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Road User Taxation in Selected OECD Countries

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FOREWORD

Adopting improved road maintenance policies is a major element of country economic management and has been the focus of the Road Maintenance Initiative of the Sub-Saharan Africa Transport Program (SSATP). One of the key reasons identified by the Road Maintenance Initiative for poor road maintenance is the lack of funding for roads. This in turn has been linked to poor road user taxing policies over the years. Previous work by the Road Maintenance Initiative indicates that this underfunding and poor maintenance of roads has been caused by other factors, including the absence of clear road tariffs, inefficient user taxing policies (particularly with respect to heavy vehicles and fuel prices), and tax structures which are complicated and difficult to enforce.

The public finance literature provides theoretical guidelines on how taxes in general, and road user taxes in particular, should be determined to raise revenue. This paper examines road user taxation in six more successful countries—the United Kingdom, Sweden, Finland, Germany, France, and Norway—and, on the basis of case studies, provides a comparative review of road user taxation policy as well as each country's approach towards determining the actual rate or level of tax. The study should provide insights for developing practical guidelines for improving road user taxation in Sub-Saharan Africa.

This document is one of a series by the Environment and Sustainable Development Division of the Africa Technical Department (AFTES) which addresses policy issues related to the management, rehabilitation, and maintenance of road infrastructure in Sub-Saharan Africa. Although these papers are meant for dissemination among policy makers and managers in African road agencies, many of the lessons should apply to other regions of the world.

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ACRONYMS

BDF	Bundesverband des Deutschen Guterfernverkehrs
BERC	Business Economics Research Centre
CEC	Commission of the European Community
CO	Carbon monoxide
CO_2	Carbon dioxide
CPGC	Conseil Général des Ponts et Chaussées
DIW	Deutsches Institut fur Wirtschaftsforschung (German Institute for Economic Research)
DOT	Department of Transport
DM	Deutsche Mark
EC	European Community
ECU	European Currency Unit
FF	French Franc
FinnRA	Finnish National Road Agency
FIM	Finnish Mark
GIER	German Institute for Economic Research
GVW	Gross Vehicle Weight
IFP	French Institute of Petroleum
ITE	Institute of Transport Economics
MOE	Ministry of Environment
MOF	Ministry of Finance
MOT	Ministry of Transport
MOTI	Ministry of Trade and Industry
N_2O	Nitrogen dioxide
NOK	Norwegian Kroner
NOx	Nitric oxides
OECD	Organisation for Economic Cooperation and Development
p	penni (Finland)
pf	pfennig (Germany)
RMI	Road Maintenance Initiative
SEK	Swedish Kroner
SMC	Social Marginal Costs
SNRA	Swedish National Road Administration
SO_2	Sulphur dioxide
SSATP	Sub-Saharan Africa Transport Program
TIPP	Internal Tax on Petroleum Products
TPA	Transport Policy Act (of Sweden)
UK	United Kingdom
VAT	Value-Added Tax
VED	Vehicle Excise Duty
VOC	Volatile Organic Components

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Annexes

SUMMARY

The objective of this paper is to examine certain issues related to road user taxation in a selection of "more successful countries." On the basis of six case studies, it provides a comparative review of policy towards road user taxation as well as each country's approach towards determining the actual rate or level of tax. The study portrays the decision-making process and the balance between theoretical optimization considerations on the one hand, and broader economic or political considerations on the other. Actual taxes are decided in the Parliaments of the various countries on the basis of many considerations, of which economic theory is just one and often not the most important.

The paper addresses a number of questions about determining road user taxes. First, the institutional framework within which decisions about road user taxes are taken is discussed. The Minister of Finance is generally responsible for deciding the level of taxation, although subject to approval by Parliament during the annual budget cycle. Other ministries (Ministry of Environment, Transport, Trade and Industry) and government agencies (road agency, railway company and railway administration) have a stake in the level of taxation and seek to influence the final decision.

Second, the main considerations taken into account in the determination of road user taxes are identified and reviewed. In studying taxation, economists traditionally focus on the question of how a given revenue can be raised in the most efficient manner. Nevertheless, in practice, governments are forced to take a much broader range of considerations into account. Road user taxes are an important instrument in the achievement of energy, environmental, and broader transportation policy goals. There has also been concern for the impact of road user taxes on trade and industry, and on any domestic motor vehicle industry. Also, recent European Community initiatives to harmonize commercial vehicle taxation will have a profound impact on the way in which road user taxes are determined at the national level. These considerations mean that governments inevitably take a broader view when determining road user taxes and that strict efficiency criteria are often not adhered to.

Third, the paper examines the extent to which the actual structure and level of road user taxes accords with or deviates from an optimal one as dictated by economic theory. In some countries (the United Kingdom, Sweden, Norway and France), studies have been commissioned by the government to look into what an "optimal" structure of road user taxes would look like and how closely the existing structure accords with that. In the remaining countries (Finland and Germany), the question of optimal road user taxes has not been addressed in official publications. Instead, the costs of road use and to what extent they are recovered have been examined. This material allows one to build a basic picture of the efficiency of the present road user tax structure and/or the degree of cost recovery without going into detailed calculations. In each country, road users are required to cover their "costs" although the definition of costs varies (including social marginal costs, public expenditures on roads, etc.).

Finally, the relationship between fuel taxation and the broad-based indirect tax system is examined and some preliminary observations are made regarding the level of the fuel tax in relation to the general consumption tax as well as the determination of indirect tax rates in general. With substantially higher tax rates on fuel than on general consumption, it appears that finance ministries have achieved at least the minimum criteria for efficiency in the taxation of fuels vis-à-vis other commodities (i.e., tax goods with a lower elasticity of demand at a higher rate). However, preliminary observation suggests that, on the basis of narrow efficiency criteria, fuel tax rates may be too high relative to the rate of general consumption taxation, supporting the hypothesis that governments take more than efficiency into account when settong tax rates. More analysis is needed to explain the substantial variation in the ratio of fuel tax rates to general consumption tax rates, and the similarity in fuel tax rates across the six countries.

The focus of this paper is on a selection of developed countries from the OECD. However, it should provide valuable insights for developing practical guidelines that improve road user taxes in Sub-Saharan Africa.

I. Introduction

Experience with road sector policy reform in Sub-Saharan Africa[1] has established that roads are critically under-funded relative to their economic and financial importance. Heggie[2] has attributed this situation largely to the poor road user taxing policies which have been pursued over the years, mainly the absence of a clear road tariff, inefficient user taxation policies (particularly with respect to heavy vehicles and fuel prices), and tax structures which are complicated and difficult to enforce. He notes that any initiative to improve the financing of roads in Sub-Saharan Africa must address the question of taxing road users.

This research was carried out as part of the Road Maintenance Initiative of the World Bank (RMI) and particularly as part of the above work on road taxing policies in Sub-Saharan Africa. The objective was to understand how are road user taxes determined in practice in a selection of "more successful countries." On the basis of six case studies, the paper provides a comparative review of policy towards road user taxation and of each country's approach towards determining the actual rate or level of tax. This involved looking at the decision-making process and the balance between theoretical optimization considerations on the one hand, and broader economic or political considerations on the other. Actual taxes are decided in the Parliament on the basis of a number of considerations of which economic theory is just one, and often not the most important.

In this paper it is important to specify what will be meant by "road user taxes." Road user taxes will refer to the main taxes which road users are required to pay in order to use the road network. These are payments which vary with road use, such as the tax on petrol and diesel and the Scandinavian kilometer tax, as well as payments which are fixed regardless of road use, such as the annual vehicle tax. In some countries (Norway and France) road users are also required to pay tolls. In Norway, the toll is paid in order to enter the central business areas of Oslo, Bergen, and Trondheim. In France, tolls are paid in order to use specific tolled roads. However, while tolls are an important instrument for charging road users in OECD countries, they are not yet of widespread relevance for Sub-Saharan Africa. Therefore, this paper does not look at road user tax policy in respect of such tolls.[3]

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1 Particularly experience gained through the implementation of the Road Maintenance Initiative (RMI), part of the donor-supported Sub-Saharan Africa Transport Program (SSATP) administered by the World Bank.

2 Heggie, Ian (1992), *Sub-Saharan Africa Transport Policy Program: Improving Management and Financing of Roads in Sub-Saharan Africa.* Africa Region, Technical Department, Infrastructure Division. Washington, D.C.: World Bank.

3 Road users are also often required to pay a host of other charges and fees such as parking fees, license fees, motor vehicle sales or purchase tax, etc. However, these will not be included in our definition of road user taxes.

Road user taxes must be distinguished from the general consumption tax paid by road users. In the six countries studied, road user taxes are paid into the general budget and hence form part of the government's overall tax revenues. Indeed, taxes are often levied specifically on road users with the objective of raising general revenues. Nevertheless, road user taxes paid into the general budget will be distinguished from the broad-based, general consumption tax also paid by road users. The general consumption tax, usually the value-added tax, is levied on a wide range of goods and services including road use (through fuel, motor vehicles, etc.). Unless otherwise stated, the term *road user tax* in this paper will exclude any general consumption tax also paid by the road user.

It is also important to make a few points regarding the use of the term *road use costs*. It is by and large accepted in the six countries studied that road users should be required to cover their "costs" and that road user taxes should be determined on the basis of this objective. However, the definition of road use costs varies from country to country, and even within countries, definitions vary according to the use being made of the concept. For instance, for the purposes of calculating road track costs, the Department of Transport in the U.K. calculates the amount of public money spent on construction, maintenance, and policing of roads. External costs are not included as an explicit category in their calculations. On the other hand, in Sweden's 1988 Transport Policy Act, which states the principles by which road users ought to be taxed, road use costs refer to the social marginal costs of road use and include external costs such as accident costs and environmental damage. In this paper, no particular definition of road use costs is adopted. Instead, differences in the use of the term are highlighted as they occur.

In looking at the determination of road user taxes, a number of related questions are addressed. First, the institutional framework within which decisions about road user taxes are taken is discussed (Chapter 2). Second, the main considerations taken into account in the determination of road user taxes are identified and reviewed (Chapter 3). In studying taxation, economists traditionally focus on the question of how a given revenue can be raised in the most efficient manner. Nevertheless, in practice, governments are forced to take a much broader range of considerations into account. Road user taxes are an important instrument in the achievement of energy, environmental, and broader transportation policy goals. There has also been concern for the impact of road user taxes on trade and industry, and on any domestic motor vehicle industry. Also, recent European Community initiatives to harmonize commercial vehicle taxation will have a profound impact on the way in which road user taxes are determined at the national level. These considerations mean that governments inevitably take a broader view when determining road user taxes and that strict efficiency criteria are often not adhered to.

Third, the extent to which the actual structure and level of road user taxes accords with or deviates from an optimal one as dictated by economic theory is examined (section IV). In some countries (the United Kingdom, Sweden, Norway and France), studies have been commissioned by the government to look into what an "optimal"

structure of road user taxes would look like and how closely the existing structure accords with that. In the remaining countries (Finland and Germany), the question of optimal road user taxes has not been addressed in official publications but instead, the question regarding the costs of road use and to what extent they are recovered has been examined. This material allows us to build a basic picture of the efficiency of the present road user tax structure and/or the degree of cost recovery without going into detailed calculations. Finally, the relationship between fuel taxation and the broad-based indirect tax system is examined and some preliminary obeservations are made regarding the level of the fuel tax in relation to the general consumption tax as well as the determination of indirect tax rates in general (section V).

The main difficulty in carrying out this work was the inability, because of the cost and time, of translating much of the country material from their original languages into English. As a result, the reader may notice some lack of detail on a number of points. Nevertheless, the paper synthesizes the findings on road user tax policy and practice according to the themes indicated previously. Although the focus is on a selection of developed countries from the OECD, it should provide valuable insights for developing practical guidelines for improving the taxation of road users in Sub-Saharan Africa.

II. Institutional Framework for Road User Tax Decision-Making

The traditional objective of road user taxation in the OECD has been to raise revenues for general fiscal purposes. However, in the six countries reviewed in this paper, other objectives have operated at different times: road user taxes have been used as an economic instrument for achieving energy, environmental, and of course transportation policy goals. Nevertheless, the objectives for the transport sector have more often been stated in general terms for the sector as a whole, than with specific reference to particular road user taxes. In fact, the latter consideration is often left out altogether. When objectives for road user taxes do exist, they often change over time. And, at any given time, objectives may not be explicitly provided or may conflict with each other. A clear example of conflicting objectives is the attempt to achieve efficiency in the use of the road network while at the same time either subsidizing commercial trucking or public transport, recovering investment costs or raising a given amount of revenue. Economic efficiency is achieved by charging road users according to the marginal social costs of road use. While such costs are substantially higher for heavy commercial and passenger vehicles, yet such traffic is often charged well below even their marginal social costs on the grounds of maintaining international competitiveness, keeping distribution costs low, or encouraging the use of public transport. Also, the need to raise general tax revenues or to cover specific investment costs will require deviation from marginal social costs where these are less than average costs. However, it does not matter so much that conflicting objectives exist as it is often the government's job to strike the necessary balance. It is more important that objectives be clearly specified and the necessary trade-offs understood.

Figure 1: Road user taxes - decision-making and intersted groups

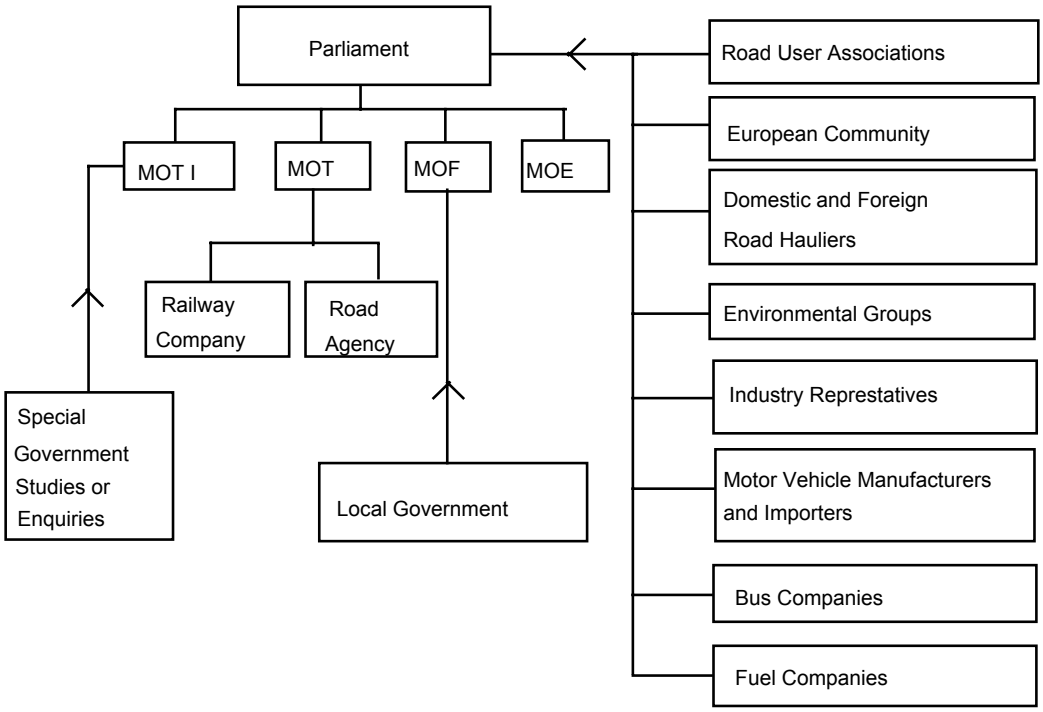

Figure 1 provides a generic illustration of how decisions about road user taxes are taken and what various groups have an interest in the outcome in the six OECD countries studied. It is shown that road user taxes are determined in a traditional way in most parliamentary democracies. Road users and, in particular, fuel consumers are regarded by the Ministries of Finance as an important source of general tax revenue, particularly since the price elasticity of demand for fuel and for road use appears to be low, at least in the short run. Therefore, in addition to paying the general consumption tax, road users are often faced with substantial additional taxes. For instance, although the fuel tax is part of a broad-based indirect tax system (VAT or other general consumption tax), it is usually supplemented by an excise tax.[4] Generally, it is the Minister of Finance who is responsible for deciding the level of road user taxes, as with other central and sometimes even local government taxes. Parliament is ultimately responsible for the final decision, taken during the annual budget cycle in the context of the government's overall revenue requirements and the availability of other tax instruments. The primary question is more often "how much revenue needs to be raised and how much can be provided by road users" rather than "how much should road users pay based on economic efficiency arguments or even road expenditure needs." In relation to the former question, issues of what is politically acceptable become crucial. Parliament is also ultimately responsible for setting overall transportation policy and passing the necessary legislation.

Government ministries are responsible for carrying out their activities within the framework of existing road user taxes. They will also take into consideration how proposed new taxes affect their activities and will bring this to the attention of Parliament. Some ministries are given the task of proposing new road user taxes, evaluating existing ones, or making proposals about various aspects of transportation policy. Certain ministries are clearly more involved than others, in particular the finance, transport, trade, industry, and environment ministries. Alongside the normal work of the ministries, there are often special government inquiries into efficient road taxes, usually carried out with the cooperation of particular ministries and other relevant government agencies.

Certain public enterprises and agencies also have an interest in road user taxes. Where railways are required to cover their financial costs, they are likely to be concerned about the effect of road user taxes on inter-modal competition and will seek from Parliament that which they regard as an appropriate level of taxes. Road agencies, vested with the overall task of actually providing the road network, will sometimes have an interest in the level of taxation since this affects road use and the choice of vehicle weights and dimensions, which in turn impacts upon the costs of maintenance congestion, etc.[5] They are also likely to be involved in any of the special government inquiries referred to above and will prepare technical studies as required.

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[4] Remember, however, that the general consumption tax paid by road users is not included in our definition of road user taxes. See page 2.

[5] Two points should be made here about the provision of roads. First, the "supply" of roads by road agencies does not respond to a price for roads as shaped by the road user tax. Instead, the provision

Local government, consisting of a number of regional units (e.g., county councils, Lander) and several smaller units (e.g., municipalities), may be responsible for deciding certain local road user taxes, perhaps in collaboration with Parliament. Where tax revenues accrue to local government, there is usually a strong interest in the level of taxation and substantial effort is made to influence rates and hence revenues. For example, in the Federal Republic of Germany, vehicle tax rates are decided by the Parliament but with the approval of the sixteen Federal Lander. Decisions are taken after consultation with the Lander and tax rates are then set on a uniform basis throughout the country. Part of the revenues accrue to the Lander and are used to finance road construction. With the highest vehicle taxes in Europe, there has been substantial pressure from road users, particularly road haulers, to reduce these taxes. However, this has been difficult to achieve since such a decision would adversely affect the income of the Lander and the federal government would have to be prepared to replace this revenue.[6] Under the Community Transport Finance Law, the aim of which is to assist local communities to finance transport infrastructure, part of the fuel tax is earmarked for local communities. These funds do not go directly from the federal government to the communities, but through the Lander which distributes the revenues according to geography and mode of transport. In France, vehicle tax rates are decided at the county level within a range set by the central government. Tax rates vary across counties and revenues accrue to the counties. In the Norwegian and Swedish Parliaments, the less populated areas tend to be much more heavily represented in Parliament than the central urban areas. This has had a perverse effect on the allocation of funds for road development. Also, in the case of Sweden, representatives from the North have been reasonably successful in obtaining lower road user taxes for that region, thus reducing the high costs of travel consequent upon long driving distances.

Outside the structure of government, there are numerous other organizations which have an interest in road user taxes and which bring pressure to bear on government decisions. These include primarily road user associations, representatives of industry, motor vehicle manufacturers or importers, bus companies, fuel companies, and the European Community.

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of roads is based on a cost-benefit analysis and on the amount of funds allocated from the general treasury. Second, as roads are provided by a single road agency, there is no competitive mechanism to increase the efficiency with which roads are provided. However in Sweden and Finland, a number of "commercialization" measures are currently being undertaken. Also, in France, concessionary companies compete for contracts to build specific tolled roads although this does not apply to the road network in general.

[6] The motor vehicle tax in Germany was reduced in July 1990 with the introduction of a road fee for domestic and foreign trucks. However, the road fee was subsequently removed and the original level of the motor vehicle tax re-instated when the European Court ruled against these actions in May 1992. This is discussed in more detail subsequently.

III. Important Considerations in the Determination of Road User Taxes

Just as the Ministry of Transport is not the sole government department with a strong interest in the level of road user taxes, so transport economics is not the only consideration in the determination of road user taxes. General considerations of public finance, industrial policy, trade policy etc. are often given greater weight. This chapter identifies six major considerations which have influenced decisions about road user taxes in the six countries studied. They have been identified from documentary sources and through direct discussions with key government ministries (including the Ministries of Finance), agencies, and other organizations with an interest in road user taxation inside each country.

