EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

REFORMING TRANSPORT TAXES

OECD

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At present, the ECMT's role primarily consists of:

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– helping also to build a bridge between the European Union and the rest of the continent at a political level.

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The issues currently being studied – on which policy decisions by Ministers will be required – include the development and implementation of a pan-European transport policy; the integration of Central and Eastern European Countries into the European transport market; specific issues relating to transport by rail, road and waterway; combined transport; transport and the environment; sustainable urban travel; the social costs of transport; trends in international transport and infrastructure needs; transport for people with mobility handicaps; road safety; traffic management; road traffic information and new communications technologies.

Statistical analyses of trends in traffic and investment are published regularly by the ECMT and provide a clear indication of the situation, on a trimestrial or annual basis, in the transport sector in different European countries.

As part of its research activities, the ECMT holds regular Symposia, Seminars and Round Tables on transport economics issues. Their conclusions serve as a basis for formulating proposals for policy decisions to be submitted to Ministers.

The ECMT's Documentation Service has extensive information available concerning the transport sector. This information is accessible on the ECMT Internet site.

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FOREWORD

This report builds on a previous work published by the ECMT under the title *Efficient transport taxes & charges* in 2000. The earlier quantitative analysis of taxation on road haulage and its impact on the competitiveness of hauliers vis a vis their counterparts in other Member countries is updated and completed with a broader analysis of the factors that determine the competitiveness of hauliers along the entire logistics chain. The publication also reports the results of a joint study with the Directorate for Transport and Energy of the European Commission comparing the transport charges and taxes in place in the year 2000 with an optional pricing benchmark. This analysis was designed to answer the question *what price and tax changes are likely to result for motorists, hauliers, rail users and other transport services from reforming transport charges to maximise efficiency?*

Policy towards the reform of transport charges and taxes is set out in two ECMT Resolutions (see the ECMT website www.oecd.org/cem/resol/index.htm :

– Resolution 2000/3 on Charges and Taxes in Transport and Particularly International Road Haulage;

– and Resolution 1998/1 on the Policy Approach to Internalising the External Costs of Transport.

These resolutions promote a gradual, stepwise reform of charges and taxes to improve the efficiency of transport, avoid discrimination and distortion of competition and provide incentives to reduce the environmental impacts of transport and manage congestion.

The resolutions were followed-up by the analysis noted above of the size of the changes in taxes and charges involved and an examination of the issues raised in political debate on pricing reform. This work confirms that:

– the potential benefits of the reforms set out in the resolutions are large;

– there are no arguments of principle that give reason to delay reform;

– therefore a focus on implementation and carrying public opinion is now indicated.

At the meeting of the ECMT Council in Brussels in April 2003, Ministers noted:

– the following report and its conclusions on reforming transport taxes and charges;

– that the two Resolutions, together with this report, provide an appropriate framework for the reform of transport charges and taxes towards greater efficiency, fairness and sustainability for the transport sector, and for the economy as a whole;

– that pricing reform needs to be co-ordinated with other instruments fundamental to achieving environmental and safety goals (emissions standards, enforcement of speed limits, etc.) and with investment in improving the quality, management and capacity of infrastructure.

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EXECUTIVE SUMMARY: REFORMING TRANSPORT TAXES AND CHARGES

Pricing reform is underway

Many ECMT member governments have taken steps over recent years to improve the efficiency of transport charges and taxes, differentiating charges in relation to emissions of air pollutants and CO_2, for example, and replacing charges that discriminate between local and foreign registered vehicles with non-discriminatory, territorial based charges. Switzerland has introduced an electronic truck t-km charge. Austria, Germany, Liechtenstein and the United Kingdom plan to do so and several other countries are expected to follow. Satellite tracking and automatic vehicle recognition systems have the potential to make further significant improvements to transport charging systems. New instruments to cope with congestion in urban areas have also been considered in many cities. London, for example, recently implemented a cordon charge to regulate traffic in the city centre. At the same time, traditional instruments such as parking charges and fares policy for public transport could be used more effectively. More efficient systems of charging offer gains including:

– reduced congestion;

– reduced pollution and noise nuisance;

– an overall increase in socio-economic welfare.

The potential benefits are large

Research undertaken for the ECMT and the European Commission[1] to model optimal charges for transport suggests that for the three largest economies examined, Britain, France and Germany, taken together, net welfare gains to society of over Euro 30 billion a year might be achieved[2]. And additional revenues of over Euro 100 billion a year could be available for these three countries to cut distortionary taxes across the economy or support beneficial public expenditure both inside and outside the transport sector.

Public opinion

Public acceptance of the reforms envisaged is a key issue and carrying pubic opinion will require careful attention. Reforming transport charges and taxes will induce adjustments in traffic and in wider patterns of economic activity. This will encounter opposition from certain groups, locally or internationally, that enjoy specific benefits from current inefficiencies in pricing systems. Communicating the benefits of the reforms proposed to the community as a whole is an essential part of implementation. Whether the ways in which governments use revenues from transport charges are viewed as fair, is also central to public opinion. The principles relevant to these issues are discussed in the paragraphs that follow.

1. See Chapter 2.

2. The gain in welfare recorded here is a net gain: it is what remains after subtracting the welfare losses at various points – in particular, the reduction in the consumer surplus currently enjoyed by motorists who are under-charged – from the sum of the various elements of welfare gain, including the increase in revenues, the reduction in travel time for motorists and freight traffic in the newly de-congested roads, the reduction in the real cost to society represented by pollution and accidents, and so on.

Charges determine the effectiveness of many other transport policies

Taxes on transport, and the way in which they are levied, have a profound influence on the way traffic and infrastructure develop and play a fundamental role in conditioning the impact and effectiveness of almost all government policies towards transport. To provide firms and individuals with pricing signals that guide their behaviour in a more rational economic manner, charges need to be levied closer to the point of use of transport infrastructure. Without this, interventions to manage congestion or influence modal split will be less than fully successful. Without better pricing, many investments and subsidies may be wasted and confidence in the outcomes of a wide range of policies undermined.

Coherent baseline

Transport pricing policies can be oriented to promoting a wide variety of aims, including for example, the economic development of regions that currently have no all-weather road connections to the rest of the country (as in large parts of Russia), promoting investment in particular types of infrastructure by increasing cost recovery and earmarking revenues (as with tolled motorways in some countries) and managing congestion. Usually a number of policy objectives are pursued simultaneously. To ensure a coherent result, pricing policies need to be based on a common principle. Economic efficiency — that is prices and charging systems that tend to maximise socio-economic welfare — provides this baseline. It should be noted at the outset that this is not a prescription for uniform charges, as prices need to be determined according to local conditions.

Guidance for reform

Ministers agreed the importance of efficient levels and structures of transport charges and taxes in Resolution 2000/3 and made recommendations as to how charging systems should evolve. The present report draws conclusions on the structures and levels of charges that should result. It is acknowledged that economic efficiency is not always the primary basis for fiscal policy. Nevertheless, an indication of the magnitude and direction of changes required for efficiency is an important guide in the reform transport charges and taxes.

Infrastructure capacity and congestion

There are two quite fundamental aspects to efficiency: efficient use of the infrastructure that exists and, over the longer term, efficient provision of transport infrastructure in terms of quantity and quality. The use of any road, railway, waterway, port, etc. is optimised when its traffic is charged the short run marginal costs of using it. When there is ample capacity, this means charging for the use of infrastructure according to the following main categories of cost: maintenance and administration; emergency services and other external accident costs; air and noise emissions. When there is a capacity shortage, a demand management charge should be used to balance demand with capacity — in place of rationing by congestion. This should ensure that capacity is reserved for the highest value uses.

Short run marginal social costs

The reference level for setting charges to achieve the economic optimum is alignment with marginal social costs. *Marginal* because we are concerned with the additional costs of adding one more user to the system, *socia*l because as well as private costs we are interested in the costs to other users of the transport system and to society as a whole, including impacts on safety and the environment. As discussed in the main text, both short and long run costs are important but the short run costs provide the basis for charging for the use of transport infrastructure.

Expanding capacity

When such charges reach levels that generate sufficient revenues to finance expansion of capacity, this should be a trigger for an assessment of the potential benefits of investing in additional infrastructure. The assessment would have to go beyond financing to consider the full range of costs and benefits that affect economic welfare, including the opportunity costs (for example of land cleared that could instead be used for housing, offices etc.) and impacts on landscape, water courses and biodiversity. Projects that pass assessment would proceed in order to ensure efficient development of transport infrastructure.

Projects that would pass this test may not always get implemented, due to shortage of available capital funds, for example. But even when efficient investments to expand capacity are not made, charges to balance demand with supply will still result in efficient use of infrastructure. Investment in infrastructure at levels that are lower than efficient is most likely to distort transport markets seriously when very different investment decision making systems apply to competing modes of transport, road and rail for example. Similar appraisal methodologies are therefore to be recommended for all types of infrastructure.

Recovering costs

When congestion is present and charged for, the capital costs of roads will normally be recovered. Where there is no congestion, optimal pricing could leave these costs uncovered. Treating transport infrastructure as a public good, these costs should be met through general taxation. In cases where governments seek to recover some or all of these costs directly from users it is most efficient to do this through fixed charges (such as annual road taxes) in order not to exclude beneficial use from the capacity available.

International traffic

Thus for international traffic it will be efficient for foreign vehicles to pay the marginal costs, including congestion, of using infrastructure in the same way as local vehicles. It is not efficient, however, to charge them for the fixed costs of that infrastructure (charging on the basis of average costs). This has important political implications for the fairness of charging systems internationally.

Charging systems

Current systems of taxes and charges for transport are the result of an accumulation of successive instruments, not always introduced for the purposes of transport policy. They do not therefore tend to follow a coherent set of principles.

Parking

In many towns and cities, parking represents the single largest cost of using cars and vans. Frequently it is not paid for, often as a result of inadequate enforcement of roadside parking fees. Failing to charge the full resource costs of parking inflates road traffic demand.

Fuel tax

Fuel taxes dominate current transport charges. Though efficient in relation to CO_2 emissions, they cannot be differentiated to provide effective incentives for reducing congestion, pollution, noise and accident costs.

Fixed charges have in many cases been differentiated to provide incentives for reducing road wear and air emissions, but in many countries it would be efficient to replace part or all of these taxes with differentiated use charges.

Beneficial taxation

Charging for the costs of pollution, noise, accidents and congestion in ways that succeed in reducing the levels of the damage caused towards an optimum level provides a direct welfare benefit. Charges that achieve this are one of the rare examples of taxation that produce direct welfare benefits as well as raising revenues.

Charging closer to the point of use

The key to achieving the potential benefits of pricing reforms is to charge closer to the point of use of the infrastructure. This would enable rational decisions by individuals and firms, informed by price signals of the full costs of their travel demands, to determine traffic levels and trends in transport demand. This is probably best achieved through electronic km charges with satellite or ground based tracking systems to differentiate charges by time and location. These systems are being introduced for trucks in a number of countries. Subject to controlling the costs of administration and enforcement satisfactorily, such systems are also attractive for managing car traffic. Even without these systems much can be achieved with more conventional instruments — parking charges, differentiated road tolls and cordon tolls.

The expected effects of moving towards more efficient, better targeted charges

Distribution of charges and revenues

Combining old taxes and new charges

The research undertaken for the ECMT and the European Commission to model optimal charges for transport in five countries[3] suggests that more efficient charges would result in the changes in relative prices and traffic levels set out below. As a heuristic device, the optimum was modelled with the replacement of all existing taxes by a new externality tax, best thought of as a differentiated km charge. This gives an estimate of the optimal level of taxes (right order of magnitude) and the direction for changes in transport prices. In practice, governments will need to consider how best to combine the new tax with old taxes they wish to retain.

Roads

The research suggests significantly higher charges for cars, trucks and vans in urban areas and on some inter-urban routes, largely as a result of charging for congestion. This would be accompanied by reductions in car traffic in the large metropolitan areas, moderate reductions in other urban areas and a mixed pattern of changes outside the urban areas. Truck traffic volumes would be little changed overall, with a small shift from peak to off peak periods. The overall pattern is for trucks and other business traffic to benefit from a rationalisation of shopping, leisure and other car trips (perhaps one shopping trip to three stores in place of three separate trips, for example).

Public transport

Urban areas would see lower charges for public transport relative to the costs of using cars, accompanied by greater efficiency in public transport services, encouraging a better modal balance. Bus and metro traffic would grow in the metropolitan areas, particularly in off-peak periods, with a mixed pattern in other areas depending on the country concerned and current prevailing prices.

3. Britain, Finland, France, Germany and the Netherlands.

Rail freight and inland waterways

There would be a change in relative road and rail prices encouraging modal shift. The size of the change in each country is dependent on how far current charges for the use of both road and rail infrastructure differ from marginal social costs. Changes in prices and volumes for freight waterways are small but generally result in increased waterways traffic.

Comparison with current charges

The research suggests price increases to arrive at efficient pricing of urban road use in peak periods of around 100% for small petrol cars that currently pay no parking charges in three of the major metropolitan areas examined (Ile de France, Munich and the Randstad) compared with the prices prevailing in 2000. For the off-peak, the increase is around 50%. In London the increases are larger, around 150% in the peak period and 100% off-peak. In all four cities, for those currently paying parking charges all these increases are halved. Although not specifically examined, part of the mixed pattern of changes expected outside of cities is likely to be explained by reductions in charges for using small cars in many rural areas.

Optimal prices for using trucks on roads in the metropolitan areas were estimated to be around 40% higher than prices prevailing in 2000, for peak periods, except in London where the increase was around 100%. Price increases for off-peak periods were roughly half these figures. For motorways outside urban areas, prices and charges for trucks in the optimum show a mixed pattern of increases and reductions, depending on the country and the structure and level of charges applied there in 2000. In the case of Germany, the level estimated for the optimal charge is around 50% higher[4] than the total charge that will apply following the introduction of the new kilometre charge in August 2003.

Caution : limits to the model

The purpose of these comparisons is only to give a rough illustration of the model output. It must be cautioned that to design charges, a different modelling exercise would be required using less aggregated data and examining specific types of vehicles and particular categories of infrastructure. The current exercise was designed only to illustrate the overall direction and magnitude of changes in charges for broad categories of transport services.

Welfare gains

The overall result would be annual welfare gains of Euro 9 to 17 billion in each of the three largest economies examined, and increased revenues from transport ranging form 57% to 74%. In Finland, a country with few cities, low population density and little road congestion the work foresaw a 20% reduction in revenues from transport charges and an annual welfare increase of Euro 300 million.

4. Optimal charges for trucks (replacing fuel tax and all other current charges) using German motorways outside urban areas were estimated at Euro cents 3 per tkm for off-peak periods and 4 cents in the peak. These are average prices per net ton transported for trucks over 3.5 tons. In 2001, 40 ton trucks on long hauls in Germany paid an average of roughly 17 cents per vkm through all the various taxes levied (See Chapter 2). This equates to 1 cent per net tkm on average, assuming an average load factor of 16 tons rather than the maximum capacity of 25 tons of a typical 38 or 40 ton truck. With the introduction of the new km charge in August 2003, this will rise to roughly 30 cents per vkm or roughly 2 cents per net tkm on motorways.

Changes from optimising charges in 2000

	Britain	France	Germany	Netherlands	Finland
Welfare gains (Billion Euro / year)	**17**	**10**	**9**	**1**	**0.3**
Revenue changes (Billion Euro / year)	**+ 39**	**+ 28**	**+ 42**	**+ 6**	**- 1**
Air pollution and CO_2 emissions costs (Result of optimising emissions control technology as well as traffic)	- 54%	- 50%	- 37%	- 33%	- 42%
Congestion Average increase in metropolitan rush-hour road traffic speed	+ 11%	+ 9%	+15%	+ 9%	+ 9%

Optimising capacity

These tax and revenue changes were produced with a model that takes current infrastructure capacity as fixed. However, the case of the Netherlands was re-examined to test the effect of increasing inter-urban road capacity 5% across the board. Relative to the case when only pricing was optimised, this was found to result in no significant potential welfare change. This is close to the findings of recent work undertaken for the Netherlands Ministry of Finance[5] that examined optimisation of road capacity in rather more detail.

This result is conditioned very much by local circumstances, including the optimality or otherwise of current road capacity and investment plans in the Netherlands. Therefore the result cannot simply be transferred to other countries. Nevertheless, for countries and regions not too dissimilar to the Netherlands the result supports rather than undermines the thesis that the biggest improvements in the management of congestion will be achieved from optimising prices rather than infrastructure capacity.

Other studies of the costs of using transport infrastructure

National values for external costs

In France, the costs of the use of infrastructure by various transport modes have been assessed periodically since 1994 by the Commissariat Général du Plan (Boiteux group). This work, updated in 2000 and 2001, provides the basis for setting out the main lines of an approach to charging following marginal social costs, including external costs. In Chapter 2, two sets of results are presented for France using, in turn, standard values for external costs as used in modelling the other countries studied, and the specific French values from the *Boiteux-2* report, that currently provide official national reference figures. Comparison of the results shows a remarkable degree of agreement.

This exercise is also repeated for the Netherlands with cost estimates developed by CE Delft in the report, *Efficient Prices for Transport*, used as quasi-official estimates by the Ministry of Transport, Public Works and Water Management. These include *inter alia* higher values for some external costs, in particular, higher emission factors. Modelling an optimal scenario using CE Delft values for external costs produces a pattern of results broadly similar to the main results for the Netherlands.

5. *Returns on Roads - Optimising road investments and use with the user pays principle*, CE Delft 2002.

Infrastructure maintenance costs

A different kind of test – a sensitivity test on the marginal cost pricing rule itself – is also applied to the Netherlands using the quasi-official estimates developed by CE Delft. Here, an alternative scenario is modelled in which all the costs of infrastructure maintenance and upkeep are charged to users. This is the principle adopted in the CE Delft study, whereas in all of the other scenarios only the costs imposed by an additional vehicle are charged to users. The pattern of results that emerges in this scenario is distinct in a number of respects. Most strikingly, and reflecting the high ratio of fixed to marginal costs in the rail mode, the new pricing rule results in a severe contraction of rail traffic volumes, for passengers and freight, and in all markets. This illustrates the thesis developed in Chapter 1. In order to achieve the welfare optimum, it is necessary to correct *the two types* of market failure in transport: the under-pricing that follows from the absence of taxes on externalities, and the over-pricing that follows from the absence of transfers to cover fixed costs. These two deviations from optimal prices do not offset each other: the first is most acute in the case of congested urban roads, the second is most acute in the case of rail. To correct one without the other must therefore result in a sub-optimal outcome.

Modal split

The main changes in modal split would be seen in large urban areas, with more passengers using public transport. Ridership would increase most on rail/metro systems in some cities and on buses in others, depending on the current levels of charges. The biggest increases in public transport ridership tend to be in the off-peak period and this would tend to increase the efficiency of these services. The large impact on modal split of changing the basis on which charges related to infrastructure maintenance are calculated, indicated above under the section *infrastructure maintenance costs*, should be noted.

Peripheral regions

Lower charges

As found in the case of Finland, in many non-urban and peripheral regions where congestion is generally absent, charges are generally likely to fall. The direction for changes in prices and revenues in peripheral countries can thus be opposite to that in countries near the economic centre of Europe but the welfare gains from optimising charges and taxes are no less significant. It should be noted that revenues in the optimum scenario are still more than sufficient to cover total infrastructure costs.

The work undertaken confirms the value of pricing reform for peripheral countries but suggests that additional studies are merited to adapt more fully the methods developed originally to model economies at the centre of Europe to the conditions prevailing in peripheral areas. Taking adequate account of local conditions is indeed essential for all regions, peripheral or not, as the purpose of pricing reform is to reflect marginal costs close to the point of use of infrastructure — by definition conditioned by local circumstances. In the case of Finland, for example, charging in relation to snow clearance deserves deeper analysis as it is a major item of expenditure.

Trucks in transit

It should be noted that when trucks from peripheral countries travel through congested areas at the centre of Europe they will be charged in the same way as local trucks. This follows from principles of both non-discrimination and efficiency. A desire to correct regional imbalances is not a good reason for overturning these principles. Issues of regional development and peripherality are best addressed by enhancing international regional infrastructure investment funds and other international redistributive policies.

Social equity

Direct mesures rather than transport policy

Some pricing reforms to promote efficiency might be regressive in terms of income distribution. As with regional equity, this is not a reason to forego efficiency. Distributional issues are much better addressed more directly through the powerful instruments available to finance and other ministries, including income tax and social security frameworks. Compensation for public service obligations and other subsidies to public transport are often partly motivated by concern for social equity but are also founded on the basis of maximising welfare as a whole.

Fuel taxes

In many countries, moving to more efficient systems of transport charges with the introduction of new instruments would permit reductions in fuel tax, and other existing taxes, notwithstanding the fact that taxation of fuel is a good way to address CO_2 emissions. This would enable a reduction in the overall burden of charges in those rural areas that are currently taxed at higher levels than efficient. Cutting fuel taxes without the introduction of more efficient instruments and making up the revenue shortfall with general taxation would, however, result in reduced welfare in most countries. It should also be noted that in some countries, for optimal pricing, variable charges like fuel tax should probably increase, with larger offsetting cuts in fixed charges.

Competition

Current differences in transport charges play very little part in determining the competitiveness of road haulage industries nationally. This is analysed in detail in Chapter 3, with the new work lending strong support to the results presented to Ministers in 2000 that underlie Resolution 2000/3. Moreover, the charging reforms outlined in the present report would work to avoid distortions and discrimination, by replacing charges based on nationality with more territorial charges.

Preventing abuses

The principles for efficient taxes outlined should not be abused to justify the introduction or maintenance of arbitrary charges for crossing international or local administrative boundaries. Moreover, pricing reforms should encompass a general rationalisation of charging systems. In some of the New Independent States in particular this would involve a reduction in the number of charges levied on road haulage, the abolition of many local charges and adoption of a more unified approach to charging internationally.

CONCLUSIONS

1. The distortions common in current transport charges and taxes undermine many transport policies, as noted during debate on modal shift at the Bucharest Council in 2002. Although pricing reforms may not solve transport problems on their own, without more efficient prices, and charging systems that provide a predictable framework for prices, measures to address congestion will be severely hampered and investments to meet transport demands will frequently fail to deliver planned results.

2. More efficient transport prices and charging systems are required in all modes if transport policies are to have their intended effects. The need is greatest with respect to road transport, which accounts for over 80% of all passenger and tonne kilometres, and greatest of all in and around major cities.

3. The ultimate aim is to charge for the use of transport infrastructure close to the point of use, with charges set at a level in line with that for other goods and services in a market economy, that is close to marginal costs. Normally, competition is relied on to achieve this outcome. In most cases competition is not feasible in the supply of transport infrastructure. So regulation will be required to establish the correct level of charges, as is the case with much other public infrastructure (telecommunications, electricity, water and so on).

4. There are two quite fundamental aspects to efficiency: efficient use of the infrastructure that exists and, over the longer term, efficient provision of infrastructure both in terms of quantity and quality. Even when efficient investments to expand capacity are not made, however, charges to balance demand with supply will still result in efficient use of infrastructure.

5. It will take time to achieve the reforms outlined in this report and to persuade public opinion of their importance. Ministers should seek, however, to ensure that changes to charges and charging systems should always move in the direction of improving efficiency, whatever the motivation for the change. Thus legislation that creates potential barriers to efficiency should be avoided and measures to harmonise or otherwise modify taxation, for example fuel taxes, should be carefully coordinated with improving the efficiency of transport charges.

6. The introduction of distance charges for trucks, differentiated by weight and environmental performance, is an important step towards greater efficiency. It would be desirable to differentiate these charges by time and location in relation to infrastructure damage, congestion, environmental and other marginal costs, using satellite or land based positioning systems.

7. Similar distance and performance based charges for cars and vans are appropriate and merit examination in terms of implementation and acceptance.

8. Conventional instruments, such as parking charges and public transport fares policy, also have an important role to play to complete the charging system.

9. For maximum efficiency, the level of charges should reflect local conditions. In general charges would be expected to rise in and around urban areas and fall in rural and peripheral areas.

10. Revenues from congestion charges might be used in the first instance to invest in traffic management systems and in increased infrastructure capacity in cases where economic and environmental assessments justify expansion.

11. In countries at the economic centre of Europe, more efficient charges are likely to result in an increase in revenues from the transport sector overall. These revenues could be used to reduce distorting taxes across the economy or to fund public spending on projects with positive socio-economic returns both inside and outside the transport sector. In peripheral countries with little congestion there may be a decline in revenues, although revenues will still be more than sufficient to cover total transport infrastructure costs.

Chapter 1

PRINCIPLES FOR EFFICIENT TAXATION

The purpose of this report is to provide a methodological framework for making international comparisons of the way the structure of transport taxes and charges affects the transport sector and the wider economy. To do this, all the various taxes and charges levied have to be identified and classified according to the way they affect the behaviour of economic agents. The analysis presented here expands and improves on ECMT's 2000 report Efficient Transport Charges and Taxes, notably in the examination of the difference between current systems of charges and an optimal scenario for efficient transport charges. The principles for efficient taxation (examined in Chapter 1) remain unchanged. They imply that the objectives of fiscal reform in transport should be to relate taxes to marginal social costs, avoid imposing 'distributive' taxes on the transport sector and discourage the practice of tax competition between countries.

Comparisons of taxes and charges may be required to inform a range of different policy questions. Different questions require different indicators in order to come to meaningful conclusions. The analysis presented in this report arrives at a series of indicators, each of which is appropriate to answering a specific set of questions. Applying the wrong indicator to the wrong question yields misleading results and care must be taken in the way the indicators are used. Chapter 2 and Annex A are concerned with efficiency and address the separate issues of infrastructure cost coverage and the internalisation of external costs. The remaining chapters deal mainly with questions of competitiveness in the road haulage sector.

1.1 The context for transport charges: fiscal and transport policy objectives

1.1.1 Fiscal policy

The primary role of taxes are to generate public resources to finance services provided by or contracted by government. The potential to use tax policy to promote micro-economic efficiency is only a secondary concern of finance ministries, although one that is receiving increasing attention. Partly by historical accident and partly due to the rapid growth of transport services in the last century and the relative price inelasticity of demand, transport taxes have become one of the major sources of public finance in European economies. This is particularly true of the excise duties levied on transport fuels. Whether there is a case for levying such charges at rates above those that would promote efficiency in the transport sector is an issue that should be addressed as new transport pricing instruments are introduced.

1.1.2 Transport policy

Transport policy is often the result of seeking to achieve several objectives simultaneously. Trade-offs have to be made and generally a range of instruments must be employed. Pricing policy alone is neither sufficient nor necessarily the most efficient instrument for each objective. An example is vehicle emissions standards. These are the first choice tool for controlling air pollution from vehicles. Though far from perfect, emissions standards can be used to internalise a major part of the potential costs of air emission costs. Moreover, the pricing instrument is most readily applied to emissions through differential charges according to the emissions standard class of vehicles. A mix of instruments including regulations, inspection and maintenance regimes, insurance requirements, driving restrictions, etc. will therefore be required together with efficient transport taxes and charges.

At the same time, taxation has a fundamental role in relation to financial instruments, for example subsidies to public transport, PSO compensation payments and rail freight grants. As various transport modes are often substitutes, the pricing framework and level of charges in each mode has a profound effect on inter-modal competition. Changes in taxes and charges in one mode can have a major impact on the success or failure of financial support given to other modes, with potentially serious impacts on the effectiveness of subsidies and the efficiency of use of public resources.

It should also be noted that there are theoretical reasons for diverging from the "first best" pricing solutions that result from the application of neo-classical economic theory, not least because real markets do not conform perfectly to some of the important assumptions on which the theory is based. This is not to say that the theory does not provide the right framework for pricing, it does. It rather points to the value of some "second best" pricing solutions and underlines the importance of non-pricing instruments for use in concert with taxes and charges.

1.2 Efficient taxation

Taxes on externalities (congestion, pollution, etc.) increase social welfare, by orienting the behaviour of producers and consumers to increase efficiency and reduce external costs. Most other taxes are welfare reducing to a greater or lesser degree and are usually designed to minimise changes in behaviour in order to preserve their revenue raising capacity. Taxes on externalities do raise revenues although this is not their primary purpose.

Three broad categories of taxes can be identified:

– efficiency and welfare enhancing taxes – charges on external costs;

– efficiency and welfare neutral taxes – e.g. taxation of economic rents on the production of natural resources;

– efficiency and welfare reducing taxes – most other forms of taxation.

All governments require revenues over and above those that can be raised by taxing externalities. They should aim to select the least welfare-reducing tax package to raise the necessary revenues. In the absence of externalities, taxes on intermediate products such as road haulage distort markets. They alter the allocation of resources in production sectors and thereby reduce the net output of the economy. They can therefore be strongly welfare-reducing, although as transport-related taxes only account for a small proportion of total production costs their impact is diluted. Ideally taxes on intermediate products should be avoided. It is less inefficient to tax inputs (labour and capital) and outputs (VAT and profit taxes) as they do not effect the efficiency of the production sector.

In general, only relatively immobile production factors can be taxed efficiently, including labour and fixed capital (e.g. land as opposed to financial capital). The optimal weighting of taxes on labour versus capital depends on the relative mobility of production inputs together with supply and demand for each input and the redistributive preferences of government. For example, when labour is in excess supply (unemployment) it will be efficient to reduce labour taxes, lowering the cost of employment which will tend to bring supply and demand into balance, other things being equal.

Extreme difficulty in the collection of many kinds of taxes, as is currently the case for example in Russia, can justify departure from these basic principles in determining the most efficient structure of taxation.

Redistribution of income is frequently an important government objective. In an optimal tax system it is always better to address income distribution concerns via taxes on final consumption and on income rather than taxes on production. Therefore distributional issues should play no role in determining the taxation of freight transport.

1.2.1 Efficient tax packages for idealised economies

Closed economy with no externalities and no increasing returns to scale

In a closed economy, in the absence of externalities (pollution, noise, accidents, congestion, road damage) the following principles for optimally efficient taxation hold[1]:

– Intermediate products (e.g. freight transport) should not be taxed (raising revenue through such taxation would decrease the overall productivity of the economy);

– Revenue should be raised using a combination of indirect consumption taxes (e.g. VAT) and taxes on inputs to production (labour and capital) and on profits;

– Rates of taxes on labour and capital should be identical for every sector of the economy (so as to avoid distorting the allocation of production factors).

Closed economy with externalities

Perfectly efficient taxation in a closed economy with externalities would be achieved by taxes on the externalities themselves – emissions, congestion, road damage, etc. – at a rate equal to marginal damage costs, with additional taxes on inputs (labour and capital) or outputs (consumption) to meet total revenue needs. Of course this assumes that one can charge freight haulage according to marginal external costs.

Open economy with no externalities

As with domestic transport services, freight haulage by foreign operators should not in theory be taxed as it is an intermediate product. This also provides a basis for efficient trade between countries.

Entry or transit taxes on hauliers that seek to protect a national haulage industry against foreign competitors are not efficient for the country that imposes them. Taxes on exports of transport services, employed sometimes to secure better terms for trade (technically known as tax exporting) may be efficient

1. Diamond and Mirlees, American Economic Review, 1971; Mayeres and Proost, Scandinavian Journal of Economics, 1997.

nationally but are not efficient for the group of countries involved as a whole. In a trading union, such as the European Union, both practices must be avoided.

Taxes on factors of production (labour and capital) should be identical across sectors within each country, but can differ between countries if preferences for the level of public expenditure differ by country.

Open economy with externalities

Sources of externality should be taxed as close as possible to the point of origin (fuel combustion, road use, etc.) and at the place where the externalities arise (according to territoriality). Taxes on externalities are the most efficient form of taxation, with taxes on inputs and outputs the next best alternative for raising revenues over and above the revenues raised from taxes on externalities if required. Apart from the taxes on externalities, freight transport, as an intermediate product, should not in theory be taxed.

Increasing returns to scale

In the absence of increasing returns to scale one can essentially rely on a competitive market to use resources efficiently and only two market failures require correction: redistribution of income (via taxes on labour and capital) and internalisation of external costs (via taxes closely correlated to the generation of externalities).

In the supply of road and rail infrastructure, however, increasing returns to scale prevail and costs are minimised when provision of infrastructure is concentrated in the hands of a single agent. This means that competition can not be relied on to ensure efficiency.

Three types of problem can be expected:

– First, in the absence of competition the agent will attempt to charge monopoly rents (which could result in the over-recovery of costs).

– Second, efficient, marginal cost based pricing will not cover total costs as marginal costs are lower than average costs with increasing returns to scale. Transfers will be required to cover the difference.

– Third, once part of the costs are covered by subsidies it becomes difficult to discipline the agent to produce at the lowest cost and behave efficiently.

Businesses exhibiting increasing returns to scale may thus require a complex system of subsidies to operate efficiently and the degree of cost coverage is not a good guide to detecting inefficiency in pricing (see section 1.3 on distortions below for further discussion).

Social Equity

When there are distortive taxes in the economy (labour taxes for example), the principles for efficient taxation suggest setting taxes on “dirty” goods equal to marginal external costs and using the revenues generated to reduce the level of the distorting taxes. This is complicated somewhat by the impact of externality taxes in reducing consumption of the taxed goods, and the knock-on effect that this has on the demand for labour. Some research suggests, therefore, that the optimal externality tax is probably somewhat lower than the marginal external cost and that it is optimal to use the revenues to reduce labour taxes (see Bovenberg and de Mooij, AER, 1974).

If equity did not matter, the optimal labour tax would be zero, or as close to zero as the need for public revenues permitted. Where there are high labour tax rates, this is a clear sign that equity concerns are an important policy objective. If one also introduces equity concerns into the design of optimal transport taxes, the optimal externality tax might take into account a weighted sum of marginal external damages (where weights are higher for low income groups) and also take into account the income level of the users of the taxes transport service. Equity considerations would also come into play in the optimal use of the extra revenues. Numerical illustrations[2] suggest, however, that optimal externality taxes are little affected by these equity concerns.

1.2.2 Taxes on fuels and materials

Natural resources, and especially oil, are frequently taxed in the form of royalties to ensure that a large part of economic rent is captured by government. This can be an efficient form of profit tax. Oil products are also frequently taxed because of strategic import dependency or terms of trade considerations. This can be justified in oil importing countries in terms of reducing dependency and vulnerability to potential cartel pricing. Of interest here, however, is whether increased excise duties on fuel for the road haulage sector can be justified.

Except with respect to externalities, it is not efficient to charge different levels of tax on the same fuel product employed for use in different sectors of the economy or different modes of transport. This is, however, frequent practice. Domestic heating oil, gas oil for gas turbines, and diesel are all essentially the same product but in most countries much higher taxes are charged on the latter. Moreover, diesel used for road vehicles and rail locomotives is taxed at different rates in some countries. For small-engined vehicles, petrol and diesel are essentially interchangeable products and it is therefore inefficient to tax them at different rates, except in relation to the marginal external costs of using each fuel.

Even to correct externalities the efficiency of fuel excise in the transport sector is limited. Fuel use is directly related to CO_2 emissions so fuel taxes are indicated for charging in relation to climate change. Fuel use is only indirectly linked to most other external costs (fuel charges are the same on congested and uncongested roads, they are the same whether or not vehicles are fitted with catalytic or other emissions control devices). External costs vary by location but it is difficult to vary fuel taxes accordingly.

A truck can fill its tank in one country and cross one or more neighbouring countries before needing to re-fuel, particularly when supplementary fuel tanks are installed. Thus the possibility of varying fuel taxes is largely determined by geography. For example, the United Kingdom is largely insulated from tank tourism by the cost of crossing the English Channel and a large fuel tax differential with other countries can be maintained. In the Netherlands, a small country with good road connections to all its neighbours and a large international haulage fleet, the amount fuel taxes can be maintained above the level in neighbouring countries is severely limited. Tank tourism gives rise to tax competition between countries. It can be in the interests of a small country to level excise taxes below marginal external costs in order to attract higher excise revenues through tank tourism. Tank tourism makes it difficult both to vary fuel excise duty by country and to levy sufficiently high charges for internalisation.

2. Mayeres and Proost, S., *Tax reform for congestion type of externalities*, Journal of Public Economics, February 2001 and Mayeres and Proost, S., *Optimal Tax and Investment Rules for Congestion Type of Externalities*, Scandinavian Journal of Economics, 99 (2), 1997.

Fuel taxes are also not suited to charging for capital infrastructure costs that vary little with use. Given their ease of collection, however, fuel taxes are often employed in place of potentially more efficient instruments.

1.2.3 Implications for tax harmonisation

The above principles from welfare theory hold true to the extent that all countries behave in an optimal way and to the extent that instruments can be designed to make transport pay its marginal external costs. These are major assumptions and do not hold in present European circumstances.

One also has to assume that all countries act co-operatively. Specifically we need to assume that each country refrains from:

- trying to export taxes or charge foreign operated transport above its marginal external costs through transit charges;
- trying to maximise revenue through tax competition, e.g. setting taxes on fuels at levels below marginal external costs, in order to undercut fuel prices in neighbouring countries and attract tank tourism.

The first choice for taxation is to levy charges on the production of externalities at a rate determined by marginal external costs. As transport is associated with significant marginal external costs one can expect transport services to be taxed, even though they are an intermediate product. As marginal external costs vary greatly with place, it is also to be expected that levels of transport charges (fuel taxes, tolls, vignettes, etc.) are not uniform across countries.

As noted, national preferences as to the level of public expenditure and the need for income redistribution will be reflected in national differences in the level of taxes on labour and capital. What is important is that within a country labour and capital employed in providing transport services are taxed at exactly the same rates as in other sectors of the economy. Differences are therefore to be expected in the level of labour and capital taxes paid by transport operators in different countries and do not necessarily imply inefficiency.

The key questions for assessing the efficiency of taxation in the transport sector are, therefore:

- the way transport charges (fuel taxes, vehicle registration taxes, vignettes, etc.) relate to marginal external costs (road wear, congestion, accident costs, air pollution, noise);
- whether transport operators pay the same level of taxes on labour and capital as other sectors of the national economy;
- whether domestic and foreign operators pay the same level of transport charges for operating within any one given country. (The best guarantee of this is that the same charges apply to both. Where different systems of charges are applied, an attempt to assess their overall impact has to be made);
- whether transport charges are applied to different transport modes on the same basis;
- whether subsidies to parts of the transport system that exhibit increasing returns to scale (e.g. road and railway infrastructure) either fail to cover fixed costs or alternatively cover not just fixed costs but spill over to cover part of marginal costs.

1.3 Inter-modal distortions

1.3.1 Subsidies, distortions and a definition of the optimum

Whatever its origin, a distortion can be defined and measured only in relation to a definition of an undistorted state. Fortunately, economics provide such a unique reference point: the "perfectly competitive" equilibrium where the prices and quantities at which goods are supplied ensure that the marginal social benefit gained from the last unit consumed equals the marginal social cost of the last unit produced. This is the point at which, under given consumer tastes and technological possibilities, the allocation of resources is at its most efficient and the welfare of society as a whole is thus maximised.

Relative to this theoretical optimum, all real world markets will, to some degree, fail – if only because the attainment of this optimum in any one market requires that it be attained simultaneously in all markets. In this sense, market failure is pervasive. The question at issue is the manner and degree of it.

In the classic counter-example to perfect competition – that is, pure monopoly – the imposition of profit-maximising monopoly pricing results in a reduction in the consumers' surplus which is greater than the increase in the producer's surplus. This so called "deadweight" loss reduces the welfare of society as a whole.

Government intervention can impose welfare losses in a similar manner. If a special excise tax is imposed on a more or less competitive market, it can result in a reduction in the sum of the consumers' and producers' surpluses which is greater than the increase in tax revenues – the creation of a deadweight loss – and thus a reduction in the welfare of society as a whole.

The consensus view amongst policy-makers is that, at least in the developed market economies of the countries of the OECD, most markets sufficiently approximate perfectly competitive markets so as not to warrant direct and detailed government intervention. It is only in those cases where markets fail in a manner which is systematic and predictable and to a degree which is measurable and large that governments are best advised to intervene directly. For the rest, competition policy and the institutional apparatus to enforce it are what are relied upon to address insufficient competition at any given time.

1.3.2 Market failure in transport

In the field of transport, markets do fail in a manner which is systematic and predictable and to a degree which is measurable and large. This is so for two main reasons (two types of market failure).

On the one hand, the provision of transport infrastructure, in each mode and to varying degrees, is characterised by increasing returns to scale and this implies:

– significant elements of natural monopoly, whereby one firm can supply the entire output required more efficiently than many;

– a high ratio of fixed costs to marginal costs;

– substantial sunk costs — that is costs which cannot be recovered by putting assets to alternative uses, even by discontinuing production.

On the other hand, the use of transport infrastructure, in each mode and to varying degrees, entails external costs (uncompensated costs imposed by one party on others). These include air and noise pollution, accidents, and the marginal external costs of congestion imposed by new users on all existing users whenever the infrastructure is operating at or above optimal capacity.

Thus, the technical characteristics of infrastructure provision mean that its marginal social cost can lie far below its average cost. On the other hand, the external costs arising from the use of infrastructure mean that the marginal social cost of transport can also rise far above its average cost. These two effects need not and clearly do not coincide to off-set each other. Comparatively, the first effect is most acute in rail and least acute in urban roads. Conversely, the second effect is least acute in rail and most acute in urban roads.

In the absence of government intervention, the private producer will continue to supply the market only if the revenues derived from users enable him fully to recover all producer costs, including fixed costs, as well as to provide for normal profit. At the same time, he will be indifferent to the recovery of external costs which he himself does not have to bear. Hence, in the absence of government action to correct both types of market failure, the immediate result would be the inefficient use of existing infrastructure – in particular, the over-pricing and under-use of rail, and the under-pricing and over-use of urban roads.

In order to prevent the emergence of serious welfare losses, government intervention in transport pricing is indeed essential. And if governments must intervene in the name of social welfare to impose an artificial price, they are best advised to opt for the welfare-maximising price, at or close to the marginal social cost.

1.3.3 Cost recovery

Since marginal social cost lies below average cost in some cases and above it in others, pricing at marginal social cost will yield under-recovery of total costs in some cases and over-recovery in others. The first case will require government to provide *transfers* to enable the infrastructure provider to break even[3]. The second case will require government to impose taxes in order to raise prices up to the level of marginal social cost.

1.3.4 Fiscal and financial distortions in the light of market failure

In the light of the above, it should be clear that fiscal and financial distortions in transport markets cannot simply be defined in relation to a non-distortionary norm applicable to competitive markets. In the case of competitive markets, it might be reasonable to define non-distortionary tax treatment as the application of a common rate of taxation and the absence of subsidies – and, derivatively, to define any special taxes and transfers as a distortion. But such an approach could be highly misleading in the case of transport markets.

On the one hand, the non-taxation of negative externalities is, in effect, a subsidy. It reduces social welfare by encouraging consumption even where marginal social costs exceed marginal social benefits. It also distorts inter-modal choice by introducing a bias in favour of those modes which are most favoured by this subsidy – in particular, urban roads.

3. Carefully targeted price discrimination — by applying price mark-ups above marginal social cost to those consumers with low price-sensitivity — can raise cost recovery without driving demand off the market. This can reduce the size of transfer required from government, but only in rare cases can it eliminate the need for subsidy.

On the other hand, the non-provision of transfers to enable and compel naturally monopolistic infrastructures to price at or close to marginal social cost entails, in effect, the imposition of a special excise tax on the users of those infrastructures.[4] And this effect applies irrespective of whether governments collect and retain the excise tax inherent in monopoly pricing via the pricing policies of public enterprises or whether they grant private parties the extraordinary right to collect and retain it – as obtains in the case of privatised monopolies.

In any case, the non-provision of the transfers required to price at or close to marginal social cost reduces social welfare by disallowing consumption even where marginal social benefits exceed marginal social costs. It will distort inter-modal choice by introducing a bias against those modes which are characterised by the highest ratio of fixed costs to marginal costs – and particularly when these modes are also the least afflicted by negative externalities. The outstanding example is rail.

It is important to note that neither the welfare loss nor the distortion of inter-modal choice can be corrected by government intervention which imposes on each mode of transport, taken separately, the obligation to price at full recovery, and no more than full recovery, of total social costs. Such a policy would, at the margin, deliver too large a "subsidy" to urban roads users and impose too large an "excise tax" on rail users[5].

The results presented in Chapter 2 of this report suggest that the marginal social cost of road use in urban areas is now significantly above average cost. The price increases required to arrive at efficient pricing of urban road use were found to be between 70% and 150% for small gasoline cars in the peak period in the four major metropolitan areas examined (London, the Ile de France, Munich and the Randstad) and also in Helsinki. At these orders of magnitude, the likelihood is that an efficient pricing regime would deliver significant over-recovery for the road network as a whole in many countries. Moreover, for the inland transport sector as a whole in the five countries examined, revenues from efficient pricing would exceed infrastructure costs.

Pricing road use at the level of full cost recovery would thus lock in a welfare-reducing price for urban areas well below the level of the efficient price. Equally it would lock in a welfare-reducing price for lightly used rural roads above the level of the efficient price.[6]

Extensive econometric studies[7] have demonstrated that the marginal social cost of vertically integrated rail lies in the range of 60-70% of average cost. Where rail services are separated from infrastructure, the marginal social cost of rail infrastructure alone will be well below 60-70% of its average cost. Price discrimination might succeed in raising cost recovery to around 60% of total cost without driving demand off the market. If so, full cost recovery would still require a further price mark-up of two thirds above the efficient price.

Pricing at full cost recovery would thus fail the test by a large margin. Even if it raised the price of road use above what would obtain in the absence of any pricing of externalities, the result would still be an underpricing and over-use of roads. And even if it restrained rail prices below what would obtain in unregulated

4. The point was noted by Hotelling sixty years ago. See his early papers in *Econometrica*: "The General Welfare in Relation to Problems of Taxation and Utility Rates", *Econometrica*, Vol. 6, 1938, and "The Relation of Prices to Marginal Costs in an Optimum System", *Econometrica*, vol. 7, 1939.

5. See Rana Roy, *Infrastructure Cost Recovery under Allocatively Efficient Pricing*, UIC/CER Economic Expert Study March 1998, UIC, Paris, 1998 – hereafter referred to as Roy (1998).

6. It should be noted that covering infrastructure costs and internalising external environmental and accident costs are separate issues and earmarking revenues raised from taxes on external environmental and accident costs to covering infrastructure costs is not warranted on theoretical grounds.

7. Quoted in Roy (1998), p. 21.

monopoly pricing, the result would still be an over-pricing and under-use of rail. And since these modes are also substitutes, the result would also include a welfare-reducing modal shift from rail to roads.

The basis for non-distortionary taxes and subsidies for transport is, therefore, the alignment of prices to marginal social costs. The question of how best to raise the revenues required to provide the necessary subsidies is separate and addressed in the section Efficient taxation in an ideal economy above. Essentially revenues should be raised through charges and taxes with the lowest welfare-reducing impact, starting with taxes on externalities.

1.3.5 Public service obligations

In general, subsidies to cover the shortfall in total cost coverage should only cover fixed costs and not spill over to cover the marginal costs of operations. This requires that payments in compensation for operations under public service obligations should be clearly and transparently separated from general infrastructure subsidies.

1.3.6 External benefits

The only significant technological external benefit (that does not get processed eventually by the market without intervention) so far identified by economists is the Mohring effect[8]: when the frequency of scheduled public transport services is increased in response to an increase in demand, waiting times fall for existing users. The new users create a benefit external to themselves but internal to the system. This is a mirror image of the effect of congestion – which is also internal to the system. The effect should be taken into account in determining the levels of fares and public subsidy.

1.3.7 Summary of grounds for efficient subsidies

To summarise the above discussion, in principle there are three, and only three, grounds on which welfare-enhancing transfers can be provided for transport infrastructure or operations. These are:

– transfers to meet full infrastructure costs in the face of increasing returns to scale;

– compensation payments for public service obligations;

– subsidies in respect of external benefits.

It is true that so long as prices for road use have not been fully corrected by means of taxes on externalities, subsidies to allow for below marginal cost pricing in alternative modes (e.g. public transport) can be justified by "second-best" reasoning. But once prices have been corrected, there is no longer any justification for such second best pricing and the larger than optimal subsidies associated with it. In principle, therefore, efficient pricing allows for subsidies only on the three grounds listed above. All other subsidies reduce economic efficiency and overall social welfare.

8. Herbert Mohring, Optimisation and Scale Economies in Urban Bus Transportation, in American Economic Review, 1972.

Chapter 2

OPTIMAL TRANSPORT PRICING

2.1 Introduction and summary of key findings

Chapter 1 set out the principles of efficient taxation. Its starting point is a tripartite classification of taxes as follows:

– taxes that enhance overall social welfare – taxes on externalities;

– taxes that are welfare-neutral – taxes on economic rents;

– taxes that reduce welfare – taxes on final consumption, on capital and labour, and, *a fortiori*, on intermediate products.

It follows that, other things being equal, revenues forgone as a result of the failure to tax externalities and economic rents will require recourse to revenues from welfare-reducing taxation.

It is important to note this point at the outset of this chapter. For the benefits of optimising transport pricing by means of taxes on externalities do not accrue only within the transport sector in the form of a reduction in the levels of congestion, pollution and accidents. They also accrue to the larger society. The new revenues from externality taxes can be put to use to reduce the level of welfare-reducing taxation for any given level of public expenditure – or to increase the level of socially beneficial public expenditure for any given level of taxation.

This chapter reports on the findings of a large-scale modelling exercise comparing outcomes in five European countries in the year 2000 with what would have obtained in an "optimal pricing scenario" for these countries in that year. *Inter alia*, it provides information on six sets of variables:

– optimal taxes and prices for passenger trips by car, bus, rail and metro, and for road and rail freight, per passenger and ton kilometre respectively – and hence the gap between current and optimal taxes and prices;[1]

– changes in the level and modal composition of traffic;

– the reduction in the incidence of external costs;

– the increase in revenues resulting from optimisation – and hence the level of revenues forgone under current tax settings;

– the relation of revenues to infrastructure costs;

– the absolute net welfare gain from optimisation.

1. "Taxes" refer to those taxes or charges that are levied on the user by governments or infrastructure operators: vehicle tax, insurance tax, fuel duty, motorway tolls, VAT, etc. But the sum of taxes is only one part of the prices faced by users. "Prices" include all monetary costs paid by the user, including depreciation on vehicles, insurance, the pre-tax price of fuel, etc.

Section 2 describes how the optimal scenario is derived. Essentially, it consists in the application of *marginal social cost pricing* to all modes of inland transport – as was proposed by the European Commission in its White Paper of 1998[2] and recommended in ECMT Resolution 2000/3. In regard to taxes, this means that, for each given trip, each user – that is, each car, bus, train, truck, etc. – is charged for the marginal cost of infrastructure damage and the marginal external cost of congestion, pollution and accidents – plus the minimal contribution to general government revenues expected of every sector, namely, VAT.[3] Moreover, motorists are obliged to pay for the resource costs of parking – the externality of unpaid parking costs is corrected.[4] But the user is *not* charged for the *fixed costs* of infrastructure provision nor burdened with *any other taxes* over and above VAT. For the reasons summarised in Chapter 1 and elaborated elsewhere,[5] this is the pricing rule that maximises social welfare at any given level of infrastructure capacity.

The remainder of this introduction provides an overview of the key findings. But it needs to be prefaced with an important caveat that is spelt out more fully in Section 2: the modelling exercise is based on certain important limiting assumptions which require that the reported findings should be read as a heuristic device. They aim to shed light on the nature, direction and orders of magnitude of the changes required to achieve a welfare-maximising outcome. They are not intended to prescribe the exact taxes and prices that should be charged to users or to predict the exact results of doing so.

Nor should the findings reported here be read as a prescription of the precise instruments to use in the process of optimisation. For heuristic purposes – and leaving aside the correction of unpaid parking costs – the optimal scenario has been modelled by replacing all existing taxes with a single new tax, best conceived as a highly differentiated kilometre charge. In practice, governments will need to determine how best to combine the new tax with existing instruments. Thus, there is a case for retaining fuel duty as an effective instrument for taxing CO_2. Retaining fuel duty at any level would, however, imply that the new tax should be at a lower level than is indicated in our findings.

The previous ECMT report on transport taxes and charges[6] reported on the results of a large-scale modelling exercise to test the revenue impact of marginal social cost pricing in the three largest member-states of the European Union.[7] These results indicated that, for Britain,[8] France and Germany, such a pricing rule would entail *inter alia*:

– large increases in taxes and prices for road-based transport, both passenger and freight, in urban areas;

– significant reductions in the volume of car traffic in urban areas;

– significant reductions in marginal external costs in all areas;

2. European Commission, *Fair Payment for Infrastructure Use: A phased approach to a common transport infrastructure charging framework for the EU*, White Paper, Brussels, 1998.
3. For the purpose of the present exercise, the level of VAT receipts is held constant so as to isolate the changes required in taxes on transport *per se*.
4. See Section 2 for a further discussion of this issue and Sections 3 and 4 for an indication of the quantitative dimension of the problem and its correction.
5. See *inter alia* EC 1998, and the scientific papers preceding it and cited therein.
6. European Conference of Ministers of Transport, *Efficient Transport Taxes and Charges*, ECMT Report, Paris, 2000.
7. Rana Roy, Ed., *Revenues from Efficient Pricing: Evidence from the Member States*, UIC/CER/European Commission DG-TREN study: Final study report, London, November 2000, published by the UIC, Paris, 2001. For a detailed description of the TRENEN models previously developed by Stef Proost et al. and adapted and applied in this study, see Stef Proost *et al.*, *TRENEN II STRAN: Final Report for Publication*, Leuven, 1999.
8. The study covers mainland Britain, not the United Kingdom of Great Britain and Northern Ireland.

