INTERNALISATION OF EXTERNAL COSTS OF GOODS TRANSPORT

Summary in English

SIKA Report 2003:6

The Commission

This report is an interim report on current calculations of marginal cost, which are relevant for charges, with the focus on goods transport, as envisaged in the official document placing government grants to SIKA for 2003. The most recently reported marginal cost calculations (see SIKA Report 2003:1) have been tested with new material presented in documentation reports submitted to the Government at the end of April 2003.

The report starts with a description of the current transport policy prerequisites for infrastructure charges within the EU, a review of the Swedish freight transport market, and current calculations of the external costs of goods transport and how these relate to present infrastructure charges. The issue is then taken up of how infrastructure charges for goods transport should be framed to produce the intended controlling effects. Finally, the effects on the distribution of transport performance are calculated of a transition to infrastructure charges based on estimated marginal costs.

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Transport policy prerequisites

The proposed framework directive on infrastructure charges promised by the EU Commission has still not been presented. The draft text which was previously produced has got stuck in the Commission's internal process of preparation. The issue has now been postponed to the indefinite future.

As regards the conditions for determination of road charges, the Commission refers to a new "Euro tax disc directive". This is to include "a Community strategy for infrastructure charging" and "set the conditions for cross-financing planned in the Commission's white paper on a common transport policy". It is stated that a directive of this kind is to be presented in June 2003 although contacts with the Commission indicate that there is a risk of delay.

This means that it is probably only within the road sector that charging legislation will be discussed in the near future. The railway legislation, according to which charges were to be based on marginal cost, has been decided and is in the process of being introduced. As for sea transport, there is no reason to expect that Sweden will have to adapt to European legislation during the next few years in this area.

The Swedish goods transport market

The goods transport market can be examined from different perspectives. It is most common in the context of transport policy to describe the transport market from the supply side, i.e. to take the various modes of transport as a starting point. If the analysis stops at the development of the various modes of transport and

market shares, there is a risk that important correlations will not be taken into account. The most important driving forces underlying the development of the goods transport market in the longer term must then be sought in the changes taking place in the demand for goods transport. With the demand side as the starting point, it will also be clearer that the goods transport market is highly differentiated and that it consists of many market segments with very differing conditions. The picture of the lines of development that apply in the goods transport market will then at the same time be a lot more complex, which can motivate a more nuanced assessment of the effects of different changes in charges as well.

A breakdown of goods transport performance by commodity groups and modes of transport illustrates the existence of well-defined market segments. Distinct market segments for import/export by sea transport and short-distance transport/distribution by lorry exist for the commodity groups oil products, soil and stone, timber goods, crude oil/coal and agricultural products, wood products, round timber, chemicals and foodstuffs, However, there is an additional market niche for some commodity groups – usually characterised as medium distances, relatively large transport volumes and low commodity values – where rail transport in certain cases is an alternative.

For the commodity groups, paper and pulp and iron ore and scrap, the railway niche has expanded and now accounts for the largest market segment. These commodity groups are characterised by export goods with rather low commodity value that are transported in large volumes in regular flows and which are suitable for system transport arrangements.

Steel products are a commodity group which has many features in common with those mentioned above, for instance, the commodity group is a large export product. The average commodity value is higher, however, which, among other things, leads to increased demands for transport time and transport frequency. This is reflected in the railway at present fully dominating the more long-term market segment for this commodity group. In the case of the commodity group finished products, which can take a large number of forms, there is a further increase in average commodity values. The requirements on delivery times, delivery frequency, and flexibility thereby become even more accentuated. This is expressed in the fact that lorry transport is also competitive here over longer transport distances.

The conclusion is that the goods transport market in Sweden is highly segmented. The fact that the pattern has been very stable over time also shows that the various market segments have the character of a technical monopoly. The changes in the share of the modes of transport of the total transport market which attract a lot of attention in discussions have accordingly very little to do with the modes of transport taking market shares in competition with one another. Instead, the largest part of the changes are the result of the transport volumes in the different market segments developing at different rates and directions. The changes in demand for goods transport in the various market segments are also generally

more related to the economic development as a whole and the structural transformation taking place in the business sector than to the design of transport policy and infrastructural charges.

