interpreted differently by economists, accountants and commercial managers; secondly, the concepts scarcity and congestion appeared to get confused with one another; and thirdly, whilst it was agreed that Ramsey Pricing was an important concept, there was confusion as to the degree to which it is a form of marginal cost based pricing, rather than an alternative to it.

## **4. Implementation in practice – key issues for urban transport and inter-urban roads**

### **4.1. Introduction**

The issues surrounding road pricing and the relevant barriers and constraints were considered in this session. The first paper seeks to identify implementation paths for road pricing in urban transport and on interurban roads, and the second paper considers the experiences of road pricing in the US and Canada.

### **4.2. Implementation paths for urban transport and inter-urban roads**

Niskanen's paper tried to provide an overview of the barriers to marginal cost based road pricing in urban transport and on inter-urban roads, and it tried to identify implementation paths for marginal cost pricing given the identified barriers. The paper sought to distinguish between barriers and constraints to pricing and concentrated on technological and institutional barriers; acceptability related barriers were recognised to be very important but were not discussed here as they were the focus of another session of the seminar.

The author identified technological barriers to marginal cost pricing. Technology for road pricing (GPS-based electronic road pricing) did exist in principle, but it was not widely tested and was believed to be too expensive and risky to be fully implemented, at least in the short run. Existing technology for road pricing was found not to fully price differentiate between different time periods, different vehicles and different geographic areas. Interoperability was seen as a problem in inter-urban road transport due to HGVs in cross-border transport. Practical barriers were that the spatial structure of urban road networks was usually very complex and there was a problem with the availability of reliable cost and other data and transferability of marginal cost and other estimates. Technological and practical barriers were seen to persist in the application of marginal cost based pricing in its full scale and with full differentiation in the short-run, but full-scale application may be possible in the medium and long run. Technology could be introduced in steps; in a smaller scale in the short-run and gradually increasing the scope and degree of differentiation in the medium and long run.

The legal and institutional barriers were identified. European approaches to urban transport and inter-urban road transport policy were found to be very different. According to the subsidiarity principle in urban transport pricing, the responsibility was with mainly local and national authorities. Policies could be pursued without taking into account the EU's plans, which could act as a barrier to effective, co-ordinated implementation of European transport pricing policy. A barrier to marginal cost pricing in inter-urban road is the lack of a common European strategy or framework. A key barrier to inter-urban road pricing was the lack of European laws being adequate to permit kilometre based charging. The current EU legislation was argued to be insufficient and contradictory.

In terms of policy objectives and supporting legislation at a national level, the following barriers were identified. Although promoting efficiency was economically a major goal of marginal cost pricing, there was a predominance of other goals in national, regional and local transport policy-making and the user/polluter pays principle was often ignored. In many

different countries throughout Europe, there is a lack of sufficient supportive legislation to permit or facilitate road pricing and the lack of laws to enable price differentiation.

The implementation of marginal cost based pricing was believed to require co-ordination and co-operation by multiple organisations; both government and non-government. However there were many barriers such as the lack of co-operation between neighbouring cities and communities, and between governments and private institutions and lack of co-ordination between local and national government bodies with different objectives and responsibilities. Integrated multi-modal urban transport pricing policy may be worked against if the management of modes in urban and inter-urban roads was in the hands of separate agencies and the number of administrative levels involved in formulating and implementing pricing policy is a problem, as the greater the number the greater the legal and institutional complexity. Supply and operation of private non-residential parking and public transport services was outside direct government control and Public-Private-Partnership (PPP) for producing and running infrastructure in an interurban road context reduces the potential for marginal cost pricing.

Legislation and policies in other areas and sectors impose constraints and affect the policy objectives of road transport pricing. Barriers include laws in many countries that could obstruct or prevent direct changes for road use. These laws may be related to fiscal taxation or basic national constitutional rights such as freedom of access and movement, privacy needs and civil liberties. Another barrier is the contradictory legislation and policies related to fiscal taxation.

In terms of stakeholder and interest groups, barriers to marginal cost pricing were identified as the opposition by non-governmental stakeholder/interest groups due to the asymmetry between winners and losers, indirectness of benefits compared to costs and the exaggeration of losers, and another barrier was the interdependence between the low socio-political acceptability and the legal and institutional status quo as most legal and institutional barriers could potentially be removed at national levels given sufficient socio-political acceptability (political will) existed.

The author explained that there were many legal and institutional barriers to implementation of marginal cost pricing, but as with technological and practical barriers, these barriers alone could not be a realistic reason for preventing road pricing. Political will could change legislation and institutional structures and a real issue may be the lack of political will. Therefore acceptability related barriers were believed to be the reason why road pricing and especially marginal cost pricing both in urban and inter-urban road transport are so rare.

The paper discussed how the barriers implied constraints on what the government could implement in the short, medium and long run. These barriers may be eased over time, which leads to the idea of a phased approach to the implementation of marginal cost pricing. Directions for potential implementation paths for marginal cost based pricing, given the identified barriers and constraints and their likely development over time were highlighted in five key policy areas as explained in table 1.

Table 1

	<b>Short term</b>	<b>Medium term</b>	<b>Long term</b>
<b>1. Urban Road Pricing</b>	area based charges including cordon tolls, in central urban areas and on weekdays, simple technology used but ensured that it is compatible with plans for more sophisticated technology in the future	distance-based electronic road pricing (ERP) replaces area based charges, pricing still restricted to central area and weekdays, ERP non-differentiated (same for all vehicles) and GPS-based, charges gradually moving towards pricing relevant marginal social costs	distance and GPS based ERP on all urban links and at all times, ultimately charges according to full marginal social cost based differentiation
<b>2. Urban Parking Charging</b>	publicly controlled parking fees by location and time, and increased where necessary to cover induced costs	publicly controlled parking fees more disaggregated by location and time, increased public control of private parking by fees and other conditions	publicly controlled parking fees fully disaggregated by location and time, also the case for private parking where possible, parking charging technology ultimately integrated with GPS-based ERP system
<b>3. Urban Public Transport Pricing</b>	public transport fare structures and subsidies adjusted according to second-best principles to be in line with area-based charges for cars, application of smart card technology	further adjustment in public transport fares and in public transport subsidies as distance based ERP is phased in, smart card technology integrated with technologically concurrent road pricing system	public transport fares and subsidies fully adjusted and smart card technology integrated with concurrent GPS-based ERP system, information systems indicating fare structures for passengers

<b>4. Inter-Urban Road Pricing</b>	distance-based kilometre charges for heavy goods vehicles (HGVs) in certain countries which may in some cases need to be compensated by reductions in other taxes, no differentiation within country by time or space, in other countries current system of Eurovignette or no road charging continues, tolls on certain roads with specific congestion or financing problems	distance-based charges for HGVs throughout Europe, most likely through technologically standard GPS-based ERP system, tolls on specific roads more common and differentiated by time of day, charges gradually moving towards pricing relevant marginal social costs	full GPS-based ERP phased in – distance based road pricing on all European inter-urban links for HGVs, road public transport and private vehicles, charges ultimately according to full marginal social cost based differentiation
<b>5. Fuel Taxation and Vehicle Licences</b>	fuel tax and vehicle license reductions may be needed to compensate for the introduction of kilometre charges	fuel taxes gradually reduced, as distance based ERP is phased in, vehicle licenses gradually reduced as is phased in	fuel taxes cover CO <sub>2</sub> emissions costs only, vehicle licenses further reduced, in some cases to zero

In each case simple short term measures such as cordon pricing in urban areas or simple kilometre based charges for heavy goods vehicles were identified which could be gradually refined over time to lead towards full marginal social cost pricing.

The author concluded the paper by suggesting that policies should be set on an aggregate level. They could then be formulated for the different countries and parts of Europe allowing for local or country specific differences and features. Road transport pricing should not be considered as an isolated issue but as part of a broader transport, economic and social system. Implementation of road pricing and marginal cost based pricing has been slow. This may be due to marginal cost pricing being considered as a radical and controversial policy, and political structures may be against it as it involves lengthy implementation paths when they need comparatively quick results.

#### 4.3. Road pricing issues and experience in the US and Canada

Robin Lindsey, a leading North American economist, based his paper on the developments and history of road pricing in the US and Canada. The aim was to draw lessons for phasing and packaging of urban and interurban road pricing reform that may be valuable for the EU.

The three barriers (technological and practical, legal and institutional, and acceptability barriers) to implementing pricing reform as identified in project MC-ICAM were discussed.

(i) Road Pricing in the US

- There has been a predominance of fuel tax - The Highway Trust Fund was set in 1956 to finance federal interstate highway networks and to support other federal highway projects, through taxes on fuel, tires, truck sales and heavy-vehicle use.
- Toll roads prior to Value Pricing: there is a long history of toll roads. States and local governments found toll financing of roads appealing due to many reasons such as seeing it as a way to accelerate road construction, an additional source of funding during periods of financial stringency, to avoid expenditure constraints imposed by revenue sharing formulas of the Highway Trust Fund, sticking to the user-pays principle by raising money from immediate beneficiaries, and to reduce demand for roads.
- Value Pricing Pilot projects: congestion pricing demonstration projects failed in the 1970s but road pricing has now achieved more respect due to the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) and the 1998 Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21). TEA-21 allowed the Value Pricing Pilot Program to fund innovative road and parking pricing measures for alleviating congestion, and permitting tolling on Interstate highways. Projects on pricing on existing free roads (11 projects; 5 on high occupancy toll (HOT) lanes, 1 FAIR lane and 1 Cordon), on new lanes (6 projects; 5 on HOT lanes, 1 queue jump), on toll roads (7 projects; Turnpikes), parking and vehicle use (5 projects; 1 on cashing out of free parking, 1 variabilisation of fixed costs and 1 mileage based insurance), and other pricing proposals (2 projects) were considered.

The barriers framework of MC-ICAM was used to determine how US road pricing should be phased in, as explained in Table 2.

Table 2

<b>Technological and practical barriers</b>	<b>Legal and institutional barriers</b>	<b>Acceptability related barriers</b>
<ul style="list-style-type: none"> <li>• <u>Pricing technology</u>: electronic tolling and other technologies (such as GPS-based) overcome technical barriers to more direct and efficient charges for either road use or other costs of driving such as parking and insurance.</li> <li>• <u>Urban form</u>: most of the value pricing projects in North America are of limited-scale and address local congestion hotspots unlike Europe where road pricing is based more in large cities. The author</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Parking pricing</u>: two reasons may explain why parking is under priced in the US. Firstly, employers may provide free parking and secondly, minimum parking requirements inflate the supply of parking and leave it under priced at the margin.</li> <li>• <u>Regulatory changes</u>: Subsidiarity principle and harmonisation are important in both EU and North American transport policy. Multiple regulatory changes going beyond pricing are required as a package to make toll truckways possible.</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Equity</u>: road pricing may make poorer households worse off but this concern has been addressed by implementing pricing on new traffic lanes and facilities giving travellers the choice between quicker and more expensive trips and free alternatives. Road pricing may allow individuals to travel faster when their value of time is high.</li> <li>• <u>Time variation</u>: a common view was that</li> </ul>

<p>believed that ‘road pricing may be more spatially concentrated and extensive, in Europe than in North America.’</p> <ul style="list-style-type: none"> <li>• <u>Interoperability</u>: toll roads do not have to use identical technology but there are economies of scale in regard to the fixed costs of ETC systems and smartcards, and it is cheaper and more convenient for users if transactions were carried out with one system.</li> <li>• <u>Problems in calculation</u>: computing second-best prices was found to be difficult. Getting the correct prices may be difficult due to inability to estimate demand elasticities, externality costs etc. There are various price distortions that leave automobile travel severely under priced in the US, therefore there was found to be little risk in taking initial steps towards raising prices.</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Private sector involvement</u>: arguments in favour of private roads are that the profit motive acts as an incentive to control costs, greater incentive to price congestion and private roads serve as a benchmark for evaluating the efficiency of public toll road counterparts. However regulation is needed to curb monopoly power. Two regulatory models have been used in North America; rate-of-return regulation allows operators to implement time-of-day pricing freely and toll-regulation with maximum tolls determined by traffic levels and an inflation index provides users with assurance about future toll levels.</li> <li>• <u>Comparison with the 19<sup>th</sup> century</u>: new roads were found to serve relatively few individuals but paid for by many, this issue could be alleviated in an immature road network by a package deal where roads serving diverse communities were approved at once, but may not be feasible today. Non-compete clauses on the sparse road network were unnecessary in the 19<sup>th</sup> century due to little competition.</li> <li>• <u>Time frame for legislation</u>: legal approval of road pricing may be easier to obtain if it is implemented on a temporary basis to alleviate a particular problem or if it is subject to a periodic review.</li> </ul>	<p>prices should vary infrequently or not at all, but many value pricing projects involve peak/off-peak time differentials. Initially there was strong opposition from focus groups regarding responsive pricing, but now it is widely accepted as it achieves a better balance between peak and off-peak periods.</p>
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The author pointed out that many US academics believed road pricing would never become widespread in the US. State authorities and capital markets may need more experience and confidence with private sector financing and operation before the existing public sector highways could be handed over to the private sector. For congestion relief in the long run, pricing of roads and parking may be effective, but new technology and capacity expansion are appropriate for the short run. Economic factors such as the business cycle may interrupt road pricing on the US road network.

