Sustainable Transport Pricing: From Theory Towards Application

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1 Setting the Stage

Transport in Europe is confronted with increasing problems. Transport Accounts elaborated within the EU research project UNITE\(^1\), for example, show adverse impacts of transport on human health and the environment, but also increasing costs caused by infrastructure extension plans and remaining congestion problems.\(^2\) There is a wide consensus in research, politics and in the public that the ongoing development is not sustainable in the long term and additional policy measures are needed.

What is the contribution of pricing to a sustainable transport policy? This paper aims to give an overview of recent applied research work in the field of transport pricing. Having in mind the considerable efforts of research and policy in the last years\(^3\), this paper does not claim to give a complete overview. Its aim is rather to highlight some of the many relevant issues from a policy perspective: How should a theoretically well based pricing policy look like? How can it be - and how has it been - implemented in the real world?\(^4\) The focus will be mainly on the Alpine crossings, an example for a region with a high relevance of transport problems and pricing issues.

2 Pricing principles: Theory and Application

2.1 Pricing approaches\(^5\)

Not surprisingly, the above-mentioned efforts in research and policy activities to increase the role of pricing in transport lead to different and partly contradictory results and conclusions. One reason for this can be seen in the different functions of prices:

\(^1\) UNITE, Unification of accounts and marginal costs for transport efficiency, http://www.its.leeds.ac.uk/research/index.html

\(^2\) For Germany and Switzerland see Link et al. (2002).

\(^3\) See e.g. ECMT (1998), or, for a recent scientific input, e.g. the Special Issue on Road Pricing in "Transport Policy" 2002 (9/3).

\(^4\) For a more extensive overview see Suter (2002), which partly served as a basis for this paper.

\(^5\) This chapter extremely benefited from the work carried out within the 5th Framework Thematic Network project IMPRINT-EUROPE and especially the overview contained in Nash and Matthews (2001). IMPRINT-EUROPE, Implementing Pricing Reform in Transport - Effective Use of Research on Pricing in Europe, http://www.imprint-eu.org
The price mechanism supports an efficient allocation of scarce goods (static efficiency). Congestion pricing is often mentioned as an efficient mean to allocate scarce network capacity.

Prices set dynamic incentives to change behavioural patterns, to develop new technologies etc. (dynamic efficiency); they can (among other things) reduce the adverse impacts of transport on the environment and human health.

Pricing generates revenues that can be used for financing purposes.

The ongoing debate partly reflects the different weights that are given to these different price functions. Basically, two main approaches can be distinguished in the ongoing discussion:

- The predominant approach in the recent research work at the European level is based on neo-classical micro- and welfare economics and gives therefore special emphasis to efficiency aspects. The advocates of this approach suggest the introduction of a pricing strategy in transport (all modes) that is oriented at short run social marginal costs.

- Opponents of this "mainstream approach" criticize the strong focus put on (static) efficiency considerations. They especially highlight the cost recovery requirements to be met by revenues from pricing. In the sense of departures from neo-classical welfare theory, the emphasis is put on "sustainable dynamic schemes of pricing and investment under institutional constraints".

In the following two sections we give an overview of these two approaches with a focus on the dominating short run social marginal cost pricing (SMCP) approach.

### 2.2 Social marginal cost pricing

The intention to transfer the basic micro-economic pricing principle of short run marginal cost pricing (i.e. to introduce a pricing scheme where prices are set equal to the additional costs of an additional kilometre travelled or trip made) is not new but rather re-emerged in the mid-nineties in the political and academic discussion.

The striking point of this approach is - at least as long as implementation issues are neglected - the theoretically well-based proof that short run social marginal cost pricing (SMCP) leads to an efficient use of the existing capacity of transport infrastructure. If combined with sound cost-benefit-analysis as decision tools for the infrastructure extension, welfare-maximising solutions result in the longer term as well. Also among the advocates of SMCP it is well recognised that these arguments are only valid under assumptions that are far from being met in the real world (e.g. perfect information, perfect markets in the non-transport sectors etc.).

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6 Rothengatter (2001), p. 3

7 However, in the two White Papers following the Green Paper, the statements made about pricing in transport leave much more room for interpretation whether the Commission still considers short run social marginal cost pricing as the only pricing approach to be implemented in all the different sub-sectors of the transport sector.
Against this background, the focus of the recent research work in transport pricing has not been so much on theory but on the ways to overcome the considerable difficulties connected with an implementation of SMCP in transport. Below we discuss some of these areas of research.