However, even if the development of the goods transport market is substantially determined by other factors, it is still important that the charges introduced are effectively designed. The main part of the adaptations that it is aimed to achieve with socio-economic marginal cost pricing will accordingly be expressed as a number of kinds of changes within existing transport arrangements. The total of all these changes may be very important for the Swedish goods transport system. It cannot either be excluded in the more well-defined parts of the goods transport market that marginal-cost based changes will have greater repercussions on the transport structure, for instance, in the form of market shifts between modes of transport. In the longer term, the charges may also have some impact on more basic demand factors by influencing the location of activities and how the commodity flows are organised.

The prerequisites for customers and operators differ considerably for different types of commodities and different modes of transport. A compilation of the number of employees per size class for a Swedish company which carries out passenger and goods transport in and outside of Sweden, shows the high concentration for railways and air transport.

A large part of the sale of lorry transport services is provided by large or medium-sized haulage companies, transport agencies and forwarding agents, special transport companies and lorry centres. The market for lorry transport consists of a number of market segments with a differing degree of concentration. Domestic long-distance transport is dominated, for instance, by a few large companies while forestry transport is carried out by many small haulage firms. Since practically all companies producing products use lorry transport, the customer side is highly diversified.

The railway market is dominated by one operator, Green Cargo, with approximately 84 per cent of the market. The customer side has a concentrated structure, dominated by large companies in the forest and steel industry, among others.

Sea transport can also be divided into a number of market segments. There is also a market segment for ferry and ro-ro-transport in regional systems to Europe, which primarily involves transport by lorries, trailers/swap bodies and railway trucks. Container traffic takes place in an integrated global system, specialised systems (for transport of new cars, refrigerated cargo and high-value forest products) and bulk transport. The operators market is largely international. Over 80 per cent of international transport takes place on foreign ships.

The air goods market has a concentrated structure on the customer side. Some thirty companies account for approximately two-thirds of Swedish exports. On the supply side, there are a number of international Swedish and international shipping agents specialising in air freight.

No attempt has been made in this report to draw definite conclusions about how changes in charges can be passed on at different stages and affect the final consumption of goods transport. However, SIKA intends in further work on marginal costs to deepen the analysis of competition in the various market segments and anticipates being able in this way to draw conclusions of this kind. On the premise that the knowledge of the goods transport market is segmented in large parts, we can anticipate that changes in the distribution of means of transport due to changed infrastructure charges will be relatively limited. This is also confirmed by the model calculations presented in chapter 7. At the same time, it is evident that the redistributions of a given transport performance expected to take place there as a result of the introduction of marginal-cost based charges are not negligible. In particular, the redistribution within a mode of transport would seem to be substantial.

The estimated marginal costs and current infrastructure charges of goods transport

SIKA's most recent compilation of estimated external effects/marginal costs for different modes of transport was made just over six months ago in SIKA Report 2003:1. The development work in this field since carried out by transport agencies has resulted in new estimates of marginal cost for wear and deformation of roads, for average marshalling cost per railway truck and for the marginal costs of sea transport for emissions to air. In addition to this, in spring 2003, SIKA presented new estimates of marginal cost to meet the intermediate objective for carbon dioxide emissions by the transport sector. Otherwise, no new cost estimates have been presented for goods transport.

SIKA has also examined the results from other development inputs for valuations of emissions to air, in particular from the VINNOVA financed ExternE-project, carried out at the National Road and Transport Research Institute (VTI) and TFK. SIKA's review shows that the knowledge of the underlying causal correlations is still uncertain in many cases and that models and calculations are in process of development. Moreover, there are effects for which it has not been possible to calculate any costs since it has not been possible to obtain quantifiable correlations with the chain-of-effect model applied. SIKA's conclusion is that there should not yet be a transition to ExternE-based marginal cost calculations and that the quality evaluation of the ExternE model Swedish application that has been initiated should be continued. Accordingly, the calculations of emission costs in this report has applied the so-called ASEK values throughout.

The costs for wear and deformation, that the National Road Administration has now presented are considerably higher than previously. SIKA makes the assessment that the estimates previously reported were probably an underestimate, but considers that a number of questions relating to the calculations remain which also make the new estimates uncertain. SIKA has therefore decided in this report to apply the values previously reported and to supplement the calculations with sensitivity analyses, in which the new, higher estimates are applied.