## (ii) Road Pricing in Canada

Key features are:-

- Roads mainly financed by general and property taxes, most fuel taxes are allocated to a general fund
- Overall road users receive a small subsidy and the extent of user-pays varies by province as a function of traffic volumes and road construction costs
- The motivation for tolling was similar to the US, but weaker in Canada in the following areas: greater commitment to public funding, less traffic and congestion, less opportunity for evading provincial taxes and no formal funding mechanisms.
- Of the 19 tolled facilities, electronic tolls are collected on only 5.
- Establishment of urban transportation agencies, which have authorisation to include public transit as well as roads and powers to raise revenues through new charges on motorists. In addition to these, major cities have planning agencies.
- In the last decade transportation policy had been the subject of 3 major federal studies: 1992 Royal Commission on National Passenger Transportation (major recommendations included user pays, subsidiarity, equity across modes, fuel tax revenue earmarked to roads, phased implementation), 1993 National Transportation Act Review Commission and 2001 Canada Transportation Act Review (examined 3 financing arrangements for roads through road funds, urban transportation agencies and toll roads).

The barriers to road pricing in Canada are explained in Table 3.

Table 3

<b>Technological and practical barriers</b>	<b>Legal and institutional barriers</b>	<b>Acceptability related barriers</b>
<ul style="list-style-type: none"> <li>• Similar to the US.</li> <li>• Interoperability of user charging technology is desirable between both provinces and territories in Canada and also between Canada and the US.</li> <li>• It is believed to be unrealistic to expect seamless integration due to differences between the countries.</li> </ul>	<ul style="list-style-type: none"> <li>• Private sector plays a prominent role in US road pricing but this is not clear in Canada, partly due to its strong tradition of state provision of public and semi-public goods.</li> <li>• British Columbia Ministry of Transportation 2003 set out guidelines for tolling of facilities that have private sector involvement in financing, delivery or management. In general, the guidelines were consistent with the user-pays principle and may gain political acceptability.</li> </ul>	<ul style="list-style-type: none"> <li>• Government policy has been driven by other goals that conflict with efficiency.</li> <li>• A goal is the alleviation of regional disparities as transportation costs may create geographical price differentials causing real income differences between regions.</li> <li>• It was suggested that an increase in the cost of transport in Canada might be regressive.</li> </ul>

The paper concluded that the experience of road pricing in US and Canada provided both lessons and questions regarding the phasing and packaging of road pricing reform. Existing policies differed across state and provinces with respect to jurisdiction size, urban structure, road network geometry, congestion level, proportion of non-resident traffic, sources of transit funding and history of toll roads. There has been a dominance of facility-based pricing, and private sector participation has been important for road pricing. A need was seen for packaging road pricing with travel demand management policies and transit investment to facilitate capacity for modal shifts from private vehicles. Interoperability of technology was regarded important both between states and provinces, and between Canada and the US. There seems to be a lot of scope for differentiated pricing in terms of weight, distance, time of day, insurance premium rates and value of service pricing. The author believed that there was more potential for widespread road pricing in the US than in Canada. Canada has relatively fewer roads that have sufficient traffic to call for tolling, but an important distinction is that Canada has accepted the Kyoto Protocol whereas the US has not and following through its commitment, this will act as a force for Canada to reduce automobile travel possibly through road pricing.

#### **4.4. Discussion**

The discussion session addressed many issues.

Congestion reduction and financing were key issues in US interurban road pricing. Highway 407 in Toronto would have taken 20 years to implement as a public project but only took 4-5 years as a private project.

The discussant Tretvik said that he did not find differentiation between the barriers and constraints helpful and technological barriers to universal implementation were so severe that a top-down approach may never work. At the specific road pricing scheme level, there was the need to find the right package to achieve political acceptance.

The discussant Eliason explained that the Stockholm 'test' will be implemented in late 2004 and a referendum will be held in 2006. Tolls were not initially part of the package but were implemented later in a short space of time, which led to mistrust among stakeholders. The legislative and political framework was unclear; there was debate over who pays and who receives the revenues. Eliason believed that a general problem with the phased approach might be that if the decongestion benefits are too small from an initial simple scheme, road pricing may be abolished once again.

A question that was raised was 'what should be the EC's next step?' It was considered that more research into implementation paths was needed. The EC appeared confused- what was happening at country and city level was independent of DG TREN. The reality was argued to be that the EC was looking at pricing only on interurban roads and for financing purposes. Cities were found to be supportive of demonstration projects and this should continue. There should also be an attempt to create projects with more participation from local politicians, such as the EUROPRICE project.

The point was made that it was important to take advantage of the 'windows of opportunity' to implement some schemes, and a discussion was raised into what to do. It could mean doing demonstration projects and value pricing. If the projects are a good idea, they will accelerate and become self-sustaining. If they are a bad idea, they will 'grind into the sand.' Eliason

believed that the legislative issue was the most serious issue. He commented that the EC draft directive on electronic fee collection risks abandoning simple schemes like Oslo. Furthermore, the EC had to do something to make it easier for cities to assure stakeholders of the benefits and revenues they will receive, given that lack of trust has been identified by acceptability research.

An issue was raised that jitney projects in the 1960s all failed because they were too small scale. This led to the question 'are many small or few large test projects better?' It was considered that a task for the EC given subsidiarity was to disseminate the results of road pricing so far. The UK is now at a point where it could consider the possibilities of implementing road pricing elsewhere in the UK following London.

## **5. Implementation paths in practice – inter-urban modelling results**

### **5.1. Introduction**

This section looks at two papers, which considered the interurban modelling of pricing reforms from various case studies and models. The first paper looked at the modelling results found by MC-ICAM and it focused on a phased approach. The second paper considered the role of equity and efficiency in transport pricing to determine acceptability. A case study looking at replacing the current charging system in Belgium with marginal social cost pricing was discussed.

### **5.2. Marginal cost pricing implementation paths in interurban transport – Evaluation of welfare effects**

The paper by Henstra et al (the leaders of the inter-urban modeling work in MC-ICAM) focuses on interurban modelling and presents the results of modelling case-studies carried out in the MC-ICAM project, which focused on phased approaches to implementation of marginal cost based pricing. The objective of the modelling was to compute the welfare effects related to implementation steps and in relation to all major interurban modes. Five major case studies were carried out, each using a different model:

#### 1) Optimal road freight taxes given constraints in the rest of the economy (KUL1 model)

- The objective was to determine the optimal pricing reform of road freight transport given pricing constraints for the rest of the economy
- Three types of pricing constraints were considered: imperfect pricing of passenger transport, existence of labour taxes and the possibility of taxation on freight intensive consumer goods
- A general equilibrium model was built that focuses on the derived effects of road freight taxation on the other distorted markets

#### 2) Pricing of road freight under tax competition (KUL2 model)

- The objective was to experiment with the pricing of road freight transport when road hauliers take different routes and different governments tax the routes, and explore the potential problems associated with the introduction of road pricing for trucks. Interaction with other modes was ignored and focus was on the road freight market
- A partial equilibrium network model was built where one government taxes part of the network and other governments tax other parts

#### 3) Interurban freight transport in the Netherlands (SMILE model)

- Analysed implementation paths for marginal cost pricing of freight transport
- Analysed the impacts of economic developments, international trade and logistic behaviour via different modes on the transport flows in the Netherlands
- Partial model where consumption and production are exogenous
- Focussed on the welfare effects of practical implementation paths, especially on transport volumes per mode and the welfare effects of different degrees of geographical differentiation

#### 4) Freight and passenger transport in Europe (SCENES model)

- Strategic model covering Europe at all transport modes for both freight and passenger transport and covering interurban movements in detail
- Focussed on the welfare effects of practical implementation paths, especially on the transport performances by mode, the welfare effects of charging different types of roads and the welfare effects of charging only freight transport versus charging both passenger and freight transport

#### 5) Interurban freight transport in Norway (PINGO/NEMO modelling system)

- Used two complementary models: PINGO and NEMO
- Combined use of the two models to calculate the welfare effects of practical implementation paths, especially on how to use the revenues and whether to redistribute to consumers or use in the public sector

The authors explained that the three dynamic network models (SMILE, SCENES and PINGO/NEMO) investigated the following implementation paths:

- a) 'Do nothing'- continuation of current policies
- b) 'First best alternative' which is an allocation defined by quantities of goods that maximise welfare given the existing technology and capital stock. Optimal prices are equal to marginal costs and the only constraints are technical.
- c) 'Implementation path "Existing EC plans"' proposes the introduction of kilometre charges for only road transport in 2005/2006 and proposes full marginal cost coverage for all modes after 2015.
- d) 'Implementation path "only road pricing"' is a variant on Implementation Path 3 and is a policy alternative where only commercial road traffic is charged for its marginal social costs.
- e) 'Implementation path "only road pricing, all traffic"' is another variant on Implementation Path 3 and is the same as the above IP except that both passenger and freight traffic are charged. It is modelled only with SCENES and not with SMILE and PINGO/NEMO as these only include freight transport.

KUL case studies did not model individual implementation paths but focussed on specific dimensions of the pricing system, including congestion effects, effects of imperfect pricing in other markets on optimal road freight charges, and lack of harmonised behaviour of different governments taxing different parts of the interurban transport network.

The key dimensions representing the barriers and constraints of a pricing system were identified:

- The coverage or scope of the pricing system. Road freight and passenger transport could be priced in KUL1 and KUL2, freight transport via road and rail was common in the other three.
- The composition and level of pricing measures. Optimal congestion charges were modelled in KUL1 and congestion charges for road freight differing per country were modelled in KUL2. Modelling all externalities was common in the other three case studies.
- The degree of differentiation of pricing measures. SMILE looked at the effects of different degrees of geographical differentiation.

- The rules and principles governing revenue use. KUL1 focussed on revenue use to reduce labour tax or increase lump sum subsidies. PINGO/NEMO focussed on revenue redistributed to consumers or used in the public sector.

Comparable local values were used for the marginal social costs and the scenarios used for modelling with the dynamic models consisted of the economic and technological component which made assumptions about the developments in the next 20 years. The format of the output was harmonised between the case studies but the welfare functions differed per case study. Year 2020 was chosen as the time horizon for the work (2022 for PINGO/NEMO).

The results that were available for the case studies at the time the paper was written were illustrated:

- KUL1 - using a static equilibrium model, the case study focuses on road freight transport and the only externality in the model is congestion. The case study shows that an increase in peak period road freight taxes increases welfare, given that road congestion is an important issue and freight and passenger taxes are below the marginal external cost. The welfare optimising charge for freight transport depends on the level of road passenger transport charges and on the use of tax revenues. Social welfare as a function of the tax on freight for three different levels of passenger transport tax (benchmark level of 35%, half the benchmark level and double the benchmark level) were plotted. The results found that the welfare gain of a given freight tax reform rises with the level of passenger tax and the higher the rate of passenger transport taxation, the lower the optimal freight tax. Optimal freight taxes and welfare levels are found to be higher when revenues are recycled through labour taxes than lump-sum taxes.
- SMILE - with the do nothing approach, total transport performance of all modes was found to increase by 55% between the years 2000 and 2020. Road transport accounts for most of the growth in absolute terms. The authors found that there would be a reduction in environmental and safety costs per kilometre due to technical developments, but the higher transport demand causes total externalities to still increase. The other IPs showed between 0.2-1% lower total transport performance compare to the do nothing approach. There was additional market share for road transport under all implementation paths. The highest welfare gain is found under full internalisation of external costs with geographical differentiation of charges. This is the closest to the first best optimum. In terms of welfare, the first step towards full differentiation was found to be the most rewarding. If the charges implemented were higher than the actual marginal social costs, the welfare effect was negative compared to not implementing any charges. When charges were equal or lower than marginal social cost, welfare effects were positive compared to no charges. Knowledge of the marginal social cost is important in order to avoid negative outcomes, as overcharging is more costly in terms of welfare loss than undercharging. Although the implementation path simulating 'Existing EC plans' has positive welfare effects, implementing marginal social cost pricing at once which is the first best alternative has greater positive effects. When only charging road transport, the welfare effects are still positive compared to not charging, but less than existing plans.
- PINGO/NEMO – with all IPs, the sum of total freight transport on road, rail and water in Norway increases and the increase is greatest when MSCP is applied to all modes and revenue is redistributed to the consumers. The second largest increase was when MSCP was applied to only road and revenue was redistributed to the consumers. The do minimum

modal split is in favour of road transport due to greater advances in fuel efficiency for road transport than other modes. Marginal social cost pricing implementation paths were in favour of waterborne transport in the short run due to marginal cost pricing leading to increased transport costs for road transport, but in the long run it was in favour of road transport due to the improvements in technology which led to less road transport taxes. The authors state that both marginal social cost pricing and improved technology reduce external costs over time. The overall welfare effects were measured by effects on household utility plus external costs of freight transport plus revenue redirected as funds for unspecific use in the public sector. Generally, the effect of marginal social cost pricing on household utility is negative when revenues are directed to the public sector but positive if revenue is redistributed to households. When all modes are covered and not only road transport, the pricing effect on household utility is stronger. Marginal social cost pricing was found to reduce the external costs of transport if revenue was used in the public sector, and redistribution to consumers leads to increased demand for goods which in turn increases transport and external costs.

