THE EXTERNAL EFFECTS OF TRANSPORT

Monitoring and development 2002

Summary

SIKA Report 2003:1

Preface

This report has been produced to comply with the request for a presentation of the development and calculation inputs on the external effects of transport, envisaged in the official document placing the government grant at SIKA's disposal for 2002. The report contains updated calculations of the external effects of road and rail transport and a description of how these effects relate to current taxation and charges.

The report also contains a description of the development inputs made within the framework of the commission and which are based on material produced in various projects carried out or commissioned by SIKA and the transport agencies. Some of the memoranda ordered by SIKA for the project are presented as annexes.

The ongoing work of developing common principles and methods for determination of the EU Member States' infrastructure charges is also examined. This should be regarded as a preparation for a more detailed examination of the contents of the method-focused "communication" that the Commission has promised to present to the Member States in spring 2003.

Consultation has taken place in the reference group, which has served for a couple of years now as a forum for co-ordinating and discussing the direction of SIKA's work and the transport agencies in the recurrent marginal cost assignments. The responsible contact persons in 2002 have been Stefan Pettersson for the National Rail Administration, Lennart Bergbom for the Civil Aviation Administration, Henrik Swahn for the National Maritime Administration, Lars Bergman for the National Road Administration and Gunnar Eriksson for the Ministry of Industry, Employment and Communications. Per Norman, Vinnova and Gunnar Lindberg, The Swedish National Road and Transport Research Institute (VTI) have also regularly participated in the group's meetings.

Per-Ove Hesselborn has been SIKA's project manager and has been responsible for compiling this report. Sections of the report have been contributed by Martina Estreen (chap 6.1), Anna Johansson (chap 8), Joakim Johansson (the section on railway noise in chap 5.2) and Roger Pyddoke (chap 7). Göran Friberg and Anders Wärmark from SIKA have also made contributions.

There are four annexes to the report, which are being published in a separate part. Material from the transport agencies is being presented in separate reports which will be made available on SIKA's website.

Stockholm, February 2003

Staffan Widlert
Director

The development of transport policy

The white paper on European transport policy presented by the EU Commission in 2001 underlined the importance of charges policy and the Commission announced that it would make proposals on a directive in 2002, among other things, "setting out the principles and structure of an infrastructure charging system and a common methodology for setting charging levels". The Commission has subsequently announced a *communication* enabling the countries to examine the principles for calculation of marginal costs that the Commission plans to draw up. The proposed framework directive on the structure of the infrastructure charges has thus been delayed.

In Sweden, the new Goods Transport Delegation has been given an overall role in this sphere. As part of its work of recommending measures to develop an efficient goods transport system, they are also to "consider forms for achieving an effective system of price signals that contributes to internalising external costs".

As a component in the implementation of the "European rail package" that includes common legislation on track charges, the Railway Commission presented an interim report in May 2002 on new railway legislation – *Rätt på spåret [On the Right Track, in Swedish]*. Parallel with this, the National Rail Administration and SIKA have carried out work focused on investigating charges. This work was presented in April 2002 *Nya Banavgifter? Analys och förslag [New Track Charges? Analysis and Recommendations, in Swedish]*. Both reports have been circulated for comment. The Government Offices are currently in the course of drafting a bill based on this work.

During the year, the Road Transport Commission has analysed taxes and charges in road transport. The commission's remit is to review the whole of the road transport tax area, including calculating the cost responsibility of the transport sector. Among other things, the commission is to make recommendations on how a Swedish kilometre tax system for heavy goods transport might be designed. An interim report included a recommendation on environmental differentiation of vehicle tax for heavy lorries. At the same time, a proposal was made to increase vehicle tax for buses/coaches and lorries with a total weight of at most 3.5 tonnes. The interim report has been circulated for comment. The matter is now being considered within the Government Offices. The commission is to present its final report by 31 December 2003.

The EU Commission has announced that it intends to make a new proposal on road charging legislation. The Commission has stated that the proposal is to be presented during the first six months of 2003.

A review of sea transport charges is presently taking place in the Government Offices. This work aims at developing a charging system that better reflects the marginal costs of transport, thus achieving more effective and fair charges. The work is taking place in close collaboration with the Swedish Maritime Administration and the marginal cost study.

The most important transport issue on the EU agenda during the Danish Presidency in the autumn has been the common European airspace. The original proposal made by the Commission contained a formulation on route charges that opened the way for marginal cost-based charges. Sweden was one of the few Member States that supported this proposal. When the transport ministers achieved a compromise on 5 December, the issue of marginal-cost differentiation of route charges had been removed, however.