– a large increase in overall revenues – an increase of around 50% – as the net result of the changes in taxes and traffic levels;

– a more than sufficient cost recovery rate at or above 150% of the fixed costs of infrastructure provision.

As is reported in Sections 3, 4 and 5 respectively, the present study employs the same models and the same modelling methodology in order to:

– update the results for Britain, France and Germany - with improved national data, applied to the latest year for which data was available, the year 2000 – and report results for a sixth variable: the absolute net gain in overall social welfare in each country;

– extend the scope of coverage to include the Netherlands and Finland;

– investigate the link between optimising the use of existing infrastructure by means of prices and optimising the provision of infrastructure capacity.

Additionally, in a separate Annex[9], we provide the results of:

• two sensitivity tests on the valuation of marginal external costs – for France and the Netherlands –using national values in place of the standardised European values used in the core study;

• a sensitivity test on the marginal cost pricing rule – for the Netherlands – applying an alternative pricing rule, charging users for the fixed costs of infrastructure maintenance as well as marginal costs.

Britain, France and Germany

For Britain, France and Germany, each of the five key findings reported in the previous study and summarised above has been confirmed.

In 2000, taxes and prices for cars and trucks in urban areas were far below their optimal levels – especially in the peak period. For cars, the problem is compounded by the incidence of non-payment for the resource costs of parking. For current non-payers, per passenger kilometre, optimisation requires an increase in peak-period prices of around 70% in the Ile de France (IdF), 95% in Munich and just over 150% in London. For trucks, per ton kilometre, optimisation requires an increase in peak-period prices of around 40% in IdF and Munich and 100% in London. These corrections to the final price faced by the user require in turn very large increases in the tax element of the price.

In urban areas, car passenger kilometres fall significantly as a result of optimisation – by around 20% in London, IdF and Munich. There is a strong increase in ridership on public transport. Taken as a whole, however, passenger kilometres fall. Ton kilometres do not fall: road freight volumes remain stable despite the large increase in prices and rail freight volumes register an increase.

Marginal external costs fall for all modes of transport, in all areas, and in each country. And this reduction in per-kilometre terms is complemented by the shift in traffic kilometres to those modes with lower marginal external costs.

9. See Annex A2, immediately following the presentation of the results of the core study at Annex A1.

Optimisation yields an increase of over 50% in overall revenues in all three countries – indeed, a weighted average increase of 66%.

Stripped of VAT so as to derive the cost recovery rate, the sum of revenues in the optimal scenario stands at above 150% of infrastructure costs in all three countries – indeed, at above 300% in Britain and Germany. A pricing rule that sets a zero price for fixed costs generates nonetheless more than sufficient cost recovery.

Finally, each of these countries registers a significant gain in overall social welfare. Unsurprisingly, the gain is largest where the problem is greatest: Britain.

Taken together, the absolute gains in revenues and welfare in the largest EU member-states serve to indicate the importance of pricing reform. By any measure, €109 billion *per annum* in additional revenues is a significant addition to public resources. And €36 billion *per annum* in net welfare gain is a significant addition to the common good.

Table 1. **Revenue and welfare changes from optimal pricing: Britain, France and Germany**

In e billions per annum

Revenues	Britain	France	Germany	Total
Reference scenario revenues	59.84	49.10	56.97	165.91
Optimal revenues	98.79	77.01	99.13	274.93
Absolute change in revenues	**38.95**	**27.91**	**42.16**	**109.02**
Percentage change	65%	57%	74%	66%
Welfare				
Absolute change in welfare	**17.42**	**10.16**	**8.76**	**36.34**

It should be noted that the gain in welfare recorded here is a net gain: it is what remains after subtracting the welfare losses at various points – in particular, the reduction in the consumer surplus currently enjoyed by motorists who are under-charged – from the sum of the various elements of welfare gain, including the increase in revenues, the reduction in travel time for motorists and freight traffic in the newly de-congested roads, the reduction in the real cost to society represented by pollution and accidents, and so on.

Thus, under the umbrella of the net welfare gain and alongside the increase in revenues, we witness for example an increase in peak-period traffic speeds of 10-15% in London, IdF and Munich and a reduction in the overall national cost of pollution damage in these three countries of 35-55%.

The Netherlands and Finland

The two “new” countries in the study exhibit some important continuities with the “old” countries and at least one important though unsurprising discontinuity.

Once again, the optimal scenario yields large increases in taxes and prices for cars and trucks in urban areas, with reductions in car traffic volumes and stable traffic volumes for trucks. Marginal external costs fall. The Netherlands, densely populated, urbanised and congested, registers a large increase in revenues. But the vast, uncongested space of rural Finland and with it Finland as a whole registers a reduction in revenues relative to the reference scenario. In contrast to all the four other countries studied here, current prices in Finland entail, on average, an over-charging for transport.

The cost recovery rate in the optimal scenario stands at around 200% in the Netherlands. In Finland, too, and notwithstanding the reduction in revenues relative to the reference scenario, cost recovery remains positive – at around 130% of infrastructure costs.

Importantly, marginal social cost pricing yields a clear welfare gain in both cases, irrespective of the course of the change in revenues.

Table 2. **Revenue and welfare changes from optimal pricing: the Netherlands and Finland**

In € billions per annum

Revenues	Netherlands	Finland
Reference scenario revenues	11.80	4.57
Optimal revenues	17.54	3.58
Absolute change in revenues	**5.74**	**- 0.99**
Percentage change	49%	- 22%
Welfare		
Absolute change in welfare	**1.29**	**0.27**

Similarly, we witness a significant improvement in the concrete indicators noted earlier. Thus, peak-period traffic speeds increase by around 10% in the Randstad and Helsinki. The cost of pollution damage falls by over 30% in the Netherlands and over 40% in Finland.

Optimising capacity

The findings summarised above, discussed at greater length in Sections 3 and 4, and reported in detail in the tables at Annex A, describe a short run optimum. They are derived from the modelled application of a pricing rule aimed at optimising the use of existing infrastructure. In the long run, however, the infrastructure stock is no longer a given but rather the result of a choice to expand, contract, or maintain capacity.

This raises the question: would optimising the provision of infrastructure capacity create a new set of outcomes – a new pattern of taxes and prices, traffic levels, external costs, revenues and cost recovery – that would supercede the pattern described and alter the nature, direction and orders of magnitude of the requisite changes?

The final section of this chapter provides an answer to this question. And the answer is in the negative.

Drawing on theoretical principles and on empirical research, on the arguments established in previous ECMT reports[10] and on the findings of the recent study for the Netherlands Government[11] – and, finally, on the results of a supplementary modelling exercise incorporating additional road capacity – we find as follows. Neither an investment rule based on the calculation of the social rate of return nor a simpler rule which approximates the results of social cost-benefit analysis would deliver more than a small addition to the stock of road capacity. The impact of such a capacity expansion on aggregate revenues is minimal. So too is its impact on aggregate welfare.

10. In particular: *Assessing the Benefits of Transport*, ECMT Report, Paris, 2001.

11. CE Delft, *Returns on Roads: Optimising road investments and use with the 'user pays principle'*, Delft, 2002.

2.2 Method

The comparison of current and optimal outcomes in the present study is conducted by means of a customised modelling exercise. There is no attempt at a qualitative commentary on current outcomes. Rather, two "scenarios" are modelled to provide an equilibrium outcome in each case: the reference scenario and the optimal scenario.[12] It is the quantitative information provided by these scenarios that provides the comparison.

The first scenario is determined by the prevailing data on costs including estimated external costs, taxes, prices and traffic. It seeks to capture as accurately as possible the real outcomes of the transport market. And its accuracy can be tested in one important particular: the revenues that emerge as the output of the model should closely match the revenues recorded in the statistical accounts.

The second scenario is determined by a welfare function that simultaneously generates a new set of costs, taxes, prices and traffic quantities.

In this scenario, *all existing transport taxes are withdrawn*. This includes not only the commonly cited taxes and charges – vehicle tax, insurance tax, fuel duty, motorway tolls – but also any fraction of rail/metro prices that represents a charge for fixed costs: this fraction is classified as a tax in the reference scenario.[13]

What is put in place is a new tax equal to the new level of marginal external costs – plus a contribution to general government revenues equal to the current level of VAT receipts. Moreover, motorists are obliged to pay correctly for the resource costs of parking – that is to say, the problem of unpaid parking costs is corrected.

Marginal external costs, reflecting as they do the response of users to the altered price signals, are now below the levels obtaining in the reference equilibrium.

Traffic levels are optimised. Trips that generate greater costs than benefits are priced out; those that generate greater benefits than costs are priced in.

The aggregate revenue result is not in any sense a chosen target but merely the outcome of this optimisation process. The aim is to maximise social welfare. The increase in revenues that follows is a by-product.

Limits of scope and precision

The extent of the transport market captured in the modelling is, inevitably, incomplete. Road transport – accounting for over 80% of both the passenger and freight markets – is covered; and so are its most

12. What follows is a very summary description. The interested reader should consult Stef Proost et al.,TRENEN II STRAN: Final Report for Publication, Leuven, 1999, or at least the 15-page summary by Edward Calthrop, Stef Proost and Bart Van Hergruggen, "The TRENEN model", reproduced at Annex A3 of the present report.

13. For the original exposition of the argument that charging users for the use-unrelated fixed costs of infrastructure provision is best described as an "excise tax", see Howard Hotelling's early papers in *Econometrica*: "The General Welfare in Relation to the Problem of Taxation and Utility Rates", *Econometrica*, Volume 6, 1938, and "The Relation of Prices to Marginal Costs in an Optimal System, *Econometrica"*, Volume 7, 1939. For recent evidence and analysis of the welfare-reducing impact of recovering fixed costs from rail users, see Rana Roy, "Infrastructure Cost Recovery under Allocatively Efficient Pricing", UIC/CER Economic Expert Study: Final study report, London, November 2000, published by the UIC, Paris, September 1998. The general argument on the economics of charging for fixed costs is summarised in Chapter 1 of the present report.

important modal substitutes. Air transport is excluded from consideration on both the passenger and freight side in view of its limited share of the total market. So are pipelines.

Of course, the national transport market everywhere is segmented into a multitude of local markets. By disaggregating into the three models of the metropolitan, other-urban and non-urban markets, these multiple markets are more fully specified – that is, their internal segmentations and responsiveness to price changes are more fully captured. But the specification is less than complete, especially in the case of the vast non-urban market.

Nonetheless, it should be recorded here that the coverage of markets was sufficiently complete to ensure that the modelled estimates of revenues for the reference scenario dovetailed neatly with official and published statistical estimates of tax receipts for all the particular modes covered in each country.

That the coverage achieved was indeed as complete as this may not be readily apparent from the tables. The reader should therefore be alerted here that the results reported at Annex A are intended to be no more than a representative sample of the full model output. And the results reported in the present chapter are no more than a small selection intended only to illustrate the key findings of the study.

The estimation of marginal external costs is necessarily inexact. In lieu of a precise estimate of the marginal external cost of congestion derived from a fully specified network model of all roads in each given country[14] – a task which has yet to be attempted anywhere – the models used here estimate a congestion function derived from three observation points in each of the modelled markets. And in lieu of a universally agreed set of estimates for the full spectrum of marginal external costs, the study relies on the best estimates established by recent large-scale EU research programmes, in particular, ExternE and UNITE.[15]

Positive externalities are also estimated, albeit incompletely. The "Mohring effect" – increased demand from new users of public transport, prompting an increase in service frequency, and leading to a reduction in waiting time for existing users – is factored into the modelling of all urban markets. Capturing this positive externality requires the provision of a subsidy. One result of providing this subsidy to capture the Mohring effect is that, depending on the level of marginal external costs, the optimal tax for public transport trips can, sometimes, be negative.

Additional parking charges

An important innovation in the present study is the reporting of the additional parking charges required to achieve optimisation. Recent and comprehensive data from the UK National Travel Survey has shed new light on the severity of the problem of unpaid resource costs of parking in British cities. But the extent of the problem varies significantly between countries and is of course negligible in the non-urban areas. Hence, the reporting of the requisite correction as part of the revenue results for each area in each country provides a much more accurate picture of this element of optimisation and of its place in the overall optimal scenario.

There remain both theoretical and empirical controversies as to whether and to what extent the additional parking charges belong to government. Some part of the currently unpaid costs is sited in public land

14. This is the ideal method recommended in the report of the High Level Group on Transport Infrastructure Charging, *Final Report on Estimating Transport Costs*, Brussels, 1999.

15. See *Environmental External Costs of Transport*, edited by Rainer Friedrich and Peter Bickel, Springer-Verlag, Berlin Heidelberg, 2001, and UNITE D5: *Pilot accounts - results for Germany and Switzerland*, Annex 3, *Valuation Conventions for UNITE*, University of Leeds, May 2002.

and some in private. An accurate estimation of the components as well as the sum of unpaid resource costs will therefore be required in order to design effective policies for pricing reform.

To side-step these controversies, we have reported optimal revenues both with and without additional parking charges.[16] In this chapter, for the purpose of illuminating the nature and extent of the problem and its correction, we report the former rather than the latter measure of optimal revenues – whilst also reporting the level of additional parking charges in each country. As will be seen, it is, everywhere, a significant quantum.

The example of parking serves to recall that the failure to charge accurately for each trip *at the margin* is not the only source of distortion in the transport market. In the five countries studied here and in the period under study, it so happens that the problem of unpaid parking costs is the only other distortion that merits attention. In other contexts, it is entirely possible that various other issues would emerge. If, for example, imperfect competition in the retail car market were to drive up the price of car travel to an artificially high level – or if subsidies to car manufacturers were to drive prices down to an artificially low level – these distortions would also require attention.

Caveats

The method by which the optimal scenario is derived is logically robust but of course its utility can only be judged in relation to its aim. The aim here is to illuminate the nature, direction and orders of magnitude of the tax and price changes required to achieve an optimal outcome. The findings reported here need to be read as a heuristic device – they should not be misread as a prescription of the exact taxes and prices that should be charged to users or a prediction of the exact results of doing so.

There are several important limiting assumptions underlying this exercise which forbid it from generating exact prescriptions and predictions.

First, we assume the absence of technical constraints. Now the optimum prices modelled here could not have been implemented in 2000 for the simple reason that the technology and technical instruments required to capture and tax the incidence of marginal external costs at this level of precision were not then available.[17]

The alternative procedure – to project forward to a future year after the requisite satellite-based systems have been put in place – is hazardous. This is not only because of the hazardous nature of forecasts, and especially forecasts of future policies and prices in a context where policy and pricing reform is on the agenda. It is also because of a second basic assumption underlying this exercise: the assumption of fixed capacity.

The optimal scenario modelled here is a short run optimum: it takes the stock of infrastructure as given. In projecting forward to a future year in which all technical barriers to implementation have been overcome, we would also be projecting forward to a future in which the infrastructure in place is the result of today's choices. To prescribe a true optimal scenario for such a future would thus require us to prescribe the

16. Tables 11 and 11a, respectively, in the country tables at Annex A.

17. As it happens, the long-established scepticism in regard to the requisite technology – see for example the report of the High Level Group on Transport Infrastructure Charging, *Final Report on Options for Charging Users Directly for Transport Infrastructure Operating Costs*, Brussels, 1999 – has now been answered by the recent decisions in Switzerland, Germany and the UK *inter alia* to implement electronic distance charging for road haulage, in some cases incorporating satellite-based tracking systems. Nonetheless, our optimal prices could not have been implemented in the year 2000.

right investments and the right tax and price settings required to make best use of the infrastructure stock that emerges from such investments – a task which would require a far more complex modelling exercise.

Thirdly, the outputs of the modelling process are liable to be less than exact as a result of several and various intractable problems in estimating input values.

These include problems in estimating values for marginal external costs – a much-subscribed area of research but one that has yet to achieve universal consensus. Nonetheless, sensitivity tests conducted for France and the Netherlands, using national values for external costs in place of the standardised European values used in the core study, do not show significant differences in results.[18]

They also include, as was noted above, the exclusion of air transport where prices are demonstrably below marginal social costs in several cases (and, hence, the exclusion of the possibility of a modal shift from air to high-speed passenger rail); the incomplete specification of the heterogeneous character of non-urban rail services; and the incomplete estimation of the Mohring effect (estimated for urban markets only).

Since each of these limitations impact mainly on the results for non-urban rail, the results for this sub-system need to be treated with caution.[19] The likelihood is that the comprehensive application of marginal social cost pricing would lead to non-urban rail gaining a higher level of traffic than is indicated in our modelled results.

So far as concerns road transport, the pre-dominant mode of transport everywhere, there is as yet no evidence to suggest serious doubts on the nature, direction and orders of magnitude of the price and tax changes required. Hence, we can be confident that the nature, direction and orders of magnitude of the overall results for the system as a whole – a large increase in revenues, more than sufficient cost recovery and significant welfare gains – are as stated here.

2.3 Results for Britain, France and Germany

In comparison to the studies of Britain, France and Germany reported in 2000,[20] the results for Britain, France and Germany reported below have benefited from significant improvements in data and in our ability to make best use of data. The overall effect is seen in the increased convergence of results between the three countries, with the points of divergence being more easily explicable by real differences on the ground.

Some of these improvements merit mention. In the previous study, it was only in the case of France that we were able to model the transport markets beyond the selected metropolis directly on the basis of national data. For both Britain and Germany, we were obliged to model "representative" markets for the other urban areas and the non-urban areas and aggregate up in order to arrive at national results. In the present study, Britain, like France, was modelled with nation-wide data.

The German results remain the results of aggregation, with modelled results for Munich scaled up to constitute metropolitan Germany (Munich plus Hamburg), modelled results for Dusseldorf scaled up to

18. See Annex A2 and cf. the equivalent tables for France and the Netherlands at Annex A1.

19. A fuller discussion of this point is provided in Roy, Ed., 2000, Part 1, Chapter 3, pp. 21-24, and in Emile Quinet, *ibid*., Part II, Chapter 2, p. 53 and p. 63.

20. See Part II, Chapters 1-3, by John Peirson, Emile Quinet & Jean-Pierre Taroux and Matthias Drews-Bormann & Karl-Hans Hartwig, respectively, in Roy, Ed., 2000.

constitute other-urban Germany, and modelled results for the Westphalia region excluding its cities scaled up to constitute non-urban Germany. Moreover, the coverage of Germany remains confined to the former West Germany minus West Berlin – a choice necessitated by intractable problems in the data relating to the former GDR, including East Berlin, and in the treatment of the exogenous step-change in the transport market of the new unified capital.[21]

Nonetheless, as a result of generally better data from both German and European sources and a more carefully selected representative sample, the accuracy of the German results has been much improved. This may be witnessed in the narrowing of the gap between modelled and statistically recorded tax revenues in the reference scenario, a key test of the accuracy of the modelling.[22]

Another innovation employed here was to ascertain and apply a capacity constraint to rail and metro, limiting the traffic increase in these modes to the extent that can be absorbed today without investment in building new capacity. The most obvious effect of this is to limit the increase in London Underground traffic levels in the optimal scenario for London.

For all three countries, the first and most consistent pattern detectable is the need for large tax increases for cars and trucks in urban areas.

As is shown in the selected examples below, peak-period car prices for current non-payers of parking costs need to rise by around 70% in the Ile de France, 95% in Munich and over 150% in London. Peak-period prices for trucks need to rise by around 40% in the Ile de France and Munich and 100% in London. This in turn requires very large increases in the tax element of the price. Of course, current taxes are a relatively small fraction of current prices. In terms of the impact on consumer budgets and consumer behaviour, it is the less extreme price increase numbers that are most relevant. But these are large enough to indicate the urgency of the need to correct urban road prices.

On the basis of available information on price elasticities, optimal pricing delivers significant alterations in the modal composition of traffic in urban areas. In London, the Ile de France and metropolitan Germany, we see in each case a reduction of around 20% in car passenger kilometres. There is a strong increase in ridership on public transport: on metro, rail, trams, coaches and buses.[23]

Table 3. **Optimal taxes/prices for urban road transport: London, the Ile-de-France and Munich**
Percentage change in taxes/prices per passenger kilometre/ton kilometre relative to Reference scenario

	London		Ile-de-France		Munich	
Transport mode	Tax	Price	Tax	Price	Tax	Price
Small gasoline car, peak-period	430%	**153%**	254%	**69%**	501%	**95%**
Small gasoline car, off-peak	329%	99%	181%	46%	409%	72%
Truck, peak period	253%	**100%**	208%	**41%**	300%	**41%**
Truck, off-peak	135%	56%	92%	19%	140%	20%

21. See *ibid.*, Part II, Chapter 3.

22. See *ibid.*, Part II, Chapter 3, Annex 1.

23. These alterations in modal composition include not only shifts between the modes listed but also and importantly shifts between these modes and the pedestrian mode. Thus, some short trips hitherto made by car are now priced off and replaced by foot – for example, three car trips to three shops with three parks are now replaced by one car trip, one park, and walking between three shops. And some longer trips made by foot in consequence of high public transport prices are now priced in and replaced by the bus.

Taken as a whole, however, passenger kilometres fall. Ton kilometres do not. Road freight volumes are remarkably stable. We see therefore an increase in the freight share of total traffic, reflecting a re-direction of scarce resources to their most urgent uses.

Table 4. **Optimal urban traffic volumes: London, the Ile-de-France and Munich-Hamburg**
Percentage change in daily passenger kilometres and ton kilometres relative to reference

	London	Ile-de-France	Munich-Hamburg
Transport mode			
Cars	- 20%	- 16%	- 28%
Buses	44%	12%	46%
Metro*	21%	22%	24%
Trucks	2%	- 0.1%	0.03%

* Heavy rail passenger services are aggregated with metro for the Ile de France and metropolitan Germany

Marginal external costs fall for all modes of transport, in all areas, and in each country – the interested reader will find the changes reported in detail in the tables at Annex A – and this reduction in per-kilometre terms is complemented by the shift in traffic kilometres to those modes with lower marginal external costs. But note that marginal external costs do not fall to zero: society has a compelling interest in undertaking the task of reducing external costs but it does not have an interest in impoverishing itself in an attempt to eliminate external costs altogether.

In each of the three countries, there is a large increase in aggregate revenues as a result of optimising transport taxes and prices – in the three countries taken together, a weighted average increase of 66% relative to current revenues.

At a disaggregated level, it is important to understand the German case in order to recognise another important pattern: the increase in aggregate revenues is driven primarily by the increase in all urban areas, secondarily by increases on inter-urban routes.

At first sight, the urban share of the aggregate change in Germany seems relatively small. But the selected "non-urban" area of Westphalia is not really non-urban: it is a part of the extended urban area of the Rhine-Ruhr. Nor is this merely an unfortunate instance of an unrepresentative example. The fact is that German urbanisation is of a different pattern to Britain and France, less concentrated, more dispersed. Neither Munich nor any other German city stands in the same relation to urban Germany as London and Paris do in relation to urban Britain and France. In this sense, Germany in its own way confirms the pattern: the large increase in aggregate revenues resulting from optimisation is primarily an urban phenomenon, a function of correcting urban road congestion.

In turn, the weight of the urban area revenue increase within the overall increase in revenues reflects in part the weight of additional parking charges – an exclusively urban phenomenon. Thus, additional parking charges from urban Britain, France and Germany total €18.11 billion, €11.26 billion and €8.13 billion, respectively. Of course, it would be misleading to compare these sums directly with the increase in revenues since the latter is a net figure, the net result of several various increases and reductions. Nonetheless, the importance of the correction to parking is clearly indicated here.[24]

24. Another indicator is this: additional parking charges make up 49%, 47% and 22% of the additional revenues from cars in Britain, France and Germany, respectively.

Table 5. **Disaggregated revenue changes from optimal pricing: Britain, France and Germany**
In € billions per annum

	Britain	France	Germany
METROPOLITAN AREA:			
Reference scenario revenues	3.96	5.32	2.60
Optimal revenues	8.12	14.18	5.63
Absolute change in revenues	4.16	8.86	3.03
OTHER URBAN AREAS:			
Reference scenario revenues	25.02	16.76	8.82
Optimal revenues	47.36	34.58	21.41
Absolute change in revenues	22.34	17.82	12.59
All urban areas:			
Reference scenario revenues	28.98	22.08	11.42
Optimal revenues	55.48	48.76	27.04
Absolute change in revenues	**26.50**	**26.68**	**15.62**
NON-URBAN AREA:			
Reference scenario revenues	30.86	27.03	45.54
Optimal revenues	43.31	28.26	72.09
Absolute change in revenues	12.45	1.23	26.45
IN AGGREGATE:			
Reference scenario revenues	59.84	49.10	56.97
Optimal revenues	98.79	77.01	99.13
Absolute change in revenues	**38.95**	**27.91**	**42.16**
Percentage change	65%	57%	74%
Urban area revenue change as a percentage of the aggregate	68%	96%	37%

To derive the cost recovery result, it is necessary to strip out the VAT component of revenues: VAT belongs properly and exclusively to general government and is no part of cost recovery. It is the sum of revenues from the taxation of externalities that needs to be compared to the fixed costs of infrastructure provision.[25]

In all three countries, marginal social cost pricing yields more than sufficient cost recovery – and this despite charging a price of zero for fixed costs. The taxation of externalities suffices to defray the fixed costs of the system.

That said, the actual rate of cost recovery depends on the relative endowment of infrastructure in each given case. Unsurprisingly, therefore, the cost recovery rate ranges from just over 150% in relatively well-endowed France to more than 300% in Germany and Britain.

Finally, the pricing reform modelled here delivers clear and large absolute gains in welfare in the case of each country – which is of course the primary justification of the reform.

Disaggregated, the larger part of the aggregate gain is, in each case, located in the gains from the urban areas.

25. For a fuller discussion, see Roy, Ed., 2000, Part I, Chapter 1.

Table 6. **Cost recovery from optimal pricing: Britain, France and Germany**
In € billions per annum

	Britain	France	Germany
Infrastructure costs with capital costs discounted at 6% for all countries [C]	22.50	36.04	27.10
Optimal revenues from all inland transport modes less VAT component [R(ex-vat)]	82.75	58.06	82.89
Cost recovery [R(ex-vat)/C]	368%	161%	306%

Table 7. **Disaggregated welfare changes from optimal pricing: Britain, France and Germany**
In € billions per annum

	Britain	France	Germany
Welfare change in			
Metropolitan area	4.47	3.89	1.49
Other urban areas	10.82	3.52	4.73
All urban areas	**15.29**	**7.41**	**6.22**
Non-urban area	2.14	2.75	2.55
In aggregate	**17.42**	**10.16**	**8.76**
Urban area welfare change as a percentage of the aggregate	88%	73%	71%

2.4 Results for the Netherlands and Finland

In this exercise, the Netherlands was divided into two areas: the metropolitan area, covering the cities of the Randstad; and the non-urban area, covering the rest of the country, including the inter-urban routes in the Randstad. Given the geography of the Netherlands, the impact of the non-specification of other urban areas is likely to be relatively minor.

Finland was divided into three areas: Helsinki; other urban areas, covering the suburban belt around the capital as well as three other cities; and the non-urban area, covering the rest of the country.

The peak period in Helsinki is of a very short duration and hence the modelled results for the tax and price changes required are not precisely comparable to peak and off-peak tax and price changes modelled for the metropolitan centres in other countries. But the impact of this on the overall national results is minimal. Finland as a whole is dominated by its vast and uncongested non-urban area, which accounts for 82% of the population and 97% of the length of the road network.

The pattern of results observable in urban Britain, France and Germany can also be detected in urban Netherlands and urban Finland. For current non-payers of parking costs, peak-period car prices need to rise by almost 100% in the highly congested cities of the Randstad. There is a clear need for increases in peak-period car prices in Helsinki – even if, for the reason noted in the preceding paragraph, the reported figure of 205% in the example below needs to be treated with caution. For trucks, peak-period prices need to rise by 50% in the Randstad and by 40% in Helsinki.

Unsurprisingly, in the Randstad and Helsinki, car traffic volumes fall in consequence of optimal pricing. Traffic volumes for trucks are virtually unchanged.

Table 8. **Optimal taxes/prices for urban road transport: the Randstad and Helsinki**

Percentage change in taxes/prices per passenger kilometre/ton kilometre relative to reference scenario

	Randstad		Helsinki	
Transport mode	Tax	Price	Tax	Price
Small gasoline car, peak-period	307%	94%	396%	205%
Small gasoline car, off-peak	182%	54%	282%	146%
Truck, peak period	312%	50%	181%	40%
Truck, off-peak	124%	20%	119%	25%

Table 9. **Optimal urban traffic volumes: the Randstad and Helsinki**

Percentage change in daily passenger kilometres and ton kilometres relative to reference

Transport mode	Randstad	Helsinki
Cars	- 8%	-34%
Buses*	22%	6%
Metro**	-12%	-5%
Trucks	-0.7%	0%

* Tram services are integrated with buses for Helsinki.
** Tram services are integrated with metro for the Randstad.

As can be seen in the country tables at Annex A, optimisation spells reductions in marginal external costs everywhere.

As is seen in the table below, both the Randstad and Helsinki deliver large increases in revenues in the optimal scenario. Revenues also rise in the non-urban area of the Netherlands. But non-urban Finland displays a different pattern to all other countries: revenues fall as a result of optimisation. This fall, when coupled with the weight of the non-urban area within Finland as a whole, delivers a reduction in revenues at a national level. Finland thus stands alone in exhibiting an over-charging for transport in the reference scenario.

Additional parking charges are an important part of the urban area correction and are estimated at €1.30 billion in the Randstad[26] and at €0.036 billion in Helsinki.

The cost recovery rate in the optimal scenario is around 200% in case of the Netherlands. In the case of Finland, and notwithstanding the reduction in revenues, it is around 130%.

Importantly, marginal social cost pricing yields a clear welfare gain in both cases, irrespective of the course of the change in revenues.

26. This corresponds to 35% of the additional revenues from cars in the Netherlands.

The welfare gain from implementing this pricing rule applies in all cases, whether or not its application also delivers increased revenues. Of course, any government facing the prospect of an aggregate reduction in revenues will need to weigh this loss against the welfare gain. But in any case the welfare gain to society as a whole is not the only issue that governments need to take into account. Even in those more typical cases where optimal pricing delivers both revenue and welfare gains, other issues may be expected to command attention – in particular, issues of distribution between differentially-affected regions, differentially-affected income groups, and so on. To acknowledge this point is only to recognise that economics alone cannot monopolise the attention of governments. But the task of this chapter is limited to disclosing the economics of optimal pricing.

Table 10. **Disaggregated revenue changes from optimal pricing: the Netherlands and Finland**

In € billions per annum

	Netherlands	Finland
METROPOLITAN AREA		
Reference scenario revenues	1.45	0.08
Optimal revenues	4.46	0.27
Absolute change in revenues	3.01	0.19
OTHER URBAN AREAS		
Reference scenario revenues		0.24
Optimal revenues		0.31
Absolute change in revenues		0.07
ALL URBAN AREAS		
Reference scenario revenues	1.45	0.32
Optimal revenues	4.46	0.58
Absolute change in revenues	**3.01**	**0.26**
NON-URBAN AREA		
Reference scenario revenues	10.35	4.25
Optimal revenues	13.08	3.00
Absolute change in revenues	2.73	- 1.25
IN AGGREGATE		
Reference scenario revenues	11.80	4.57
Optimal revenues	17.54	3.58
Absolute change in revenues	**5.74**	**0.99**
Percentage change	49%	- 22%
Urban area revenue change as a percentage of the aggregate	52%	na

Table 11. **Cost recovery from optimal pricing: the Netherlands and Finland**

In € billions per annum

	Netherlands	Finland
Infrastructure costs with capital costs discounted at 6% for all countries [C]	7.21	1.57
Optimal revenues from all inland transport modes less VAT component [R(ex-vat)]	14.47	2.03
Cost recovery [R(ex-vat)/C]	201%	129%

Table 12. **Disaggregated welfare changes from optimal pricing: the Netherlands and Finland**
In € billions per annum

	Netherlands	Finland
Welfare change in:		
Metropolitan area	0.47	0.06
Other urban areas		0.04
All urban areas	**0.47**	**0.10**
Non-urban area	0.82	0.17
In aggregate	**1.29**	**0.27**
Urban area welfare change as a percentage of the aggregate	36%	37%

2.5 Optimising capacity and its impact on optimal pricing

In the language of economics, the "short run" is the period over which the capital stock must be taken as given. Since the provision of new infrastructure happens to be characterised by considerably longer lead times than applies to most investment goods, the "short run" at issue here is in fact quite a lengthy period[27]. This report's focus on the short run should not be confused in any way with what is called "short-termism" in ordinary language.

Nonetheless, it is true that in the economic long run – where the infrastructure stock is no longer given but rather the result of a choice to expand, contract, or maintain capacity – a policy of enforcing short run marginal cost pricing whilst refraining from optimising the provision of infrastructure capacity is untenable.

In principle, it is clear enough that a decision-maker committed to delivering a welfare-maximising outcome would seek to enforce an investment rule that optimised capacity *at each window of opportunity* alongside a pricing rule that optimised the use of capacity *at each and every point*.

In practice, without information on the welfare loss resulting from the failure to optimise capacity, it is difficult to judge the urgency of this task.

Now in the context of *introducing* optimal pricing, it is indeed imperative to put in place an investment rule that seeks to optimise capacity. "Without it" – to quote from a recent ECMT report – "the revenues from congestion pricing will increasingly be perceived not as a derivative of the act of correcting prices but rather as the targeted outcome of a deliberate under-provision of infrastructure. Without it, therefore, the consensus supporting the pricing regime and hence the pricing regime itself would face the threat of collapse."[28] In short: the failure to optimise capacity could well impact negatively on the prospective pricing regime and *thereby* impact negatively on welfare.

What does not follow is that the optimisation of capacity would mean a large expansion of capacity, resulting *inter alia* in a large reduction of the revenues from optimal pricing.

27. Some additional capacity can be created more rapidly by the use of telematics or cruder short-cuts (bringing emergency lanes into use). But by and large providing new capacity takes time.

28. Rana Roy, "Means and Ends: Cost-Benefit Assessment and Welfare-Maximising Investment", London, December 1999, Annex 1 in Assessing the Benefits of Transport, ECMT Report, Paris, 2001. The argument is carried through into the main report and its Executive Summary.

In principle, the ideal investment rule is to subject each project to a social cost-benefit analysis and proceed with those projects whose net present value (NPV) is positive.[29] A project's NPV is the sum of its benefits minus the sum of its costs over the period of its economic life, with its value in each future year adjusted by an appropriate discount rate. The relevant costs and benefits include capital costs and other costs of construction, the increase or reduction in revenues, the increase or reduction in consumers' surplus, and the increase or reduction in external costs and benefits. For public-sector projects, the discount rate should reflect the opportunity cost of public funds, which will be equal to or greater than the interest rate on long-term government bonds (depending on the expected impact of new borrowing on the bond rate).

Without undertaking an exhaustive social cost-benefit analysis for all five countries – a forbiddingly costly exercise – it is not possible to quantify the changes that would result from the enforcement of this rule. But some general conclusions can be deduced.

Once prices have been optimised, social cost-benefit analysis, correctly applied, will tend to generate a rather different pattern of results in regard to project proposals in urban areas to those it generates in regard to project proposals in non-urban areas. On the benefits side, in both settings, consumer surplus gains resulting from de-congestion will be offset to a greater or lesser extent by reductions in revenues. But the cost side of the equation is another matter.

For urban projects, there will obtain a large premium over and above conventional costs of construction to reflect the high opportunity costs of building in already built-up areas. In most cases, the premium will take the form of large compensation payments. In other cases – such as historic landmarks in city centers – the premium will be forbiddingly high. This last and limiting condition does not of course apply to the urban periphery. Overall, however, projects to expand urban road capacity will tend to face a high hurdle to reflect the high opportunity costs. Projects to expand capacity on inter-urban roads will not face the same – except in the special case of environmentally or otherwise sensitive areas.

But it is precisely in urban areas that optimal pricing generates the most significant changes – in taxes, prices, revenues and welfare. Therefore, the higher hurdle that opportunity cost calculation will impose on urban road projects suggests that optimising capacity will have a relatively limited impact on the pattern established in our optimal pricing scenario.

Moreover, some indicative quantification of this impact can be supplied with the aid of a simpler investment rule that arguably approximates the results that would follow from the ideal rule. This simpler rule is the one proposed in the recent study for the Netherlands Government, *Returns on Roads*. It states: "Providing that infrastructure expansion involves *no* external costs or benefits, *the time to expand road capacity at a particular location is when the revenues from an optimised congestion charge levied on new, additional capacity are precisely sufficient to fund the capital costs of that capacity.*"[30]

As the report notes, road building in urban and protected areas *would* entail external costs. And, clearly, the rule cannot be applied to rail and metro, where scale economies and external benefits come into play – especially so in urban areas.

Nonetheless, the results are highly informative. The report envisages the introduction of a basic kilometre charge reflecting the external costs of road traffic and the cost of maintenance to replace

29. What follows draws on Chapter 2.5 in Roy, 1998, pp. 29-32, which in turn draws on Section 3 of the Editors' Introduction to Cost-Benefit Analysis, edited by Richard Layard and Stephen Glaister, Second Edition, Cambridge: Cambridge University Press, 1994, pp. 25-44.

30. CE Delft, Returns on Roads: Optimising road investments and use with the 'user pays principle', Delft, 2002, p. 6.

most existing charges, coupled with full implementation of the road building projects in the government's long-term infrastructure and transport program to 2010. It then examines two scenarios for the period from 2010 to 2020: an “environment scenario” incorporating an optimised congestion charge with no further road construction beyond 2010; and a “market scenario” incorporating the optimal pricing of the environment scenario but with construction of additional road capacity in accordance with the investment rule cited above. The application of this rule results in:

– The addition of 400 lane kilometres to the road network, that is to say, an expansion of capacity by 3%;

– €1.7 billion in additional revenues – as against €1.9 billion in the environment scenario;

– a welfare gain of €700 million – as against €680 million in the environment scenario.

Now the environment scenario – at least from 2010 – may stand as a proxy for the results of optimal pricing without optimal capacity. Relative to this state, the act of optimising capacity – over and beyond the road programme to 2010 – thus generates a 3% expansion of road capacity, a 10% reduction in revenues, and a 3% gain in welfare.

Suppose now that we apply not this approximation to the ideal investment rule but the ideal rule itself. Assuming some increase in external costs but not enough to freeze all road construction, and all other things being equal, we arrive at the following result relative to the scenario of optimal pricing without optimal capacity: an expansion of road capacity by less than 3%, a reduction in revenues by less than 10%, and a welfare gain of less than 3%.

The final piece of evidence is provided by the results of a supplementary modelling exercise for the Netherlands, on the basis of the same data as our main Netherlands study but incorporating some addition to road capacity. Taking the proposals in *Returns on Roads* as our starting point and recognising the differential results of social cost-benefit analysis in urban and non-urban settings, the capacity addition here takes the form of a uniform addition of 5% to road capacity in the non-urban model. The impact of thus complementing optimal pricing with additional road capacity is as shown below: a revenue reduction of 1% and no gain in welfare.

Table 13. **Revenue and welfare changes from complementing optimal pricing with additional road capacity: the Netherlands Non-urban area**

In e billions per annum

	Netherlands, Non-urban
Revenues	
Optimal scenario	13.08
With additional road capacity	12.92
Absolute change	0.16
Percentage change	- 1.2%
Welfare	
Optimal scenario	0.825
With additional road capacity	0.822
Absolute change	0.003
Percentage change	0%

Without undertaking a comparable analysis for other countries, it would be quite inappropriate to assume that the quantitative results for the Netherlands will apply elsewhere. But without evidence to suggest that the Netherlands is in a class apart from the rest of Europe, it is entirely reasonable to arrive at a more general conclusion on the relative impacts of optimising capacity and pricing. It is indeed important to optimise capacity as well as pricing but it is the optimisation of pricing that is likely to deliver the greatest gains.

ANNEX A
(ANNEXES TO CHAPTER 2) :

MODELLING OPTIMAL TRANSPORT TAXES

A1 - NATIONAL DATA SETS

Please see the main text for interpretation of the data tables. Please note that the tables 1, 2, 3, 5, 7 and 9 present only a selection of the full model output. The types of vehicles, infrastructure and services displayed were selected to be of most interest to policy makers but space prevents many relevant categories from being included. For example, the information on cars is restricted to small-engined petrol cars only, and road freight vehicles over 3.5 tonnes are all grouped together under the heading of trucks.

RESULTS FOR GREAT BRITAIN

Prepared by
Dr. John Peirson

The Reference Equilibrium in 2000

Table 1. **The London Transport Market in 2000**

In Euros per passenger-kilometre/ton-kilometre

Mode	Price (incl. Tax)	Tax	Marginal external Cost
Small Gasoline car, solo-driven, peak (payers)	0.562	0.117	0.375
Small Gasoline car, solo-driven, off-peak (payers)	0.547	0.105	0.175
Small Gasoline car, solo-driven, peak (non-payers)	0.332	0.117	0.375
Small Gasoline car, solo-driven, off-peak (non-payers)	0.317	0.105	0.175
Bus, peak	0.241	0.000	0.171
Bus, off-peak	0.215	0.098	0.287
Metro, peak	0.269	-0.010	0.000
Metro, off-peak	0.218	0.035	0.000
Passenger rail, peak	0.165	0.025	0.000
Passenger rail, off-peak	0.124	0.029	0.000
Truck, peak	0.085	0.034	0.187
Truck, off-peak	0.085	0.034	0.130

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger-kilometre/ton-kilometre

Mode	Price (incl. Tax)	Tax	Marginal external Cost
Small Gasoline car, solo-driven, peak (payers)	0.462	0.108	0.200
Small Gasoline car, solo-driven, off-peak (payers)	0.449	0.098	0.099
Small Gasoline car, solo-driven, peak (non-payers)	0.321	0.108	0.200
Small Gasoline car, solo-driven, off-peak (non-payers)	0.308	0.098	0.099
Bus, peak	0.165	0.029	0.028
Bus, off-peak	0.143	0.033	0.040
Metro, peak	0.164	0.073	0.000
Metro, off-peak	0.117	0.072	0.001
Passenger rail, peak	0.166	0.025	0.000
Passenger rail, off-peak	0.098	0.024	0.000
Truck, peak	0.086	0.033	0.094
Truck, off-peak	0.086	0.033	0.069

Table 3. **The Non-Urban Transport Market in 2000**

In Euros per passenger-kilometre/ton-kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak	0.308	0.099	0.141
Small Gasoline car, solo-driven, off-peak	0.301	0.093	0.080
Bus, peak	0.134	0.034	0.015
Bus, off-peak	0.101	0.025	0.007
Passenger rail, peak	0.156	-0.010	0.002
Passenger rail, off-peak	0.123	0.019	0.002
Truck, peak	0.086	0.033	0.052
Truck, off-peak	0.086	0.033	0.033
Freight rail	0.069	0.013	0.000

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure Cost Recovery
Cars	43.75		
Buses	2.13	17.0	347%
Trucks and vans	13.17		
Passenger rail	0.41	3.5	19%
Freight rail	0.24		
Metro	0.14	2.0	7%
Total Transport	**59.84**	**22.5**	**266%**
of which VAT	16.04		
Ex-VAT	**43.80**	**22.5**	**195%**
Total Non-Transport	190.25		
Total	**250.09**		

Effects of Marginal Social Cost Pricing in London 2000

Table 5. **Optimal Scenario in London in 2000**

In Euros per passenger-kilometre/ton-kilometre

	Price (incl. Tax)	Tax	Marginal external Cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.840	0.390	0.280	-25%
Small Gasoline car, solo-driven, off-peak (payers)	0.660	0.220	0.140	-20%
Small Gasoline car, solo-driven, peak (non-payers)	0.840	0.620	0.280	-25%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.630	0.450	0.140	-20%
Bus, peak	0.230	-0.010	0.040	-77%
Bus, off-peak	0.030	-0.090	0.050	-83%
Metro, peak	0.293	0.018	0.000	0%
Metro, off-peak	0.151	-0.030	0.000	0%
Passenger rail, peak	0.170	0.030	0.000	0%
Passenger rail, off-peak	0.120	0.030	0.000	0%
Truck, peak	0.170	0.120	0.120	-36%
Truck, off-peak	0.133	0.080	0.080	-38%

Table 6. **Traffic volumes and revenues in London in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		Plus additional parking charge
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	
Cars, peak	44.21	33.68	-24%			
Cars, off-peak	51.33	42.74	-17%			
Sub-total cars	**95.54**	**76.42**	**-20%**	2.79	4.38	2.24
Buses, peak	10.13	11.73	16%			
Buses, off-peak	9.27	16.28	76%			
Sub-total buses	**19.40**	**28.01**	**44%**	0.27	-0.42	
Metro, peak	14.68	15.84	8%			
Metro, off-peak	10.16	14.10	39%			
Sub-total metro	**24.84**	**29.94**	**21%**	0.08	-0.04	
Passenger rail, peak	25.57	24.69	-3%			
Passenger rail, off-peak	8.85	9.03	2%			
Sub-total passenger rail	**34.42**	**33.72**	**-2%**	0.27	0.33	
Trucks and vans, peak	7.48	7.61	2%			
Trucks and vans, off-peak	13.43	13.82	3%			
Sub-total trucks and vans	**20.91**	**21.43**	**2%**	0.55	1.63	
Total				**3.96**	**5.88**	**2.24**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.590	0.240	0.160	-25%
Small Gasoline car, solo-driven, off-peak (payers)	0.500	0.150	0.080	-24%
Small Gasoline car, solo-driven, peak (non-payers)	0.590	0.380	0.160	-25%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.500	0.290	0.080	-24%
Bus, peak	0.100	-0.040	0.020	-40%
Bus, off-peak	0.010	-0.100	0.030	-33%
Metro, peak	0.090	0.000	0.000	0%
Metro, off-peak	0.010	-0.040	0.000	0%
Passenger rail, peak	0.170	0.030	0.000	0%
Passenger rail, off-peak	0.100	0.030	0.000	0%
Truck, peak	0.124	0.070	0.070	-34%
Truck, off-peak	0.107	0.050	0.050	-38%

Table 8. **Traffic volumes and revenues Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		Plus additional parking charge
Mode	Reference	Optimal	% change	Reference	Optimal	
Cars, peak	357.67	295.88	-17%			
Cars, off-peak	508.88	375.10	-26%			
Sub-total cars	**866.55**	**670.98**	**-23%**	19.53	26.76	15.87
Buses, peak	54.99	68.72	25%			
Buses, off-peak	45.51	85.02	87%			
Sub-total buses	**100.50**	**153.74**	**53%**	0.93	-3.51	
Metro, peak	2.04	2.56	25%			
Metro, off-peak	0.68	1.17	72%			
Sub-total metro	**2.72**	**3.73**	**37%**	0.06	-0.01	
Passenger rail, peak	5.01	4.82	-4%			
Passenger rail, off-peak	5.01	5.05	1%			
Sub-total passenger rail	**10.02**	**9.87**	**-1%**	0.07	0.09	
Trucks and vans, peak	70.34	70.74	1%			
Trucks and vans, off-peak	118.91	120.42	1%			
Sub-total trucks and vans	**189.25**	**191.06**	**1%**	4.43	8.16	
Total				**25.02**	**31.49**	**15.87**

Effects of Marginal Social Cost Pricing in Non-urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak	0.390	0.184	0.133	-6%
Small Gasoline car, solo-driven, off-peak	0.330	0.121	0.079	-1%
Bus, peak	0.150	0.046	0.012	-20%
Bus, off-peak	0.110	0.031	0.005	-29%
Passenger rail, peak	0.210	0.038	0.002	0%
Passenger rail, off-peak	0.130	0.026	0.002	0%
Truck, peak	0.100	0.047	0.047	-10%
Truck, off-peak	0.080	0.031	0.031	-6%
Freight rail	0.056	0.000	0.000	0%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres-Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	441.66	421.27	-5%		
Cars, off-peak	590.91	594.03	1%		
Sub-total cars	**1032.57**	**1015.3**	**-2%**	21.43	31.38
Buses, peak	49.36	51.59	5%		
Buses, off-peak	57.46	59.75	4%		
Sub-total buses	**106.52**	**111.34**	**5%**	0.93	1.27
Passenger rail, peak	42.91	38.46	-10%		
Passenger rail, off-peak	42.91	44.09	3%		
Sub-total passenger rail	**85.82**	**82.55**	**-4%**	0.07	0.79
Trucks and vans, peak	170.60	168.62	-1%		
Trucks and vans, off-peak	318.08	321.35	1%		
Sub-total trucks and vans	**488.68**	**489.97**	**0**	8.19	9.87
Freight rail	**60.33**	**64.12**	**6%**	0.24	0.00
Total				**30.86**	**43.31**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues		Infrastructure costs	Infrastructure cost recovery	
	Reference	Optimal		Reference	Optimal
Cars	43.75	80.63			
Buses	2.13	-2.66	17.0	347%	574%
Trucks	13.17	19.66			
Metro	0.14	-0.05	2.0	7%	-3%
Passenger rail	0.41	1.21	3.5	19%	35%
Freight rail	0.24	0.00			
Total Transport	**59.84**	**98.79**	**22.5**	**266%**	**439%**
of which VAT	16.04	16.04			
Ex-VAT	**43.80**	**82.75**	**22.5**	**195%**	**368%**
Total Non-Transport	190.25	192.76			
Total	**250.05**	**291.55**			

Table 11a : **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues		Infrastructure costs	Infrastructure cost recovery	
	Reference	Optimal		Reference	Optimal
Cars	43.75	62.52			
Buses	2.13	-2.66	17.0	347%	468%
Trucks	13.17	19.66			
Metro	0.14	-0.05	2.0	7%	-3%
Passenger rail	0.41	1.21	3.5	19%	35%
Freight rail	0.24	0.00			
Total Transport	**59.84**	**80.68**	**22.5**	**266%**	**359%**
of which VAT	16.04	16.04			
Ex-VAT	**43.80**	**64.64**	**22.5**	**195%**	**287%**
Total Non-Transport	190.25	192.76			
Total	**250.05**	**273.44**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
London	4.47
Other Urban	10.82
Non-urban	2.14
Total	**17.42**

RESULTS FOR FRANCE

Prepared by

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Jean-Pierre Taroux

The Reference Equilibrium in 2000

Table 1. **The Ile de France Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, peak (payers)	0.553	0.113	0.204
Small Gasoline car, off-peak (payers)	0.507	0.096	0.055
Small Gasoline car, peak (non-payers)	0.415	0.113	0.204
Small Gasoline car, off-peak (non-payers)	0.378	0.096	0.055
Bus, peak	0.175	-0.07	0.049
Bus, off-peak	0.175	-0.08	0.046
Metro/passenger rail, peak	0.081	-0.04	0.003
Metro/passenger rail, off-peak	0.081	-0.01	0.005
Truck, peak	0.129	0.026	0.13
Truck, off-peak	0.129	0.026	0.083

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, peak (payers)	0.48	0.113	0.144
Small Gasoline car, off-peak (payers)	0.439	0.096	0.047
Small Gasoline car, peak (non-payers)	0.415	0.113	0.144
Small Gasoline car, off-peak (non-payers)	0.378	0.096	0.047
Bus, peak	0.227	-0.19	0.037
Bus, off-peak	0.227	-0.21	0.035
Metro/passenger rail, peak	0.105	-0.08	0.002
Metro/passenger rail, off-peak	0.105	-0.02	0.002
Truck, peak	0.129	0.026	0.072
Truck, off-peak	0.129	0.026	0.048

Table 3. **The Non-Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, peak, motorways	0.260	0.092	0.032
Small Gasoline car, off-peak, motorways	0.260	0.092	0.027
Small Gasoline car, peak, other roads	0.226	0.058	0.039
Small Gasoline car, off-peak, other roads	0.222	0.055	0.028
Bus, peak	0.078	0.032	0.005
Bus, off-peak	0.078	0.032	0.004
Passenger rail, peak	0.088	0.011	0.002
Passenger rail, off-peak	0.073	0.009	0.002
Truck, peak, motorways	0.145	0.042	0.029
Truck, off-peak, motorways	0.145	0.042	0.025
Freight rail	0.035	0.005	0.000
Waterways	0.024	0.004	0.002

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure Cost Recovery
Cars	37.53		
Buses	0.51	26.55	184
Trucks and vans	10.83		
Metro/urban passenger rail	-0.41		
Non-urban passenger rail	0.33	8.83	2%
Freight rail	0.28		
Waterways	0.03	0.66	4%
Total Transport	**49.10**	**36.04**	**136%**
of which VAT	18.95		
Ex-VAT	**30.15**	**36.04**	**84%**
Total Non-Transport	266.88		
Total	**315.97**		