2.2.1 Calculation of price-relevant costs and resulting price signals

SMCP needs comprehensive marginal cost information. The "price-relevant costs" can be arranged in three groups, i.e. producer costs, user costs and transport system external costs. For each cost category, difficulties can be found in the cost calculation but also in the resulting price signals. Some illustrating examples:

- **Producer costs (or marginal infrastructure costs)**
  - Difficulties to estimate the additional wear and tear costs.
  - Counter-intuitive price signals because the marginal reinvestment costs are higher for roads with a rather poor road strength. Thus, the price for road users would be higher if they travel on the secondary road network (lower quality of pavement) than on the main road network.

- **User costs**
  - Difficulties in the calculation of congestion costs.
  - Seemingly unlogic price signals: The worse the traffic situation, the more the users have to pay; or: the better the quality (low congestion) the lower the price.

- **Transport system external costs**
  - Large differences in results prevail especially for bottom-up approaches (e.g. impact-pathway approach). They reflect the specific differences in the characteristics of the case study areas. This makes generalisation and transferability very difficult.
  - Information about the impacts on cultural and historical values, forest damages, recreational value of the nature, fauna and biodiversity is still insufficient.
  - In the case of traffic noise, above a very low level marginal costs hardly increase with rising traffic volumes. Therefore, a pricing scheme based SMCP would result in very low prices along/around noisy transport infrastructure with high traffic volumes. It is obvious that such a pricing scheme would not solve the noise problem for those concerned. At least, it would lead to a channelling of transport flows.
  - A similar situation exists for the accident costs where other factors than the traffic volume have a higher influence on the number of traffic accidents. Econometric analysis even show

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8 The application of the theory of social marginal cost pricing in transport has, for example, been analysed in detail within the EU research project PETS (Pricing European Transport System, see Jansson and Lindberg (1997)) and the different publications of CAPRI (Concerted Action on Transport Pricing Research Integration).

9 For an overview of the state of the art see for example van den Bossche et al. (2000) or Lindberg (2002).

10 See for example the results for different European countries given in DIW et al. (1998).


12 The problem of generalisation and transferability of marginal cost estimates is treated in detail in Deliverable 15 of UNITE “Guidance on Adapting Marginal Cost Estimates” (forthcoming). First results have been presented at the UNITE final conference in Leuven, 18-19 June 2002.
that the accident risk decreases with an increase in transport volume, the marginal external accident costs would be negative. It is hardly imaginable that any transport policymakers would propose the strict consequence, namely to subsidise the marginal additional user of the relevant part of the road network. Rather the insight has grown that other approaches are needed than a pricing scheme oriented at marginal external accident costs per kilometre travelled.\footnote{The EC High Level Group on Transport Infrastructure Charging supports, for example, the principle "charging transport users for the costs of the accidents they cause should, as far as possible, be implemented through extension and refinement of the existing insurance system" (Goodwin (2001, p. 27)).}

### 2.2.2 Level of differentiation of pricing schemes

The considerable variations of several marginal cost types according to location, time, vehicle category etc. demands a strongly differentiated pricing strategy to "realise" the potential welfare gains of SMCP. The limits with regard to implementation are well known: Implementation costs and acceptability problems.

### 2.2.3 The issue of cost recovery

In its pure interpretation, cost recovery is not explicitly treated but understood as a residual variable of SMCP. There are studies suggesting that SMCP generates enough revenues to cover the total costs of the transport sector as a whole - others contradict.\footnote{Roy (2000) suggests overall surpluses for France, Germany and the United Kingdom, Maibach et al. (1999) and Wickart et al. (2002) find overall deficits for Switzerland. Different marginal cost estimates used as pricing basis and different road congestion situations are two important reasons for the different results. Nevertheless, because marginal cost estimates still differ that much, cost recovery ratios are strongly influenced by the choice of specific values by the study authors.} The reasons are surpluses in certain parts of the network\footnote{Typically, urban areas are mentioned where congestion pricing in road transport generates higher revenues than needed to cover total infrastructure costs.} and the revenues from the inclusion of transport system external costs in the pricing scheme.

Even if cost recovery is assumed, the question remains: How relevant is cost recovery for the transport sector as a whole? It implies serious distributional effects because those who pay the charges do not necessarily profit from the use of the revenues generated by the charges. In the debate about the implementation of urban road pricing schemes, one insight is confirmed in almost every study: For the acceptability of such schemes it is crucial that the revenues remain in the urban area, other solutions are hardly considered as fair. Thus, there are limits to use the revenues from urban congestion pricing "elsewhere" in the transport system.