Within the Swedish Civil Aviation Administration, development work is currently taking place on the nitrogen oxide charge. When introducing a developed charge, consideration must be taken to the possibilities of creating a harmonised charge system in the European civil aviation organisation, ECAC. However, according to the official document placing the government grant for 2003, the Swedish Civil Aviation Administration is also to study the feasibility of basing a further-developed emission charge on the social marginal costs.

UNITE – principles, methods and calculation results

As preparation for examining the Commission's planned communication, SIKA has attempted to identify and assess the proposals on principles for charging and methods for cost calculation that the Commission has had developed to date and presented in various documents. The recently completed UNITE project, financed by the EU Commission, then appeared to be the starting point that was closest at hand when looking for charging principles and calculation methods, that the Commission can be assumed to be willing to propose.

Within UNITE, it is established that charging is to be based on the short-term external marginal costs. The charging principles are the same that apply in Swedish transport policy. However, UNITE wishes to include a couple of components that have not been given closer attention in Sweden to date, namely the costs that operators have for changing capacity and changed user costs in the form of what is known as the Mohring effect. SIKA makes the assessment that it may be necessary to clarify the importance of these components in future work on marginal costs in Sweden.

The ExternE method is recommended to calculate the costs of air pollution. This is the method recommended in ASEK3, which we started to apply in pilot studies aiming at calculating the emission costs of sea transport and air transport.

In the case of carbon dioxide emissions, UNITE recommends that the valuation be based on a calculated cost for complying with the EU Member States' commitment within the framework of the Kyoto protocol, to reduce emissions by eight per cent in relation to an average year for the period 2008–2012 and in relation to 1990. This raises the question of how Sweden is to react to any proposal from the Commission that entails that pricing of carbon dioxide emissions from transport is to be based on the principle recommended by UNITE.

The UNITE project also presents the results from a number of case studies from various European countries. In order to obtain a better picture of the methods used in the case studies and of the results in terms of level and variability for individual marginal cost components, SIKA has commissioned Gunnar Lindberg, VTI [1], to examine the material with the focus on choice of method, the estimates obtained and how these vary between studies (see Annex 1).

It is clear that the case studies do not produce any clear picture of the size of the marginal costs that are relevant to charges or how marginal costs of different kinds differ from country to country. The target area for different estimates of a particular external effect is often large and a number of estimates must be regarded as very uncertain. The conditions for transfer of results from one country to another do not seem to have been examined in detail.

Marginal cost estimates in different modes of transport

Road transport

The National Road Administration presents development initiatives and new calculations regarding the marginal *wear and tear costs* of road transport.

As expected the weight of vehicles has a great impact on deformation. The sensitivity of different types of road to deformation moreover varies: the cost is approximately four times as great per kilometre for those with the lightest traffic compared with the most heavily used roads. The values now produced are consistently lower than those we last used.

In last year's *emission cost calculations* a correlation term was applied for emission factors in built-up areas which increased linearly with the density of population. As the National Road Administration now points out, this was an improvement compared with previously, since only one emission factor per vehicle type had been used for built-up areas. Work has continued and the intention of this year's contribution is to show how more situation-specific emission factors could be produced as a basis for marginal cost estimates.

Through its study, the National Road Administration has shown the possibilities of estimating marginal costs in built-up environments in a more nuanced way with the aid of existing emission databases. The National Road Administration considers at the same time that the design of the existing databases is not optimal for this purpose and discusses what would be required to make possible an approach to more situation-specific estimates of emission costs.

SIKA has commissioned Gunnar Lindberg to produce a memorandum, summarising the state of knowledge with regard to *accident costs* that are relevant to charging (see Annex 2). Lindberg emphasises that a charge corresponding to an

[1] Gunnar Lindberg is in charge of the "marginal cost theme", the research project that is being carried out at VTI with the aid of funds from Vinnova, Banverket and National Road Administration and focused on producing a basis for an application of the marginal cost principle in different modes of transport.

external accident costs is not sufficient to produce optimal road safety. It gives an optimal traffic volume but does not generally lead to optimal driving conduct. Lindberg also discuss externalities related to the driver's choice of speed and possible interventions to correct these.

Lindberg has also examined the method for determination of marginal noise costs that the National Road Administration produced earlier. He has compared the method with the impact pathway approach recently introduced within UNITE. Lindberg compares the two approaches with one another and identifies a number of tasks for further work.