Effects of Marginal Social Cost Pricing in Ile-de-France Area in 2000

Table 5. **Optimal Scenario in Ile-de-France Area in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, peak (payers)	0.700	0.260	0.153	-25%
Small Gasoline car, off-peak (payers)	0.550	0.140	0.047	-15%
Small Gasoline car, peak (non-payers)	0.700	0.400	0.153	-25%
Small Gasoline car, off-peak (non-payers)	0.550	0.270	0.047	-15%
Bus, peak	0.270	0.020	0.027	-45%
Bus, off-peak	0.210	-0.050	0.025	-46%
Metro/passenger rail, peak	0.130	0.008	0.003	0%
Metro/passenger rail, off-peak	0.050	-0.050	0.005	0%
Truck, peak	0.182	0.080	0.080	-39%
Truck, off-peak	0.153	0.050	0.050	-40%

Table 6. **Traffic volumes and revenues in Ile-de-France Area in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		
Mode	Reference	Optimal	% change	Reference	Optimal	Plus additional parking charge
Cars, peak	91.57	79.55	-13%			
Cars, off-peak	105.02	86.01	-18%			
Sub-total cars	**196.59**	**165.56**	**-16%**	5.33	8.73	3.89
Buses, peak	6.24	6.61	6%			
Buses, off-peak	10.41	12.08	16%			
Sub-total buses	**16.66**	**18.69**	**12%**	-0.30	-0.10	
Metro/passenger rail, peak	28.21	30.52	8%			
Metro/passenger rail, off-peak	37.83	47.54	26%			
Sub-total metro	**66.04**	**78.05**	**18%**	-0.38	-0.46	
Trucks and vans, peak	33.780	33.658	0%			
Trucks and vans, off-peak	38.730	38.794	0%			
Sub-total trucks and vans	**72.51**	**72.45**	**0%**	0.67	2.13	
Total				**5.32**	**10.29**	**3.89**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, peak (payers)	0.580	0.214	0.120	-17%
Small Gasoline car, off-peak (payers)	0.460	0.120	0.040	-15%
Small Gasoline car, peak (non-payers)	0.580	0.279	0.120	-17%
Small Gasoline car, off-peak (non-payers)	0.460	0.181	0.040	-15%
Bus, peak	0.450	0.028	0.026	-30%
Bus, off-peak	0.390	-0.050	0.023	-34%
Metro/passenger rail, peak	0.180	0.000	0.002	0%
Metro/passenger rail, off-peak	0.070	-0.060	0.003	50%
Truck, peak	0.158	0.055	0.055	-24%
Truck, off-peak	0.140	0.037	0.037	-23%

Table 8. **Traffic volumes and revenues Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		Plus
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**additional parking charge**
Cars, peak	268.39	253.02	-6%			
Cars, off-peak	307.79	303.59	-1%			
Sub-total cars	**576.18**	**556.61**	**-4%**	15.62	23.27	7.37
Buses, peak	6.75	6.55	-3%			
Buses, off-peak	11.25	11.21	-0%			
Sub-total buses	**18.00**	**17.76**	**0%**	-0.87	-0.08	
Metro/passenger rail, peak	0.87	0.94	8%			
Metro/passenger rail, off-peak	1.46	1.89	29%			
Sub-total metro	**2.33**	**2.83**	**21%**	-0.02	-0.03	
Trucks and vans, peak	37.87	38.11	1%			
Trucks and vans, off-peak	189.39	190.99	1%			
Sub-total trucks and vans	**227.26**	**229.10**	**1%**	2.02	4.04	
Total				**16.76**	**27.20**	**7.37**

Effects of Marginal Social Cost Pricing in Non-urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, peak, motorways	0.230	0.065	0.030	-6%
Small Gasoline car, off-peak, motorways	0.230	0.066	0.023	-15%
Small Gasoline car, peak, other roads	0.240	0.073	0.036	-8%
Small Gasoline car, off-peak, other roads	0.240	0.073	0.024	-14%
Bus, peak	0.090	0.042	0.003	-40%
Bus, off-peak	0.090	0.042	0.002	-50%
Passenger rail, peak	0.110	0.037	0.002	0%
Passenger rail, off-peak	0.100	0.035	0.002	0%
Truck, peak, motorways	0.130	0.025	0.025	-14%
Truck, off-peak, motorways	0.120	0.021	0.021	-16%
Freight rail	0.030	0.000	0.000	0%
Waterways	0.023	0.002	0.002	15%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	53.23	53.37	0%		
Cars, off-peak	647.43	648.24	0%		
Sub-total cars	**700.66**	**701.61**	**0%**	16.57	18.22
Buses, peak	11.46	11.42	0%		
Buses, off-peak	139.27	135.67	-3%		
Sub-total buses	**150.73**	**147.08**	**-2%**	1.68	1.90
Passenger rail, peak	7.93	7.26	-9%		
Passenger rail, off-peak	96.41	85.68	-11%		
Sub-total rail	**104.34**	**92.94**	**-11%**	0.33	1.08
Trucks and vans, peak	13.13	13.08	0		
Trucks and vans, off-peak	561.69	571.12	2%		
Sub-total trucks and vans	**574.82**	**584.19**	**2%**	8.13	7.04
Freight rail	**24.33**	**24.12**	**-1%**	0.03	0.02
Waterways	**184.51**	**188.52**	**2%**	0.28	0.00
Total				**27.03**	**28.26**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	37.53	61.48			
Buses	0.51	1.72	26.55	184%	288%
Trucks	10.83	13.21			
Metro/urban passenger rail	-0.41	-0.49			
Non-urban passenger rail	0.33	1.08	8.83	2%	7%
Freight rail	0.28	0.00			
Waterways	0.03	0.02	0.66	4%	3%
Total Transport	**49.10**	**77.01**	**36.0**	**136%**	**214%**
of which VAT	18.95	18.95			
Ex-VAT	**30.15**	**58.06**	**36.0**	**84%**	**161%**
Total Non-Transport	266.88	267.82			
Total	**315.98**	**344.83**			

Table 11a : **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	37.53	50.22			
Buses	0.51	1.72	26.55	184%	245%
Trucks	10.83	13.21			
Metro/urban passenger rail	-0.41	-0.49			
Non-urban passenger rail	0.33	1.08	8.83	2%	7%
Freight rail	0.28	0.00			
Waterways	0.03	0.02	0.66	4%	3%
Total Transport	**49.10**	**65.75**	**36.0**	**136%**	**182%**
of which VAT	18.95	18.95			
Ex-VAT	**30.15**	**46.80**	**36.0**	**84%**	**130%**
Total Non-Transport	266.88	267.82			
Total	**315.98**	**333.57**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
Ile-de-France	3.89
Other Urban	3.53
Non-Urban	2.75
Total	**10.16**

RESULTS FOR GERMANY

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The Reference Equilibrium in 2000

Table 1. **The Munich Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak (payers)	0.683	0.093	0.454
Small Gasoline car, solo-driven, off-peak (payers)	0.672	0.085	0.176
Small Gasoline car, solo-driven, peak (non-payers)	0.487	0.093	0.454
Small Gasoline car, solo-driven, off-peak (non-payers)	0.476	0.085	0.176
Bus, peak	0.144	-0.040	0.037
Bus, off-peak	0.144	0.033	0.026
Metro/passenger rail, peak	0.144	0.014	0.000
Metro/passenger rail, off-peak	0.145	0.101	0.000
Truck, peak	0.178	0.025	0.176
Truck, off-peak	0.178	0.025	0.088

Table 2. **The Dusseldorf Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak (payers)	0.683	0.093	0.337
Small Gasoline car, solo-driven, off-peak (payers)	0.672	0.085	0.146
Small Gasoline car, solo-driven, peak (non-payers)	0.487	0.093	0.337
Small Gasoline car, solo-driven, off-peak (non-payers)	0.476	0.085	0.146
Bus, peak	0.147	0.006	0.039
Bus, off-peak	0.147	-0.050	0.050
Metro/passenger rail, peak	0.147	0.022	0.000
Metro/passenger rail, off-peak	0.147	0.102	0.000
Truck, peak	0.178	0.025	0.151
Truck, off-peak	0.178	0.025	0.091

Table 3. **The Non-Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak	0.476	0.085	0.098
Small Gasoline car, solo-driven, off-peak	0.476	0.085	0.075
Bus, peak	0.130	0.071	0.010
Bus, off-peak	0.130	0.102	0.012
Passenger rail, peak	0.064	0.012	0.002
Passenger rail, off-peak	0.064	0.040	0.002
Truck, peak, motorways	0.178	0.025	0.041
Truck, off-peak, motorways	0.178	0.025	0.032
Freight rail	0.053	0.005	0.000
Waterways	0.019	0.000	0.002

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure Cost Recovery
Cars	43.58		
Buses	3.39	19.86	274%
Trucks and vans	7.36		
Metro/urban passenger rail	1.62	2.72	87%
Non-urban passenger rail	0.73		
Freight rail	0.29	3.63	8%
Waterways	0.00	0.89	0%
Total Transport	**56.97**	**27.10**	**210%**
of which VAT	16.24		
Ex-VAT	**40.73**	**27.10**	**150%**
Total Non-Transport	286.90		
Total	**343.86**		

Effects of Marginal Social Cost Pricing in Metropolitan Area in 2000

Table 5. **Optimal Scenario in Munich in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.950	0.358	0.240	-47%
Small Gasoline car, solo-driven, off-peak (payers)	0.820	0.230	0.100	-43%
Small Gasoline car, solo-driven, peak (non-payers)	0.950	0.559	0.240	-47%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.820	0.433	0.100	-43%
Bus, peak	0.105	-0.080	0.019	-49%
Bus, off-peak	0.000	-0.110	0.015	-42%
Metro/passenger rail, peak	0.133	0.003	0.000	0%
Metro/passenger rail, off-peak	0.051	0.007	0.000	0%
Truck, peak	0.251	0.100	0.100	-43%
Truck, off-peak	0.213	0.060	0.060	-32%

Table 6. **Traffic volumes and revenues in Metropolitan Area in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		Plus
Mode	Reference	Optimal	% change	Reference	Optimal	additional parking charge
Cars, peak	25.06	19.68	-21%			
Cars, off-peak	46.55	31.84	-32%			
Sub-total cars	**71.61**	**51.52**	**-28%**	1.96	3.79	1.61
Buses, peak	2.01	2.37	18%			
Buses, off-peak	3.91	6.29	61%			
Sub-total buses	**5.92**	**8.66**	**46%**	0.01	-0.27	
Metro/passenger rail, peak	8.31	9.09	9%			
Metro/passenger rail, off-peak	16.13	21.28	32%			
Sub-total rail/metro	**24.43**	**30.36**	**24%**	0.52	0.10	
Trucks and vans, peak	4.69	4.67	0%			
Trucks and vans, off-peak	9.95	10.01	1%			
Sub-total trucks and vans	**14.63**	**14.68**	**0%**	0.11	0.40	
Total				**2.60**	**4.02**	**1.61**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.940	0.349	0.240	-29%
Small Gasoline car, solo-driven, off-peak (payers)	0.800	0.210	0.120	-18%
Small Gasoline car, solo-driven, peak (non-payers)	0.940	0.546	0.240	-29%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.800	0.407	0.120	-18%
Bus, peak	0.120	-0.020	0.023	-41%
Bus, off-peak	0.121	-0.070	0.029	-42%
Metro/passenger rail, peak	0.134	0.009	0.000	0%
Metro/passenger rail, off-peak	0.000	-0.040	0.000	0%
Truck, peak	0.260	0.110	0.110	-27%
Truck, off-peak	0.223	0.070	0.070	-23%

Table 8. **Traffic volumes and revenues Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		Plus
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**additional parking charge**
Cars, peak	95.44	76.67	-20%			
Cars, off-peak	177.26	133.11	-25%			
Sub-total cars	**272.69**	**209.78**	**-23%**	8.07	14.35	6.69
Buses, peak	28.92	33.49	16%			
Buses, off-peak	56.14	70.58	26%			
Sub-total buses	**85.06**	**104.06**	**22%**	-0.72	-0.88	
Metro/passenger rail, peak	16.57	18.30	10%			
Metro/passenger rail, off-peak	32.21	47.53	48%			
Sub-total rail/metro	**48.77**	**63.82**	**31%**	1.10	-0.25	
Trucks and vans, peak	11.74	11.76	0%			
Trucks and vans, off-peak	37.31	37.47	0%			
Sub-total trucks and vans	**49.05**	**49.24**	**0%**	0.38	1.50	
Total				**8.82**	**14.71**	**6.69**

Effects of Marginal Social Cost Pricing in Non-urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak	0.540	0.145	0.094	-4%
Small Gasoline car, solo-driven, off-peak	0.510	0.120	0.072	-4%
Bus, peak	0.100	0.039	0.009	-10%
Bus, off-peak	0.060	0.036	0.010	-17%
Passenger rail, peak	0.080	0.025	0.002	0%
Passenger rail, off-peak	0.050	0.022	0.002	0%
Truck, peak, motorways	0.190	0.039	0.039	-5%
Truck, off-peak, motorways	0.180	0.031	0.031	-3%
Freight rail	0.048	0.000	0.000	0%
Waterways	0.021	0.002	0.002	0%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	776.31	744.55	-4%		
Cars, off-peak	688.40	681.64	-1%		
Sub-total cars	**1464.71**	**1426.18**	**-3%**	33.55	55.59
Buses, peak	84.59	96.34	14%		
Buses, off-peak	74.98	93.10	24%		
Sub-total buses	**159.57**	**189.44**	**19%**	4.10	2.14
Passenger rail, peak	51.73	50.61	-2%		
Passenger rail, off-peak	45.65	49.61	9%		
Sub-total rail	**97.38**	**100.21**	**3%**	0.73	0.71
Trucks and vans, peak	359.58	357.85	0%		
Trucks and vans, off-peak	539.36	542.27	1%		
Sub-total trucks and vans	**898.94**	**900.12**	**0%**	6.87	13.50
Freight rail	**191.90**	**201.16**	**5%**	0.29	0.00
Waterways	**223.72**	**217.94**	**-3%**	0.00	0.15
Total				**45.54**	**72.09**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues		Infrastructure costs	Infrastructure cost recovery	
	Reference	Optimal		Reference	Optimal
Cars	43.58	82.03	19.86	274%	496%
Buses	3.39	0.99			
Trucks	7.36	15.40			
Metro/urban passenger rail	1.62	-0.15	2.72	87%	21%
Non-urban passenger rail	0.73	0.71			
Freight rail	0.29	0.00	3.63	8%	0%
Waterways	0.00	0.15	0.89	0%	17%
Total Transport	**56.97**	**99.13**	**27.1**	**210%**	**367%**
of which VAT	16.24	16.24			
Ex-VAT	**40.73**	**82.89**	**27.1**	**150%**	**306%**
Total Non-Transport	286.90	288.66			
Total	**343.86**	**387.78**			

Table 11a : **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues		Infrastructure costs	Infrastructure cost recovery	
	Reference	Optimal		Reference	Optimal
Cars	43.58	73.72	19.86	274%	454%
Buses	3.39	0.99			
Trucks	7.36	15.40			
Metro/urban passenger rail	1.62	-0.15	2.72	87%	21%
Non-urban passenger rail	0.73	0.71			
Freight rail	0.29	0.00	3.63	8%	0%
Waterways	0.00	0.15	0.89	0%	17%
Total Transport	**56.97**	**90.82**	**27.1**	**210%**	**335%**
of which VAT	16.24	16.24			
Ex-VAT	**40.73**	**74.58**	**27.1**	**150%**	**275%**
Total Non-Transport	286.90	288.66			
Total	**343.86**	**379.48**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
Metropolitan	1.49
Other Urban	4.73
Non-Urban	2.55
Total	**8.76**

RESULTS FOR THE NETHERLANDS

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The Reference Equilibrium in 2000

Table 1. **The Randstad Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak (payers)	0.672	0.138	0.359
Small Gasoline car, solo-driven, off-peak (payers)	0.659	0.130	0.102
Small Gasoline car, solo-driven, peak (non-payers)	0.448	0.138	0.359
Small Gasoline car, solo-driven, off-peak (non-payers)	0.435	0.130	0.102
Bus, peak	0.101	-0.170	0.055
Bus, off-peak	0.101	0.013	0.042
Metro/tram, peak	0.101	-0.290	0.001
Metro/tram, off-peak	0.101	-0.020	0.002
Passenger rail, peak	0.186	-0.094	0
Passenger rail, off-peak	0.131	0.048	0
Truck, peak	0.105	0.017	0.095
Truck, off-peak	0.105	0.017	0.045

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
na			

Table 3. **The Non-Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak	0.500	0.134	0.117
Small Gasoline car, solo-driven, off-peak	0.500	0.134	0.055
Bus, peak	0.101	-0.233	0.012
Bus, off-peak	0.101	-0.095	0.006
Passenger rail, peak	0.186	-0.094	0.002
Passenger rail, off-peak	0.131	0.048	0.002
Truck, peak, motorways	0.105	0.017	0.030
Truck, off-peak, motorways	0.105	0.017	0.017
Freight rail	0.018	0.001	0.000
Waterways	0.015	0.001	0.002

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure Cost Recovery
Cars	11.97		
Buses	-0.69	4.93	247.6%
Trucks and vans	0.92		
Metro/tram	-0.29		
Passenger rail	-0.15	1.87	-23.4%
Freight rail	0.00		
Waterways	0.03	0.41	7.6%
Total Transport	**11.80**	**7.21**	**163.7%**
of which VAT	3.07		
Ex-VAT	**8.73**	**7.21**	**121.1%**
Total Non-Transport	22.52		
Total	**34.32**		

Effects of Marginal Social Cost Pricing in Randstad in 2000

Table 5. **Optimal Scenario in Randstad in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.870	0.339	0.270	-24.8%
Small Gasoline car, solo-driven, off-peak (payers)	0.670	0.142	0.090	-11.8%
Small Gasoline car, solo-driven, peak (non-payers)	0.870	0.561	0.270	-24.8%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.670	0.366	0.090	-11.8%
Bus, peak	0.286	0.011	0.037	-32.7%
Bus, off-peak	0.068	-0.020	0.030	-28.6%
Metro/tram, peak	0.394	0.000	0.001	11.1%
Metro/tram, off-peak	0.087	-0.030	0.002	0.0%
Passenger rail, peak	0.315	0.035	0	na
Passenger rail, off-peak	0.104	0.021	0	na
Truck, peak	0.158	0.070	0.070	-26.3%
Truck, off-peak	0.126	0.038	0.040	-11.1%

Table 6. **Traffic volumes and revenues Randstad in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/a

Mode	Traffic volumes Reference	Optimal	% change	Tax Revenues Reference	Optimal	Plus additional parking charge
Cars, peak	20.21	18.28	-9.5%			
Cars, off-peak	43.18	39.86	-7.7%			
Sub-total cars	**63.39**	**58.14**	**-8.3%**	1.84	2.74	1.30
Buses, peak	4.50	4.47	-0.6%			
Buses, off-peak	5.83	8.12	39.3%			
Sub-total buses	**10.33**	**12.60**	**21.9%**	-0.21	-0.02	
Metro/tram, peak	3.03	2.69	-11.3%			
Metro/tram, off-peak	4.11	5.33	29.8%			
Sub-total metro	**7.14**	**8.02**	**12.3%**	-0.28	-0.04	
Passenger rail, peak	2.87	2.67	-7.1%			
Passenger rail, off-peak	1.74	1.88	8.0%			
Sub-total passenger rail	**4.62**	**4.55**	**-1.4%**	-0.05	0.04	
Trucks and vans, peak	5.29	5.23	-1.1%			
Trucks and vans, off-peak	19.10	18.98	-0.6%			
Sub-total trucks and vans	**24.40**	**24.22**	**-0.7%**	0.15	0.44	
Total				**1.44**	**3.15**	**1.30**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
na				

Table 8. **Traffic volumes and revenues Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

Mode	Traffic volumes Reference	Optimal	% change	Tax Revenues Reference	Optimal	Plus additional parking charge
na						

Effects of Marginal Social Cost Pricing in Non-Urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak	0.510	0.140	0.109	-6.8%
Small Gasoline car, solo-driven, off-peak	0.450	0.084	0.053	-3.6%
Bus, peak	0.370	0.036	0.010	-16.7%
Bus, off-peak	0.220	0.022	0.003	-50.0%
Passenger rail, peak	0.310	0.027	0.002	0.0%
Passenger rail, off-peak	0.100	0.014	0.002	0.0%
Truck, peak, motorways	0.120	0.028	0.028	-6.7%
Truck, off-peak, motorways	0.100	0.016	0.016	-5.9%
Freight rail	0.017	0.000	0.000	na
Waterways	0.016	0.002	0.002	15.0%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	124.52	117.82	-5.4%		
Cars, off-peak	261.48	272.53	4.2%		
Sub-total cars	**386.01**	**390.36**	**1.1%**	10.13	11.60
Buses, peak	4.41	2.45	-44.5%		
Buses, off-peak	6.05	4.09	-32.4%		
Sub-total buses	**10.47**	**6.54**	**-37.5%**	-0.48	0.08
Passenger rail, peak	15.41	11.26	-26.9%		
Passenger rail, off-peak	23.58	28.24	19.7%		
Sub-total train	**39.00**	**39.51**	**1.3%**	-0.09	0.20
Trucks and vans, peak	25.29	24.25	-4.1%		
Trucks and vans, off-peak	91.24	92.21	1.1%		
Sub-total trucks and vans	**116.53**	**116.46**	**-0.1%**	0.76	1.10
Freight rail	**2.96**	**3.01**	**1.7%**	0.00	0.00
Waterways	**104.46**	**104.96**	**0.5%**	0.03	0.07
Total				**10.35**	**13.07**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	11.97	15.65			
Buses	-0.69	0.05	4.93	247.6%	350.2%
Trucks	0.92	1.55			
Metro/tram	-0.29	-0.05			
Passenger rail	-0.15	0.25	1.87	-23.4%	10.7%
Freight rail	0.00	0.00			
Waterways	0.03	0.07	0.41	7.6%	17.7%
Total Transport	**11.80**	**17.54**	**7.21**	**163.7%**	**243.2%**
of which VAT	3.07	3.07			
Ex-VAT	**8.73**	**14.47**	**7.21**	**121.1%**	**200.6%**
Total Non-Transport	22.52	22.65			
Total	**34.32**	**40.18**			

Table 11a : **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	11.97	14.35			
Buses	-0.69	0.05	4.93	247.6%	323.8%
Trucks	0.92	1.55			
Metro/tram	-0.29	-0.05			
Passenger rail	-0.15	0.25	1.87	-23.4%	10.7%
Freight rail	0.00	0.00			
Waterways	0.03	0.07	0.41	7.6%	17.7%
Total Transport	**11.80**	**16.23**	**7.21**	**163.7%**	**225.2%**
of which VAT	3.07	3.07			
Ex-VAT	**8.73**	**13.16**	**7.21**	**121.1%**	**182.6%**
Total Non-Transport	22.52	22.65			
Total	**34.32**	**38.88**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
Randstad	0.46
Non-urban	0.82
Total	**1.29**

Effects of Marginal Social Cost Pricing with Additional Road Capacity in Non-Urban Areas in 2000

Table 13. **Optimal Scenario with additional road capacity Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC*
Small Gasoline car, solo-driven, peak	0.500	0.131	0.100	-8.3%
Small Gasoline car, solo-driven, off-peak	0.450	0.083	0.052	-1.9%
Bus, peak	0.370	0.035	0.008	-20.0%
Bus, off-peak	0.220	0.022	0.003	0.0%
Passenger rail, peak	0.310	0.027	0.002	0.0%
Passenger rail, off-peak	0.100	0.014	0.002	0.0%
Trucks and vans, peak	0.110	0.026	0.026	-7.1%
Trucks and vans, off-peak	0.100	0.016	0.016	0.0%
Freight rail	0.017	0.000	0.000	na
Waterways	0.016	0.002	0.002	0.0%

* relative to original optimal scenario

Table 14. **Traffic volumes and revenues with additional road capacity Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres –Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Optimal**	**with additional road capacity**	**% change**	**Optimal**	**with additional road capacity**
Cars, peak	117.82	118.28	0.4%		
Cars, off-peak	272.53	272.21	-0.1%		
Sub-total cars	**390.36**	**390.50**	**0.0%**	11.60	11.46
Buses, peak	2.45	2.44	-0.3%		
Buses, off-peak	4.09	4.08	-0.2%		
Sub-total buses	**6.54**	**6.52**	**-0.2%**	0.08	0.08
Passenger rail, peak	11.26	11.23	-0.3%		
Passenger rail, off-peak	28.24	28.19	-0.2%		
Sub-total train	**39.51**	**39.43**	**-0.2%**	0.20	0.20
Trucks and vans, peak	24.25	24.33	0.3%		
Trucks and vans, off-peak	92.21	92.16	0.0%		
Sub-total trucks and vans	**116.46**	**116.50**	**0.0%**	1.10	1.09
Freight rail	**3.01**	**3.01**	**0.0%**	0.00	0.00
Waterways	**104.96**	**104.94**	**0.0%**	0.07	0.07
Total				**13.07**	**12.92**

Table 15. **Welfare gain resulting from optimal pricing with additional road capacity Non-Urban Areas in 2000**

In billion Euro/a

Optimal pricing	Optimal pricing with additional road capacity	% change
0.825	0.822	0

RESULTS FOR FINLAND

Prepared by

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The Reference Equilibrium in 2000

Table 1. **The Helsinki Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak (payers)	0.372	0.115	0.421
Small Gasoline car, solo-driven, off-peak (payers)	0.361	0.109	0.238
Small Gasoline car, solo-driven, peak (non-payers)	0.222	0.115	0.421
Small Gasoline car, solo-driven, off-peak (non-payers)	0.211	0.109	0.238
Bus/tram, peak	0.105	-0.070	0.024
Bus/tram, off-peak	0.105	-0.020	0.042
Metro, peak	0.105	-0.080	0.000
Metro, off-peak	0.105	-0.010	0.000
Passenger rail, peak	0.105	0.000	0.000
Passenger rail, off-peak	0.105	0.042	0.000
Truck, peak	0.073	0.016	0.065
Truck, off-peak	0.073	0.016	0.044

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak, motorways	0.210	0.108	0.180
Small Gasoline car, solo-driven, off-peak, motorways	0.201	0.102	0.064
Small Gasoline car, solo-driven, peak, other roads	0.222	0.115	0.197
Small Gasoline car, solo-driven, off-peak, other roads	0.211	0.109	0.055
Bus, peak, other roads	0.105	-0.071	0.013
Bus, off-peak, other roads	0.105	-0.025	0.009
Passenger rail, peak	0.105	0.000	0.002
Passenger rail, off-peak	0.105	0.042	0.002
Truck, peak, motorways	0.052	0.015	0.029
Truck, off-peak, motorways	0.052	0.015	0.014

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 3. **The Non-urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak, motorways	0.210	0.108	0.127
Small Gasoline car, solo-driven, off-peak, motorways	0.201	0.102	0.056
Small Gasoline car, solo-driven, peak, other roads	0.210	0.108	0.091
Small Gasoline car, solo-driven, off-peak, other roads	0.201	0.102	0.057
Bus, peak, other roads	0.130	0.021	0.003
Bus, off-peak, other roads	0.130	0.065	0.004
Passenger rail, peak	0.115	0.011	0.002
Passenger rail, off-peak	0.115	0.053	0.002
Truck, peak, motorways	0.052	0.016	0.018
Truck, off-peak, motorways	0.052	0.016	0.009
Freight rail	0.033	0.004	0.000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro per annum

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure Cost Recovery
Cars	3.56		
Buses/trams	0.15	1.18	370%
Trucks and vans	0.67		
Passenger rail	0.15	0.38	51%
Freight rail	0.04		
Metro	-0.01		
Total Transport	4.56	1.56	291%
of which VAT	1.54		
Ex-VAT	3.01	1.56	193%
Total Non-Transport	8.86		
Total	**13.43**		

Effects of Marginal Social Cost Pricing in Helsinki in 2000

Table 5. **Optimal Scenario in Helsinki in 2000**

In Euros per passenger kilometre/ton kilometre

	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.675	0.418	0.307	-27%
Small Gasoline car, solo-driven, off-peak (payers)	0.518	0.265	0.205	-14%
Small Gasoline car, solo-driven, peak (non-payers)	0.676	0.570	0.307	-27%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.519	0.416	0.205	-14%
Bus/tram, peak	0.212	0.034	0.016	-33%
Bus/tram, off-peak	0.159	0.032	0.032	-24%
Metro, peak	0.209	0.024	0.000	0%
Metro, off-peak	0.138	0.027	0.000	0%
Passenger rail, peak	0.125	0.020	0.000	0%
Passenger rail, off-peak	0.094	0.031	0.000	0%
Truck, peak	0.102	0.045	0.045	-31%
Truck, off-peak	0.091	0.035	0.035	-20%

Table 6. **Traffic volumes and revenues in Helsinki in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		Plus
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**additional parking charge**
Cars, peak	1.05	0.85	-19%			
Cars, off-peak	1.59	0.89	-44%			
Sub-total cars	**2.64**	**1.74**	**-34%**	0.08	0.13	0.03
Buses/trams, peak	0.54	0.50	-7%			
Buses/trams, off-peak	1.66	1.83	10%			
Sub-total buses/trams	**2.20**	**2.36**	**6%**	-0.02	0.03	
Metro, peak	0.66	0.54	-19%			
Metro, off-peak	0.81	0.86	6%			
Sub-total metro	**1.47**	**1.40**	**-5%**	-0.01	0.01	
Passenger rail, peak	0.55	0.48	-12%			
Passenger rail, off-peak	0.79	0.82	3%			
Sub-total passenger rail	**1.34**	**1.30**	**-3%**	0.01	0.01	
Trucks and vans, peak	0.76	0.753	-1%			
Trucks and vans, off-peak	3.05	3.052	0%			
Sub-total trucks and vans	**3.81**	**3.81**	**0%**	0.02	0.04	
Total				**0.07**	**0.22**	**0.03**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak, motorways	0.292	0.190	0.141	-22%
Small Gasoline car, solo-driven, off-peak, motorways	0.187	0.087	0.063	-2%
Small Gasoline car, solo-driven, peak, other roads	0.314	0.208	0.174	-12%
Small Gasoline car, solo-driven, off-peak, other roads	0.184	0.081	0.053	-4%
Bus, peak, other roads	0.257	0.081	0.009	-31%
Bus, off-peak, other roads	0.171	0.041	0.004	-56%
Passenger rail, peak	0.169	0.064	0.002	0%
Passenger rail, off-peak	0.091	0.028	0.002	0%
Truck, peak	0.058	0.021	0.021	-28%
Truck, off-peak	0.048	0.011	0.011	-21%

Table 8. **Traffic volumes and revenues Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	2.14	2.03	-5%		
Cars, off-peak	3.20	3.65	14%		
Sub-total cars	**5.33**	**3.67**	**6%**	0.17	0.17
Buses, peak	0.46	0.37	-21%		
Buses, off-peak	1.38	1.09	-21%		
Sub-total buses	**1.84**	**1.46**	**-21%**	-0.02	0.02
Passenger rail, peak	0.17	0.16	-5%		
Passenger rail, off-peak	0.97	1.12	16%		
Sub-total passenger rail	**1.14**	**1.28**	**12%**	0.01	0.01
Trucks and vans, peak	8.85	8.73	-1%		
Trucks and vans, off-peak	4.27	4.41	3%		
Sub-total trucks and vans	**13.12**	**13.14**	**0%**	0.07	0.10
Total				**0.23**	**0.31**

Effects of Marginal Social Cost Pricing in Non-Urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak, motorways	0.242	0.139	0.102	-20%
Small Gasoline car, solo-driven, off-peak, motorways	0.174	0.075	0.053	-5%
Small Gasoline car, solo-driven, peak, other roads	0.231	0.128	0.081	-11%
Small Gasoline car, solo-driven, off-peak, other roads	0.178	0.079	0.054	-5%
Bus, peak, other roads	0.171	0.062	0.003	0%
Bus, off-peak, other roads	0.090	0.025	0.003	-25%
Passenger rail, peak	0.154	0.049	0.002	0%
Passenger rail, off-peak	0.084	0.021	0.002	0%
Truck, peak, motorways	0.051	0.015	0.015	-17%
Truck, off-peak, motorways	0.045	0.009	0.009	0%
Freight rail	0.029	0.000	0.000	0%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres-Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	10.80	9.94	-8%		
Cars, off-peak	97.15	99.02	2%		
Sub-total cars	**107.95**	**108.96**	**1%**	3.30	2.27
Buses, peak	5.23	4.48	-14%		
Buses, off-peak	8.65	9.54	10%		
Sub-total buses	**13.87**	**14.02**	**1%**	0.20	0.15
Passenger rail, peak	1.38	1.15	-17%		
Passenger rail, off-peak	7.82	8.50	9%		
Sub-total passenger rail	**9.20**	**9.65**	**5%**	0.12	0.07
Trucks and vans, peak	5.78	5.76	0%		
Trucks and vans, off-peak	76.72	77.46	1%		
Sub-total trucks and vans	**82.50**	**83.22**	**1%**	0.57	0.50
Freight rail	**33.70**	**33.69**	**0%**	0.04	0.00
Total				**4.25**	**3.00**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues		Infrastructure costs	Infrastructure cost recovery	
	Reference	Optimal		Reference	Optimal
Cars	3.56	2.58			
Buses/trams	0.15	0.20			
Trucks	0.67	0.65	1.18	370%	290%
Metro	-0.01	0.01	na	na	na
Passenger rail	0.15	0.09			
Freight rail	0.04	0.00	0.38	51%	24%
Total Transport	**4.56**	**3.54**	**1.56**	**291%**	**226%**
of which VAT	1.54	1.54			
Ex-VAT	**3.01**	**1.99**	**1.56**	**193%**	**127%**
Total Non-Transport	8.86	8.85			
Total	**13.43**	**12.39**			

Table 11a. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues		Infrastructure costs	Infrastructure cost recovery	
	Reference	Optimal		Reference	Optimal
Cars	3.56	2.54			
Buses/trams	0.15	0.20			
Trucks	0.67	0.65	1.18	370%	287%
Metro	-0.01	0.01	na	na	na
Passenger rail	0.15	0.09			
Freight rail	0.04	0.00	0.38	51%	24%
Total Transport	**4.56**	**3.50**	**1.56**	**291%**	**224%**
of which VAT	1.54	1.54			
Ex-VAT	**3.01**	**1.95**	**1.56**	**193%**	**125%**
Total Non-Transport	8.86	8.85			
Total	**13.43**	**12.35**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
Helsinki	0.05
Other Urban	0.04
Non-urban	0.16
Total	**0.26**

A2 – SENSITIVITY TESTS

The values ascribed to external costs in national studies sometimes differ from the values established in the large-scale European research programmes used in the current study. Such differences will have an impact in determining optimal levels of transport charges and taxes. But they will not affect the main features of the changes described in chapter 2: large increases in taxes and prices for road transport, both passenger and freight, in urban areas; significant reductions in the volume of car traffic in urban areas; significant reductions in marginal external costs in all areas; a large increase in overall revenues; more than sufficient recovery of the fixed costs of infrastructure provision. Differences in the valuation of marginal external costs will instead translate into a tendency to increase, or decrease, certain trends in the basic pattern of results.

This is the main conclusion of the two sensitivity tests on the valuation of marginal external costs conducted for France and the Netherlands.

In France, the costs of the use of infrastructure by various transport modes have been assessed periodically since 1994 by the Commissariat Général du Plan (Boiteux group). This work, updated in 2000 and 2001, provides the basis for setting out the main lines of an approach to charging following marginal social costs, including external costs. In the tables that follow in this annex a full set of results are presented for France using the specific French values from the Boiteux-2 report that currently provide official national reference figures. Comparison of the results with the standard results in Annex A1 shows a remarkable degree of agreement.

In the Netherlands, cost estimates developed by CE Delft in the report, *Efficient Prices for Transport,* are used as quasi-official estimates by the Ministry of Transport, Public Works and Water Management. These include inter alia higher values for some external costs, in particular, higher emission factors. Modelling an optimal scenario using CE Delft values for external costs produces a pattern of results broadly similar to the results for the Netherlands reported in Annex A1.

A different kind of test – a sensitivity test on the marginal cost pricing rule itself – is also applied to the Netherlands using the quasi-official estimates developed by CE Delft. Here, an alternative scenario is modelled in which all the costs of infrastructure maintenance and upkeep are charged to users. This is the principle adopted in the CE Delft study, whereas in all of the other scenarios only the costs imposed by an additional vehicle are charged to users. The pattern of results that emerges in this scenario is distinct in a number of respects. Most strikingly, and reflecting the high ratio of fixed to marginal costs in the rail mode, the new pricing rule results in a severe contraction of rail traffic volumes, for passengers and freight, and in all markets.

The test illustrates well the thesis developed in Chapter 1. In order to achieve the welfare optimum, it is necessary to correct the two types of market failure in transport: the under-pricing that follows from the absence of taxes on externalities, and the over-pricing that follows from the absence of transfers to cover fixed costs. These two deviations from optimal prices do not offset each other: the first is most acute in the case of congested urban roads, the second is most acute in the case of rail. To correct one without the other must therefore result in a sub-optimal outcome.

Marginal External Cost Estimates

Metropoles Areas	France : Ile de France		The Netherlands : The Randstad		
Mode	Standard values	Boiteux 2 values	Standard values	CE values	CE values plus fixed maintenance costs
Small Gasoline car, peak	0.204	0.242	0.383	0.381	0.398
Small Gasoline car, off-peak	0.055	0.085	0.101	0.119	0.136
Bus, peak	0.049	0.028	0.058	0.069	0.071
Bus, off-peak	0.046	0.023	0.042	0.065	0.068
Metro/passenger rail, peak	0.003	0.001	-	-	-
Metro/passenger rail, off-peak	0.005	0.002	-	-	-
Metro/tram, peak	-	-	0.001	0.001	0.002
Metro/tram, off peak	-	-	0.001	0.002	0.004
Passenger rail, peak	-	-	0.000	0.033	0.078
Passenger rail, off-peak	-	-	0.000	0.066	0.156
Truck, peak	0.13	0.121	0.099	0.107	0.108
Truck, off-peak	0.083	0.084	0.045	0.054	0.056

Non-Urban Areas	France		The Netherlands		
Mode	Standard values	Boiteux 2 values	Standard values	CE Valeurs	CE Values plus fixed maintenance costs
Small Gasoline car, peak, motorways	0.032	0.040	-	-	-
Small Gasoline car, off-peak, motorways	0.027	0.036	-	-	-
Small Gasoline car, peak, other roads	0.039	0.044	-	-	-
Small Gasoline car, off-peak, other roads	0.028	0.033	-	-	-
Small Gasoline car, solo-driven, peak, all roads	-	-	0.132	0.095	0.112
Small Gasoline car, solo-driven, off-peak, all roads	-	-	0.055	0.033	0.050
Bus, peak	0.005	0.001	0.014	0.018	0.020
Bus, off-peak	0.004	0.001	0.006	0.016	0.019
Passenger rail, peak	0.002	0.002	0.002	0.004	0.027
Passenger rail, off-peak	0.002	0.002	0.002	0.007	0.042
Truck, peak, motorways	0.029	0.042	0.033	0.029	0.031
Truck, off-peak, motorways	0.025	0.040	0.017	0.016	0.018
Freight rail	0.000	0.000	0.000	0.006	0.031
Waterways	0.002	0.000	0.002	0.007	0.013

RESULTS FOR FRANCE
BOITEUX 2 VALUES FOR EXTERNAL COSTS

Prepared by

Emile Quinet, Jean-Pierre Taroux

The Reference Equilibrium in 2000

Table 1. **The Ile de France Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, peak (payers)	0.553	0.113	0.242
Small Gasoline car, off-peak (payers)	0.507	0.096	0.085
Small Gasoline car, peak (non-payers)	0.415	0.113	0.242
Small Gasoline car, off-peak (non-payers)	0.378	0.096	0.085
Bus, peak	0.175	-0.070	0.028
Bus, off-peak	0.175	-0.080	0.023
Metro/passenger rail, peak	0.081	-0.040	0.001
Metro/passenger rail, off-peak	0.081	-0.010	0.002
Truck, peak	0.129	0.026	0.121
Truck, off-peak	0.129	0.026	0.084

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, peak (payers)	0.480	0.113	0.158
Small Gasoline car, off-peak (payers)	0.439	0.096	0.071
Small Gasoline car, peak (non-payers)	0.415	0.113	0.158
Small Gasoline car, off-peak (non-payers)	0.378	0.096	0.071
Bus, peak	0.227	-0.190	0.027
Bus, off-peak	0.227	-0.210	0.026
Metro/passenger rail, peak	0.105	-0.080	0.002
Metro/passenger rail, off-peak	0.105	-0.020	0.002
Truck, peak	0.129	0.026	0.090
Truck, off-peak	0.129	0.026	0.073

Table 3. **The Non-Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, peak, motorways	0.260	0.092	0.040
Small Gasoline car, off-peak, motorways	0.260	0.092	0.036
Small Gasoline car, peak, other roads	0.226	0.058	0.044
Small Gasoline car, off-peak, other roads	0.222	0.055	0.033
Bus, peak	0.078	0.032	0.001
Bus, off-peak	0.078	0.032	0.001
Passenger rail, peak	0.088	0.011	0.000
Passenger rail, off-peak	0.073	0.009	0.000
Truck, peak, motorways	0.145	0.042	0.042
Truck, off-peak, motorways	0.145	0.042	0.040
Freight rail	0.035	0.005	0.000
Waterways	0.024	0.004	0.000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure cost recovery
Cars	37.53		
Buses	0.51	26.55	184%
Trucks and vans	10.83		
Metro/urban passenger rail	-0.41		
Non-urban passenger rail	0.33	8.83	2%
Freight rail	0.28		
Waterways	0.03	0.66	4%
Total Transport	**49.10**	**36.04**	**136%**
of which VAT	18.95		
Ex-VAT	**30.15**	**36.04**	**84%**
Total Non-Transport	250.29		
Total	**299.39**		

Effects of Marginal Social Cost Pricing in Ile de France Area in 2000

Table 5. **Optimal Scenario in Ile de France Area in 2000**

In Euros per passenger kilometre/ton kilometre

	Price (incl. tax)	Tax	Marginal external cost	Change of MEC
Small Gasoline car, peak (payers)	0.750	0.310	0.195	-19%
Small Gasoline car, off-peak (payers)	0.580	0.170	0.081	-5%
Small Gasoline car, peak (non-payers)	0.750	0.440	0.195	-19%
Small Gasoline car, off-peak (non-payers)	0.580	0.300	0.081	-5%
Bus, peak	0.270	0.017	0.023	-18%
Bus, off-peak	0.200	-0.050	0.022	-4%
Metro/passenger rail, peak	0.130	0.006	0.001	0%
Metro/passenger rail, off-peak	0.050	-0.050	0.002	0%
Truck, peak	0.209	0.110	0.110	-9%
Truck, off-peak	0.185	0.080	0.080	-5%

Table 6. **Traffic volumes and revenues in Ile de France Area in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**Plus additional parking charge**
Cars, peak	91.57	79.30	-13%			
Cars, off-peak	105.02	84.68	-19%			
Sub-total cars	**196.59**	**163.98**	**-17%**	5.33	9.21	3.49
Buses, peak	6.24	6.68	7%			
Buses, off-peak	10.41	12.30	18%			
Sub-total buses	**16.66**	**18.98**	**14%**	-0.30	-0.12	
Metro/passenger rail, peak	28.21	30.76	9%			
Metro/passenger rail, off-peak	37.83	48.32	28			
Sub-total metro	**66.04**	**79.08**	**20%**	-0.38	-0.50	
Trucks and vans, peak	33.78	32.96	-2%			
Trucks and vans, off-peak	38.73	37.79	-2%			
Sub-total trucks and vans	**72.51**	**70.75**	**-2%**	0.67	2.87	
Total				**5.32**	**11.46**	**3.49**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, peak (payers)	0.600	0.230	0.140	-11%
Small Gasoline car, off-peak (payers)	0.490	0.144	0.070	-1%
Small Gasoline car, peak (non-payers)	0.600	0.295	0.140	-11%
Small Gasoline car, off-peak (non-payers)	0.490	0.205	0.070	-1%
Bus, peak	0.460	0.036	0.025	-7%
Bus, off-peak	0.410	-0.020	0.026	0%
Metro/passenger rail, peak	0.190	0.005	0.002	0%
Metro/passenger rail, off-peak	0.080	-0.040	0.002	0%
Truck, peak	0.188	0.085	0.085	-6%
Truck, off-peak	0.176	0.073	0.073	0%

Table 8. **Traffic volumes and revenues Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**Plus additional parking charge**
Cars, peak	268.38	254.01	-5.4%			
Cars, off-peak	307.78	303.35	-1.4%			
Sub-total cars	**576.18**	**557.37**	**-3%**	15.62	24.02	7.38
Buses, peak	6.75	6.46	-4%			
Buses, off-peak	11.25	10.85	-4%			
Sub-total buses	**18.00**	**17.31**	**-4%**	-0.87	-0.00	
Metro/passenger rail, peak	0.87	0.94	8%			
Metro/passenger rail, off-peak	1.46	1.92	32%			
Sub-total metro	**2.33**	**2.86**	**23%**	-0.02	-0.02	
Trucks and vans, peak	37.87	37.18	-2%			
Trucks and vans, off-peak	189.39	185.58	-2%			
Sub-total trucks and vans	**227.26**	**222.76**	**-2%**	2.02	6.75	
Total				**16.76**	**30.75**	**7.38**

Effects of Marginal Social Cost Pricing in Non-urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, peak, motorways	0.240	0.072	0.041	3%
Small Gasoline car, off-peak, motorways	0.240	0.073	0.036	0%
Small Gasoline car, peak, other roads	0.240	0.076	0.044	0%
Small Gasoline car, off-peak, other roads	0.240	0.074	0.033	0%
Bus, peak	0.090	0.043	0.001	0%
Bus, off-peak	0.090	0.042	0.000	-20%
Passenger rail, peak	0.110	0.037	0.000	0%
Passenger rail, off-peak	0.100	0.035	0.000	0%
Truck, peak, motorways	0.150	0.043	0.043	2%
Truck, off-peak, motorways	0.140	0.040	0.040	0%
Freight rail	0.030	0.000	0.000	0%
Waterways	0.021	0.000	0.000	0%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	53.23	53.64	1%		
Cars, off-peak	647.43	654.88	1%		
Sub-total cars	**700.66**	**708.52**	**1%**	16.57	17.45
Buses, peak	11.46	11.42	-0%		
Buses, off-peak	139.27	135.09	-3%		
Sub-total cars	**150.73**	**146.50**	**-3%**	1.68	1.90
Passenger rail, peak	7.93	7.29	-8%		
Passenger rail, off-peak	96.41	85.63	-11%		
Sub-total rail	**104.34**	**92.92**	**-11%**	0.33	1.07
Trucks and vans, peak	13.13	12.97	-1%		
Trucks and vans, off-peak	561.69	562.79	0%		
Sub-total trucks and vans	**574.82**	**575.76**	**0%**	8.13	11.11
Freight rail	**24.33**	**25.52**	**4.9%**	0.03	0.00
Waterways	**184.51**	**192.88**	**4.5%**	0.28	0.00
Total				**27.03**	**31.53**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	37.53	61.56			
Buses	0.51	1.78	26.55	184%	317%
Trucks	10.83	20.72			
Metro/urban passenger rail	-0.41	-0.52			
Non-urban passenger rail	0.33	1.07	8.83	2%	6%
Freight rail	0.28	0.00			
Waterways	0.03	0.00	0.66	4%	0%
Total Transport	**49.10**	**84.61**	**36.04**	**136%**	**235%**
of which VAT	18.95	18.95			
Ex-VAT	**30.15**	**65.66**	**36.04**	**84%**	**182%**
Total Non-Transport	250.29	222.87			
Total	**299.39**	**307.49**			

Table 11a. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	37.53	50.68			
Buses	0.51	1.78	26.55	184%	276%
Trucks	10.83	20.72			
Metro/urban passenger rail	-0.41	-0.52			
Non-urban passenger rail	0.33	1.07	8.83	2%	6%
Freight rail	0.28	0.00			
Waterways	0.03	0.00	0.66	4%	0%
Total Transport	**49.10**	**73.74**	**36.04**	**136%**	**205%**
of which VAT	18.95	18.95			
Ex-VAT	**30.15**	**54.79**	**36.04**	**84%**	**152%**
Total Non-Transport	250.29	222.87			
Total	**299.39**	**296.61**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
Ile-de-France	1.93
Other Urban	1.61
Non-Urban	1.96
Total	**5.50**

RESULTS FOR THE NETHERLANDS
CE-DELFT VALUES FOR EXTERNAL COSTS

Prepared by

Henk van Mourik

The Reference Equilibrium in 2000

Table 1. **The Randstad Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak (payers)	0.672	0.138	0.381
Small Gasoline car, solo-driven, off-peak (payers)	0.659	0.130	0.119
Small Gasoline car, solo-driven, peak (non-payers)	0.448	0.138	0.381
Small Gasoline car, solo-driven, off-peak (non-payers)	0.435	0.130	0.119
Bus, peak	0.101	-0.170	0.069
Bus, off-peak	0.101	0.013	0.065
Metro/tram, peak	0.101	-0.290	0.001
Metro/tram, off-peak	0.101	-0.020	0.002
Passenger rail, peak	0.186	-0.094	0.033
Passenger rail, off-peak	0.131	0.048	0.066
Truck, peak	0.105	0.017	0.107
Truck, off-peak	0.105	0.017	0.054

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
na			

Table 3. **The Non-urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak	0.500	0.134	0.095
Small Gasoline car, solo-driven, off-peak	0.500	0.134	0.033
Bus, peak	0.101	-0.233	0.018
Bus, off-peak	0.101	-0.095	0.016
Passenger rail, peak	0.186	-0.094	0.004
Passenger rail, off-peak	0.131	0.048	0.007
Truck, peak, motorways	0.105	0.017	0.029
Truck, off-peak, motorways	0.105	0.017	0.016
Freight rail	0.018	0.001	0.006
Waterways	0.015	0.001	0.007

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure cost recovery
Cars	11.97		
Buses	-0.69	4.93	247.6%
Trucks and vans	0.92		
Metro/tram	-0.29		
Passenger rail	-0.15	1.87	-23.4%
Freight rail	0.00		
Waterways	0.03	0.41	7.6%
Total Transport	**11.80**	**7.21**	**163.7%**
of which VAT	3.07		
Ex-VAT	**8.73**	**7.21**	**121.1%**
Total Non-Transport	22.52		
Total	**34.32**		

Effects of Marginal Social Cost Pricing in Randstad in 2000

Table 5. **Optimal Scenario in Randstad in 2000**

In Euros per passenger kilometre/ton kilometre

	Price (incl. tax)	Tax	Marginal external cost	Change of MEC
Small Gasoline car, solo-driven, peak (payers)	0.890	0.355	0.290	-23.9%
Small Gasoline car, solo-driven, off-peak (payers)	0.680	0.156	0.110	-7.6%
Small Gasoline car, solo-driven, peak (non-payers)	0.890	0.578	0.290	-23.9%
Small Gasoline car, solo-driven, off-peak (non-payers)	0.680	0.380	0.110	-7.6%
Bus, peak	0.298	0.023	0.049	-29.0%
Bus, off-peak	0.084	0.000	0.046	-29.2%
Metro/tram, peak	0.394	0.000	0.001	0.0%
Metro/tram, off-peak	0.088	-0.030	0.002	0.0%
Passenger rail, peak	0.348	0.068	0.033	0.0%
Passenger rail, off-peak	0.170	0.087	0.066	0.0%
Truck, peak	0.172	0.084	0.084	-21.5%
Truck, off-peak	0.136	0.047	0.047	-13.0%

Table 6. **Traffic volumes and revenues Randstad in 2000**

In Millions of Daily passenger kilometres/ ton kilometres – Revenues in Billion Euro/an

	Traffic volumes			Tax Revenues		
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**Plus additional parking charge**
Cars, peak	20.21	18.26	-9.7%			
Cars, off-peak	43.18	39.75	-7.9%			
Sub-total cars	**63.39**	**58.01**	**-8.5%**	1.84	2.93	1.29
Buses, peak	4.50	4.47	-0.6%			
Buses, off-peak	5.83	7.99	37.0%			
Sub-total buses	**10.33**	**12.47**	**20.6%**	-0.21	0.02	
Metro/tram, peak	3.03	2.72	-10.4%			
Metro/tram, off-peak	4.11	5.45	32.4%			
Sub-total metro	**7.15**	**8.16**	**14.2%**	-0.28	-0.04	
Passenger rail, peak	2.87	2.64	-8.3%			
Passenger rail, off-peak	1.75	1.79	2.6%			
Sub-total passenger rail	4.62	4.43	-4.2%	-0.05	0.10	
Trucks and vans, peak	5.30	5.15	-2.7%			
Trucks and vans, off-peak	19.10	18.69	-2.1%			
Sub-total trucks and vans	**24.40**	**23.85**	**-2.3%**	0.15	0.48	
Total				**1.44**	**3.49**	**1.29**