The author drew conclusions on the implementation paths that were evaluated in the case studies. The 'do nothing' approach led to an increase in total transport performance, which was mainly due to the growth in road transport. Due to the growing transport volume, there was an increase in total externalities but externalities per tkm decreased. 'Existing EC plans' showed that in comparison to the do nothing approach, there was an initial decrease in the modal share of road transport, but after technological developments, road transport grew more strongly than rail and water modes. A reason for this increase is the change in traffic patterns is due to geographical differentiation of charges. Routes that go through less densely populated and less congested areas are made more appealing. The ways the revenues are used affects the total transport performance, as redistribution to consumers leads to a growth in demand for transport but increases total external costs whilst distribution to the public sector leads to a slightly smaller increase in total transport performance than the do nothing approach and lower externalities. The overall welfare effect in existing EC plans was found to be more positive than the do nothing approach with a higher effect for revenues used in the public sector than redistributed to consumers. 'Only road pricing for freight transport' was found to be identical to the previous one up to 2015.

Conclusions for the key dimensions of the pricing systems were drawn. Coverage or scope of the pricing system looked at the modes road, rail and water and found marginal social cost pricing led to a positive welfare effect and that pricing road as a first step in an implementation path was a big step from a welfare perspective. Composition and level of pricing measures looked at KUL1 and found that optimal freight taxes were low when rates of passenger transport taxation were high. Degree of differentiation of pricing measures considered the SMILE results, which found that every step towards total geographical differentiation led to additional welfare gains. For the rules and principles governing revenue use, KUL1 and PINGO/NEMO case studies showed that the use of revenues had a big effect on the optimal price level and the level of welfare.

### **5.3. Reforming transport pricing: An economic perspective on equity, efficiency and acceptability**

The paper by Mayeres and Proost (KU Leuven) looked at how equity and efficiency were applied to transport pricing and tried to determine a framework to define acceptability. The

effects of replacing the current transport pricing system by marginal social cost pricing (MSCP) in Belgium were analysed. The paper considers the economic framework to study the equity, efficiency and acceptability trade-offs, numerical analysis of the concepts with MSCP and comparing two policy reforms implementing MSCP in the Belgium case study, and ends with conclusions and problems. The welfare effects on different income groups due to the pricing reform were calculated using a computable general equilibrium model.

It was argued that acceptance to a major pricing policy could only be gained if the policy showed a welfare gain or no welfare loss to a majority of voters. Voters may only be willing to accept the policy if it does not reduce their utilities, but if the utility impacts are unequally distributed, acceptance may be hard to gain.

The equity-efficiency framework measures individual welfare by a utility function that includes all the relevant characteristics of the individual and their working environment. Efficiency looks at the maximisation of the sum of individual utilities whilst equity issues consider a weighted sum of utilities where the individuals with lower incomes receive a higher weight, and the utility levels are used to define acceptability. The authors explain that a transport reform is classed as economically acceptable when it increases welfare or does not change welfare for a large number of people. When considering the efficiency-equity trade-off, the economy is restricted to two groups of individuals; poor and rich. A utility function is said to define the total benefit an individual can get from their consumption bundle (not only including market transactions but also quality aspects of consumption), leisure and labour effort. The utility function was found to be useful when discussing the trade-off between consumption possibilities and non-market elements of individual well-being. Absolute utility levels were seen as important for equity reasons to compare how well off is one individual compared to another. The welfare levels of individuals are defined by their utility functions ( $U_{\text{poor}}$ ,  $U_{\text{rich}}$ ), which measure the net benefits of market and non-market goods.

For the framework, the authors assumed that the economy had the given resources of time and capital (human). A given utility combination ( $U_{\text{poor}}$ ,  $U_{\text{rich}}$ ) is found to be achieved by combining these resources in a production process and distributing labour effort and production over different individuals. A utility possibility set could be achieved with the given resources, institutions and policy instruments. Assuming at first that there are no market impediments and the transport sector is like any other production sector creates a benchmark. A perfectly competitive economy would always lead to a point on the first best frontier, where each point is assumed to be Pareto efficient and it is not possible to increase the utility of a person without decreasing the utility of another. The market is believed to reach a point on the first best frontier when there is no policy intervention. But policy intervention through individualised lump-sum taxes and transfers can achieve equity without loss of efficiency. However in reality, perfect individualised lump-sum taxes do not exist due to the lack of information on individual behaviour, and other tax schemes such as income tax are used instead which distort prices and cause efficiency losses. Therefore this allows allocation only on the second best frontier, which is defined as the efficiency-equity trade-off curve where it is only possible to increase the utility of the poor by using high labour taxes that discourage labour supply and create high welfare losses.

The first and second best frontiers only meet each other at one point and this is when there is optimal income distribution in the perfect competition equilibrium. However this position is unlikely, as the policy maker prefers a more equal distribution and would relinquish some efficiency to gain more equity. When there are market imperfections, it is not possible to

reach the first and second best frontiers and the economy is located at points below these frontiers. It is believed that institutional and technological barriers lead to a reduction in utility possibilities. Imperfect pricing could restrict the economy to remain in a region inside a frontier that is lower than first and second best frontiers, and distributive policies such as labour taxes could only lead to points on the frontier. More efficient points located on the second best frontier could only be reached if the barriers to the pricing reform are removed, but it is not possible to reach the first best frontier, as for that individualised lump-sum taxes are needed. The authors explain that a movement to a point on the second best frontier implies in terms of policy reform that not all revenues are used to reduce labour taxes and there are departures from MSCP. When there are distortions in the labour market, the policy may be to reduce taxation on transport goods that are used mostly by the poor and tax commuting transport less than leisure transport to alleviate labour market distortions. A policy is assumed acceptable if the utility of an individual is greater or equal to the current position and this will only be accepted by society if it holds for a large majority of voters. Pareto improvements where at least one person gains and no one loses are extremes but enable reforms to be accepted by everybody. However the definition of acceptability used is found to have a few problems; it assumes that everybody correctly perceives the policy change effect on their utility level, ignores loss aversion and envy phenomena, and it assumes that each person only cares about ranking policy reforms and is not part of a social choice mechanism.

The authors analysed the welfare effects of replacing the current charging system in Belgium with a marginal social cost pricing system. The Belgium case study found that marginal social cost pricing led to greater tax revenues, which could be used in two scenarios, firstly to reduce labour taxes and secondly be recycled through higher social security transfers. Economic efficiency was believed to be achieved by both the scenarios but they differed in equity impacts and acceptability.

The characteristics of the model used to evaluate the utility effects of the reform are:

- Welfare effects evaluated by Computable General Equilibrium (CGE) model for Belgium
- Considers four types of economic agents: five consumer groups, fourteen main production sectors, government and foreign sector.
- Individuals in different consumers groups are assumed to differ in terms of productivity, tastes, share of capital goods and government transfers. Individuals from the same group are assumed to be the same in terms of need.
- CGE model distinguishes between passenger and freight transport, various transport modes, vehicle types and for some modes (eg, road) between peak and off-peak transport.
- Four types of externalities are taken into account: congestion, accidents, air pollution and road damage externalities.
- Benchmark equilibrium considers the situation in Belgium in 1990 using expenditure survey by income class of 1995 and emission characteristics of cars and trucks of 2000.

The authors found that strong price increases were needed for almost all transport modes including public transport. Both scenarios were found to have similar price changes, which meant that revenue use did not have large effects on the amount of transport and marginal external costs. Changes in labour income taxes and social security transfers were implied to affect externalities. Marginal social cost pricing increased the overall level of transport prices, reducing the total use of passenger and freight transport. The strongest decrease was found to be for peak car transport and for off-peak bus use. Substitution effects were gained from public transport, which explains the net increase in the amount of rail freight. Consumer surplus was found to reduce for almost all transport users. Based on this, it would be difficult

to gain acceptance of the reform, but benefits in terms of decreased externalities and revenues need to be taken into account.

The welfare effects of the policy are considered in terms of income classes. Usage of public transport was found to be unequally distributed over population groups, as the highest income group consumed in total more private and public transport than the lowest, and their consumption was more concentrated in private car transport. The highest income group consumed rail more than the other public transport modes such as bus, compared to the other groups, and this may distort the values. The authors stated that marginal social cost pricing led to a maximum social equivalent gain (defined as change in individual's original equivalent income that would produce a level of social welfare equal to that obtained in the post-reform equilibrium) when the revenues were used to reduce labour taxes. Social transfers could be increased using tax revenues, but this could lead to a loss in efficiency, however it may be the preferred option when taking equity into account. The size of the welfare gains with MSCP appear to be large compared to the transport sector's expenditure levels.

The authors explain that MSCP may improve society's welfare when considering the social equivalent gain, but in order to discuss if it is acceptable, the welfare effects of different income groups need to be assessed. With respect to the benchmark equilibrium, changes in equivalent income were measured. Scenario one (MSC + lower labour income tax) showed that almost all of the five quintiles (1 being the lowest income quintile and 5 being the highest) gained except for quintile 3 which consumed a lot of transport and benefited relatively less than highest quintiles from the decrease in labour income tax. The highest welfare gain was found for the highest quintile as whilst consuming lots of transport, they gain the most from lower labour taxes and the reduction in externalities. Scenario 2 showed a more unequal distribution of welfare gains. In this scenario, the highest income group was found to suffer a welfare loss and benefit the least from higher social security transfers. Even though the welfare effects were unevenly distributed among the quintiles, most people gained from the tax reform, which was good for acceptability. The higher quintiles tended to have a higher valuation of a reduction in externalities and of time than the lower quintiles. However the use of the extra revenue had to be taken into account in order to completely assess the equity effects and acceptability of MSCP. The political acceptability of transport pricing reforms could be increased greatly when the revenue is put to appropriate use.

The authors concluded that the efficiency, equity and acceptability of a pricing reform depend both on the level of transport pricing and on the use of extra revenue. The degree of inequality aversion may not have a big effect on the ranking of three transport instruments (peak road pricing, fuel tax and subsidies to public transport) but affect the choice of how the revenue is recycled. However the model had some limitations:

- The methodology was based on standard economic theory that needs to be able to measure and compare utility functions to measure equity concerns.
- The numerical exercise has a high level of aggregation.
- Equity effects need to be assessed in more detail through disaggregation of consumers and consumer goods, through income, household characteristics and spatial dimension.
- CGE model does not consider the location decisions of households and firms, therefore the equity effects of location changes are not captured.
- Different trip purposes are not considered, such as commuter and leisure travel and their relationship with labour supply is not taken account of.
- The shift towards more fuel efficient vehicles was not considered.

## 5.4. Discussion

The discussant and the attendees brought up a number of issues. An issue that was discussed was whether or not it would be good idea to sell pricing based on a 'Nash equilibrium' where nobody loses. A scheme had to be devised where everybody gained, but it was felt this would be difficult to do if there were lots of income groups or other categories. The effects may differ if the limitations of the model were taken into account.

The outcomes of pricing reform were found to be very dependent on the way revenue was used. The use of revenue was crucial but it was argued that it made things difficult in some ways. It was difficult to work out what would have been the situation without the pricing reform and assess the effects on the economy with and without the reform. Selling the idea of the pricing reform to people was seen as a credibility issue. People have to be sure that the revenue is used for the purpose intended, but as the economic situation may change, this may be difficult to demonstrate and may risk the loss of acceptance and credibility of the policy. If the government has earmarked revenue for a specific purpose and uses it for that purpose, this would gain credibility but however this is not usually the case in the real world and certain revenue is not set aside for specific funding. Many people may not know to what use the revenue is put to and this lack of transparency may be a major argument against the pricing reform.

The uncertainty of the values used in the models was considered. In one of the MC-ICAM studies, overcharging was found to lead to large losses in welfare from a sensitivity perspective. However if there was uncertainty about the values, extra caution may need to be applied when assessing the welfare implications. Uncertainty of the estimates of the values may endanger the validity of the final results. It was felt that more research had to be done on elasticities. The effects of elasticity of labour supply would have an impact on calculating welfare.

An issue that was raised was that MC-ICAM findings showed that road traffic was increasing and externalities per traffic unit were decreasing, but what did that assume about capacity and congestion? An increase in road traffic would surely lead to more congestion?

## **6. Implementation paths in practice – urban modelling results**

### **6.1. Introduction**

This section is concerned with looking at the results of various models on road pricing. The first paper looked at road pricing models in four major Western European cities Paris, Brussels, Helsinki and Oslo. The second paper looked at three different road pricing models in Stockholm, based on zones, distance and optimal congestion pricing.

### **6.2. Implementation of marginal cost pricing in urban transport**

This paper by De Palma et al (leaders of the urban modeling work in MC-ICAM) summarised project MC-ICAM's case studies to assess phased implementation of road pricing in Paris, Brussels, Helsinki and Oslo. The aim of the paper was to describe the simulation models used and to summarise and compare the main findings of the case studies.

