The impact of air pollution costs on the infrastructure programme – some Swedish results

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1. Introduction

The purpose of this paper is to present some Swedish results concerning the importance for infrastructure programmes of internalising air pollution costs. The work that is presented was done by SIKA for a parliamentary commission appointed in 1994 with the task of suggesting a new transport policy compatible with demands for long run environmental sustainability. The commission delivered a first report on infrastructure investments early in 1996 and the final report about the new transportation policy early in 1997. Decisions on goals and financial resources for investments in road and rail infrastructure were taken in parliament in the beginning of 1997. Decisions on transport policy will be taken in parliament during spring 1998.

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2. The need for an integrated infrastructure planning and traffic policy analysis

In order to be able to decide which transport infrastructure is desirable, one must begin with an evaluation of the future demand for travel and transport. In order to look at the benefits of infrastructure investments a long time-span (40-60 years) is needed, so that the benefits during the entire life expectancy of the investment can be considered.

The demand for travel and transport has to date been closely linked with economic development. But, since economic growth has been hard to predict, errors have been unavoidable.

Predictions have been made even more complicated by the fact that there may now be environmental reasons to restrain the growth of traffic. Therefore, when one evaluates the future demand of travel and transport, both economic development and the effects that arise from the chosen traffic policy need to be taken into account.

A Government Commission on Transport and Communications (“Kommunikations-kommittén”) was given the task of drawing up a national plan for communication, which will form the basis of a new resolution on transport policy. This new resolution is to be passed by the Swedish Parliament in the spring of 1998. In an interim report presented during 1996, the

Commission recommended an approach to infrastructure planning for the period 1998-2007. The commission emphasised that the preparation of a national plan for communication requires external factors in the national economy to be taken into account, and adjusted in one way or another. An attempt was made to integrate the analyses of infrastructure planning and traffic policy.

The approach is based on socio-economic analyses of alternatives with different focuses (on traffic safety, on environment, on regional balance etc.). The purpose of this presentation is to give an account of the impact on the infrastructure programme of one particular alternative, the one that attaches special importance to the objective of a good environment. For this alternative a traffic policy is assumed, that should bring down the transport sector emissions of air pollutants and carbon dioxide to predefined levels aiming at sustainability.

3. The need for reducing different types of motor vehicle emissions

Preliminary long-term *emission targets* concerning the prerequisites of sustainable development, and interim emission targets showing the rate at which the long-term targets are to be achieved, have been developed for Sweden in a project lead by the Swedish Environmental Protection Agency.

Intermediary emission targets, specific for the transport sector, for 2000, 2010 and 2020 have been formulated for nitrogen oxides (NO_x), volatile organic compounds (VOC) and carbon dioxide (CO_2).

While the emissions of NO_x, VOC and other pollutants have diminished considerably the last years, in spite of the fact that traffic volumes have grown, the emissions of CO_2 have increased.

Targets and the outcome predicted for total emissions without any change in policy are shown in figure 1.

Figure 1: Transport Sector Emissions compared to targets (percent)

	2000	2010	2020
Nitrogen oxides			
(compared with 1980)			
Forecasted emissions	-49	-61	-57
Targets	-50	-75	-82
Volatile organic compounds			
(compared with 1988)			
Forecasted emissions	-60	-76	-79
Targets	-50	-85	-90
Carbon dioxide			
(compared with 1990)			
Forecasted emissions	+12	+26	+35
Targets	+-0	-10	-20

As can be seen, the targets for nitrogen oxides will not be reached without further policy action. The target for VOC will be reached by 2000. However the VOC-targets for 2010 and 2020 will not be reached due to traffic growth. Neither will the targets for CO_2 be reached without further action.

These targets for total emissions relate to regional and global damage. The *air quality standard*s, that reflect concern about health risks from pollutants emitted in urban areas, are also important. To avoid exceeding the limit values for concentrations of carbon monoxide and, in particular, nitrogen dioxide, policy measures to reduce the influence from motor vehicle emissions may often be essential. Further reductions of the emissions of sulphur dioxide and particles (both produced by diesel engines) may also be essential.

4. The adjustments and policies available to reduce emissions

Different types of adjustments and policy measures are available to reduce the emissions. Reductions may be achieved with the help of measures related to vehicles and fuels, i.e. by reducing the specific emissions from vehicles, as well as by affecting the demand for transport. This may mean a decrease in traffic, a rerouting of traffic or switching to more environmentally favourable forms of transport. Further improvements may of course be achieved by changes in driving behaviour due to speed limits, signal regulation or other traffic management measures.