Effects of Marginal Social Cost Pricing in Other Urban Areas in 2000

Table 7. **Optimal Scenario Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	**Price (incl. Tax)**	**Tax**	**Marginal External Cost**	**Change of MEC**
na				

Table 8. **Traffic volumes and revenues Other Urban Areas in 20000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/an

	Traffic volumes			Tax Revenues		
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**	**Plus additional parking charge**
na						

Effects of Marginal Social Cost Pricing in Non-Urban Areas in 2000

Table 9. **Optimal Scenario Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost	Change of MEC
Small Gasoline car, solo-driven, peak	0.490	0.123	0.089	-6.3%
Small Gasoline car, solo-driven, off-peak	0.430	0.063	0.032	-3.0%
Bus, peak	0.380	0.046	0.017	-5.6%
Bus, off-peak	0.230	0.035	0.016	0.0%
Passenger rail, peak	0.310	0.029	0.005	12.5%
Passenger rail, off-peak	0.100	0.019	0.007	0.0%
Truck, peak, motorways	0.110	0.027	0.027	-6.9%
Truck, off-peak, motorways	0.100	0.015	0.015	-6.3%
Freight rail	0.024	0.007	0.007	8.3%
Waterways	0.021	0.007	0.007	4.3%

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**Optimal**	**% change**	**Reference**	**Optimal**
Cars, peak	124.53	118.12	-5.1%		
Cars, off-peak	261.48	275.43	5.3%		
Sub-total cars	**386.01**	**393.55**	**2.0%**	10.13	10.04
Buses, peak	4.42	2.36	-46.5%		
Buses, off-peak	6.05	3.67	-39.3%		
Sub-total buses	**10.47**	**6.04**	**-42.3%**	-0.48	0.09
Passenger rail, peak	15.41	10.96	-28.9%		
Passenger rail, off-peak	23.59	25.57	8.4%		
Sub-total train	**39.00**	**36.53**	**-6.3%**	-0.09	0.24
Trucks and vans, peak	25.29	24.27	-4.0%		
Trucks and vans, off-peak	91.24	92.41	1.3%		
Sub-total trucks and vans	**116.53**	**116.68**	**0.1%**	0.76	0.90
Freight rail	**2.96**	**2.85**	**-3.7%**	0.00	0.00
Waterways	**104.46**	**104.23**	**-0.2%**	0.03	0.22
Total				**10.35**	**11.51**

Contribution to Fiscal Revenue and Welfare Gain in the Optimal Scenario in 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	11.97	14.27			
Buses	-0.69	0.12	4.93	247.6%	320.0%
Trucks	0.92	1.38			
Metro/tram	-0.29	-0.05			
Passenger rail	-0.15	0.34	1.87	-23.4%	16.1%
Freight rail	0.00	0.01			
Waterways	0.03	0.23	0.41	7.6%	55.7%
Total Transport	**11.80**	**16.31**	**7.21**	**163.7%**	**226.2%**
of which VAT	3.07	3.07			
Ex-VAT	**8.73**	**13.24**	**7.21**	**121.1%**	**183.6%**
Total Non-Transport	22.52	22.63			
Total	**34.32**	**38.94**			

Table 11a. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues Optimal	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery Optimal
Cars	11.97	12.98			
Buses	-0.69	0.12	4.93	247.6%	293.7%
Trucks	0.92	1.38			
Metro/tram	-0.29	-0.05			
Passenger rail	-0.15	0.34	1.87	-23.4%	16.1%
Freight rail	0.00	0.01			
Waterways	0.03	0.23	0.41	7.6%	55.7%
Total Transport	**11.80**	**15.01**	**7.21**	**163.7%**	**208.2%**
of which VAT	3.07	3.07			
Ex-VAT	**8.73**	**11.94**	**7.21**	**121.1%**	**165.6%**
Total Non-Transport	22.52	22.63			
Total	**34.32**	**37.64**			

Table 12. **Welfare gain resulting from optimal pricing in 2000**

In billion Euro/a

Area	Welfare gain
Randstad	0.516
Non-urban	0.792
Total	**1.308**

RESULTS FOR THE NETHERLANDS COMBINING CE-DELFT VALUES FOR EXTERNAL COSTS WITH AN ALTERNATIVE PRICING RULE

(Charging for the fixed costs of infrastructure maintenance in addition to marginal maintenance and external costs)

Prepared by

Jos M. W. Dings, Henk van Mourik

The Reference Equilibrium in 2000

Table 1. **The Randstad Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost
Small Gasoline car, solo-driven, peak (payers)	0.672	0.138	0.398
Small Gasoline car, solo-driven, off-peak (payers)	0.659	0.130	0.136
Small Gasoline car, solo-driven, peak (non-payers)	0.448	0.138	0.398
Small Gasoline car, solo-driven, off-peak (non-payers)	0.435	0.130	0.136
Bus, peak	0.101	-0.170	0.071
Bus, off-peak	0.101	0.013	0.068
Metro/tram, peak	0.101	-0.290	0.002
Metro/tram, off-peak	0.101	-0.020	0.004
Passenger rail, peak	0.186	-0.094	0.078
Passenger rail, off-peak	0.131	0.048	0.156
Truck, peak	0.105	0.017	0.108
Truck, off-peak	0.105	0.017	0.056

Table 2. **The Other Urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost Plus Fixed Maintenance Cost
na			

Table 3. **The Non-urban Transport Market in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax	Marginal External Cost Plus Fixed Maintenance Cost
Small Gasoline car, solo-driven, peak	0.500	0.134	0.112
Small Gasoline car, solo-driven, off-peak	0.500	0.134	0.050
Bus, peak	0.101	-0.233	0.020
Bus, off-peak	0.101	-0.095	0.019
Passenger rail, peak	0.186	-0.094	0.027
Passenger rail, off-peak	0.131	0.048	0.042
Truck, peak, motorways	0.105	0.017	0.031
Truck, off-peak, motorways	0.105	0.017	0.018
Freight rail	0.018	0.001	0.031
Waterways	0.015	0.001	0.013

Contribution to Fiscal Revenue in the Reference Scenario in 2000

Table 4. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000**

In billion Euro/a

Mode	Contribution to Fiscal Revenue	Infrastructure costs	Infrastructure cost recovery
Cars	11.97		
Buses	-0.69	4.93	247.6%
Trucks and vans	0.92		
Metro/tram	-0.29		
Passenger rail	-0.15	1.87	-23.4%
Freight rail	0.00		
Waterways	0.03	0.41	7.6%
Total Transport	**11.80**	**7.21**	**163.7%**
of which VAT	3.07		
Ex-VAT	**8.73**	**7.21**	**121.1%**
Total Non-Transport	22.52		
Total	**34.32**		

Effects of New Pricing Rule in Randstad in 2000

Table 5. **New Scenario in Randstad in 2000**

In Euros per passenger kilometre/ton kilometre

	Price (incl. tax)	Tax
Small Gasoline car, solo-driven, peak (payers)	0.910	0.372
Small Gasoline car, solo-driven, off-peak (payers)	0.700	0.173
Small Gasoline car, solo-driven, peak (non-payers)	0.900	0.594
Small Gasoline car, solo-driven, off-peak (non-payers)	0.700	0.397
Bus, peak	0.300	0.025
Bus, off-peak	0.088	0.000
Metro/tram, peak	0.396	0.001
Metro/tram, off-peak	0.090	-0.030
Passenger rail, peak	0.395	0.115
Passenger rail, off-peak	0.263	0.180
Truck, peak	0.174	0.086
Truck, off-peak	0.137	0.049

Table 6. **Traffic volumes and revenues in Randstad in 2000**

In Millions of Daily passenger kilometres/ ton kilometres

	Traffic volumes			Tax Revenues		
Mode	Reference	New	% change	Reference	New	Plus additional parking charge
Cars, peak	20.21	18.21	-9.9%			
Cars, off-peak	43.18	39.41	-8.7%			
Sub-total cars	**63.39**	**57.63**	**-9.1%**	1.84	3.12	1.28
Buses, peak	4.50	4.50	0.1%			
Buses, off-peak	5.83	8.10	38.9%			
Sub-total buses	**10.33**	**12.60**	**22.0%**	-0.21	0.03	
Metro/tram, peak	3.03	2.73	-9.7%			
Metro/tram, off-peak	4.11	5.53	34.5%			
Sub-total metro	**7.14**	**8.27**	**15.8%**	-0.28	-0.04	
Passenger rail, peak	2.87	2.58	-10.0%			
Passenger rail, off-peak	1.74	1.68	-3.4%			
Sub-total passenger rail	**4.62**	**4.27**	**-7.5%**	-0.05	0.17	
Trucks and vans, peak	5.29	5.15	-2.7%			
Trucks and vans, off-peak	19.10	18.70	-2.1%			
Sub-total trucks and vans	**24.40**	**23.85**	**-2.2%**	0.15	0.49	
Total				**1.44**	**3.79**	**1.28**

Effects of New Pricing Rule in Other Urban Areas in 2000

Table 7. **New Scenario in Other Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax
na		

Table 8. **Traffic volumes and revenues in Other Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues		
Mode	Reference	Optimal	% change	Reference	Optimal	Plus additional parking charge
na						

Effects of New Pricing Rule in Non-urban Areas in 2000

Table 9. **New Scenario in Non-Urban Areas in 2000**

In Euros per passenger kilometre/ton kilometre

Mode	Price (incl. Tax)	Tax
Small Gasoline car, solo-driven, peak	0.510	0.141
Small Gasoline car, solo-driven, off-peak	0.450	0.080
Bus, peak	0.380	0.048
Bus, off-peak	0.230	0.038
Passenger rail, peak	0.330	0.052
Passenger rail, off-peak	0.140	0.054
Truck, peak, motorways	0.120	0.029
Truck, off-peak, motorways	0.100	0.017
Freight rail	0.048	0.031
Waterways	0.027	0.013

Table 10. **Traffic volumes and revenues Non-Urban Areas in 2000**

In Millions of Daily passenger kilometres/ton kilometres – Revenues in Billion Euro/a

	Traffic volumes			Tax Revenues	
Mode	**Reference**	**New**	**% change**	**Reference**	**New**
Cars, peak	124.53	118.22	-5.1%	10.13	11.53
Cars, off-peak	261.48	277.10	6.0%		
Sub-total cars	**386.01**	**395.32**	**2.4%**		
Buses, peak	4.42	2.42	-45.3%	-0.48	0.10
Buses, off-peak	6.05	3.44	-43.1%		
Sub-total buses	**10.47**	**5.86**	**-44.1%**		
Passenger rail, peak	15.41	10.63	-31.0%	-0.09	0.49
Passenger rail, off-peak	23.59	20.40	-13.5%		
Sub-total train	**39.00**	**31.03**	**-20.4%**		
Trucks and vans, peak	25.29	24.36	-3.7%	0.76	1.00
Trucks and vans, off-peak	91.24	92.65	1.5%		
Sub-total trucks and vans	**116.53**	**117.00**	**0.4%**		
Freight rail	**2.96**	**2.42**	**-18.2%**	0.00	0.02
Waterways	**104.46**	**104.20**	**-0.2%**	0.03	0.41
Total				**10.35**	**13.58**

Contribution to Fiscal Revenue and Welfare Gain in the New Scenario for 2000

Table 11. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges included)**

In billion Euro/a

Mode	**Contribution to fiscal revenues**		**Infrastructure costs**	**Infrastructure cost recovery**	
	Reference	**New**		**Reference**	**New**
Cars	11.97	15.95			
Buses	-0.69	0.14	4.93	247.6%	356.8%
Trucks	0.92	1.51			
Metro/tram	-0.29	-0.04			
Passenger rail	-0.15	0.68	1.87	-23.4%	35.1%
Freight rail	0.00	0.02			
Waterways	0.03	0.42	0.41	7.6%	101.8%
Total Transport	**11.80**	**18.66**	**7.21**	**163.7%**	**258.8%**
of which VAT	3.07	3.07			
Ex-VAT	**8.73**	**15.59**	**7.21**	**121.1%**	**216.3%**
Total Non-Transport	22.52	22.67			
Total	**34.32**	**41.33**			

Table 11a. **Contribution to fiscal revenues, infrastructure costs and cost recovery in 2000 (with additional parking charges excluded)**

In billion Euro/a

Mode	Contribution to fiscal revenues Reference	Contribution to fiscal revenues New	Infrastructure costs	Infrastructure cost recovery Reference	Infrastructure cost recovery New
Cars	11.97	14.66			
Buses	-0.69	0.14	4.93	247.6%	330.7%
Trucks	0.92	1.51			
Metro/tram	-0.29	-0.04			
Passenger rail	-0.15	0.68	1.87	-23.4%	35.1%
Freight rail	0.00	0.02			
Waterways	0.03	0.42	0.41	7.6%	101.8%
Total Transport	**11.80**	**17.38**	**7.21**	**163.7%**	**241.0%**
of which VAT	3.07	3.07			
Ex-VAT	**8.73**	**14.31**	**7.21**	**121.1%**	**198.4%**
Total Non-Transport	22.52	22.67			
Total	**34.32**	**40.05**			

Table 12. **Change in welfare**

Limitations in data, coupled with the constraints of the model, forbid the derivation of a robust estimate of the change in welfare.

A3 - THE TRENEN MODEL

CALTHROP E., PROOST S. (CES-KULEUVEN[1]), VAN HERBRUGGEN B. (TMLOUVAIN[2])

The numerical results of this study have been generated by applying a 'TRENEN'-type model to regions and cities in Britain, France, Germany, Finland and the Netherlands. This annex serves as an introduction to that model, whilst listing the minor improvements and adjustments that have been made to previously published versions of the model.

This annex draws heavily on De Borger & Proost 2002[3], where the interested reader can find further details on the modelling approach and the full mathematical representation of the model.

This Annex divides into 2 sections: Section 1 presents a simple introduction to the models; Section 2 provides further details on operationalising the model concepts.

1. AN INTRODUCTION TO THE TRENEN MODEL

Two complementary approaches are used to explain the basic idea underlying the TRENEN model used in this study. The first is based on a demand and supply diagram for one transport market, the second on a model flow chart.

1.1 Diagrammatical approach

The transport sector is an important cause of external costs specific to transport like congestion and accidents, but also of other external costs like air pollution. These problems are often tackled by piecemeal policies and technologies treating one problem domain at a time. A way to integrate these considerations is to use equilibrium models for the transport market in which external cost aspects are included.

The basic idea of the TRENEN model is to look for the optimal combination of price and regulatory policies in the transport and environment domain via the optimisation of a welfare function. This optimum will be implemented as a market equilibrium with different types of taxes, public transport prices and environmental standards. This can best be illustrated by using a figure with only one transport market.

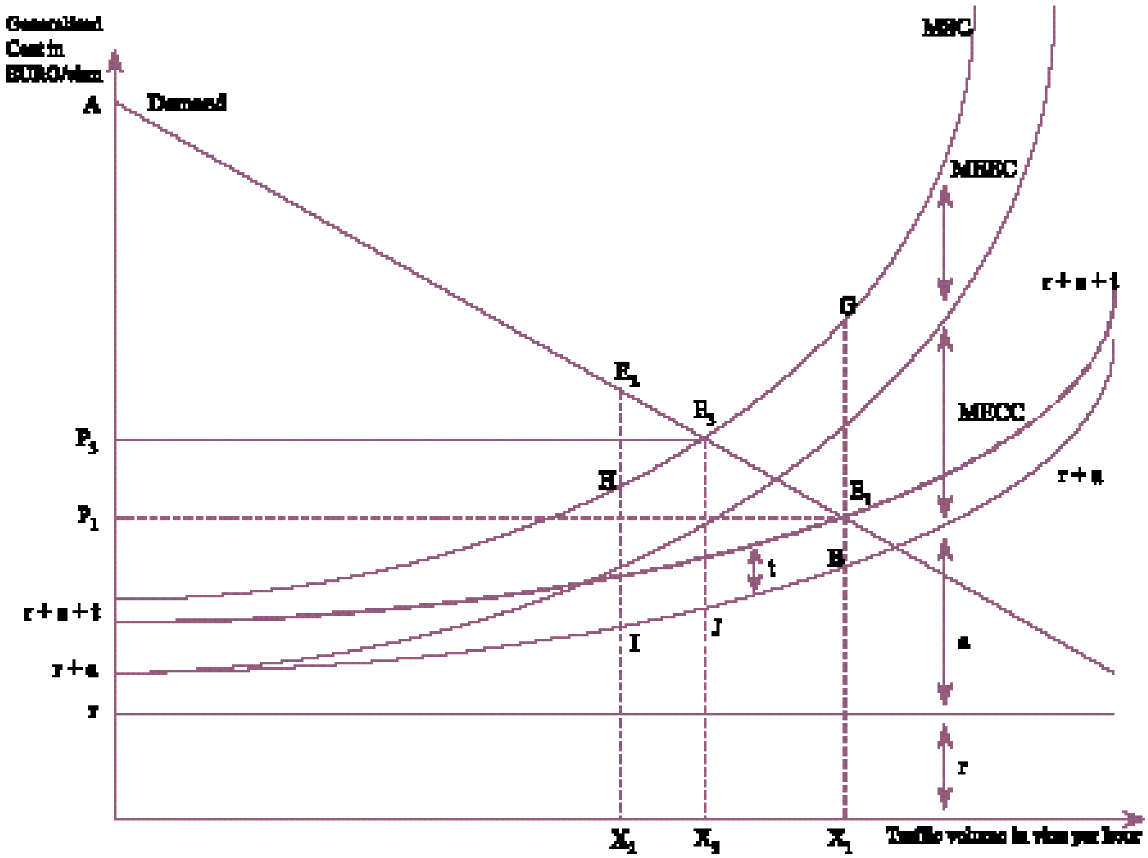
Consider the market for car km on a specific road link between two cities as depicted in Figure 1.1. This figure represents the market for car km in one particular period (peak) with one particular type of car (small petrol car with catalytic converter) on a road infrastructure with given capacity.

On the horizontal axis we represent the volume of car use (vehicle kilometre per hour). On the vertical axis we represent the generalised cost of car use. This generalised cost will equal the sum of the money cost (Euro/vehicle kilometre) paid by the car user plus the time cost needed per car kilometre.

1. Centre for Economic Studies, University of Leuven.
2. Transport and Mobility Leuven.
3. De Borger, B., S.Proost (eds.), "Reforming Transport Pricing in the European Union", Edward Elgar 2002. This is a reworked and extended version of the TRENEN II STRAN project results (ST 96 SC 116), July 1999, funded by the European Commission under the Transport RTD Programme of the 4th Framework Programme.

The *demand function* expresses the marginal willingness to pay to use a car at each volume of car kilometres. The surface under the curve is thus a measure of the total benefits of car use: at a very high price only the strictly necessary car km would be demanded - as generalised costs drop, more and more households are ready to use the car for a variety of purposes.

♦ Figure 1.1. **A transport market**



In this market, the equilibrium volume of car use will be determined by the generalised cost of car use. Take any point on the vertical axis: the corresponding volume of car use on the horizontal axis is given by the demand curve. At this level of car use, the marginal willingness to pay of the last car user equals the generalised cost. Obviously, the volume of car use depends on many other elements: prices, speeds and quality of other modes, location, income, composition and social attitudes of the household. In the TRENEN model, the effect of prices, speeds and quality of the other modes and of income variations is taken into account by shifts in the demand function. In our graphical example with only one mode, these interactions are not represented but they are present in the model. Household location, composition and social attitudes are exogenous to the TRENEN model.

In order to determine the equilibrium volume of car use, we need to determine the *generalised private cost of car use*. The generalised private cost of car use consists of three elements: the resource costs, the taxes or subsidies and the average time cost. The resource costs equal the marginal production costs of the different inputs needed to use a car: fuel cost, maintenance cost, tyres and physical vehicle depreciation. It is represented by the line r in Figure 1.1. The average time costs are represented by the curve r+a. The average time cost increases when the volume of car use increases due to congestion: speeds drop and all drivers have higher time costs. When we add taxes on car use (aggregate of taxes on fuel, maintenance, registration, etc.) we obtain the *private cost of car use* (dotted line r+a+t). In Figure 1.1, this means that the equilibrium volume of car use is X_1 and the generalised price equals P_1. This is the equilibrium we observe.

External costs

There are external costs in this equilibrium. External costs are costs that are generated by a car user and that are not paid by him. The first externality is the marginal external congestion cost. The marginal external congestion cost is the cost of the additional time losses imposed by one extra car user on others.

This cost (MECC in Figure 1.1) is steeply increasing when we reach the capacity of the road network because of two reasons. First, adding one car decreases the speed more and more. Secondly, when there are more cars on the road, the decrease in speed will affect more cars. The marginal external congestion cost in Figure 1.1 corresponds to the increase in slope of the average time cost curve times the volume of car use. It is important to recognise that, although every car user experiences congestion (higher time costs) himself, he does not pay for the time losses caused to other car users (the external part of the congestion costs).

We add a second external cost on top of external congestion costs: this can be air pollution, noise, accidents etc. (distance MEEC in Figure 1.1).

The *total marginal social cost* of car use is now given by the sum of resource costs, average time costs, external congestion costs and other external costs (excluding taxes that are a private cost but not a cost at the level of society). This marginal social cost includes all costs of car use. The optimal volume of car use would be reached when the willingness to pay for the car use equals at least this social marginal cost. This means in Figure 1.1 that X^3 is the optimal volume of car use. The corresponding optimal generalised price equals P_3. This equilibrium can be reached by using an optimal tax E_3J. This tax equals the difference between the marginal social cost and the private cost of car use (before taxes). The welfare gain of implementing this optimal tax equals the area E_3GE_1: the excess of social marginal costs over the private value of car transport to the user (given by the demand function).

Computing optimal prices

In the current study, the TRENEN model is used to compute optimal prices like the distance E_3J. This is done by starting from a reference point like E_1 and by comparing for this volume the level of the private marginal cost with the social marginal cost. If there is a discrepancy (like GE1 in Figure 1.1), the model is used to look for the optimal tax E_3J.

In order to do this, the model needs four types of information: the observed volume and composition of private cost in the reference equilibrium, the slope of the demand function, the slope of the private cost function before taxes and finally the magnitude and slope of the marginal external costs.

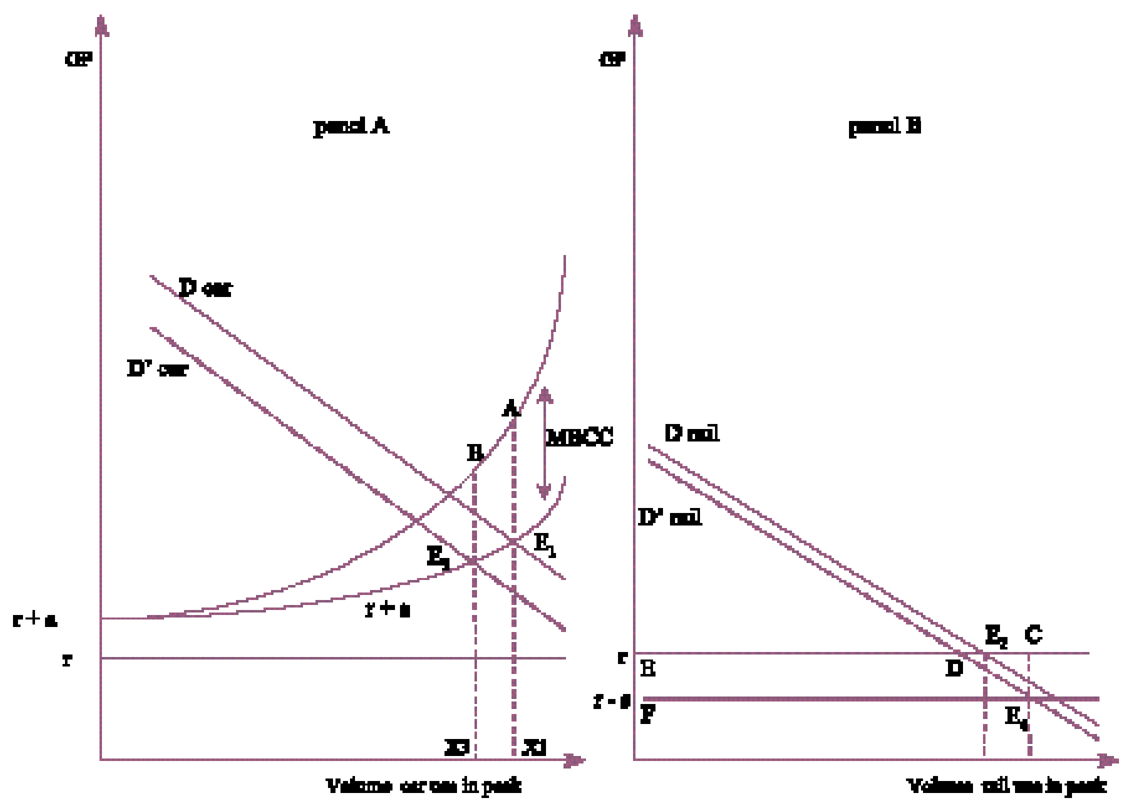
Computing point E_3 for one market is not difficult and a graphical tool could do the job. In general, a model is needed because of the interaction between different transport modes and the constraints on the choice of policy instruments.

In addition, there may be a need to raise revenue from the transport sector to finance general government spending. Optimal taxes would then equal marginal external costs plus some mark-up.

Optimal pricing with several modes

When several modes compete for the same trip, optimal taxes need to be co-ordinated. The interactions to be taken into account are illustrated in Figure 1.2. We start in Panel A of this figure with a given volume of car use X_1 that is too large: there is an important marginal external congestion cost (A E_1). In Panel B we have a rail service where the price equals the marginal variable cost r. The equilibrium is E_2. We can simulate the effects of a subsidy s to rail in Figure 1.2. The subsidy decreases the price of the rail mode to r-s. This will make the demand curve for car use shift to the left (D'): for the same generalised cost of car use there will be less car users because some of them prefer the train. When taxes on the car market remain unchanged (to keep it simple we have assumed no taxes here), the external congestion cost decreases to BE_3. Because the equilibrium volume of car use decreases to X3 there will be a decrease in the generalised cost of car use (the average time cost decreases). The decrease in the generalised cost of car use will produce a shift to the left of the demand function of rail use (D'). The ultimate equilibrium is E_3 for car use and E_4 for rail use.

♦ Figure 1.2. **Interaction of transport modes**



In order to compute the net welfare gain of this subsidy one needs to balance the welfare loss on the rail market with the welfare gain on the car market. There is an efficiency loss on the rail market because some users now make trips that do not cover the marginal resource cost of rail trips. There is a welfare gain on the peak car market because the number of car trips for which the willingness to pay is lower than the social marginal cost has now been reduced. Summing up, a subsidy to public transport can be justified when the peak car use does not pay for its marginal social cost. To determine the optimal second-best subsidy on rail or buses, one needs information on the cross-price elasticities and the own-price elasticities as well as on the marginal resource cost and the external costs of private and public transport.

1.2 The model flow chart

Figure 1.3 shows the principal components of the TRENEN model. It contains three parts: a demand part, a supply part and an equilibrium price module.

We start with the *demand part* at the left hand side of Figure 1.3.

A representative household has different transport options:

- it can vary overall demand for transport, i.e. choose between transport and other goods to maximise utility;
- choose the moment of the day for travel;
- choose between motorised and non-motorised transport ;
- choose between two modes in order to fulfil transport needs: private or public mode;
- and more specifically between metro or tram and bus, and on the private side: solo driving or shared driving (car pool);
- if the car mode is chosen, different sizes of vehicles are available;
- and finally there is a choice between several types of fuel, here diesel and petrol.

In the demand part, consumers choose between alternative types of transport on the basis of their subjective preferences and on the basis of the relative prices of the different transport alternatives supplied to them. The transport goods consumed will have the dimension vehicle kilometre in a specific type of vehicle (large car, small car or public transport).

We can apply a similar reasoning to freight transport. In producing a given output, a representative producer has a choice between:

- using more freight transport or more of other inputs (labour, capital);
- using private or public transport;
- using trucks in the peak or off-peak.

The *supply part of the model* (right-hand side of Figure 1.3) represents the activities and choices made by the producers of cars and the suppliers of other inputs like fuels, car maintenance, etc. Choices in the supply part of the model will be taken on the basis of maximum profit subject to government regulation on the technology and equipment of vehicles. With perfect competition among the suppliers, the supply will be delivered at marginal resource costs plus producer taxes; so in the absence of producer taxes, producer prices will equal the least cost combination of marginal resource costs. If there is no regulation or taxation of pollution, suppliers will typically supply vehicle kilometres with dirty cars.

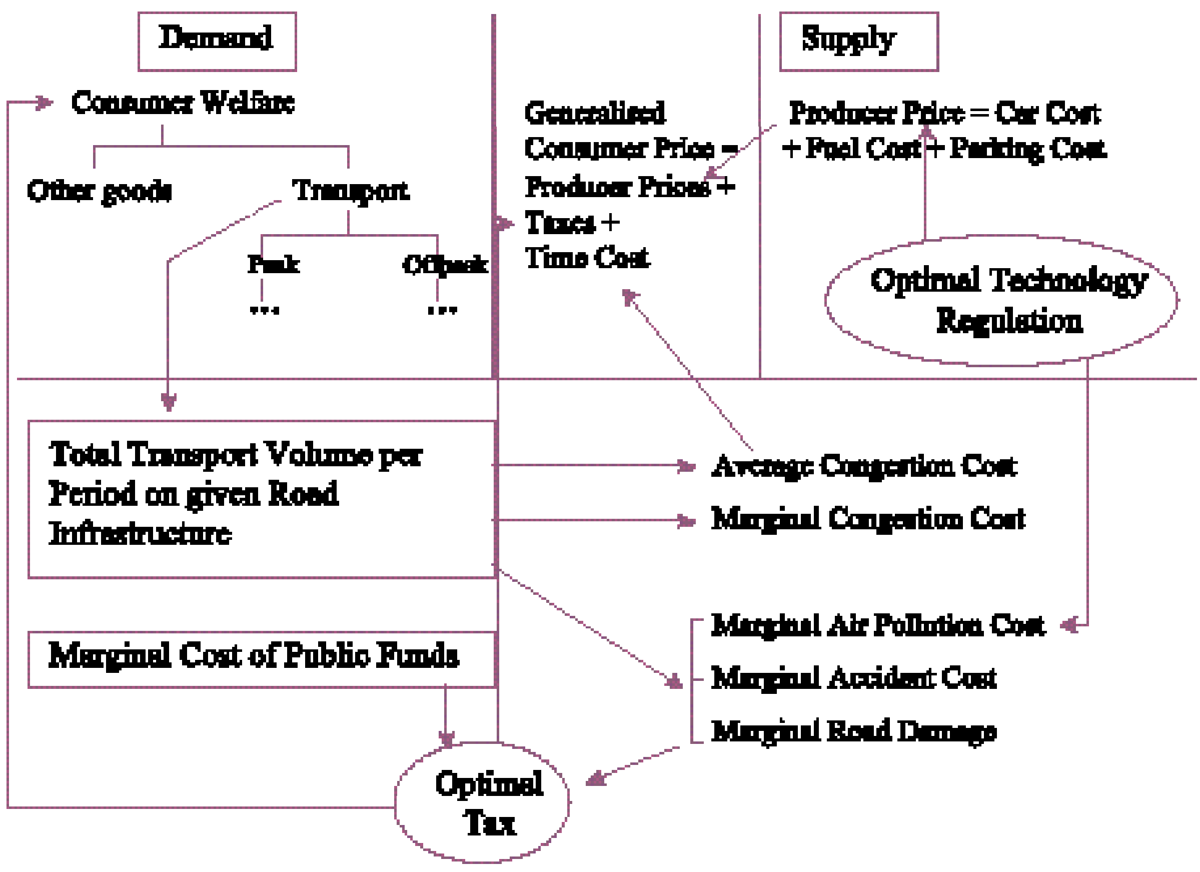
TRENEN is a static model that optimises pricing for a given infrastructure. Therefore the supply of infrastructure is not included in the model.

In the *equilibrium price module* (middle and lower part of Figure 1.3), generalised prices are computed for the different types of transport modes. The generalised price is the sum of three elements:

- a producer price for different types of vehicle km - this price is determined by the supply module;
- a transport time cost that will be a function of the total volume of traffic in equilibrium - this transport time contains the average congestion cost;
- a tax (or subsidy) that has two functions: to raise tax revenue or subsidise certain modes of transport and, also, to correct for certain external costs like air pollution, marginal congestion costs, etc. This tax is differentiated for the different types of transport goods. The magnitude of the tax is determined by the marginal cost of public funds (the benefit of raising tax revenue in the transport sector equals the cost of public funds raised in other sectors) and by the level of the marginal external costs.

Besides taxes, the policy maker can also impose certain *environmental regulations* in the form of ad hoc constraints on the supply part of the model: minimum energy efficiency, banning certain types of fuels, etc. This will increase the producer price but will decrease the external effects associated with vehicle use.

♦ Figure 1.3. **TRENEN-model flow chart**



The urban and inter-regional models

Two basic types of TRENEN model are used in the current study. Both rely on the same underlying principles but are adapted to focus on slightly different questions.

TRENEN URBAN:	focus on representation of passenger transport in urban areas, distinction between commuters and inhabitants and between those who have and those who do not have access to free parking
TRENEN INTER-REGIONAL:	focus on inter-regional passenger transport and freight transport, tolled and untolled roads, freight transit transport

For the purpose of the present study, however, the TRENEN urban model was separately applied to the “metropolitan” and “other urban” areas of the three countries. In both cases, *urban road freight* was also brought into focus.

2. OPERATIONALISING THE MODEL CONCEPTS

We discuss below the representation of demand and supply, the congestion function, and the contribution to general government revenues.

2.1 Demand representation

Passenger transport demand is represented using a nested CES[4] function. The CES function has been chosen because it is easy to calibrate and requires a minimum of behavioural information: prices and quantities in a reference equilibrium together with substitution elasticities at each level. Its main limitations are the unitary income elasticities, which makes it unsuited for long term forecasting, and the separability structures imposed on consumer’s preferences. Nested logit functions are in theory a superior way to represent transport demand but are more data-intensive and cannot easily be used for the computation of optimal taxes.

The urban model

We take the example of a given metropolitan area. The nested CES utility function for consumers contains seven levels. The elasticity of substitution is given between brackets; they are chosen assuming that the lower we go down the tree, the easier one can substitute between the alternatives.

1. transport and non-transport goods (0.5);

2. peak and off-peak transport (0.9);

3. motorised and non-motorised (walking only) (0.3);

4. public and private transport (1.1 in peak and 1.95 in off-peak);

5a. solo or carpool for car (0.6 in peak and 1.6 in off-peak);

4. Centre for Economic Studies, University of Leuven. For details of this type of function see De Borger B., Proost S., (eds.) Reforming transport pricing in the European Union – a modelling approach, Edward Elgar 2002.

5b. metro or bus & tram for public transport (1.1 in peak and 1.65 in off-peak);

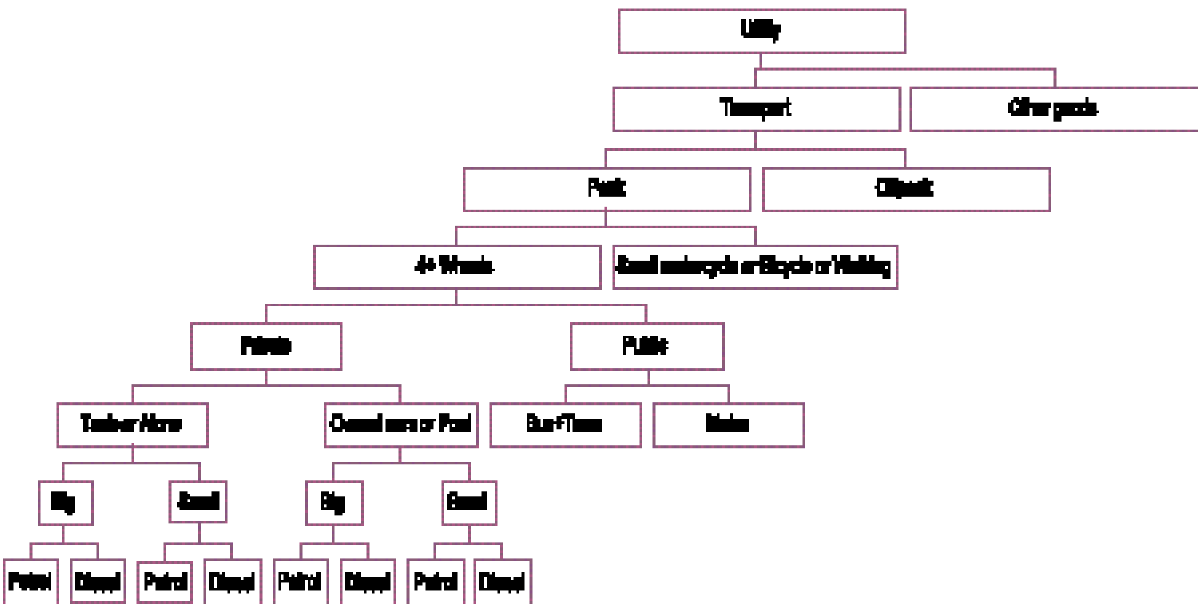
6. small and large cars (1.5);

7. petrol and diesel cars (1.6).

The structure of the consumer utility tree is shown in Figure 2.1.

In determining the order of the nests one should bear in mind the assumption of separability underlying the nested structure. All goods that are located on the same branch of a tree will react identically (in compensated terms) to a price change of a good that is situated on another branch of the tree.

♦ Figure 2.1. **Utility tree urban model**[5]



The urban models have been applied slightly differently to each country case-study. In the case of British cities, urban rail was included in place of non-motorised transport. In non metropolitan urban areas, there is no metro available. Due to data availability, the distinction between commuters and residents was dropped in some cities.

In addition, we model producers' preferences via a production tree. The production of a representative good (demanded by consumers as 'other goods') requires both transport and non-transport inputs. Transport inputs for urban producers are combined from peak and off-peak period road freight, which is further divided between heavy-duty vehicle trucks (HDVs) and light-duty vehicles (LDVs). Note that, in order to reduce computational complexity, we assume a fixed consumer price for the good. Experiments with the full TRENEN model suggest that this introduces only a very small bias into the model.

5. Note that in the case-study of a Metropolitan area, we use walking (rather than small motorcycles or bicycles) and solo- and pooled-car use (rather than, respectively, taxis or owned cars).

Elasticities of substitution are given for a metropolitan area:

1. transport and non-transport inputs (0.2);

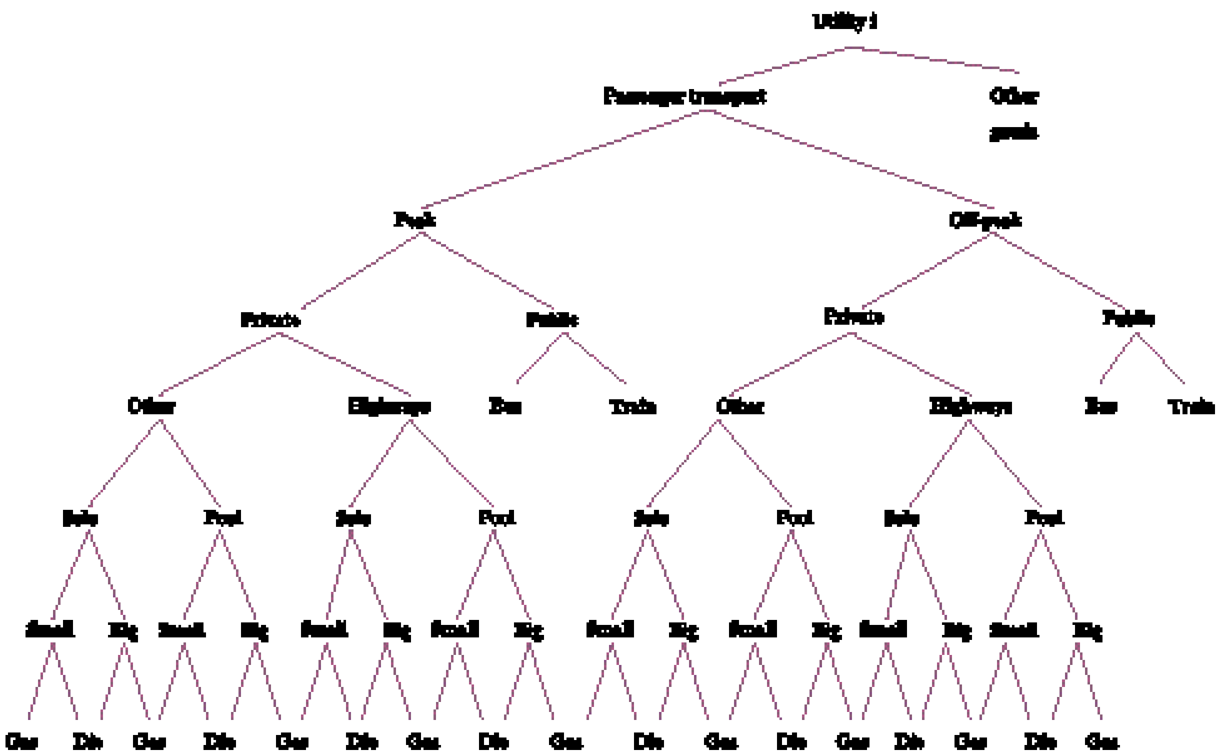
2. peak and off-peak transport (0.5);

3. HDVs and LDVs (0.5 in peak, 0.5 in off-peak).

The inter-regional model

The inter-regional model uses a similar nested CES structure. The consumer utility tree is shown in Figure 2.2.

♦ Figure 2.2. **The inter-regional nested-CES utility function**



The nested CES-function that has been used for passenger transport in the inter-regional model contains 7 nests too (elasticities of substitution for country 1):

1. transport and non-transport goods (0.4);

2. peak and off-peak transport (0.8);

3. private and public transport (0.8);

4a. other roads and highways (0.5);

4b. bus and train (1.05);

5a. solo and pooled driving (1.6);

6. big and small cars (1.5);

7. petrol and diesel cars (1.5).

At the highest level, total utility depends on two aggregate goods, viz., passenger transport and other goods, the production of which generates freight transport. At the first level of the utility tree, the transport sub-utility component contains transport demands in two periods of the day (peak and off-peak) as arguments. At the second level, peak transport demand includes "private" and "public" peak demand. At the third level, public transport can be desegregated into bus and train. At even lower levels in the tree structure, private transport (i.e., car) can occur either on highways or on other major roads. At level four, both private transport on highways and on other major roads can occur either with "carpooling" or "driving solo". Furthermore, two car sizes are being considered, viz., big and small. Finally, there are two possible fuels, gasoline and diesel.

Similarly, there is a nested production tree. Production of a good requires both transport and non-transport goods. Further, a producer can choose between road and non-road freight. Non-road freight consists of rail freight only for Britain and rail freight or waterways for France and Germany. Road freight consists of further choices between peak and off-peak supply, HDVs or LDVs and route choice. As in the case of the urban models, the link between the price of the representative other good and production costs is severed. The elasticity of substitutions used for Westphalia are:

1. transport and non-transport inputs (0.2);
2. road and non-road freight (0.3);
3. peak and off-peak transport (0.5);
4. rail and waterways (0.5);
5. HDVs and LDVs (0.5 in peak, 0.5 in off-peak);
6. route choice for trucks (0.5).

2.2 Supply representation

The supply part is kept very simple in this model. The main function of the supply part is to represent the resource costs of alternative transport modes. In the present version, there is no real possibility of choice included in the model for most parts of the supply process, except for the emission technology of cars. The producer can be forced by regulation to offer a particular car technology. For the present study, in the optimum we provide that pricing signals have resulted in all vehicles meeting the latest vehicle emissions regulations (i.e. the passenger car fleet in 2000 was entirely composed of EURO3 vehicles).

The assumption of perfect competition for the private transport modes ensures that producers will minimise total costs and sell the quantity demanded at marginal cost. This marginal cost will be equal to the marginal resource cost.

Two types of modes are distinguished: public and private transport modes.

Private transport modes

For the private passenger transport modes, a distinction is made between large and small cars, between diesel and petrol cars, and between pooled and non-pooled cars. Resource costs are taken as constant per vehicle kilometre for each of these categories. This implies that the costs of ownership and of use of cars are not explicitly distinguished. This is less of a problem in a static implementation of the model that represents a long run adjustment.

We distinguish six different inputs, which, combined, produce a car km. There is no substitution possible between these inputs, their proportions are thus fixed. To obtain one km in period X by individual of type Y with car type Z, there is a fixed amount of fuel and parking time needed, the other costs being vehicle depreciation costs, insurance costs, maintenance costs and (possibly) road toll costs.

The relevant costs are the marginal costs per vehicle km.

- Fuel cost:

This cost equals the product of (1) the resource cost per litre of fuel and (2) the fuel consumption in litres needed per km. The first part is simply the cost (thus exclusive of taxes) of a litre of petrol or a litre of diesel, which is a constant. The second part is not only different per fuel type, but will also depend on the size of the car and the occupancy rate (car-pool is slightly more fuel consuming than car-solo). Fuel consumption depends on traffic speed.

- Vehicle cost:

Because we are not able to treat differently fixed and variable cost components, we have to express the cost of the vehicle as a cost per vehicle km (assuming a certain amount of km driven during the lifetime of an average vehicle and using an annuity concept). We use a constant cost for each vehicle type (size and fuel type).

- Parking cost:[6]

The two components of this are (1) the resource cost per hour of parking and (2) the average parking time per vehicle km driven. The cost of an hour of parking can be different according to the period of the day and the size of the vehicle. Parking time may also depend on period of day, and it can differ between residents and non-residents of the city.

- Other resource costs:

- The costs of oil, tyres, maintenance and insurance are grouped in this cost component. Their level depends on vehicle and fuel type.

Public transport modes

The cost of public transport is represented via a linear cost function. The total cost of operating public transport on an annual basis equals the sum of fixed cost (FC) and a variable cost that is different in the peak (p) and in the off-peak (op) period.

6. On the role of parking fees in Trenen model one can consult E. Calthrop, S. Proost, K. Van Dender, (2000), *Parking Policies and Road Pricing,* Urban Studies, January.

$$TC = FC + v_p.VOL_p + V_{op}.VOL_{op}$$

The fixed cost component covers these cost components that do not vary strongly with output. The extent of the fixed cost element determines the degree of increasing returns to scale in producing public transport. The variable cost component for the peak contains the capacity costs of the carriages (peak load pricing principle) as well as wages of drivers, fuel and maintenance. The off-peak variable cost does not contain capacity costs. Fixed occupancy rates that differ between the peak and off-peak period have been used. For London an exogeneous capacity limit has been introduced for public transport. In this particular case, the model will ration demand for public transport to the available capacity by using increasing the users' fee.

The Mohring effect

In the urban model, we have introduced walking times to the public transport stops and waiting times at stops as part of the generalised cost of public transport. We allow waiting times to vary as a function of public transport volumes. The relation between waiting times, bus frequencies and public transport volumes is based on the optimality rule derived by Mohring discussed at length in the final TRENEN report. By introducing a returns-to-scale factor in public transport, optimal pricing will reflect a partial subsidy. We assume that frequency can be changed (increased or decreased) at constant marginal costs.

The inter-regional model, in contrast, does not allow for returns-to-scale in generalised costs of public transport. While the Mohring effect may well apply to inter-regional public transport in the form of reduced schedule delay costs from higher frequency of service, the lack of empirical data on this issue obliges us to exclude the effect.

2.3 The congestion function

The model represents the city as a hypothetical one link system with homogenous congestion conditions for the whole city. The congestion function used is exponential. This form is based on extensive tests with detailed urban network models in cities with different structures.[7]

2.4 Contributions to general government revenue[8]

As stressed in Section 1, optimal pricing on transport markets should reflect both the need to correct for external effects and the need to raise revenues to finance general government spending. The standard TRENEN approach stresses the effect of transport revenues in enabling government to lower existing labour taxes via the use of a marginal cost of public funds parameter. In the present study, however, where the principal aims were to estimate the size and nature of the changes in transport charges involved and the revenues potentially available from optimising *transport* taxes, we preferred to avoid the use of any such further assumptions in regard to governments optimising *other* taxes. Furthermore, it was an explicit concern to

7. See De Borger & Proost, 2002 op. cit. for more details.

8. Optimal use of government revenues is a difficult subject and for a complete treatment of this question a general equilibrium model is required. One can consult I. Mayeres, S. Proost (2001), "Tax reform for congestion type of externalities", Journal of Public Economics, 79, 343-363 and I. Mayeres, S. Proost (1997) "Optimal Tax and Investment Rules for Congestion Type of Externalities", Scandinavian Journal of Economics, 99 (2), 261-279.

eliminate any implicit upward bias in the estimation of the level of revenues in the optimal scenario. It was therefore decided to value 1 Euro of tax revenue as exactly equal to 1 Euro of consumer surplus.

In this application of TRENEN we have taken the current standard VAT level on non-transport goods as given and applied it in both the reference and optimal scenarios to the transport sector as a constant. In seeking the optimal tax rate for the transport sector the model thus takes into consideration existing taxes on non transport goods as well as external costs in the transport sector. This means that in the absence of any external effects in the transport sector, optimal taxes for the sector would equal approximately[9] the VAT rate for non transport goods. Indeed, in order not to distort the allocation of income between transport and non-transport goods, it is optimal to tax transport goods if non-transport goods are already taxed.

9. The tax rates would be exactly equal if the price elasticities of transport and non-transport goods were identical.

Chapter 3

SUMMARY ANALYSIS OF ROAD HAULAGE CHARGES

International comparisons of taxes and charges related to road haulage require a framework that can relate all the various taxes and charges levied on transport activities to marginal costs, if they are to provide satisfactory answers to the following types of question.

- Do hauliers in one country pay more than in the other, and what impact does this have on the profitability of haulage in each country?
- Is the impact of an increase in tax on diesel the same in each country or are differences in the taxation of labour more significant?
- Do these differences distort the international haulage market?

This report develops such a framework, expanding the work reported in Efficient Transport Taxes and Charges, ECMT 2000. This part of the study aims to compare road freight transport fiscal regimes in 16 European countries in quantitative terms.

Rates of fuel, vehicle taxes and user charges change on different dates in different countries and different years. The rates used in this study are set for 1998, 2000 and 2001 according to the rates enforced by each country for each fiscal year. These are the rates applicable to 40 tonne, Euro I trucks except for Switzerland where the vignette-like flat fee levied in 1998 and 2000 is applied to fictitious 40-t trucks. In countries where rate changes occurred during the year, rates applicable in September are used. See the spread sheets annexed for details. The exchange rates used in the calculations are from the beginning of each year.

The countries for which road haulage charges are analysed are: Austria (A), Belgium (B), Switzerland (CH), the Czech Republic (CZ), Germany (D), Spain (E), France (F), Finland (Fin), Hungary (H), Italy (I), the Netherlands (NL), Norway (NO), Poland (PL), Sweden (S) and the United Kingdom (UK). Results for Portugal (PG) are included where available. For each country a threefold data table and accompanying calculations are provided with respect to 1998, 2000, and 2001 (see the country tables in main DATABASE www.oecd.org/cem/topics/taxes/taxdocs.htm). For each year, data, calculations, and results are supplied.

Data are presented in regard to diesel prices, tax rates for all inputs to road haulage and input share structures. Calculations are made on the basis of total charges for 400-km domestic hauls (40 tonne truck in principle). Results are produced in terms of total charges per standard haul, vehicle-km and tonne-km and as ad valorem rates and METRs (marginal effective taxation rates). The work is thus organised as a series of analytical steps evolving towards increasingly synthetic indicators of taxation.

i) First, the absolute levels of specific charges on road freight transport (fuel tax, vehicle taxes, road tolls, etc.) are inventoried. According to standard national freight hauls (standard 40-t, 400-km haulage scenarios by country) *net amounts of charges paid* are then expressed *on a t-km basis* for both gross weight and maximum net load.

ii) Second, the net amounts of transport charges per domestic haul are converted with respect to a common cost element — the pre-tax price of fuel — for combination into *ad valorem net effective charge rates*.

iii) The next analytical step addresses the calculation and comparison of effective tax rates on the marginal cost of production of road freight transport on the basis of country specific input share structures (labour, capital, and fuel) and respective taxation rates. *Marginal effective tax rates* (METRs) are estimated.

iv) In a separate stage of analysis, net transport charges in t-km are examined with respect to an optimal pricing scenario.

This chapter summarises the analysis of steps i to iii, with a more detailed account provided in an annex.

3.1 Absolute levels of charges

The framework for the analysis consists of an inventory and a comparison in quantitative terms of all charges that various countries levy on freight transport by road. The inventory is compiled according to variables such as rate of taxation, basis of imposition, amount paid, type of payment, refunds, rebates and exemptions. The inventory is provided for the years 1998, 2000 and 2001.