The authors comment that the focus and use of road pricing varies in the different case studies. They also vary in terms of mathematical structure, user choices involved and sets of policy instruments covered. Therefore the models should be regarded as complements rather than substitutes. Brussels (TRENEN) model is most suited to conduct first-best analysis and to account for revenue allocation. Oslo (RETRO) and Helsinki (MEPLAN) models include land use, and can capture long term changes in location choice and urban structure. Paris (METROPOLIS) model is believed to have a fine level of temporal and spatial disaggregation, presented through its ability to handle large scale road networks and to track the evolution of traffic flows on a second-by-second basis.

Three types of constraints on pricing and revenue usage were identified. These constraints were on the number of market segments that could be priced, on the use of certain pricing instruments and on the degree of differentiation. Implementation paths are defined by the authors as 'sequences of constrained optima, where over time either the number of constraints or the 'tightness' of individual constraints change.' The key points on each of the case studies were highlighted.

#### Paris case study

- Impacts of pricing policies are analysed using 'dynamic' simulation model METROPOLIS.
- The types of pricing policies considered are: distance-related pricing (determined by charge per kilometre), flat tolls (time-dependent), step tolls (peak/off-peak prices), flat cordon tolling (constant throughout the day), time-varying cordon tolling (varies by time of day) and combinations of instruments.
- Accident and environmental costs were found to be much lower for public than private transport.
- The impact of road pricing was to be studied over 10 years by phased implementation (3 phases).
- Phase 0 (base case 2002): tolling restricted to 4 major highways leading into Paris, tolls initially set at low levels and price differentiated by link (road/highway)

- Phase 1 (2005): cordon charge with a flat or time variant toll is added, price differentiated by link and objective shifts from acceptability to efficiency
- Phase 2 (2008): time variation in the cordon toll is introduced, price differentiated by link and time of day
- Phase 3 (2012): distance based pricing is added on all links, and price differentiated by link and time of day
- 3 road pricing instruments were examined; link-based tolls on individual highways, cordon tolls in and around the city centre and a distance based tax.
- Link-based and cordon tolls were modelled in two forms; as time-invariant or flat tolls and as modular or time-varying tolls with peak and off-peak levels.
- Modest welfare improvements were found to result from link based tolling at phase 0.
- Welfare gains from tolling several routes are roughly equal to the sum of the gains from tolling them independently
- Link-based tolls in phases 0 and 1 create lower efficiency gains than the cordons in phases 2 and 3 and the distance tax in phase 3. Also greater efficiency is gained from modular tolling than flat tolling.

### Brussels case study

- Focuses on two types of obstacles in implementing marginal social cost pricing, which are constraints on the use of policy instruments and difficulties arising with multiple levels of government differing in their objectives and powers.
- Zone within the outer ring road of Brussels is the geographical area for the case study
- The pricing situation and modal split in the reference situation was computed using 2005 forecast data from IRIS (1993). Three types of pricing inefficiencies were found: most people do not pay the resource costs of parking, the dominant external costs are the external congestion costs therefore peak car use is under priced and public transport users pay less than the marginal cost.
- Strategic model TRENEN URBAN is used, which is assumed to represent the transport network via one aggregated speed flow relationship.
- The optimal combination of price and regulatory policy in the transport and environment area are identified, and constraints on policy instruments are taken into account by constrained optimisation of a welfare function.
- Three phases in the Implementation Path: P1) Parking only, P2) P1 + Optimal bus pricing and P3), P2 + Time differentiated electronic toll.
- It was found that split responsibilities between authorities led to problems; if the city of Brussels were responsible for road pricing, cars coming into Brussels from outside would be overcharged. The best solution was for the region to have complete control of transport pricing, though for the city of Brussels to control parking charges was not a great problem.

### Helsinki case study

- Carried out using MEPLAN model, which was described as a ‘comprehensive land-use and transport interaction modelling package that can represent strategic multi-modal networks/services and estimate transport demand based on the spatial economic interactions between households, employment and land use.’
- Five-year time step is chosen to track changes in travel demand and land use. Evaluation framework developed in MC-ICAM D3 is used.
- Choice of Implementation Path was based on considering the high level of taxation (e.g. fuel taxes) in the Helsinki metropolitan region. In order to make pricing reform politically

acceptable, continued increases in fuel tax would have to be phased in gradually with a simultaneous decrease in public transport fares. The authors explain that as it is unlikely that technology for distance based tolls will be fully developed until some time, it is assumed that more traditional cordon tolls will be used in the year 2010.

- The Implementation Path was: Phase 1 (2005 short term) Petrol tax +25% and Public transport fares –25%, Phase 2 (2010 medium term) Petrol tax +75%, Public transport fares –25% and 1.7/0.85 Euros radial/cordon peak road tolls per passage in the metropolitan area, and Phase 3 (2015-2020 long term) Petrol tax +150%, Public transport fares –50% and 0.10/0.07/0.03 Euros distance-based peak tariffs per km in the metropolitan area.
- Results show a shift to public transport and a reduction in the average distance of car trips. Also a significant decrease in auto travel and a fall in accidents and most emissions.
- The case study found that the ‘big bang’ approach may lead to higher efficiency gains than the ‘basic path,’ but may be assumed to be impractical or impossible due to barriers to implementation. Implementation paths in MEPLAN exhibit hysteresis due to rigidity in building and road infrastructure and inertia in location choices. The advantage of fuel taxes was that it was applied areawide and unlike cordon tolls, it did not lead to undesirable route diversions. But in terms of relieving congestion, it is seen as a blunt instrument both spatially (no discrimination between routes) and temporally (no differentiation between peak/off-peak). Reduced welfare gains were created by policy measures with restricted geographical coverage.

#### Oslo case study

- Objective was to describe a selection of implementation paths for the Greater Oslo area with different scenario assumptions and constraints, and make an evaluation of the effects on transport activity and land-use.
- Two scenarios considered (I): without extra CO<sub>2</sub> tax on fuel and (II) with extra CO<sub>2</sub> tax on fuel. Two implementation paths (A and B) in each scenario with differing constraints are analysed. Path A is only constrained by legal and technological barriers, but Path B also includes additional constraints on equity between zones, current value of finance, and constraints on upper and lower limits on available second-best measures.
- RETRO model was used which is an ‘equilibrium land use and transport model with a network representation of the transport infrastructure.’ It is capable of predicting short term and long term effects of land use and transport policy measures on residence and employment location and travel behaviour. It evaluated the effects of a 28 year implementation path of marginal cost pricing.
- Welfare effects of marginal cost pricing were found to be large due to land use adaptations over time more refined pricing measures.
- Welfare was found to be slightly lower in Path B than A. The greatest discounted benefits were found in Path A (II) with climate costs included.
- Considering land use and transport indicators, car trips and travel distance decreased and the speed on roads increased along Path A.
- Despite the reduction in car travel and increase in public transport trips, public transport operators lose out due to lower fares and parking operators also lose out.
- The study found that fuel charges and link-based tolls acted as substitute measures for reducing congestion. The type of policy used for marginal social cost pricing affected the direction of land use effects as toll charges made people/businesses move away from the toll ring and towards the city centre and more remote districts, whilst link-based charges made them concentrate towards the city centre. Therefore the study highlights the importance of land use effects in analysing transport policy measures.

The authors commented that the case studies were similar in that they focussed on large cities in Western Europe, examined phased implementation paths with progressively relaxed constraints and all except Brussels examined paths with four time periods. The case studies differed in the models used, dimensions of exogenous user behaviour, consideration of land use decisions, detail in representation of road and public transit networks, set of policy instruments considered, accuracy of computing optimal first and second best policies and the treatment of excess burden.

The authors concluded the paper by highlighting various lessons found from the case studies for phased implementation of marginal cost pricing. The Paris and Helsinki models found that efficiency gains resulting from pricing rise with the priced proportion of transport networks. Greater efficiency gains were found to be derived from more finely tuned measures with respect to mode, time, location, vehicle characteristics etc. It was found that an implementation path may not progress monotonically, the Brussels study showed that prices can first rise and fall later or vice versa, and the Oslo study showed that users could gain in the early stages and lose later or vice versa. Lack of coordination between levels of government controlling different policy instruments may lead to welfare losses. The Helsinki study found that investment in additional transport infrastructure capacity may help to gain acceptability for pricing but may not be justifiable on efficiency grounds unless there was adequate demand to use the capacity.

### **6.3. Modelling pricing reform in Stockholm**

The author Mattsson (Swedish Royal Institute of Technology) based the paper on discussing the effects of road pricing on traffic, congestion and location in Stockholm. Three ex ante studies of alternative road pricing system were presented and compared. The first study looked at the effects of a zone based pricing system for Stockholm, the second looked at the effects of a distance-based pricing system and the third looked at the effects of optimal congestion pricing on a generic city resembling Stockholm.

Many objectives for road pricing were explained. There was the efficiency objective of road pricing as a way of reducing congestion to the optimal level. First-best congestion pricing would be set at a level, which reflects the increased costs of the road user's presence on other users, and the charge had to vary with the time of day, road type and other road user's value of time, which is very complicated, therefore second-best pricing may be more likely for actual implementation. Another objective of road pricing was reducing the environmental impacts of traffic and the charge had to take into account the costs of pollution and noise. A very popular objective among policy makers was raising revenue to finance transport infrastructure. These objectives may be conflicting with each other. A combination of the objectives in an integrated strategy may be needed to achieve public acceptability. A key issue affecting political and public acceptability is how the revenues generated are spent, which may help to explain why the previous attempt to introduce road pricing in Stockholm was unsuccessful.

The case study considering the application of a zone-based road based pricing system in Stockholm compared this type of pricing with a reference scenario (situation without road pricing). The inner city was subdivided into five zones and vehicles were charged for both entering and travelling within the inner city. The total charge on the vehicle depends on the amount of travelling within the inner city and it is calculated by the number of times the

vehicle crosses the border between the zones. 41 charging points were needed for both around and within the zones and charging was imposed during Monday-Friday from 6am to 7pm. The charge level was set at 9.75 SEK for light vehicles and 3 times higher for heavy vehicles. The traffic simulation model Fredrik was used, which combines a travel demand model with a network model to allow the effects of traveller's decisions on road congestion to be modelled properly. The Fredrik system handles route, mode, destination and frequency choices. However the choice of departure time is not taken into account and this may lead the Fredrik system to underestimate the car traffic reduction effect of road pricing during the charging time periods, and overestimates the overall reduction effect.

The results from the Fredrik system showed that once the charges were implemented, the traffic reduction effect averaged over all weekly hours was 19%, and 30% in charged hours. Some of this traffic will be diverted to the semi-orbital route which may become more congested. Implementing road pricing was found to lead to less interaction between the different sub regions in the county of Stockholm. A 15% reduction of vehicle trips to and from the inner city was found. The zone-based pricing system may have a large impact on the level of congestion as speed on inner city roads will be increased by 17% and on inner city arterials by 24%. However speeds on semi-orbital routes will be lower due to traffic diversion. In terms of travel time, the largest effects were found in the inner suburbs where trip lengths fell by 7-8%. The road pricing system was estimated to generate a daily revenue of 5.7 million SEK and amounts to approximately 1.4 billion SEK per year (780 SEK per individual per year).

The application of a distance-based road pricing system was considered for Stockholm, to show how it could reduce congestion in the city. Two charge areas were identified as inner city and inner suburbs when subdividing the densely built-up area of Stockholm. A distance-based charge was levied on vehicles travelling in the charge areas during peak or office hours. Peak hours were defined as workdays 7-9am and 4-6pm, and office hours were 9am-4pm. The charging period was 2 hours lower than the previous study. Two different road pricing scenarios were identified; high and low, and the charge level in the low scenario was half the level of the high scenario. The charge levels differed depending on the areas (inner city/inner suburbs) travelled and peak or office hours. An electronic system was seen as necessary to implement the distance-based charges but was not discussed in detail in the paper. The distance-based pricing scenario was compared to a reference scenario, which was the same, but without the charges. National transport model Sampers was used which includes a regional model covering the Stockholm area. It treats similar choices as the Fredrik model and choice of departure time is not taken into account.

The results of the distance-based pricing system showed that it leads to a reduction in the distance travelled which varies between the time periods and the scenarios. The reduction is equal to or possibly lower than the previous study. Distance travelled in the high scenario in the inner city had the greatest reduction by 35% in peak hours and 19% in office hours at charges of 4 and 2 SEK/km respectively. There is less of a rerouting effect in this study, as vehicles strictly pay for the distance travelled in the charged area and the semi-orbital route unlike the previous study is not priced low to offer a route diversion alternative. The semi-orbital route may need to be priced lower to reduce the amount of vehicles travelling through the city centre. The distance-based road pricing system would generate total annual revenues of 2.7 and 1.6 billion SEK for the high and low scenarios respectively (1,280/730 SEK per individual per year), and of these 1.8 and 1.0 billion SEK per year respectively are for driving in the inner city.