Traffic and environmental policies related to vehicles and fuels should probably play the main roles. Land use planning, leading to changes in activity locations that are less transport demanding, may be important in the long run. But what should be the role of infrastructure investments?

New transport infrastructure can reduce total pollution loads as congestion falls, average vehicle speeds rise, and routes are shortened. But road improvements can also encourage vehicle use and increase total emissions. Improved air quality, in areas where limit values are exceeded, may certainly be an important motive for investments in bypasses. But additions to infrastructure capacity should, generally, make only little difference to total emissions of air pollutants and carbon dioxide.

5. Identifying the appropriate emission reduction policy

The policies that are available to reduce motor vehicle emissions imply cost increases leading to more expensive transport. When such policies are introduced the demand for transport will therefore, presumably, go down. A reduction in the demand for infrastructure services should normally lead to a smaller infrastructure program.

The impact of different policies that may be used to reduce motor vehicle emissions to targeted levels may, however, vary significantly. Since decisions taken now on the expansion of the infrastructure will have long-term consequences, it should therefore be important to form some idea, at least, of what the traffic policy will be.

As far as the emissions of nitrogen oxides and volatile organic compounds are concerned it would appear to be possible to develop and use technologies that would enable us to achieve even distant reduction targets for reductions at relatively low costs. Traffic therefore need not constitute a problem in the longer term for these substances.

As far as the emissions of carbon dioxide are concerned, the picture is different. These emissions are not affected by improvements in filtering techniques. A prerequisite for a reduction in the emissions of carbon dioxide, if the amount of transport should not be reduced, is that either the fuel economy of vehicles is improved or that alternative fuels are developed.

Investments in environmentally favourable technology will normally lead to certain cost increases and thus to more expensive transports. Presumably, these cost increases will not, however, significantly affect the demand for transport. Therefore, one preliminary conclusion is that only the policy introduced to limit carbon dioxide emissions might be important in terms of infrastructure programme impact.

Ideally, a cost-effective mix of adjustments may be achieved indirectly by ”getting the prices right”. Such adjustments should be stimulated if the pricing system contained accurate information of the marginal costs of reaching emission targets. To make transport pricing compatible with emission targets (and air quality standards) monetary values could be derived as implicit values that reflect the marginal abatement costs of reaching targeted levels.

Variable transport taxation has been suggested as the method by which external costs of road use – including the costs of motor vehicle air pollution – should be ”internalised”. The tonne-kilometre tax was a distance-related charge that was used in Sweden (and Norway) to internalise road damage costs from diesel-using heavy goods vehicles. Unfortunately, this tax had to be abandoned for reasons of European tax harmonisation in 1993. After that the only variable charges available in Sweden are charges related to fuel consumption.

To work in the way desired, tax bases ought to be strongly correlated with the emissions. But fuel tax increases stimulate car owners to reduce fuel consumption, not emissions. This is a problem because only emissions of carbon dioxide are sufficiently correlated to fuel consumption. Neither is fuel taxation the appropriate instrument to take local cost differences for pollutants into account.

For these reasons the policy maker should not rely too much on variable transport taxation as the solution. Specific cost-effective adjustments identified should also be used as a basis for choosing the appropriate regulatory (and other) measures.

6. The impact of an environmentally appropriate traffic policy on the infrastructure program

As we have seen neither the targets for carbon dioxide nor the targets for nitrogen oxides or volatile organic compounds will be reached without further policy action (only the 2000 target for VOC will be reached). The Transport and Communications Commission has, however, identified a traffic policy that should make it possible to reach all the targets.

To reduce the emissions of nitrogen oxides and volatile organic compounds in a cost-effective way more stringent value limits for vehicle emissions have been suggested. The targets should, roughly, be reached if the value limits are made 15 % more stringent than today.

Emissions of carbon dioxide are assumed to be cost-effectively reduced by a fuel tax that should increase the price of petrol to SEK 12 – about 1.4 ECU – per litre in 1997-prices. This is based on the assumptions that long-term petrol price elasticities with respect to petrol consumption and traffic are -0.5 and -0.3 respectively.

The amount of traffic is predicted to be significantly affected by the price changes. Traffic growth is reduced due to the fuel tax, the predicted increase in traffic being 20 % instead of 30 %. The possibility of achieving the carbon dioxide target with a 20 % reduction between 1990 and 2020 will also, to a large extent, depend on the possibilities of reducing specific fuel consumption of motor vehicles and increasing the proportion of bio-based fuels.