In the case of road transport, our estimates show that the marginal cost of heavy lorries in rural transport is approximately double as high as for light lorries. The same relationship applies for the size of the emission cost, excluding carbon dioxide. The emission cost component represents the highest cost portion per kilometre. It is approximately 40-50 per cent for heavy lorries. For light lorries, the emission cost and the accident cost account for approximately the same proportion of the costs. For heavy lorries with trailers, the National Road Administration's new estimates for wear and deformation cost are on a level with the estimates for accident cost and noise cost respectively at low speed.

The marginal cost for heavy transport in urban areas is approximately three times as high as in rural areas. The emission cost is also high in urban areas. It is the largest cost item for lorries between 3.5 and 16 tonnes in weight. However, the noise costs are approximately equal for heavy lorries.

The carbon dioxide emissions account for a high proportion of the total marginal costs for heavy transport. The proportion is higher for rural than for urban transport. In an evaluation of carbon dioxide that corresponds to the present tax rate, the carbon dioxide cost is approximately 35–40 per cent of the total marginal costs. The corresponding proportion of the considerably higher valuation of SEK 2.70/kg. which corresponds to the revised cost to achieve the current intermediate objective for carbon dioxide is as much as 65–70 per cent.

For railway transport, the track charge dominates, which corresponds to a provisional estimate of the marginal costs of track wear. As much as 73 per cent of the rail charges from goods transport come from the track charge. The costs for carbon dioxide emission, for which no charge is presently made, are valued at SEK 1.50 per kg emission of the same size range.

In the case of sea transport, the estimated marginal costs are dominated by emissions to air, which have been calculated for different types of vessels. The estimated emission cost very much depends on the valuation method selected. The total damage cost for emissions in Swedish territorial water has thus been estimated at SEK 1,200 million when applying ASEK values and at SEK 300 million applying the ExternE values.

Comparisons have been made between current estimates of marginal costs and the corresponding taxes and charges in the respective mode of transport. This provides a picture of the extent to which the different variable charges/taxes exist today – energy tax for diesel, rail infrastructure charges for the railway and sea transport charges for goods transport at sea – cover the external costs that are caused by different goods transportation.

For heavy road vehicles, the tax charged is consistently low in relation to the marginal cost. The proportion of the costs covered by the energy tax is approximately the same as for diesel-driven cars – highest in rural areas, approximately 30 per cent, and lowest in urban areas, approximately 10 per cent, if the comparison is based on energy tax in 2003.

For rail transport, SIKA makes the assessment, that the actual marginal costs are considerably higher than today's rail infrastructure charges. It has been estimated that income would increase by approximately SEK 64 million, if the rail infrastructure charges were adjusted to the estimated marginal costs. Income would increase by a factor of three if carbon dioxide tax and energy tax were imposed on electric rail transport.

It is difficult to assess the extent of internalisation for sea transport because of the high level of uncertainty about how to calculate emission costs. According to the assessment of the Swedish Maritime Administration, an ExternE-based calculation, even when it includes certain damage components not included to date (relating to regional effects), is at a considerably higher level than the present level of fairway charges. However, using ASEK as a basis for determining emission costs, the agency's calculations produce the opposite effect; the level of charges would then be considerably higher than the level that now applies.

What should infrastructure charges reflect?

To be able to steer towards efficient solutions with the aid of infrastructure charges, it is required that charges cover the marginal costs, and also that they are differentiated according to purpose. Accordingly, we endeavour to identify the level and variation of five types of external costs – infrastructure, congestion, accident, exhaust emission and noise costs – for different vehicles/craft which at different times use different parts of the infrastructure within the respective mode of transport.

Knowledge of the level and variation of the external costs is still incomplete unfortunately, but nevertheless sufficient to be able to motivate both the introduction of certain charge components and the differentiation of certain other charge components. Accordingly, SIKA considers, for instance, that a noise cost component should now be introduced into the rail infrastructure charge system for rail transport, and that if a kilometre tax system is introduced for lorry transport, it should be capable of differentiating the tax per km according to the vehicle's environment class and the human environment.

The calculations carried out indicate that applying an environmental classification of heavy lorries produces considerable efficiency benefits. It can also be assumed that there are considerable efficiency benefits arising from a differentiation according to wear and deformation costs for different types of heavy road vehicle driven on different parts of the road network. Unfortunately, there are still no reliable estimates of these costs. SIKA regards as desirable a differentiation of track charges according to differences in wear effect from different railway rolling stock that is operated on different parts of the railway system. However, reliable estimates of wear costs are still not available for railway transport.