First, road user taxes have been used to help achieve certain *energy policy goals*:

(i) During an oil crisis, a government may wish to smooth out fluctuations in the consumer price of petroleum products. In that case, both oil-importers and oil-exporters will adjust taxes to counter the movement of producer prices. This was done in Finland in 1974 when the government ceased to impose its turnover tax on fuels because of the high oil prices created by the energy crisis. The UK has also used its fuel tax to compensate for such fuel price fluctuations.

(ii) Concern for energy conservation and for reducing the dependence on imported oil (either by reducing the number of kilometers driven or by increasing the fuel efficiency of the vehicle stock) would lead to an increase in the fuel tax. This has happened in the UK in 1980 and Finland in 1990 when the need to control the growth in energy consumption was cited as a reason for increased fuel taxes.

(iii) Concern for the security of fuel supplies in countries with limited resources has led to the imposition of a special tax on fuel to cover the costs of keeping emergency reserves. Sweden had such a special tax on oil products which was abolished in 1985. Germany continues to impose a tax to support an emergency storage fund. In France, an allowance for each firm's own emergency storage costs is included in the fuel producer price, and in Finland, a precautionary stock fee is levied. Such taxes however are not significant as they often amount to only a tiny fraction of the total taxes levied on fuel.

(iv) The availability of alternative sources of fuel often constrains the government's ability to raise fuel taxes. Cheaper fuel in Sweden, relative to Norway, recently created a trade leakage as consumers close to the border crossed over to purchase cheaper fuel there. For this reason, the Norwegian government was

unable to raise fuel taxes in the 1992 budget for fear of aggravating the situation.

Second, road user taxes are an important instrument for achieving *environmental policy objectives*. This is becoming increasingly important as many countries have now adopted targets for controlling or reducing emissions of nitrogen oxide, sulphur dioxide, carbon dioxide, and hydrocarbons. In the transport sector, taxes on road users are the main economic instrument for achieving such goals, and some countries have already introduced a range of environmental taxes. In 1988, the Finnish government indicated its intention to reform the taxation of transport fuels so that the costs of environmental damage would be taken into account. In 1990, fuel tax increases were justified on these grounds, and a supplementary tax was introduced and graduated for petrol according to its lead content. In 1993, the supplementary tax on diesel was graduated to favor sulphur-free diesel oil. In 1991, both Sweden and Norway introduced a carbon dioxide (CO_2) tax on road fuels, and Sweden started to tax diesel according to its sulphur and hydrocarbon content. Norway also imposes a sulphur tax on its diesel. The United Kingdom, France, and Germany at present have no environmental taxes on their road fuels, although the British government is currently reviewing the question. All the countries reviewed have a tax differential favoring lead-free as against leaded petrol.

Third, certain *trade and industrial concerns* have been a highly significant consideration in the minds of governments taking decisions about road user taxes. Most importantly, the interests of domestic road haulage companies in competition with foreign ones have created political pressures in several countries for lower taxation of heavy vehicles. Germany is an interesting case in point. Located in the middle of Europe with good road infrastructure, Germany is a transit country and one of the most important transportation hubs in Europe. This has been accentuated by the re-unification of Germany, the upheaval in Eastern Europe, and the continuing development of the European Community. However, Germany also has the highest motor vehicle taxes on trucks in Europe (DM 10,505 annually in April 1992 for a representative 40 ton truck and trailer) and very high safety standards, putting German truckers at a severe disadvantage compared to their European competitors. This has created strong political pressures for improving the situation, and in July 1990, a Road Use Fee Law went into effect which imposed a tax on all trucks, both domestic and foreign, while effectively reimbursing domestic trucks through the simultaneous reduction of the motor vehicle tax. The collection of this road tax has been temporarily suspended, however, and the motor vehicle tax increased to its original level since the European Court ruled against the German law in May 1992 on the grounds that it was incompatible with European Community law.

Another trade-related concern is the cost of distribution of goods. In many countries, there are concerns that the high road use costs associated with heavy vehicles, if fully reflected in vehicle taxes, would drive distribution costs too high. This concern often leads to substantial undercharging of heavy vehicles relative to the large social costs they generate. That this occurs has been confirmed by government reports on the recovery of road use costs in Norway, Sweden, and France. In neither country does the

receipts from taxes on heavy vehicles cover the social marginal costs attributed to heavy vehicle traffic. An exception to this, however, is the UK where the stated aim of the government with regard to the taxation of lorries is to ensure that road track costs are correctly reflected in distribution costs so as to avoid inefficiencies in the use of the road network for commercial purposes. In practice, in the UK, heavy vehicles, as for all vehicles, pay more than the budgetary costs allocated to them (budgetary costs include investment, maintenance and policing and exclude most external costs). However, heavy vehicles pay proportionally less than other categories of vehicles.

Fourth, the existence of an important domestic *motor vehicle manufacturing industry* has been an important factor in government decisions about taxes on the acquisition of vehicles. The need to provide support for such an industry by encouraging sales of motor vehicles may exert political pressures for low acquisition taxes. Where there are sizeable exports of motor vehicles, this may lead to lower import duties on vehicles so as to avoid retaliation from other countries. In the UK, which has significant production and export of motor vehicles, the car tax was halved in March 1992 from 10 to 5 percent of the wholesale price in order to boost car sales. The UK does not levy duties on car imports. France and Germany both also have sizeable domestic motor vehicle production and export business and there are no taxes on the acquisition of vehicles nor duties on vehicle imports. On the other hand, Finland and Sweden, with only minor vehicle production, and Norway, with none at all, levy sizeable taxes on vehicle acquisition. In Finland, such taxes are levied at the border. For most passenger cars these amounted, as of October 1992, to 122 percent, levied on top of the cif price plus the import duty, less FMk 4,600. Sweden also levies an import tax and a purchase tax on certain vehicles. Norway levies a customs duty, a registration tax, and an import tax. While these observations do not provide sufficient evidence to draw a line of causation from the importance of a motor vehicle industry to the way in which vehicle acquisition is taxed, they do suggest that motor vehicle manufacture and export are important considerations in determining the level of vehicle acquisition taxes.

Fifth, road user taxes have been a key economic instrument in achieving *transportation policy objectives*. In Norway, Sweden, and Finland, kilometer taxes are levied on diesel-driven vehicles, with the objective of charging road users according to their use of the road network and the costs generated by that use (the cost-responsibility principle). If the charges are set at the "right" level (i.e., equal to the marginal cost of the trip), then such a charging mechanism would be ideal for influencing the marginal trip decision, trips being taken only when the benefit to be gained from each kilometer driven outweighs the costs of driving that kilometer. In Sweden, the kilometer tax was also expected to make taxation of the road sector more economically efficient, and to reduce or eliminate the problems of control and tax evasion that occurred with fuel oil taxation. In general, a number of countries have tried to shift the burden of road user taxation towards use-dependent charges such as the kilometer tax and also the fuel tax. There is discussion in Finland about adjusting road user taxes so as to shift the focus from the taxation of vehicle acquisition and ownership towards vehicle use. This was achieved in the UK in 1986 with a freezing of the vehicle excise duty and an increase in road fuel taxes. Such use-dependent charges are better suited for mirroring costs directly related to road use, such as maintenance, congestion, accident, and environmental costs. In an

effort to reduce urban congestion, France is considering varying charges on toll roads by location and time of day.

Influencing the composition of the vehicle fleet towards more road-friendly vehicles has also been an important concern for road agencies responsible for road maintenance and construction. According to the fourth power law, the amount of damage done by vehicles to roads is proportional to the static weight of the axle raised to the fourth power.[7] Based on this law, Britain uses the vehicle excise duty to encourage road haulage operators to choose vehicles which cause less damage to roads so as to reduce the need for maintenance expenditure (although they point out that the vehicle excise duty forms only 2 to 6 percent of lorry operating costs and hence has a limited influence on operator's decisions). In each of the countries surveyed here, vehicle taxes and also the kilometer tax are graduated to increase with gross vehicle weight and, in the case of the kilometer tax, with axle-weight. However, due to concerns about distribution costs and the international competitiveness of road haulage companies, the graduation never fully compensates for the additional wear and tear imposed by the heavier vehicles. Similar considerations also often lead to lower taxes on diesel than on petrol, as diesel is used largely by heavier commercial vehicles.

The encouragement of public (bus) transport at the expense of private (car) transport in order to reduce congestion and environmental damage has generally led to significant subsidization of public transport. In Norway, buses have been exempt from paying the kilometer tax. However, the abolition of the kilometer tax and the increase in the tax on diesel oil which took effect on January 1, 1993 are expected to increase the costs of bus traffic. Concern for the undesirable effects of this on the competitiveness of the mass transportation system in relation to private vehicles has led the Norwegian government to increase the general subsidies normally granted to the mass transportation sector. In Sweden and France, urban public transport is also significantly undercharged.

Countries with railways have used road user taxes to encourage road-railway competition, primarily through avoiding the provision of unfair tax advantages to one or the other. For example, the UK has been concerned with creating the conditions necessary for fair competition among different classes of lorries and between lorries and British Rail's freight business which is expected to operate commercially.

Finally, the present *initiatives in the European Community to harmonize the taxation of commercial vehicles* will probably be the most important influence on the way in which road user taxes are determined in these six countries in the future. These developments started in the 1960s when the Commission put forward a proposal aimed at harmonizing tax structures, ensuring the coverage of at least marginal costs, and

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[7] The fourth power law was derived from large-scale experiments carried out by the American Association of State Highway Officials (AASHO) between 1958 and 1960. Recent work (Small, Winston, and Evans, *Road Work: A New Highway Pricing and Investment Policy*) suggests that the proportionality may be closer to a third power law.

providing options for recovering total costs. The present proposal for a Council Directive, aimed at eliminating distortions and implementing a common transport policy, was put forward in 1991 and is a modification of a 1988 proposal.[8] The proposed measures are:

(i) Introduction of common vehicle tax rates.

(ii) Harmonization of fuel excise tax rates. The proposed range for diesel is 245 - 270 ECU/1000 liters, including a CO_2 tax of 50-65 ECU/1000 liters. Rates would be subject to regular review. It should be noted that a higher tax rate and/or another form of charging will be needed if the average variable road infrastructure costs for heavy goods vehicles are to be covered.

(iii) Application of the principle of "territoriality" to tolls and vehicle taxes as a long-term objective. This means that haulers would pay only for the costs of infrastructure actually used. On toll roads, such costs would be covered by tolls. On the remaining network, minimum community-wide vehicle tax rates would be applied to cover that part of the road infrastructure costs not covered by the diesel excise.[9]

(iv) Harmonization of vehicle weights and dimensions, driving hours and rest times, technical control of vehicles, and requirements for establishing a road haulage business.

Given the long-term nature of the objectives for vehicle taxes, the final system is expected to begin in 1995, with an interim solution being prepared for 1992 through 1994.

A number of points may be noted about the European Community proposals. First, the vehicle tax is ineffective for achieving the principle of territoriality unless vehicle mileage in different member states is ascertained and transfers made where necessary. If this is not done, there will be undercoverage of infrastructure costs by foreign vehicles in countries where the ton-kilometers performed by foreign vehicles at home exceed the ton-kilometers performed by its vehicles abroad. This would be the case

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[8] Commission of the European Communities (1991), Com (90 540 final: *Modification of the Proposal for a Council Directive on the Charging of Transport Infrastructure Costs to Heavy Goods vehicles, (COM (87) 716 final)*, Brussels.

[9] No decision has yet been made by the European Community on the magnitude of vehicle taxes. However various proposals have been produced and are presently in the process of being redrafted. In the latest proposal, a community-wide vehicle tax would be determined in three steps: (i) determine average variable and fixed road infrastructure costs by vehicle category; (ii) determine a single vehicle tax rate for each category of road vehicle (three steps - determine road infrastructure costs by vehicle type, estimate annual diesel consumption by vehicle type, set vehicle tax rate for each vehicle type equal to a certain percentage of the road infrastructure costs not covered by diesel excise (the minimum obligatory rate); (iii) to avoid double-taxation due to payment of both vehicle taxes and tolls, refund proportion of vehicle tax according to number of kilometers driven on toll roads.

in countries like France and Germany where there is usually a net foreign usage of domestic infrastructure. Conversely, countries with a net domestic usage of foreign infrastructure would earn a surplus.

Second, the Commission has adopted a flat vehicle tax system to the detriment of the kilometer tax, based on arguments about the technical feasibility of monitoring odometers (despite mandatory annual technical inspection of vehicles). Given that annual distances travelled vary, this penalizes local and short-haul traffic and favors long-distance and regional/international traffic. Third, proposed vehicle tax rates are based on the assumption that diesel excise taxes are already harmonized. Yet, such harmonization has been assigned to the second stage of tax harmonization. Fourth, external costs have not been included in the cost calculations, since it is not presently considered feasible to determine them. Finally, the vehicle tax will be based upon the allocation of infrastructure costs between vehicle types using the method used in Britain.

The European Community proposals will have a profound impact on the way in which commercial vehicle and diesel taxes are determined in the six countries under review. There will be decreased scope for independent national initiatives as national transport policy becomes increasingly linked to EC policy. The role of the member states will now involve supplying data to the Commission of the European Community which will then carry out the necessary calculations and determine the minimum vehicle taxes and the diesel excise band to be applied in the member states. It will then be up to the member states to set the diesel excise tax within the European Community band and to decide whether to increase vehicle taxes above the floor stipulated by the Commission of the European Community.

IV. Efficiency of Road User Taxation: A Survey of Official Inquiries

So far we have looked at the various factors which generally influence decisions about road user taxes. The actual process of arriving at a tax rate is a political one, involving weighing several factors in order to arrive at an acceptable decision. Nevertheless, in some countries (the United Kingdom, Sweden, Norway and France) studies have been commissioned by the government to look into what an "optimal" structure of road user taxes would look like and how closely the existing structure accords with that. In the remaining countries (Finland and Germany), the question of optimal road user taxes has not been addressed in official publications but instead, the costs of road use and the extent they are recovered have been examined. The results of such studies sometimes provide a more rational basis for political decisions, but there is no clear evidence that these exercises bring actual road user taxes closer to the theoretical ideal. This chapter discusses the methods and findings of some of the recent inquiries carried out in the six countries reviewed. Table 1 summarizes some key points about the studies.

To a greater or lesser extent, official inquiries into efficient road user taxes carried out in the six countries are based upon the results of the current theory of public finance. This theory suggests that all road users should pay the social marginal costs of road use such that the sum of the social and the private marginal costs faced by the last road user just equals their marginal benefit.[10] Any additional taxation for the recovery of fixed costs and the raising of general revenues should be designed to achieve production efficiency, so that distortionary taxes fall only on final consumers. Since road users can be divided into freight transport (intermediate input into production) and passenger transport (generally final consumption), such additional taxes should be levied on passenger transport and other final consumers according to the same principles, established in the public finance literature, which ought to guide the design of indirect taxation. This is particularly so where the provision of roads is a public sector activity (as it predominantly is in the six countries under review) and fixed road costs are just another item of public expenditure forming the overall revenue requirements of the government.

On the basis of the theory, one can identify a number of steps in the determination of road user taxes. First, one must identify the marginal social cost (the extra cost to society) of allowing the last vehicle to make a particular trip *at the point where social plus private marginal costs equal marginal benefit*. Second, it is necessary

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[10] Prior to charging social marginal costs, road users face only their private marginal costs, and demand is such that the marginal benefit of an additional journey is equal to these private marginal costs. If road users additionally become faced with the social marginal costs incurred at that level of road use, then demand will be reduced to the point where the marginal benefit is equal to the (social plus private) marginal costs now faced. Road users would then be overcharged with respect to the new social marginal costs which decreases with reduced road use. To equate charges with costs actually incurred, the relevant social marginal costs are that where total marginal costs (= social marginal costs + private marginal costs) equal marginal benefit.

to recover this cost from all road users through the available tax instruments. One can already begin to see the numerous problems involved in carrying out such an exercise. First, there is substantial variation in the types of vehicles using the road network and the marginal social cost will differ for different types of vehicles. This means that we must either ignore vehicle differences (effectively assuming a single social marginal cost curve) or calculate the social marginal costs for each vehicle category. Second, it is necessary to know the social marginal costs at the optimal level of road use (where social plus private marginal costs equals marginal benefit) rather than at the existing level of road use. To know this, we need information on the demand and social marginal cost curves at their point of intersection. We can begin to see that the informational requirements of accurately evaluating the relevant social marginal costs are substantial.

The third step in the determination of road user taxes is to determine the level of any additional taxes and the means for levying them. Efficient prices are those which are equated to marginal social costs. However, the resulting financial deficits, as well as the desire to raise additional revenues to finance general items of public expenditures, will require raising prices above marginal costs. The literature on optimal indirect taxation establishes that if goods are unrelated in consumption, then the taxes on all final consumer goods should be inversely related to their price elasticities of demand. Furthermore, additional taxes should only be levied on passenger traffic (assumed to be mainly a consumption good) to avoid distortions in production. Organized around these three steps, the rest of this chapter reviews the efforts of the six OECD countries to determine the correct level of road user taxes.

Identification of social marginal cost

Some of the difficulties in determining social marginal costs have already been identified. These were knowing the costs generated by different vehicle categories as well as knowing those which prevail at the optimal level of road use. There are also difficulties in knowing costs at the margin (the cost of the *last* vehicle). Despite these problems, both Norway and Sweden endorse the principle of social marginal cost recovery for road traffic.[11] France, at the time of the adoption of the axle tax in 1971, also endorsed the principle of charging road users their marginal social costs. Consequently,

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[11] See: (i) Government of Sweden (1979 and 1988), *Transport Policy Acts*; and (ii) Government Publication Series: Norwegian Official Commissions 1992:3, *Towards More Cost-Effective Environmental Policies: Principles and proposals for better pricing of the Environment*, Report of the Green Tax Commission. Chapter 11.

the axle tax was designed to cover, together with excise taxes on fuel, the marginal social costs of the non-tolled network.[12]

[12] Commissariat Général du Plan (1992), *Transports 2010: Rapport du groupe présidé par le Commissaire au Plan* (La Documentation Français - Paris). Chapter 2.