Rail transport

Mats Andersson, VTI, claims in an appendix to the Swedish National Rail Administration's report that it may be possible to obtain a basis to enable econometric estimates to be made similar to those previously made in Johansson and Nilsson (2001), the study of the maintenance component in wear and tear costs that was presented in the track charge report. However, he points out that accessibility to the necessary data requires an energetic participation on the part of the Swedish National Rail Administration. He also makes recommendations as to how it would be possible to tackle the data problems. This entails developing (and maintaining) transport, infrastructure and cost data. However, the Swedish National Rail Administration draws the conclusion that it is now practically impossible to calculate reinvestment cost through econometric studies – or by studies based on degradation models.

The National Rail Administration has initiated a review of the marshalling yard charge. The initial analysis of the material indicate that the cost per marshalled goods wagon has increased since the last occasion on which it was calculated in 1986. The National Rail Administration intends to develop the analysis of marshalling costs and to investigate the possibilities of estimating the marginal cost in 2003.

Kågeson has been commissioned by SIKA (see Annex 4) to examine new assessments of the composition of marginal electricity production and the social marginal cost of changed demand for electricity in the Nordic countries. The new assessments also specify coal condensate as the marginal type of production in the Nordic power system.

In its documentation report, the Swedish National Rail Administration states that an attempt has been made to estimate marginal noise cost but a number of problems have been encountered. The Swedish National Rail Administration underlines at the same time that the marginal effect of railway noise is probably small.

SIKA considered in conjunction with the track charge commission that the marginal cost of noise in many cases could be considerable and it should also be possible to estimate it. SIKA has now proposed a work procedure to be applied

when calculating the marginal noise cost of rail transport. SIKA considers that information is available for indicative estimates.

Air Transport

In its report, the Swedish Civil Aviation Administration presents a case study of the *land infrastructure costs* for the Stockholm-Gothenburg route. The result is that the airport-related charges with a marginal cost-related charge system are only approximately a tenth of the costs now paid.

The Swedish Civil Aviation Administration previously investigated the correlation between *wear and tear on the runways* and the volume of traffic. The conclusion was that it was not possible to find any correlation, so that the marginal wear cost was assumed to be zero. This wear component has now been calculated for our three biggest airports and for aircraft of different sizes to be in the interval of SEK 6.60 to SEK 24.20 per landing.

The Swedish Civil Aviation Administration states that marginal cost estimates are still lacking for the part of air transport services that do not relate to the airport itself. In order to cover this gap in knowledge, a study of marginal costs for *"Area Control Service"* (ACC) was initiated in autumn 2002.

The calculation of *congestion costs* is said to be included in the aforesaid study to some extent, as well as calculations of *costs to maintain an unchanged traffic safety level* in the event of changes in the volume of traffic. The latter type of costs could be an expression for the marginal accident cost.

Together with SIKA, the Swedish Civil Aviation Administration has commissioned a consultancy input during the year to study *the local and regional environmental effects of exhaust emissions from air transport when taking off and landing*. This study started in the autumn and the results will be presented in spring 2003.

The climate effects of emissions from air transport have been taken up on the basis of a study from UN's climate panel (IPPC). Compared with the Swedish Civil Aviation Administration's interim report in June 2002, the estimate of the effect on climate of vapour trails has been greatly reduced. The *climate cost* for an example flight between Arlanda and Gothenburg has been calculated.

Sea transport

Nothing new has been presented in the Swedish Maritime Administration's report on marginal costs of fairway activities, although the agency points out that it may be motivated within the framework of the ongoing review of service levels in pilotage, fairway activities and ice-breaking to deepen previous analyses of marginal costs.

The UNITE project has reported research results that are relevant for calculation of the marginal costs of sea transport. One project relates to *marginal costs for*

port service in Swedish ports. For ports in locations with very limited land area, the short-term marginal cost (excluding environmental effects) can be said to be substantial, mainly due to congestion effects in goods handling and queuing time for ships.

Gunnar Lindberg has dealt with the accident costs of sea transport in another UNITE project. The question is if there is any marginal external accident cost for sea transport and, if so, whether it is relevant to include a component of this kind in a charge that depends on distance. Lindberg takes the view that there is nothing to indicate that any large accident cost exists that is relevant for charges. However, he underlines that neither the cost for oil discharges nor for so-called catastrophic accidents have been included in the analysis. Due to the design of the limitation rules, the external component can also be considerably larger in the case of more serious accidents.