Collation is organised according to an economic standard, ranging charges in categories from the most purely fiscal to the most commercial (i.e. closest to a price for infrastructure use), see Table 3.1a.

Four categories of taxes were also created according to the territorial characteristics of their application – i.e. the degree to which charges are linked to the use of particular sections or regions of the infrastructure network (Table 3.1b).

In practice the two systems of classification tend to go hand in hand, and territoriality is retained as the criteria of most interest as this principle already applies through some existing road freight transport charges.

Table 3.1a. **Economic categorisation of charges levied on road freight transport**

Charges	**Vehicle taxes**	**Fuel excise duties**	**User charges**	
			Vignettes*	**Tolls + user charges on a distance/weight basis****
Description	Trucks are imposed on the basis of ownership in the country of registration	Weak link with usage*	User charges due on a flat rate basis	The amount to be paid is determined by usage (number of km and admissible weight or tonnes transported)
Economic criterion	Fiscal charges	Earmarked charges	Fixed prices	Prices
Result	Purely fiscal structure according to share of revenue generated by each category of charge			

* Eurovignette, Austrian StraBA, Czech Vignette, Swiss RTPL flat fee.
* Hauliers may choose to fill tanks in one country while using roads in a neighbouring country.
** Swiss HVF (RPLP).

Table 3.1b. **Territorial categorisation of charges levied on road freight transport**

Charges	Vehicle taxes	Fuel excise duties	User charges: Vignettes*	User charges: Tolls + user charges on a distance/weight basis**
Description	"National" charges relative to the territorial criterion	Hauliers may choose to not fulfil the territorial link (tanking in country A while using roads in country B).	Charges bounded to a specific territory though not linked to the quantity used (fixed price)	Charges strictly bounded to a specific territory and to the quantity used (price)
Territorial criterion	National charges	Least territorial charges	Middle territorial charges	Most territorial charges
Result	Territorial structure of taxation according to share of fees paid on specific hauls			

* Eurovignette, Austrian StraBA, Czech Vignette, Swiss RTPL flat fee;
** Swiss HVF (RPLP).

An inventory of charges levied is shown in Table 3.2. As the countries in the study do not all levy the same types of charges, superficial comparisons are meaningless. Thus comparing levels of a specific tax (for example Swiss and French fuel duties) in isolation gives no indication of the impact of differences between the levels of that tax on hauliers. Similarly the impact in different countries of an increase or reduction in any particular type of tax can not be assessed without reference to the other charges and taxes levied in each country.

Table 3.2. **Inventory Table**

Country	Vehicle taxes	Fuel excise duties	User charges: Vignettes	User charges: Tolls + User charges on a distance/ weight basis	VAT: On fuels	VAT: On tolls
Austria	√	√	StraBa	—	√	
Belgium	√	√	Eurovignette	—	√	
Czech Republic	√	√	Vignette	—	√	
Finland	√	√ + pollution fee	—	—	√	
France	√	√	—	√	√	√
Hungary	√	√	—	√	√	√
Germany	√	√	Eurovignette	—	√	
Italy	√	√	—	√	√	√
The Netherlands	√	√ + disposal and ecotaxes	Eurovignette	—	√	
Norway	√ + environmental tax	√ + CO_2 and sulfur taxes	—	Urban tolls	√	
Poland	√	√	—	√	√	√
Portugal	√	√	—		√	
Spain	√	√	—	√	√	√
Switzerland	√	√	RTPL to 2001	HVF since 2001	√	
Sweden	√	√ + CO_2	Eurovignette		√	
United Kingdom	√	√	—	—	√	

Goverment sources.

3.2 Net taxation

The next methodological step addresses net taxation of road haulage in selected countries. The aim is to compare different road freight tax regimes by computing the net amount of charges that a 40 t truck has to pay on a 400 km haul within its country of registration. Standard road haulage scenarios were constructed on a spreadsheet to do this, details are given in the annexes. Scenarios are constructed instead of simply dividing tax revenues by vkm and tkm because this facilitates selecting specific categories of trucks, making standard comparisons over time and combining the various charges into a single indicator. Tax revenues by country are examined in section 3.3 to provide a check on the accuracy of the scenarios.

First, all charges are calculated with allowed refunds (on VAT), rebates, and exemptions deducted. All of the countries studies refund VAT paid on fuel and other inputs to hauliers. Some countries allow rebates on various excise taxes up to certain limits (although in France VAT on tolls is not refundable). And one-off rebates were awarded in some countries in respect of fuel excise duty in 2000/2001 in the wake of the fuel price hike in autumn 2000. See Annex B for details.

Swiss Heavy Vehicle Fee (RPLP, Redevance sur le trafic des Poids Lourds liée aux Prestations)

The new HVF (or t-km fee) replaced a fixed annual charge on 1.1.2001 with the following objectives:

1. raising the weight limit from 28 tonnes to 34 tonnes from 1.1.2001 and 40 tonnes from 1.1.2005 (in accordance with the EU-Swiss agreement on inland transport);
2. full scale charging of the external costs of freight transport;
3. contributing to the financing of major rail projects;
4. leverage for transferring freight to the railways.

Maximum tariff:

The maximum tariff is set by law. The average charge is currently 1.68 Swiss centimes per kilometre and per ton registered maximum weight of the vehicle. Under the EU agreement the tariff will increase in stages to 2.70 Swiss centimes with the opening of the Lotschberg rail tunnel or at the latest in 2008. The tariff is derived on the basis of the following factors:

1. the distance driven across Switzerland by vehicles of various weight categories, estimated at 47 billion t-km;
2. the size of estimated external costs, total 1.15 billion Swiss francs in 1993;
3. the ratio of external costs to t-km (1.15 billion francs over 47 billion t-km), 2.5 Swiss centimes per t-km.

Note the calculation was based on figures for 1993 and the values are in the process of being updated.

Implementation:

Average charges are levied as follows, depending largely on the category of vehicle and its pollution rating.

Rates to 2004:

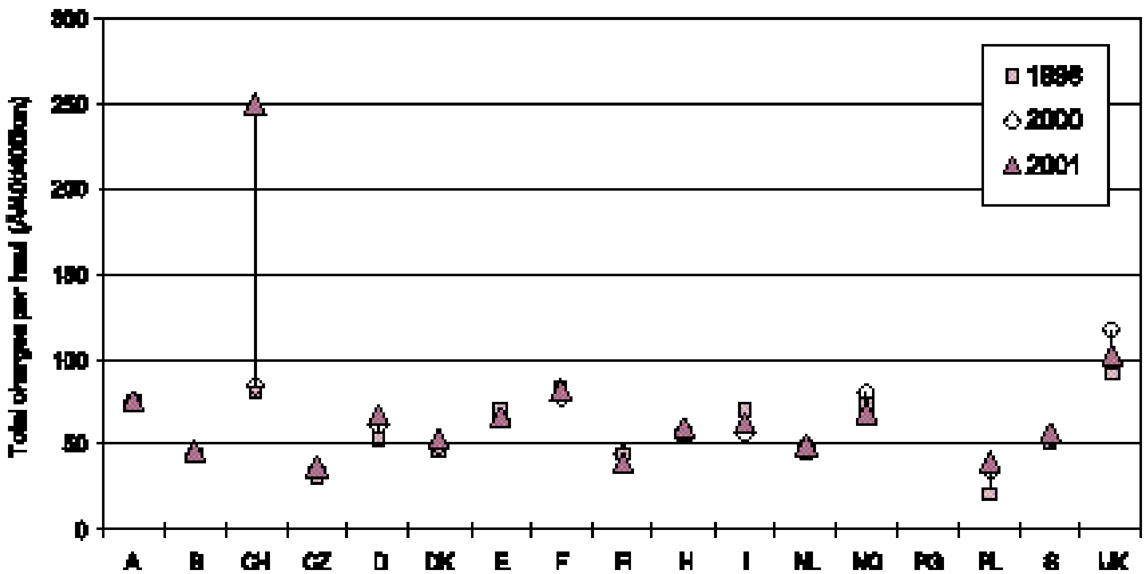
1. Category 1 (corresponding to Euro 0 trucks) : 2.0 Swiss centimes per t-km;
2. Category 2 (corresponding to Euro I trucks) : 1.68 Swiss centimes per t-km;
3. Category 3 (corresponding to Euro II and III trucks) : 1.42 Swiss centimes per t-km.

Based on Fair and Efficient – The Distance-related Heavy Vehicle Fee (HVF) in Switzerland, Federal Office for Spatial Development, Bern.

Figure 3.1 shows amounts paid (net sum total in Euros) for a 40 t, 400 km haul within the country of registration for the years 1998, 2000 and 2001. For example, 56 Euros are charged for a Swedish truck in Sweden, while 90 Euros are charged for a French Truck in France, and 101.5 Euros for a UK truck undertaking a comparable haul within the United Kingdom.

The introduction in Switzerland of a new distance/weight user charge in 2001 resulted in a large change in net absolute charges paid there. Changes elsewhere are much smaller but the impact of the fuel price protests in the autumn of 2000 can be seen in some countries. Several governments responded to the September 2000 fuel price protests by reducing the tax burden on road haulage and / or providing additional support to the industry. Some of the tax reductions, e.g on fuel duty in France and Germany, were adopted as short-term measures, though remained in force for 2 years or more. Others, such as the cuts in Vehicle Excise Duty (VED) rates in the UK, have been consolidated into a new simplified tax structure.

♦ Figure 3.1. **Net amount of charges paid on a standard domestic haul, 1998, 2000, 2001 (Euro)**



In the next step, standard scenarios by country are performed, running 40 t trucks[1] on an imaginary 400 km road haul. The net amount of charges (net taxation) paid along each run is computed. The share of each territorial category of charge paid can be identified (see Figure 3.2).

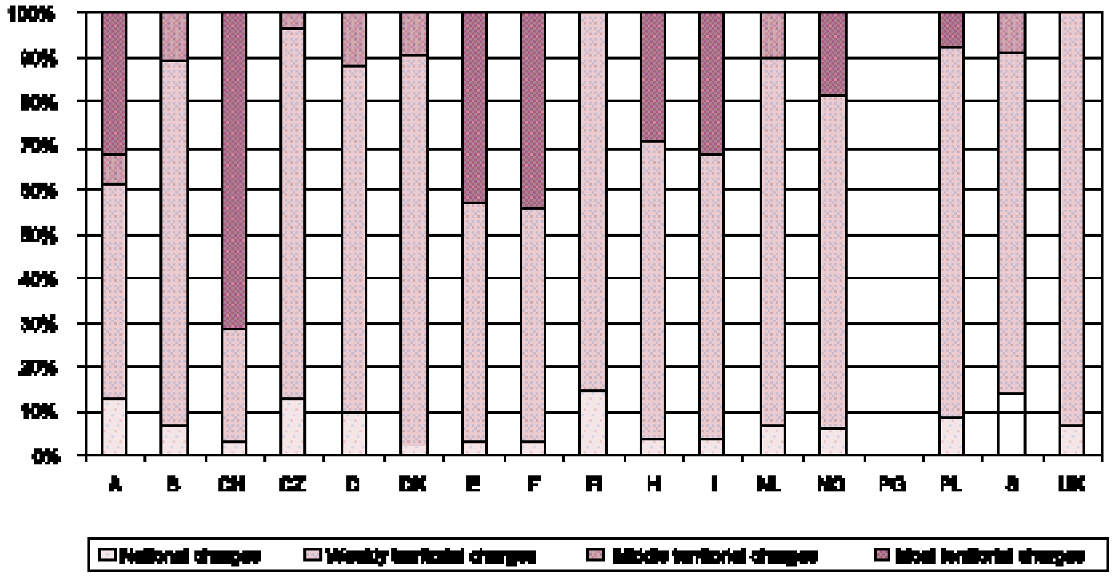
Net taxation per vehicle-km and t-km is also calculated. Net taxation per t-km is first calculated on the basis of gross weight (which is the most relevant figure for road wear) and then on the basis of maximum net load (resulting amounts are consequently higher than in the case for gross weight).

Net taxation per t-km is a useful indicator, particularly for comparisons with Switzerland because of the introduction of the HVF on 1 January 2001 (the former 28t limit was phased out, raising the weight limit to 34 tonnes accompanied by an annual quota for 40 t trucks; see Figure 3.3). In 2001 the quota was not fully taken up (therefore 40t was chosen as the relevant figure for deriving net taxation per t-km in Switzerland

1. This varies in cases where national trucking industries predominantly use a different truck configuration attracting significantly different rates of taxation - see Annex A for details.

in 2001). As a consequence, 40-t trucks were also incorporated in the 1998 and 2000 calculations to make all domestic scenarios comparable.

♦ Figure 3.2. **Territorial structure of taxation according to share of fees paid on domestic hauls, 2001**



Figures per v-km are sometimes more useful in relation to social marginal costs (see Figure 3.3). For any given class of vehicle, fuel consumption, emissions, noise levels, vibration and accident costs do not increase as a linear function of payload weight. Nor do t-km figures reflect vehicle utilisation/loading factor. For example, 1 000 tonne-kms of freight movement generated by two 40 tonne articulated trucks carrying 12.5 tonnes 40 km will cause more environmental damage than a similar number of tonne-kms produced by a single 40 tonne moving a full load of 25 t over 40 km.

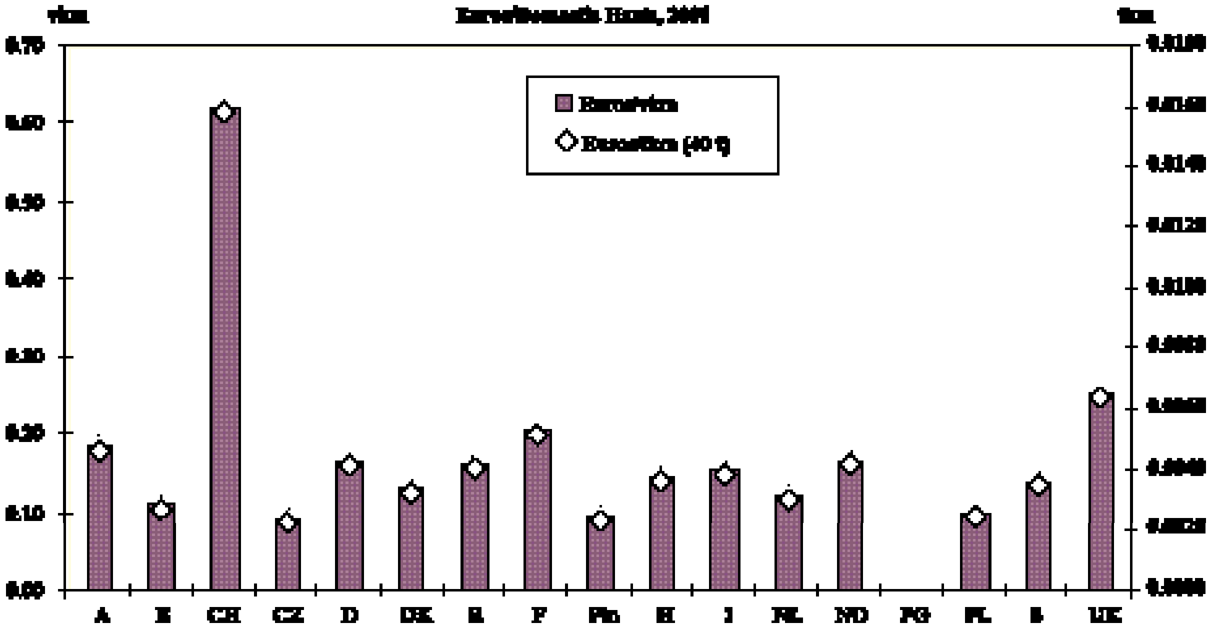
3.3 Fiscal share structures by category of revenues

The significance of different types of charge, by share of total revenues generated for the countries under review is summarised in Figure 3.4. This Figure shows revenue share structures by category of revenue raised from charging road freight transport in the different countries. The relationship between share and absolute level of each tax varies by country and a broader picture must be drawn in order to formulate meaningful comparisons.

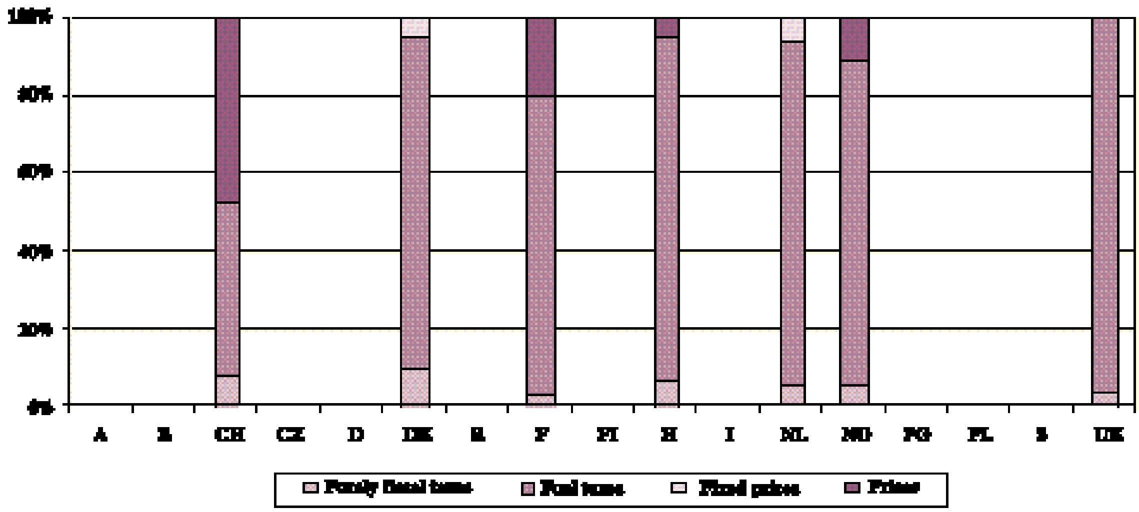
One simple conclusion that can be drawn from the comparison is that fuel excise duty has a different weight in the total burden of taxes and charges in each country, and therefore an increase or decrease in fuel duty will have different impacts in different countries. It is also clear that in any comparison between the revenues generated by taxes and expenditure on road infrastructure, all of the tax and charge elements must be considered.

In addition, it should clearly not be concluded that because one country does not apply a certain category of charge there is likely to be under-coverage of infrastructure costs when compared to other countries, or that it might be advisable to introduce the missing category of charge in the country where it is absent.

♦ Figure 3.3. **Net amount of charges paid on a gross t-km and v-km basis (domestic hauls, 2001)**



♦ Figure 3.4. **Fiscal share structures by category of revenues (proportional shares), 2001**



3.4 *Ad valorem* net effective charge rates

Transport taxes are levied on various bases (vehicle ownership, fuel and use) and it is first convenient to combine all these charges into a single indicator related to a single denominator in order to obtain road related taxation rates that can be interfaced with other taxation rates. This was done by converting all charges levied on freight transport (with respect to the standard 40-t, 400-km haulage scenarios by country) to a common cost element — the pre-tax price of fuel. In this way, "ad valorem net effective taxes rates" were computed. This is a useful comparative tool because it allows direct comparisons to be made between very different fiscal and territorial regimes. Country specific ad valorem net effective charge rates were computed relative to the 2001 average pre-tax diesel price in the European Union. Figures using country specific 1997, 2000, and 2001 pre-tax diesel prices are available in the Annexes.

♦ Figure 3.4.b. **Structure of revenues (proportional shares) from road freight transport, 1995**

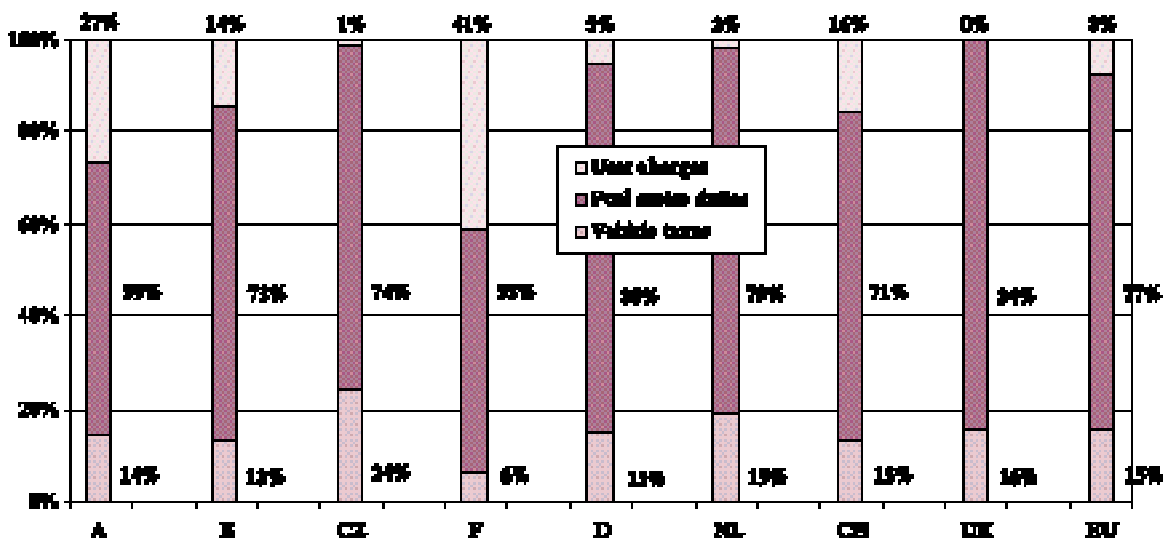


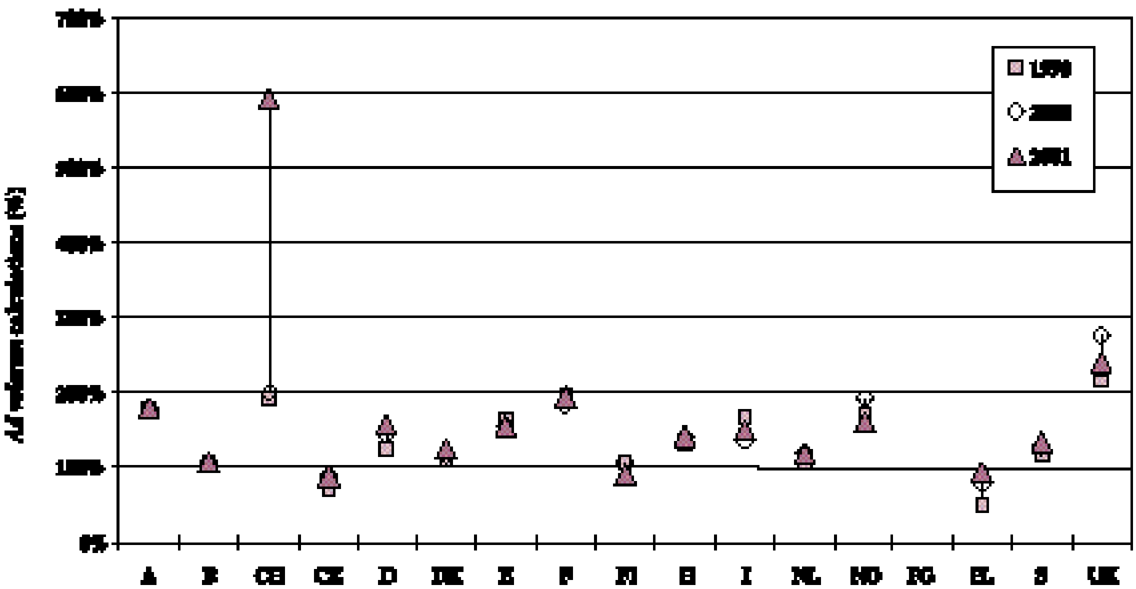
Table 3.1. ***Ad valorem* net effective charge rates for some European Countries based on 2001 average pre-tax diesel price in the European Union**

Countries	Ad valorem net effective tax rates (2001 mean European pre-tax fuel price)		
	1998	2000	2001
A	177%	177%	179%
B	105%	106%	107%
CH	219%	228%	632%
CZ	72%	87%	87%
D	125%	144%	158%
E	166%	154%	155%
F	198%	183%	196%
Fin	106%	106%	106%
H	130%	140%	141%
I	167%	135%	148%
NL	107%	119%	118%
NO	174%	191%	160%
PL	51%	80%	93%
S	118%	128%	133%
UK	216%	278%	240%

2. Source for pre-tax fuel prices is "Diesel oil prices per litre in Europe" (French Ministry of Transport). Pre-tax prices range from 0.29 cents (Germany) to 0.37 cents (Finland); separate arrangements or rebates are not accounted for as in the further analysis an average European fuel price is used.

Country specific ad valorem net effective charge rates are shown in Table 3-I and Figure 3.5 for the years 1998, 2000 and 2001. Transport charges, amalgamated as a hypothetical ad valorem rate according to the previously calculated net charges, add up to as much as 630% of the pre-tax price of fuel – the case for the newly introduced Swiss distance/weight charges[2].

♦ Figure 3.5. ***Ad valorem* net effective tax rates for some European Countries based on 2001 average pre-tax diesel price in the European Union**



3.5 Effective tax rates on the marginal cost of producing freight transport by road (METRs)

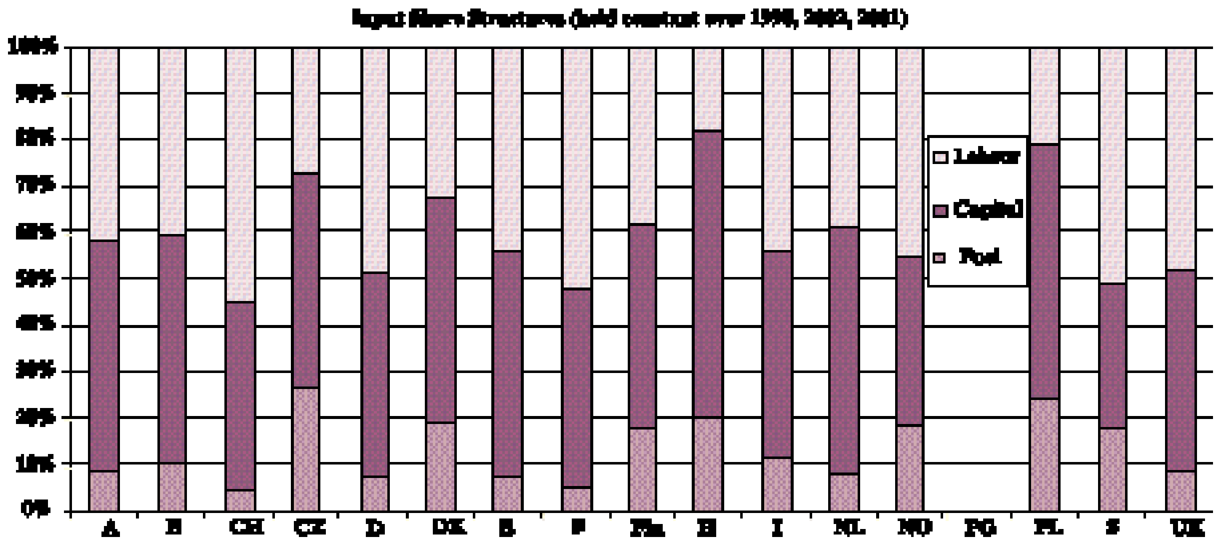
The next stage of methodology aims at considering the taxation of all of the main inputs that are involved in producing freight services: vehicle, fuel, road usage, capital and labour.

Ad valorem taxation rates. Net taxes on vehicle, fuel, and road usage were computed into “ad valorem net effective taxes rates” based on the pre-tax fuel price. Single tax rates by country are thus available. Pre-tax fuel costs usually account for a share of 8 to 10% in the road haulage input cost share-structure (more in Poland and the Czech Republic and even Hungary, Italy and Sweden).

Tax rates on labour and capital are more modest than transport charges, but these two categories of input account for a much larger share of the cost structure in heavy goods transportation by road (see Figure 3.6).

Taxes on labour. The calculation of taxes on labour is complicated by differing national structures of the employers' shares of income tax and social charges. Most countries exhibit one peculiarity or another that impact on the effective rate of taxation. No one peculiarity was considered significant enough to merit adjustment to the general calculation. Differences in the application of working time regulations and enforcement of insurance and other employment regulations are likely to have more impact and there is no obvious route for accounting for these factors. In the previous edition of this study, income tax plus employees and employers social security contributions were summed to provide the relevant factor for labour taxation, adding up to 30 to 50% of pre-tax labour costs (source OECD). In the present study, employer contributions to social charges alone were taken as the appropriate indicator, being most directly linked to the international competitiveness of haulage operations. These ammount to some 9 to 33% of pre-tax labour costs.

♦ Figure 3.6 **Input share structures in the haulage industry**



Taxes on capital. Incorporating taxes on capital into METRs is not straightforward but an appropriate factor can be derived from:

– the standard (or haulage industry specific) rate of company taxation;

– the period allowed/discount rate for depreciation of trucks in national accounting rules, or the nominal average life of a truck;

– the discount rate used in national tax rules.

The relevant basis for taxation is considered to be the value of vehicles (ignoring the value of land, buildings and other capital assets employed in haulage and related local property taxes). Vehicle purchase taxes are ignored also. Company tax is taken as the relevant tax, although it is not levied directly on trucks, as the cost of investing in new vehicles is generally offset against taxes on profits in all the countries studied. Differences between countries and over time in the amount of investment that can be deducted from profits before taxation are what determines the impact of taxation on competitiveness. These differences are the relevant factor in comparing effective tax rates. Thus company taxes, adjusted for these differences, are considered to be the most suitable basis for integrating capital charges with transport charges.

The difference between the discount rates employed in accounting and tax rules allows the cost of purchasing trucks to be offset against company tax. Eventually the entire cost is offset, but spread over a number of years according to the rates applied. This determines the net present value of a) the cost of a truck to a company according to accounting rules and b) the tax allowance accorded by tax rules. The difference between the two discount rates employed determines the amount by which we should reduce company taxes to derive the rate for capital taxation incorporated in the function used to derive METRs.

However, data on the economic (accounting) depreciation rate is not readily available in many of the countries studied. To find an acceptable proxy for use as an indicator of effective capital taxation various indicators were compared with the ideal calculation for three countries where complete data was available. This suggested that the simple reciprocal of the fiscal depreciation rate is an appropriate indicator for effective capital taxation rates. Fiscal capital depreciation rates are situated between 12% and 40% of the value of trucks in the countries studied.

It should be noted that more and more haulage companies lease rather than buy vehicles. According to UK truck dealerships only 20-30% of vehicles sold are bought by hauliers. This does not undermine the calculation of the effect of capital taxation in METRs, however, as the benefits should largely be passed on to hauliers.

METRs. As already noted, the impact in different countries of an increase or reduction in any particular type of tax can not be assessed without reference to the other charges and taxes levied in each country. METR calculations offers a route to making comparisons that does take account of the wider fiscal environment. All inputs (labour, capital and fuel), their respective shares and individual tax rates are combined into a single equation for computing marginal effective tax rates. METRs represent overall tax rates paid for one additional unit of freight service. The aim is to determine to what ex-tent METRs differ and how sensitive they are to different taxation scenarios. The calculations are made using a Cobb-Douglas cost function, in which the inputs are labour (L), capital (K), fuel and user charges (G).

METRs are given by the following equation: $T = (1+t_L)^{\alpha L} \times (1+t_K)^{\alpha K} \times (1+ t_G)^{\alpha G} - 1$, in which t is the rate of tax and a the share of the relevant input. Two parameters are thus taken into account: the proportional share of the relevant input and its taxation rate.

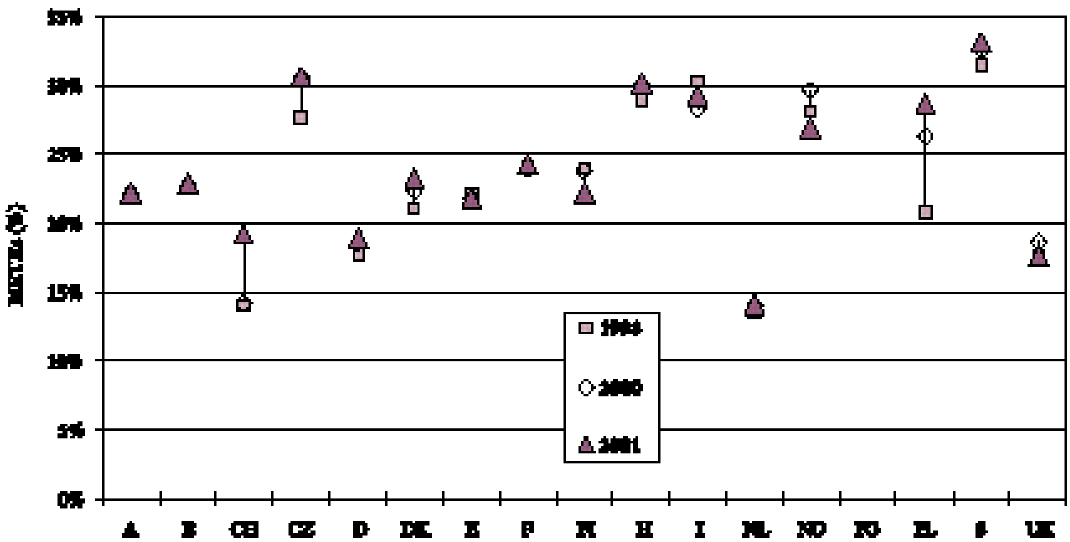
Figures 3.7 and 3.8 show country specific METRs. These deliver a different view on international differences in comparison with absolute levels of charges, net charges calculated on a t-km basis or net effective ad valorem tax rates. From this new standpoint, international differences soften as compared to differences in transport charges alone (the Swiss case is eloquent). Differences in road related taxes tend to be cancelled out by differences in charges lev-ied on other inputs (labour and capital). In the case for Switzerland, both a low fuel input share and low taxes on labour explain why the impact of the newly introduced HVF softens when comparisons take account of the wider fiscal environment.

3.6 Conclusions and use of the indicators developed

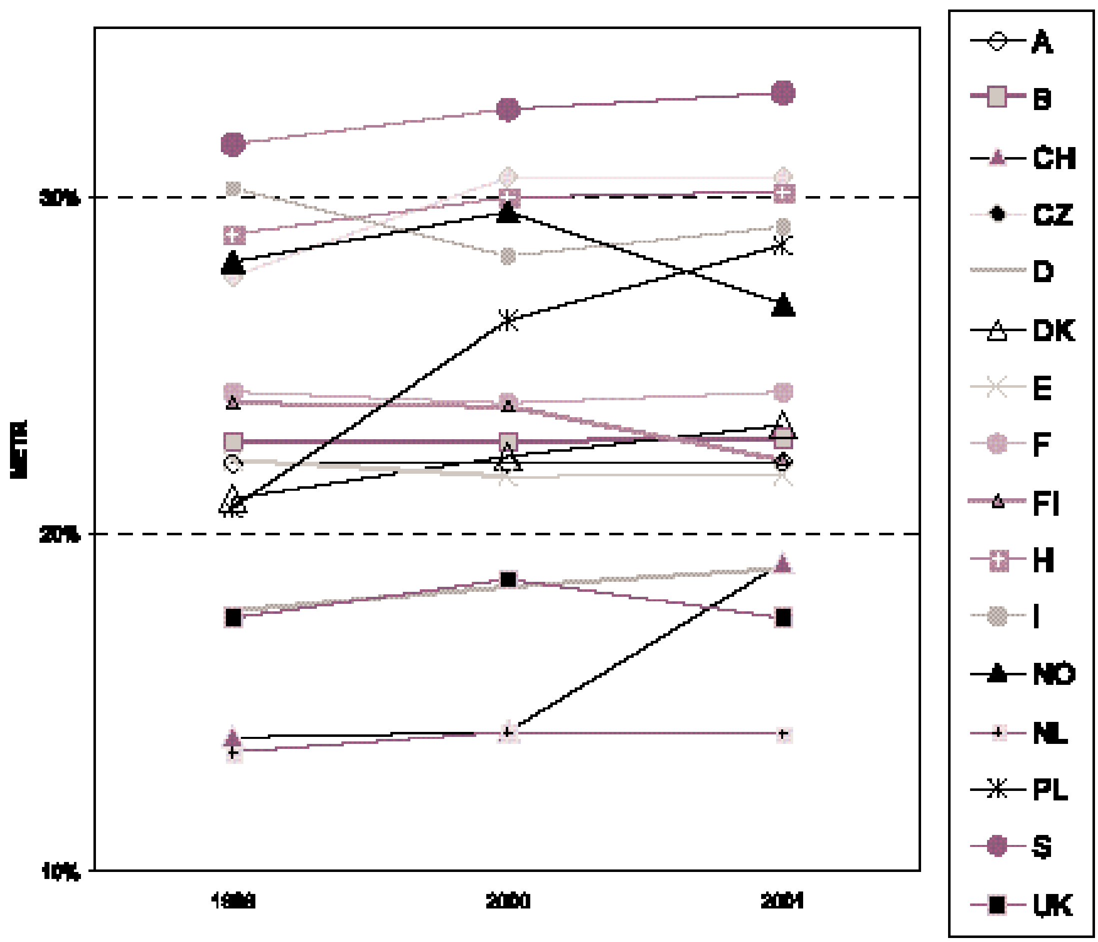
In order to assess the impact of taxes on national haulage industries, the taxation of labour and capital has to be taken account of in addition to transport taxes and charges. Although the analysis confirmed that there are large differences between countries in net effective rates of transport charges, it found that differences in labour and capital taxation cancel out most of the variation. Moreover, with the exception of Switzerland where a radical change in the structure of taxation was introduced in 2001, transport charges tended to converge over the period 1998-2001.

High Swedish, Norwegian, and Italian METRs are explained by large fuel and labour shares in their respective input share structures and high labour costs. Poland, Hungary, and the Czech Republic have large fuel shares, though with low labour costs. Trends in Switzerland and the United Kingdom are explained by the new user charge for the former country and by a cut in vehicle excise duty rate together with an increase in capital allowance for UK.

♦ Figure 3.7 **Country specific METRs (Incorporating ad valorem net effective tax rates based on 2001 average pre-tax diesel price in the EU)**



♦ Figure 3.8 **Marginal Effective Taxation Rates for 1999, 2000 and 2001 (based on 2001 average European pre-tax fuel price)**



It should be noted that there is no suggestion that harmonisation of METRs should be a policy objective — see chapter 1 for a discussion of the theory of efficient taxation. It must also be remembered that other factors — including pre-tax prices of labour and capital, quality of service provided and exchange rates — are primarily responsible for the competitive advantages that do exist in practice.

By describing fiscal structures and integrating operating factors (input structure), we highlight differences in the taxation of road freight transport between countries.

The differences that this chapter has sought to identify relate to:

– Net taxation (t-km and v-km basis);

– Fiscal (and territorial) tax structures;

– Factors of production (L, K and their respective taxation);

– Marginal taxes (all inputs and taxes together).

These are differences, not distortions, until they are related to optimal pricing (on the basis of social marginal costs). Questions of the efficient level of taxation can only be resolved with reference to marginal social costs (see chapter 2). METR is, however, particularly useful for examining international issues of competitiveness and taxation in the haulage industry.

Chapter 4

TAXATION AND COMPETITIVENESS IN THE EUROPEAN ROAD HAULAGE MARKET

4.1 The impact of charges on competitiveness examined with METRs and other indicators

The impact of charges like the Vehicle Excise Duty (VED) can be assessed by running trucks of different nationality on standard hauls through Europe, calculating appropriate indicators.

4.1.1 International haulage scenarios by flag

Two international haulage scenarios were constructed for the analysis by flag (indicating the country in which the haulage firm is based and where it is liable to pay national taxes) with runs made for 1998 and 2001:

– Scenarios #1: from Manchester to Milan (via Reims, Stuttgart and Basle),

– Scenarios #2: from Manchester to Zaragoza (via Rotterdam, Munich and Zurich).

The routes were chosen to cross a maximum of different countries rather than designed to be typical itineraries. The roads to be taken were specified, the number of kilometres calculated, travel time worked out (with types of roads, speed and distance parameters). The trucks (Euro I semi-trailers) have a maximum authorised weight of 40 t[1] and make exactly the same hauls at the same speed and fill fuel tanks at the same places (all fuel up first in the United Kingdom and then at places on route where the price is lowest, and none are equipped with extra tanks). Taxes, duties, user charges, rebates, refunds and exemptions are calculated on this basis for each flag, for both international haulage scenarios. Annex B gives more details of the way these haulage scenarios were constructed and how the calculations were made.

The calculations produce (for sixteen European countries):

– standardised net taxation (sum total) per international haul by "flag";

– standardised net taxation per t-km per international haul by "flag";

– net ad valorem tax rates;

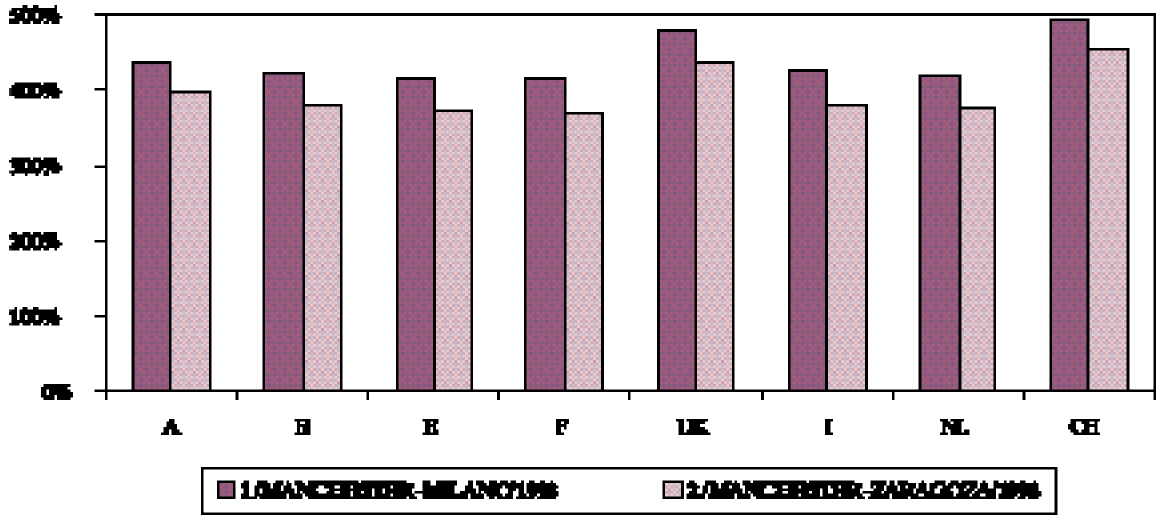
– METRs; and

– *flag*-related territorial charge share structures; that is, *the degree of national taxes* associated with different flags performing the same international road haul (in as far as other, territorial components of these structures, are frozen by the use of fixed routes).

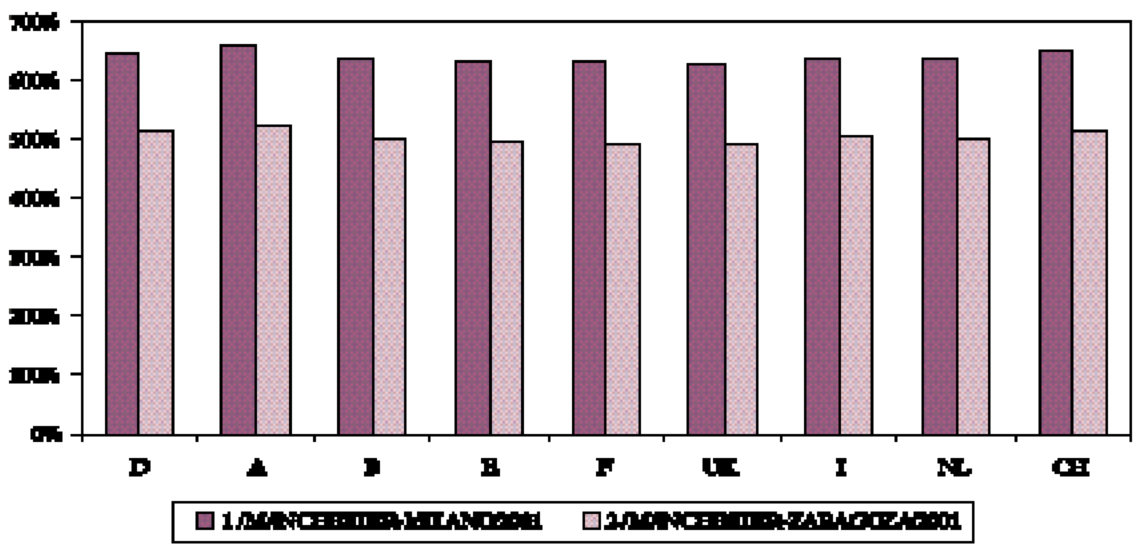
1. 40 t trucks are allowed to cross Switzerland subject to the new HVF in 2001; for the sake of comparison, 40 t trucks run through Switzerland in 1998 subject to the old RTPL vignette.

Figure 4.1 shows ad valorem net charges by flag on both itineraries (Swiss 40-t trucks) for 1998 and for 2001. Net ad valorem charges did increase even though pre-tax diesel prices went up. Figure 4.2 shows METRs for both scenarios. An increase in METR level is observed. Differences in METR levels can be explained by the diesel share taken in the input share structure – rather high for Belgium and Italy, and a rather low share in the case for Switzerland.

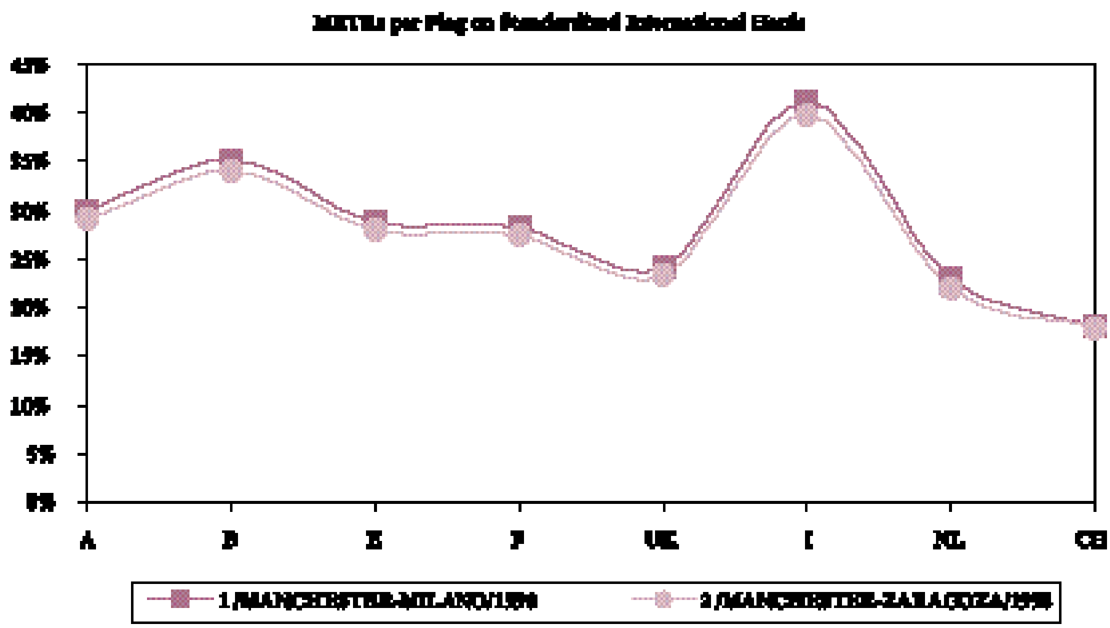
♦ Figure 4.1a. **Net *Ad Valorem* Charges per Flag on International Hauls, 1998**



♦ Figure 4.1b. **Net *Ad Valorem* Charges per Flag on International Hauls, 2001**



♦ Figure 4.2a. **METRs for both Scenarios, 1998**



♦ Figure 4.2b. **METRs for both Scenarios, 2001**

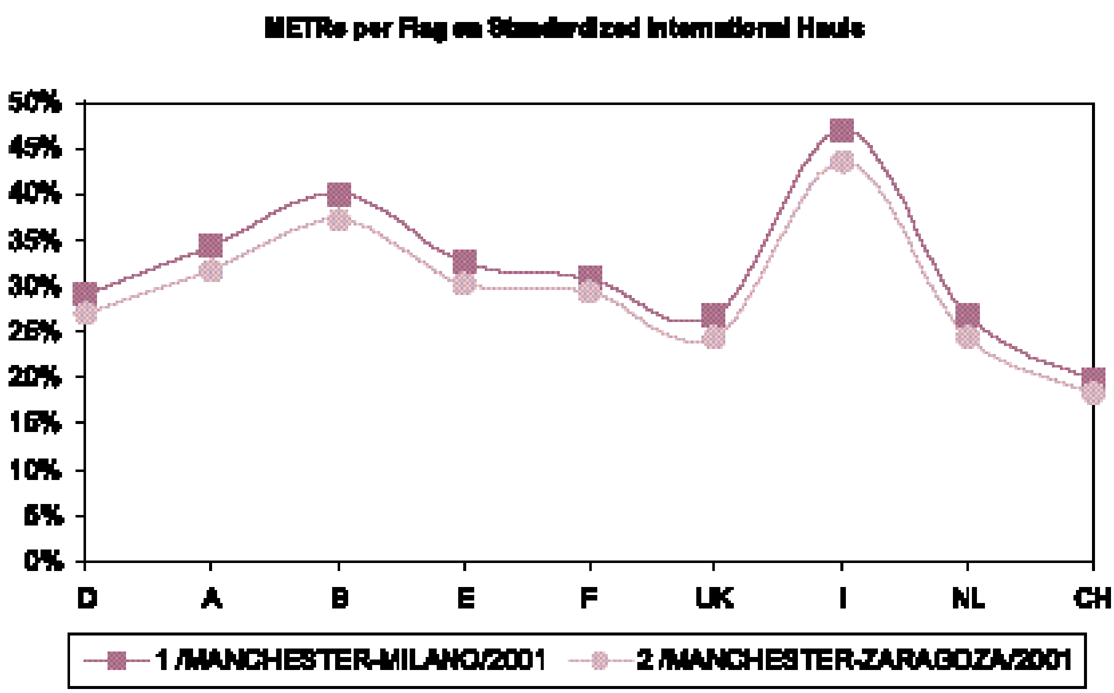
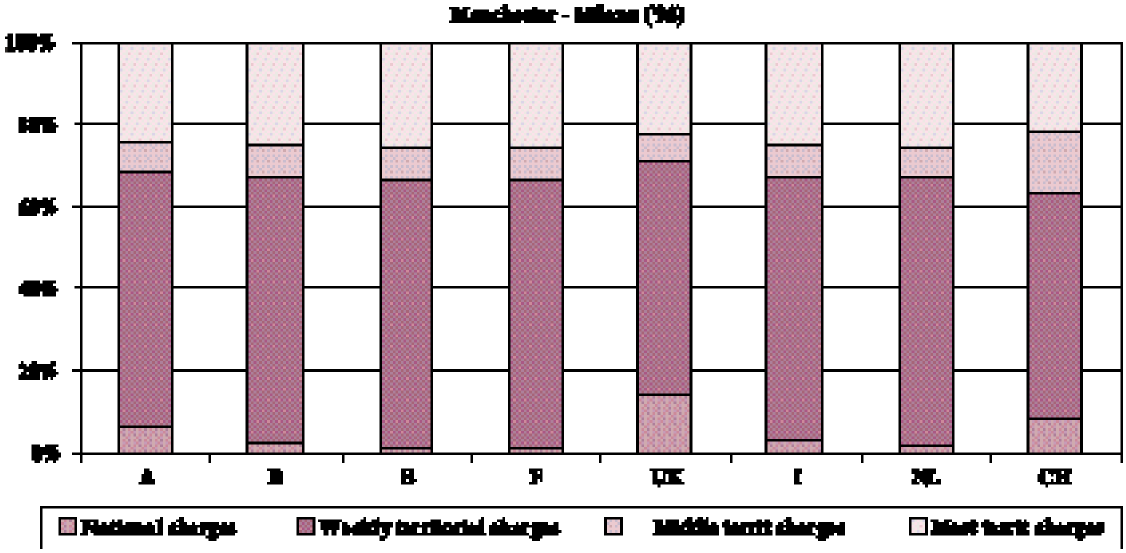
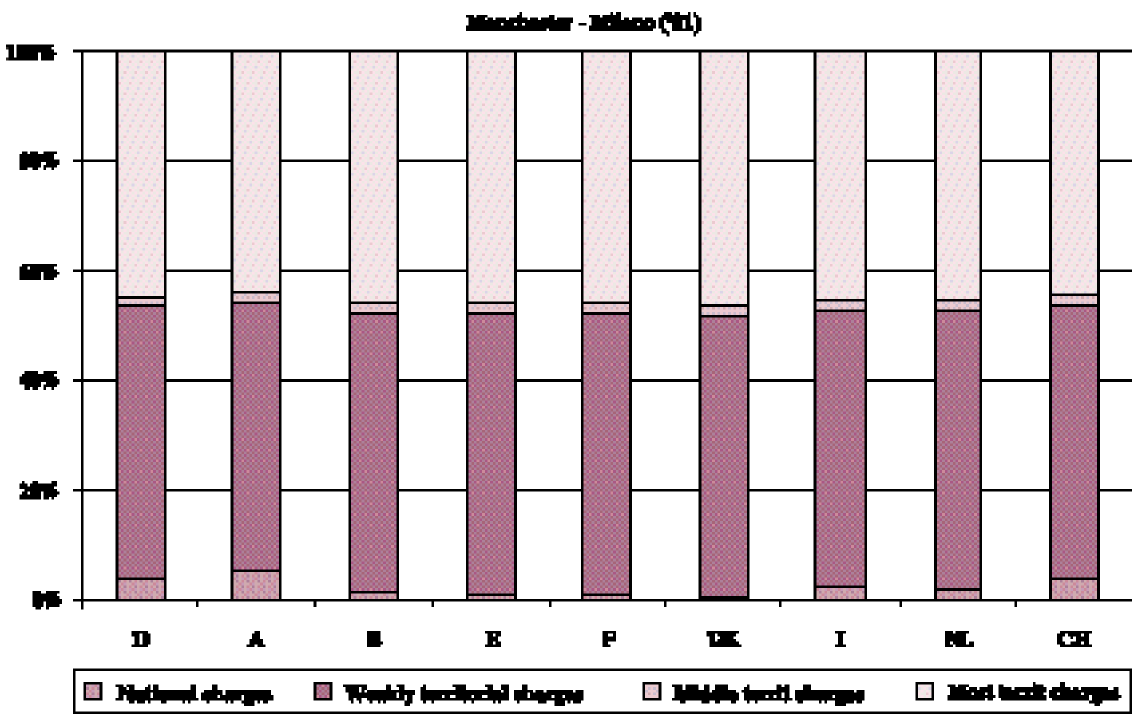


Figure 4.3 shows flag-related territorial charge share structures for Scenario #1 (from Manchester to Milan) for 1998 and 2001. The share of the "most territorial" charge category expanded as a result of the introduction of the Swiss HVF. At the same time, cuts in national vehicle taxes went into application. In total, the territorial structure of international hauls (going through Switzerland) moved towards a figure in which fuel taxes (weakly territorial charges) and the most territorial charges together predominate, from a structure in 1998 in which fuel excise duties were dominant. The same phenomenon is true for Scenario #2.