Table 1: Official Inquiries into the Efficiency of Road User Taxation

Country	*Inquiry*	*Pricing Principle*	*Costs*	*Main Conclusions*
United Kingdom	The Allocation of Road Track Costs,Department of Transport,annual.	Each vehicle category should cover their road track costs through the fuel tax and the VED.	Public expenditures on construction, maintenance and policing allocated to each vehicle category. External costs excluded.	In 1992/93, all vehicle groups covered their costs. Cars, light vans and taxis paid just over three times the costs attributed to them while buses, coaches and heavy goods vehicles paid just 10 to 20 percent more than their costs.
Sweden	1979 Transport Policy Act	Variable road user taxes should cover social marginal costs (SMC) and fixed taxes should cover remaining fixed costs.	Primarily marginal costs of maintenance and traffic accidents. Costs of air pollution were considered important but could not then be calculated.	
	1988 Transport Policy Act	Variable road user taxes should cover SMC and fixed taxes should cover remaining fixed costs.	Primarily marginal costs of maintenance, traffic accidents and air pollution.	Fuel and kilometer taxes should be based on the following SMC (in ore/vehicle kilometer) for 1987: Rural traffic: private car without catalytic converter-20, Trucks-81, Buses-70. Urban traffic: private car without catalytic converter-87, trucks-192, buses-386. Based on these calculations, all road traffic was undercharged.
	1989 calculations of SMC responsibilities, presented in Hansson.	Based on principles and costs adopted in 1988 TPA.	Marginal costs of road maintenance, traffic surveillance, average congestion, accidents, health and environment for 1987.	Calculations indicate the following degrees of cost coverage: Rural traffic and highways: private car with catalytic converter-93 percent, private car with catalytic converter-76 percent, trucks-70 percent, coaches-55 percent. All road traffic incl. urban: private car with catalytic converter-45 percent, private car without catalytic converter-65 percent, truck-50 percent, coach-40 percent, buses-10 percent.
Finland	1975 Parliamentary Traffic Committee.	Tariffs should be based on cost-revenue correspondence, i.e. each category of traffic should bear its costs		
	Cost-revenue correspondence in road and rail traffic.	Principle of cost-revenue correspondence.	Total network (investment and maintenance), surveillance and administration, and external costs. External costs comprised accident, emissions, congestion, noise and vibration costs	In 1986 and 1987, road traffic as a whole covered all its costs. The study did not look at cost recovery for specific categories of road vehicles.
	1991 Second Parliamentary Traffic Committee.	Full responsibility for road maintenance; tax for pollution and accidents; taxes for use rather than ownership; annual tax on petrol-vehicles related to environmental qualities.	Information unavailable but pricing principle suggests the inclusion of at least total road maintenance, pollution and accidents.	The tax burden rested largely on vehicle acquisition rather than on vehicle use which is preferable. The Committee proposed a structure of road traffic taxes for 1991. Compare to actual taxes in 1991.
Country	*Inquiry*	*Pricing Principle*	*Costs*	*Main Conclusions*

Germany	Calculation of the Costs and Expenditures for the Routes of Railroad, Road, Inland Shipping and Air Traffic in the Federal Republic of Germany for the Year 1987, 1990.	This report only examined the degree of infrastructure cost and expenditure coverage. In the case of roads, revenues from the motor vehicle and petroleum tax were compared with road costs and expenditures. The question of the appropriate levels of the road user taxes were not discussed.	"Costs" were taken to include capital costs (depreciation and interest) of the fixed assets distributed over the period of economic utilization, plus current costs for maintenance, operations and administration. "Expenditures" were taken to mean outlays from the government budget each period.	The degree of cost coverage for the whole network in 1987 was 98 percent. Passenger cars and vans that were fully subject to taxation covered 46 percent of their costs while commercial trucks covered 33 percent of their costs. Federal freeways covered 165 percent of their costs with motorcycles and passenger cars covering over 200 percent. Federal long-distance highways covered between 110 and 161 percent of their costs depending on how the calculations were made. The degree The degree of expenditure coverage for the road network in 1987 was 139 percent.
France	Principle adopted in 1971	NON-TOLLED NETWORK: Passenger traffic required to cover social marginal costs through the fuel tax and fixed costs through the vehicle tax; freight traffic required to cover social marginal costs through the fuel and axle tax. TOLLED NETWORK: financial cost recovery is one criteria for setting tolls. To avoid overcharging, traffic paying axle tax is refunded according to distance driven on the tolled network..	?	
	Most recent (1988) Ministry of Equipment study on updating the axle tax.	Revenues from the axle tax and excise taxes on fuel should cover marginal social costs of the non-tolled network.	?	Calculations made for 1985 indicate that a substantial increase in axle tax rates is required for the main vehicle categories.
	Transports 2010, Rapport du Groupe preside par le Commissaire au Plan, 1992.			Freight transport and urban transport are undercharged. Receipts from road user taxes and highway tolls on freight traffic do not cover the costs (excl. externalities) attributed to trucks.
	Other recent official inquiries were confidential.			
Norway	Report of the Green Tax Commission, Government Publication Series: Norwegian Official Commissions 1992:3.	Variable road user taxes should cover social marginal costs and fixed road user taxes should recover any resulting deficits as well as those external costs not covered by variable taxes.	Marginal maintenance, congestion (referred to as peak damage), capacity and accident costs.	Study presents social marginal costs for 1985-1989 in ore per kilometer at 1992 prices. Diesel-driven passenger cars are undercharged through the kilometer tax. Petrol-powered passenger cars are overcharged through the petrol tax. Heavier vehicles are undercharged through the kilometer tax, especially light and medium-heavy trucks and for distances over 30,000 kilometers per annum. Buses are exempt from km taxes and hence do not cover any of their costs. These conclusions assume that environment charges are correct in relation to environment costs and objectives.
			Marginal environment costs.	The sulphur and CO_2 charges should be given a more cost-effective formulation and the magnitude of the gasoline lead charge should be evaluated.

However in other countries, the difficulties in calculating marginal costs have given rise to the use of different cost concepts. In Finland, the First Parliamentary Traffic Committee of 1975[13] argued that each type of traffic (roads, railways, etc.) should bear its "total network (investment and maintenance) plus external costs." Since then, the Finnish study *Cost-Revenue Correspondence in Road and Rail Traffic*[14] has examined these total investment, maintenance and external costs of road and rail traffic and compared them to the revenues from road and rail traffic as a whole. It did not look at cost recovery nor appropriate road user taxes in the case of particular vehicle categories, classes of roads, or regions. The Second Parliamentary Traffic Committee of 1991[15] proposed that the costs of road maintenance should be fully charged to road users according to their responsibility, with additional taxes to cover pollution and accident costs. Moreover, the 1991 Committee argued that the annual budget proposal should contain calculations of both road use costs and road user tax revenues, illustrating what part of the road user tax revenues covered road maintenance and what part covered external costs. They also argued that differences between tax revenues and the funds reserved for road maintenance should be explained, and so should the basis for pollution and accident taxes. In principle, road traffic in Finland is required to pay all its direct and indirect financial costs (this principle is in fact applied to all modes of transport), although departures from this rule may be made on the basis of regional policies and/or policies to improve the international competitiveness of domestic road haulers.

In Germany, the study produced by the German Institute of Economic Research in 1990[16] did not get into the question of road user taxes and what their levels ought to be. Instead, it simply calculated the revenues from road users and compared these to the "costs" and "expenditures" (defined later) involved in providing the road network. The degree of cost and expenditure recovery was examined for different vehicle categories and for different types of roads. In principle, road users are required to cover the total public expenditure of the federal government, the Lander, and the municipalities on roads. In practice, there has been a high degree of cost recovery (over 100 percent).

In the United Kingdom, the policy of the Department of Transport (DOT) is somewhat narrower and is confined to recovering from each vehicle category their "road track costs," i.e., the public expenditures incurred on behalf of a particular vehicle

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13 Government of Finland, Committee Report 1975, *Report of the Parliamentary Traffic Committee*. Helsinki

14 Government of Finland. *Cost-Revenue Correspondence in Road and Rail Traffic: Calculation Principles and Realization*. Helsinki.

15 Committee Report 1991:3, *Report of the Second Parliamentary Traffic Committee, Traffic 2000*. Helsinki

16 German Institute of Economic Research (1990), *Calculation of the Costs and Expenditures for the Routes of Railroad, Road, Inland Shipping and Air Traffic in the Federal Republic of Germany for the Year 1987*. Commissioned by the Federal Minister for Transportation and Prepared by Heinz Enderlein and Uwe Kunert, Berlin.

category and allocated to that vehicle category. Road track costs exclude most external costs.[17]

Another problem in calculating road user taxes is the question of which costs are to be recovered. Road use involves four main external costs (costs borne by the society at large rather than by the road users themselves) which are additional to the private costs incurred by the road user. These are accident costs, environmental damage costs, congestion costs, and maintenance costs. Nevertheless, many official studies have chosen to exclude one or more of these costs from their calculations, usually on the grounds of data availability or difficulty of calculation. The Department of Transport in the United Kingdom does not include any external costs explicitly in their annual road track cost allocation exercises, and seeks only to recover, from each vehicle category, the public expenditures on construction, maintenance and policing allocated to that vehicle category. Discussions have been carried out regarding the inclusion of accident costs in road track cost calculations. However, the proposal was not approved since it was felt that no other sector paid these costs. Inclusion of environmental costs have also been considered, but these have been considered too difficult to measure. Nevertheless, allocated road track costs do implicitly reflect some social costs since roads expenditure, on which the costs are based, includes measures taken to deal with some of these problems (e.g., road safety measures, noise barriers, etc.). Furthermore, all road vehicles pay more than their allocated road track costs, and this excess is regarded by the government as a contribution towards any social costs. However, the DOT argues that social costs cannot be reliably quantified, and hence these are not included in the road track cost calculations.

Sweden's 1979 Transport Policy Act[18] considered environmental damages to be important, but acknowledged that they were difficult to determine. As a result, they were not included in calculations of road user taxes until the 1988 Transport Policy Act. At that time, the social marginal costs for road traffic were calculated for 1987 in ore per vehicle kilometer and used as a basis for proposing petrol and kilometer taxes. The costs calculated were road maintenance costs (averaged over different tire and axle configurations), traffic surveillance costs, congestion costs, accident costs, and health and environment costs. The Finnish cost-revenue correspondence study,[19] following the recommendation of the 1975 Parliamentary Traffic Committee, presented as far as possible the total costs of road traffic for 1986 and 1987. The report presented figures for investment and maintenance costs, surveillance and administrative costs, and external costs, the latter including accident, emissions, congestion, noise and vibration costs. Norway's 1992 *Report of the Green Tax Commission*[20] presented estimates provided by

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17 Department of Transport (annually), *The Allocation of Road Track Costs*. Statistics bulletin prepared by the Government Statistical Service, London.

18 See: (i) Government of Sweden (1979 and 1988), *Ibid*

19 Government of Finland, *Ibid*.

20 Government Publication Series: Norwegian Official Commissions 1992:3, *Ibid*.

the Institute of Transport Economics of marginal maintenance costs, peak damage (congestion) costs, capacity costs (time costs due to congestion or investment costs to expand the road network due to congestion), accident costs and environment costs. These were used to evaluate existing road user taxes.

The German study[21] distinguished between costs and expenditures: "costs" were taken to include the cost of capital invested in fixed assets (depreciation and interest) and the current costs required for maintenance, operations, and administration (including traffic police). "Expenditures" were taken to mean outlays from the government budget each period. In the cost calculations, current costs corresponded to expenditures required each period while capital costs were the costs of capital invested over many years and differed fundamentally from the investment expenditures of each period. These capital costs were distributed over the period of economic utilization so that depreciation referred to the assessed consumption of goods due to the use of the infrastructure, while interest represented the costs of tying up capital. The report argued that road user revenues based on such a calculation would ensure that road users covered the costs of previous investments used by them while not being burdened with the full costs of new facilities used only during a portion of their useful life. Also, a comparison of road user tax revenues with this definition of costs would indicate the extent to which the average resources needed annually for road maintenance were collected through road user taxes.

Additional taxation for passenger traffic

Although charging marginal social costs is the theoretical ideal, most countries require road users to pay more than just the marginal social costs of road use. Norway's 1992 *Report of the Green Tax Commission*[22] and Sweden's 1979 and 1988 Transport Policy Acts[23] proposed that road users cover the fixed costs of road use as well as their social marginal costs, although it is not clear whether freight transport would also be required to bear any of the additional taxes. In Norway, there are also discussions under way regarding ways to levy additional taxes on road traffic in order to finance other public sector activities. In France,[24] private toll roads are required in principle to cover their total financial costs, and in order not to double-tax the large commercial users of the tolled network which also pay an axle tax, such users are allowed to make tax deductions on the basis of the presentation of receipts from the toll roads. On the non-tolled network, the principle adopted in 1971 was that passenger traffic should be responsible for not only their marginal social costs but should pay the total costs they imposed. This meant that they should pay both their fixed costs as well as their social marginal costs. Freight traffic on the other hand should only pay their marginal social

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[21] German Institute for Economic Research (1990), *Ibid*.

[22] Government Publication Series: Norwegian Official Commissions 1992:3, *Ibid*.

[23] Government of Sweden (1979 and 1988), *Ibid*.

[24] See Commissariat Général du Plan (1992), *Ibid*.

costs. As we have seen, the Finnish cost-revenue correspondence study[25] argued for the coverage of total social costs and not just marginal costs. In practice, Finnish road users are required in principle to cover all financial costs. Also, the UK requires road users to cover their total budgetary costs, although there are suggestions that these should be expanded to include external costs as well. The 1990 report of the German Institute for Economic Research[26] did not discuss road user taxes and as such did not consider either marginal cost or any other pricing principles, nor the problems of recovering fixed costs. However, their comparison of total revenues from road users with both total "costs" and total "expenditures" would suggest support for road user taxes based on the recovery of some definition of total costs.

Charging road users through available charging instruments

Once road use costs have been determined, the next question is how to recover these costs from road users through the available tax instruments. Costs vary as between roads, the time of day, and the category of road users, and ideally we would like a structure of taxes which reflect such variations in costs. Unfortunately, the available tax instruments are imperfect in this regard and it is not possible to fully capture all variations in costs. Table 4.2 lists the main road user tax instruments employed in the six countries studied. Following is a discussion of how each country proposes to cover road use costs through these tax instruments.

In the UK, fuel taxes and the vehicle excise duty are the key instruments for taxing road users. In their annual report on road track cost allocation,[27] the Department of Transport (DOT) compares the road costs allocated to different vehicle categories with estimates of the level of taxes paid by that vehicle category. Since fuel taxes are decided by the Chancellor in conjunction with Parliament, the vehicle excise duty is the only transport policy tool available to DOT. The recommendations provided by DOT regarding the level of the vehicle excise duty are based mainly on the objective of recovering those road costs not covered by the fuel tax, although other concerns do often influence the final recommendation. Both vehicle excise duty and the fuel tax are used to recover total road track costs, with no "division of labor" in recovering marginal as opposed to fixed costs as happens in some other countries.

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25 Government of Finland, *Ibid*.

26 German Institute of Economic Research (1990), *Ibid*.

27 Department of Transport (annually), *Ibid*.

Table 2: Road User Charging Instruments in OECD Countries

Country	*Charging Instruments*
United Kingdom	Fuel tax, vehicle excise duty.
Sweden	Fuel tax, kilometer tax, vehicle tax.
Finland	Fuel tax, motor vehicle tax, kilometer tax on foreign vehicles.
Germany	Petroleum tax, vehicle tax.
France	Fuel tax, vehicle tax, axle tax, tolls.
Norway	Fuel tax, kilometer tax, annual vehicle tax, tolls

Swedish policy, as set out in the 1979 and 1988 Transport Policy Acts,[28] is that variable road user taxes (the fuel and kilometer tax) should cover the social marginal costs and that additional taxes (the annual vehicle tax) should be levied to cover fixed costs. In urban areas where there are considerably higher social marginal costs, it was proposed that special measures for recovering these costs be considered. As a result, a Parliamentary Committee was appointed with the task of analyzing different possibilities, and one of the measures proposed for Stockholm was area licenses.

The Norwegian approach is similar to that in Sweden. Government policy, also endorsed by the 1992 *Report of the Green Tax Commission*, is that variable road user taxes (the fuel and kilometer tax) should be used to recover social marginal costs while fixed road user taxes (the annual vehicle tax) should recover fixed costs. However, three cities (Oslo, Bergen, and Trondheim) operate cordon tolls which charge commuters for entering these areas. The decision to operate cordon tolls was based entirely on the need to supplement grants from the central government to finance major programs of capacity expansion of the road network. However, increasing congestion, particularly in Oslo and Bergen, has led to suggestions of increasing the toll rate during peak periods. Rates at other times of the day would be eliminated so that only the required revenue is collected. This would also have the added advantage of reducing the costs of toll collection. If the objective of tolls is to reduce congestion, then the determination of other road user taxes on the basis of recovering social marginal costs will have to take into account tolls already paid by road users in order to avoid overcharging.

The Finnish cost-revenue correspondence study[29] did not go into the question of how tax instruments ought to be used in the recovery of costs from road users. However, the Second (1991) Parliamentary Traffic Committee pointed out that the present tax

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[28] Government of Sweden (1979 and 1988), *Ibid*.

[29] Government of Finland, *Ibid*.

burden in Finland rested largely on the acquisition of vehicles rather than on their use and proposed a shift towards more use-related tax instruments. This would suggest an increased role for fuel and kilometer taxes and a reduced role for the fixed annual motor vehicle tax in the recovery of total road use costs.[30] The German report[31] did not discuss how the costs or expenditures related to road use should be recovered through the available tax instruments. In practice however, the two primary instruments for taxing road users in Germany are the petroleum tax and the motor vehicle tax. Through these instruments, all public expenditures on roads are recovered and have been recovered since at least 1960. In 1991, the degree of expenditure coverage was 206.1 percent.

At the time of the introduction of the French axle tax in 1971, both passenger and freight traffic on the non-tolled network were required to cover their social marginal costs through the fuel excise tax and, in the case of certain vehicles (primarily freight traffic), through the axle tax as well. Since passenger traffic in principle also had to cover their fixed costs, it would appear that this role was assigned to the vehicle tax (which was not levied on vehicles paying the axle tax), although this is not absolutely clear from the French reports obtained. A look at the approximate rates of the vehicle tax presently in force (Table 1, Annex 5) indicates that although taxes on trucks increase with the weight of the truck, they increase less than proportional to the damage caused.[32] Since 1971, the axle tax has never been re-evaluated, and there is presently substantial undercoverage of the marginal social costs of the non-tolled network. Tolls are meant to recover the total financial costs of the tolled-network.[33]

Findings of official inquiries

The differences in approach towards road user taxes, definitions of costs, and the way in which costs are allocated to vehicle categories render cross-country comparisons of findings difficult. Furthermore, imperfections in the method of calculation also means that proposed road user taxes will differ somewhat from the theoretical optimum. However this section summarizes the findings of the official inquiries reviewed above and points out, where possible, the impact they have had on actual road user taxes.

A comparison between the road user taxes paid by different vehicle categories and their allocated road track costs since 1980 indicates that all vehicle groups in the UK have paid more than their allocated road track costs.[34] The only exceptions are buses and

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30 Committee Report 1991:3, *Ibid*.

31 German Institute of Economic Research (1990), *Ibid*.

32 Bear in mind that French vehicle tax rates are decided at the county level and varies throughout the country, and that the rates indicated in Table 1 of Annex 5 are only a range of existing rates provided by the French Ministry of Transport.

33 See Commissariat Général du Plan (1992), *Ibid*.

34 Department of Transport (various years), *Ibid*.

coaches, which have paid less than their allocated budgetary costs. In addition, fuel taxes are remitted to most local bus operators. In general, heavy commercial vehicles have paid a lower proportion of their costs than have light commercial and passenger vehicles, and buses and coaches have paid the lowest proportion of their costs. The inclusion of externalities in the costs allocated to road traffic would reduce the degree of cost recovery of each vehicle group, but it is not clear which vehicle groups would continue to be overtaxed or not.

Based on the principles set out in the 1988 Transport Policy Act in Sweden, the social marginal costs of road traffic were calculated for 1987 in terms of ore per vehicle kilometer, and petrol and kilometer taxes were proposed based on these calculations. As a consequence of these calculations, petrol and kilometer taxes were raised in 1989, and Hansson presents information on the resulting degrees of cost recovery based on the 1987 social marginal costs[35]. These are shown in Table 3, Annex II. We can see that despite the increase in taxes, all categories of vehicles remained undercharged. The most undercharged category of vehicle was urban buses, which paid only 10 percent of their social marginal costs, while the least undercharged was private cars with catalytic converters on rural roads and highways which paid 93 percent of their costs. For urban traffic, no category of vehicle paid more than 65 percent of their social marginal costs. With regard to total costs, Hansson presents figures for 1989-1990 showing that road traffic as a whole covered its total financial costs, including traffic surveillance and medical care for people injured in traffic accidents, although it did not meet its total social/external costs, including the cost of traffic accidents and emissions.[36] We have seen that the Finnish 1990 *Cost-Revenue Correspondence Study* did not look at cost recovery for specific categories of vehicles but for road traffic as a whole. It was found that in 1986 and 1987, road traffic as a whole covered its total costs (i.e., investment and maintenance, surveillance and administration, accident, emissions, congestion, noise and vibration).[37]

The German study[38] found that the degree of "cost" coverage for the whole road network in 1987 was 98 percent, with domestic vehicle traffic fully liable for taxes covering 112 percent of its costs. Passenger cars and vans that were fully subject to taxation reached a cost coverage of 46 percent, while commercial trucks had a cost coverage of 33 percent. The degree of cost coverage for the federal freeways was 165 percent. All vehicle categories on the federal freeways had a degree of cost coverage of

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35 Hansson, Lars (1990), *The Swedish Approach to Multi-Modal Transportation Planning*, Swedish State Railways, Stockholm, Sweden.

36 Hansson, Lars (1990), *Ibid*.

37 Government of Finland, *Ibid*.

38 German Institute of Economic Research (1990), *Ibid*.

over 100 percent, while motorcycles and passenger cars were over 200 percent. The degree of cost coverage for the federal long-distance highways was between 161 and 110 percent depending on how the calculations were made. With regard to the degree of "expenditure" coverage, road revenues in 1987 were 39 percent more than road expenditures.

The report *Transports 2010*[39] found that in France, both road freight transport and urban transport were under charged. Receipts from road user taxes and highway tolls (excluding VAT) do not cover the costs attributed to truck traffic. The shortfall was estimated at 5 billion francs a year and would be even larger if externalities were included in the calculations of costs. It should be noted that foreign trucks sometimes escape French fuel taxes by taking advantage of slightly lower fuel taxation in neighboring countries, since the capacity of today's fuel tanks makes it possible to cross France without refuelling. The reasons for undercharging in urban transport were identified by the report as insufficient efforts to control pollution due to private automobile use, and a desire to facilitate access to public transport for social reasons. The report also identified some undercharging on the tolled network. It pointed out that under 1990 economic conditions, achieving a balanced budget for toll roads would require toll rates for all trucks of around 69 cents per kilometer, slightly higher than the present level. This rate would be even higher if externalities were included.