If cost recovery is not assumed, funds collected outside the transport sector would be needed to cover the transport sector deficit. Issues like inter-sector distortions and the costs of public funds become relevant topics.
2.2.4 Organisational and institutional issues

The prevailing organisational and institutional structures in transport policy are in most cases not suitable for the implementation of SMCP.\(^{16}\) Often, distributional conflicts occur between federal, regional and local authorities and difficult interfaces between the management bodies of public and private transport.

2.2.5 Conclusion on SMCP

Taking into account the difficulties summarised above, the analysis and derivation of second-best solutions has become the focus of research and is the challenge for the future. Second-best

- because of the need to "average" cost figures for imperfect pricing instruments
- because of cost recovery requirements
- and in order to overcome organisational institutional and acceptability barriers.

Most probably, this new focus will bring SMCP in transport closer to alternative pricing strategies as presented in the next section.

2.3 An alternative pricing approach

The re-emergence of SMCP in transport is not taken without contradiction, neither in the academic nor in the political world. Especially in Germany, alternatives have been developed. The report of the Scientific Advisory Council on Transport at the Federal Ministry of Transport, Construction and Housing outlines an alternative approach. One central difference refers to the treatment of cost recovery: Cost recovery ratios should not be a residual variable of a pricing scheme. Pricing in transport should rather be designed in a way that well defined cost recovery goals are achieved, and this due to different reasons:

- Transport infrastructure is considered as a "club good": It should fully be paid by those who use it (club members). Taxpayer should only contribute if there is a special interest of the general public in the provision of the specific infrastructure or service (e.g. promotion of regional economic development).
- If the users have to pay the full costs - minus public contributions in the case of a special public interest - there is no incentive to overemphasize the need for new infrastructure. In the case of SMCP, such an incentive exists in situations where the extension leads to lower user prices (e.g. because of lower congestion and lower maintenance costs). The low user prices will not cover total costs of the extension. The burden is transferred to taxpayers or to users of other, congested parts of the network.

Pricing schemes oriented at cost recovery can make private sector involvement in the financing of new transport infrastructure easier. Inter- and intramodal competition in transport does not require that a certain pricing principle is defined for the different transport sectors and modes. Fair competition rather requires the same conditions for all transport providers (no discrimination) and harmonised cost recovery ratios for all transport infrastructures in all Member States.

High prices in urban areas caused by congestion pricing under SMCP can have undesirable impacts on land-use by accelerating urban sprawl.

At first sight, the differences between this pricing approach and short run social marginal cost pricing seem large. However, if this approach is seen as a kind of second-best solution for a "SMCP-world", the divergence is much smaller.

2.4 Implementation of pricing approaches

There is an enormous gap between theory and reality: Short run social marginal cost pricing (SMCP) may be dominant in the present discussion in the academic world, but it is certainly not in the political world: The pricing systems rarely rely on SMC which is viewed too complicated rely mainly on financial concerns and are based on long run marginal costs or on average costs.

An example: Pricing the Alpine crossings

The Thematic Network "ALP-NET" has brought together many thoughts and concerns of the last years with regard to trans-alpine transport. The workshop on pricing in September 2002 came to a number of conclusions. Some of them illustrate that pricing policy is more and more seen as the result of a political process and less as purely economic efficiency issue:

- "Multiple objectives - multiple instruments

  In Alpine transport policy, there are multiple objectives and a variety of instruments. Objectives have to be set in a political process. Pricing and financing mechanisms are effective tools but they will not solve all problems. A comprehensive Alpine transport policy needs to include pricing and financing instruments, but should not be limited to those. Additional complementary measures will be necessary.

- The role of social marginal cost pricing

  The pure SMCP concept cannot be realistically implemented. However, adhering to its

17 For a recent general overview see Debande (2002).
18 According to an overview carried out within UNITE, see Quinet (2001).
19 Ecoplan (2002), Trans-Alpine Crossing - Pricing & Financing. The conclusions are of course not binding for the European Commission or any of the other participating organisations.
core principles, it is recommended to develop more differentiated, mileage- or load-related and comprehensive pricing schemes across Europe. Economists alone cannot set right price levels for infrastructure use. The level of road and rail charges has rather to be set according to policy goals, distributional questions and financing needs.

- Harmonisation of pricing systems

In order to avoid distortions, pricing systems in the Alps should be harmonised, following the principles of territoriality and non-discrimination. The cost calculation principles should be harmonised, still leaving a range for the overall price levels. No consensus was reached in the question of setting upper or lower limits to pricing.