Kilometre tax systems make it possible to tax heavy transport according to the route travelled, the time and the place where the negative external effects arise. The vehicle tax has like the Euro tax disc the disadvantage that it does not take into consideration the route travelled or where and when the transport takes place.

A kilometre tax system is an excellent way of internalising the external costs of lorry transport. It applies in practice for all marginal cost components except for carbon dioxide, which can be best internalised by fuel tax. A kilometre tax system moreover creates equal conditions for Swedish and foreign hauliers. Diesel tax has a clearer link with the distance driven than the Euro tax disc system although it cannot be used to register the differences in marginal costs arising from when and where transport takes place.

The assessments of the Swedish Environmental Protection Agency and SIKA show that the Road Transport Commission's recommendations on an environmentally-differentiated vehicle tax would only have a small impact on the environment. The environmental effect of a non-environmentally differentiated kilometre tax are calculated to be greater. However, an environmentally-differentiated kilometre tax system, which reflects both the route travelled by the lorry and the environmental class, is assessed as being most suitable to internalise the emission costs of goods traffic.

The Swiss and the proposed German kilometre tax system have been differentiated according to EURO classes. A harmonised environmentally-differentiated kilometre tax at the European level would increase the incentive for lorry manufacturers to offer vehicles in better environmental classes. The corresponding reasoning should apply to the vehicle's "noise classes".

The negative external effects of lorry transport are also affected by the type of human environment. According to a calculation example, the average charge for a lorry transport from Stockholm to Gothenburg is approximately 35 per cent higher if the charge is differentiated according to the type of human environment than if it is only charged on the basis of conditions for driving in rural areas. The higher marginal costs in urban areas can be dealt with by differentiating kilometre tax according to location and time.

A marginal-cost based kilometre tax system should, as in Switzerland, take into consideration the number of kilometres driven on the whole road network and be differentiated according to the weight of the vehicle or the number of axles and according to the environmental class.

Effects of marginal-cost based infrastructure charges on goods transport

The Samgods model has been used to quantify the effects of the distribution of transport performance between and within modes of transport of shifting to infrastructure charges based on estimated marginal costs. These estimates have been made for different cases: for three cases where the effects of a one-sided shift to marginal-cost based charges for road, rail and sea transport is assumed, and a case where these charges are introduced at the same time for all three modes of transport.

In the case of lorry transport, this means an increase of approximately 40 per cent on the kilometre tax based on rural conditions. With a one-sided changeover to

marginal-cost based charges for road transport, it is expected that lorry transport would decrease by just under 6 per cent. If the charge component for wear and deformation is set equally to the approximately three times higher value that the National Road Administration recently calculated, the reduction would be 8 per cent.

In the case of a one-sided changeover to charges/taxes for rail transport calculated on the basis of the principal case with carbon dioxide tax and electricity charges, the charges/taxes for electric trains would increase by a factor of 1.5 and for diesel trains by a factor of 3. It has been calculated that these increase would lead to a shift of goods to lorry and sea transport of approximately 15 per cent. Without the carbon dioxide tax and the electricity charge, the shift of goods to the other modes of transport would be small, less than one per cent.

If the present fairway charges for sea transport (excluding environmental discounts) were replaced one-sidedly by a marginal cost based charge, this would lead to an approximately 70 per cent higher charge burden for domestic coastal shipping, and an approximately 330 per cent higher charge burden on ferry transport. Charges for European and trans-ocean sea transport would at the same time be reduced by 60 and 80 per cent respectively. Only small redistributions between modes of transport are expected in this case. Considerable redistribution effects within sea transport have been estimated, however. Accordingly, it is calculated that ferry transport would lose over 20 pre cent of its transport performance at the same time that cargo vessels would select ports with short entrance fairways to a greater extent than before.

In the case of a shift to marginal-cost based infrastructure charges for all modes of transport at the same time, it is expected that transport performance by cargo vessels would increase by over 5 per cent. Transport performance by lorry is estimated at the same time to decrease by 3 per cent and transport performance by train by approximately 11 per cent in one main case.

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- To carry out studies for the Government
- To develop forecasts and planning methods
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