Norway's 1992 *Report by the Green Tax Commission*[40] compared 1992 variable road user taxes with estimates of the marginal costs of maintenance, peak damage (congestion), capacity (time costs due to congestion or investment costs to expand the road network due to congestion), and accident costs for the 1985-1989 period expressed in 1992 kroner. The report found that diesel-driven passenger cars were undertaxed through the kilometer tax while petrol-powered passenger cars were overtaxed through the petrol tax. The latter remained true even if the taxes for damages due to CO_2 and lead were disregarded. Heavy vehicles were undertaxed through the kilometer tax, the extent of undertaxing being greatest for light and medium-heavy trucks travelling more than 30,000 kilometers per annum. Buses are at present exempt from the kilometer tax and thus do not cover any of their costs. The Committee's findings assumed that environmental taxes were correctly fixed in relation to environmental costs and objectives. However, an evaluation of the environmental taxes suggested that: (i) the existing sulphur tax on oil products should be reformulated so as to achieve more cost-effective reductions in sulphur discharges; (ii) the lead tax on gasoline should be continued although the magnitude should be evaluated; and (iii) the CO_2 taxes should be given a more cost-effective formulation.

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[39] Commissariat Général du Plan (1992), *Ibid*.

[40] Government Publication Series: Norwegian Official Commissions 1992:3, *Ibid*.

Summary and Conclusions: Road User Taxation in Principle and in Practice

This section has reviewed a number of official efforts to determine the correct level of road user taxes and to evaluate the existing tax structure. Where there was no exercise to determine road user taxes, as in Finland and Germany, assessments of road use costs and the degree of cost recovery were reviewed. The main points regarding road user taxation in the six countries are summarized in Table 3. The last three rows address three additional questions. First, to what extent have governments attempted to promote efficiency in the use of roads by defining a clear and explicit road tariff? To some extent, the Scandinavian kilometer tax and the tolls in France and Norway form an explicit road tariff. These taxes are payments for the use of the network and can be manipulated to regulate demand and promote efficiency. The Scandinavian kilometer tax effectively links payments to distance travelled, while the French and the Norwegian tolls respectively charge for using a specific tolled road and for entering an area. Varying the toll rate by time of day and by location would more effectively capture the costs due to congestion. Nevertheless, these taxes do not form a tariff for roads in general since they by themselves are not intended to charge for the use of the entire road network (also, they do not fully and correctly reflect the external costs of using the road network). As a result, there is no explicit tariff for the road network as a whole in any of the six countries. Nevertheless, road user taxes form part of the private costs of road use taken into account by road users.

Second, what link is there between road user taxes and the efficiency of the road agency? In France, tolls are partially determined by commercial criteria. Revenues accrue to the toll road companies and influence the provision of tolled roads. However, the efficiency of these companies is more related to the bidding for toll concessions than to the tolls themselves. Off the tolled network, and in the remaining five countries, there is no link between road user taxes and the efficicency of the road agency. Road tax revenues accrue to the general treasury and not to the road agency, and road investments are based on cost-benefit analyses and on the amount of funds allocated to roads out of the general budget. In effect, costs are passed on to road users “as is”. In Finland and in Sweden, however, a number of reforms are currently being implemented to improve the efficiency of these agencies.

Third, what hypothecation of road user taxes is there? Hypothecation is a form of fiscal policy designed to raise and allocate tax revenues for a specific purpose. The main benefit appears to be increased certainty regarding the level of finance for investment and maintenance, although there is no clear evidence hypothecation or earmarking of road user taxes for spending on roads has been almost non-existent since it has traditionally been viewed unfavorably by ministries of Finance which would undergo substantial loss of revenues as a result.

A few instances of hypothecation of road user taxes were identified through discussions with finance ministries. In Norway in July 1990, a local fuel tax of NOK 0.50 per liter (including VAT) was instituted in Tromso county. The only objective of this additional fuel tax was to provide funds for various road and tunnel projects in the area and for the development of the main roads. There were no secondary objectives

related to traffic management or other matters, although it was recognized that the tax might have an impact on travel and transport. Norway's general policy with regard to such earmarking at the local level is that the revenues must be connected to some specific use and the scheme must be desired locally. If revenues are no longer put to their original purpose, the scheme must be discontinued. In France, there have been two attempts to establish a road fund. The first was the Special Fund for Road Investments set up in 1952 with a specified proportion of the fuel tax dedicated to the fund. The proportion was determined annually by Parliament but was gradually decreased each year until the amounts raised were no longer adequate to finance the increased traffic. It was finally abandoned altogether in the 1980s. The second attempt was the Special Fund for Road Works, set up in 1982 and also based on the fuel tax. Funds were to be used to repay loans for road investment and other public infrastructure. This was abandoned in 1986. In Germany, the revenues from fuel taxes used to be dedicated to transport. However the proportion dedicated has gradually declined until today there is no more earmarking of fuel taxes. Nevertheless, there is the Community Transport Finance Law aimed at assisting local communities to finance transport infrastructure. Under this law, part of the fuel tax is earmarked for local communities. These funds do not go directly from the federal government to the communities but via the Lander which distributes the revenues according to geography and mode of transport. Part of the revenues of the vehicle tax accrue to the Lander and are used to finance road construction. There is no earmarking of road user taxes in the United Kingdom, Finland or Sweden.

Table 3: Summary of Road User Taxes in Practice and in Principle

	United Kingdom	*Sweden*	*Finland*	*Germany*	*France*	*Norway*
Principle for taxing road users	Each vehicle category must cover, through the VED and the fuel tax, their road track costs, i.e., the public expenditures incurred on behalf of and allocated to that vehicle category.	Variable taxes to cover social marginal costs and fixed taxes to cover fixed costs. Not clear whether freight traffic is expected to bear fixed costs.	Road users must cover the total direct and indirect financial costs	Road users must cover the total expenditures of the federal government, the Lander and the municipalities on roads.	NON-TOLLED NETWORK: In principle, passenger traffic required to cover social marginal costs through the fuel tax and freight traffic required to cover social marginal costs through the fuel and axle tax. It appears that fixed costs of passenger traffic are to be covered through the vehicle tax. Vehicle tax not levied on vehicles paying axle tax.In practice, there is substantial under-coverage of social marginal costs. TOLLED NETWORK: Financial cost recovery is one criteria for setting tolls. To avoid overcharging, traffic paying the axle tax is refunded according to distance driven on the tolled network	Variable taxes to cover social marginal costs and fixed taxes to cover fixed costs. Not clear whether freight traffic is expected to bear its fixed costs. Also, tolls are levied to enter Oslo, Bergen, and Trondheim to raise funds for road investment and other improvements.
Costs included	Public expenditures on construction, maintenance and policing allocated to each vehicle category. External costs excluded.	Marginal costs of road maintenance, traffic surveillance, congestion, accidents, health and environment.	"	"	?	Marginal costs of maintenance, congestion, capacity, accident and environment costs.

	United Kingdom	*Sweden*	*Finland*	*Germany*	*France*	*Norway*
Environmental taxes	None. A carbon tax is currently being discussed.	Carbon dioxide and sulphur tax since 1991.	Supplementary tax since 1990.	None. Various measures are being considered for reducing carbon dioxide emissions.	None.	A carbon dioxide and a sulphur tax since 1991.
Promotion of efficiency in road use through a clear "tariff for roads"	None.	Kilometer tax. To be abandoned.	For motor vehicles registered abroad, the kilometer tax is combined with a flat rate tax to form a clear transit fee. Otherwise, there are no explicit tariffs for road. Domestic road users do not face the kilometer tax.	None.	Tolls are a clear tariff for using the tolled network. Varying tolls by time of day and by location is being considered as a measure to improve efficiency on the tolled network. Otherwise there are no explicit tariffs for roads.	Tolls in Oslo, Bergen, and Trondheim are a clear tariff for entering these areas. There is also the kilometer tax but this is to be abandoned. Otherwise, there are no explicit tariffs for roads.
Link between road user taxes and efficiency of road agency	None.	None. Commercialization of Swedish National Road Agency.	None. Commercialization of Finnish National Road Agency.	None.	Tolls are partially determined by commercial criteria. Revenues accrue to the toll road companies and influence the provision of tolled roads. However the efficiency of these companies is more related to the bidding for toll concessions than to the tolls themselves. Otherwise there is no link between road user taxes and the efficiency of the road agency.	None.
Earmarking of road user taxes	None.	None.	None.	Fuel tax used to be earmarked but now discontinued. Part of the revenues from the vehicle tax now goes to the Lander. Part of the fuel tax now earmarked for local communities.	Road funds were attempted but abandoned during the 1980s.	In Tromso, a local fuel tax is earmarked for transport.

To conclude this section, the following observations about road user taxation in the six countries reviewed are provided. First, the determination of road user taxes have been based upon several objectives, whether implicit or explicitly stated, and not just on pure economic efficiency criteria. Although the importance of achieving efficiency in tax policy has been recognized (as illustrated by attempts to calculate social marginal costs and by the generally higher taxation placed upon road users), to varying degrees, a purely efficient structure of taxes has not been achieved. Practical problems of determining social marginal costs, the political necessity of sometimes appeasing particular groups of road users, and economic considerations such as subsidizing industry have all contributed to a less than efficient tax structure. Second, country-specific circumstances have been very important in shaping road user tax policy. For instance, the instruments available for taxing road users vary from country to country and influence the extent to which social marginal costs are reflected in road user taxes; attitudes about the environment help determine whether road users are taxed for environmental damage; the level of institutional and technological sophistication, as well as historical factors, influence the tax policy; and economic and political considerations vary and deterine the objectives upon which tax policy is based. This provides an important lesson in that, if policy advice to less developed countries is to be sustainable, it will need to recognize of the special needs and circumstances of the country and incorporate these needs into any program. The provision of a standard prescription will have to be avoided.

V. Fuel and Indirect Taxation

Let us now take a closer look at fuel taxation in the context of a broad-based indirect tax system. The optimal tax model provides valuable insights into what an efficient structure of indirect taxes should look like. The inverse-elasticity rule says that, as long as goods are unrelated in consumption, tax rates should be inversely proportional to the price elasticities of demand. Hence, the lower the elasticity of good one relative to good two, the higher should be the rate of tax on good one relative to good two. If we take the case of fuel versus all other commodities, a lower elasticity of demand for fuel relative to that of other general consumption goods would require a higher rate of tax on fuel than on other consumption goods in order to increase economic welfare.

How far has this result held in the indirect taxation of the six OECD countries studied? Table A1.1 provides data on the rates of taxation of fuel (leaded petrol) and of general consumption for the years 1980 to 1991. All tax rates are gross rates, shown as a percentage of the consumer price (i.e., the tax-inclusive price). The general consumption tax is usually the value-added tax with, the exception of Finland prior to August 1986 when there was a turnover tax, and Sweden prior to March 1990.

These figures allow us to make a number of preliminary observations regarding indirect taxation in general and fuel taxation in particular in the six countries. First, given that we expect the demand for fuel to be less elastic than the demand for other commodities, then the higher fuel tax rates relative to the general consumption tax rates are justified from an efficiency point of view. The six Finance Ministries therefore

appear to have achieved at least the minimum criteria for optimality in the taxation of fuels as compared to other commodities.

Second, the columns called "ratio" in Table 4 provide the ratios of the rates of fuel taxation to the rates of general consumption taxation. These range from 2.09 to 5.05. If the simple optimal tax model adequately describes the six economies studied here, and if the cross price elasticity of demand between fuel and general consumption is close to zero, then these ratios should also capture the ratio of the compensated demand elasticity for general consumption to that for fuel. Table 5 presents estimates of the elasticity of demand for fuel (taken from various surveys) and the elasticities of demand for general consumption which would be implied by our "ratios." However, the latter appear to be absurdly large, which suggests that while fuel tax rates are quite rightly higher than general consumption tax rates from an efficiency point of view, fuel tax rates are too large relative to general consumption tax rates. We have discussed a number of factors taken into account by governments when determining road user taxes (including the fuel tax). Again, these figures suggest that efficiency is not the only consideration of indirect tax policy. Furthermore, it must be borne in mind that the effect of the cross elasticities on the optimal tax rate has not yet been considered.

Third, the ratio of the fuel tax rate to the general consumption tax rate in the six countries shows substantial variation both across countries and over time, varying between 2.09 and 5.05. However, there is no reason to expect the ratios of the elasticities of demand to vary so widely across such similar countries. Over time, there appears to be a generally increasing trend in the tax ratios. If elasticities are stable over time, then the taxation of fuel and of general consumption must either be moving closer to or away from the optimum. This variation again suggests that governments take factors other than efficiency into account when determining tax rates.

Finally, despite the absence of any coordination of indirect taxation among the six countries, fuel tax rates remain quite similar across countries. One possible explanation was that governments wish to avoid wide disparities in the final consumer price (one expects producer prices to be similar across countries) to avoid arbitrage activity. However, this explanation is not valid if we consider that fuel is not a highly tradeable commodity. Therefore, there needs to be another explanation of this similarity if it is not pure coincidence. In general, substantially more information is needed before more definitive statements can be made about the preceding observations.

Table 4: Comparison between taxes on fuel and general consumption goods

Year	*United Kingdom*			*Sweden*			*Finland*			*Germany*			*France*			*Norway*		
	Fuel taxes (%)	*G.C. taxes (%)*	*Ratio*	*Fuel taxes (%)*	*G.C. taxes (%)*	*Ratio*	*Fuel Taxes (%)*	*G.C. taxes (%)*	*Ratio*	*Fuel taxes (%)*	*G.C. taxes (%)*	*Ratio*	*Fuel taxes (%)*	*G.C. taxes (%)*	*Ratio*	*Fuel taxes (%)*	*G.C. taxes (%)*	*Ratio*
1991	65.98	14.89	4.43	67.68	20	3.38	61.31	17.5	3.50	67.59	12.28	5.50	75.02	15.68	4.78	67.43	16.67	4.04
1990	62.19	13.04	4.77	65.46	20	3.27	55.32	17	3.25	63.08	12.28	5.14	74.21	15.68	4.73	62.92	16.67	3.77
1989	63.61	13.04	4.88	-	-	-	52.40	16.5	3.18	65.04	12.28	5.30	74.56	15.68	4.76	62.68	16.67	3.76
1988	67.11	13.04	5.15	-	-	-	53.49	16	3.34	64.32	12.28	5.24	77.04	15.68	4.91	67.03	16.67	4.02
1987	64.11	13.04	4.92	-	-	-	48.09	16	3.01	62.85	12.28	5.12	75.29	15.68	4.80	64.12	16.67	3.85
1986	63.9	13.04	4.90	-	-	-	46.67	16	2.92	61.47	12.28	5.00	73.89	15.68	4.71	60.57	16.67	3.63
1985	54.29	13.04	4.16	-	-	-	35.08	16	2.19	48.72	12.28	3.87	62.25	15.68	3.97	50.86	16.67	3.05
1984	54.93	13.04	4.21	-	-	-	34.03	16	2.13	48.68	12.28	3.96	57.29	15.68	3.65	50.26	16.67	3.01
1983	54.08	13.04	4.15	-	-	-	33.45	16	2.09	50.04	11.5	4.35	53.67	15.68	3.42	49.36	16.67	2.96
1982	54.25	13.04	4.16	-	-	-	32.15	14	2.30	48.13	11.5	4.18	52.70	14.97	3.52	48.14	16.67	2.89
1981	51.04	13.04	3.91	-	-	-	33.71	14	2.41	46.23	11.5	4.02	52.91	14.97	3.53	50.00	16.67	3.00
1980	46.29	13.04	3.55	-	-	-	36.10	14	2.58	48.67	11.5	4.23	57.99	14.97	3.87	51.66	16.67	3.10

Notes: (a) Fuel tax rates are the rates prevailing on leaded petrol. (b) All fuel and general consumption tax rates are gross rates, shown as percentages of the consumer price (the price including all taxes). Gross tax rate = net tax rate / (1 + net tax rate). (c) The fuel tax rates shown here include the general consumption tax paid on fuel.

Source: International Energy Agency (1991), *Energy Prices and Taxes.* Paris: OECD.

Table 5: Elasticities of demand for petrol and implied elasticities of demand for general consumption (all elasticity figures are negative)

Survey	*Elasticities of demand for petrol*		*Implied elasticities of demand for general consumption 1/*	
	SR	LR	SR	LR
Oum, Waters and Yong a	0.25 - 0.93	-	0.52 - 4.70	-
"	0.20 - 0.50	0.32 - 1.37	0.42 - 2.52	0.67 - 6.92
Bates and Moore, b	-	2.12	-	4.43 - 10.71
Dahl and Sterner,c	0.22 - 0.31	0.58 - 1.02	0.46 - 1.57	1.21 - 5.15
Overall range	0.20 - 0.93	0.32 - 2.12	0.42 - 4.70	0.67 - 10.71
Most likely range	0.20 - 0.50	0.58 - 1.37	0.42 - 2.52	1.21 - 6.92

Notes:

1/ If the cross price elasticity of demand between fuel and general consumption is close to zero and if tax rates are efficient, then the elasticity of demand for general consumption should be between 2.09 and 5.05 times as large as the elasticity of demand for fuel.

Sources:

a. Oum, Tae H., W. G. Waters, II and Jong Say Yong (1990), *A Survey of Recent Estimates of Price Elasticities of Demand for Transport*, WPS 359. Infrastructure and Urban Development Department. Washington, D.C.: World Bank. p.19.

b. Bates, Robin W. and Edwin A. Moore (1991), *Commercial Energy Efficiency and the Environment*, Background Paper No. 5, *World Development Report 1992p*. Washington, D.C.: World Bank. P. 47.

c. Dahl, Carol and Thomas Sterner (1990), "Analyzing Gasoline Demand Elasticities: A Survey," *Energy Economics*, July 1991 p.210.

ANNEX I

Road User Taxation in the United Kingdom's Transport Policy

Road user taxes in principle

The principles underlying the present method of road use cost allocation in the UK are largely those set out by the Department of Transport in 1968.[41] However, they were not formally embodied in a published bulletin until 1978 following a consultation document and related technical paper issued in 1976. The principles have continually been reaffirmed, in the 1980 Armitage Report,[42] again after public consultation in 1983─84, and again in the 1987 National Audit Office report on heavy lorries. The calculations are carried out annually by the Department of Transport.[43] While the Department tries to incorporate the latest knowledge in its calculations, stability in the method is also required as fluctuations would create uncertainty and mask historic trends.

The government's policy is that public money spent on roads should be recovered in full from road users and, furthermore, that each vehicle category should cover their costs. Therefore, the present method is based on, first, the evaluation of roads expenditure and, second, the allocation of that expenditure to vehicle groups according to each group's "responsibility" for that expenditure. Roads expenditure consists of the amount spent by national and local governments on construction, maintenance (including street lighting, road sweeping and bridge maintenance), and policing. Expenditure on administration, research, and road safety publicity is also included. An average is taken of three years' financial expenditure in order to smooth out annual fluctuations. The total expenditure is split among four categories of roads: motorways, trunk roads, principal roads and other roads. After evaluating total road expenditures, this amount is allocated to vehicle groups according to the extent to which each group is responsible for these expenditures. Expenditures which can be said to be incurred on behalf of a particular vehicle class are allocated to that class and are known as its "road track costs." Remaining expenditures are shared among all vehicles, using measures related to road use. The allocation is based on advice from engineers, supported by background research.

External effects (air pollution, traffic accidents, noise disturbance, vibration and visual intrusion) are not included in UK evaluations of road track costs. Recommendations

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41 Department of Transport (1968), *Road Track Costs.* London

42 Armitage (1980), *Report of the Inquiry into Lorries, People and the Environment*, London.

43 Department of Transport (annually), *The Allocation of Road Track Costs*, Statistics bulletin prepared by the Government Statistical Service, London.

from the 1980 Armitage Report[44] which recommends inclusion of road accident costs, were rejected by the concerned ministers in 1984. It was considered that allocating the public costs of accidents to road users would be discriminatory compared with those industries and high-risk sports which are not charged similar costs. With regard to the other costs, the government policy is that these costs are a factor to be taken into account in deciding road user taxes. However, they are not included in cost calculations because of severe measurement problems. In 1984, the ministers reaffirmed the view stated by Armitage that such costs should be dealt with by introducing a margin between allocated road track costs and actual road user taxes, particularly for heavy vehicles. In practice, the size of the margin remains a matter for the Chancellor to decide, given his broader fiscal strategy. Congestion costs are regarded as private costs by the Department and are not included in road track cost calculations.