The choice of vehicle technologies to reach targets for NO_x and VOC were assumed not to affect the demand for transport. This is in spite of the fact that investments in environmentally favourable technology may lead to certain cost increases and thus to more expensive means of transportation.

The reduction of carbon dioxide emissions from road traffic (per year) is calculated to be 4.2 million tonnes. A large amount, 2.8 million tonnes, is due to the reduction of traffic growth caused by the tax, while the remaining 1.4 million tonnes are due to improved fuel economy of cars (caused by the petrol price increase).

So, what will the impact of this policy on the infrastructure programme be?

According to the socio-economic calculations road investments should be decreased by 16 % as a result of the reduced traffic growth. The calculations also show that investments in the national rail network should be increased by 28 % because of the increase in the number of rail passengers.

In their interim report the Swedish Commission on Transport and Communication suggested regulation of vehicle fuel consumption to complement a (lower) fuel tax increase. The preliminary proposal of the commission actually was to (1) raise the price of petrol, in real terms, by SEK 0.1 per litre and year between 1990 and 2020. The price of petrol will then by the end of the period be SEK 2.30 per litre and to (2) raise the average fuel economy of new cars to 0.63 litre per 10 km. Today the average fuel consumption of new cars is 0.92.

With this particular combination of policy measures, the costs per driven kilometre will be reduced and the amount of person-km will be higher compared to the case where only the fuel tax is used. It should also be pointed out that the road infrastructure programme with this policy is significantly smaller than in the other case.

7. The impact of a more drastic fuel price increase

The impact of traffic policy on the infrastructure programme is critically dependent on the amount of traffic reduction it causes. Obviously, a further rise in fuel prices will lead to a further reduction in the demand for infrastructure services and to a smaller infrastructure program. To illustrate this a case with a more drastic fuel price increase has been studied.

In this new case the petrol price is assumed to rise to SEK 18 per litre (1997-prices). Private car use is now predicted to decrease to 22.5 billion person-km, compared with 24.7 billion in the SEK 12 per litre case. Compared to that case, the emissions of carbon dioxide will be reduced by about 7 %.

According to the socio-economic calculations, the volume of profitable road investments is reduced by 75 % compared to the situation with a price of SEK 12 per litre.

There may of course be other reasons for a further fuel tax increase than to achieve a cost-effective reduction of carbon dioxide emissions. The fuel tax may be used, for instance, to internalise other externalities from vehicle use. As already indicated, fuel taxation may not be the cost-effective solution to these other problems however.

8. Conclusion

Growing environmental consciousness among people will lead governments to introduce traffic policies that will restrain damaging emissions from motor car use. These policies will typically imply transport cost increases leading to decreased demand for infrastructure services that should affect infrastructure programmes. Thus, when future demand for travel and transport is evaluated to decide which new infrastructure is desirable, not only the economic development predicted but also the demand effects that arise from traffic policy need to be taken into account.

The impact of traffic policy is critically dependent on the traffic reduction it causes. The amount of traffic reduction in turn is heavily dependant on the type of policies introduced to reduce emissions. As a consequence, since decisions taken now on the expansion of the infrastructure will have long-run consequences, it should be important to form some idea of what the traffic policy should be.

More stringent limit values for vehicle emissions should make it possible to cost-effectively meet targets for the emissions of nitrogen oxides and volatile organic compounds. This type of policy measures should not affect the demand for travel and transport significantly.

The fuel tax policy suggested to meet the target for carbon dioxide may however have a significant traffic reducing effect. According to the Swedish study the fuel price increase necessary to reach the transport sector target for carbon dioxide in 2020, imply a significant reduction in traffic growth.

The study referred to in the presentation concludes that the volume of profitable road projects is decreased by 16 % if the carbon dioxide target is to be met with an increase of the petrol price. In this case, rail investments should be increased with 28 %.

A further fuel tax increase – introduced either to meet stricter targets for carbon dioxide or internalise other externalities from vehicle use – should lead to further traffic reductions and changes in the infrastructure programme.

The Swedish study shows that a petrol price increase to SEK 18 per litre will lead to a decrease in private car use by 9 % compared to the base case. The emissions of carbon dioxide are now predicted to be decreased by 7 % compared to the base case. Moreover, a rather dramatic transfer of freight to railways will take place.

References

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