Obviously, there is a low socio-political acceptability of SMCP: Against this background, it is not surprising that pricing solutions explicitly oriented at social marginal costs can hardly be found in transport. Rather, some examples exist where elements of both pricing approaches can be found - again suggesting that the differences between the two approaches are probably not as large when it comes to implementation under real world conditions:

- In the case of rail transport, infrastructure access charging schemes explicitly oriented at social marginal costs - however permitting non-discriminatory mark ups to improve cost recovery - are required by the railway directive of the European Commission. In Switzerland, the relevant law demands that the infrastructure access charges should cover at least the marginal costs but can be amended by charging elements taking into account different total costs of the network, environmental and scarcity aspects.

- The well-known urban toll rings around the three Norwegian cities of Oslo, Bergen and Trondheim have primarily been introduced to generate revenues for transport infrastructure extensions and improvements of public transport. This purpose does certainly not correspond with the core idea of SMCP. But they also reduced traffic volume and therefore congestion which gives them a touch of a congestion pricing, a major issue of SMCP.

- For Central London, the introduction of a congestion charging scheme is in discussion. Whereas the idea of congestion pricing corresponds with a core concern of SMCP, the design of the scheme only very roughly transforms SMCP. From 7:00am to 6:30pm, a standard charge of £5 will have to be paid for entering the very heart of central London. It is obvious that this standard rate cannot take into account speed-flow relationships on different roads in different time periods.

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21 For a recent overview, see also Perkins S (2002).
23 For an overview of the scheme see for example Dix (2002).
The Swiss MRHVT (Mileage Related Heavy Vehicle Tax)\textsuperscript{24} is distance-dependant which meets one of the basic requirement of SMCP. The fee rate distinguishes between more or less polluting trucks (EUROI, II and III) but there is no further differentiation (time, location). The rate of the fee was not derived from marginal but rather from average social cost estimates. Looking at the uncertainties in social cost estimation and the wide range of available estimates, the rate may even be a possible "average" value for social marginal costs.

These examples can be considered as first steps in the direction of a social marginal cost based pricing in transport. Extensions and further differentiation in the long run are not out of question though the transaction costs connected with a next step should not be underestimated (new political effort, new technological equipment in-/outside the vehicles, new administrative procedures etc.).

Advocates of SMCP have well realised that only a stepwise implementation path is appropriate to overcome the many and substantial constraints for a successful implementation of "their approach". The ongoing EU research project MC ICAM\textsuperscript{25} examines optimal implementation paths from a situation with low pricing of transportation to a situation with socially optimal pricing. Implementation paths are understood as a sequence of second-best optima, which arise as the set of constraints on pricing changes over time (typically, the number of constraints and/or their "tightness" can be expected to decrease during the course of an implementation path). The following motivations for implementation paths reflect the types of constraints considered:\textsuperscript{26}

- to gain public acceptance over time
- to teach the public to understand increasingly complex pricing schedules
- to reflect that capacity, too, cannot be optimised instantaneously
- to help the regulator get used to pricing - i.e. set up toll collection agencies, acquire experience in automated billing, etc. - in a small scale project or using a simple pricing schedule
- to reflect that the degree of policy coordination between vertically or horizontally ordered governments will change (typically increase) over time
- to reflect that practical and/or technical consideration may prevent simultaneous implementation across modes

According to Verhoef, three archetypes of implementation paths can be identified and may serve as guideline for evaluation within MC ICAM:

- stepwise expansion over sub-markets (e.g. increase the number of priced links of a network over time)
- stepwise convergence to optimal prices over all sub-markets simultaneously (e.g. all links of a network get prices, which move to optimal levels in a discrete number of steps)

\textsuperscript{24} A detailed discussion of the question to what extent the MRHVT complies with SMCP is given in Suter and Walter (2001). For a description of the MRHVT in detail see Federal Office for Spatial Development (2002).


• stepwise (further) differentiation of second-best prices (e.g. increase of the degree of differentiation of prices within a mode over time)

If not everything can be done at once, the question is where to start. Priorities are often set as follows:\(^{27}\)

• Road transport: Introduction of road pricing in congested areas, reform of the charging system for commercial vehicles and especially heavy goods vehicles (incl. taking into account the external costs)

• Rail transport: Adjustment of infrastructure access charges in a non-discriminatory way, prices at or - to comply with cost recovery constraints - above social marginal costs only together with the pricing reform in road transport.

Looking at the development in policy, there is a concern among economists that adjustments (mostly liberalisation) in rail transport are realised whereas the inclusion of external costs in the pricing schemes is foreseen only in a next phase. In particular, it is feared that the market conditions of competition between road and rail transport would worsen for the latter.

3 Impacts of SMCP: Results from Selected Studies

3.1 Effects on prices and transport volumes

In the tables below we have summarised some of the recently published results for marginal costs illustrating the wide range of values given in the literature.