Road user taxes in practice

Fuel tax

Petrol and diesel in Germany are subject to an excise tax (the petroleum tax), a Petroleum Reserve Levy, and the value-added tax. Table 1 shows the development of these taxes in Germany since 1981. Through the Petroleum Tax Modification Law of 1 April 198, the tax on petrol was for the first time differentiated between leaded and lead-free petrol. The VAT has been levied at the rate of 14 percent since 1 July 1983. Prior to that it was 13 percent.

There are currently no environmental taxes on fuel in Germany. However, the federal government wishes to reduce, by the year 2005, CO2 emissions by 25 percent compared with the 1987 level. To explore the non-technical measures which may be employed to achieve this goal, the government commissioned PROGNOS AG in Basel to prepare a study on the effectiveness of a number of measures with regard to their reduction potential. The study, carried out within the framework of the activities of the interministerial working group on CO2 reduction, encouraging replacement of these fuels by unleaded petrol. In 1991, fuel duties were increased by 15 percent which was more than needed to compensate for the freezing of the VED (discussed in the next section). The objective was to provide incentives to reduce pollution and congestion.

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[44] Armitage (1980), *Ibid*.

Table 1: Petrol and diesel taxation in pfennige per liter

Valid as of	Petrol			Diesel		VAT
	Petroleum tax		PRL	Petroleum tax	PRL	
	Leaded	Unleaded				13.0%
1.7.79						
1.4.81	51.00	51.00	0.56	53.25	0.60	
1.9.81			0.71		0.77	
1.4.83			0.64		0.68	
1.7.83						14.0%
1.1.85			0.56		0.59	
1.4.85	53.00	49.00				
1.4.86		46.00				
1.4.87		47.00				
1.4.88		48.00	0.72		0.73	
1.1.89	65.00	57.00				
1.1.91	67.00	60.00				
1.1.91	92.00	82.00		65.30		

Source: EID

There are at present no carbon taxes in the UK. However, the country is currently participating in EC discussions on a proposed Carbon Energy Tax. It is proposed that such a tax should apply to a wide range of energy uses, and not only to transport. The objective would be to increase awareness of the need for conservation and to distribute more evenly the cost of protecting the environment.

Vehicle Excise Duty

The VED is an annual tax levied on motor vehicles according to weight. Because the road wear caused by lorries depends upon the weight transmitted through each axle, the VED structure was changed in October 1982 from an unladen weight basis to one based on gross vehicle weight as shown by a vehicle's "plate." For lorries over 12 tons, duties were also to be based on the number of axles. This new basis enabled the VED to be more closely related to road track costs and provided tax incentives for operators to choose lorries with more axles, causing less road wear per ton of load carried. However, the government recognizes that the VED has a limited influence on operator's decisions since it forms only 2 to 6 percent of lorry operating costs.

The 1980 Armitage Report recommended that:

> "The VED on the heaviest classes of lorries which do not pay their full road track costs should be increased at the earliest opportunity using the present system of taxation."[45]

Accordingly, in 1983, the VED was reduced by about 10 percent for certain lighter lorries and increased between 5 and 26 percent for certain heavier lorries. The largest increases were for 32.5 ton 4 axle articulated lorries since they were seen as being furthest from covering their road track costs. For new lorries up to 38 tons, VED rates were set such that those lorries paid at least enough to cover their full road track costs. This was in line with the government's commitment given in the debate on the Armitage proposals. For both existing and new lorries and for each weight band, there are substantially lower tax rates for lorries with more than a given number of axles since they cause less road damage.

In 1986, it was decided to adjust the balance between the fuel tax and the VED in order to increase the burden of taxation on road use relative to vehicle ownership. The VED was therefore frozen and road fuel duties were over-revalorized to compensate. This policy is still in force.

Evaluation of UK road user taxes

Table 1 shows the degree of cost recovery for different vehicle groups since 1980 based on the ratio of road user tax revenue to allocated road track costs for each vehicle category. It shows that, excluding general consumption taxes such as the VAT, all vehicle groups have paid more than their allocated road track costs (budgetary expenditures) since 1980, with the exception of buses and coaches which were subsidized to the tune of 10 percent between 1984─85 and 1988─89. However, cars, taxis and light vans have consistently paid a higher proportion of their costs than have goods vehicles. Heavy goods vehicles (over 3.5 tons GVW) have paid proportionally less of their costs than have lighter goods vehicles (under 3.5 tons GVW). Buses and coaches have paid the lowest proportion of their costs. In 1992─1993, the excess of road user taxation over allocated road track costs was lower than usual for some vehicles. This was related to a combination of larger road expenditures and a fall in vehicle numbers for most groups which meant that average road track costs were higher than usual.

The figures show a divergence between road user taxes paid and allocated road costs. The main reason is that decisions about roads user taxes are not automatically based on the results of road track cost allocation exercises. Instead, numerous economic and political issues outside of narrow road track cost allocation bear upon decisions about fuel taxes and VED. In addition, the policy of the government is to charge more than the allocated road track costs. This may be interpreted as a contribution to external costs and/or a contribution to general revenues.

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[45] Armitage (1980), *Ibid*.

Road user taxation in the United Kingdom - A Summary

The key observations about road user taxation in the UK may be summarized as follows:

1. Road users are required in principle to cover their "road track costs." These are public expenditures incurred on behalf of a particular vehicle category and allocated to that category. Public road expenditure consists of the amount spent by national and local governments on construction, maintenance, and lighting.

2. The external costs of road use are not included in UK road track cost calculations, although they are taken into account when deciding road user taxes.

3. In practice, road users have covered their road track costs except for buses and coaches, which have sometimes been subsidized. The excess of road user tax revenues over road track costs may be regarded as a contribution to external costs or to general tax revenues.

4. There are at present no explicit carbon or other environmental taxes in the UK although a carbon tax is currently being discussed.

5. Road users do not face an "explicit tariff for roads." However, to the extent that road user taxes reflect the external costs of road use, these become internalized and form part of the private costs taken into account by users. This promotes efficiency in the use of roads.

6. There is no link between road user taxes and the efficiency of the road agency (Department of Transport). Road user tax revenues accrue to the general treasury and not to the road agency and therefore do not influence the provision of roads. Road investment decisions are based on cost-benefit analyses carried out by the Department and on the amount of funds allocated to roads out of the general budget.

7. There is no hypothecation of road user taxes.

Table 2: Road Tax Revenue to Cost Ratios, 1980-1981 ─ 1992-1993

	Ratio of road tax revenue to costs					
Year	*Cars and taxis*	*Buses and coaches b/*	*Light vans (under 30 cwt unladen)*	*Goods vehicles (over 30 cwt unladen): under 3.5 tons GVW*	*Goods vehicles (over 30 cwt unladen): over 3.5 tons GVW*	*All vehicles*
1980─81	2.4:1	1.5:1	3.4:1	2.9:1	1.0:1	2.2:1
1981─82	2.9:1	1.7:1	4.0:1	3.3:1	1.1:1	2.5:1
1982─83	2.9:1	1.5:1	4.0:1	3.0:1	1.0:1	2.3:1
1983─84	3.1:1	1.3:1	4.0:1	3.0:1	1.0:1	2.4:1
1984─85	3.1:1 a	0.9:1	-	3.0:1	1.1:1	2.4:1
1985─86	3.3:1 a	0.9:1	-	2.7:1	1.2:1	2.5:1
1986─87	3.2:1 a	0.9:1	-	3.0:1	1.2:1	2.5:1
1987─88	3.2:1 a	0.9:1	-	2.7:1	1.3:1	2.5:1
1988─89	3.5:1 a	0.9:1	-	3.0:1	1.3:1	2.7:1
1989─90	3.4:1 a	1.1:1	-	3.1:1	1.3:1	2.6:1
1990─91	3.2:1 a	1.2:1	-	n.a.	1.3:1	2.5:1
1991─92	3.1:1 a	1.26:1	-	n.a.	1.26:1	2.5:1
1992─93	3.1:1 a	1.1:1	-	n.a.	1.2:1	2.4:1

Notes:

1/ Includes light vans under 30 cwt unladen.

Source: Department of Transport (various years), *The Allocation of Road Track Costs.* Statistics bulletin prepared by the Government Statistical Service.

ANNEX II

ROAD USER TAXATION IN THE SWEDISH TRANSPORT POLICY

Road user taxes in principle

The Swedish approach to road pricing has been shaped by three major parliamentary decisions: the Transport Policy Acts (TPA) of 1963, 1979, and 1988. The TPA of 1963 stated that transport modes should pay the total investment and maintenance costs of the infrastructure. This was much debated since it was felt that marginal rather than total costs should be the relevant pricing principle. Furthermore, the question of external costs had been left out of the picture as the 1963 Act only referred to public expenditures.

In 1979, the Swedish parliament adopted the policy of charging social marginal costs rather than total financial costs. At that time the main social cost under consideration was that of traffic accidents. Air pollution was mentioned as an external effect that could not then be calculated. Charging social marginal costs was to be achieved through variable road user taxes, in particular the petrol and kilometer tax. In addition, fixed taxes, such as the annual vehicle tax, were to be used to recover remaining fixed costs. Any deviations from charging based on marginal social costs would therefore be motivated by political considerations and not related to economic efficiency.

The 1988 TPA also endorsed the main principles of the 1979 Act, except that environmental effects were also to be incorporated into calculations of social marginal costs, albeit with caution. The social marginal costs for road traffic, in ore per vehicle kilometer, were calculated for 1987 and used as a basis for the 1988 TPA and for evaluating existing variable road user taxes, namely petrol and kilometer taxes. These are shown in Table A3.1. The figures highlight the considerably higher social marginal costs in urban areas compared to rural areas. Due to the difficulty of dealing with these through petrol and kilometer taxes, a Parliamentary Committee was appointed with the task of analyzing special measures for dealing with urban traffic problems. One of the measures proposed for Stockholm was area licenses.

Road user taxes in practice

The results of Sweden's cost responsibility exercises are not automatically translated into actual road user taxes, although they have had some influence in shaping government decisions. The current system of road user taxes consists of a fixed ownership-based vehicle tax and variable use-related taxes. The variable taxes applicable to gasoline-powered vehicles are the gasoline tax, including a carbon dioxide tax introduced on January 1, 1991. The variable taxes applicable to diesel-powered vehicles consist of a diesel fuel tax and a kilometer tax. The tax on diesel fuel consists of a general energy tax, a sulphur tax, and the carbon dioxide tax, the latter two introduced January 1, 1991. Gasoline and diesel are also subject to VAT, levied on the tax-inclusive consumer price.

The kilometer tax is levied according to the provisions of the Road Traffic Act (1988:327, VSL), which also contains regulations regarding vehicle taxation.

Fuel taxes

Energy taxation in Sweden has become more concerned with the environment during the 1980s.

Table 1: Social marginal costs for road traffic in 1987 in ore/vehicle kilometer (1987 prices)

	Private cars		*Trucks (22.5 ton)*		*Buses (16 ton)*	
	Rural	*Urban*	*Rural*	*Urban*	*Rural*	*Urban*
Road maintenance	0.8	0.7	31.8	23.0	27.8	20.1
Traffic surveillance	1.1	1.1	1.1	1.1	1.1	1.1
Avg. congestion	0.8	18.0	5.5	54.0	2.2	54.0
Accidents	11.0	38.0	15.0	46.0	16.0	148.0
Health and environment	6.5	29.0	27.5	68.0	23.0	161.5
Total	20.0	87.0	81.0	192.0	70.0	386.0

Note*:*

1. 100 ore = 1 SEK = US$ 0.15

2. Social marginal costs are for private cars without catalytic converters. The social marginal costs for health and environment are 1 and 5 ore respectively for a car with catalytic converter.

3. Road maintenance costs for trucks and buses are average values for different tire and axle combinations.

Source: Hansson, Lars (1990), *The Swedish Approach to Multi-Modal Transportation Planning*. Stockholm, Sweden.: Swedish State Railways.

Fuel taxes were increased, partly to deal with environmental damage and partly to encourage various forms of energy saving.

In 1980, the tax on petrol included a basic petrol tax, an energy tax, and a special tax for oil products. The petrol tax was increased in 1982, 1984 and 1985, the special tax was substantially reduced in 1984, and the energy tax was abolished in 1985. On January 1 1985 the energy tax was abolished. On January 1 1986, the petrol tax distinguished between leaded and unleaded petrol. The differential was then 20 ore per liter and was subsequently widened in 1987, 1990, and in 1991 to reach 31 ore per liter in 1991. The objective of the differentiation was to provide an incentive both to switch to unleaded petrol for cars that can run on either type and to change sooner than otherwise to cars that use unleaded fuel. On January 1 1991, the petrol tax on both leaded and unleaded

petrol was reduced (the differential remained the same), the special tax for oil products was eliminated, and the CO2 tax introduced. The CO2 tax was levied on the same fuels subject to the energy tax (hence also diesel) and corresponded to a rate of SEK 0.25 per kg of CO2 released. It provided an incentive to switch to types of energy where the emission of CO2 was low. The sulphur tax, also introduced in 1991, induces purification measures as well as a change to grades of oil with a lower sulphur content and to other types of energy. On January 1 1993, the CO_2 tax will be raised from SEK 0.25 to SEK 0.32 per kg. As a consequence, the CO2 tax on petrol will increase. Since March 1 1990, VAT has been levied on petrol at a rate of 20 percent of the taxable base value (i.e., the price, plus other taxes and charges plus VAT). This rate was reduced to 18 percent on January 1 1993.

Prior to July 1, 1981, diesel used in buses bore a lower tax rate than diesel used in other motor vehicles. Since then, both taxes have been the same. In 1980, taxes on diesel consisted of an energy tax and a diesel tax. On January 1 1985, the diesel tax was eliminated and the energy tax was increased, the total tax remaining the same. On January 1 1991, a CO2 tax was imposed, and this tax was increased as of January 1 1993, in line with the increase in the general level of the tax. Also in 1991, diesel was divided into three environmental classes according to the content of sulphur and hydrocarbons and the energy tax was differentiated between these three classes of diesel. Class III bore the highest energy tax, being the least environment-friendly. On January 1 1992, the differential between classes I and II on the one hand and class III on the other was widened. A sulphur tax was also introduced at the beginning of 1991, but the sulphur content of the fuels used in road vehicles is below the level where the sulphur tax is imposed, so that in practice there is no sulphur tax on these products. The sulphur tax on oil was levied at the rate of SEK 27 per cubic meter for every 0.1 percent by weight of sulphur in the product. Since March 1 1990, VAT has been levied on diesel at the rate of 20 percent of the taxable base value. This rate was reduced to 18 percent on January 1 1993.

Vehicle tax

The vehicle tax is an annual tax levied according to the type and weight of the vehicle, the number of axles and the fuel used. On February 1 1980, the vehicle tax was increased as part of the government's efforts to reduce oil consumption. In July of the same year, vehicle taxes on passenger cars used in the north of Sweden were reduced as such traffic had been under-taxed given the relatively longer driving distances. It was felt that taxes linked to road use rather than vehicle ownership, such as the fuel tax, were better for recovering road use costs in these regions. On January 1 1988, vehicle taxes on heavy lorries and trailers were raised in order to discourage the use of such heavy vehicles. The government also needed more tax revenue.

Kilometer tax

The kilometer tax was introduced on January 1 1974, for diesel-powered passenger vehicles, trucks, and buses. It was extended two years later to apply also to heavier trailers over 3,000 kgs pulled by vehicles subject to the kilometer tax. The tax is based

on the distance driven domestically and is graduated according to the type and weight of the vehicle. Kilometer taxes are also levied on certain foreign vehicles used temporarily in Sweden. The government provided three reasons for the introduction of the kilometer tax. First, it was expected to be the best way of taxing according to the cost-responsibility principle adopted in 1963. Second, it would be easier to confine the kilometer tax road use only. Third, it was assumed that the problems of control and the tax evasions that had occurred in connection with the fuel oil taxation could be rectified with the introduction of this tax. Since then, a special government commission was given the task of surveying the road user taxation system, including evaluating the kilometer tax and considering other forms of taxation. It was concluded (Report Ds Fi 1984:22) that the kilometer tax should be retained. The Swedish Parliament also adopted a similar position in its discussion of the issue and merely decided to undertake certain minor changes in the system (Prop. 1985/86:92, SkU 31, rsks. 190).

On February 1 1980, the kilometer tax, as well as a number of other energy taxes, were increased in an attempt to discourage oil consumption. In November 1980 and again in 1985, the kilometer tax was increased to raise revenues for the government. The cost responsibility calculations for road traffic for 1987, used as a basis for the 1988 TPA, pointed out the discrepancy between road user taxes and the social marginal costs of road traffic at that time. As a result, in 1988, the kilometer tax on passenger cars was increased to bring charges closer in line with the social marginal costs. In 1989, kilometer taxes for trucks were increased 45 percent and those for buses and coaches were increased 100 percent. These increases lead to a 93 percent social marginal cost recovery for private cars with catalytic converters on rural roads. However, the increases remained insufficient to achieve full social marginal cost recovery from other categories of vehicles. Nevertheless, political difficulties kept the charges to these levels. In March 1990, the kilometer tax on passenger cars was again increased. This was part of the 1991 tax reform and also served to compensate for the loss of revenues from other tax reductions. On January 1, 1993, the kilometer tax on buses and trucks, excluding the very lightest vehicles, was reduced by approximately 10 percent. This was to reduce industry's tax burden because of the increase in the CO2 tax on petrol and diesel which resulted in an increase in the total taxation of heavy traffic.

Proposed changes in road user taxation

The kilometer tax is to be eliminated altogether when Swedish road taxes are harmonized at the EC level. It is proposed that the diesel tax be formulated in such a way that its revenues are equivalent to existing revenues from both the kilometer tax and the diesel tax. This would imply a diesel tax well above the minimum level agreed upon by the EC (see Table 2).[46]

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[46] Proposals for changes and other aspects of road traffic taxation are discussed in: (i) Ministry of Finance (1992), *Taxation on Diesel Oil: Findings of the Report on the Taxation of Diesel-Powered Vehicles.* Swedish Government Official Report 1992:53. Stockholm: Ministry of Finance, Government of Sweden; and (ii) Ministry of Communications (1992), *Traffic Charges on Socio-Economic Conditions.* Report 1992:44. Stockholm: Government of Sweden.

Table 2: Proposed Swedish diesel tax vs. EC minimum tax level (SEK per liter)

	Proposed Swedish diesel tax		*EC minimum diesel tax*
	Environment class 2	*Environment class 3*	
Diesel tax	1.35 1/	1.35 1/	1.81 3/
Energy and CO_2 tax	1.21 2/	1.46 2/	0.39 4/
Total diesel tax	2.56	2.81	2.20

Notes:

1/ Proposed diesel tax to replace Swedish kilometer tax. Calculated to counterbalance revenues lost from eliminating kilometer tax.
2/ Swedish proposed energy and CO_2 tax on diesel as presented in Government Bill 1991/92:150.
3/ Minimum diesel tax agreed upon by the EC.
4/ EC proposed energy and CO_2 tax on diesel for the year 2000.

Evaluation of Swedish road user taxes

The social marginal costs of road traffic in 1987, calculated for the 1988 TPA, were used to evaluate the existing structure of road user taxes. On that basis, petrol and kilometer taxes were increased in 1988 and 1989 as they were insufficient to cover the costs imposed by road traffic. Still, by 1989 only private cars with catalytic converters were paying according to the 1987 evaluations of external costs. Private cars without catalytic converters (65 percent of passenger car kilometers in 1990), trucks, buses, and coaches were paying only a fraction of their external costs. Table 3 shows the coverage of social marginal costs by different vehicle groups after the 1989 tax increases.

With regard to the total as against the marginal costs of road traffic, Hansson[47] provides calculations comparing the total financial and the total social-economic costs of road traffic to actual road user taxes for fiscal year 1989─1990. They indicate that road traffic in Sweden did not cover their total *external costs*, including traffic accidents and emissions, although the total *financial costs* of the network, including traffic surveillance and medical care for people injured in traffic accidents, were covered.

47 Hansson, Lars (1990), *Ibid*.

Table 3: Social Marginal Cost coverage in road traffic, 1989

	Social marginal cost responsibility
Rural traffic/highways	
Private car, catalytic converter	93%
Private car, non-catalytic converter	76%
Truck	70%
Coach	55%
Road traffic (including urban areas)	
Private car, catalytic converter	45%
Private car, non-catalytic converter	65%
Truck	50%
Coach	40%
Bus	10%

Source: Hansson, Lars (1990), *The Swedish Approach to Multi-Modal Transportation Planning*, Swedish State Railways, Stockholm, Sweden.