The final study, which is based on the application of optimal congestion pricing to a generic city, includes location effects of road pricing in the analysis. Unlike the previous studies where the charge levels were fixed in advance, in this study the charge levels are determined endogenously to internalise the external effects of congestion and will therefore vary with the level of congestion on different links in the road network, but such an optimal congestion pricing system is presently technically infeasible and will rather be seen as a benchmark.

A combined optimal transport and location model of a generic city were applied to analyse optimal congestion pricing effects. Four types of activities (households, workplaces, shops and service establishments) were identified, their location depended on the location of other activities and generalised costs of travelling between the activities, and three different modes were used; car, public transport and slow mode (biking and walking). Only cars could use the ring road but the radial links could be used by all modes. There were three time periods for travelling; morning peak, office hours and afternoon peak.

The author explained that optimal congestion pricing could be achieved by charging each road user a fee equivalent to the additional cost their presence on the road imposes to other users. This charge includes the social marginal congestion cost of driving on that road. The congestion pricing scenario is compared to a reference scenario without road pricing. The results showed that the congestion charges per km were highest in the morning and afternoon peaks for the inner-most links, whilst the optimal congestion charge was almost zero for the outermost link. The total revenue collected per inhabitant/worker was estimated to be 2,380 SEK per annum, which was much higher than the previous two studies because in this model, the population was assumed to be more densely located and the road system was sparser leading to more congestion, than actually the case in Stockholm. Congestion pricing was found to reduce car distance travelled by 25% and link speeds for cars were found to be much higher. The largest increases in car speed due to congestion pricing in comparison with the reference scenario, were found in the morning and afternoon peaks on the inner-most links and the ring road. Small effects were found on the location pattern due to congestion pricing as for most of the zones, relocation was less than 1% of the activities. The ring road was made more expensive to use for shopping trips and it was more attractive to locate shops in the city centre. Congestion pricing was also seen to have a slightly decentralising effect. The location effects of congestion pricing were described as ambiguous in such a highly stylised city and they depended on the specific design of the road network and the cost of interaction.

The paper was concluded by discussing whether it was possible to find out the effects of road pricing. This could be via comparing the situation before and after road pricing has been implemented and carrying out an ex ante study which is the approach chosen for the paper. The effects of road pricing depend on user's alternatives such as route changing, mode, destination and even rearranging certain trips. More reliable results regarding the effects could be found when comparing the different studies. The author believed that the three road pricing systems were not so different apart from the fact they were differentiated by being either zone-based, distance-based and based on the optimal congestion pricing principle. All three studies showed a decrease in the vehicle distance travelled due to charging. For the zone-based system, inner city traffic volumes were predicted to fall by 30% at charge level 3 SEK/km, for distance-based system, a fall of 35% and 19% at charge levels 4 and 2 SEK/km for peak and office hours, and for optimal congestion pricing,

reduction of 25% at an average charge level of 2 SEK/km. The zone-based study showed additional effects of a 20% increase in speed on inner city and arterials. Accessibility to activities in the opposite half of the city may be reduced significantly. A reduction of 30% was predicted in the number of vehicle trips between the inner northern and inner southern suburbs. The location effects predicted were quite small.

#### **6.4. Discussion**

The studies presented by the speakers provided the attendants with a series of estimations of the welfare gains of various pricing strategies and implementation paths tested through modelling in a number of European cities and of the transport and location effects of road pricing analysed by comparing three studies carried out on the same city (Stockholm).

The discussion focused on three main issues:

- i) Can we trust the results?
- ii) How can we learn from one city to another through modelling?
- iii) Where research has to go to next?

Concerning the first point, this provocative question is aimed at underlining that the results of simulations are heavily city- and system-specific. A considerable number of studies have already been carried out for urban areas, but drawing robust and more general conclusions on actors' behaviour against various possible implementation paths requires that wider evidence is available: a bigger number of simulations, also in context with varying characteristics, should be carried out for the purpose of increasing the credibility of results.

Connecting modelling results to real-life implementation must take into account that the existence and importance of effects (in terms of changes to users' behaviour as to how, when, where, if travelling) also depend on the alternatives to paying the charge available to users.

The question of comparability of results, and consequent possible transferability to studies on other cities, was also put on the table. Investing resources in the comparability of studies in terms of objectives, implementation paths modelled and methodologies is a necessary pre-requisite for allowing learning from one city to another through modelling.

The speakers and the attendants agreed that research has to proceed further, in two parallel directions: a first path is that of increasing the available evidence through new simulations as mentioned above, the other is to devote bigger attention and more efforts to aspects somewhat neglected till now. Among them it is worth mentioning the distributional effects of pricing policies, the use of revenues to compensate losers and the effects on trade and industry, on freight and distributional traffic. The focus should also be enlarged to look at the effects on other markets such as the labour and housing market, at the questions of economic competitiveness and sustainable development. It is important to have a long run perspective when looking at these issues, since along the implementation path they might not proceed monotonically, and the distribution of winners and losers may change over time.

The experience of Stockholm described by Eliasson raised great interest. It is an ambitious plan to introduce in a very short time a road pricing system on an area of about 30 km<sup>2</sup> (50% larger than the tolled area in London). Big efforts were and are currently put to create a success story, despite the scepticism of the media (more focused on the fee levels than on revenues use for reducing congestion). A question was raised as to the technology chosen for

road pricing implementation. In fact despite the very short time for the introduction of the system, it was decided to use transponders, which implies high investment costs. Eliasson clarified that the high investment costs are counterbalanced by the lower operational costs.

## **7. Policy Implications**

### **7.1. Introduction**

The papers in this session considered the optimum transport pricing policies, how to implement them and the impacts of implementation. The first paper summarised the policy conclusions from the MC-ICAM project and the second paper considered applying the ‘user pays principle’ to road transport to take account of the costs and to use revenues from charges for infrastructure investment.

### **7.2. Policy Conclusions from MC-ICAM**

The paper by Nash, Niskanen and Verhoef summarised the main policy conclusions of the MC-ICAM project. The authors found that there had been a lot of literature on pricing in transport and especially marginal social cost pricing (MSCP) over recent years. However there has been a shift in the literature from deriving the pricing rules towards how to implement the policies. There was recognition that MSCP could not be universally implemented simultaneously. Interest in possible IPs was expressed in the 1998 White Paper on infrastructure charging and the 2001 White Paper on the common transport policy, which referred to IPs with lots of stages and different rates of progress on some transport modes compared to others. There was a lack of research on identifying practical IPs and measuring their costs and benefits, and the aim of MC-ICAM was to look into areas like these.

The main results from the work on barriers, constraints and IPs looked into second-best versus first-best pricing on links, nodes and transport networks, the distinction between underlying barriers versus implied second-best constraints, and the concept of IP: motivation and definition. A need to study second-best policies for MSCP and to consider marginal cost based pricing was emphasized. The practical implementation of MSCP was considered in terms of second-best solutions due to the departures from first-best conditions elsewhere in the economy and due to barriers in the transport sector which make achieving MSCP difficult. Policy packaging was seen as important when considering second-best policies, as the failure to reach the ideal result using one policy instrument led to a search for packages that would improve the situation using other policy instruments.

MC-ICAM made a conceptual distinction between underlying barriers and implied constraints to which they led to, and the factors that may lead the barriers and constraints to be eased over time were considered. The best way to devise IPs was seen as identifying the barriers that prevented the full implementation of MSCP and the constraints to which they led. Knowing these constraints, the second-best optima could be found. There is the need to identify the succession of second-best optima, each better than the last, which becomes feasible after the constraints are eased. The constraints influence what you can actually do but the barriers are something that could be worked with and overcome. The best that could possibly be done given the constraints may be the appropriate way forward.

The main technical results found from work related to modelling and evaluation analysis in MC-ICAM were in the areas of lessons from previous modelling exercises and comparative review of existing models, integrated modelling and cost-benefit framework for evaluation and modelling implementation paths in eight case studies. Also considered were the issues that should be the subject of modelling case studies, attributes of the models and appraisal of the results.

The authors explained that MC-ICAM identified the barriers and constraint for urban and interurban road, rail, air and sea. The three types of barriers to implementation were technological, institutional, and public and political acceptability.

#### Technological barriers:

- The big issues in terms of urban and interurban road transport are cost and reliability of the technology and confidence that it will work rather than availability per se.
- Inter-operability is seen as important especially in terms of interurban road pricing, where different countries are going in different directions and inter-operability is seen as crucial to the avoidance of waste.
- For urban public transport, smart card technology was removing the technological barriers to full MSCP.
- The big issue for rail, air and sea is not the technology but creating appropriate ways of measuring the costs of congestion and scarcity of capacity and reflecting these in charges. Further work on measuring marginal social costs is underway in projects such as SPECTRUM.

#### Institutional barriers:

- There is the need for EU and national legislation to permit and support MSCP.
- The relationship between different levels of government leads to institutional problems. MSCP may be best implemented if all decisions were centralised and taken by the state or EU but there is a risk of government failure.
- Issues arise in the roles of deregulation and privatisation versus government control when implementing MSCP. An approach would be to deregulate and privatise firms because competitive markets would force firms to implement MSCP to survive, and externalities would be accounted for by the use of Pigovian taxes and subsidies. However due to the market power some firms possess especially in cases of natural monopolies, firms may not apply MSCP therefore government intervention may be needed. Government control may risk government failure, as governments may not have enough information or motive to act in the public's best interest.

#### Acceptability barriers:

- Public and political acceptability is the key barrier.
- A number of points were seen as important in order to gain acceptability. It was best to start off with a simple system (e.g. cordon charges) and move to a more complicated system as confidence builds up. Packages and measures within and across all modes such as environmental charges on all modes at once help acceptability. There is the need for increases in charges to be gradual and the way the revenue generated is used is crucial.
- Many factors make acceptability less of a barrier in interurban road transport than in urban road transport. These include more complexity in urban networks and focussing where a vehicle is registered and fuelled rather than where it is running which is common in interurban road transport.

The MC-ICAM modelling case studies looked at both urban and interurban traffic and explored several differing dimensions of road pricing in terms of mathematical structure, user choices involved, and sets of policy instruments covered. The models were then viewed as complements rather than substitutes due to the differences.

The urban case studies focussed on four cities. The Paris model examined the structure of charges and was very detailed in modelling choices, including route and time of trip. The Brussels model looked at alternative pricing instruments and the impact of the responsible level of government. It was best suited to conduct first-best analysis and to account for revenue allocation. The Oslo and Helsinki models looked at the impact on locations and land use.

For interurban transport, five parallel simulation modelling case studies were carried out. They emphasised freight transport as being the main problem and considered issues such as the interaction between freight and passenger charging, interaction between modes of transport and degree of differentiation, and the interaction between charges and the rest of the economy, including the use of revenue. Institutional arrangements between governments were also considered. The case-studies show the effects of pricing on welfare, efficiency and equity. Key areas of the pricing system were the coverage and scope of the system and the composition and levels of prices and the degree of differentiation, and the use of revenues. These had to be considered in the short, medium and long term.

The authors commented that the impacts of a pricing system depended on its scope or coverage. (What is priced and who are priced?) The market segments that could be priced may be distinguished by geographical or spatial coverage, model coverage, user groups covered and externalities covered. The MC-ICAM modelling case-study results estimated welfare effects and other indicators as a function of varying scope or coverage as compared to the welfare levels related to the base case and the first-best cases. In general, the results showed that the impacts were not encouraging if the scope of the pricing scheme was narrow. Given that sufficient scope is secured, even simple pricing schemes may be worth implementing, as it may be the only way to get started and many of the benefits achievable in the first-best benchmark may be generated. This may emphasise the need for a phased pricing reform by introducing simple measures as soon as possible rather than waiting for the ideal solution. Possibilities of differentiation in the long run may improve efficiency and be regarded as a means to promote equity and acceptability.

MC-ICAM defined IPs in terms of sequences of consecutive second-best optima. The authors believed an important question was ‘how do second-best analyses and resulting policy conclusions appear convincing, in a dynamic context in practice where the relevant equilibria under consideration may not be long lasting, if they exist at all?’ Second-best optimisation may lead to initial price levels that have to be changed radically later when constraints are changed or relaxed. MC-ICAM modelling results highlighted the existence of many of these problems. The view that that second-best pricing along an IP may cause certain prices to fluctuate and problematic reverses in the direction of movements of charges may give rise to a caveat. Second-best optimisation that allows for current distortions in other modes or markets may lead to problems in implementing policy in the longer term which may lead to issues with acceptability. The authors explained that the way MC-ICAM considered second-best optima along IPs was effective for revealing potential problems. An important lesson from MC-ICAM was that ‘rather than focussing on fine-tuning of the derivation of second-best prices, and often very detailed technical problems related to implementation, the policy makers and analysts should pay more attention to identifying the key barriers and their implied constraints, and how to avoid or remove them.’

The use of revenues is seen as a crucial issue in transport pricing. It is important in terms of both public and political acceptability, and it can have great welfare effects. The use of the

revenue depends on the government introducing the pricing policy. The authors explained that in partial equilibrium models, the welfare effects of using revenues outside the transport sector have typically been captured by the concept of shadow pricing of public funds.