Table 3-1 makes clear how difficult it is to answer to the very relevant question for policy makers: How would the prices change? Obviously, the answer depends on two points:

• the reference case, i.e. the existing pricing and subsidisation schemes in transport

• the choice of the concrete values for the cost estimates

Looking at the range of the values it is clear that from a scientific point of view it is very difficult to make a robust suggestion for the latter. The choice is to some degree arbitrary - and this will not change even if large research efforts may somewhat reduce the range of uncertainty. This should be kept in mind when studies are evaluated that calculate in detail the impacts of new pricing strategies in transport. The "price set" assumed strongly influences the results. Nevertheless, we present some results of such exercises below.

\(^{27}\) See for example Goodwin (2001) and Nash and Mathews (2001).
### Table 3-1: Selected marginal cost estimates, in € / 1'000 pkm

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>European urban average</td>
<td>21.3</td>
<td>Infras and IWW (2000)</td>
</tr>
<tr>
<td>European urban average</td>
<td>7.5</td>
<td>ECMT (1998)</td>
</tr>
<tr>
<td>European inter-urban average</td>
<td>0.17</td>
<td>Infras and IWW (2000)</td>
</tr>
<tr>
<td>European rural average</td>
<td>2.9</td>
<td>ECMT (1998)</td>
</tr>
<tr>
<td>Stuttgart, daytime and nighttime</td>
<td>10.4 - 31.3</td>
<td>UNITE, case study, in Nash and Johnson (2002)</td>
</tr>
<tr>
<td>Berlin, daytime and nighttime</td>
<td>3.3 – 10.1</td>
<td>UNITE, case study, in Nash and Johnson (2002)</td>
</tr>
</tbody>
</table>

Within the research project PETS, a number of case studies has been carried out to assess the price changes and the changes in transport volumes connected with an implementation of SMCP. The issue of uncertainty has been taken into account by defining low and high social marginal cost estimates.

Whereas inter-urban passenger transport seems to be generally overpriced - if started from the social marginal cost rates as assumed by PETS -, this is not the case for freight transport. In one of the PETS freight case studies, "Transalpine Freight", the price changes resulting from an introduction of SMCP for the two modes road and rail freight transport differ between the transalpine corridors in Italy, France, Switzerland and Austria. Table 3-2 shows the results for the most important crossings.

- The values reflect the somewhat arbitrary choice of the "right price" for infrastructure usage mentioned further above: Both, the low and the high values can be supported with available social cost estimates.
- The large differences in the price changes between the corridors reflect the different pricing schemes being in force at present: Whereas in some of the corridors considerable charges are levied (e.g. Gotthard and Brenner) this is not the case for others (e.g. Ventimiglia).

What are the impacts on transport and traffic volume? These effects are summarised as modal split changes in Figure 3-1 below.

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28 The original value is given in € / vehicle kilometre. We use an average German load factor for cars of 1.44 to calculate the figure in € / passenger-kilometre (Source: Infras and IWW (2000), p. 167).

29 The original value is given in € / vehicle kilometre. We use an German European load factor for cars of 1.44 to calculate the figure in € / passenger-kilometre (Source: Infras and IWW (2000), p. 167).


31 We focus on freight. For passengers, see Suter (2002), where the conclusion is: In general it seems that public transport profits from SMCP if rather high cost estimates are assumed. However, the change in modal split is rather limited because of the strong dominance of road transport in the reference case. Only in the urban case study, a significant change in modal split in favour of public transport is assessed.

32 Suter et al., 1999
### Table 3-2: Changes in prices for freight transport, unconstrained marginal cost pricing scenario, in € / passage and in relative terms compared to the base case (i.e. business as usual BAU) (1995 prices, 2010 values)

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Cost estimate</th>
<th>€ / passage</th>
<th>Price change compared to BAU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventimiglia</td>
<td>low</td>
<td>27.6</td>
<td>-44%</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>90.0</td>
<td>+82%</td>
</tr>
<tr>
<td>Mont Blanc</td>
<td>low</td>
<td>39.6</td>
<td>-76%</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>128.9</td>
<td>-23%</td>
</tr>
<tr>
<td>Gotthard</td>
<td>low</td>
<td>37.2</td>
<td>-76%</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>121.2</td>
<td>-21%</td>
</tr>
<tr>
<td>Gr. St. Bernard</td>
<td>low</td>
<td>26.3</td>
<td>-86%</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>85.5</td>
<td>-55%</td>
</tr>
<tr>
<td>Brenner</td>
<td>low</td>
<td>36.5</td>
<td>-75%</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>118.7</td>
<td>-19%</td>
</tr>
<tr>
<td>Schoberpass</td>
<td>low</td>
<td>28.4</td>
<td>-36%</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>92.5</td>
<td>107%</td>
</tr>
</tbody>
</table>

The changes do not only depend on the price changes of Table 3-2 but also on two further points:

- A part of transalpine freight transport is long-distance transport. Thus, the impacts on transport volume also depend on the pricing strategy outside the transalpine crossings. The case study assumes that in the "rest of Europe" social marginal cost pricing is introduced too. The result is that infrastructure usage charges should be lowered if the low marginal cost estimates are assumed (-36.8%), and increased (doubled!) if the high values are used.