♦ Figure 4.3a. **Flag-related territorial charge share structures for Scenario #1, 1998**



♦ Figure 4.3b. **Flag-related territorial charge share structures for Scenario #1, 2001**



4.1.2 Flagging-out scenarios

Differences in rates of national charges led hauliers in some countries to flag-out their vehicles (registering them in countries with lower national charges, see section 4.7.1 for details) and this became an issue at the end of the 1990s. Figure 4.3a shows how different the shares taken by VED were in 1998 in comparison with other, more territorial taxes. Figure 4.4a presents the same data in absolute rather than proportional terms highlighting the higher than average levels of national charges (vehicle excise duty and national vignettes) in the United Kingdom, followed by Switzerland and Austria. In 2001 (Figure 4.4b), Austria, Switzerland and Germany show higher than average rates and the United Kingdom no longer stands out following a sharp cut in VED.

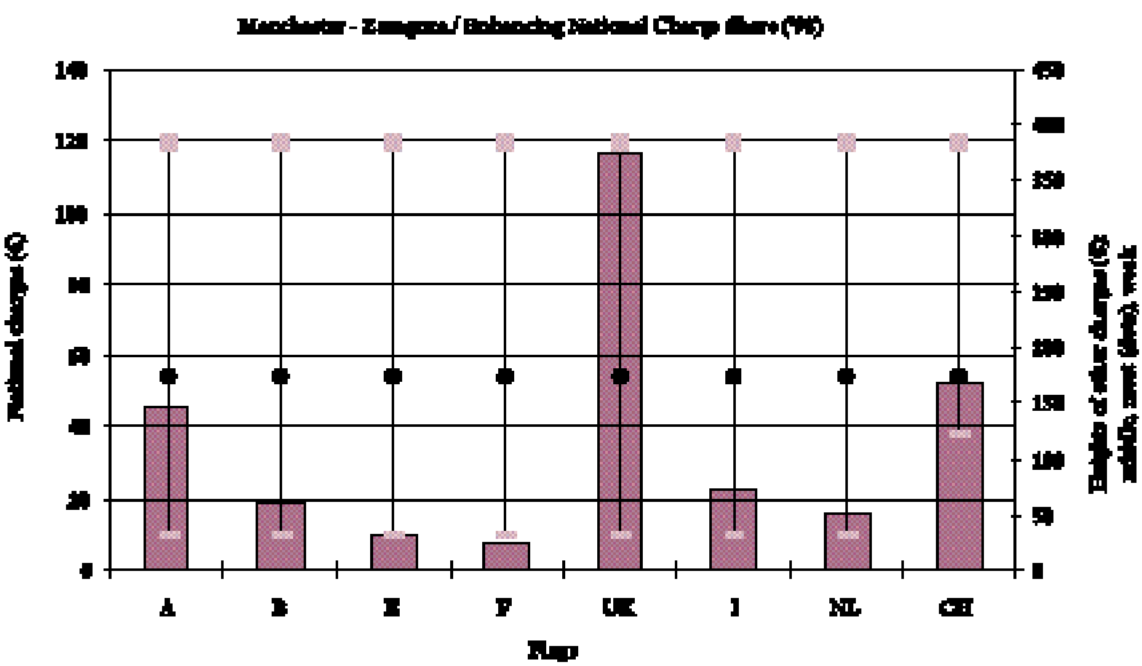
4.1.3 Examining net taxation for pairs of flags

This section further examines differences between "flags" in net transport charges paid. In a first step, scenarios were built to show results for French and UK trucks hauling in each other's countries and at home. Scenarios were also constructed for other pairs of flags from neighbouring countries and for groups of flags hauling in specific countries.

Comparison between UK and French flags

An arbitrary haul of 200 km was constructed in each country. French and British trucks were "run" over the haul each crossing 200 km in France and 200 km in the United Kingdom. See annex B for details of the calculations (2001 data). The new hauls were constructed so that the combined 400 km runs could be made in one day, simplifying calculations.

♦ Figure 4.4a. **National Charges by Flag, Scenario #2, 1998**



♦ Figure 4.4b. **National Charges by Flag, Scenario #2, 2001**

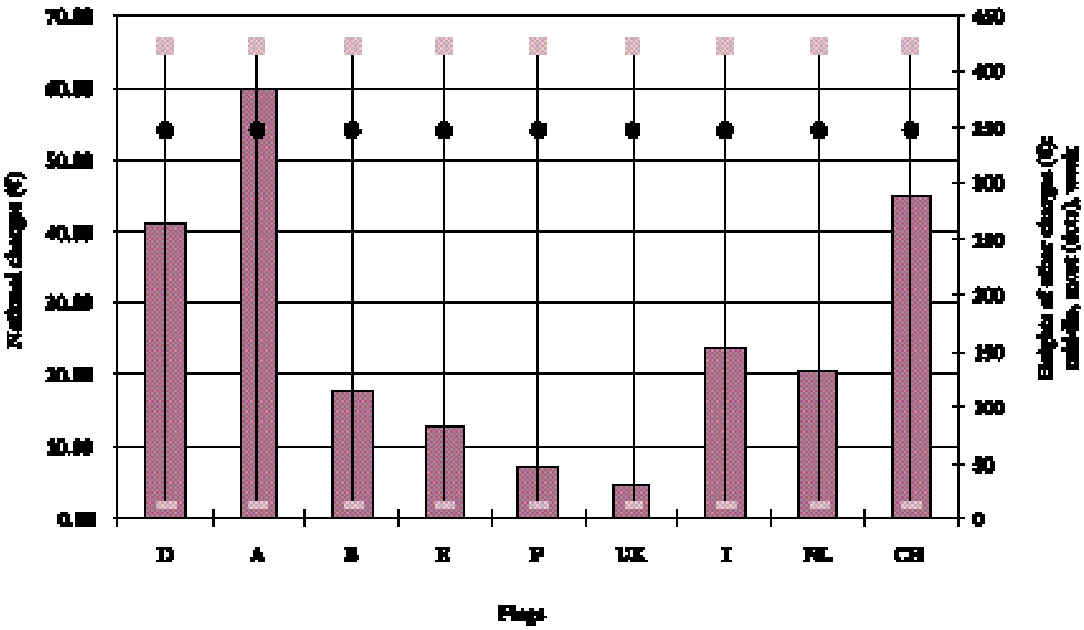
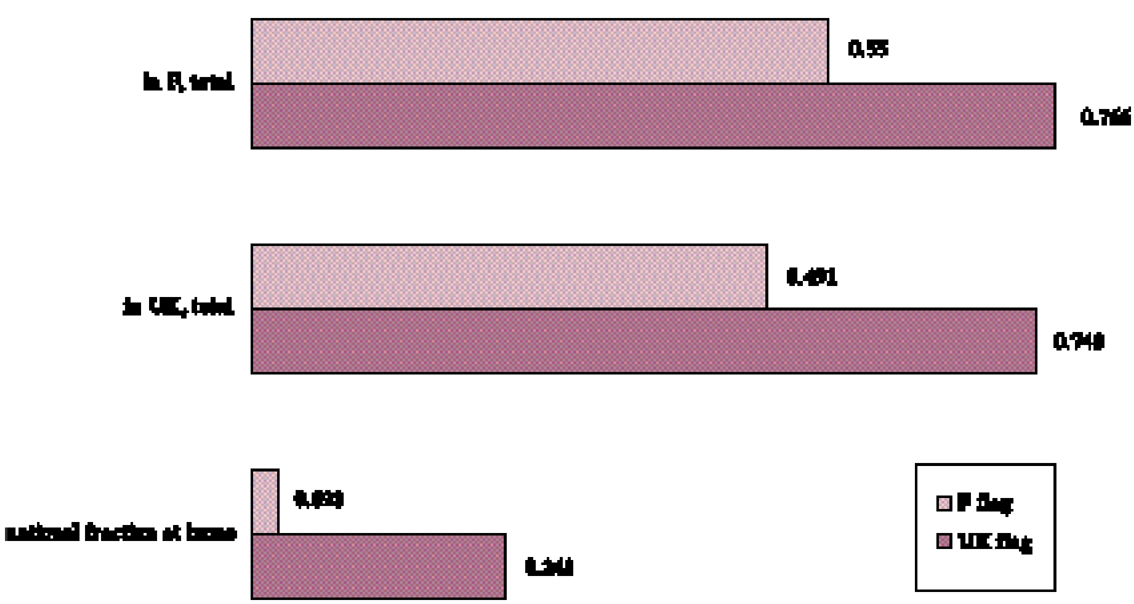


Figure 4.5 shows the results for UK and French trucks hauling at home and abroad in 1998 and in 2001. Territorial charges paid vary with the specific fiscal regime of the country crossed while the "national" fraction of charges (calculated as an average paid per haul) remains constant.

♦ Figure 4.5. **Flag specific crossed hauls between France and the United Kingdom 1998**

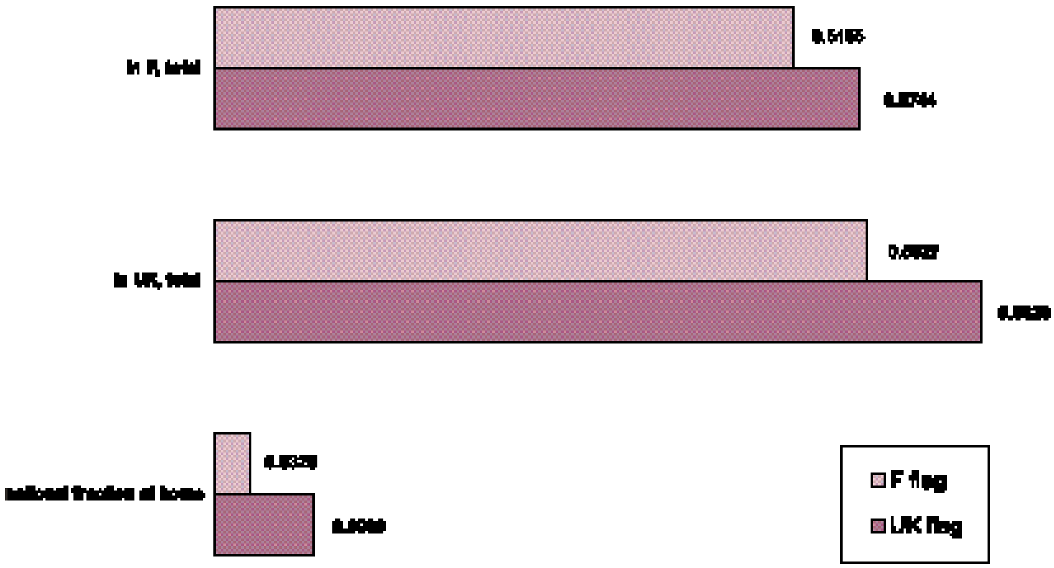
(Net taxes in € cents per t-km)



The French national fraction (axle tax) is reimbursed when hauling away.

♦ Figure 4.5bis. **Flag specific crossed hauls between France and the United Kingdom 2001**

(Net taxes in € cents per t-km)



In 1998, for both flags (French and UK), it was cheaper to haul in the United Kingdom. UK hauliers pay higher net charges then French hauliers in which ever of the two countries they haul.

French trucks pay 0.49 cents per t-km in the United Kingdom and 0.55 cents per t-km at home.

UK trucks pay 0.75 cents per t-km at home and 0.77 cents per t-km in France.

National charges are much higher for UK flags (0.24 cents per t-km) than for French flags (0.03 cents per t-km). For almost all countries this fraction is independent of the country where hauls are performed. In the case of France a refund is available against the annual axle tax for each day spend hauling abroad.

In 2001, French flagged trukcs pay lower charges hauling in either country. However, French hauliers pay slightly higher charges in the United Kingdom than UK hauliers pay in France:

French trucks pay 0.58 cents per t-km in the United Kingdom and 0.52 cents per t-km at home.

UK trucks pay 0.88 cents per t-km at home and 0.57 cents per t-km in France.

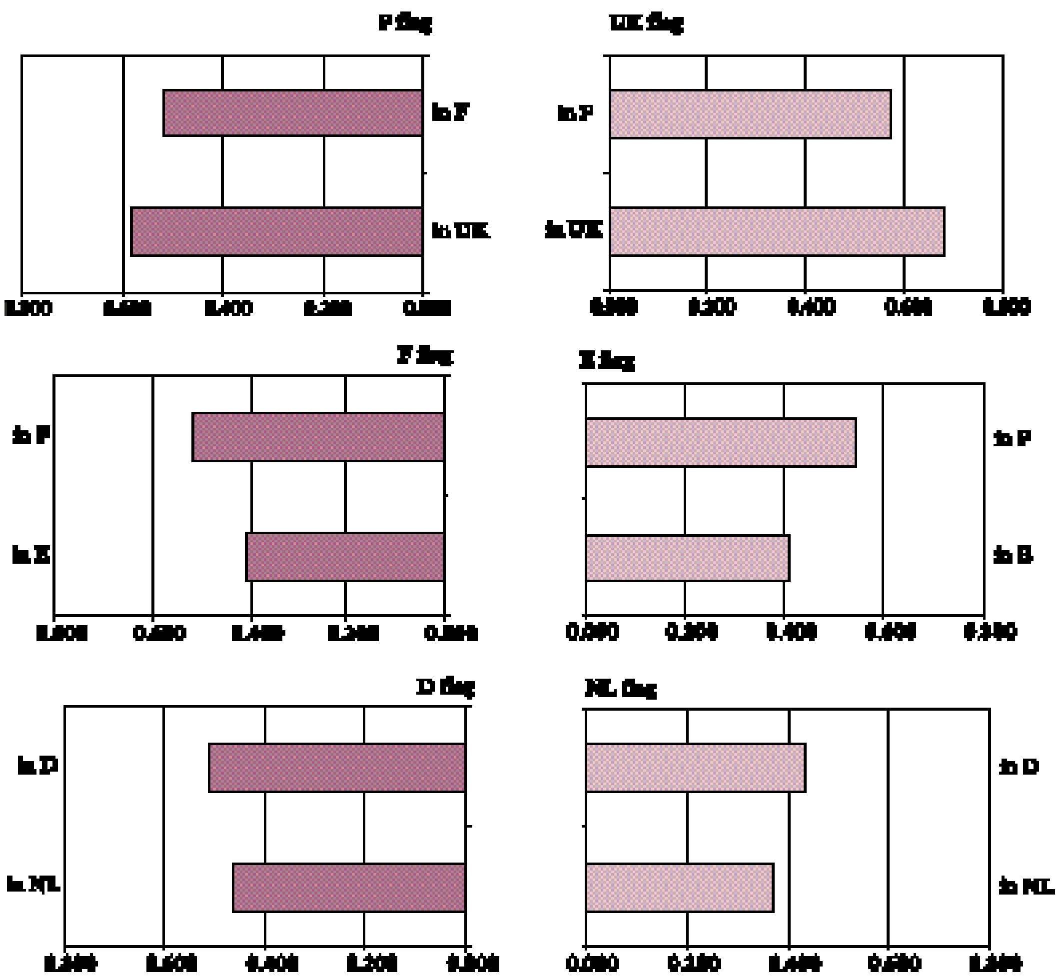
In France, there was a partial TIPP (fuel duty) refund in 2001.

National charges are higher for UK flags (0.09 cents per t-km in 2001 Vs. 0.24 cents in 1998) than for French flags (about 0.03 cents per t-km in 2001 and in 1998). For almost all countries this fraction is independent of the country where hauls are performed. In the case of France a refund is available against the annual axle tax for each day spend hauling abroad.

Overall results

Figure 4.6 shows results for the six pairs of flags in a crossed manner following the same calculations as in the France-UK case study. Results are expressed as net taxes in cents per t-km. Overall the results show that, independently of the country of haulage, one flag is in most cases cheaper in a pair (F-flags are cheaper than UK-flags and than E-flags, NL-flags are cheaper than D-flags). These results can not be used directly to gauge the impact of taxation on competitiveness as taxes on labour and capital also have to be taken into account. This is done below.

♦ Figure 4.6. **Results for six pairs of flags (net taxes in € cents per t-km), 2001**



Marginal effective taxation rates and competitiveness

The relative positions of hauliers competing with trucks from neighbouring countries in each others markets is the next step in examining the impact of differences of taxation on competitiveness. The 200 km scenarios described above were used again to examine METRs for pairs of national haulage industries (flags). The results are presented in table 4.1.

The biggest difference between neighbouring pairs was found to be for British and French hauliers in France, where METRs are 44% higher for British hauliers and in the United Kingdom, where METRs are 30% higher for French hauliers. Dutch and German hauliers are also subject to significant differences in taxation. In both markets German hauliers face METRs 26 to 30% higher than their Dutch counterparts.

Table 4.1. **Pairs of flags, example for the UK-F pair, over 200 km**

(euros/haul, cents/t-km, and ad valorem rates)

Calculations UK truck in UK		Semi-trailer 40t, 200 km, 1 day
	Euros/l	Euros/64 l
Tax on diesel:	0.74	47.36
	%	Euros/64 l
VAT diesel:	17.50%	11.45
	Euros/year	Euros/day
Vehicle tax :	2008.05	7.28
	Euros/km	Euros/100 km
User charges :	—	0.00
	Euros/year	Euros/day
Other taxes or charges :	—	0.00
	%	Euros/64 l
VAT diesel (-) :	17.50%	-11.45

Results	
Euros total (40t, 200 km)	54.64
Cents per ton	0.683
ad valorem (%)	258.49%

Calculations UK truck in F		Semi-trailer 40t, 200 km, 1 day
	Euros/l	Euros/64 l
Tax on diesel (2001 situation) :	0.38	24.32
	%	Euros/64 l
VAT diesel:	20.60%	8.78
Deductible VAT on tolls	6.00%	-1.08
	Euros/year	Euros/day
Vehicle tax :	2008.05	7.28
	Euros/km	Euros/100 km
User charges: tolls (on 100 km) :	0.18	18.00
	Euros/l diesel	Euros/64 l
Partial TIPP refund	0.04	-2.56
	%	Euros/64 l
VAT diesel (-) :	20.60%	-8.78

Results	
Euros total (40t, 200 km)	45.95
Cents per ton	0.574
ad valorem (%)	237.39%

Calculations F truck in F		Semi-trailer 40t, 200 km, 1 day
	Euros/l	Euros/64 l
Tax on diesel (total as for March 01) :	0.38	24.32
	%	Euros/64 l
VAT diesel:	20.60%	8.78
Deductible VAT on tolls	6.00%	-1.08
	Euros/year	Euros/day
Axle tax :	707.36	2.56
	Euros/km	Euros/100 km
User charges: tolls (on 100 km) :	0.18	18.00
	Euros/year	Euros/day
Partial TIPP refund	0.04	-2.56
	%	Euros/64 l
VAT diesel (-) :	20.60%	-8.78

Results	
Euros total (40t, 200 km)	41.24
Cents per ton (gross weight)	0.516
ad valorem (%)	195.39%

Calculations F truck in UK		Semi-trailer 40t, 200 km, 1 day
	Euros/l	Euros/64 l
Tax on diesel (1) :	0.74	47.36
	%	Euros/64 l
VAT diesel:	17.50%	7.43
	Euros/year	Euros/day
Axle tax :	707.36	2.36
	Euros/km	Euros/100 km
User charges :	-	0.00
	Euros/year	Euros/day
Other taxes or charges :	—	0.00
	%	Euros/64 l
VAT diesel (-) :	17.50%	-7.43
	Euros/day	Euros/day
Deduction for days in foreign country :	3.30	-3.30

Results	
Euros total (40t, 200 km)	46.42
Cents per ton (gross weight)	0.580
ad valorem (%)	220.74%

These difference in METR appear likely to have an impact on competitiveness although a specific market analysis would be required to confirm the importance of these differences in taxation compared to other influences on competitiveness. It must be remembered that other factors — including pre-tax prices of labour and capital, quality of service provided and exchange rates — are primarily responsible for the competitive advantages that do exist in practise.

The large difference revealed in the table (40%) between the impact of taxes on the competitiveness of UK versus Spanish hauliers in the French market is difficult to assess. The opportunities for such potential competition are probably limited and would need to be investigated on the basis of specific markets – for example haulage from French ports where UK and Spanish trawlers unload fish. This is beyond the scope of the present report.

Table 4.2 takes up this point and a number of further multiple comparisons. Again it is difficult to draw firm conclusions as to the impact of the differences on haulage markets without figures for specific markets. For example, it would be interesting to examine markets for transport out of the port of Rotterdam to test whether UK hauliers enjoy an advantage over other non-Dutch hauliers given that METR for the UK flag is even lower than for the local haulage industry in the Netherlands. Such differences are even greater in the Spanish market.

Table 4.2. **Differences in METRs between flag pairs**

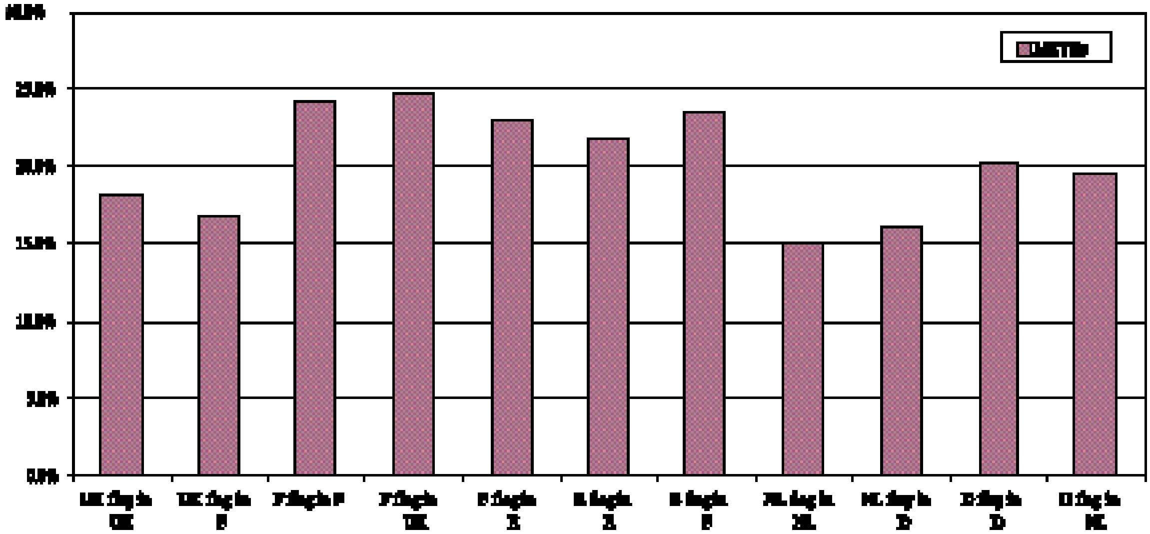
Flags	METRs	Differences in METRs % established between highest and lowest METRs in one country, realtive to the lowest METR	
UK flag in UK	18.1%	37%	in the United Kingdom
F flag in UK	24.8%		
UK flag in UK	18.1%	2%	in the United Kingdom
NL flag in UK	18.5%		
F flag in F	24.2%	44%	UK/F in France
UK flag in F	16.8%	40%	UK/E in France
E flag in F	23.6%	3%	F/E in France
E flag in E	21.8%	23%	in Spain
F flag in E	23.1%		
NL flag in NL	15.0%	30%	in the Netherlands
D flag in NL	19.5%		
NL flag in NL	15.0%	3%	in the Netherlands
UK flag in NL	14.6%		
D flag in D	20.1%	26%	in Germany
NL flag in D	16.0%		

Table 4.3. **Differences in METRs for flags in neighbouring countries**

Flags	METRs	Differences in METRs (%)	
UK flag in UK	18.1	37%	in UK
F flag in UK	24.8		
NL flag in UK	18.5		
NL flag in F	17.5	44%	in France
F flag in F	24.2		
UK flag in F	16.8		
E flag in F	23.6		
NL flag in E	16.3	171%	in Spain
E flag in E	39.5		
F flag in E	44.2		
NL flag in NL	15.0	30%	in the Netherlands
D flag in NL	19.5		
UK flag in NL	14.6		
F flag in NL	22.3		
E flag in NL	24.0		
D flag in D	20.1	25.90%	in the Germany
NL flag in D	16.0		

Differences are established between highest and lowest METRs in one country, relative to the lowest METR.

♦ Figure 4.7. **Results in METRs for all pairs of flags**



4.1.4 Conclusions

In order to assess the impact of taxes on the competitiveness of national haulage industries, the taxation of labour and capital has to be taken account of in addition to transport taxes and charges.

The analysis in chapter 3 found that although there are large differences between countries in net effective rates of transport charges, differences in labour and capital taxation cancel out most of the variation. Moreover, with the exception of Switzerland where a radical change in the structure of taxation was introduced in 2001, transport charges tended to converge over the period 1998-2001.

Applying the analysis to a situation in which hauliers from each of the countries examined "compete" to undertake the same international haul revealed that differences in the impact of taxation on competitiveness are minimal. They derive from differences in national charges, and these have, moreover tended to converge in recent years (figure 4.4). Thus differences in competitiveness that do currently exist in trans-continental haulage markets arise from comparative advantage, differences in pre-tax prices of inputs and possibly other factors but not from differences in taxation. This is confirmed by the extremely low figure for cabotage in European haulage markets, estimated at around 0.22% of t-km by the European Commission in 1998[2]. If differences in vehicle taxes conferred major competitive advantages to the hauliers of some countries one would expect a much higher rate of cabotage.

Competition between differently flagged hauliers within a particular country is likely to be more seriously affected by variations in national vehicle tax rates. However, flagging out is comparatively rare and largely confined to the United Kingdom and its near neighbours, precipitated by a sharp divergence in UK vehicle taxation rates from those of France, Ireland and the Benelux. The British Government has taken legal steps to control flagging out and reduced the incentive for it by reform of its VED rates – well illustrated by Figures 4.4a (1998) and 4.4b (2001).

The key factor within transport charges (excluding for a moment labour and capital taxes) in determining the impact of taxation on the competitiveness of hauliers is the relative weight of more purely fiscal, national based taxes compared with more territorial charges in the sum of taxes levied. Potential impacts on competitiveness can be avoided by limiting the weight of national charges (such as vehicle excise duty) in the country's basket of transport taxes.

It should be noted that a full assessment of the impact of taxation on competitiveness would require an evaluation of the influence of tax differences on total vehicle operating costs and the wider logistics costs the combine to determine company profitability. It would also need to examine the nature of the trading relationship between hauliers and their clients and the extent that this is affected by tax changes. Hauliers working on a spot-hire basis generally find it difficult to recover tax increases in contrast to larger logistics companies whose contracts often include tax recovery clauses. These factors are addressed in section 5.2 below. For vehicle taxes there are significant, though diminishing. Although the impact on competitiveness of differences in levels of charges was not fully determined, the analysis demonstrates that distortion of competition can be avoided by partially replacing vehicle charges with territorial charges.

2. Commission of the European Communities '2nd Report on the Implementation of Regulation (EEC) No 3118/93 Laying down the conditions under which non-resident carriers may operate national road haulage services within a Member State (Cabotage)' Brussels, 1999.

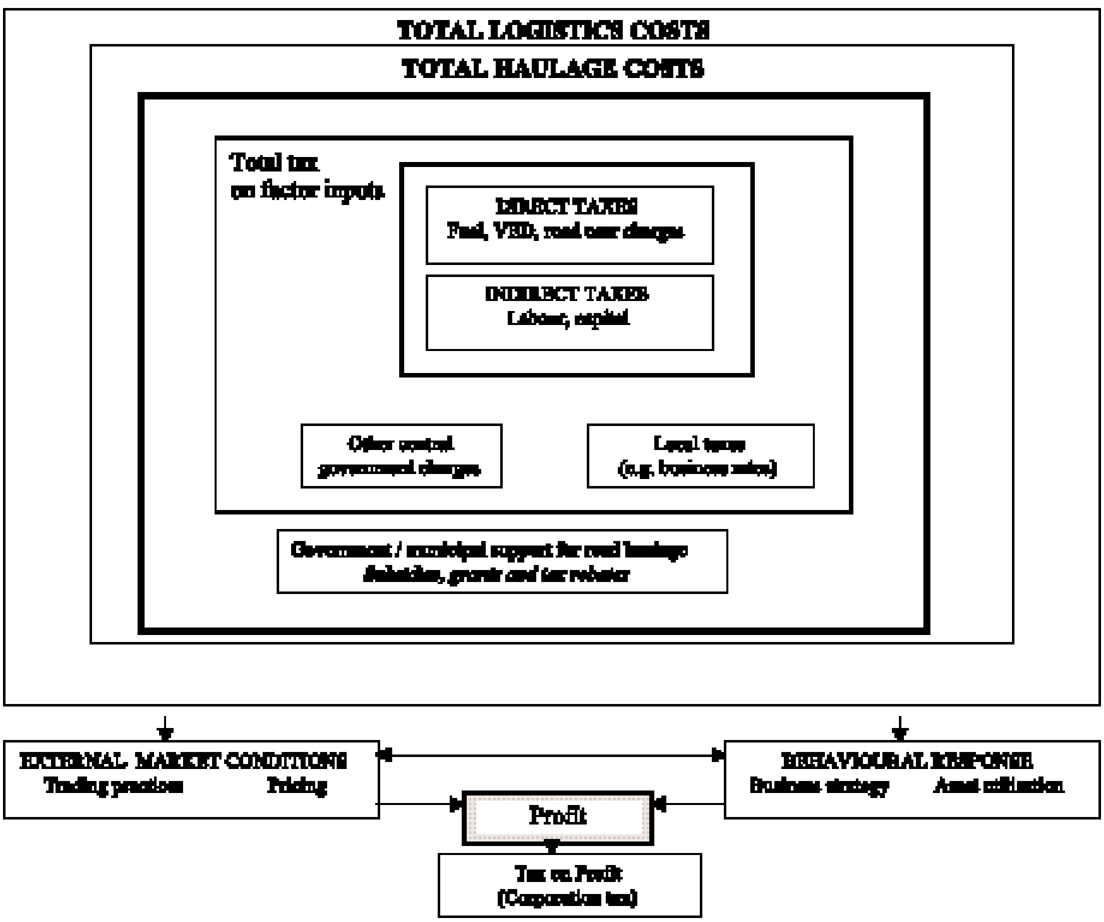
Chapter 5

OTHER FACTORS AFFECTING COMPETITION IN THE EUROPEAN ROAD HAULAGE MARKET

5.1 Introduction

The analysis described so far has been confined to direct taxes on road haulage operations (fuel, vehicle excise duties and road user charges) and the dominant forms of indirect taxation (on labour and capital). To fully assess the effects of international differences in haulage tax regimes on competitiveness it is necessary to examine these taxes in a wider business context. Figure 5.1 illustrates the broader framework within which this examination will be conducted. The main direct and indirect taxes combined in marginal effective taxation rates (METRs) lie at the core of this framework. There are, nevertheless, other public charges imposed on road haulage which vary geographically. At a national level, for example, hauliers must purchase operators' licences and pay fees for vehicle maintenance tests. At a local level, they incur business property rates or other forms of municipal tax.

♦ Figure 5.1. **Analytical framework**



Against all the taxes and charges must be set a range of benefits. The main benefit is clearly the provision of transport infrastructure. As this does not directly impact on the haulier's balance sheet it has been excluded from the framework. National and local governments also inject public funds into the haulage industry in the form of grants and subsidies which directly affect competitiveness and profitability. The nature and level of this government assistance varies from country to country. By deducting these offsetting benefits, one should be able to calculate full net taxation on the road haulage industry.

Taxes are also imposed on profits at varying rates around Europe. The level of these corporation taxes can influence the competitive behaviour of haulage businesses.

Net taxes are only one of a range of operating costs the haulier must incur. Some of these costs vary with the distance travelled ('distance-related charges'), while others do not ('standing charges'). These standing charges can be further subdivided into vehicle- and non-vehicle-related charges. In Figure 5.1 all the distance-related and standing charges have been subsumed under the general heading of 'total haulage costs'. An increasing proportion of road transport is being undertaken by companies that provide an integrated logistics service comprising, inter alia, warehousing, materials handling, inventory management and order processing. Their competitiveness and profitability is determined by the cost and effectiveness of this broad mix of activities. This further dilutes the effect of road taxes and charges on overall performance.

In establishing the final link between logistics costs and profitability, two other elements need to be introduced:

i. the nature of the industry response to tax levels and other cost pressures. In countries with high fuel taxes, for example, hauliers have a greater incentive to improve fuel efficiency. Some hauliers may choose to register the vehicles and / or obtain an operator's licence in other countries (i.e. 'flag out') to escape high levels of vehicle excise duty in their home countries. Business strategy will be influenced by the relative costs of the various factor inputs, including taxation, and be reflected in vehicle utilisation.

ii. external conditions in the haulage / logistics market: For example, in some countries, trading practices, such as the specification of distribution contracts, allow hauliers to recover tax increases with relative ease, whereas in others such concessions are much harder to secure. The marketing and pricing of haulage services also vary between countries further distorting the effects of tax differences on competitiveness and profitability.

There is obviously an interaction between the external market environment and the behaviour of the individual operator. It is through this interaction that the effects of tax measures will be mediated.

This section of the report examines factors in the outer layers of this framework surrounding the core 'direct' and 'indirect' tax boxes which have already been analysed in depth. It is based on a review of literature and several unpublished reports. From these sources, it has been possible to obtain quantitative data on international differences in vehicle operating and logistics costs. Insufficient data have been found, however, to extend the formal modelling work above into a complete quantitative analysis of the impact of differing national tax regimes on competition in the European haulage market. However, the relevant issues are examined in some detail and the conclusions of the modelling work reinforced.

5.2 Taxation

Local taxes and operating licences

The METR analysis includes all the main taxes and charges levied by central governments on road haulage businesses. These businesses also incur local taxes, which are usually property-based. In the UK, for example, it has been estimated that these rates can account for 2-3% of the total annual expenditure of a road haulage business. Incorporating these local property taxes into an international comparison of haulage taxation would be extremely difficult, however, for several reasons:

1. The level of these taxes can vary as much within countries as between them.

2. As local business taxes are not levied on a uniform basis, account would have to be taken of the structure of the local tax system.

3. Haulage business property requirements vary, depending on the size of fleet and range of ancillary services provided, such as warehousing. This is reflected in the amount of local property tax they pay.

The payments that hauliers make for operating licences and vehicle maintenance tests also vary internationally. These represent minor items in the average haulier's budget, even in those countries where the charges are relatively high and their effect on international competitiveness is likely to be negligible.

Corporation Tax

Road haulage and logistics companies pay taxes on the profits they earn. Table 5.1 shows the variation in the main rates of corporation tax across the EU in 2002. In several countries, the rates vary by size of company, sector etc. It is difficult to make a direct comparison between corporate tax rates as consideration must also be given to the various tax allowances that businesses claim. Furthermore, as Poole (1999) notes 'the calculation of taxable profit earned by a company varies widely across the EU' (p.17). Some countries that impose relatively high taxes on factor inputs, such as the UK and Sweden, set corporation taxes at a relatively low level. As profit margins in the general haulage industry are low and the international differences in corporation tax rates relatively narrow, this does little to redress differences in fuel duty and VED.[1]

Table 5.1. **Main Corporation Tax Rates (% of taxable profit), January 2002**

Belgium	40	Austria	34
Greece	35	France	34
Germany	38	UK	30
Italy	40	Spain	35
Netherlands	34.5	Ireland	16
Portugal	33	Sweden	28
Denmark	30	Finland	29
Luxembourg	30		

Source: World-wide Corporate Tax Rate Survey, KPMG, 2002.

5.3 Financial Support to the Road Haulage / Logistics Sector

European governments have provided financial support to their road haulage industries in various ways. The nature and level of this support varies from country to country, for example:

1. For the METR analysis, company tax factor in relation to capital taxation. Although it is not levied directly on trucks, the cost of investing in new vehicles is generally offset against taxes on profits in all the countries studied. Differences between countries and over time in the amount of investment that can be deducted from profits before taxation are what determines the impact of taxation on competitiveness.

– *France*: since 1996 the French government has offered financial incentives to small haulage businesses to merge or close down (Kerwer and Teutsch, 2000).

– *Italy*: small Italian hauliers have benefited since 1990 from a government scheme which grants them rebates on fuel tax, motorway tolls and other charges. These concessions were strengthened in the mid-1990s to cushion small hauliers against the adverse effects of the abolition of quantity licensing on their business (Kerwer, 1999).

– *Spain*: In September 2002, the European Court of Justice granted the Spanish government permission to resume providing subsidies to road hauliers for the purchase of new commercial vehicles.

– *UK:* Following the 'fuel crisis' of September 2000, the government offered hauliers substantial rebates on VED and created a £100 million fund to '*support modernisation in the road haulage industry and to secure environmental objectives*'.

It appears that no attempt has yet been made to compile a comprehensive list of all the publicly-funded schemes set up by EU governments to support road haulage. Further research would be required to assess the value of the resulting benefits and set this against tax revenue.

Allowance would also have to be made for local financial incentives available to haulage and logistics companies locating in particular areas. In districts of the Netherlands, Belgium and northern France, for example, various grants and tax concessions are available to companies investing in distribution facilities (Davis, 1995). While these incentives are ostensibly tied to investment in buildings and other fixed installations, they can indirectly subsidise associated road haulage operations, especially where they are provided as part of an integrated logistics package. As with business rates, the availability and level of local financial incentives can vary as much within as between countries. A published list to the incentive packages available in North West European countries in 1993 (Damesick and McKinnon, 1993) appears not to have been updated.

5.4 Surveys of Total Vehicle Operating Costs

International Comparative Surveys

Several attempts have been made to compare the overall cost of operating road goods vehicles in different European countries. The standard vehicle used in these cost comparisons is the 40-tonne 5 axle articulated unit, as used for the METR calculations.

1. IRU Study of East-West Road Transport Costs

This study, undertaken by Prognos and NEA (1999), compared the vehicle operating costs of hauliers from several Eastern European as well as Western European countries on three international round trips: Vienna-Istanbul-Vienna; Vienna-Moscow-Vienna and Rotterdam-Budapest-Rotterdam. The operating costs of Austrian, German and Dutch hauliers on the last of these routes were very similar (they were not compared on the other routes). The costs incurred by Eastern European operators were substantially lower and exhibited much greater variation by country (Hungary, Poland, Czech Republic, Slovakia and Russia).

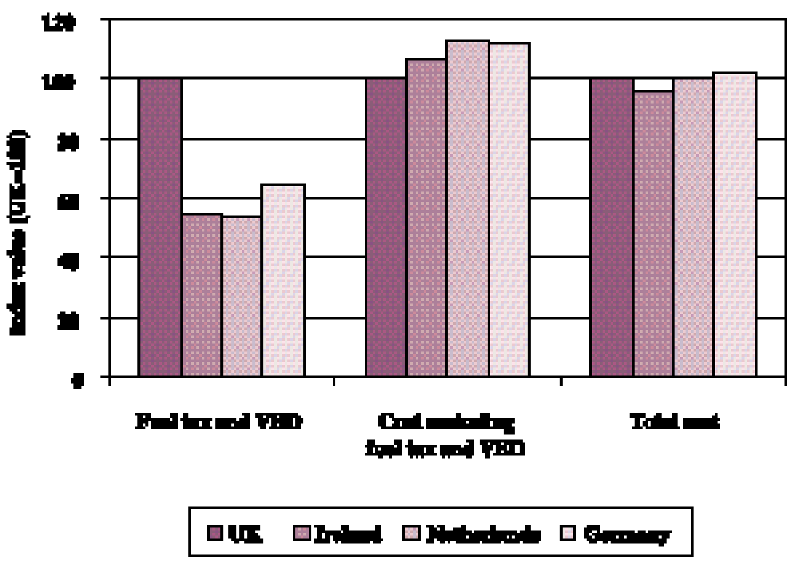
2. Irish Road Haulage Industry Study

This study undertaken by Indecon, Price-Waterhouse Coopers and NEA for the Irish Department of Public Enterprise in 1999 compares operating costs in four countries: Ireland, the UK, Germany and the

Netherlands. Although the choice of vehicle is not specified in the report, the cost estimates for the UK suggests that it is a 38-40 tonne artic. Allowance was made for the older age profile of the Irish truck fleet in the depreciation calculation by using a longer vehicle life-span (10 years for tractor unit instead of 6 years for the other three countries) and lower residual value (5% instead of 10%). Identical values were used for some of the cost elements (overhead costs, cargo insurance and tyre costs) across three or more of the countries. Road tolls were excluded from the calculation.

The analysis revealed that international differences in fuel duty and VED could be more than offset by variations in other cost elements (Figure 5.2). In the highest taxed country (the UK) fuel duty and VED combined were 86% higher than in the country with lowest taxes (Netherlands). In the Netherlands, tax represented 11% of total operating costs as opposed to 21% in the UK. Costs excluding taxes in the Netherlands were, however, 12.4% higher than in the UK, almost exactly offsetting the tax differential. Across the four countries, the variation in total operating costs was only 6%. Differences in labour costs cancelled out most of the tax differential.

♦ Figure 5.2. **Comparison of road haulage tax levels and operating costs**



Source: Indecon et al. 1999.

3. Trade Association Surveys

A group of six trade associations representing users and providers of freight transport services have compiled data on vehicle operating costs in four countries: the UK (FTA), France (FNTR), Belgium (FEBETRA) and the Netherlands (NIWO, TLN and EVO). Data were collected on the same set of nine cost elements (VED, fuel, vignette / road tolls, depreciation, vehicle insurance, tyres, maintenance, drivers' wages and overheads) for a standard 40 tonne articulated truck (Table 5.2). Unlike in the Irish study, they included road user charges but excluded cargo insurance. In comparing costs, the trade associations also distinguished domestic haulage operations from cabotage. The data relate to more recent periods than the Irish study, April 2000, October 2000 and January 2001. (Disaggregated cost data were only obtained for October 2000).

The three organisations in the Netherlands collected their data independently and their average cost estimates differ quite significantly. The issue of data inconsistency is discussed in the next section but for the purposes of international comparison, the three sets of values for the Netherlands were averaged.

The results of these surveys confirm that international variations in total vehicle operating costs are much narrower than differences in direct taxes. In October 2000, taxes varied by a ratio of 2:1, whereas for total vehicle operating costs the ratio was only 0.9 : 1. Between April 2000 and January 2001 there was a significant narrowing of these operating cost differences mainly as a result of the tax measures introduced by national governments in response to the September 2000 'fuel crisis' and also changes in French labour laws.

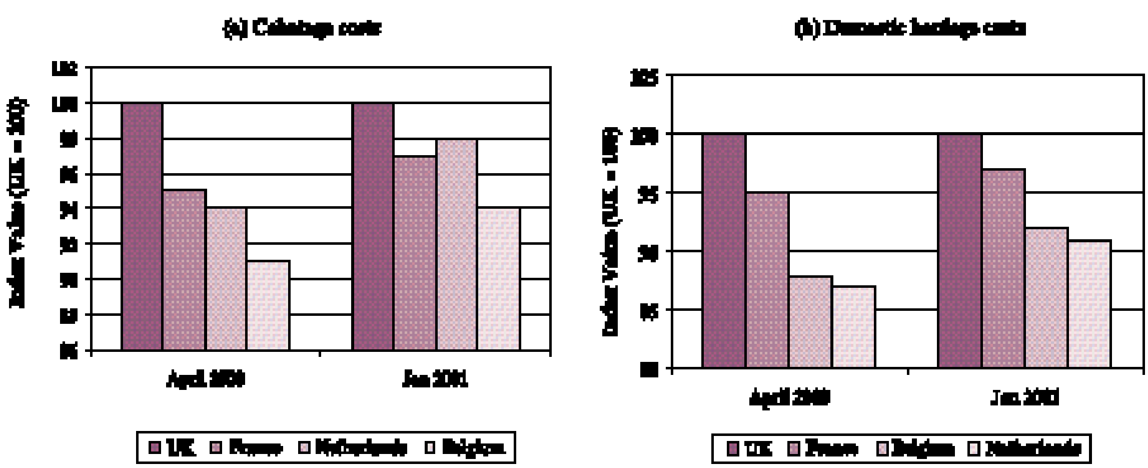
Table 5.2. **International Variations in Road Haulage Taxes and Operating Costs**

				Netherlands		
	UK	**France**	**Belgium**	**KNV**	**TLN**	**EVO**
VED	1 850	486	929	670	670	670
Road tolls	0	5 611	840	749	749	749
Fuel duty	21 844	11 113	9 950	11 222	11 222	11 222
total tax	23 694	17 210	11 719	12 641	12 641	12 641
tax index	***100.0***	***72.6***	***49.5***	***53.4***	***53.4***	***53.4***
Other costs	65 241	69 105	69 581	69 389	70 227	66 240
Total cost	88 935	86 315	81 300	82 030	82 868	78 881
Cost index	***100.0***	***97.1***	***91.4***	***92.2***	***93.2***	***88.7***
Tax as % of cost	27%	20%	14%	15%	15%	16%

Source: European Freight Transport Trade Associations (unpublished report).

The differences in total costs were wider for domestic haulage operations than for cabotage (Figures 5.3a and 5.3b). In April 2000, for example, Dutch and Belgian hauliers operating in their home markets had operating costs around 12% lower than those in the UK. By January 2001, this gap had narrowed to around 8-9%. As a result of strong and weak territorial taxes (respectively road user charges and fuel), differences in the total cost of cabotage operations were significantly smaller than those of domestic hauliers working in their home countries. As a result of the new tax measures, the cabotage cost levels for British, French and Belgian hauliers working in each other's markets were nearing parity in January 2001.

♦ Figure 5.3. **International variations in vehicle operating costs**



Source : European Freight Transport Trade Associations (unpublished report).

The narrowing of cost differentials between the UK, Belgium and the Netherlands is corroborated by a study undertaken by the Swedish Employers' Confederation. Its figures for France, however, deviate quite markedly from those of the trade associations and suggest little convergence been April 2000 and January 2001. This can be partly attributed to the failure of this study to take account of the reduction in the working week which occurred in France in 2000 and had the effect of increasing labour costs.

The trade association figures differ from those released by the UK government in mid-1999 which suggested that the total annual cost of running a fleet of fifty 38 tonne trucks in the UK would be £0.43 million cheaper than in France, £0.6 million cheaper than in the Netherlands and £0.8 million cheaper than in Belgium (Poole, 1999). These figures were broadly supported by study of international variations in business costs undertaken by KPMG (1999) for the Canadian High Commission.

A recent study by the UK Freight Transport Association, however, using data for October 2002, indicates that despite large reductions in British VED rates, total vehicle operating costs are, respectively, 10.1%, 9.4% and 3.2% higher in the UK than in France, the Netherlands and Belgium (Table 5.3).

Table 5.3. **International Variations in Vehicle Operating Costs: October 2002 (40 tonne gvw (3+2) axle articulated vehicle)**

	Standing costs (£)	Running costs (£)	Driver costs (£)	Overheads (£)	Total costs (£)	Variation from UK
UK	13 319	37 229	22 697	12 248	85 493	-
France	11 926	30 669	19 898	14 364	76 857	10.1%
Netherlands	12 069	28 169	23 830	13 361	77 429	9.4%
Belgium	11 980	29 157	27 693	13 918	82 748	3.2%

Source : Freight Transport Association, 2002.

Inconsistencies in Vehicle Operating Cost Data

It was noted above that the three trade organisations in the Netherlands produced significantly different cost estimates. Their cost estimates also differ from those of Ernst and Young (1999), quoted by the UK government. A study for the UK DETR in 1998 compared estimates of vehicle operating costs (for British hauliers) from various sources and found that they differed by 21% for a 17 tonne rigid vehicle and 12% for a 38 tonne (5-axle) articulated vehicle (Dodgson, McKinnon and Begg, 1999). This highlights the difficulty of making international comparisons of road haulage costs on a consistent basis. Differences in cost estimates for individual countries can be magnified when these estimates are used to compare cost levels in several countries.

Even if one controls for vehicle type, weight class, axle configuration and age, assumptions still have to be made about depreciation rates, fuel efficiency, average vehicle mileage, maintenance standards, administrative overheads and property-related costs. Surveys often differ in the assumptions they make about these variables. There is also an important distinction to be drawn between cost estimates based on surveys of vehicle operators and those derived from vehicle manufacturers' performance tables or test runs by specimen vehicles. In the UK, for example, cost tables published in trade magazines such as Motor Transport and Commercial Motor, which are largely based on data from vehicle manufacturers, quote operating costs significantly below survey-based estimates, particularly in the case of rigid vehicles (Dodgson, McKinnon and Begg, 1999).

The comparison of tax rates is also distorted by differences in maximum vehicle weights. Most of the international surveys of haulage taxation and cost levels relate to the standard 40 tonne gross-weight articulated vehicle with five axles. As 40 tonnes is the maximum weight permitted for cross-border movement and for domestic haulage in most EU countries and as it is the dominant class of heavy goods vehicle in Europe it is an obvious choice for these surveys. In those countries, such as the UK, the Netherlands and Sweden, where the maximum weight limit for domestic operations is significantly higher and where much of the haulage work is undertaken by heavier vehicles, the use of the 40 tonne vehicle as a benchmark is likely to over-estimate average haulage costs per tonne-km. The degree of over-estimation is likely to be even greater in the UK where trucks with gross weights in excess of 40 tonnes (up to 44 tonnes) and running, as legally required, on 6-axles have a VED rate one third lower than that of the 40 tonne 5-axle vehicle.

5.5 International Variations in Factor Costs

The comparative studies of vehicle operating costs in small groups of countries have shown that there are wide international variations in factor costs and that these can more than offset differences in the level of tax imposed on road haulage businesses. Data are available from other sources for a much broader cross-section of EU countries to confirm that cost differences are wide for individual cost elements.

Labour costs

A survey in 1999 indicated that total labour costs, including social security and other indirect payments, varied between 7 euro per hour in Portugal to 27 euro per hour in Austria with other countries quite evenly spread across the intervening range (Figure 5.4). The country with the highest transport taxation, the UK, had labour costs slightly below the EU average. These are mean figures for employment in manufacturing and services. The trade association survey, quoted above, obtained disaggregated labour cost for the road freight sector in April 2000. Table 5.4 shows how driver costs were between 20% and 40% lower in the UK than in neighbouring countries, partly as a result of the lower level of employer social contributions (the indicator used in the METR analysis above).