The policy conclusions from the modelling results were discussed both in terms of urban and interurban transport.

#### Urban transport:

- It is worth implementing simple pricing structures if this is the only way to get started. But further differentiation in time and space is believed to be worthwhile (Paris, Brussels, Oslo case-studies).
- Second best pricing to allow for distortions in other modes/markets may lead to big fluctuations in price which is problematic from the viewpoint of long run development (Brussels case-study).
- Which level of government should be responsible is an issue, but pragmatic solutions may be found (Brussels case-study).
- Location and land use effects may be important and differ significantly between cordons and differentiated link charges (Oslo case-study).

#### Interurban Transport:

- Most of the benefit can be obtained by tackling the dominant mode-road (Netherlands, Norway case-studies).
- Also in this area, second best pricing to allow for distortions in other modes/markets may lead to big fluctuations in price. A big increase in freight alone is charged followed by a reduction when passengers are charged (UK case-study).
- The use of the revenue is crucial. Benefits may be several times greater if revenue is used to reduce distorting taxes rather than returned to users as lump sum payments (UK, Norway case-studies). Optimal charges are higher when revenue is used in the best way.

The authors drew many conclusions from the MC-ICAM project. It was seen as best wherever possible to go straight to the first-best solution. But there were also good scientific and practical reasons for the need of phasing and packaging. Some barriers definitely stood in the way of achieving first-best solutions therefore second-best solutions were needed. Uncertainty tended to remain about the barriers and the exact nature of the constraints to which they lead to and the degree to which they could be eased over time, including the level of government intervention. But the MC-ICAM methodology was seen as a valuable step forward. MSCP is seen as radical and there is strong opposition against it despite its long treatment in economic literature and policy, but there has been an inevitable trend that MSCP's potential for solving transport related problems is more understood and accepted. Many problems come from the attempt to apply MSCP in a naïve way, in practice; second-best considerations and policy packaging mean that it is better to refer to marginal social cost pricing as the aim. MC-ICAM modelling results indicate that sensible phasing can lead to worthwhile benefits already in the early phases whilst building up acceptability for sophisticated developments later. It may be more valuable to identify and tackle the barriers to implementation than to fine-tune second best pricing. The best IP can be seen as a set of constrained second-best optima, with the constraints determined by the barriers to pricing reform.

The presenter and the attendees in the session held a discussion that raised many questions. The question 'If first best is impossible, then why is second-best not first-best?' was asked. However although first-best may be seen as impossible due to barriers and constraints, it can

be argued that it is still the option that should be strived towards if the barriers and constraints could be removed and may achieve the optimum results and be seen as the benchmark situation. Another question was whether achieving the desired outcome and not raising revenue was acceptable? Acceptability was found to be the greatest barrier, as solutions could be seen for technological and institutional barriers, but not as easily for acceptability.

### **7.3. Return on Roads**

The authors Dings et al (CE Delft) based their paper around the ‘user pays principle’, which was seen as important to regulate supply and demand, and assessed whether the principle could be applied to road transport. A charging system was developed to take account of congestion and transport demand. Government funds paid for road infrastructure through tax revenue but the taxes were not tied to the actual usage of the infrastructure and or the externalities created by road travel. The Dutch Ministry of Finance commissioned the authors to answer the following questions:

- ‘Is it feasible to design a funding regime for investments in new road infrastructure and for covering the various other costs of road traffic that is based on ‘the user pays principle’ and, if so, what form might such a regime take?’
- ‘What are the general implications of such a pricing and funding regime for infrastructure investments, road congestion and travel demand, or ‘mobility’?’

Therefore the aim of the study was to develop and assess ‘the user pays principle’ in road transport. This was done in two parts; the theoretical part looked into the development of the pricing and investment regime and the empirical part looked into assessment with the advanced Dutch network model with respect to investments, and road use and congestion. The paper was designed to cover the theory of the funding and pricing model, elaboration of the modelling system, results of the three scenarios, discussion and interpretation of the results, and evaluation and recommendations.

The study considered that the various costs related to the use of road infrastructure had to be paid for, in accordance to the user pays principle. An issue to tackle was how were these costs going to be paid for. Although road users currently have to pay taxes and charges, these are not directly related to the actual costs caused by road user traffic. Various literatures have emphasized the need for external costs of road transport to be passed on vehicle owners and operators. This could be done via a per-kilometre charge differentiated in terms of vehicle size and category, and possibly time of day and road location. Fuel duty and possibly tradable emission rights could help reduce CO<sub>2</sub> or other emissions. The kilometre charge may also help cover the costs of road upkeep. The overall charge may include the fixed capital costs of new and existing roads needed to serve new housing estates or poorly serviced areas, and designed not to relieve congestion. For such uncongested ‘access infrastructure’, the authors explain that road users should pay a fixed charge in the form of an Annual vehicle Circulation Tax (ACT). Another set of costs that need to be covered are the capital costs of ‘congestion-relieving infrastructure’ such as road widening. The use of one road user affects the potential use of others therefore these roads cannot be classified as public goods as the non-rivalry characteristic is not fulfilled. It may be economically viable to introduce a congestion charge, which reflects scarcity of infrastructure in the road usage price. The charge should increase with the level of scarcity.

The authors explain that revenue should not grow indefinitely from the charges and it makes sense to expand capacity. Using the investment rule, investment in infrastructure should be made when revenues from optimal congestion charges levied on new capacity are precisely sufficient to fund the capital costs of that new capacity. This rule is only valid when new capacity does not lead to external costs or benefits. Road building in urban environment and protected areas, is linked with large external costs and the investment rule would lead to over-construction. To represent the extremes, two scenarios were developed; a 'market scenario' where the external costs of road expansion were ignored and road-building was based on the investment rule, and an 'environment scenario' assuming finite external costs and implying no investment. The investment rule for capacity expansion in congested areas is believed to ensure that the capital costs of the additional infrastructure are paid for by the users. The advantage of the investment rule is that it identifies the point where the user's willingness to pay justifies capacity expansion and this is similar to standard cost-benefit analysis where a project is only justified when benefits exceed costs.

The paper explained that the pricing and funding regime was fed into the Dutch National Road Traffic Model (LMS model). The charge system contained the following elements:

- 1) Basic kilometre charge to cover the external costs of road traffic and the cost of infrastructure upkeep
- 2) A quarter of ACT revenues are sufficient to fund access roads and other fixed vehicles taxes are assumed to be abolished
- 3) Introduction of an optimised congestion charge was assumed and a procedure to calculate the charges was developed.

The modelling horizon was taken as 2020 and full implementation of the government's long-term infrastructure and transport programme (MIT) was for 2002-2010. Three scenarios were run through to the year 2020: a reference scenario including the basic kilometre charge and reduced fixed vehicle taxes, an environment scenario which was as the reference scenario but with an optimised congestion charge and no additional road construction post-MIT, and a market scenario which had the optimum pricing of the environment scenario but with additional road construction after MIT according to the investment rule.

The results of the three scenarios were illustrated in the paper. The traffic and tailback situation for the reference scenario for the year 2020 found that the main capacity hold-ups are in the coastal conurbation and the south and east of the country, with Zeeland and the northern provinces relatively uncongested. The optimal congestion charges in the environment scenario per vehicle kilometre in morning rush hour on a primary road network showed that at most sections of the network, the congestion charges would not exceed 2.5 Euros cts per car kilometre and for some selected spots, over 5 Euros cts would be levied. Charge levels could even exceed 50 Euros cts per car km at some 'hot spots'. When considering the traffic and tailback situation for the environment scenario, the proposed charge was found to reduce congestion effectively by keeping traffic volume below 75% of capacity on most roads. In comparison to the reference scenario, the environment scenario generated a net gain in welfare of approximately 680 million Euros. When considering the traffic and tailback situation for the market scenario, capacity usage was found to only slightly differ from the environment scenario.

The authors commented that the most surprising and least robust results were in the market scenario of the low estimate of 400 lane kilometres for projected expansion of the primary

road network post-MIT (2010-2020) with investment of 2 billion Euros. The level of expansion was an initial approximation based on the willingness to pay of peak-time road users. More accurate or robust estimates of optimum road capacity and building programme were not feasible in the market scenario given the constraints. However the post-MIT result may be more modest than the government's National Transport and Traffic Programme. The environment scenario was found to be effective for curbing congestion on arterial roads, there was a loss of only 8% in mobility due to structural congestion in everyday tailbacks, and congestion charge revenues totalled 1.1 billion Euros. The market scenario led to only slightly greater improvements in mobility, congestion, charge revenues and welfare compared to the environment scenario.

The study was found to provide new insights in many policy areas. The willingness to pay of road users was important for evaluating road infrastructure investments, complementing social CBA and other policy tools. A more robust market scenario could be useful for the optimum design and scale of investments in new road capacity, but may lack precision to draw quantitative conclusions on the investments. Elaboration of the user pays principle was described to create vistas on the dynamics and structure of the travel market without calling for private participation. The project highlights the importance of road pricing in the form of congestion charges as a price for road space scarcity. Road pricing has to include a fee for capacity expansion in order for it to be effective in implementing the user pays principle.

The computer model may need to be developed further before more quantitative contributions could be made on the area of road infrastructure charging. Improvements to the model may be needed in calculating optimum road capacity and required investments in new road capacity and on technical points such as travel cost functions and traffic allocation procedure. Validation of the results with the National Road Traffic Model is needed and the results should take into account economic growth, travel time evaluation and infrastructure costs.

## **8. Perspectives on Acceptability**

### **8.1. Introduction**

Public acceptance is a key factor determining whether a policy can be implemented, its likely impacts and its potential to achieve specified goals. Three papers were discussed during this session. The first paper by Schade and Schlag looked into the factors determining acceptability, perspectives from businesses and politicians, acceptability for pricing interurban roads and best practice to overcome acceptability barriers. The second paper by Glazer looked at how policies that were initially unpopular could be made popular after implementation. The third paper by Garling looked into household behaviour regarding car use following the implementation of a travel demand management measure such as congestion pricing.

### **8.2. Acceptability of Pricing Reform**

The paper by Schade and Schlag, based on their work for MC-ICAM, argues that the main barriers to implementing transport pricing reform are the lack of public and political acceptability. They highlight that in democratic societies it is generally seen to be inappropriate to impose policies against public will, and that attempts to impose policies with insufficient acceptability amongst users could actually lead to the failure of the policy, eg due to strong public resistance.

The authors provided a useful exposition of the main factors which contribute to the low acceptability of transport pricing measures and which should be taken into account when trying to enhance acceptability, as follows:

- Problem perception: High problem awareness may lead to a higher willingness to accept solutions, though some contradictory studies show that even those who see traffic congestion as a major problem are against road pricing.
- Mobility related social norms and pressure: argued to be the most important factor, greater social pressure to accept a pricing strategy may lead to higher acceptability; however this area needs more research.
- Knowledge/information about policy alternatives: knowledge is seen to be an important factor, though the authors believe that current research does not allow us to draw a final conclusion regarding its influence on acceptability.
- Perceived effectiveness of the proposed measures: Acceptability is greater if a measure is believed to have the potential to be effective in reducing transport problems (and vice versa).
- Equity/fairness: Acceptability of a policy measure depends on whether the public regard it as 'fair', 'equitable' and 'just', though the authors recognise that there are complexities in defining these terms. The differential impacts pricing policies have on different income groups are often highlighted as a key equity issue, but this should be considered in conjunction with how the pricing revenues are used.
- System characteristics: Characteristics such as the method of charging, the charged areas and the times of charging may influence acceptability.

Shade and Schlag report that business views towards road pricing have found that higher transport prices are expected to have a negative effect on competition, employment and overall prosperity in the area affected. Where these negative effects impact on a city's ability to compete with neighbouring cities and regions, business acceptability is thought to be particularly difficult to attain.

The support and acceptability of politicians is important for implementing a pricing system. The decisions of politicians have to not only be based on their own interests but also those of different groups in society. In order to maximise votes in elections, politicians have to consider what society wants and they will be reluctant to apply policies, which may deter re-election. Two main reasons were identified for the low socio-political acceptability of transport pricing. Firstly, missing attribution as the effects on popularity and re-election influence politician's actions and there is a preference for direct interventions rather than anonymous pricing measures. Secondly, the government may lose power when introducing road pricing, other direct actions such as issuing permits for otherwise congested roads may generate political support and monetary donations at election time as those who want the permits would try to lobby the government. However the AFFORD survey showed that politicians had underestimated the public acceptability of road pricing. It is said that politicians have to be aware of the concept of social fairness when it comes to the pricing system, as the system may affect the poor more than the rich. An argument is that road pricing allows the rich to continue using their cars whilst inhibiting the use by poorer groups. The need for governments to justify policies on practical terms rather than aggregate levels referring to efficiency and equity was identified. The issue of public transport fares and services is important for politicians in order to promote public transport use as an alternative to car use.