Road user taxation in Sweden - A Summary

The key observations about road user taxation in Sweden may be summarized as follows:

1. In principle, road users are required to cover their social marginal costs through variable road user taxes (petrol and kilometer tax), with any remaining fixed costs covered through fixed taxes (annual vehicle tax). It is not clear whether freight traffic is required to bear its fixed costs. In practice, most vehicle categories do not fully cover their social marginal costs.

2. Marginal maintenance, traffic surveillance, congestion, accident, health, and environment costs are included in calculations of social marginal costs.

3. A carbon-dioxide and a sulphur tax has been in place since 1991.

4. The kilometer tax was an attempt to improve the link between road use and road taxes. It acts as an "explicit tariff for roads," promoting efficiency by presenting users with the costs of road use. However, this is to be abandoned as part of the EC harmonization of commercial vehicle taxes.

5. There is no link between road user taxes and the efficiency of the road agency (Swedish National Road Administration): revenues accrue to the general treasury and not to the road agency and therefore do not influence the provision of roads; road investments are based on cost-benefit analyses and on the amount of funds allocated to roads out of the general budget. However, there have been attempts

to reduce the costs of operations and maintenance through commercializing the agency.

6. There is no hypothecation of road user taxes.

ANNEX III

ROAD USER TAXATION IN THE FINNISH TRANSPORT POLICY

Road user taxes in principle

There have been a number of exercises by the Finnish government to determine the costs imposed by road traffic However, there has been no official attempt to propose a set of road user taxes for Finland based on these costs. The principle of charging road users according to their social costs has not yet been applied in practical decisions about road user taxes, although in practice road users are required to cover total direct and indirect financial expenditures. The Finnish National Roads Administration is of the opinion that this system of budgetary funding should be changed to a system of user-based finance as soon as possible. This would involve the recovery of maintenance expenditures from taxes on motor fuels, and the recovery of investment costs from vehicle license fees and tolls. The calculations of road traffic costs carried out by the Finnish government and reviewed here have been used in the evaluation of alternative road projects rather than in the determination of road user taxes. Three official studies are discussed in this Annex. The first compared costs and revenues in road and rail traffic, the second computed road traffic accident costs, and the third examined the pricing of traffic noise and exhaust emissions.

Cost-revenue correspondence in road and rail traffic

In 1975, the Parliamentary Traffic Committee proposed that one important objective of tariff policy in the traffic sector should be the application of the principle of cost-revenue correspondence.[48] This meant that each category of traffic should bear the costs imposed by it. The Committee's report did not lead to any concrete measures to this effect. However, in the 1980s, cost-revenue correspondence in the Finnish road and rail sectors was examined in a study entitled *Cost-Revenue Correspondence in Road and Rail Traffic*.[49] This study sets out the methods for calculating costs and revenues in the road and rail sectors, and analyzed whether and how road and rail traffic covered their costs. Traffic was considered as a whole and not according to category of vehicle or geographic area. The study was concerned with the total costs of traffic, although marginal costs were also noted to be important.

Four problems were identified in determining costs and revenues: (i) the extent problem (which revenues and costs should be included); (ii) the valuation problem; (iii) the measurement problem; and (iv) the attribution problem. Nevertheless, the study presented estimates for the magnitudes of the costs of road traffic as a whole for 1986

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[48] Committee Report 1975, *Report of the Parliamentary Traffic Committee*.

[49] Government of Finland, *Cost-Revenue Correspondence in Road and Rail Traffic: Calculation Principles and Realization*.

and 1987 and, in some cases, in all years throughout the 1980s. In the case of roads, the costs calculated were network (operation and maintenance), surveillance and administration, and external. The latter included the costs of accidents, traffic emissions, congestion (time losses), and noise and vibration. Revenues from road traffic, including special taxes and charges levied on traffic and fines imposed for traffic offenses, and the correspondence between road traffic revenues and costs, were also presented. The net result for the roads sector was that road traffic covered their costs, even when costs included those incurred by local municipalities and private persons, and emissions costs. Railways were found to be always in deficit.

This study did not consider the costs imposed by specific categories of vehicle. Road traffic costs were calculated for road traffic as a whole, but no attribution was made to different categories of vehicle. As a result, it is not possible to derive a set of road user taxes based on the cost calculations made.

Costs of road traffic accidents

The Finnish National Road Administration (FinnRA) has carried out a number of exercises to determine road traffic accident costs. The most recent study was commissioned by FinnRa and carried out by the Business Economics Research Center (BERC). The results are presented in *Road Traffic Accident Costs In Finland In 1990.*[50] Accident costs have been calculated in Finland since the 1960s. The methods of calculation have changed somewhat since then but have remained the same since the Parliamentary Traffic Committee of 1975 which determined the method to be used for calculating such costs.

In Finland, accident costs are divided into real economic losses and welfare losses. The former contains production losses, resources used to repair damage, etc. The latter is a measure of human suffering and is based on the resources required to care for a person with 100 percent invalidity. The value obtained for welfare losses can thus be regarded as a minimum value. The method used is imperfect as all costs or losses due to a traffic accident cannot be evaluated in monetary terms and there are obviously some omissions from the Finnish calculations. Table A4.1 presents the total costs of road traffic accidents in Finland in 1988, as calculated by the BERC study.

Pricing of traffic noise and exhaust gases

In 1990, FinnRA decided that the costs of damage caused by noise and exhaust gases ought to be taken into account in any social cost calculations of road projects. A Working Group was established to examine the grounds and procedures to be used for the pricing of such damage. Their report, published in 1992 and entitled *Pricing of*

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[50] Finnish National Road Administration (1990), *Road Traffic Accident Costs 1990*. Memorandum, Finnish National Road Administration, Planning Department, Research Centre.

Traffic Noise and Exhaust Gases in Road Planning[51] is the most recent calculation of the costs of noise and exhaust gases.

Table 1: Total costs of road traffic accidents in 1988 (FIM mn)

Accident type	*Costs (FIM mn)*
Fatal	5,240.0
Resulting in permanent injury	1,490.9
Resulting in temporary injury	1,012.3
Material damages only	1,744.0
Total	9.487.2

Source*:* Finnish National Road Administration (1990), *Road Traffic Accident Costs 1990*. Memorandum. Finnish National Road Administration, Planning Department, Research Centre.

Estimates of the cost of traffic noise and exhausts in Finland by the FinnRA Working Group are based on a number of assumptions and generalizations. The estimates are based on the economic losses caused by different kinds of damage, excluding those caused by climate changes. The cost of climate changes are based on the charges and fees needed to stop the growth of CO_2 emissions. These costs are presented in Table 2.

[51] Finnish National Road Administration (1992), *Pricing of Traffic Noise and Exhaust Gases in Road Planning*, FinnRA Reports 15/1992, Helsinki.

Table 2: Cost estimates of damage caused by traffic exhausts and noise in Finland in 1989

	FIM mn
EXHAUST GASES	
Diseases	260
Fouling	410
Corrosion	40
Forestry: stock loss	220
Crop yield loss	220
Comfort	300
Climate change	1,500
TOTAL	2,900
NOISE	
Comfort	1,600
TOTAL	**4,500**

Source: Finnish National Road Administration (1992), *Pricing of Traffic Noise and Exhaust Gases in Road Planning*. FinnRA Reports 15/1992, Helsinki.

The cost of the impact of noise and traffic exhausts in 1989 were FIM 4.5 billion, of which exhaust gases accounted for FIM 2.9 billion and noise for FIM 1.6 billion. The costs of exhaust gases may be translated into a price per kilometer for light and heavy vehicles. For instance, the emissions costs of existing vehicles without catalytic converters are on the average 6.5 pf/km in road driving and 7.0 pf/km in city driving. The emissions from vehicles with catalytic converters ware 70-80 percent lower, and the costs are consequently also lower. The emissions costs of existing heavy vehicles are on the average 27 pf/km in road driving and 32 pf/km in city driving. The emissions and costs of such heavy vehicles are expected to be 50-60 percent lower in the future. The costs of damage caused by noise were determined by the duration of noise and the time unit prices used by FinnRA. The used unit price of the damage caused by noise was FIM 5000 per person affected at the 1991 price level.

Road user taxes in practice

The Finnish road traffic cost estimates discussed here have not been used to design a structure of road user taxes for Finland. Instead, the Finnish Parliament takes decisions about road user taxes independently of these cost estimates.

Fuel taxes

Petrol and diesel in Finland have been subject to a turnover tax since 1964. An additional excise tax has also been levied. On May 1, 1974, fuels became exempted from the turnover tax because of the energy crisis which led to substantial increases in the price of fuels. The turnover tax which was calculated as a percentage of the price, was no longer considered appropriate. Only the excise tax was levied and this was calculated in pennies per liter.

The Energy Taxation Committee established in its report (Committee Report 1983:35) of spring 1983 that the taxation of various forms of energy was "heterogenous and lopsided in relation to their prices." In addition, it was found that the taxation system weakened the competitiveness of industry. The committee recommended a reform of the energy taxation system so that it would be based on the turnover tax. On July 1, 1986 the turnover tax was re-introduced on petrol and diesel at the normal rate of 16 percent. The excise tax was retained and the combined amount of the turnover tax and the excise tax was designed to correspond to the tax level already prevailing at the time. To encourage the use of unleaded petrol for environmental policy reasons, the price of unleaded petrol was reduced by 12 pennies per liter.

In 1988, the government reported to Parliament on environmental policy. It indicated its intention to reform the taxation of traffic fuels so that environmental costs are taken into account. It was also felt that a more active use of the price mechanism was required for environmental protection. In the 1989 report of the Environment Committee, it was suggested that the possibility of a CO2 tax be examined and established on the basis of the average, relative carbon content of fuels. (It was observed that the maintenance of neutrality in international trade would require that a CO2 tax be applied at the same time in competitor countries). The reduction of other emissions was also an objective. The Environment Committee also proposed an increase of the taxes on transport fuels. In 1989, Parliament adopted a resolution that economic instruments be applied for the purpose of limiting the use of natural resources and protecting the environment. Parliament at that time requested government to undertake the necessary studies and to prepare proposals for the introduction of such instruments by 1990.

It was against this background that on 1 January 1990 the tax on petrol and diesel was increased. The reasons provided were to control the growth of energy consumption and to reduce the environmental damage caused by energy production and consumption. An environment tax was imposed on transport fuels in the form of a supplementary tax (supplementary to the excise tax). The structure of taxation was also amended so that the excise tax on petrol became the same for all qualities, i.e., 128 pennies per liter. The excise tax on diesel was 73 pennies per liter. The graduation of taxation was to be realized through the supplementary tax, levied to its full amount at 27 pennies per liter on leaded petrol and on diesel. There was no supplementary tax on unleaded petrol, although a supplementary tax of 13.5 pennies per liter was levied on mixtures of leaded and unleaded petrol. In the final analysis, the tax on petrol increased by about 18 pennies per liter while that on diesel increased by about 16 pennies per liter.

On January 1 1993 the excise tax on petrol and diesel was increased by 102 and 14 pennies per liter respectively over 1990 levels. In addition, the supplementary tax was graduated so that the tax on reformulated traffic fuels which reduce vehicle emissions was lower than that on other qualities. The graduation was realized through granting a 15 pennies per liter tax advantage to sulphur-free diesel oil, and a 5 pennies per liter tax advantage to reformulated petrol, both leaded and unleaded. The excise tax increases served to compensate for the reduction in revenues on account of the changes in the supplementary tax. In general, the main motivation for the 1993 changes were public finance, energy policy, and environment policy.

Motor vehicle tax

The motor vehicle tax includes a motor car and motorcycle tax levied on petrol-powered vehicles and an annual "diesel" tax levied on all vehicles using fuel other than petrol. The motor car tax is levied on passenger cars, delivery vans, other motor cars weighing less than 1,800 kg and motor cycles registered in Finland and is the same for imported cars and cars manufactured in Finland. Certain special vehicles are exempt from this tax. As of June 28 1991, the amount of the tax for vehicles, except motor cycles, was the taxable value of the vehicle (equivalent to the cif price plus the import duty for imported cars and the ex-factory price in the case of cars manufactured in Finland) plus 22 percent less FIM 4,600. The deduction is subject to the condition that the tax must be at least 50 percent of the taxation value of the car. Cars with low emissions are allowed a special deduction of FIM 4,500, which is made from the taxable value of the car.

The motor car tax has developed since 1977 as shown in Table 3. It is shown that, since 1977, motor vehicle taxation has steadily declined through a reduction in the percentage of the taxable value included in the tax from 45 percent in 1977 and by an increase in the fixed deduction from FIM 2,500 in 1977.

Table 3: Development of the motor car tax

Date of Change	*Tax*
1 January 1977	1.45 x taxable value - FIM 2,500
24 May 1982	1.44 x taxable value - FIM 3,000
14 May 1984	1.40 x taxable value - FIM 3,500
6 May 1985	1.35 x taxable value - FIM 4,000
1 January 1987	1.32 x taxable value - FIM 4,600
1 September 1990	1.27 x taxable value - FIM 4,600
28 June 1991	1.22 x taxable value - FIM 4,600

Source: Ministry of Finance, Tax Department, Helsinki.

The annual "diesel" tax is levied on passenger cars, delivery vans, and lorries. The rate of taxation is based on the type of vehicle and the total weight, and in the case of lorries, on the number of axles, bogie design, and on whether a trailer or semi-trailer will be attached. For a passenger vehicle of about 1,200 kg, the vehicle tax amounts to SEK 1,770 per annum.

Taxes applicable to motor vehicles registered abroad

Motor vehicles registered abroad and using fuel other than petrol are subject to a flat rate tax for each day of use and a tax based on the number of kilometers travelled in Finland, if they are used temporarily in Finland (see Table 4).

Table .4: Taxation of motor vehicles registered abroad

	Flat rate tax, FIM/day	*Kilometer tax,FIM/km*	*Minimum kilometer tax, FIM/day*
Delivery van	80	0.50	200
Bus	90	0.90	360
Lorry	150	2.40	960
Trailer of a lorry	90	0.90	360

Source: Ministry of Finance (1992), *Taxation in Finland 1992*. Helsinki.

Vehicles registered in a state which is a party to the Geneva road traffic conventions are exempt from the flat rate tax. Finland has granted reductions or exemptions through bilateral agreements with several states or through decisions by the Ministry of Finance.

Evaluation of road user taxes

Due to the lack of estimates of road traffic costs by vehicle category, it is not possible to evaluate road user taxes according to whether or not they cover the costs allocated to them. However, the Second Parliamentary Traffic Committee argued in its 1991 report[52] that the structure of road user taxes on passenger cars was at that time inappropriate from the point of view of traffic policy. As Table 5 illustrates, the tax burden rested largely on the acquisition of vehicles rather than on their use, whereas the latter was the more relevant object of taxation, since maintenance and other traffic costs are related to vehicle-use rather than vehicle-acquisition.

Based on these findings, the Committee proposed that the car tax should be gradually and considerably decreased to achieve a European level of taxation. The Committee went further to propose a set of principles on which road user taxes should be based. It was argued that road users should be fully responsible for the costs of road maintenance; taxes should be imposed to compensate for the damages due to pollution and accidents;

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[52] Committee Report 1991:3, *Report of the second Parliamentary Traffic committee, Traffic 2000*. Helsinki: Government of Finland.

road user taxes should be more related to road use than to vehicle ownership; the annual tax on gasoline powered vehicles should be related to the environmental qualities of the vehicle such as fuel efficiency; and emissions regulation should be given more consideration than emissions taxation in the attempt to reduce emissions. On the basis of these principles, the committee proposed a structure of fuel taxes, vehicle taxes, and annual taxes for 1991.

Table 5: Estimated revenue from road traffic taxes in 1990 (FIM millions)

	Acquisition	*Possession*	*Use*	*TOTAL*	*Pennies per km driving*
Passenger cars	7,150	270	4,845	12,265	35.8
Vans		85	325	460	15.8
Buses			230	230	34.9
Trucks and lorries		366	1,427	1,790	61.3
TOTAL	7,150	721	6,877	14,745	

Source: Committee Report 1991:3, *Report of the Second Parliamentary Traffic committee, Traffic 2000*.

Road user taxation in Finland - A Summary

The key observations about road user taxation in Finland may be summarized as follows:

1. The 1975 Parliamentary Traffic Committee endorsed the principle that road users as a whole should cover their total network (investment and maintenance), surveillance and administration, and external costs. Cost recovery for particular vehicle categories was not discussed. The Second Parliamentary Traffic Committee of 1991 argued that road users should be fully responsible for the costs of road maintenance, with additional taxes to compensate for pollution and accident damages.

2. The way in which tax instruments were to be used to recover total costs was not discussed by the 1975 committee. However, the 1991 committee endorsed an increased role for variable as against fixed road user taxes in the recovery of total costs.

3. In practice, road users are required to cover total direct and indirect financial expenditures related to the provision of roads.

4. An environmental tax (the supplementary tax) has been in place since 1990.

5. The kilometer tax is combined with a flat rate tax to form a clear transit fee for motor vehicles registered abroad. This kilometer tax improves the link between road use and road taxes. It approximates an "explicit tariff for roads," promoting efficiency by presenting users with the costs of road use. However, it is to be

abandoned as part of the EC harmonization of commercial vehicle taxes. Domestic road users do not currently face the kilometer tax.

6. There is no link between road user taxes and the efficiency of the road agency (Finnish National Road Administration): revenues accrue to the general treasury and not to the road agency and therefore do not influence the provision of roads; road investments are based on cost-benefit analyses and on the amount of funds allocated to roads out of the general budget. However, there have been attempts to reduce the costs of operations and maintenance through commercializing the agency.

7. There is no hypothecation of road user taxes.

ANNEX IV

ROAD USER TAXATION IN THE GERMAN TRANSPORT POLICY

Road user taxes in principle

The German Institute for Economic Research has regularly been commissioned by the Federal Minister for Transportation to calculate the infrastructure costs and expenditures for all traffic modes for the Federal Republic of Germany. The latest report was published in 1990[53] and a more recent report is currently being prepared. The 1990 report of the German Institute for Economic Research calculates the total costs and expenditures of providing the road transportation infrastructure, the payments from road users for using the infrastructure, and the resulting degree of cost recovery. There was no calculation of road user taxes based on either costs or expenditures.

Costs, revenues, and cost recovery of roads, federal freeways, and federal highways

Total costs were taken to include the cost of capital invested in the fixed assets (depreciation and interest) and the current costs for maintenance, operations, and administration (including traffic police). While current costs corresponded to expenditures required each period, capital costs were the costs of capital invested over many years and differed fundamentally from the investment expenditures of each period. These capital costs were distributed over the period of economic utilization. By this process, depreciation referred to the assessed consumption of goods due to the use of the infrastructure, while interest represented the costs of tying up capital. The report argued that road user revenues based on such a calculation would ensure that road users covered the costs of previous investments used by them while not being burdened with the full costs of new facilities used only during a portion of their useful life. Also, a comparison of road user tax revenues with this definition of costs would indicate the extent to which the average resources needed annually for road maintenance were collected through road user taxes.

Payments for the use of the entire road network were taken to include revenues from the motor vehicle tax and from the petroleum tax. On the basis of these definitions and the calculations made, the report established the following cost recovery figures: the degree of cost coverage for the whole road network in 1987 was 98 percent, while domestic vehicle traffic that was fully liable for taxes covered 112 percent of its costs. Passenger cars and vans that were fully subject to taxation reached a cost coverage of 46 percent, while commercial trucks had a cost coverage of 33 percent. The degree of cost coverage for the federal freeways was 165 percent. All vehicle categories on the federal freeways

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[53] German Institute for Economic Research (1990), *Calculation of the Costs and Expenditures for the Routes of Railroad, Road, Inland Shipping and Air Traffic in the Federal Republic of Germany for the Year 1987*. Commissioned by the Federal Minister for Transportation and prepared by Heinz Enderlein and Uwe Kunert, Berlin.

had a degree of cost coverage of over 100 percent, while motorcycles and passenger cars were over 200 percent. The degree of cost coverage for the federal long-distance highways was between 161 percent and 110 percent, depending on the method of calculation used.

Road user taxes in practice

For the purposes of recovering road track costs, the relevant road user taxes consist of the fuel tax and the vehicle excise duty (VED). However, it is important not to confuse allocated road track costs with what road users actually pay. Fuel taxes are decided by the Chancellor on the basis of broader fiscal considerations. VED is ultimately decided by parliament, although the Department of Transport makes recommendations on the basis of different fuel tax scenarios, and with the primary aim of achieving full cost recovery.