- Social marginal cost pricing affects also the rail freight transport prices. Only in the case of the low cost estimate infrastructure usage charges would decrease compared to the base case.

The main findings of the analysis of a change to SMCP in transalpine freight transport found in the PETS case study can be summarised as follows:

- The current pricing schemes in transalpine freight transport do not reflect short-run marginal social costs, neither in road nor in rail transport. In the case of road freight, the need for action is a priority at the European level (i.e. outside the Alpine area) and for the transalpine corridors with low existing charges and tolls.

- The marginal cost pricing scenario does not lead to a substantial increase in rail transport. The cost estimates derived from the literature and additional calculations within PETS are not high enough to change the prices in a way that induces road transport to switch extensively to rail transport.

- Switzerland cannot hold its high share of rail transport if SMCP is introduced. In the case of the low cost estimates, the road transport volume on the Swiss corridors almost doubles whereas it...
decreases on the French and Austrian corridors. First of all traffic from the Brenner and the Mont Blanc divert back to the Gotthard if Switzerland gives up its rail-friendly transport pricing policy.

The results calculated suggest that pricing based on economic efficiency objectives alone will not save rail - if it starts from the price-relevant cost rates assessed in PETS. Substantially higher productivity gains than assumed in the case study are needed if rail wants to increase its market share under a social marginal cost pricing scheme.

Figure 3-1: Change in modal split, unconstrained social marginal cost pricing

- This finding is confirmed by the EU research project STEMM$^{33}$ where the potential impacts of different policy instruments on modal split has been estimated for transalpine freight transport.$^{34}$ A successful liberalisation of the rail freight market and more appropriate pricing schemes in road freight transport proved to be the most effective instruments to make freight switch from road to rail.

Such improvements are especially needed if - as suggested by representatives of the alternative pricing approach - rail should bear its total infrastructure costs in the long term. Calculations

$^{33}$ STEMM, Strategic European Multimodal Modelling, http://www.cordis.lu/transport/src/stemm.htm
$^{34}$ See Ecoplan and MDStransmodal (1998).
within PETS suggest that rail freight transport would largely cease to exist if it had to achieve total cost recovery.

- Further scenarios calculated within the PETS case study show that with additional pricing measures in favour of rail a change in the modal split in favour of rail can be achieved. There might be reasons for such additional measures:
  - In the case of plausible capacity constraints in the road network it might be cheaper to increase the rail share of total transalpine freight transport than to extend the road infrastructure.\textsuperscript{35}
  - The external cost estimates underestimate the real external costs of transport because a range of Alpine-specific cost factors (e.g. impact on bio-diversity, impact on the shelter function of Alpine forests) had to be neglected in the assessment due to the limited knowledge and data availability.
  - SMCP scenarios may entail, compared to the current situation, significantly higher road transport volumes in the case of marginal cost pricing than the public are prepared to tolerate, given the sensitive Alpine environment and sustainability considerations. Or to say it the other way around: If the Alps as a sensitive area should be preserved as an intact living space and habitat, a pricing scheme should rather be oriented at certain politically defined sustainability objectives than on SMCP where Alpine-specific issues are not treated adequately.

3.2 The welfare impacts of changes in transport pricing

According to theory, efficiency or welfare gains are the central arguments in favour of a change to social marginal cost pricing in transport. The open question is how large these welfare gains might be. Within the UNITE project, comprehensive General Equilibrium Analysis has been carried out with Computable General Equilibrium models (CGE models) to assess the welfare, distributional and economic impacts of different pricing scenarios for Belgium and Switzerland.\textsuperscript{36}

In an Alpine context, especially the results for Switzerland are of interest. In the case study, the effects of the various pricing scenarios with elements of both pricing approaches of chapter 2 are analysed.

The results suggest the following evidence:

- The simulations for Switzerland predict a limited increase of total welfare for SMCP in transport (+0.17% and +0.18% for the two “pure” SMCP scenarios). These limited welfare gains should be kept in mind when an implementation of SMCP is considered: The analysis assumed “perfect in-

\textsuperscript{35} In this context it should be noted that the PETS case study did not take into account congestion. However, one can assume that the results would not change dramatically because congestion is first of all an issue for passengers transport (peak loads on a limited number of days, e.g. Eastern or at the beginning of school holidays) or connected with extraordinary events (e.g. closure of the Gotthard and Montblanc tunnel).