The authors explained that with regard to charging interurban traffic, problems of non-acceptability have been small, therefore charges for the use of interurban roads are common than in urban roads. This may be because interurban transport occurs on well-defined links, which makes it easier to assess the expected effects and to convey the results to the public. The two principles that only new facilities should be tolled and that there must be a parallel free of charge road have more or less been the basis for interurban road pricing in many countries and have limited public resistance. Acceptability problems in interurban roads may be related to the purpose of revenue use and whether acceptability is expected from the start, as communication needs to remain before and after the implementation.

The authors feel that there is the need to determine best practice for overcoming the various acceptability related barriers. Experiences from where the policies have already been successfully implemented or tested need to be considered and an overall framework to analyse and draw conclusions will be needed.

Norway was found to traditionally use urban road tolls to finance urban road investments and this seemed to be accepted by all parties. This was because Oslo had suffered unsatisfactory traffic flow with delays for everyone, environmental problems and pressure on local streets and residential roads, and the public funds needed for road construction were insufficient. The toll was introduced to finance the road investment programme and it was thought to enable implementation of projects within 15 years which is 10 years less than if financed by public grants. Reasons that led to public acceptability of the road pricing tolls besides the public awareness of the problem and the long tolling tradition, were the simultaneous implementation of the toll with a tunnel opening that improved traffic as this showed the direct benefits justifying the new toll, and the pricing system was set up for a limited period (only up to 2007) and was presented as a trial which could potentially be reversed therefore this led to less resistance from the public.

It was found that tolls with the aim of managing demand for infrastructure or achieving economic efficiency were not as publicly acceptable as tolls for financing expansion of road capacity, and environmental and safety improvements. The objectives of the pricing system had to meet the public's main concerns such as traffic problems in cities. Pricing schemes were seen as effective systems but good convincing reasons were needed to gain public acceptance. The authors explained the objectives of the intended measures had to be highly valued by the public and people had to believe that their behaviour made a contribution to achieving these objectives. Charging only new facilities may gain acceptance through value pricing because people want to get something for their money. People must have confidence in the system and especially in the effectiveness, fairness, possibility of participation in the decision process and in the use of revenues, therefore transparency in the pricing system from an early stage may be required. It is explained that there is a connection between participation, commitment, acceptability and effectiveness.

The authors explained the steps for acceptable implementation of the transport pricing process:

- 1) Problem discussion: raising problems that are perceived important in different areas
- 2) Consultation: visible consultation is needed to make sure that the scheme is being properly designed taking stakeholders views into account
- 3) Stakeholder and media involvement: there is the need to communicate to different groups who can exercise influence the way the scheme is received
- 4) Solution forming/presentation: assessment of the alternative solutions and identification of potential winners and losers. Results are communicated fully starting with the positive benefits and then considering the costs and who should pay, and try to reach a consensus.
- 5) Implementation/Supplementary measures: people will only accept road pricing if they are get something for their money, so investments and improvements may be made simultaneously with pricing.
- 6) Follow-up assessment: continuous monitoring of the scheme and willingness to change the scheme if problems occur are needed for acceptability.
- 7) An additional step could be to conduct a referendum before the implementation step.

The authors concluded results from public acceptability research were that pricing measures could only be implemented if people could get value for their money and the use to which the revenue was put to could be a key measure to alleviate some of the acceptability barriers.

Some of the key acceptability related barriers were found to be:

- Acceptability problem of road users of having to pay directly for road use which has traditionally been free at the point of use or for higher parking charges
- The public dislikes complex charging schemes for public transport and roads
- Marginal cost pricing is not perceived by all to be the best pricing approach in practice
- Pricing may receive low political priority due to the indirect link of the policy's benefits to the political party
- Spatial acceptability issues related to the distributional impact of charges (horizontal equity) as both the public and businesses need to make sure they are not being disadvantaged compared to each other
- Vertical equity issues requiring that the pricing system does not make certain groups in the city worse off

- Local acceptability issue that revenue raised locally needs to be used for local benefit
- Road user acceptability issue that revenue raised from car travel needs to be spent on benefiting road users through improving road travel conditions and/or improving public transport
- General public acceptability issue that new taxes may be perceived badly unless used for a popular cause
- The public need to feel that they are involved in the pricing process rather than having it imposed on them
- There should be a commitment to review the scheme if problems occur after implementation

The discussion considered that when looking at the social acceptability of pricing by voters, studies tend to subgroup existing users and potential users. However, for political reasons, more interest should be placed on the existing actual users as this enables an insight to the amount of actual revenue to expect.

There was discussion over the view of the acceptance of access restrictions over pricing. It was questioned whether access restrictions could be part of the implementation path. A possibility was to implement access restrictions for a while and then to replace them with pricing.

### **8.3. How to make unpopular policies popular after adoption**

The author Glazer (a leading North American academic) argued that when designing a policy, factors that affect political support both before and after adoption of the policy have to be considered. Firms are said to be more willing to undertake costly investments if they perceive the policy to be successful and that it will be continued. A lot of research has been done on why certain policies are implemented, but this paper looks at why policies are maintained or reversed. It looks at the conditions, which make policies more popular after implementation, referring to two mechanisms; investment and information. The main conclusions drawn are that it is harder to implement a policy than to ensure its continuation, and policies that require firms or consumers to make investments are harder to implement in the first place, but once implemented, they are difficult to reverse and are usually continued.

Following the implementation of a policy, if people expect the policy will be continued, they will make investments which are only profitable if the policy is continued, which in turn increases the political support for the policy. There is a trade off between flexibility and commitment. If a policy is flexible, there is the chance that it might be reversed, which makes it difficult for people to commit to. In order to reduce the costs or to benefit from the policy, firms/consumers can take actions such as firms constructing offices in less congested areas, consumers moving to homes closer to work etc. These actions can lead to increased support for the policy in the future, because as firms/consumers have made the investment sacrifice, they hope in return for the continuation of the policy. Glazer explains that multiple equilibria can appear when consumer's actions generate network externalities or economies of agglomeration exist. The expectations of consumers are said to play an important part in determining reaction to a congestion toll. In some equilibria, the toll will induce lots of change and will generate political pressure for its continuation, in other equilibria, the toll may be ineffective. Multiple equilibria relates to the credibility of the policy. The credibility of the policy affects private investments. If a policy such as a congestion toll is implemented, people think that there is more support than they first expected for it. If they believe the policy

will be continued, they may make investments, which makes the policy more attractive and ensures continuation, but if they expect the policy to be changed, they will be unwilling to make these investments. The current decisions of economic agents depend on their expectations of future policy. The stability of the politicians in power can affect the expectations of the policy. Politicians with short terms in office are likely to find it difficult to impose tolls that would hurt consumers, as they lack the time to turn around consumer views and need to keep consumers on side to be re-elected. However politicians who are secure in office may be more willing to impose unpopular tolls and continue them, change the expectations of consumers and bring about investment, and eventually reap the rewards of increased welfare.

The author explained that people cared more about losses than about gains. Empirical estimates of loss aversion showed found that losses were weighted twice as strongly as gains. However such loss aversion is found to make it difficult to introduce a policy and to reverse it later, due to the status-quo bias. Glazer illustrated this point with an example. A congestion toll imposed at the entrance to a city would increase property values inside the cordon and reduce property values outside the cordon. If only considering the number of gainers and losers, then implementing the policy would not change the political forces favouring and opposing the toll. Supposing that the intensity of feeling also matters, the toll may benefit only a minority of property owners and hurt a majority. When gains in wealth matter less than losses in wealth to an individual, political pressures may oppose the toll. But once the toll is imposed, removing it increases the wealth of a majority and reduces the wealth of a minority. However political pressures may favour continuing the toll if wealth losses matter more than gains which leads to the status quo bias.

Another reason that the author claims makes the policy more popular after it is adopted is the revelation of information. Implementation of the policy provides information about the preferences or characteristics of politicians, which changes political pressures favouring or opposing the policy. It is believed that it is harder to impose the policy in the first place than to continue it. The amount of information or level of ignorance possessed may influence support for a policy. Support for a policy can be higher when the beneficiary's identity is unknown than when it becomes common knowledge. Officials may be less willing to continue policies if the public is better informed of their competence.

Public officials are thought to be very concerned with their reputations. Voters may have incomplete knowledge over the effects of implemented policies, but if they see policy makers go back on a policy by reversing it, this signals that the policy maker made an error and that they may be incompetent. Therefore the officials may continue their policy to protect their reputation and to keep face. An official who opposed transport pricing has a continued incentive to oppose it and vice versa.

Glazer concluded that the paper explored many reasons that would make policy reversal unlikely. These reasons were:

- Reputation or Information Relevance: the longer the policy has been in effect, the more likely it will be for it to continue in the future
- Trade-off between the cost of a policy and its performance: less costly policies tend to have less opposition. Policies that need firms or consumers to make investments can make implementation of the policy less likely, but once the policy is implemented, the investment creates opposition to reversal of the policy as the investors may incur large capital costs.

- Allocation of responsibility across different levels of government: this can affect the confidence of consumers and firms over continuation of the policy. Joint responsibility of a central or local government, or of different groups within government are said to make implementation and reversal of a policy more difficult. The author states that policies approved at both local and central level are very effective as they show a broader political consensus than policies produced by a unified regime. This will make people behave in ways that enable the policy to succeed and show their support for it. Expected large future upswings in policy makes people hesitate when responding to unified regimes.
- Credibility of the policy: this may consider whether policies are enacted at local or at national levels. Support for local policies may on average be more stable over time than support for national policies. Local policies may be more reliable in aggregate and these expectations may make the policies more successful, this reliability enables local governments to successfully implement policies that would fail for the national government.

#### **8.4. Household's adaptation to their private car use to congestion pricing schemes**

Garling's paper (Goteborg University) looks at travel demand management measures for reducing private car use in metropolitan areas such as congestion pricing schemes. It considers how these measures cause individuals and households to respond and to reduce car-use when experiencing mobility restrictions through monetary costs or inconveniences. Ways an individual can reduce car use could be by more efficient car use, suppressing trips and switching travel mode. Congestion pricing is assumed to make households set a car-use reduction goal. The paper develops a cost-minimising principle of attaining car-use reduction goals. Households are assumed to make decisions using simple heuristics and that they trade-off effectiveness against cost.

The growing trend in car ownership and use is expected to cause great environmental and societal costs such as congestion, noise, air pollution and depletion of energy.

Garling explained that he was not in principle opposed to transport pricing as there was no reason why people should not pay for transport services like they pay for other services. But the levels at what the transport prices are set is said to be a complex issue. Not many economists agree on the rate congestion prices should be set at, which is different from the goods market where the market sets the prices. When introducing transport pricing to influence people's choices, it is important to see if it achieves the desired intended effects. The rationality of the decision making is distinguished into coherence (following a theory to be consistent) and correspondence (achieving the stated objectives) rationality. It was stated that the effectiveness of road pricing in the short or long run should not be taken for granted. The potential effectiveness of the measures depends on the response of car owners. There are many reasons why congestion pricing may not affect the household's decision regarding car travel, such as households lack information, they set other cost-reduction goals and that they adapt to price over time.

There are many measures that may reduce the demand for car use such as increasing the costs of driving, prohibiting or physically restricting car traffic, improving alternative travel modes such as public transport, cycling and walking, and reducing driving distances by changing the relative locations of homes, work places, shopping centres etc. These measures may differ in effectiveness, cost, technical and physical feasibility. The author notes that the more coercive travel demand management measures may have negative effects outweighing the expected

benefits, such as costs or sacrifices incurred by households. The less coercive measures may be based on how much households are willing and able to change their car use.

Road pricing is said to vary in coerciveness depending on the household's income. It was found that the public seemed to prefer prohibition to road pricing. This is because road pricing is perceived as unfair as it may affect the poor more than the rich, and may not force the wealthy households to adapt their behaviour. However prohibition is perceived to affect everyone equally.

Garling tried to analyse the effects of travel demand management measures on private car use by using a cost-minimization principle of adaptation of car use. Car using households compare the present situation to a reference value or car use reduction goal. If these differ, then some action is carried out with the aim of minimizing the discrepancy. Travel choices are said to be determined by the bundles of attributes characterizing them (including purposes, departure and arrival times, monetary costs) and the goals set by the households. Congestion charging may cause households to set a car use reduction goal when they find their travel options have declined in terms of increased monetary costs or inconveniences. They will then form implementation intentions that plan how to attain the goals. In order to reduce car use, households may consider a range of options such as stay at home, car pooling, travelling to closer destinations or using other transport modes. Longer term options include moving house, changing workplace and changing work hours (compressing the working week). People are found to prefer options that enable them to achieve their car use reduction goal at a minimal cost. The effectiveness of the options is traded off with the cost of the action.

Garling explained that the first step would be to make car use more efficient by chaining trips, car pooling or choosing closer destinations, however there is the cost of planning ahead which means there is less flexibility. The second step in addition to more efficient car use, is that trips could be suppressed to achieve a reduction in car use costs in addition to planning are the suppression of activities such as shopping and leisure. The third step is in addition to the second step; there is a change in travel mode. (e.g, use of public transport) The possible costs are additional planning, increased time pressure, activity suppression and inconveniences.