The Swedish Maritime Administration considers it important that the work started in the study on the external accident costs of sea transport can be developed and deepened.

The Swedish Maritime Administration reported in the interim report submitted to the government in June 2002 on the result of the study jointly commissioned by SIKA and the Swedish Maritime Administration to calculate the emission costs of the emissions of sea transport to air by the "ExternE method". The main part of the work input has subsequently been devoted to developing the system described in the interim report to calculate the emissions of sea transport to the air and the related damage costs in approach fairways and ports. The calculation system has been limited to territorial water and Swedish inland waters.

The Swedish Maritime Administration stresses that the large individual variations between ships and fairways mean that pricing must be supported by disaggregated calculations. The Swedish Maritime Administration can also now present such differentiated calculations of emission costs. Detailed emission calculations have been commissioned by the agency. The result of the calculation is presented in the Swedish Maritime Administration report.

The congestion costs of road transport

An attempt has been made to summarise the state of knowledge with regard to calculation of marginal-cost based congestion charges in large cities. A review has been made of existing model systems and the effect correlations normally used. SIKA considers that it is possible to make at least a rough estimate of optimal charges.

Two studies are referred to in which optimal charges have been simulated for all road links in Stockholm county. Studies show that marginal costs vary markedly for different links. In central Stockholm, the optimal charge level considerably exceeds the energy tax on petrol, while the difference is small in the outer areas.

According to the calculations made, it would be possible to realise a socio-economic net benefit of between SEK 2 and 3 billion annually with an "ideal" charge system. Calculations also indicate that it would be possible to realise as much as two-thirds of the net benefit even with charges that were half of the optimal level.

The extent of internalisation and fiscal effects of marginal-cost based charges

The report contains updated calculations of the external costs of road and rail transport and a presentation of how these effects relate to present taxation and charging.

In the case of *road transport*, wear and tear and deformation costs have been calculated based on new estimates presented by the National Road Administration. The new estimates that have been produced with an econometric method based on statistics for Västerbotten and Norrbotten, are consistently lower than those presented previously. No new information has been produced for the remaining marginal cost components associated with road transport for which estimates exist – accident costs, emission costs and noise costs. However, an upward index adjustment has been made with regard to price movements and changes in real income. This upward adjustment has a considerable effect on the aggregated marginal costs. These increase in the range of 10–20 per cent depending on the type of vehicle and the location of transport (countryside/rural areas).

The aggregate marginal costs exceed taxation for most of the types of vehicles included in the estimates. The exception is cars with catalytic converters in rural transport, which pay more tax than their marginal cost. Overall, marginal costs are met to a greater extent in rural transport than in urban. In general, cost coverage is also lower for transport by diesel than by petrolyvehicles. Compared with the results presented in the previous years' reports, the gap between marginal cost and taxation (energy taxation) has increased. This is because estimates of marginal cost are adjusted upwards according to index but also because of a slight reduction in energy taxation.

If a differentiated kilometre charge for cars and different types of heavy vehicles based on calculated marginal costs is introduced, at the same time as energy tax and vehicle tax are abolished, government revenue will increase by approximately SEK 9 billion to SEK 26 billion. To this should be added income from value-added tax on fuel. After a change of this kind, transport in urban areas will meet a considerably larger proportion of the taxes/charges paid.

No new estimates have been made for marginal costs for *rail transport* compared with those presented when the track charge report was produced. The cost components for which estimates exist – wear and tear, accident and emission costs – have been adjusted upwards by index in a similar way as for road transport.

The track charge system is intended to include marginal-cost based charges, although the marginal costs calculated by SIKA give large discrepancies from the present charges for a number of charge components. If the track charges are set to equal estimated marginal costs, the track charges would be reduced for passenger transport by SEK 86 million. The figures then include diesel tax. At the same time, we would have a reduction of charge income by approximately SEK 80 million.

If a general energy tax at SEK 0.229/kWh on electric train transport were to be introduced, according to earlier recommendation from SIKA, the income from rail transport would increase by approximately SEK 500 million.

THE SWEDISH INSTITUTE FOR TRANSPORT AND COMMUNICATIONS ANALYSIS

The Swedish Institute for Transport and Communications Analysis, SIKA, is an agency that is responsible to the Ministry of Industry, Employment and Communications. SIKA was established in 1995 and has three main areas of responsibility in the transport and communications sector:

- To carry out studies for the Government
- To develop forecasts and planning methods
- To be the responsible authority for official statistics

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