\textsuperscript{36} See Mayeres et al. (2002) and Wickart et al. (2002). See also Proost et al. (2002).
Instruments" (i.e. no transaction costs) whereas we mentioned before that sophisticated instruments and differentiated price signals will result in high transaction costs.

- The more flexibly the budget constraint is implemented, the higher is the welfare level. Thus, cross-subsidisation between modes can increase the efficiency of a pricing strategy containing revenue requirements.

- A scenario was simulated where marginal social cost pricing - and thus an internalisation of external costs - is implemented first or even solely in road transport and where the situation for rail transport remains unchanged. This "road-first"-scenario slightly increases welfare.

- There are significant welfare implications of the treatment of foreign traffic and their contribution to revenues.

- SMCP results, for road transport, in an increase in traffic volume, for rail a decrease! These impacts are not in line with the official goals of the Swiss transport policy confirmed in several public votes: Neither a reduction of the adverse environmental impacts of transport would result, nor an increase of the share of rail transport on modal split.

- The impacts on the Swiss economy - measured as changes in GDP induced by the pricing schemes - are more or less neutral or negative. Thus, we don't find economic arguments advocating a change of the existing charging and taxation scheme in the direction of any of the transport pricing scenarios described in this modelling case study. Only in a small number of sectors the impact on the gross production value (or "turnover") exceeds +/-1%.

Again, we stress that these conclusions are valid for the analysis carried out in this case study for Switzerland. They strongly depend on the assumptions made in the modelling work and especially on the cost bases chosen to define the transport prices. Simple generalisation is not possible as a comparison with the results of a similar analysis for Belgium shows. The higher congestion level in Belgium compared to Switzerland and other marginal cost estimates as pricing basis result in higher welfare gains of SMCP.

Our main conclusion from the CGE modelling exercises refers not that much to efficiency implications (which is strongly influenced by the assumptions for the social marginal cost rates and the reference situation in a country); in our view, the studies first of all disclose politically highly relevant distributional effects of changes in the existing pricing schemes.

### 3.3 The Case of the The Swiss Mileage-related Heavy Vehicle Tax

The new MRHVT (Mileage-related Heavy Vehicle Tax) in Switzerland came into force on 1st January 2001 and replaced the existing flat rate. However, at the same time, the weight limit of 28 tons was partially abandoned, which increased logistical efficiency and the attractiveness of the Swiss transit

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37 See Mayeres and Proost (2002).

38 A partial equilibrium analysis carried out for several urban areas in Germany and England is - as expected with regard to the relevance of congestion - more in line with the results for Belgium than for Switzerland (see Mayeres et al, 2002).
routes and hereby compensated to some degree the higher costs of the MRHVT. The following effects have been observed so far: 39

- Traffic on Swiss territory: While traffic increased between 1997 and 2000 with average growth rates of about 5% to 6%, the corresponding period in 2001 saw a clear 4% decrease in traffic. In the first year after its introduction, the MRHVT has therefore not only counteracted the trend towards growth in road haulage traffic, it has even produced a slight decrease in kilometre performance across the whole of Switzerland.

- Traffic on the Alpine crossings: After a steady increase in the years before, the transit of lorries was reduced by 3% in 2001. 40

- Use of Rolling Highway: Since the introduction of the MRHVT a slight increase has been recognised, but it is quite difficult to detect the extent to which the increased number of transported vehicles is due to the MRHVT.

- Fleet composition: The transport industry has adapted the fleet composition to the MRHVT tariff: High-emission trucks have been replaced by new low emission vehicles. Also, the vehicle sizes have been adapted to the goods that are regularly transported (e.g. a carrier buying special low weight trucks if he runs a business transporting paper towels). This process has been noticeable well before the start date of the MRHVT. In Switzerland the truck sales have been booming in the year 2000.

To conclude, this example shows that modern pricing systems can be effective with regard to dynamic as well as to static efficiency, however, the effect for the Alpine crossings is limited so far, since the weight limits were abandoned. Further more, the tax level is not yet at its final level and the lower tax levels in the surrounding countries as well as the poor railway performance are limitations for the modal-split effect.