In order to respond to congesting pricing, the author explained that the household had to detect the changes in costs. This can be done in two ways; changes in travel options and public information. As car use is known to be a habitual process, households may be unwilling to actively seek information. If there is lack of transparency in information about costs, congestion pricing may not have any effect. Households may set themselves a threshold level of acceptance that would induce them to change their behaviour if the cost increases of congestion pricing exceeded this level. But these changes in behaviour may be cutting costs not related to travel, rather than changing car use. The effects of congestion pricing may change over time; one reason for this is the adaptation to the price level. However households may choose more costly adaptations such as moving house or compressing working weeks and this takes time to implement. Congestion pricing is believed in principle to reduce car use but Garling argued that a more realistic view was that it might smooth traffic peaks. The goals of information technology via Intelligent Transportation Systems are to reduce congestion, increase safety, decrease stress for travellers, provide maximum access to system information and to promote free flowing traffic. For these reasons, the author expected the system increase the effectiveness of the transport demand management measures by reducing its adaptation costs and enabling people to achieve their car use reduction goals more easily.

Garling summarised his paper by recognizing the need for effective travel demand management measures to alleviate traffic related problems. Although coercive measures seemed to be the most effective, politicians were reluctant to use them. Households were assumed to set car use reduction goals when the travel demand management measures impaired their travel options, and options that achieved the goal at minimum costs were preferred. Steps that could be applied sequentially over time to achieve the car use reduction goals included more efficient car use, suppression of car trips and mode switching. Additional planning, activity suppression, increased time pressure and inconveniences are identified as the costs to the steps. Intelligent Transportation systems were seen to play an effective role in reducing the costs of the measures.

## **9. Using research to inform implementation**

### **9.1. Introduction**

This section looks at the presentation by Steven Perkins of ECMT, on how research can be used to inform policy implementation. The section is concluded with a discussion including round table contributions from Jim Evans (European infrastructure manager's association), Gunnar Eriksson (Swedish ministry of transport) and Katalin Tanczos.

### **9.2. Using research to inform implementation**

Stephen Perkins commented on the nature of debates on transport pricing policy within ECMT. New ECMT reports included the research project Optimal Transport Pricing carried out jointly with the EC, Efficient Transport Taxes and Charges 2003 to be published later this year, and Reforming Transport Taxes and Charges. Modelling was done in five countries: the UK, France, Germany, the Netherlands and Finland. The work looked at the gap between current charges and optimal charges at a very broad level. The model split each of the countries into three areas: metropolitan, other cities and non-urban areas. Different modes were considered such as road, rail and water in terms of freight and passenger markets. It also looked at selected vehicle and infrastructure categories. The impacts in terms of welfare, revenues, selected external costs and the speed of urban traffic were derived.

Metropolitan roads in the peak for small petrol cars not currently paying parking costs generally increased by 100% in the overall package of charges being paid and a higher figure of 150% in London. In the off-peak, the increase was half as much and for current payers of full parking costs, the increase again was half. Mixed patterns were found in the rural areas with likely reductions in charges in some places. The other key area was the impact on trucks, again on metropolitan roads in the peak an increase of an average 40%, higher again in London, but in off-peak the increase is half, and outside the urban areas is a mixed package. Every country is different depending on starting points. To give just one example: in Germany, the optimal charge is 50% higher than what will be the new total of charges after the introduction of the electronic charging in August.

The political debate on the expert recommendations went to the ECMT committee of minister's deputies and then to the council of ministers. There were 43 member countries and 34 of the countries were represented by their ministers at the Brussels Council.

Ministers needed to acknowledge the issue of public acceptance to not appear naïve in their conclusions. There is a long running debate over public distrust of increased revenues from introducing charging, especially for congestion. There was the problem of declining revenues in rural areas where ministers felt that they could not ask for increased taxes to cover deficits. This may be a false position as financial ministers do increase taxes every year. The distrust towards increasing revenues needed to be addressed in the policy recommendations.

A tendency for ministers to believe revenue generation was a good thing was found as it increased resources for the ministry. This was a common attitude particularly at the senior civil service level and the recommendation focussed towards using the revenues generated to their most efficient use. And that would be in the first case to reduce the most strongly welfare reducing taxes elsewhere. It was seen as potentially dangerous if ministers got too enthusiastic about the new charges. Ministers liked to talk about the projects in their country

that they wanted to finance, but there were also as many uneconomical projects to be supported as efficiency enhancing investments on their list of projects to be financed. This could lead to difficulties with the ministries of finance. Positive examples were the cross-financing of buses in London and cross-financing of rail in Switzerland. Investment in traffic management was supported by a large number of ministries and was considered as a good use of the revenues. It was seen as important by a lot of the countries traditionally reluctant to consider pricing reforms in the south of Europe, and had very wide support for use of the revenues.

In providing quality alternatives to road, the point was stressed by a lot of ministers but the distinction was blurred as to whether this should apply to specific cases and specific routes or should apply everywhere. If it was applied everywhere, for example financing the railways, Perkins commented that there was the danger of pouring lots of money down a very big hole with little effect. The argument of pushing forward 'acceptance' was seen to have its negative effects too.

The strategy of trucks first then cars was put forward. This received general support, but some felt that it was nonsense not to charge cars for congestions if trucks were charged.

An issue was whether congestion was regarded as an external or club effect. Charging to internalise environmental costs was now accepted even in the southern states but charging for congestion was still resisted by southern countries and regarded with suspicion by peripheral countries. Perkins commented that among many research circles exists the idea that it was possible to charge for congestion if only a more attractive way of presenting it could be found. This way was suggested to be charging on the basis of quality of service. However some did not think it was possible to justify introducing a charge where the service levels were low and congestion was high. It was a difficult argument to push and may not improve the chances of selling congestion charges. Methodologies for the calculation of external costs should be using transparency in the cost elements as a basis for charges rather than accuracy in the estimation of costs. Another common problem of road pricing was the potential regressive impacts of road pricing. The issue was not raised in the debate; this may be because perhaps it was addressed thoroughly.

The biggest argument among the experts was optimising long term supply of road capacity against optimising short term use of infrastructure. Investment in 'Pan-European transport corridors' was seen as the key part of a package for sustainable transport. The argument for optimising current capacity with short run marginal cost pricing whilst making decisions on capacity enhancement separately with social cost benefit analysis appears to be politically accepted. Ministers were believed to be more concerned with investments with high economic value than with the overall capacity of the network. An old issue that came under a new disguise was international equity. Peripheral countries put forward that truck congestion increases the cost of trade and raises revenues that produce compensating benefits nationally but do not necessarily bring benefit to trading partners.

Three final conclusions were drawn based on the principles, evidence and implementation. Much success was found getting across the principle of local charges needed for local costs. Also that local conditions determine charge levels, therefore different remedies were expected in urban and non-urban areas. It was believed that pricing changes should always move in the direction of the first-best and changes running opposite to greater efficiency and improved internalisation should be avoided. Technology was now finally available to implement

charges. On the evidence put forward to the ministers, estimates of the changes in costs for users were found to be extremely useful. The other estimates of changes in revenues, welfare and external costs were useful, but the trick was to attach the welfare gains to something that was politically attractive such as revenues or votes. This is due to welfare gains being a vague concept and will only be pursued by politicians if something more politically concrete such as revenues was linked to them. Another point put across was that the results from pilot systems in London and Switzerland were rated positively. In terms of implementation, top civil servants were very good with areas of inventive second best pricing philosophies and special exemptions from pricing systems. Bad systems or much better systems could be invented, and the shift of collateral strategy does not confer control over what happens to it once it gets into the political arena. It could be evolved or abused. On the quantitative results, it was very important to make explicit the limitations to applicability and transferability. Politicians were found to be real experts on acceptance. They seemed rather more relaxed than the advisors, and required transparency, simplicity and balance. The supply side needed to be addressed when the demand side is addressed. And it had to be noted that experts could become ministers.

An issue that was raised during the presentation was why was there so much consensus in ECMT? This was answered by acknowledging that the European Commission was very different from the European Council of the European Union. ECMT was more relaxed and discussed the long term direction, since it was not so directly concerned with policy implementation.

### **9.3. Discussion**

Discussants at the round table talked about how they saw the situation regarding the implementation of pricing reform, and how to build up support for what was seen as the sensible next steps.

Jim Evans from the European Infrastructure Managers Association said that rail had already got pricing and charging systems. He was looking forward to seeing the new framework paper but was not sure if he shared the view that just concentrating on road was good. When tackling the Eurovignette, it needed to be made clear if there was going to be a major change in road charging or just tweaking the existing Eurovignette.

Gunnar Eriksson from the Swedish government believed that the focus on phasing and the incremental approach in the seminar had been very useful and it had brought research a little bit closer to reality and policy making. Swedish policy had the marginal cost principle since the 1970s and had never really gone for the big bang implementation. From the first incremental step when fuel taxes were differentiated depending on leaded content in the fuel, substantial progress was made in small steps. Currently fairway charges and possibilities of raising cap charges are being reviewed. To raise the existing differentiation, it was suggested that it was not the big bang approach that was needed but a step towards the right direction. For road, the current road taxation was reviewed and incremental steps were considered as a revision to taxation in order to implement the environmental differentiation for heavy goods vehicles and private cars, and also look at the kilometre tax issue.

It was discussed that maybe it was time to forget about talking of marginal cost pricing for two reasons: it was hard to implement and it should go ahead as it was time now to implement it in reality instead for talking about it.

Katalin Tanczos from Budapest University of Technology and Economics, discussed pricing in the newly associated states (NAS). A few of the issues that were raised included:

- The ten NAS were not equal, their commerce was well differentiated. Also from the pricing side, the geo-political position had to be considered as to who are the neighbours. The main European corridors fed their system to the neighbours.
- The local purchasing power in the NAS countries was significantly lower than in the member countries. For example, in Hungary, GDP per capita is approximately half of the EU average.
- It was very difficult to disseminate at home for local politicians, civil servants and decision makers what was to be done because the messages were not clear and not in one direction.

It was discussed whether some modes or issues were regarded more important than others. Were the big problems identified and tackled first? Was there a real shift of opinion?

It was said that there may not be a real shift in opinion. The priority over the next few years was increased differentiation and not pure marginal cost pricing, working on all transport modes.

An alternative opinion was also expressed. There was the directive for railways to set infrastructure pricing. For roads, the real cost element that matters is congestion and the real tension is between cars and trucks. When implementing road pricing, it has to be considered whether we should levy the charges on trucks first and on cars second and could we justify doing it that way. Maybe once truck drivers start paying for congestion on the road, they may start pointing fingers at car drivers.

National policies were found to be different in every country. Cost recovery of railways also differed between each country. German railways tended to have high cost recovery. Charges paid by rail users in Norway only covered 4% of infrastructure costs. No access charges were paid for passenger trains in Norway because Norwegian buses are free on the road, and therefore the government has given passengers on the railway system free access. In the UK, around 55% of access charges were believed to be met by the users in form or another. It was argued that nearly every railway, perhaps with the exception of the German railway, should go along with the concept of marginal cost coverage. The actual expectation of cost coverage is different in every country and something has to be done about this to get a sensible international rail policy.

## 10. Conclusion

This seminar focused on phasing and packaging of pricing reform, concentrating heavily on the results of the MC-ICAM project. It introduced the idea of an implementation path as a sequence of second best optima, resulting from constraints on the implementation of marginal social cost pricing. It found that starting with simple pricing reforms was likely to be the best first step, paving the way for more sophisticated systems later. However second best policies should be treated with caution; wherever possible it was better to remove the barriers that were causing the constraints rather than accept them. Moreover pure second best pricing could lead prices to move in the opposite direction to that ultimately intended, which could certainly cause implementation problems.

Acceptability was considered to be the real barrier to implementation, but there were both theoretical and empirical reasons to believe that acceptability would increase as reforms were implemented. Open, transparent and appropriate use of revenue was very important for acceptability as well as for efficiency and equity. The point was made that politicians might welcome the revenue raising implications of transport pricing reform but would not necessarily use the revenue in an effective way.

A number of important issues were identified for further research. Institutional issues were important, and evidence was provided that inappropriate allocation of pricing decisions between levels of government could cause problems. Although the results of MC-ICAM suggested that well designed transport pricing schemes would have beneficial effects on land use, more evidence on this, on equity issues and on the broader economic effects of transport pricing reform were still needed.

A few comments were raised to close the seminar. It was commented that we are currently at a stage where, in terms of charging, things are looking very encouraging. The London experience has been more positive than expected and many countries are getting interested in doing something better in terms of charging heavy goods vehicles. However the negative side is that things are moving more slowly at the Commission than many participants wished. In particular, the lack of a framework Directive and common methodology paper so far were seen as disappointing. The way forward in promoting pricing reform was not trying to persuade people of the theoretical case for marginal cost pricing but to quantify the benefits. Selling the theoretical case for marginal cost pricing had been tried for many years with little or no success. In London, the Mayor was clearly interested in reducing congestion, improving the environment and improving public transport, rather than in pricing principles. Under his leadership, London has taken the first step towards a more efficient transport pricing system, whether it is explicitly based on social cost pricing or not, and this first step in the implementation path may gradually lead on to moves to extend the area covered by pricing and move on to more sophisticated systems.

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