With regard to the taxation of heavy vehicles through the fuel tax and the VED, governement policy is that:

(i) road track costs must be correctly reflected in distribution costs;

(ii) there should be a comparable treatment of track costs between different classes of lorries and between lorries and other modes of transport so as to ensure fair competition, particularly in the case of British Rail's freight business which is expected to operate commercially.)The railways are required to cover their full infrastructure costs, charged on the basis of actual expenditure year on year);

(iii) economic incentives should be provided to road haulage operators to choose vehicles which cause less damage to the roads.

Fuel tax

In recent years, the policy underlying changes in the fuel tax has been to maintain its real value. In some years, over-indexing has been required in order to achieve particular government objectives. These have included raising revenue, shifting the burden of taxation from direct to indirect taxes, conserving energy, ensuring the security of fuel supply during fluctuating world oil prices, compensating for movements in world oil prices, reducing pollution and congestion, and generally protecting the environment. In taking decisions to increase the rates of fuel tax, the government has responded in the past to a number of concerns such as the costs imposed on rural motorists, on rural economies, on the costs of distribution of commodities, on industry, and on the haulage industry.

In 1980, the duty differential favoring petrol over the diesel engine road vehicle fuel (known as derv), introduced in 1977, was removed when the duty on petrol was raised to conserve oil. In the following year, the proposed increase in the duty on derv was halved because of concerns about the extra costs that would be imposed on rural motorists and on the haulage industry. The resulting duty differential in favor of derv has continued

until the present day. A duty differential favoring unleaded over leaded petrol was introduced in 1987. The objective was to assist the introduction of lead-free petrol by offsetting its higher production costs, namely, a favorable duty differential. The differential was widened in 1988 due to low consumption levels. In 1989, the differential was widened further and a surcharge was placed on 2 and 3 star petrol with a view to encouraging replacement of these fuels by unleaded petrol. In 1991, fuel duties were increased by 15 percent which was more than needed to compensate for the freezing of the VED (discussed in the next section). The objective was to provide incentives to reduce pollution and congestion.

Annual motor vehicle tax

The level of the annual motor vehicle tax is related to the weight, the cylinder capacity and the date of first registration of the vehicle. Since 1985, it has also been related to the exhaust gas readings of the vehicle. At the beginning of 1992, the Federal Environment Minister considered taxing automobiles also on the basis of pollutant emissions, noise level, and fuel consumption, effective 1993. Vehicle tax rates are decided by the Parliament but with the approval of the sixteen Federal Lander. Decisions are taken after consultation with the Lander and tax rates are then set on a uniform basis throughout the country. Part of the revenues accrue to the Lander and are used to finance road construction. Table 2 shows the motor vehicle taxes, excluding VAT, applicable to heavy vehicles as of April 1992.

Table 2: Annual motor vehicle taxes applicable to heavy vehicles as of April 1992

Vehicle	DM per year
16 ton tractor	3,407
22 ton trailer	5,957
38 ton truck and trailer	9,364
24 ton trailer	7,097
40 ton truck and trailer	10,505

Source: Federal Ministry of Transport.

On July 1, 1990 a Road Use Fee Law was applied to trucks. The road fee was introduced because while German trucks were often required to pay freeway tolls abroad, German roads were free to foreign trucks. This attracted large amounts of traffic, the share of foreign trucks in German freight traffic being about 65 percent, and the resulting substantial infrastructure costs being imposed on Germany were not being recovered. Moreover, motor vehicle taxes in Germany were significantly higher than in other EC countries (e.g., DM 10,000 for a 40 ton truck and trailer compared to DM 120 for a similar vehicle in France). This put German truckers at a further disadvantage. The road

use fee was applied to both domestic and foreign trucks. However domestic trucks were effectively reimbursed through the simultaneous reduction in the motor vehicle tax. Other objectives of the road fee were to reduce automobile traffic and pollution emissions as well as to finance the railroad corporation (Eisenbahn AG). The EC Commission brought a suit against this law before the European Court and, in May 1992, the Court rejected the German law as it was found to be incompatible with EC law. The collection of the road use fee was therefore temporarily suspended, and the motor vehicle tax was raised retroactive to March 1, 1991. In June 1992, after the decision of the European Court, the EC Commission made suggestions to the Federal Ministry of Transportation on how a truck fee compatible with EC law could be framed as a transitional arrangement since the desired harmonization of motor vehicle taxes in the EC was not yet in sight. In July 1992, the Federal Minister of Transportation announced that truck fees were to be reintroduced in 1993 and freeway fees for the first time in 1995-1996. In Bavaria, a legislative bill for a general road fee for freeways and federal highways is planned. According to the Bavarian proposal, a road fee of up to DM 400 for passenger cars, DM 800 for buses, and DM 100 for motorcycles would be collected through the sale of stickers. For trucks, fees of up to DM 9,000 were proposed.

Evaluation of road user taxes

Cost and expenditure recovery figures based on the calculations of the German Institute of Economic Research have already been presented. Table 3 presents figures on the ratio of revenues from the petroleum tax and the motor vehicle tax to road expenditures of the federal government, the Lander, and the municipalities since 1980. These do not correspond to the cost recovery figures put forward by the German Institute for Economic Research. In Germany, road users are required to cover the total expenditures of the federal government, the Lander, and the municipalities on roads. The figures indicate that road users have more than covered these budgetary costs of road use since 1980, and in fact this has been the case since at least 1960 when the degree of coverage was 100.9 percent. The expenditure figures however do not include the external costs of road use and thus do not indicate the extent to which these are recovered.

Road user taxation in Germany - A Summary

The key observations about road user taxation in Germany may be summarized as follows:

1. In principle, road users are required to cover the total expenditures of the federal government, the Lander, and the municipalities on roads. In practice, there has been a high degree of cost recovery (over 100 percent).

2. Road users are not in principle required to cover the external costs of road use. However, the excess of road user tax revenues over road expenditures may be interpreted as a contribution to external costs (or to the general revenues).

3. At present there are no environmental taxes, although various measures are currently being considered for reducing carbon dioxide emissions.

4. Road users do not face an "explicit tariff for roads." However, to the extent that road user taxes reflect the external costs of road use, these become internalized and form part of the private costs taken into account by users. This promotes efficiency in the use of roads.

5. There is no link between road user taxes and the efficiency of the road agency. Revenues accrue to the general treasury and not to the road agency and therefore do not influence the provision of roads. Road investment decisions are based on cost-benefit analyses and on the amount of funds allocated to roads out of the general budget.

6. The fuel tax used to be earmarked but this has now been discontinued. Part of the revenues from the vehicle tax accrues to the Lander to support road construction. Part of the fuel tax is now earmarked for local communities. A portion of the revenues from the annual vehicle tax accrue to local government to support road construction.

Table 3: Road traffic tax revenues, expenditure on roads, and cost recovery (millions of DM)

Year	*Expenditures chargeable to taxable road transport 1/*	*Motor vehicle tax*	*Petroleum tax 3/*	*Excess cover (2+3)-1*	*Degree of cover*
	(1)	(2)	(3)	(4)	(5)
1980	20,555	6,585	19,066	5,096	124.8%
1981	19,957	6,593	20,201	6,837	134.3%
1982	18,248	6,689	21,225	9,666	153.0%
1983	17,655	6,984	21,669	10,998	162.3%
1984	17,793	7,284	22,297	11,752	166.2%
1985	18,355	7,350	22,308	11,303	161.6%
1986	19,437	9,356	23,700	13,619	170.1%
1987	19,737	8,365	24,250	12,878	165.2%
1988	19,983	8,169	24,900	13,086	165.5%
1989 b/	20,530	9,167	28,630	17,267	184.1%
1990 b/	20,861	8,314	29,750	17,203	182.5%
1991	22,408	9,536	36,635	23,763	206.1%

Notes:

1/ Expenditures of the federal government, the Lander, and the municipalities. Includes highway expenditures and traffic police and excludes the government's share of those expenditures amounting to 12 percent of traffic police and 25 percent of highway expenditures. This is based on government use of roads and tax exemptions.
2/ 1989 and 1990 figures are estimates.
3/ Only the share of motor vehicle traffic.

Sources: (i) Deutsches Institut fur Wirtschaftsforschung (DIW), Berlin; (ii) Calculations and estimates by the Bundesverband des Deutschen Guterfernverkehrs (BDF) e.V., Frankfurt/M. and the Deutsche Strassenliga e.V., Bonn.

ANNEX V

ROAD USER TAXATION IN THE FRENCH TRANSPORT POLICY

Road user taxes in principle

In 1970, French transport policy adopted two main principles for pricing infrastructure. These were to: (i) charge at marginal social cost for the transport of goods; and (ii) charge at full cost for the transport of passengers. In order to recover social marginal costs, the axle tax was introduced in 1971 and designed to work in conjunction with the excise tax on fuel. A refund was made for the number of kilometers travelled on the tolled network. Since its introduction, the axle tax has never been revised and actual charges are now below marginal social costs. Since passenger transport is also required to cover its fixed costs, it appears that this role is assigned to the vehicle tax which is not levied on those vehicles paying the axle tax.

Since the adoption of these charging principles, several studies have been carried out by the Conseil Général des Ponts et Chaussées regarding different aspects of the cost of road transport and its allocation to road users. The report of the Infrastructure Cost Commission, *Report on the Allocation of Infrastructure Costs to Road Freight Vehicles*, proposed general rules for charging the different users and indirect beneficiaries on the basis of their cost responsibility, the benefits they derived and the inconvenience to other users. Investment and maintenance costs, the cost of highway police, congestion costs, and safety costs were included and fixed and variable charges were determined in each case. Rules for allocating these costs to light and to heavy vehicles were established. The *Report on the Establishment of Accounts for the National Network (CGPC 79-15)* used a comparable approach but was limited to the national highway networks. Congestion was included among the external costs considered, but not pollution. The *Report of the Working Group Formed to Assess the Cost to the National Community of Road Passenger and Freight Transport (CGPC 81-40)* calculated the actual expenditures of public authorities and individual users in 1978 for all road transport, both passenger and freight. The costs of congestion and other external costs were excluded. The *Report of the Working Group formed to Assess the Cost for the Community of Road Transport (CGPC 83-60)* used the same basic approach as the previous report and calculated the actual expenditures in 1981 of public authorities, insurance companies, and individual users (both passenger and freight). Expenditures were broken down between light and heavy transport vehicles and between freight and passenger traffic.

Reports CGPC 79-15 and CGPC 81-40 focused on the actual financial expenditures of the different economic agents rather than on the external costs of road use. It is important to bear this in mind when interpreting the figures. In the case of the public authorities, which include the government, local authorities, and highway corporations, expenditures refer to maintenance expenditures. Also included are the social security payments made in the case of physical injury. Payments for physical injury were also made by insurance companies and other relevant authorities. The expenditures of individual road users, both heavy and light and commercial and private, include insurance premiums and the whole range of road user taxes. The figures presented do not lend themselves to the

determination of a set of road user taxes as they are merely an accounting of the actual financial expenditures resulting from road use. In the case of individual users, the figures are a statement of private road use costs. External costs were taken into account only to the extent that they gave rise to actual monetary transfers, such as measures to eliminate the externality or compensation paid in the case of physical injury. Determining road user taxes would require knowing the "external costs" of road use, including the financial expenditures of the public authorities, and allocating these to the various vehicle categories.

The most recent review of French transport policy is *Transports 2010*, a report of a group chaired by the Commissaire du Plan and published in 1992[54]. In the area of pricing for the use of infrastructure, the report recommended that, until decisions are taken at the European level, France ought to maintain the basic principles adopted in 1971. However, in the area of road transport, a number of additional measures were recommended. First, the tax on goods vehicles should be raised so that the combination of goods vehicle taxes and the tax on petroleum products for each vehicle category is brought in line with the level of marginal social costs for that vehicle category. This should occur regardless of whether the tax on petroleum products is also raised. Tolls collected should be taken into account. Second, for distances travelled on toll roads, the level of the marginal social costs for each vehicle category should be determined by a special commission of experts. Third, the setting of highway tolls should be determined by new provisions. The report's proposals concerning the level of vehicle taxes and highway tolls are discussed later in this Annex.

Road user taxes in practice

Fuel taxes

In France, petrol and diesel are subject to a range of taxes in addition to the VAT: (i) the Internal Tax on Petroleum Products (TIPP), an excise tax, which accounts for about 95 percent of all taxes excluding VAT; (ii) a charge which goes to the Fonds de Soutien des Hydrocarbures (a hydro-carbon fund) and to the French Institute of Petroleum (IFP); and (iii) a charge for the storage costs of strategic reserves of fuel. In the case of premium petrol and automotive diesel oil, there is also a charge for the special fund for public works. VAT is levied at the rate of 18.6 percent since 1 July 1982. Prior to that date, the rate was 17.6 percent.

Annual vehicle taxes

The annual vehicle tax is levied on vehicles not subject to the axle tax and is based on the power of the engine and the age of the vehicle. Rates are decided annually at the county level (there are ninety-six home and six overseas counties) within a range set by the central government. Their approximate levels for 1992 are shown in Table 1. Total

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54 Commissariat General du Plan (1992), *Transports 2010: Rapport du groupe présidé par le Commissaire du Plan*. Paris: La Documentation Français.

revenues from the vehicle tax, including revenues from vans and small trucks, approximated F 550 million in 1992.

Axle tax

The axle tax was instituted by the Loi de Finances of 1971, at a time when the tolled network was very limited (1,125 kilometers consisting essentially of the North-South Lille-Paris-Marseille highway). It was designed to bring in revenues covering, together with excise taxes on fuel (the TIPP and nondeductible VAT), the marginal social costs. Rates were determined on the basis of costs measured on the non-tolled network and of average annual distances travelled on all networks. A refund was made based on the number of kilometers travelled on the tolled networks. The tolled network at that time was of secondary importance for trucks. Today, however, with the rapid development of toll roads and the increased use of the main corridors, this network has become of major significance for the carriage of goods by truck.

Table 1: Annual vehicle tax rates in 1992

	Range of vehicle tax rates
Passenger cars	up to F 1,200
Small trucks	F 1,200 - F 2,600
Large trucks	F 1,800 - F 3,700
40 ton trucks	F 3,530

Source: Ministry of Transport, France.

The axle tax has remained unchanged since its inception in 1971, and the excise tax on diesel oil has risen more slowly than infrastructure costs. Also, the VAT has become first partially and then fully deductible. These factors have combined to reduce coverage of road use costs by road user taxes. Table 2 summarizes axle tax rates in existence.

Table 2: Axle taxes presently in existence

Vehicle category	*Annual charge*
2-axle vehicle	400 - 5,000 Francs
3-axle vehicle	900 Francs
2-axle tractor and 1-axle semi-trailer	200 - 14,400 Francs
3-axle tractor and 1-axle semi-trailer	900 - 5,600 Francs
2-axle tractor and 2-axle semi-trailer	1,600 - 5,200 Francs
2-axle trailer	2,200 - 3,200 Francs
Very heavy vehicles	1,000 - 5,000 Francs

Source: Direction Générale des Douanes et Droits Indirects/General Administration of Customs and Indirect Duties

The Ministry of Equipment has, at regular intervals, conducted or commissioned studies for updating the axle tax, the most recent one dating to 1988 and covering economic conditions in 1985. According to this study, updating the axle tax and at the same time maintaining the principles on which it was originally based (including reimbursement for travel on toll roads) would lead to a substantial rate rise for the main vehicle categories (see Table 3). The resulting receipts would total approximately 5 billion francs as against 618 million in 1985.

Highway tolls

In France, highway toll concessions are granted to both mixed and private companies. Given the concessionary companies' need to achieve long-term financial balance, highway tolls are more closely related to balanced budget charges than to marginal social costs. The overall level of intercity highway tolls are currently determined by the Ministry of Finance on the basis of several criteria. The last increase, in effect since August 1991, follows several years of no change. With regard to the future determination of highway tolls, *Transports 2010* recommended distinguishing between existing and new infrastructure. On new infrastructure, the institutional organization of the highway sector (of which the granting of highway toll concessions to both mixed and private companies is central) requires that initial and subsequent highway charges cover the financial costs of the new network. On the existing network, revenues should be used primarily to pay off the debts of the mixed companies and to partially finance new investments. In the case of trucks tolls, the system should be enhanced by the creation of new rate categories for very heavy trucks. Variable highway charges (over space and time) should be used to control congestion during peak periods at affected locations.

Table 3: Updating the axle tax

	Truck	*3-axle vehicle*	*4-axle vehicle*	*5-axle vehicle*
	19 ton	32 ton	38 ton	40 ton
Updated schedule (long zone)	21,800 F	62,800 F	46,700 F	26,600 F
Updated schedule (single zone) 1/	13,300 F	38,300 F	31,700 F	18,000 F
Current schedule (long zone)	5,000 F	14,400 F	5,200 F (vignette)	* 3,000 F

Notes:

1/ Schedule calculated where no distinction is made between the long zone, the short zone and the trucking zone. (Currently, the long zone is twice as high as the short zone and four times as high as the trucking zone schedule).

Source: Commissariat General du Plan (1992), *Transports 2010: Rapport du groupe preside par le Commissaire au Plan.* Paris: La Documentation Francais.

Hypothecation of road user taxes

In France, there have been two attempts to establish a road fund. The first was the Special Fund for Road Investments set up in 1952 with a specified proportion of the fuel tax dedicated to the Fund. The proportion was determined annually by Parliament but

was gradually decreased each year until the amounts raised were no longer adequate to finance the increased traffic. It was finally abandoned altogether in the 1980s. The second attempt was the Special Fund for Road Works, set up in 1982 and also based on the fuel tax. Funds were to be used to repay loans for road investment and other public infrastructure. This was abandoned in 1986.

Evaluation of road user taxes

Transports 2010 found that, in France, both road freight transport as well as urban transport (public and private) are under charged. Road user taxes on freight vehicles have been kept lower than justified by costs in order to keep distribution costs low and to strengthen their competitiveness against European freight haulers. In France, receipts from the taxation of heavy vehicles (including highway tolls and excluding VAT) do not cover the road use costs attributed to truck traffic. *Transports 2010* estimates the shortfall at about 5 billion francs a year excluding externalities. Highway tolls for trucks are only 1.7 times higher than those for light vehicles, even though trucks take up 2.3 times the road space used by light vehicles and subject the pavement to much more wear and tear (roughly 3 to 4 times as much by axle load). Furthermore, tolls were frozen between January 1989 and August 1991. A recent estimate of the General Highways Department Council indicates that taxes paid by vehicles of more than 3.5 tons approximately offset costs (excluding externalities) except in the case of very heavy trucks with four or five axles. It should be noted that foreign trucks sometimes escape French fuel taxes by taking advantage of slightly lower taxation in neighboring countries since the capacity of today's fuel tanks make it possible to cross all of France without refueling. In urban transport, undercharging has been the result of insufficient effort to control pollution due to private automobile use as well as a desire to facilitate access to public transport for social reasons. There is also some undercharging on the tolled network. *Transports 2010* points out that to meet the balanced budget criteria given 1990 economic conditions, a generic toll rate for all trucks of around 69 cents per kilometer, slightly higher than the present level, would be required. The rate would be even higher if it charged for externalities.

Road user taxation in France - A Summary

The key observations about road user taxation in France may be summarized as follows:

1. In principle, all traffic is required to cover its social marginal costs through the fuel tax and, in the case of freight traffic, through the axle tax. Passenger traffic is additionally required to cover its fixed costs, and it seems that this role is assigned to the vehicle tax. In practice, there is substantial under-coverage of social marginal costs.

2. On the tolled network, financial cost recovery is one criteria for setting tolls. To avoid overcharging, traffic paying the axle tax is refunded according to distances driven on the tolled network.

3. Varying toll rates by time of day and by location are being considered as a measure to reduce congestion. The creation of new toll rate categories for heavy

trucks is being considered as a measure to more effectively capture the costs of road use.

4. With the exception of tolls, road users do not face an "explicit tariff for roads." However, to the extent that road user taxes reflect the external costs of road use, these become internalized and form part of the private costs taken into account by users. This promotes efficiency in the use of roads. Varying tolls by time of day and by location would improve the way in which congestion costs are reflected in the private costs of road use.

5. Toll rates are partially based on commercial criteria (financial cost recovery). Revenues accrue to the toll road companies and influence the provision of tolled roads. However, the efficiency of these companies is more related to the bidding process for toll concessions than to the toll rate itself. Off the tolled network, there is no link between road user taxes and the efficiency of the road agency. Revenues accrue to the general treasury and not to the road agency. Road investment decisions are based on cost-benefit analyses and on the amount of funds allocated to roads out of the general budget.