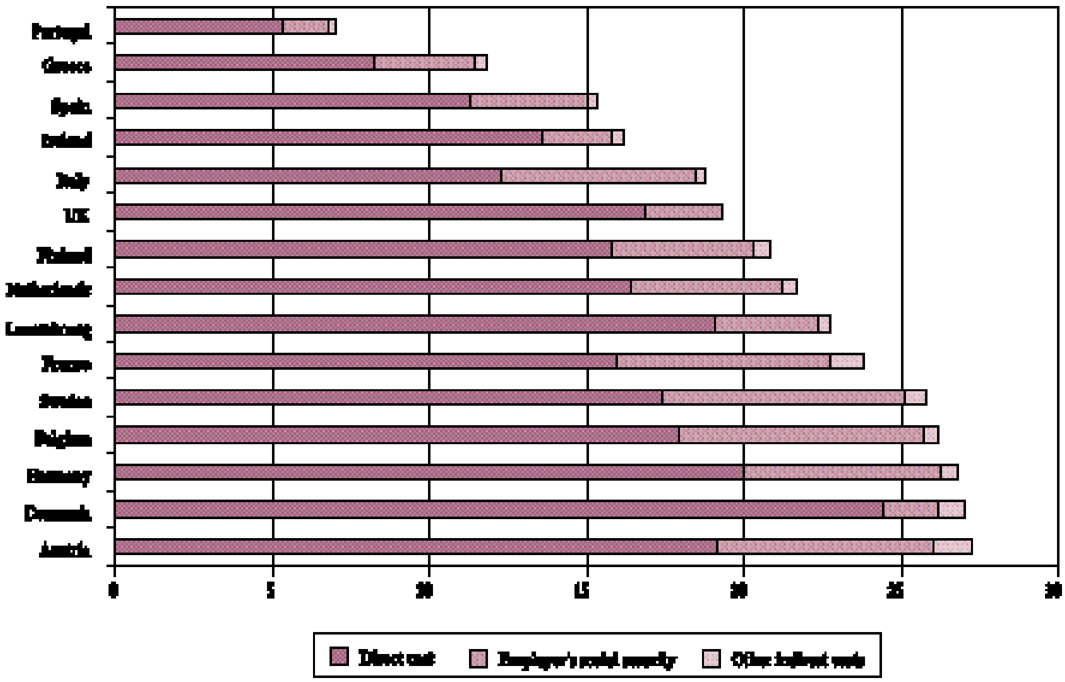
In a study for the Road Haulage Association, the Centre for Economic and Business Research (2001) argues that most of the difference in taxation (other than fuel, VED and road user charges) between the UK and other EU states 'relates to social security taxation'. It claims that 'the majority of UK employment is covered by compulsory private pension provision which is not included in the figures, where the equivalent for much of the EU is contributions into state pension schemes which are included in the figures. So the comparison does not give an accurate picture of the comparison of employers' costs' (p. 6-7). By focusing on the tax element in labour costs, however, this study overlooks the fact that total labour costs in the haulage sector vary widely across the EU and these differences largely offset variations in transport-specific taxes.

Table 5.4. **Variations in the Average Cost of Employing Drivers and Social Contributions**

	UK	France	Belgium	Netherlands		
				(KNV)	(TNL)	(EVO)
Average cost of employing drivers (index values)	100	137	121	135	147	118
% employer social contributions	10	48	40	30	30	30

Source: Freight Transport Association (unpublished report).

♦ Figure 5.4. **Variations in labour costs in manufacturing and services, 1999 (Euro per hour)**



Source: Eurostat.

Some European hauliers are substantially reducing labour costs by employing Eastern European drivers. For example, drivers from Hungary, Romania and Slovakia are typically paid 16-23% of the average wages of a British driver. In addition to directly cutting labour costs, this enables hauliers to make indirect savings by double-manning their vehicles to achieve higher vehicle utilisation rates whilst complying with drivers' hours restrictions. As labour costs typically represent 30-50% of vehicle operating costs, such wage savings can have a much greater impact on competitiveness and profitability than tax differentials. The ability of EU hauliers to employ Eastern European drivers varies from country to country. According to industry sources, licensing authorities in Germany and France impose tighter restrictions on the use of non-EU drivers than other countries, such as Italy.

Pre-tax fuel prices

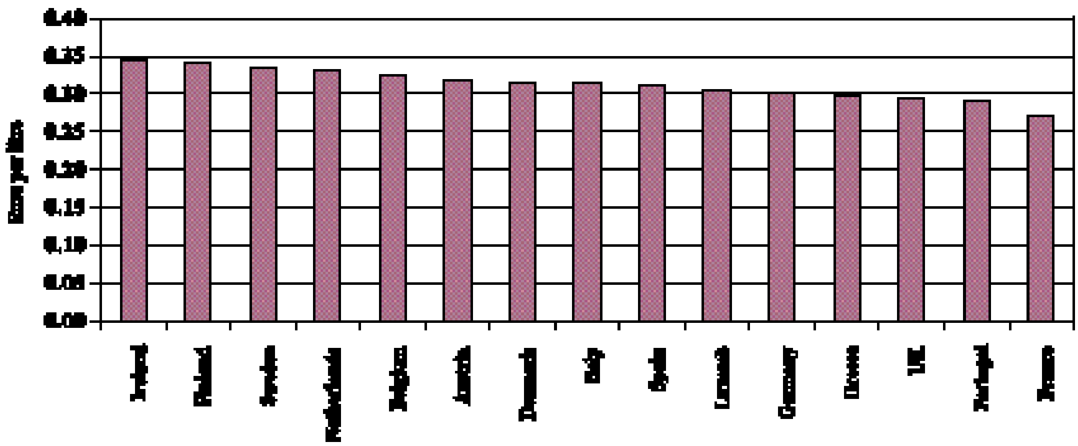
According to EU data, in September 2002 pre-tax fuel prices varied by 8 euro cents per litre between the highest (Ireland) and lowest priced (France) EU country in June 2000 (Figure 5.5). For the average 40 tonne 5 axle vehicle, running around 100 000 kms per annum this would represent a difference of approximately 2 800 euro in annual fuel costs.

Property costs

For the larger haulage and logistics companies with warehouses / depots, property costs can represent 15-25% of total costs, depending on the nature of the distribution operation. Distribution property costs vary enormously across the continent. Across the sample of locations surveyed by European Logistics

Management / Colliers in September 2001, warehouse rentals per square metre varied by a factor of five (Table 5.5). Surprisingly, some of the most central locations with high accessibility on the European trunk road network (e.g. Paris and Antwerp) had the lowest rentals, whereas more peripheral areas (e.g. Dublin and Oslo) were at the upper end of the range. Unlike other factor costs, which tend to offset the UK's high level of transport taxation, the cost of distribution property tends to be well above the European average in and around major British cities.

♦ Figure 5.5. **Variations in pre-tax fuel prices, September 2002**



Source: Commission européenne, 2000.

Table 5.5. **Average Rentals for Distribution Warehouses in European Cities, 2001**

	Euro per square metre	
	New buildings	**Old buildings**
London	209.65	158.31
Dublin	141.02	108.51
Olso	109.88	73.25
Glasgow	106.97	77.02
Frankfurt	91.22	54.77
Madrid	85.92	57.16
Stockholm	85.74	70.68
Lisbon	83.18	69.83
Barcelona	78.73	53.74
Copenhagen	65.04	45.01
Vienna	64.86	62.47
Rotterdam	60.93	41.59
Hamburg	60.76	48.61
Paris	51.86	46.21
Antwverp	44.16	39.19
Lyons	42.27	30.29

Source: European Logistics Management, 30th September 2001.

Other costs

There also appear to be significant international differences in the cost of new vehicles and insurance charges, though this observation is based on anecdotal rather than statistical evidence. One British-based haulier with fleets in both the UK and France claims that he has been able to buy tractors of the same make and specification at a price 17% lower in France. To obtain this price and take advantage of an attractive buy-back scheme after 3-4 years, he has had to register the vehicles in France. Companies operating vehicles in the UK and the Netherlands claim to be able to obtain vehicle insurance more cheaply in the latter country (Commercial Motor, 30/11/ 2000). The lower insurance rates only apply to vehicles registered within that country. In the UK, the cost of insuring trucks has increased by 25-30% over the past two years, raising total vehicle operating costs by 1% (Freight Transport Association, 2002).

5.6 Logistical Context

5.6.1 Integrated Logistics Service

In most countries, the general road haulage industry is characterised by low entry costs, high rates of entry and exit, intense competition, heavy reliance on spot hiring, low returns on capital and slim profit margins. Many haulage companies have tried to escape these pressures and expand their businesses by adopting one or more of the following strategies:

– specialising in particular types of haulage, such as temperature-control or tanker movements, for which they can charge premium rates;

– providing services on a dedicated basis to individual clients;

– increasing the proportion of work undertaken on a contractual basis;

– diversifying into related activities and offering clients an integrated logistics service.

It has been forecast that by 2010 that there will be substantial reorientation of the European road freight market away from basic general haulage and groupage services to contract distribution (Table 5.6). By trading up into integrated logistics, the larger carriers are able to add value to their services, create niche markets with much higher entry costs and secure longer term contracts with clients. This enables them to improve both their profitability and growth prospects. Table 5.7 shows the range of value-added-logistics (VAL) services that some of the larger operators now provide.

Table 5.6. **Forecast Changes in the European Road Freight / Logistics Market: 1990-2010**

Market segment	**% share**	
	1990	**2010**
Contract Distribution	8	25
Express	10	14
General haulage and storage	43	23
Groupage	30	28

Source: Davis, 1995.

Table 5.7. **Value Added Logistics: Service Portfolio**

Transport	Vehicle maintenance
Storage	Palettisation
Break-bulk	Packaging / repacking
Load consolidation	Return of packaging / handling equipment
Order picking	Labelling
Order processing	Quality control / product testing
Stock control	Customisation
Pick-and-pack	After sales service
Track-and-Trace	Consultancy advice

The transformation of road haulage businesses into third party logistics providers (3PLs) has weakened the effect of transport taxation on competitiveness and profitability in several ways:

1. It has reduced the share of 3PL's costs and revenue associated with transport. A survey conducted for the European Logistics Association in 1998, found that, across a cross-sectoral sample of 'over 200' producers, wholesalers and retailers, transport represented around 43% of total logistics expenditure (Figure 5.6). Assuming that this proportion is reflected in the budgets of 3PL companies and that direct taxes on transport represent, on average, around 17% of vehicle operating costs, these taxes would account for only 7% of their total expenditure. Total logistics costs are therefore relatively insensitive to international variations in direct tax on transport operations. Moreover their sensitivity appears to have been declining as transport's share of total logistics costs has been diminishing (Figure 5.7).

2. These companies are able to cross-subsidise their transport operations from earnings on other logistical activities.

3. A large proportion of integrated logistics services are provided on a contractual basis, with contracts which allow the 3PL to recover tax increases. This applies particularly in the case of dedicated services performed on an 'open-book' basis with complete financial transparency. As explained in Section 5.7.3, however, there are international differences in both the prevalence and specification of these logistics contracts which make it easier to reclaim tax increases in some countries than in others.

4. Companies awarding dedicated distribution contracts attach great emphasis to quality of service, especially reliability, in their choice of 3PL. This sector of the logistics market is therefore less price sensitive than general haulage and hence less susceptible to international variations in tax levels.

To assess the impact of this evolution of road haulage businesses into 3PLs it is necessary to take a broader view of the structure of the European logistics market.

5.6.2 European Logistics Market

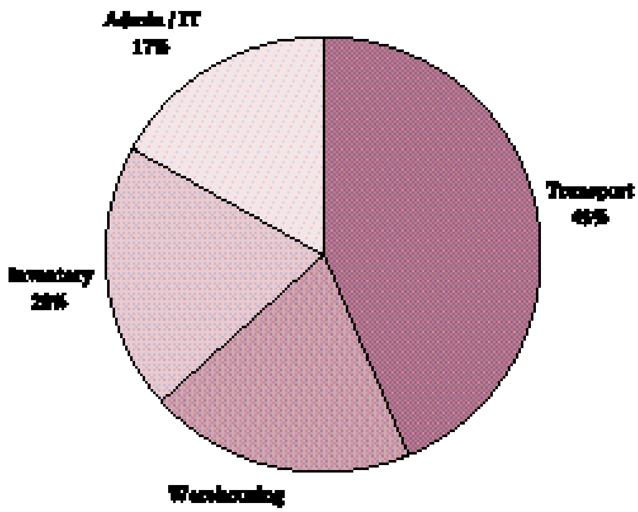
Browne and Allen (1999) devised a simple taxonomy of the strategies that the larger European 3PLs might adopt (Figure 5.8):

Multi-domestic: where a company develops separate distribution systems in each country and focuses on providing logistics services at a national level.

Euro-linking: where a company develops a network of international road haulage services linking national markets with a series of cross-border trunk hauls

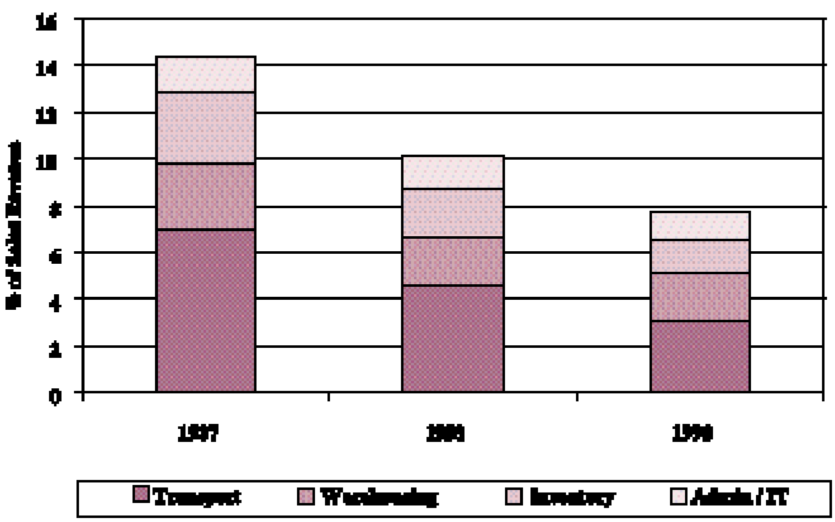
Pan-European: where a company combines the multi-domestic and Eurolinking strategies to provide an integrated distribution services across the continent as a whole.

♦ Figure 5.6. **Breakdown of logistics costs, 1998**



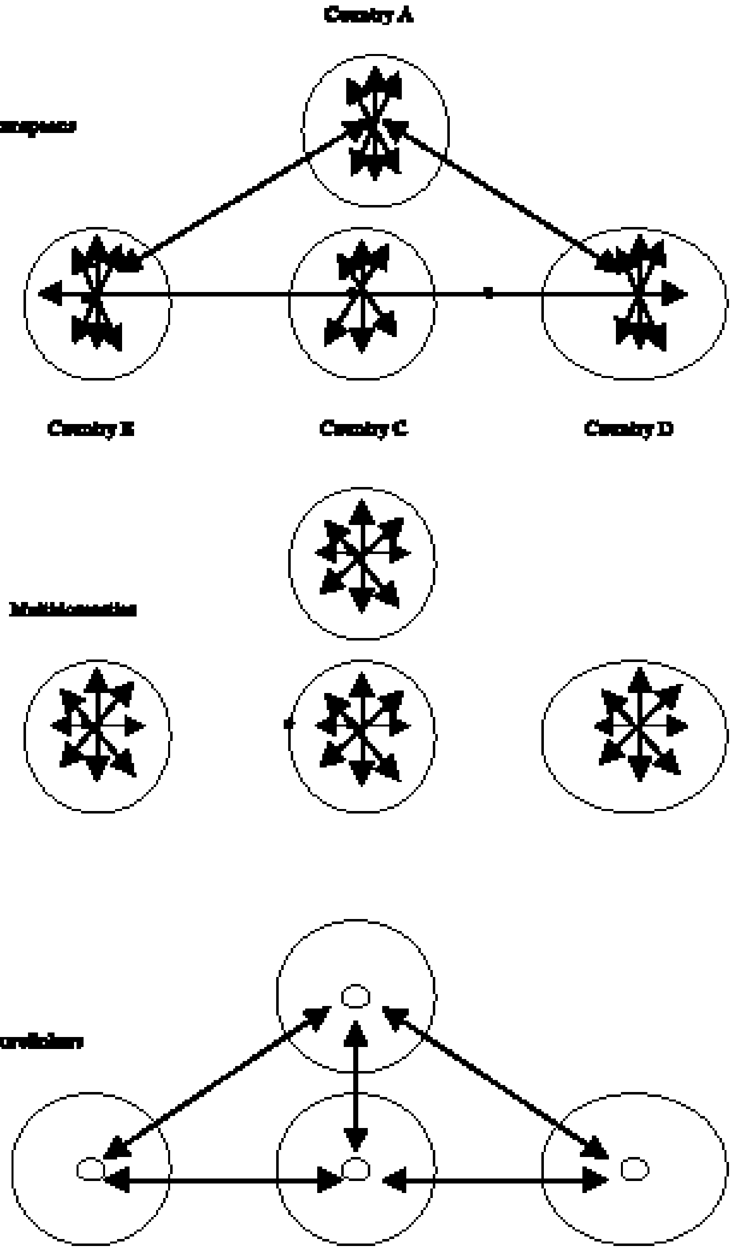
Source: A.T. Kearney Ltd, 1999.

♦ Figure 5.7. **European logistics costs trends, 1987-1998**



Source: A.T. Kearney Ltd, 1999.

♦ Figure 5.8. **Classification of European 3PL strategies (Browne and Allen, 1999)**



To date, no truly Pan-European operators have emerged, though several of the larger 3PLs have declared an ambition to assume this role. Integrated logistics services have developed mainly at a national level, with the level of development varying quite widely between countries (Datamonitor, 2000). Dedicated contract distribution is, for example, well established in the UK, but still comparatively rare in Mediterranean countries such as Greece and Portugal.

As the provision of integrated logistics services tends to be nationally-based, competition between service providers is relatively unaffected by international variations in transport taxation. Most logistics contracts are awarded to 3PLs based in the home market. International competition for these contracts is increasing, however. Where a 3PL secures a contract in a foreign market, it will almost invariably register the vehicle fleet in that country thus adopting the tax and operating cost profile of a domestic operator. Many of the larger 3PLs which operate in more than one country have achieved this geographical expansion by acquiring foreign haulage / distribution businesses.

Eurolinking operations (i.e. cross-border line haul movements) should, in theory, be more affected by international differences in tax levels. The international haulage market is dominated by small hauliers / owner-drivers either working independently or as sub-contractors to larger agencies. These small operators provide a basic transport service with minimal diversification into related logistical activities. Total costs and revenues are, therefore, heavily, if not, totally transport-dependent.

Relating these points on logistics market structure back to the main conclusions of the METR analysis, one can make the following observations:

1. Tax variations were widest between differently flagged hauliers operating in the same national market. It is within national markets, however, that there has been the greatest development of integrated, 'value-added' logistics, where road haulage is incorporated within a broad package of services. This has been 'diluting' the effects of tax differences. It is also worth noting that the country with the highest level of direct taxation on transport, the UK, is also regarded as having the most highly developed 3PL market, with a relatively large proportion of haulage work undertaken as part of an integrated distribution contract (Datamonitor, 2000). Furthermore, in the UK, distribution contracts often contain clauses which allow operators to reclaim in full additional taxes or charges imposed by government, particularly where 'open book' accounting is used. These clauses have been used primarily to recover fuel tax increases. They were beneficial to the larger logistics companies during the period between 1994 and 2000 when the fuel duty escalator policy was in force and fuel taxes in the UK sharply diverged from those in other EU countries (Figure 5.9). (As the fuel tax escalator policy was designed to raise fuel taxes (in real terms) by regular annual increments on a steady and predictable basis, haulage / logistics contractors should have been able to factor it into their charges over the duration of a contract. In practice, however, the effects of fuel charges on rates were typically reviewed and renegotiated on an annual basis. This was partly a tradition but also reflected uncertainty about the nature and duration of the fuel tax escalator policy. Following the change of government in 1997, for example, it was raised from a 5% to a 6% annual increment. Also, despite government assertions in 1997 that the policy would remain in force at least until 2003, it was abandoned in 2000.)

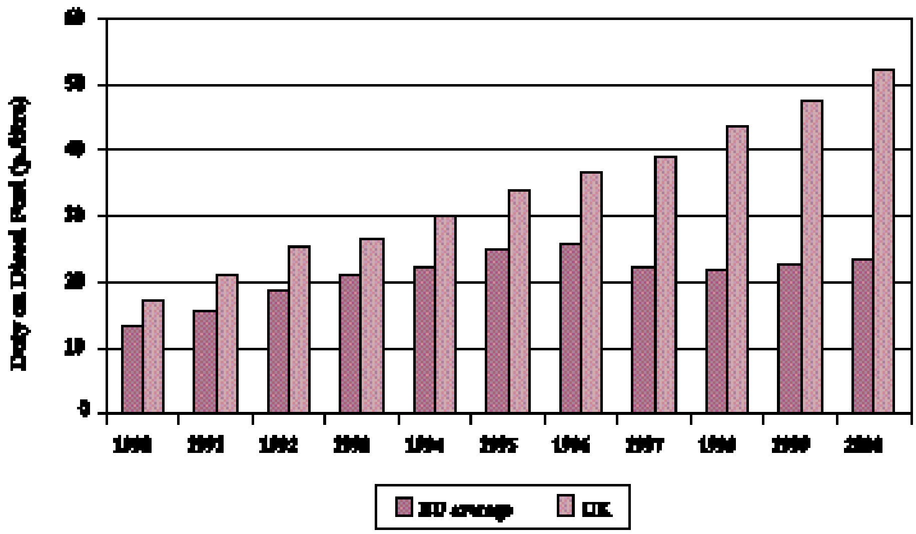
2. In the METR analysis, only slight variations were found in the amounts of tax paid by differently flagged hauliers on long cross-border hauls. It is on these hauls, that tax differentials could potentially have their greatest impact, as carriers are generally small, do not provide ancillary logistical services and undertake much of the work on a spot-hire basis. Where international haulage is done on a contractual basis, these contracts seldom make provision for the recovery of tax increases. So, paradoxically, where the risk of tax differentials distorting competition is greatest, the differentials are relatively small.

5.6.3 International Variations in Logistics Costs

Several attempts have been made to compare average expenditure on logistics in EU countries. This has involved surveying varied samples of companies in each country. Figure 5.10 presents the results of a survey undertaken for the UK Institute of Logistics in 1995 (Touche Ross, 1995). A repeat survey in 1998 claimed that 'the variations in cost by country were broadly similar', though the comparative logistics cost for that year were not actually published (Deloitte and Touche Consulting Group, 1998). This survey indicated that the UK had amongst the lowest logistics costs and transport costs (expressed as a % of sales revenue) despite having the highest taxes imposed on its road freight sector. One could infer from these results that higher transport taxes were more than offset by greater efficiency in transport operations and lower warehousing / inventory costs. Another survey in 1996, undertaken by the Logistics Consulting Group for the Danish Ministry of Industry and Business, found that Ireland was a very cheap location for logistics, with the UK at the upper end of the cost range (Table 5.8). This survey, however, was confined to three industrial sectors: pharmaceuticals, electronics and food.

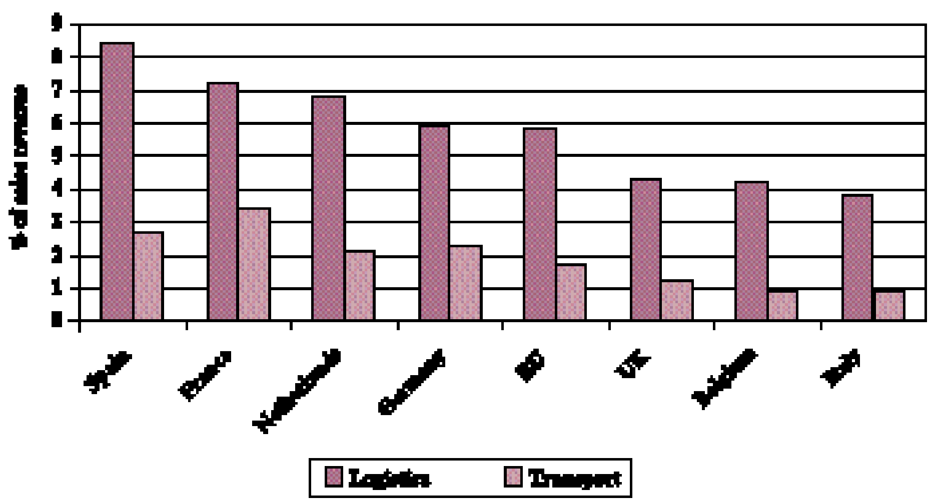
These logistics cost averages must be interpreted with caution. The sample sizes were relatively small and not representatively stratified either by industrial sector or by country. Differences in accounting practices at both country and company levels also cast doubt on the comparability of the data.

♦ Figure 5.9. **Divergence of fuel duty levels: UK and EU average**



Source: Road haulage Association, 2000.

♦ Figure 5.10. **International variations in average logistics and transport costs**



Source: Touche Ross, 1995.

Table 5.8. **International Variations in Total Logistics in Three Sectors: (Index Values: Average Logistics Cost by Sector = 100)**

	Pharmaceuticals	High Tech	Food	Average
Ireland	46	91	54	64
Denmark	102	87	83	91
Netherlands	131	69	78	93
Sweden	100	102	79	94
Germany	119	92	82	98
UK	79	71	162	104
Belgium	89	171	124	128
France	148	105	142	132

Source: Logistics Consulting Group, 1996.

5.7 Factors Influencing the Competitive Impact of Taxation

5.7.1 Behavioural Responses to Tax Pressures

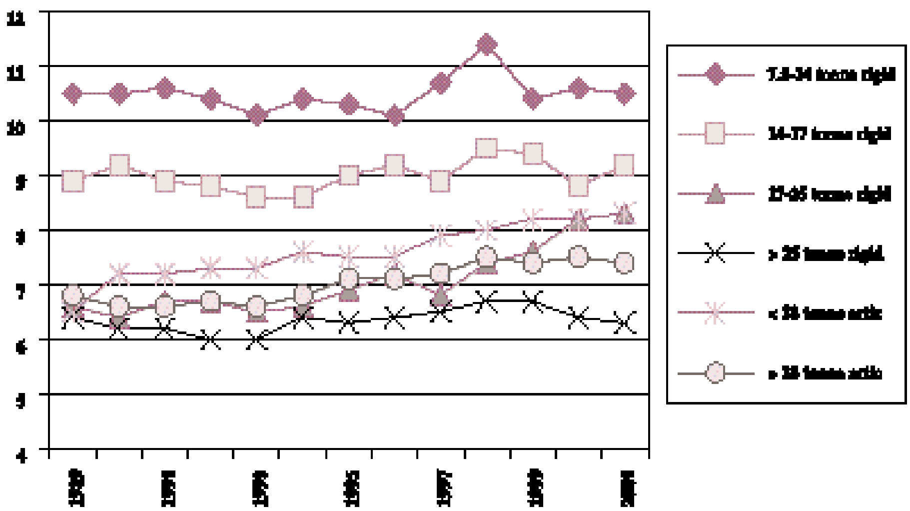
Efficiency Improvement

One might hypothesise that high fuel duties and VED will incentivise road hauliers to operate their vehicles more efficiently. They can economise on fuel by adopting measures which increase kilometres / litre such as driver training and incentive schemes, aerodynamic profiling, improved maintenance and the purchase of more fuel efficient vehicles (McKinnon, Stirling and Kirkhope, 1993) and measures which raise the average vehicle load factor (McKinnon, 2000). Improving vehicle load factors and reducing vehicle downtime also increases asset utilisation, spreading the annual VED across a larger volume of revenue-earning traffic. The resulting efficiency gains offset at least some of the tax penalty and thereby can reduce the adverse effects of a high tax policy on competitiveness.

Research by Schipper et al (1997), however, has indicated that the link between fuel prices and the energy intensity of trucking operations is rather tenuous. Across a sample of developed countries they found 'a weak inverse relation between fuel price and (road) freight intensity in 1992'. On the other hand, during the period when the fuel duty escalator was in force in the UK, there was a steady and significant improvement in the fuel efficiency of road haulage operations, particularly those employing articulated vehicles (Department for Transport, 2002) (Figure 5.11). In addition to promoting short-term fuel economy measures, the escalator policy is likely to have encouraged some companies to factor regular planned increases in fuel duty into longer term investment decisions on vehicle acquisition and maintenance, driver training, etc. Various trade bodies have argued, though, that high fuel taxes reduce the resources available to operators to renew and upgrade their fleets with more fuel-efficient vehicles. It is difficult to determine how much of the observed improvement in fuel efficiency would have occurred anyway for other reasons. Improvements in vehicle technology, after all, have been steadily increasing km per litre. Comparable fuel efficiency data for other EU countries over the same period could be used to construct a 'counterfactual' scenario.

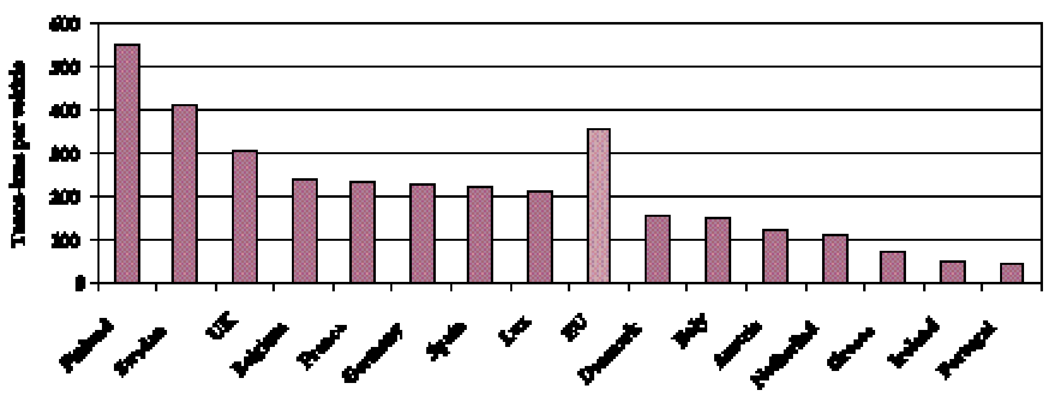
Currently available statistics permit only very crude measurement of levels of truck utilisation around Europe. Figure 5.12 uses EU statistics to show the variation in tonne-kms per vehicle (European Commission, 2000a). The variations are so wide that the data appear suspect. Indecon et al (1999) provide comparative utilisation data for four EU countries (Table 5.9). These showed a 30% variation in utilisation expressed in tonnes per vehicle per annum and 90% variation in tonne-km per vehicle per annum. Estimates of the energy-intensity of trucking operations in 1995 (measured in MJ / tonne-km) also suggested quite wide disparities between five EU countries: Denmark (4.2) UK (3.1) Netherlands (2.9) Sweden (2.4) Germany (2.3) (Schipper and Marie-Lilliu, 1999).

♦ Figure 5.11. **Variations in average fuel efficiency for road haulage operations, United Kingdom 1989-2001 (miles per gallon)**



Source: Department for Transport, 2002.

♦ Figure 5.12. **International variations in truck utilisation (annual t-km per vehicle)**



Source: Commission européenne, 2000.

Further research is required to test the hypothesis that higher taxes induce greater efficiency in the road freight sector and, if confirmed, to calculate the associated elasticities.

Table 5.9. **International Variations in Truck Utilisation**

	Ireland	Netherlands	Germany	UK
Annual tonnes per vehicle	4 296	4 493	5 541	5 309
Index	100	105	129	124
Annual tonne kms per vehicle	356	684	569	608
Index	100	192	160	171

Source: Indecon et al. (1999).

Flagging out

Road freight operators can escape high VED rates in one country by registering their fleets in another country charging lower rates. As VED represents a very small proportion of total operating costs, flagging out is only justified where the VED differential, usually between adjoining countries, is large. In a study for the International Road Transport Union, Venema (1996) estimated that direct vehicle taxes accounted for only 0.5-1% of operating costs. There have, nevertheless, been wide deviations from this mean figure. The VED rate of £5750 imposed by the UK government in 1999 on the 40 tonne 5-axle vehicle represented around 7% of the cost of operating such a vehicle travelling an average of 100 000 km per annum. Comparable VED rates in Spain, France and the Netherlands were, respectively, £295, £437 and £602 (Environment, Transport and Regional Affairs Committee, 2000). This wide gulf in VED rates gave British hauliers a strong incentive to flag out their operations. One legal firm specialising in haulage matters, received enquiries from 2000 operators contemplating this action (Commercial Motor, 15/7/1999).

Broadly speaking flagging out can take two forms: full and partial (Table 5.10). Full flagging out occurs where the operator not only registers vehicles in a foreign country but also obtains an operator's licence in that country and employs drivers resident there. Such operators are subject to all of the relevant regulations and taxes imposed in that country. Schmidt and Doggart (2000) outline in detail the numerous restrictive conditions which hauliers must satisfy in fully flagging out their vehicles. The legality of this type of cabotage is not in dispute. For British hauliers, the higher labour costs in neighbouring countries, such as France, the Netherlands and Belgium offset much of difference in VED rates, making full flagging out commercially unattractive. The British-based subsidiaries of the French haulage business Norbert Dentressangle, for example, examined the case for full flagging out their fleets and decided that this would yield little or no commercial benefit. Consultants Ernst and Young (1999) confirmed that differences in total operating costs between the UK and neighbouring countries were marginal (Ernst and Young, 1999). This form of flagging out has only proved economical for international hauliers whose vehicles run most of their annual mileage outside the home country.

Table 5.10. **Flagging out Options**

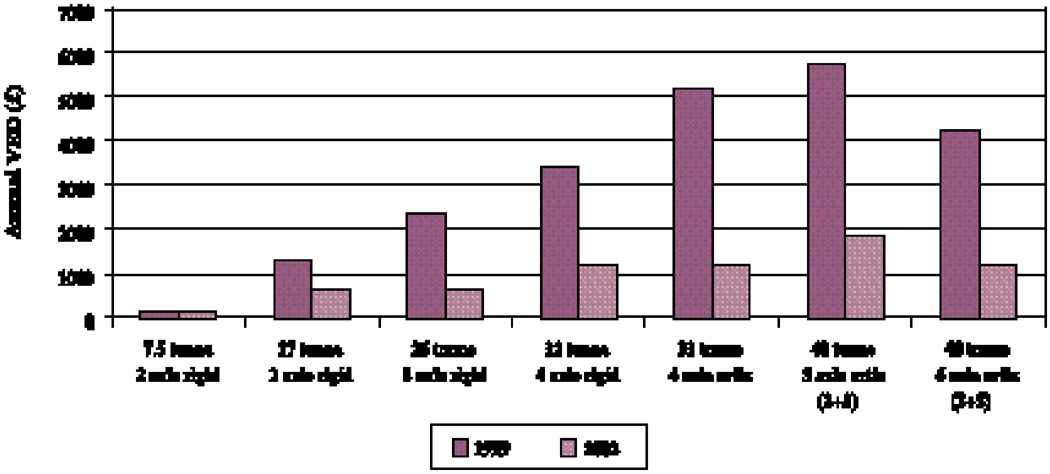
Vehicle Registration in: / **Operateur's Licence in:**	**Home Country**	**Other Country**
Home Country		Partial flagging out
Other Country	Partial flagging out (very rare)	Full flagging out

Companies which partially flag out their operations register their vehicles in another country with lower VED rates, but retain an operator's licence in their home country and generally continue to employ staff resident there. This essentially gives British hauliers the 'best of both worlds'. They can take advantage of the low levels of VED in another EU member state while continuing to employ staff at the lower UK rates and avoiding the need to obtain an O-licence and set up an operating centre in the other country. Anecdotal evidence suggests that some hauliers were able to make significant savings by flagging out. One UK haulier which flagged out 18 of his 42 vehicles in the Netherlands claims to have incurred a cost of £18,000 but achieved savings of £60-70,000 per annum (Commercial Motor, 15/7/1999). No statistics are available on the numbers of UK hauliers that partially flagged out their operations, though it is understood to be 'several hundred'. This, nevertheless, represents only 1-2% of all UK hauliers. Predictions in 1999 that wide VED differentials would provoke a major 'exodus' of haulage businesses from the UK greatly exaggerated the demand for flagging out.

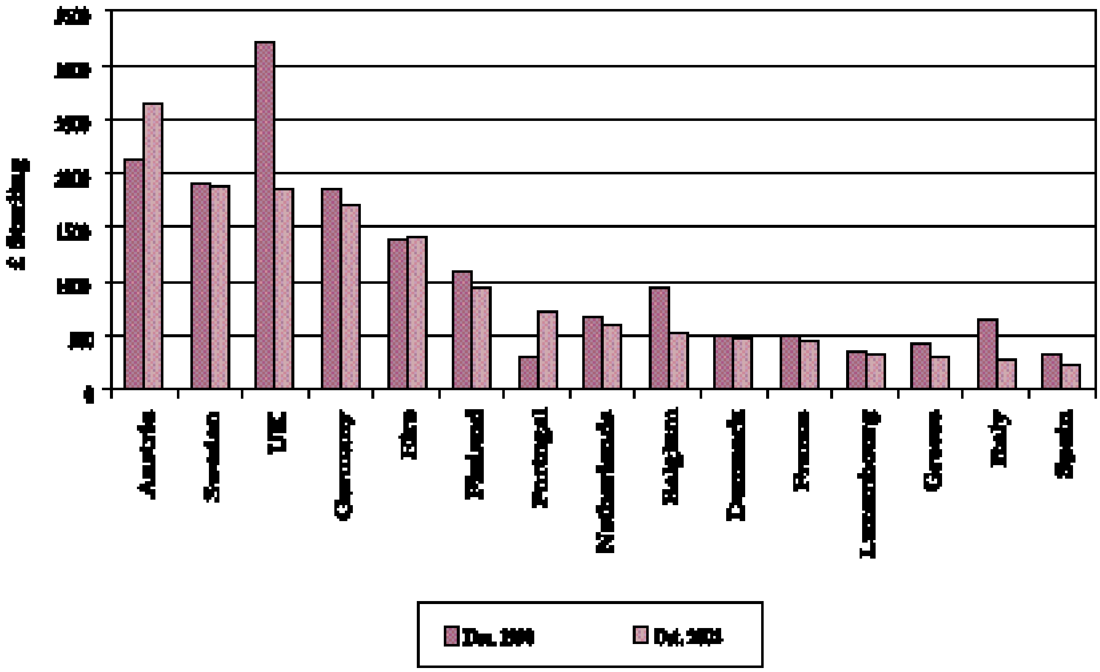
Many of the operators that have partially flagged out undertake domestic haulage within the UK. The official view of the UK government has been that foreign-registered vehicles operated on a British O-licence should only be used 'temporarily' on UK roads. No attempt has been made, however, to define 'temporarily' in terms of time, distance travelled or tonnage carried.

Serious doubts have been expressed about the legality of partial flagging out. It appears to contravene the EU ban on the cross-border hiring of vehicles (European Council Directive 92/881/EC). This is also the view of licensing authorities in France, Belgium and the Netherlands. Numerous British hauliers have been issued with spot fines in these countries for operating foreign-registered vehicles on a UK O-licence. The situation within the UK, however, has until recently been confused, with the British government and Traffic Commissioners giving conflicting advice on this practice (Commercial Motor, 20/1/2000). The senior Traffic Commissioner has opposed partial flagging out arguing that it creates unfair competition for 'reputable' UK operators with British O-licences who register and tax their vehicles in the UK. In a test case (20th February 2001), involving a Scottish haulier, the Transport Tribunal endorsed this view and concluded that a haulier with a British O-licence 'must comply in every respect with the domestic law of Great Britain including the vehicle excise duty legislation' (Commercial Motor, 28/2/2001). This judgement effectively outlawed partial flagging out. Regional Traffic Commissioners thereafter acted upon this ruling and indicated that hauliers with a British O-licence were not permitted to operate foreign-registered vehicles after the 30th April 2001. This tightening of the regulations governing flagging out occurred at a time when the economic case for registering vehicles in other countries was being undermined by sharp reductions in VED rates within the UK. Following the reduction in tax rates announced in the March 2001 budget (Figure 5.13), the differences in VED rates between the UK and neighbouring countries were greatly reduced (Figure 5.14).

♦ Figure 5.13. **UK VED rates for heavy goods vehicles in 1999 and 2002**



♦ Figure 5.14. **International variations in VED rates: December 1998 and October 2002**
(for a 40 tonne gvw (2+3 axle) articulated vehicle, except UK in 1998 where VED rate applied to a 38 tonne vehicle)



Source: Poole (1999), FTA (2002).

5.7.2 Structure of the Road Freight Sector

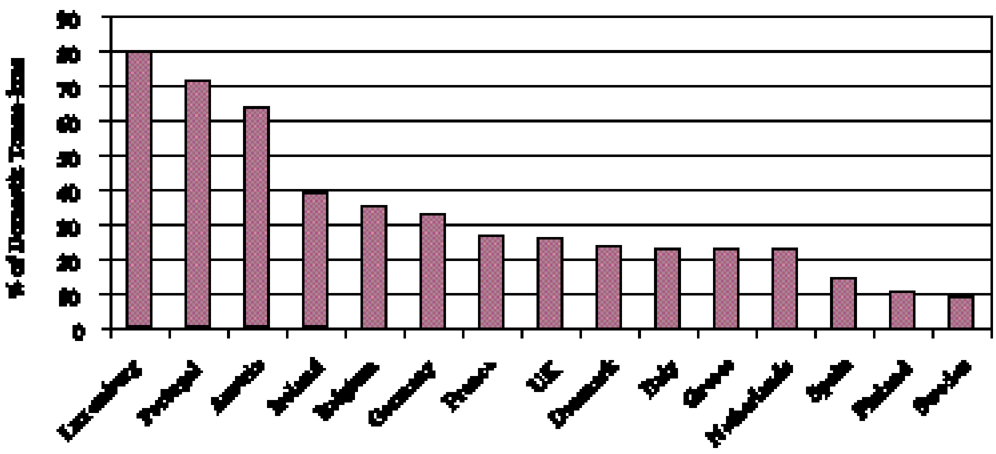
The road freight sectors of EU countries vary in several respects:

1. Own account / hire and reward split: There are wide international variations in the proportion of domestic road tonne-km moved by hire-and-reward carriers (Figure 4.15). In 1995, for example, own account transport represented over 60% of tonne-km in Portugal and Austria and under 10% in Finland and Sweden. This has relevance to the debate on transport taxation. For own-account operators, road transport is not a core activity. Transport usually accounts for a small proportion of the total budget and is frequently cross-subsidised by other activities. Many own-account operators, after all, justify running their own vehicles primarily on grounds of service quality and are prepared to incur costs in excess of the prevailing haulage market rates to meet service requirements. Such firms are better able to absorb higher fuel and VED taxes than hire-and-reward hauliers for whom transport is the core function and the opportunities of offsetting these taxes against other activities is limited, except where they have evolved into 3PLs. International variations in the own account / hire-and- reward split are much less significant in the case of cross-border haulage as own account transport has only a tiny share of this market.

2. Sub-contracting, alliances and merger activity: Over the past decade there has been a sharp increase in the sub-contracting of haulage services, both within countries and internationally. At a European level, elaborate sub-contracting networks have developed which enable a haulier in one country to employ the services of a foreign haulier to deliver in the foreign market or to extend the contracting haulier's delivery reach into other more distant markets. Some of these

sub-contracting relationships have been formalised through the creation of alliances. There has also been a relatively high level of merger activity in the haulage / logistics sector which has established many multi-national haulage networks (mainly of the 'multi-domestic' type) (Datamonitor, 1999). These trends have had two consequences of relevance to the present study. First, they have ensured that domestic haulage work continues to be undertaken predominantly by vehicles registered within the home market, with minimal cabotage penetration. Second, within these multi-national networks, larger operators can redistribute haulage work between fleets flagged in different countries in response to international variations in VED and other operating costs.

♦ Figure 5.15. **Domestic t-km carried by own account vehicles, 1995**

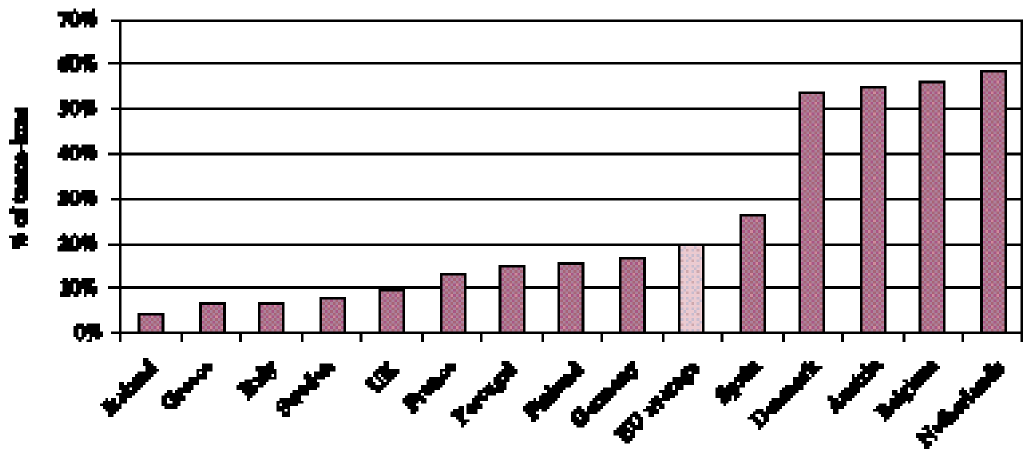


Source: Scharf et Smolders, 1999.

3. Relative dependence on international haulage: National road haulage industries have varying levels of dependence on cross-border movement (Figure 5.16). For example, over half the tonne-km carried by Dutch, Belgian, Austrian and Danish hauliers is across international frontiers, whereas for their Irish, British and Greek counterparts it is less than 10%. The METR analysis concluded that differences in national tax regimes would be likely to have a greater impact on competition within domestic haulage markets than on international journeys. Broadly-speaking, this could place at a significant disadvantage national haulage industries which undertake relatively little international work and are subject to high levels of taxation in their home markets. The UK, for example, falls into this category. Indeed, Britain's peripheral location and island status, which are partly responsible for its limited involvement in international haulage, enabled the UK government to sustain unilaterally a high fuel tax and VED policy.

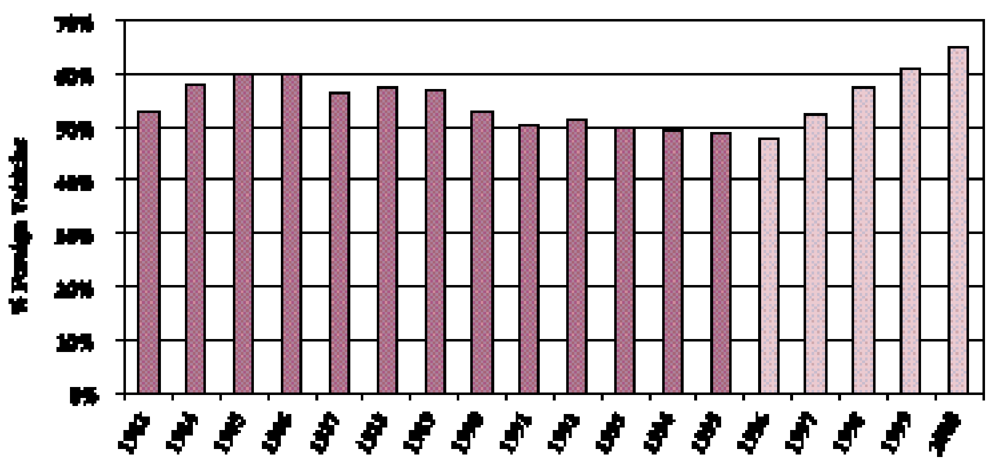
It is interesting to note, however, that the main organisations opposing this high tax policy, the UK Road Haulage Association and Freight Transport Association, cited the declining competitiveness of the UK's international haulage operations as one of the main arguments for cutting fuel tax and VED. The main statistical evidence advanced to support his claim has been the recent increase in the proportion of foreign-registered trucks on the cross-Channel routes, up from 48% in 1996 to 72% in 2002 (Department for Transport, 2002b). In the late 1990s this increase resembled a cyclical upswing though the foreign share has now risen well above the previous peak of 60% in the mid-1980s (Figure 5.17). While widening tax differentials have undoubtedly contributed to the recent trend, other factors, particularly the strength of sterling relative to the Euro and the deterioration in Britain's trade balance with the rest of the EU, have also been important factors.

♦ Figure 5.16. **Dependence of national road haulage sectors on international traffic**
(% of total t-km transported internationally)



Source: European Commission 2000.

♦ Figure 5.17. **Foreign share of international road haulage traffic between UK and European mainland**



Source: Department of the Environment, Transport and the Regions, 2001.

4. Degree of cabotage penetration: This can be measured in two ways; as the proportion of domestic haulage in a country undertaken by foreign-registered hauliers and the dependence of a

national road haulage industry on cabotage in other national markets. EU statistics indicate that there are wide international variations in the level of cabotage both within national markets and for national haulage fleet (European Commission, 2001). Even at its maximum extent, however, cabotage represents a small proportion of domestic road freight movement (0.7% of road tonne-kms in Germany in 1998). For Dutch haulage businesses, which accounted for 27% of all cabotage tonne-kms in the EU between 1990 and 1998, it represented only 0.01% of the total tonne-km they carried nationally and internationally over this period. Cabotage penetration rates are too low at present for these international variations to have much impact on the European haulage market as a whole.

According to the METR analysis of haulage taxation, the country whose tax system put domestic hauliers at the greatest disadvantage relative to foreign-registered hauliers ('caboteurs') was the UK. A DETR survey in January 2000 of 1019 foreign trucks returning from the UK found that only 2.6% had undertaken any cabotage work while in the UK (Department of the Environment, Transport and Regions, 2000b). Data from this survey suggested that cabotage represented only 0.06% of domestic road t-km in the UK. An EU survey in 1997 yielded a cabotage penetration estimate of 0.05% for the UK. Over the intervening 3 years Britain's fuel duty escalator policy had widened the tax difference between the UK and EU average from 17p per litre to 29p per litre (Figure 4.9). By fuelling their vehicles before entering the UK, foreign operators can travel around 1600 km on a single tank, significantly undercutting the fuel costs of domestic hauliers. The large French haulage company, Norbert Dentressangle, for example, claimed in 1999 that it bought *'virtually no fuel for the 150,000 cross-Channel movements it (made) annually'* in the UK (*Truck*, 1/4/1999). The fuel duty escalator policy, however, appeared to have very little impact on the level of cabotage penetration in the UK. This is, nevertheless, disputed by the Road Haulage Association which claims that the 2000 survey substantially under-estimated the true level of cabotage.

5.7.3 Methods of Purchasing Road Haulage Services

A key issue in this study is the extent to which international differences in haulage tax rates affect shipper's choice of differently flagged carriers. It has been argued that the effects of the tax differences are likely to be fairly weak because tax represents only around 17% on average of haulage costs and because tax differences can be more than offset by variations in other factor costs and efficiency levels. A question remains, however, about how shippers actually purchase transport services and how sensitive their purchasing decisions are to variations in transport costs.

Market research on carrier choice has established that many shippers attach as much importance to quality of service variables, in particular reliability, as to cost (McKinnon, 1999). Often hauliers are required to meet a threshold level of quality. Those deemed to meet that level are then differentiated in terms of their quoted rates. A review of the literature has failed to reveal any comparative studies of the quality of road haulage services in European countries. Such research would be very difficult to conduct as there are also likely to be wide differences in service quality within national road haulage industries. Distribution managers sometimes allude to hauliers from one country being more or less reliable than those from another, opinions based on individual experience. One large food manufacturer with extensive production and distribution operations across Europe which has monitored the standard of service received from hundreds of haulage companies against various reliability and 'turnaround time' criteria, claims that there are significant and consistent variations between hauliers of different nationalities. It is not known, however, to what extent this company's experience can be generalised. A proxy measure of quality would be the proportion of hauliers in a country with the ISO 9000 quality accreditation, as used by Indecon et al. (1999), though this is related to internal management procedures rather than operational performance. It is not possible to say, therefore, whether higher haulage rates in one country resulting from a heavier tax burden can be offset by a superior standard of service and whether the majority of shippers can actually perceive international differences in service quality.

It is important to distinguish the purchase of transport in isolation from its purchase as part of a package of logistics services.

(a) Purchase of road haulage service

This has traditionally been done on a spot-hire, 'transactional' basis. The services are usually fairly standardised and generally bought at minimum price. The high degree of fragmentation in the road haulage industry ensures that there are numerous small hauliers available to provide an economical service at short notice. Buying haulage services in this way inflates transaction costs, particularly for bigger shippers employing large numbers of hauliers, and can make it difficult to monitor and enforce quality standards. In practice, even within the spot market, firms have been able to alleviate these problems by making regular use of the same set of hauliers, often on the basis of a 'gentleman's agreement'. There has also been a downward trend in the average number of carriers that shippers employ.

By using intermediaries, shippers can reduce transaction costs while continuing to use numerous hauliers and thus exploit the competitive rates available in the general haulage market. Intermediaries can be divided into three categories:

Freight forwarders or 'spedition' companies: there are marked differences in the role played by freight forwarders in national freight markets. In some countries, such as the UK, they play virtually no part in the domestic road haulage market, whereas in others, most notably Germany, they still have an important, through diminishing role (following the deregulation of the road freight market).

Third Party Logistics Providers (3PLs): Under a `freight management' arrangement, some of the larger 3PLs act as 'principal' or 'lead logistics provider' and, on a particular client's behalf, sub-contract trunk haulage operations to smaller carriers.