4 Conclusions

The recent discussion about pricing in transport has been dominated by a re-emergence of the microeconomic pricing principle of short run social marginal cost pricing (SMCP). As long as the discussion concentrated on theory, the simplicity of the approach was a strong argument. However, the “splendour of simplicity” is more and more replaced by complexity and critics, as implementation issues become the focus of attention:

- The strong focus on short run efficiency and welfare gains set by economists is just one viewpoint in transport policy and not the most important one among politicians. So far, fairness or equity considerations (who covers deficits, who gets surpluses?) and financial constraints (cost recovery, the need for private sector involvement) have played a more important role.

39 Based on interim reports of the DESIRE project, see also: Balmer (2002).
40 The period where the Gotthard tunnel was closed is eliminated in these data.
• Though a large number of studies has come up with the proof that the basis for SMCP, i.e. social marginal costs can be estimated, the available set of cost estimates is neither complete (all modes, all relevant cost types) nor robust enough (large uncertainties) to claim that the welfare optimising prices are known. The prices will be the result of a political decision process, and this process will first of all be governed by genuine and controversial interests and only very partly by evidence from research. Therefore, even a further narrowing of the range of plausible cost estimates will not lead to political consensus on price levels.

• Finally, public concerns about the environmental impacts of transport will only decrease if a policy proves to be effective and not solely efficient. In the case of transalpine freight transport, for example, the inhabitants would hardly accept a solution where the modal split changes in favour of road transport - even if they were told that this solution is efficient.

Against this background, there are merely any advocates of SMCP that do not conclude that "pure marginal social cost pricing has to be modified to take all these issues into account". Modification means that second-best issues become the centre of research interest.

Our conclusion is that it is time to merge both pricing approaches because a political path favouring exclusively one approach is unlikely. A number of recommendations – common to "promotors" and "opponents" of SMCP - can be suggested:

• **More differentiation, appropriate incentives**: Both approaches accept that transaction costs will limit the possibilities of differentiation. The assessment of external costs as carried out in the context of the SMCP-discussion provide important inputs to determine which differentiations should have priority. A number of studies and real-world experiences have shown that pricing is a powerful mean to induce changes in traffic behaviour.

• **Territoriality principle**: Both approaches are in favour of less charges and taxes based on the country-of-origin principle and more infrastructure usage related charges.

• **Inclusion of external costs into the charging and taxation scheme**: Both approaches agree, even if advocates of SMCP propose to include these costs in infrastructure charging schemes whereas representatives of the alternative approach suggest a strict separation of infrastructure user charges and taxes for the internalisation of external effects.

• **Cost recovery issues**: Advocates of SMCP have recognised the high importance of financial constraints: Second-best approaches should address exactly this issue (multi-part tariffs, Ramsey pricing). Important points to be addressed in further research should be:
  - For which units (sub sectors, parts of a network) should cost recovery ratios be defined in a second-best world?
  - Should cost recovery requirements be defined - as proposed by representatives of the alternative pricing approach - mode-specifically or is an integrated (intermodal) view more appropriate under certain circumstances (e.g. in the sense of a "least-cost-planning-

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approach" for a defined transport corridor)? The issue of cross-financing would then again become relevant.

- **Optimal use of the existing infrastructure**: This key concern of SMCP especially for urban areas (congestion pricing) is recognised by representatives of the alternative pricing approach. Peak load pricing is seen as one possibility. Land-use planning instruments and improvements in alternative transport modes help to prevent undesirable effects on land-use caused by urban road pricing schemes. For urban areas, where infrastructure extensions are often strongly limited, SMCP may remain the dominant approach. In an inter-urban context, where infrastructure improvements and extensions are a major issue, this will most probably not be the case.

- **Treatment of sensitive areas**: The appropriateness of the SMCP approach is limited because the impact-pathway-approach used to derive marginal cost estimates cannot be applied due to knowledge and data gaps (e.g. impacts on bio-diversity, monetarisation of these impacts). As long as this is the case - a change is not within sight - pricing should be used as a mean to achieve politically defined sustainability goals. One cannot imagine that advocates of SMCP would propose to simply neglect impacts of transport that are a major concern of the public but cannot be expressed in monetary terms.

- **Need for packaging**: The alternative pricing approach emphasises this need because different goals cannot be achieved with one instrument (effectiveness): The SMCP approach sees a case for a packaging of second-best instruments in order to "replicate the full set of incentives given by hypothetical first-best pricing as closely as possible". A pragmatic interpretation of this theoretical statement may bring the two approaches quite closely together.

And finally, we would like to quote the last of the ALP-NET recommendations:

*Science in general and economics in particular cannot provide sound answers to all questions of policy makers. Many decisions have to be taken politically rather than based on pure economic theory. On the other hand, this does not mean that economics has nothing to contribute to real world pricing systems. In any case, today's knowledge is good enough to start acting immediately!*

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43 Ecoplan (2002).
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