6. Hypothecation of road user taxes and the establishment of road funds were attempted but eventually abandoned during the 1980s.

ANNEX VI

ROAD USER TAXATION IN THE NORWEGIAN TRANSPORT POLICY

Road user taxes in principle

The Norwegian government has commissioned several inquiries into the size of external road use costs, the correct level of road user taxes, and the extent to which existing taxes reflect external costs. Norway's Institute of Transport Economics (ITE) has for some time been engaged in the estimation of the external costs of road use and the correct road use taxes based on these. The Green Tax Commission,[55] established by the Norwegian government in December 1989, examined the extent to which existing road user taxes reflected the marginal external costs estimated by ITE. The Commission argued, as did ITE, that variable road user taxes should be designed so as to make the transport user pay attention to the external marginal costs, namely marginal maintenance, congestion (peak damage), capacity, accident and environment costs. Any resulting deficits were to be recovered through fixed road user taxes. Fixed taxes could also be used to recover those use-related external costs not recovered by the variable taxes. Their final report to the Minister of Finance of 1992 provides the most recent evaluation of road user taxes, including environmental taxes, in Norway.[56]

Marginal maintenance, capacity, and accident costs

Most of the analyses of marginal maintenance, capacity, and accident costs, presented in public reports and white papers, are based on a method prepared by ITE.[57] In 1988, ITE updated its calculations of the marginal external costs for both the roads and railway sector. These updated calculations yielded lower costs than ITE's earlier ones.[58]

ITE has recently undertaken a new discussion and further updating of external costs, this time in connection with the work of the Green Tax Commission and the Ministry of Finance, the latter having to do with the discussions of the kilometer tax.[59] These calculations also include an estimation of accident costs (loss of production, medical

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55 The Green Tax Commission consisted of government officials from the Ministries of Environment, Transport, Industry, Oil and Energy, and Finance as well as outside experts from the Central Bureau of Statistics, the University of Oslo, and the Norwegian Institute of Petroleum.

56 Government Publication Series: Norwegian Official Commissions 1992:3, *Towards More Cost-Effective Environmental Policies in the 1990s: Principles and Proposals for Better Pricing of the Environment*, Report of the Green Tax Commission. Chapter 11.

57 This method has been discussed in: Government Publication Series: Norwegian Official Commissions 1975:42, *The Motor Vehicle Charges*.

58 These updated calculations have been discussed in: *Norwegian Railway Plan 1990-93*, White Paper No. 54 for 1988-89, Appendix I.

59 See Institute of Transport Economics (1990), *Road Costs of Vehicle Traffic*, Report No. 0950/1990, prepared by Harald Hjelle.

costs, and administrative costs) based on actual costs rather than willingness to pay. ITE was however unable to provide marginal accident costs for different vehicle groups due to the lack of statistics, although it pointed out that accident costs were somewhat higher for large vehicles.

The main results of ITE's most recent calculations are shown in Table 1. They are based on figures from the 1985─1989 period and are in 1989-kroner. The figures have been incorporated into the report of the Green Tax Commission and used to examine the extent to which variable road user taxes recover external marginal costs (discussed below).

Table 1: Marginal maintenance, capacity and accident costs and use-dependent taxes, in ore per kilometer, 1992 prices.

Permitted vehicle total weight	*Marginal maintenance costs*	*Marginal congestion (peak damage) costs*	*Marginal capacity costs 1/*	*Marginal accident costs*	*Total*	*Kilometer taxes under 30,000 km 2/*	*Kilometer taxes over 30,000 km 2/*	*Proposed diesel charges 3/*
Passenger vehicle: petrol 4/	0.2	1.7	11.7	5.4	19.1	24.9	24.9	-
Passenger vehicle: diesel	0.2	1.7	11.7	5.4	19.1	16.6	16.6	17.5
Delivery van: 2 to 3 tons	3.4	8.7	29.2	5.4	46.7	16.6	6.2	26.5
Truck: 7 to 8 tons	21.8	8.7	29.2	5.4	65.1	28.6	15.7	53.0
Truck: 16 to 17 tons	86.3	8.7	29.2	5.4	129.7	95.7	69.0	70.5
Truck: 22 to 25 tons e/	119.4	8.7	29.2	5.4	162.7	140.4	110.9	83.5
Juggernaut: 24 to 26 tons e/	-	-	-	-	320.0	245.0	196.8	113.0

Notes:

1/ Short-term marginal capacity costs are the time costs borne by road users and others of an extra vehicle using a road network of given capacity. Long-term marginal capacity costs refer to the costs of investments to increase the capacity of the road network due to increased vehicle usage. Projects financed by toll revenues are excluded from the calculations of long-term marginal capacity costs.

2/ Excludes toll revenues and includes taxes on petrol and/or the kilometer tax, converted into a rate per kilometer.

3/ Includes the ordinary tax on diesel plus the proposed increase of 2.20 kroner per liter which will replace the kilometer tax. Converted to kilometer rates on the basis of the estimated diesel consumption for different vehicles. These estimates of fuel consumption are based on average considerations and are, among other things, based on TOI's truck cost examination for 1988. The fuel consumption and thus the diesel charge load may vary considerably both among different vehicle types within the same weight class and in connection with different use of the same vehicle.

4/ For gasoline, the tax rate for unleaded gasoline, excluding the CO_2 tax, is used. The calculation is based on an average gasoline consumption of 0.9 liters per mile.

5/ Vehicle with bogie.

Source: Institute of Transport Economics, Norway, and the Ministry of Finance.

Marginal environmental costs

Road traffic is a considerable source of environmentally harmful discharges (see Table 2). ITE has been involved in various official projects aimed at arriving at concrete cost estimates for the different discharges into the air and on this basis determining a diesel tax which would recover the costs of environmental damage. *Environmental Costs of the Transport Sector* has been commissioned by the Ministry of Communications and the Ministry of the Environment, while *Environmental Costs of Road Traffic in Urban Areas* has been commissioned, among others, by the Directorate of Highways.

Table 2: Contribution of road traffic to various types of environmentally harmful discharges into the air, 1988. 1/

	SO_2	*NOx*	*CO*	CO_2	*VOC*	*Particles*	*Lead*	CH_4	N_2O
Share of road traffic in total discharge	7%	37%	61%	22%	18%	21%	91%	1%	2%

Notes:

1/ The discharge figures are indicated in terms of 1,000 tons, except for CO_2 (millions of tons) and lead (tons).

Source: National Bureau of Statistics: Natural Resources and Environment (1990).

Environmental Costs of the Transport Sector estimates the size of the average environmental costs in terms of ore per kilometer for different vehicle groups and for different regions (see Table 3). The figures indicate large variations in costs, both regionally and among vehicle groups. The report then provided average environmental cost figures based on the share of driving in rural areas and in Oslo in kroner per kilometer (see Table 4). The figures indicate that costs per kilometer vary a great deal, from 0.10 kroner for the smallest vehicles to 2.38 kroner per kilometer for "other special vehicles." Ideally, one would like differentiated environmental taxes on diesel oil according to the type of vehicle using the diesel oil. However, the administrative costs of this would be too high, and therefore it is necessary to arrive at an environmental tax that reflects average costs in the best possible way. The ITE study suggested a tax on diesel of 1.20 kroner per kilometer on the basis of the figures in Table 4. This would correspond to an environmental tax on diesel of 3.40 kroner per liter, assuming a diesel oil consumption of 0.35 liters per kilometer. This would be in addition to the tax of 2.20 kroner per liter proposed for replacing the kilometer tax, and the already existing tax of 0.69 ore per liter. ITE calculated that such a tax would result in an increase in the operating costs of all vehicle types of between 2.9 and 11.3 percent, depending on the type of driving and the distance covered.

The report of the Green Tax Commission did not get into the details of marginal environmental cost estimates. Instead, it discussed certain principles which ought to underlie environmental taxing. The Commission was of the opinion that, where there are objectives for the reduction of discharges, environmental taxes should be determined on

the basis of what is necessary to achieve the desired discharge reductions. The Commission also argues that for cost-effectiveness in environmental pricing, environmental taxes should be the same for discharges from the transport sector as for corresponding discharges from other sources.

The Commission's report made a number of additional points with regard to environmental taxing. First, the kilometer tax was felt to be the best instrument for charging for several types of environmental costs since it was based upon distance travelled as well as vehicle characteristics. For these purposes, the Commission preferred the kilometer tax to the fuel tax.

Table 3: Average environmental costs in ore per kilometer

Vehicle group	*Rural*	*Urban*	*Oslo*	*Center of Oslo*
Delivery vans (diesel)	2.2	6.9	11.6	21.2
1.0 - 4.9 tons	6.5	61.9	118.7	232.5
5.0 - 7.9 tons	8.8	83.8	160.8	314.9
8.0 - 10.9 tons	7.4	80.3	155.0	304.2
11.0 - 12.9 tons	13.8	105.5	200.3	390.0
Over 13 tons	14.7	171.7	332.0	652.8
Tank trucks	12.9	96.0	182.1	354.2
Semitrailers	12.5	104.5	198.3	386.1
Other special vehicles	16.3	162.2	311.8	611.1

Table 4: Average environmental costs in kroner per kilometer based on the share of driving in rural areas and in Oslo

Vehicle group	*Environmental costs, kroner/km*
Delivery vans, diesel	0.10
1.0 - 4.9 tons	0.96
5.0 - 7.9 tons	1.23
8.0 - 10.9 tons	1.18
11.0 - 12.9 tons	1.54
Over 13 tons	1.10
Tank trucks	1.06
Semitrailers	1.33
Other special vehicles	2.38

Second, for environmental problems which varied primarily with fuel consumption (of which there are a number), fuel taxes were appropriate. Where environmental damage varied with time and space as well, fuel taxes became less appropriate. Also, where discharges per consumed unit of fuel varied among different types of vehicles, fuel taxes would also be less effective in recovering costs. Third, fuel taxes do not provide incentives for choosing more environmentally-friendly vehicles. To provide such incentives, fuel taxes would have to be combined with other instruments such as a differentiation of fixed road use taxes according to vehicle characteristics. On the basis of these principles for formulating environmental taxes, the Commission made a few recommendations with regards to existing environmental charges in Norway. These are discussed later.

Road user taxes in practice

Norway's road user taxes are primarily the results of the political decisions of Norway's Parliament, although the findings of special commissions and working groups on the subject have had an impact at times.

Fuel taxes

In Norway, petrol and diesel are subject to an excise tax, a CO2 tax and a sales (value-added) tax. In the case of petrol, the excise tax has been differentiated between leaded and unleaded types since 1986, and the differential has been widened every year from 0.20 kroner per liter in 1986 to 0.65 kroner per liter in 1992. Also, the tax rate has been increased every year since 1985 and stood at 3.42 kroner per liter for leaded petrol and 2.77 kroner per liter for unleaded petrol in 1992. The CO2 tax was introduced on January

1 1991 at an additional 0.60 kroner per liter and was raised to 0.80 kroner per liter in 1992. The VAT is levied at the rate of 20 percent of the price and taxes.

In the case of diesel, the total tax amounted in 1992 to 0.69 kroner per liter. This included 0.32 kroner as the basic excise tax, 0.30 kroner as a CO2 tax, and a sulphur-graduated tax of 0.07 kroner per liter applied to diesel with a sulphur content above 0.05 weight percentage. Prior to 1992, the sulphur tax was the same for all types of diesel oil, regardless of the sulphur content. The VAT is levied at the rate of 20 percent of the price and taxes.

On May 8 1992, the government presented a proposal to the Norwegian Parliament to reduce the tax on diesel oil by 0.14 kroner per liter. The purpose would be to provide additional support to Norwegian industry. The resulting loss of tax income would be compensated for through an increase in the petrol tax by 0.28 kroner per liter for both leaded and unleaded petrol.

In Norway in July 1990, a local fuel tax of NOK 0.50 per liter (including VAT) was instituted in Tromso county. The only objective of this additional fuel tax was to provide funds for various road and tunnel projects in the area and for the development of the main roads. There were no secondary objectives related to traffic management or other matters, although it was recognized that the tax might have an impact on travel and transport. Norway's general policy with regard to such earmarking at the local level is that the revenues must be connected to some specific use and the scheme must be desired locally. If revenues are no longer put to their original purpose, the scheme must be discontinued.

Kilometer tax

Norway introduced a kilometer taxation system in 1959. This tax is levied on diesel-powered motor vehicles as well as on trailers of a total weight of over 2,000 kg. The tax is levied on vehicles of all nationalities, except vehicles of those countries exempted through bilateral agreements, such as Germany, France, Spain, and Italy. Rates are based on the distance covered and the weight of the vehicle. They increase regressively up to a certain weight and then increase progressively thereafter. In 1992, the taxes ranged from 0.17 kroner per kilometer for passenger vehicles and small delivery vans (under 2,000 kg) up to 1.58 kroner per kilometer for the heaviest trucks. The rates of taxes for trailers are, on the average, 30-40 percent lower than for vehicles of the same total weight. A reduction in taxes is granted for vehicle operation beyond 30,000 km per annum for vehicles of a total weight exceeding 2,000 kgs. Tractors as well as buses, coaches, and hire buses with permits are exempt from taxes.

In 1987, the Norwegian government set up a working group to look into the discontinuation of the kilometer tax and to examine alternative taxation systems. Norway has had to relinquish its requirement of certain other countries to pay the kilometer tax, and this has put Norwegian transport companies at a competitive disadvantage. The report of the working group (June 1 1989) recommended that a combination of fuel and vehicle taxes replace the kilometer taxation system. On this basis, the Norwegian

government proposed that the kilometer tax be replaced by an additional tax on diesel of about 2.20 kroner/liter plus a weight-graduated annual tax on heavier vehicles, effective January 1 1993.[60] The revenue from the new taxation system is expected to yield the same amount of income as that derived from the kilometer tax.

The majority of Norwegian buses are not presently subject to the kilometer tax. However, the increased diesel oil taxes resulting from the reforms will increase the costs of bus operation, having undesirable effects on the attractiveness of public as compared to private transport. The government therefore intends to compensate bus operators by increasing the subsidies presently granted to the public transport sector.

The Green Tax Commission, in their evaluation of Norwegian road user taxes, stressed that the proposed diesel tax would be inferior to the kilometer tax in recovering the external costs, excluding the environmental costs, of road use. The Commission felt that with a few corrections in the rate structure, the kilometer tax would recover these external costs more efficiently than the proposed diesel tax. However, the proposed diesel tax would be more accurate in recovering the costs of smaller trucks and buses than the existing kilometer tax. A report by the ITE[61] pointed out that in the case of diesel-powered passenger vehicles, the proposed tax reforms would not result in any major change in the tax burden. The same report also pointed out that the proposed diesel charge of 2.20 kroner per liter would not recover the costs of heavier trucks and, in fact, would be lower than the existing kilometer tax.

The Green Tax Commission argued that the proposed annual weight tax, which increases with increasing vehicle weight, would compensate to some degree for the fact that fuel taxes paid would increase with increasing weight at a lower rate than marginal external costs. The annual weight tax would affect the composition of the vehicle fleet more so than a diesel tax alone. Compared to the existing kilometer charge, however, the proposed diesel tax and annual weight tax would increase the share of heavier vehicles in the vehicle fleet and thus increase road wear and tear.

Another point made by the Green Tax Commission was that if road user taxes were calculated to recover the marginal external costs excluding the environmental, then there was no basis for a lower tax on diesel than on petrol when the kilometer tax was eliminated. (Diesel taxes are often lower than petrol taxes as diesel tends to be used by heavier commercial vehicles). Fuel consumption per kilometer is normally lower when using diesel than when using petrol in otherwise identical vehicles. This is because diesel has a higher energy content than gasoline, and diesel motors are more energy efficient than gasoline motors. Therefore, the per liter diesel tax should be higher than the per liter petrol tax in order for the tax per kilometer to be equal.

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[60] The proposal has been discussed in detail and evaluated in *Taxes and Indirect Taxes to the Treasury,* White Paper No. 1, 1991-92.

[61] Institute of Transport Economics (1991), *Charge Systems in Goods Transport*, Report 0982/1991.

Annual vehicle tax

The annual tax is levied in accordance with the Law of June 19 1959, No. 2. It is levied on passenger vehicles, delivery vans, gasoline-powered trucks, tractors and combined vehicles, non-gasoline-powered combined vehicles with a total weight below 3,500 kg., and camping vehicles. In 1992, this annual tax amounted to 1,400 kroner for all vehicle types with the exception of buses and diesel-powered trucks. For camping trailers with a net weight above 350 kg. and motor cycles both light and heavy, the annual tax amounted to 700 kroner and 1,150 kroner respectively. Certain vehicles are exempt from paying the annual tax such as buses and diesel-powered vehicles above 3,500 kg.

Evaluation of road user taxes

On the basis of ITE's calculations of marginal external costs (maintenance, capacity, and accident) the report of the Green Tax Commission provided an evaluation of existing road user taxes in Norway. Its conclusions are based on the assumption that environmental taxes are correctly fixed in relation to environmental costs and environmental objectives, and are based upon equal treatment with respect to discharges from other sources. In relation to charging for environmental damage, ITE found that an additional diesel tax of around 3.40 kroner per liter would be required if the costs of environmental damage were to be covered. The Green Tax Commission was of the opinion that: (i) the existing sulphur tax on oil products should be reformulated so as to achieve a more cost-effective reduction of the sulphur discharges; (ii) the lead charge on gasoline should be continued, although the magnitude should be evaluated; and (iii) the CO2 tax should be given a more cost-effective formulation. The third point requires that the difference in CO2 taxes between gasoline and diesel be eliminated and that the basis for the CO2 tax should be expanded to comprise the use of fossil fuel which is today exempt from the tax. Calculated per unit of discharge, the CO2 tax on gasoline in 1992 was approximately three times higher than the CO2 tax on diesel oil.

Variable road user taxes, excluding environmental taxes

The report provides several conclusions regarding the relationship between variable road user taxes on the one hand, and the different external marginal costs (maintenance, congestion (peak damage), capacity and accident costs on the other. First, diesel-driven passenger cars are found to pay less through the kilometer tax than their marginal costs. They will also pay less through the proposed diesel tax. Second, petrol-powered passenger cars are found to pay more in petrol taxes than their marginal costs. This is also true if the taxes for CO2 and lead are disregarded. Third, the marginal costs of heavier vehicles appear to be higher than the existing kilometer taxes. The difference is largest for the light and medium-heavy trucks and where more than 30,000 km are covered annually. Fourth, the proposed diesel tax will increase the taxation of smaller trucks with regard to the existing kilometer tax and hence reduce the deviation between marginal costs and the marginal tax levy. Fifth, the proposed diesel tax will reduce even further the marginal tax levy for heavier trucks. Finally, buses are at present exempt from kilometer taxes and thus do not cover any of their costs. However, buses would be required to pay the proposed diesel tax which will replace the kilometer tax. The views

of the Green Tax Commission and ITE on the existing kilometer tax as compared to the proposed tax reforms have already been discussed in the section on kilometer taxes. In presenting its evaluation of existing road user taxes based on ITE's calculations of external costs, the Commission was careful to point out the considerable uncertainty involved. This point was also stressed by ITE. For instance, the calculations do not capture regional variations in external costs but only provide averages figures. The Commission also underlined the importance of updating the calculations of external costs at regular intervals since the situation in the transport market may change considerably.

Road user taxation in Norway - A Summary

The key observations about road user taxation in Norway may be summarized as follows:

1. In principle, road users are required to cover their social marginal costs through variable road user taxes (petrol and kilometer tax), with any remaining fixed costs covered through fixed taxes (annual vehicle tax). It is not clear whether freight traffic is required to bear its fixed costs. In practice, certain vehicle categories (mainly diesel-driven passenger cars, heavy vehicles, and buses) do not fully cover their social marginal costs.

2. Marginal maintenance, congestion/peak damage, capacity, accident, and environment costs are included in calculations of social marginal costs.

3. Tolls are levied for entering Oslo, Bergen, and Trondheim. Rates are determined on the basis of raising funds for road investment and other road improvements.

4. A carbon dioxide and a sulphur tax have been in place since 1991.

5. The kilometer tax was an attempt to improve the link between road use and road taxes. It acts as an "explicit tariff for roads," promoting efficiency by presenting users with the costs of road use. However, this is to be abandoned as part of the EC harmonization of commercial vehicle taxes.

6. There is no link between road user taxes and the efficiency of the road agency (Public Roads Administration): revenues accrue to the general treasury and not to the road agency and therefore do not influence the provision of roads; road investments are based on cost-benefit analyses and on the amount of funds allocated to roads out of the general budget.

7. In Tromso, a local fuel tax is earmarked to raise revenues for transport.