On-line Freight Exchanges: Several internet-based exchanges have been established to create electronic markets for road haulage capacity (Rowlands, 2000). These enable firms to trade haulage capacity on particular routes at particular times. At present only a tiny fraction of European road haulage business is traded in this way. It is predicted, however, that these online exchanges will capture a substantial proportion of the road haulage market over the next 5-10 years. After only two years the largest exchanges Freight Traders, is handling around 600 million Euro of European road haulage business. It provides a web-enabled tendering service for its "community" of 150 Shippers and 850 carriers across Europe.

Computer-based load matching, tendering and auction systems, controlled by new on-line exchanges, 3PLs or freight forwarders, are likely to further 'commoditise' the general road haulage market and intensify price competition. They will make it easier for foreign operators to find cabotage opportunities and have the potential to create a truly European market for cross-border haulage. This could create competitive conditions in the European haulage market which are more sensitive to international variations in tax levels.

(b) Purchase of integrated logistics services

Road haulage acquired as part of logistical package is likely to be purchased on a contractual rather than spot-hire basis. According to surveys by PE Consulting (1990 and 1996) in the UK the proportion of third party logistics services not subject to a contract declined from 37% to 20% between 1990 and 1996. Logistical contracts typically run for 2-3 years, though if they are 'asset based' involving investment by the

3PL in vehicle fleets or fixed installations they can be significantly longer (Datamonitor, 2000). Taxes on road haulage are likely to have very little bearing on competition in the 3PL market between service providers based in different countries, for several reasons:

– Transport taxes represent a small proportion of the total cost of the logistics package and can be offset by other factor cost / efficiency savings.

– Most logistics packages relate to distribution within countries and employ vehicle fleets registered in the national market and using fuel sourced there.

– Heavy emphasis is placed on the quality of the logistics service and the development of longer term relationships / partnerships.

– Logistics contracts often allow for the sub-contracting of transport services to local carriers.

– Dedicated contracts are often 'open-book' with the service provider receiving remuneration on a 'cost-plus' basis. These contracts can contain clauses which enable the 3PL to reclaim tax increases. (Open-book contracts and tax recovery clauses are more prevalent in some countries than others. They are much more common in the UK, for example, than in France and Spain. This partly reflects the higher level of development and greater maturity of contract distribution in the UK).

There are, therefore, conflicting trends in the purchase of road haulage services. The purchase of longer distance trunk haulage is likely to become more price-sensitive, magnifying international tax differences. In contrast, the integration of transport, usually shorter distance delivery work, within contract logistics packages is reducing the sensitivity of the purchase decision to tax variations.

Another factor which is likely to affect the relationship between tax regimes and the competitiveness of countries' road haulage industries is nationalistic bias in the sourcing of haulage services. Little empirical research appears to have been done to confirm that this bias exists or to measure its strength. It is nevertheless widely acknowledged within the logistics industry that many companies tend to favour domestic operators (Marketline International, 1997). This has been offered as a reason for the relatively low level of cabotage throughout the EU and the failure of the larger 3PLs to develop truly pan-European logistics networks. The majority of companies distributing throughout Europe outsource their logistics to several contractors usually on a country-by-country basis. This was the strategy adopted by 59% of a sample of 68 of Europe’s 500 largest manufacturers surveyed in 1997 (Peters et al., 1998). There is a strong belief that hauliers based in a particular national market will have a better knowledge of local geography, delivery practices and language and hence be able to provide a superior service. Moreover, according to one large European manufacturer, staff at the reception bays of factories and warehouses sometimes favour hauliers of the same nationality giving them faster turnaround.

5.7.4 Terms of Trade

Preference for local carriers can be further reinforced by the terms on which goods are sold ('Incoterms'). These terms determine the division of responsibility between supplier (exporter) and vendor (importer). Table 5.11 lists the main Incoterms, indicating the point at which responsibility for transport is transferred. Most goods distributed within national markets are sold on a 'delivered price' basis, with the supplier assuming responsibility for delivery to the customer's premises. In international markets, however, a substantial quantity of trade is either sold ex works, where the vendor controls the transport, or free-on-board (FOB) / cost-insurance-freight (CIF) where responsibility for transport is split between exporter and importer, usually transferring at a port, airport or other freight terminal. The companies purchasing the transport services have a natural tendency to employ local freight forwarders / carriers. Research in the 1980s revealed that there were wide international differences in the relative use made of the different terms of trade (Davies, 1984). Exporters in the UK, for example, made much greater use of ex works and FOB pricing than their counterparts in other European countries. This was identified as a factor constraining the share of UK-European trade carried in British registered vehicles (Cooper, Browne and Gretton, 1987). No more recent data have been found on the trade terms used by businesses across the EU. It is not possible therefore to assess the effect of national differences in the prevalence of particular trade terms on competition within the European road haulage market.

Table 5.11. **List of the Main Trading Terms: Incoterms 2000**

Title	Abbreviation	Division of Responsability for Transport Cost
Ex works	EXW	Seller makes good available at own premises; carriage arranged and paid by buyer
Free Carrier *(…named place)*	FCA	Cost transferred from seller to the buyer when the goods have been delivered to the carrier at the named place (e.g. carrier's depot)
Free on Board *(…named port of departure)*	FOB	Cost transferred from seller to the buyer when the goods pass the ship's rail
Cost and Freight *(…named port of destination)*	CFR	Cost transferred at port of destination, buyer paying such costs as are not for the sellers account under the contract of carriage
Cost Insurance Freight *(…named port of destination)*	*CIF*	Cost transferred at port of destination, buyer paying such costs as are not for the sellers account under the contract of carriage (including insurance)
Delivered at Frontier *(…named place)*	DAF	Cost transferred from the seller to the buyer when the goods have been delivered to the frontier
Delivered Duty Paid *(…named place of destination)*	DDP	Cost transferred from the seller to the buyer when the goods have been placed at the disposal of the buyer

Source: International Chamber of Commerce: ICC Publication No. 614, Paris.

5.7.5 Illegal Operation and Enforcement

A significant proportion of road hauliers regularly infringe regulations thereby gaining a cost advantage over law-abiding operators. It is estimated, for example, that 15-20% of the Irish road haulage fleet is unlicenced (Indecon et al, 1999 p.35). In France it has been calculated that '*observance of all the legal obligations would increase the average road haulage rates by a third*' (Royal Commission on Environmental Pollution, 1994, p.174). The extent of illegal operation, the stringency of enforcement regimes and the level of penalties are all acknowledged to vary from country to country (European Commission, 1994). This also distorts competition within the European road freight market, possibly to a much greater extent than differences in transport taxation. No evidence could be found to show that the level of infringement is greater in countries with higher taxes.

Another form is illegality is 'fuel fraud', where operators avoid paying the normal duty on fuel. They can do this mainly by:

– using rebated fuel to power road vehicles. This fuel, which carries a very low of duty, is restricted to certain applications, such as running farm vehicles and refrigeration equipment. It is differentiated from fuel paying the full level of duty by the presence of a coloured dye (e.g. 'red' diesel in the UK or 'green' diesel in Ireland).

– smuggling fuel from countries with a lower level of duty.

In countries with relatively high fuel taxes, the potential rewards from these practices are large. It has estimated by the National Audit Office (2002) that the UK government loses around £450 million per annum in fuel duty from the illegal use of rebated diesel fuel and a further £230 million from the smuggling of diesel fuel from the Irish Republic into Northern Ireland, where in May 2002 the fuel duty was 26p pence (41 Euro) per litre higher (38%) (Northern Ireland Affairs Committee, 2002). In 2001 the illegal use of 'red' diesel resulted in a 4% loss of fuel duty revenue in the UK. The same study by the NAO also notes that the nature and level of enforcement of fuel duty regulations varies across EU member states.

5.8 Conclusions

The marginal effective taxation rate (METR) analysis of chapters 3 and 4 examined international variations in the taxes imposed on road haulage businesses but taxation is only one of many factors affecting the competitiveness of a country's road haulage industry. Analysis in this section of the report attempts to put the results of the taxation analysis into a wider business context by examining a range of other factors. Insufficient data are available to subject many of these factors to econometric modelling. General cost data were obtained for road haulage and logistical operations in several groups of EU countries. These indicate that tax differences are largely offset, and in some cases eliminated, by variations in other cost elements, particularly labour. In addition, diversification of the range of logistical services provided by road haulage companies has reduced the contribution of transport to both revenue and profit. This has weakened the effect of tax levels on competitiveness and the overall performance of haulage and logistics businesses.

Factors such as the structure of the haulage industry, shipper purchasing behaviour, terms of trade, illegality and enforcement levels all vary internationally and can exert a stronger influence on competition within the European road haulage market than differences in taxation. Although further empirical research would be required to quantify the nature and extent of their influence, all of these factors support the conclusions from the METR analysis that differences in national structures and levels of transport taxation are greatly diluted by other more important factors for the competitiveness of national haulage industries.

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ANNEX B
(ANNEX TO CHAPTERS 3 AND 4)

ROAD HAULAGE DATA AND DETAILS OF CALCULATIONS

B.1 - ABSOLUTE LEVELS OF SPECIFIC CHARGES AND CORRESPONDING NET TAXATION BY T-KM

Preparing an inventory of levels of specific charges is the first step for comparing taxes and other charges levied on road freight transport between countries. Although absolute levels of charges on road haulage in one country cannot, in isolation, be compared meaningfully with those in other countries, the fiscal (and territorial) structures that emerge are important.

B.1.1 Methodological stages

The aim is to compile for seventeen European countries an inventory of all taxes and other charges (upon vehicle, fuel, roads, and so on) levied on freight transport by road (B.1.1.1). Charges can then be classified according to economic criteria (purely fiscal versus more commercial) (B.1.1.2) and total charges per standard domestic hauls can be calculated (B.1.1.3, B.1.1.4).

B.1.1.1 Inventory

Building an inventory is the first methodological step for examining the structure and level of charges. The inventory must include all charges levied on road freight transport; that is, taxes on vehicles, fuel duties, user charges like vi-gnettes and tolls, VAT, and so on. Data were collected for all countries under review (Austria-A, Belgium-B, Switzerland-CH, the Czech Republic-CZ, Germany-D, Spain-E, France-F, Finland-Fin, Hungary-H, Italy-I, the Netherlands-NL, Norway-NO, Poland-PL, Sweden-S, the United Kingdom-UK and Denmark-DK). All sources used were official. For each charge, the following data were compiled:

– of imposition (vehicle, fuel or usage);

– amount paid (per year, per km, per litre, …);

– type of payment (time period, road segment, bridge, …);

– VAT on diesel and tolls;

– VAT refunds, rebates and other exemptions obtained.

Data draws on the Ecosys final report on European taxation of heavy goods transportation (1998)[1], on ECMT 2000 report[2] as well as on further inventory tasks (this study).

1. *Redevances sur le Trafic Routier Lourd en Europe: Comparabilité et Possibilités d'Harmonisation*, Ecosys for SET, Federal Department for Transport, Communications, Energy and Environment, Berne, published 1998.

2. *Efficient Transport Taxes and Charges*, ECMT, Paris, published 2000.

B.1.1.2 Classification

In order to allow comparisons, all charges inventoried are organised according to economic criteria classifying charges into four categories ranging from the most purely fiscal to the most commercial:

Purely *fiscal taxes* such as taxes upon motor vehicles. These taxes are purely fiscal because they are levied on the possession of a vehicle, regardless of where and how much the vehicle is used. As they are payable in the country of registration of that vehicle, vehicle taxes are "flag" related charges.

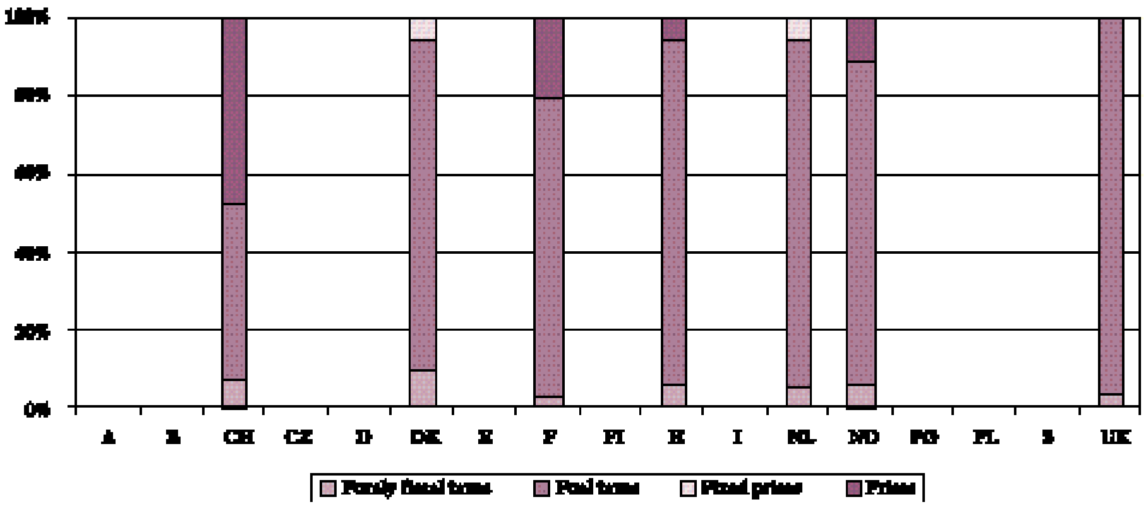
Fuel taxes. Although they relate closely to usage, their territorial linkage is weak. In other words, trucks may fuel-up in one country while using the roads of another country.

Fixed prices - infrastructure use charges that apply on a flat rate basis (per day, per year, and so on) like the Eurovignette.

Prices - infrastructure use charges applied on a more direct usage basis (per km, per t-km, per segment, etc.) such as tolls for passage across a bridge or along a section of a motorway and the 2001 Swiss distance-weight related heavy vehicle fee (HVF). Tolls and distance-weight related charges come very close to prices.

This system of classification can be used to make international comparisons of the fiscal structures applied to road haulage by producing fiscal structures on the basis of the yearly revenues yielded in each country for each category of charge (see ECMT 2000) (and of territorial structures by producing such structures on the basis of charges paid per standard domestic haul – see below). Fig. B1.1 shows fiscal structures in 2001.

♦ Figure B.1.1. **Fiscal structures based revenue yielded in each country (shares)**



B.1.1.3 Haulage scenarios by country

Standard scenarios by country were elaborated in order to calculate the net amount of charges paid for a standard haul in each country. Scenarios are constructed instead of dividing tax revenues by v-km and t-km because this enables the selection of specific categories of trucks and facilitates standard comparisons over time by combining all charges into a single indicator. The standard haul is 400 km for a 40t semi-trailer driven in its country of registration, without any specific itinerary defined. A 40 t, 5 axle articulated vehicle was chosen for the scenarios as it is the standard workhorse of the European haulage market.

The composition of truck fleets by vehicle type, weight class, dimensions and axle configuration varies considerably from country to country. So too does the proportion of long distance haulage work undertaken by 40 ton 5 axle vehicles. To some extent the composition of truck fleets has been shaped by past national vehicle taxation policies. To give one example, after the ending of an EU derogation in 1999, the UK government increased maximum lorry weight from 38 tonnes on 5 axles to 40 tonnes on 5 axles or 41 tonnes on 6 axles. It was concerned that the heavy drive-axle on the 40 tonne vehicle would substantially increase road wear and so imposed a high VED rate on this vehicle (of £5750). A much lower rate was charged on the new 41 tonne vehicle (£2500) in an effort to encourage operators to move to six axle vehicles. Largely as a result of VED policy, relatively few 38 tonne vehicle involved in domestic haulage work were up-plated to 40 tonnes. In late 1999, for instance, the proportions of tonne-kms carried in the heaviest three categories of articulated lorry were, respectively, 70%, 10% and 20% for 38 tonne, 40 tonne and 41 tonnes. To avoid distortion in the analysis arising from differences in predominant truck configurations nationally, adjustments were made in a number of cases. For example in the UK the vehicle excise duty applicable to 6 axle 41 ton trucks is substituted for the higher rate attracted by 40 ton 5 axle trucks. Details are proved in the data tables at the end of the Annex.

400 km hauls were adopted, as opposed to 500 km as used in the scenarios for the previous report in 2000, in order to be closer to typical long distance journeys and avoid over-emphasising distance based charges in relation to fixed and time based charges.

Charges for crossing specific bridges, tunnels and passes are ignored. In countries with tolls (France, Spain, Italy, Hungary), toll roads are set to account for half the haul (200 km; 100 km in Hungary to approximate to current use of tolled motorways versus untolled routes in that country; 100 km in Finland as only urban tolls are concerned). The average figure is arbitrary but close to the figure used by Ernst and Young for France in their international comparison of haulage taxes and costs[3].

The calculations produce:

- standardised net taxation (sum total) for 40 t, 400 km country-related hauls;

- standardised net taxation per v-km and t-km for 40 t as a gross weight and 27 t as max net load country-related hauls.

National charges (annual vehicle charges) were computed on an average daily basis (276 working days per year) rather than an average km basis.

Thus, for example, the rate of UK vehicle excise duty (VED) applied to a standard haul was one 276th part of the annual VED payment. (Calculating the standard haul on the basis of the annual VED payment divided by the annual average number of km driven multiplied by 400 would yield a different, more accurate result. However, calculation on a daily basis was preferred to facilitate calculations in later stages, as France offers refunds against its national axle charge on the basis of days of haulage worked abroad.)

B.1.1.4 Total charges per standard domestic hauls

According to standard national freight hauls (standard 40-t, 400-km haulage scenarios by country) net amounts of charges paid are expressed on a t-km basis for both gross weight (40 t) and maximum net

3. Ernst et Young, Flagging out : a Viable Option, Londres, 1999.

load (27 t). Amounts are “net” in as far as VAT refunds, rebates and other exemptions obtained are subtracted.

There are numerous possible refunds, rebates and exemptions ranging from VAT re-funds to partial TIPP (fuel excise tax) reimbursement in France, to 100% refunds of some charges in some cases for some countries.

B.1.1.5 Territorial structures

The "territorial structure" of taxation can be established according to the criteria in Table B1.I. Figure B1.2 shows the territorial structures that result for 2001.

Table B1.1. **Territorial criterion**

Charges	**Vehicle taxes**	**Fuel excise duties**	**User charges**	
			Vignettes*	**Tolls + user charges on a distance/weight basis****
Description	“National” charges relative to the territorial criterion	Hauliers may choose to not fulfil the territorial link (tanking in country A while-using roads in country B)	Charges bounded to a specific territory though not linked to the quantity used (fixed price)	Charges strictly bounded to a specific territory and to the quantity used (price)
Territorial criterion	National charges	Least territorial charges	Middle territorial charges	Most territorial charges
Result	Territorial structure of taxation according to share of fees paid on specific hauls			

* Eurovignette, Austrian StraBA, Czech Vignette, Swiss RTPL.
** Swiss HVF (RPLP).

B.1.2 Results

B.1.2.1 Inventory

Table B1.2 shows the types and levels of various charges in different European countries.

All countries apply taxes that are of fiscal (national) character (vehicle taxes). Possessors of trucks pay these taxes in the country of registration. Exception: Swiss trucks do have to pay a portion of the French vehicle tax (axle tax) per day spent in France.

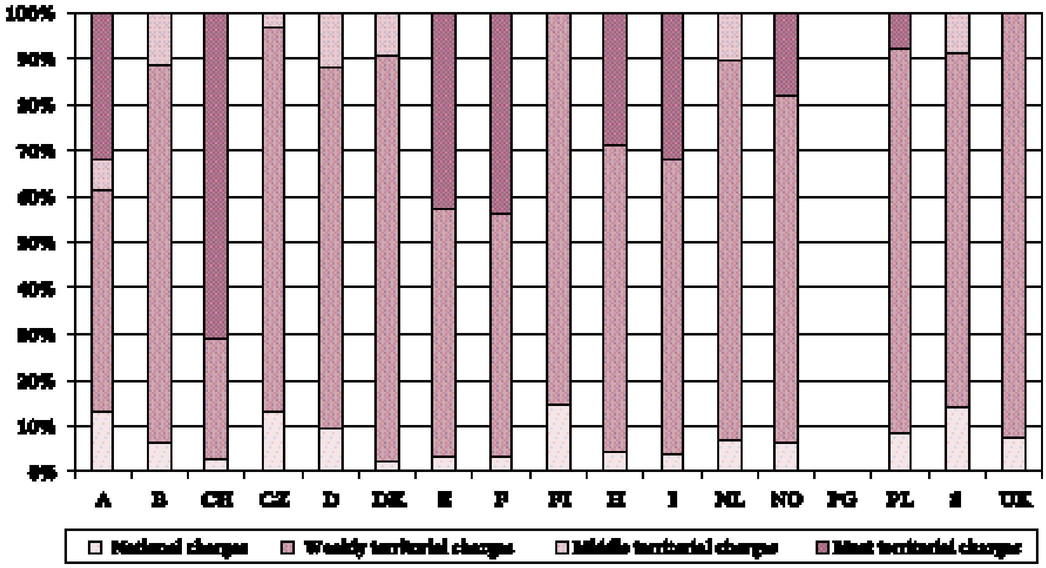
All countries charge duties on fuel.

All countries but Finland and the United Kingdom apply user charges, though of quite different types. France, Italy and Spain apply tolls on highways, bridges, tunnels and passes; Germany, the Netherlands, Sweden and Bel-gium (plus Denmark and Luxembourg) apply the Eurovignette; there are tollgates in the United Kingdom for a few bridges and tunnels; Switzerland applies its heavy vehicle fee; Austria applies a user charge called StraBA, a highway vignette as well as tolls for some tunnels and passes. The Czech Republic applies a highway vignette, and Poland and Hungary apply tolls on highways.

Countries do not fully and systematically internalise environmental or other social costs though Finland applies an oil pollution fee and an environmental tax to Euro 0-II truck categories, the Netherlands a diesel disposal tax and an ecotax, Norway an environmental tax, a CO_2 tax on diesel and a sulphur tax, and Sweden a CO_2 tax on diesel.

There are numerous possible refunds, rebates and exemptions ranging from VAT re-funds to partial TIPP (fuel excise tax) reimbursement in France, to 100% refunds of some charges in some cases for some countries.

♦ Figure B.1.2. **Territorial structures based charges paid per standard domestic haul (shares)**



B.1.2.2 Similarities and differences between total charges per standard hauls in different European countries

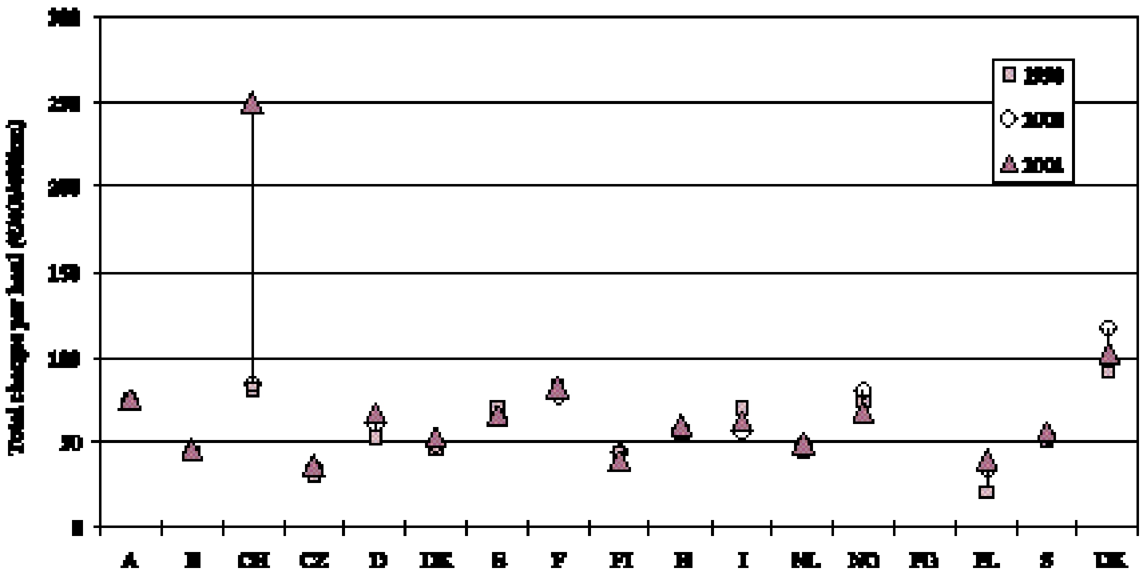
Figure B1.3 compares total charges on the basis of the net charges obtained from the different categories of charges levied on road freight transport when a standard 40 t/400 km haul is performed within the country.

Every country except Switzerland and to a much lesser degree Poland and Germany shows nearly stable or falling charges.

In Switzerland, the new federal HVF was implemented in 2001 together with higher cantonal vehicle taxes on average. It should be noted that these increased charges are thought to have been compensated by the increase in productivity enabled by removing the 28 t gross limit for trucks using Swiss roads.

Fuel taxes were reduced in many countries in the autumn of 2000 in response to temporary increases in prices on world oil markets. In the United Kingdom and Belgium vehicle taxes were also reduced substantially while in France a partial reimbursement on TIPP was granted.

♦ Figure B.1.3. **Total (net) charges for standard 40 t/400 km domestic hauls (in Euros)**



B.1.2.3 T-km net taxation rates

Table B1.2 shows net taxation per t-km in some European countries by gross weight (40 t) and maximum net load (27 t) in 2001.

Table B1.2. **Net taxation per t-km by gross weight and maximum net load, 2001**

Countries	**Net taxation per t-km: gross weight 40t (Euro cents)**	**Net taxation per t-km: max net load 27t (Euro cents)**
A-Autria	0.005	0.007
B-Belgium	0.003	0.004
CH-Switzerland	0.016	0.023
CZ-Czech Republic	0.002	0.003
D-Germany	0.004	0.006
DK-Denmark	0.003	0.005
E-Spain	0.004	0.006
F-France	0.005	0.008
Fin-Finland	0.002	0.004
H-Hungary	0.004	0.006
I-Italy	0.004	0.006
NL- The Netherlands	0.003	0.005
NO-Norway	0.004	0.006
PL-Poland	0.002	0.004
S-Sweden	0.003	0.005
UK-United Kingdom	0.006	0.009

Table B1.3. **Taxes and other charges on road haulage in some European countries (in Euros), 2001**

Charges	Type	A	B	CH	CZ	D	E	F	Fin	H	I	NL	NO	PL	S	UK
Vehicle tax, €/year	Tax	2747	818	2063	1300	1881E1	600 incl. bus tax	707 Axle tax	1555	642	697	940	1177 incl. env. tax	910	2202	2008
Fuel duties €/ (diesel)	Excise duty	0.28	0.29	0.51	0.24	0.42	0.27	0.38	0.26	0.31	0.38	0.33	0.34	0.26	0.18	0.74
Add. environ taxes €/l	Ecotax	—	—	—	—	—	—	—	0.0003	—	—	0.02	0.06	—	0.18	—
Eurovignette €/year	Flat rate basis	—	1400*	—	—	1400	—	—	—	—	—	1400	—	—	1400	—
Others vignettes €/yr	Flat rate basis	1400 StraBA**	—	***	354	—	—	598°	—	—	—	—	—	—	—	—
Tolls (highways) €/km (mean)	Distance pricing	—	—	—	—	—	0.16	0.18	—	0.19	0.10	—	0.12 urban	0.02	—	—
Tunnels, passes, bridges, €/single case	Distance pricing	109 Brenner	—	112 Gd Saint Bernard	—	—	20 Cadi	143 Mt Blanc	—	—	—	—	—	—	—	3.36 Dartford Bridge
User charges as €/t-km	Distance + weight pricing	—	—	0.011 HVF°°	—	—	—	—	—	—	—	—	—	—	—	—
VAT on diesel (%)	Tax	20	21	7.6	22	16	16	19.6	22	25	20	19	24	22	25	17.5
VAT on tolls (%)	Tax	—	—	—	—	—	16	6; Refund since 01	—	12	n.a.	—	n.a.	7	—	—
VAT Refunds	Refund	✓	✓	✓	✓°°°	✓	✓	✓ diesel only	✓	✓	✓	✓	✓	✓	✓	✓
Rebates	Discount	—	—	—	✓	—	—	✓ axle tax			✓Toll refund	—	—	—	—	—

* Obligatory yearly vignette for vehicles registered in Belgium.
** Euro I Category.
*** former RTPL was replaced in 2001 by a distance-weight related charge (HVF, see below).
° In the case the axle tax does not apply.
°° 40 t, Euro I Category.
°°° No refund for c2 trucks when hauling abroad.

B.1.3 Conclusions

The inventory of taxes and other charges levied on road haulage in different European countries shows similarities and differences in the charges paid for standard domestic hauls as well as rather different fiscal patterns associated these charges, the general trend showing a convergence of the main fiscal charges. One country only implemented in 2001 a new "price" category of charge. At this point in the analysis these differences can not be called distortions as no optimal pattern is yet defined.

B.2 - AD VALOREM NET EFFECTIVE TAX RATES AND EFFECTIVE TAX RATES ON THE MARGINAL COST OF PRODUCTION OF ROAD FREIGHT TRANSPORT (METRs)

This section first examines how charges on vehicle, diesel and infrastructure use can be converted with respect to a common cost element – the pre-tax price of fuel. They get combined into ad valorem net effective tax rates.

Secondly, it examines how various inputs – fuel (ad valorem composite rate for vehicle, diesel and user charges), labour and capital – together affect the marginal cost of road freight transport. All these inputs and respective tax rates are combined by share into a single equation for computing marginal effective tax rates (METRs). METR estimates — at the margin — the effects of all payments on the three main inputs to freight transport. It gives the rate of a single composite tax that could be levied, hypothetically, on the marginal production cost of road freight transport in place of all the various existing charges.

B.2.1 Methodological stages

B.2.1.1 Estimation of an ad valorem composite rate for vehicle, fuel and infrastructure use charges

The first methodological step is to combine fuel, vehicle and other road user charges into a composite indicator that can subsequently be combined with rates of taxation on labour and capital in a Cobb-Douglas cost function for deriving METRs. The net road taxation rates calculated in chapter 3 are converted to an ad valorem rate by comparing them with the national pre-tax price of fuel. This produces a net effective ad valorem rate for road taxes.

The rate is "net" because all refunds (specifically VAT) and rebates are deducted; it is "effective" because such tax rates result from observable and measurable rates according to domestic haulage scenarios; it is "ad valorem" because it is in proportion to pre-tax fuel prices. This is a "composite" approach that relates charges paid along the road to a common cost element, the pre-tax price of fuel. The source used for pre-tax fuel prices is: "Diesel oil prices per litre in Europe" (French Ministry of Transport). This price varies from one country to another (from 0.29 cents (Germany) to 0.37 cents (Finland). There are large discounts for bulk diesel purchases in some countries. Accurate national data is difficult to obtain but some surveys exist, e.g. in Sweden. It is likely that discounts offered in Scandinavia are lager than elsewhere. In countries where competition results in generally low pump prices (e.g. France) there is less scope for discounts. Due to the difficulty of obtaining comprehensive data these discounts are ignored in the calculations. In deriving METRs the average pre-tax fuel price across the countries examined is used in the calculations instead of national pre-tax prices of fuel.

Composite ad valorem net effective tax rates were calculated according to the haulage scenarios introduced in the previous section. The national scenarios are for 40-t trucks over 400-km hauls.

The composite "ad valorem net effective tax rate" is defined as:

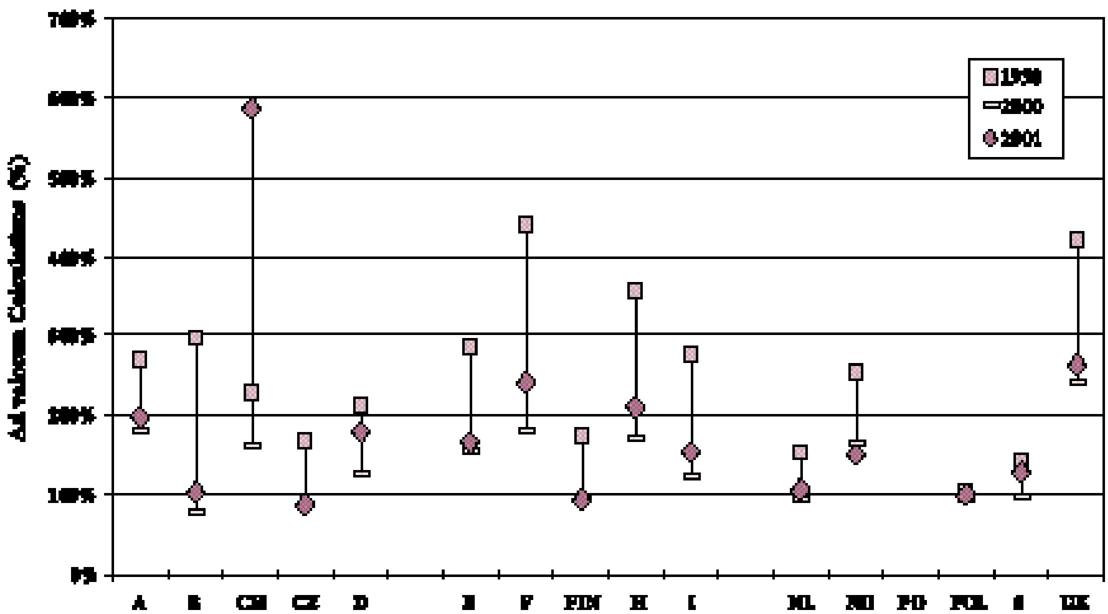
Net charges (Euros) / amount of fuel (litres) / pre-tax price of fuel (Euros/litre) × 100

Table B2.1 shows the composite ad valorem tax rates for the countries under review while Figure B2.1 plots the results in a time perspective.

Table B2.1. **Ad valorem net effective tax rates for some European countries**

Pays	**Ad valorem net effective tax rates (2001 mean European pre-tax fuel price)**		
	1998	**2000**	**2001**
A	177.28%	177.28%	178.88%
B	105.45%	105.63%	106.91%
CH	191.89%	199.82%	592.12%
CZ	72.05%	87.04%	87.04%
D	125.37%	144.20%	158.24%
DK	110.08%	117.37%	125.97%
E	166.35%	153.67%	154.51%
F	197.52%	182.72%	195.57%
FI	106.05%	106.01%	91.68%
H	130.32%	140.05%	141.42%
I	166.52%	134.51%	147.95%
NL	106.55%	118.78%	117.63%
NO	174.03%	191.17%	159.90%
PG			
PL	50.68%	80.35%	93.44%
S	118.10%	128.07%	132.57%
UK	215.94%	277.86%	240.27%

♦ Figure B.2.1. **Ad valorem net effective tax rates for 1998, 2000, 2001**



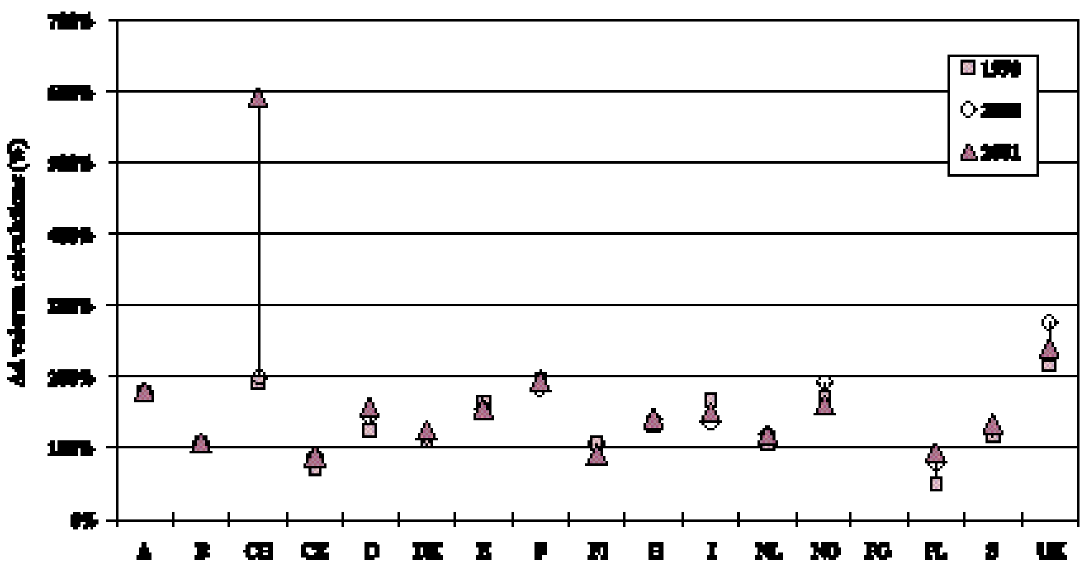
In 1998, The United Kingdom, France and Hungary stood out with high rates. The United Kingdom is a fuel duty and vehicle tax oriented country; the United Kingdom also has a quite low pre-tax price of fuel. France is a fuel duty and tolls oriented country with a low pre-tax fuel price.

In 2001, Switzerland stands out with a high rate due to the introduction of the heavy vehicle fee while the other countries show their rates converging. In The United Kingdom, that rate went down by roughly half; its vehicle tax was cut by about two-thirds (as in Belgium); in Hungary vehicle tax was cut by about one-third.

Finland, Poland, the Netherlands and the Czech Republic maintained their place at the bottom of the chart.

Note that in deriving METRs (see below), the 2001 average European pre-tax fuel price is used instead of national pre-tax fuel prices for each year. The impact of eliminating pre-tax fuel price variations in ad valorem rates is illustrated in Figure B2.2.

♦ Figure B.2.2. **Ad valorem net effective tax rates for 1998, 2000, 2001 based on the pre-tax fuel price for 2001**



B.2.1.2 Estimation of marginal effective tax rates (METRs)

The application of the METR methodology to road haulage services in this study is aimed at estimating the composite net effect of taxes on fuel, labour and capital, on the marginal cost of freight transport. In order to determine to what degree taxes influence marginal costs, several steps must be taken.

(a) The taxes and charges actually paid on the various inputs must be calculated:

– Fuel taxes: composite ad valorem net effective tax rates (vehicle taxes, fuels duties and user charges computed as composite ad valorem net tax rates on pre-tax fuel prices) – as calculated above, though based on the 2001 average European pre-tax price of fuel;

– Labour taxes: the appropriate part of labour taxation for the analysis was taken as the employers contribution to social charges as the indicator most closely lined to the international competitiveness of haulage operations (in the previous study a different basis was taken, calculating for a single individual at the income level of the average production worker, including employees' and employers' social security premiums) – source OECD Observer N° 214, 1998 giving figures for 1996 (see section 4.1.4).

– Capital taxes: taking fiscal depreciation rules (capital cost allow-ances (CCA)) into consideration by retaining (for simplicity) the reciprocal of the capital depreciation rate associated with heavy goods vehicles in each country as a reasonable proxy – various national sources (see section 4.1.4).

(b) Taxes paid by national road freight services must be estimated as a proportion of the total marginal costs of these services, for which it is necessary to:

– Standardise the haulage (running haulage scenarios by country in this study).

– Estimate the relative input shares of the various inputs (inventory by country).

B.2.1.3 Marginal effective tax rates

Assuming a Cobb-Douglas cost function, with inputs of fuel and other consumables (G), labour (L) and capital (K), McKenzie, Mintz and Scharf (1992) derived the following expression for the effective tax rate on marginal costs (T):

$$T = (1+t_L)^{\alpha L} \times (1+t_K)^{\alpha K} \times (1+ t_G)^{\alpha G} - 1$$

In which t is the "marginal" effective tax rate on the relevant input[4] and αL, αK, αG are the shares of the various inputs — labour (L), capital (K) and fuel and user charges (G) — in the total costs. This equation makes it possible to estimate the effective marginal tax rate using only two parameters: the rate of tax on each input (t_L, t_K and t_G) and the share of each input in the marginal costs (α).

B.2.1.4 Tax Rates on Labour and Capital

The rates of taxation on labour and capital used in the calculations are summarised in table 4.2.

Tax rates on labour. The calculation of taxes on labour is complicated by differing national structures of the employers' shares of income tax and social charges. Most countries exhibit one peculiarity or another that impact on the effective rate of taxation. No one peculiarity was considered significant enough to merit adjustment to the general calculation. Differences in the application of working time regulations and enforcement of insurance and other employment regulations are likely to have more impact and there is no obvious route for accounting for these factors. In the previous edition of this study, income tax plus employees and employers social security contributions were summed to provide the relevant factor for labour taxation, adding up to 30 to 50% of pre-tax labour costs (source OECD). In the present study, employer contributions to social charges alone were taken as the appropriate indicator, being most directly linked to the international competitiveness of haulage operations. These ammount to some 9 to 33% of pre-tax labour costs.

4. It should be noted that, in reality, a tax on one input will be split between producers and consumers according to the relative price elasticities of demand and supply for that input. For simplicity reasons and lack of data, it is assumed that the tax is fully paid by the user of the input.

Tax rates on Capital. Capital depreciation rates are fiscally situated between 12% and 40% of the value of road vehicles for heavy goods transport. Of course fiscal allowances such as capital depreciation rates do not constitute tax rates in the same way as vehicle or income taxes – even though they are charges on capital from a book-keeping viewpoint. Fiscal allowances indicate the extent to which fiscal authorities are willing to reduce corporate taxes/taxes on profits in the sector. Indeed capital allowances constitute tax rebates. More precisely the impact of depreciation allowances in terms of tax rebate is given by the difference between the legally allowed fiscal depreciation rate and the real economic depreciation rate applicable in the road haulage industry. The reciprocal of this ideally serves as our indicator of effective capital taxation.

Data on the real economic depreciation rate is, however, not readily available in many of the countries studied. To find an acceptable proxy for use as an indicator of effective capital taxation, various alternative indicators were compared with the ideal calculation for three countries where data was available. This suggested that the simple reciprocal of the legal fiscal depreciation rate (capital depreciation allowance) is an appropriate indicator for effective capital taxation rates.

B.2.2 Computation of country specific METRs (standard haulage scenarios by country)

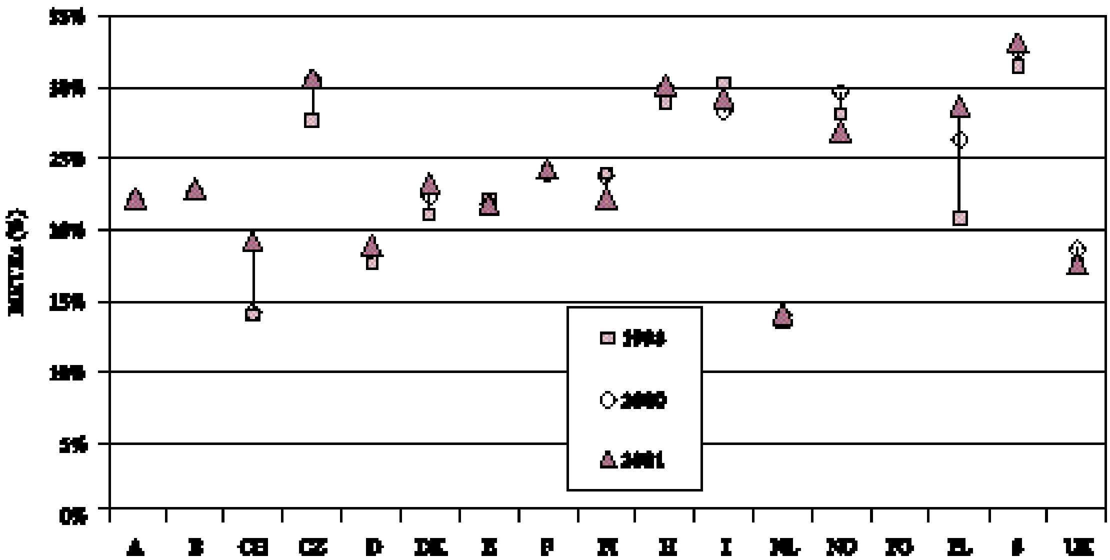
Table B2.2 summarises the calculation of METR by country. The results shown are country specific composite METRs. Results for three years are shown in figure B2.3. Average 2001 fuel prices are used for all three years in order to eliminate the impact of changing oil prices and highlight the impact of changes in taxes.

Table B2.2. **Rates used in calculation of METRs for 2001 based on an average European pre-tax fuel price**

	Imput Share Structures*			Taxation rates			
Countries	**Fuel**	**Capital**	**Labour**	**Fuel** Ad val tax rates**	**Capital° (1/CCA)**	**Labour°° Soc sec**	**METRs**
A	9%	49%	41%	179%	5.9%	20%	22%
B	10%	50%	40%	107%	8.0%	26%	23%
CH	5%	40%	54%	592%	6.2%	10%	19%
CZ	27%	46%	27%	87%	8.0%	26%	31%
D	8%	44%	48%	158%	5.9%	17%	19%
DK	20%	48%	32%	126%	10.5%	0%	23%
E	8%	49%	43%	155%	6.3%	24%	22%
F	6%	43%	51%	196%	5.0%	30%	24%
FIN	18%	44%	38%	92%	3.6%	20%	22%
H	21%	62%	18%	141%	5.0%	32%	30%
I	12%	45%	43%	148%	6.3%	32%	29%
NL	9%	53%	39%	118%	6.8%	8%	14%
NO	19%	37%	45%	160%	4.0%	11%	27%
POL	25%	55%	20%	93%	5.4%	33%	29%
S	18%	31%	51%	133%	6.7%	25%	33%
UK	9%	44%	47%	240%	4.0%	9%	18%

Sources:
* Taken from studies by major transport industry associations (IRU and members) or by governments, this study.
** Calculations, this study.
° The reciprocal of the capital depreciation allowances reported in the following sources *Guides to European taxation*, 1996, *La fiscalité des sociétés dans la E.E.E*, 3rd ed., *Etude fiscale de l'OCDE*, 1990 as compiled in ECMT, 2000.
°° Employer contributions to social security, *OECD Observer* N° 214, 1998.

♦ Figure B.2.3. **Country specific METRs for 1998, 2000 and 2001**



Seen in this light, road-related taxes are in a way “counter balanced” by taxes on the other country specific inputs (labour and capital). This gives a different picture than that obtained by comparing road related taxation rates only. It needs to be stressed once again that still no judgement can be made as to the impact on efficiency of the differences in taxation from one country to the other without reference to the benchmarks developed in further chapters.

METR can be used to examine questions of international competitiveness although in depth examination of the role and impact of each single component in the METR equation might be needed. In particular, accelerated capital depreciation allowances might have small effects on short term production levels while allowing less efficient production to remain or become ‘profitable’[5]. However, according to METR calculations in this study, the conjunction of a change in more than one component proves important. For example, a high capital depreciation rate compounded by a large cut in vehicle excise duty (VED) results in low METRs for the United Kingdom.

In 1998, METRs for France, Germany and Austria lay somewhat closer together than in the t-km and ad valorem rate comparisons, while Switzerland’s position is reversed when compared to the figures for absolute charges.

In 1998, The Czech Republic, United Kingdom and France had the highest METRs. Reasons: the United Kingdom had the highest ad valorem and capital taxation rates; France had a low capital depreciation allowance; the Czech Republic had a very different structure of input costs to the other countries. Although pre-tax diesel prices were little different they accounted for a much higher share of input costs in the Czech Republic thus while its fuel tax rate was similar to other countries this yielded a very high METR.

In 2001, for all countries but Switzerland, METRs, just like ad valorem taxation rates are lower than in 1998. Switzerland’s position is much lower than in the figure comparing absolute charges while it is the reverse case for countries like the Czech Republic, Sweden, Hungary, Italy, Norway and Finland.

5. Pieters, J., « What makes a subsidy environmentally harmful », First Draft, June 2002.

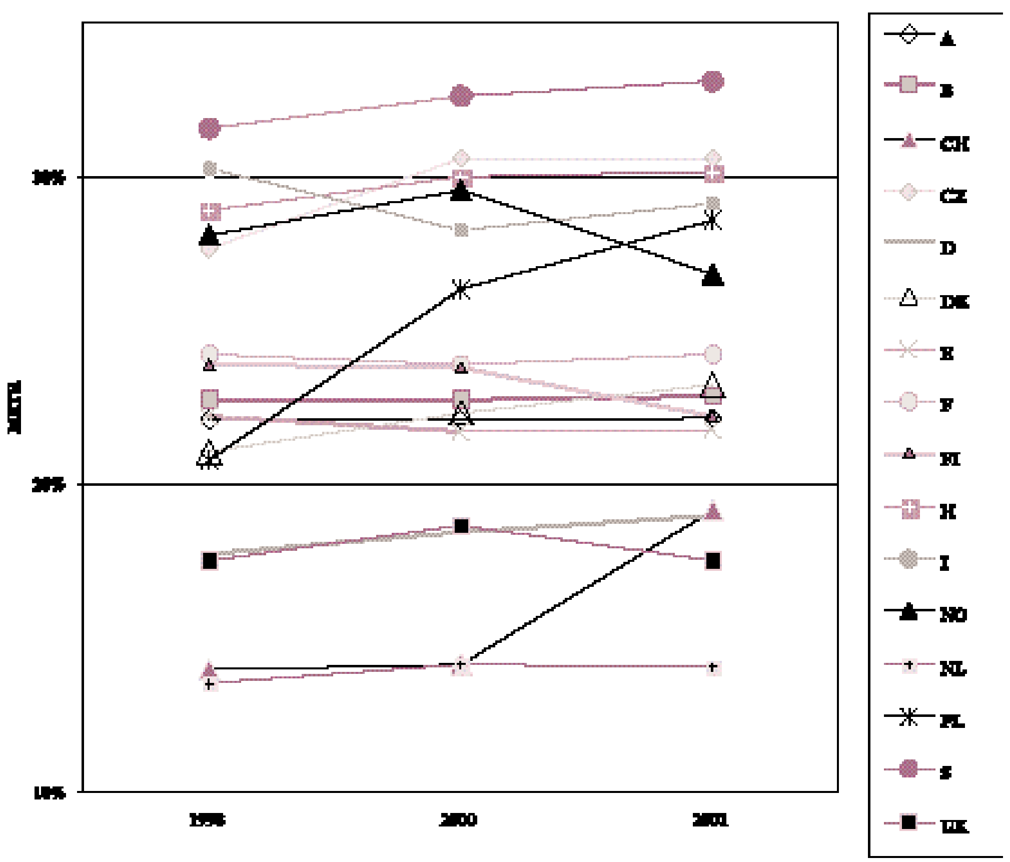
In 2001, Switzerland, Spain, the Netherlands, and the United Kingdom have the lowest METRs (France stands in the middle). Reasons: Switzerland has a very high capital depreciation rates and low labour taxes; Spain has a very low ad valorem taxation rate and quite low capital and la-bour rates; the Netherlands has a low ad valorem taxation rate and one of the lowest fuel shares; the United Kingdom shows a much lower ad valorem taxation rate in 2001 (due to a large cut in VED) together with low tax rates on income and capital.

B.2.3 Conclusions

METR calculations shed fresh light on the comparison of the charges levied on road freight transport. Taking into account other inputs than fuel, vehicles and infrastructure use, i.e. labour and capital, leads to a wholly different image of road freight transport taxation. Country specific METR calculations give a new picture of the fiscal regimes that prevail in Europe. The image is different because of differences between countries in the weights of taxation on labour and capital. To take the case of Switzerland, it was the "most expensive" country with respect to the net taxation by t-km. According to calculations that take into account all inputs, Switzerland shows in 2001 one of the lowest METRs of all the countries examined (together with Spain and the Netherlands. See figure B2.4.

In general, given the relatively small shares of fuel in the production of freight transport by road, high ad valorem net effective tax rates only moderately affect taxation as expressed by METRs. Payments on labour and capital probably have much more influence on the relative competitiveness of road haulage services.

♦ Figure B.2.4. **METRs for 1998, 2000, 2001**
(based on the 2001 average European pre-tax fuel price)



High Swedish, Norwegian, and Italian METRs are explained by large fuel and labour shares in their respective input share structures and high labour costs. Poland, Hungary, and the Czech Republic have large fuel shares, though with low labour costs. Trends in Switzerland and the United Kingdom are explained by the new user charge for the former country and by a cut in vehicle excise duty rate together with an increase in capital allowance for UK.

B3 - ROAD HAULAGE DATA SPREADSHEETS

Nota bene : Only data spreadsheets concerning Switzerland are reproduced hereafter as an example.
The data spreadsheets for all other countries are available at the following address:
http://www.oecd.org/cem/topics/taxes/taxdocs.htm

Switzerland 1998

In use: 2001 average pre-tax diesel price (EU) 0.33

DATA

Diesel prices 09.1998 (€)

litre incl. tax (TTC)	0.74	data
litre excl. tax	0.26	data

1 euro = 1.6284 CHF (mean '98)

Tax rates (%)

ad valorem equivalent of fuel and transport charges combined	191.80%	calculation
capital (1/LFDR)	6.10%	calculation
labour	10.00%	OECD
C depreciation rate (1998)	18.16%	data

Input shares (%)

diesel	5.11%	data
capital	40.40%	data
labour	54.49%	data

Country specific data
Attention: max. weight in 1998: 28 t. Fuel excise duties + vehicle tax + vignette-like rate however applied to a fictitious 40-t Euro I.

CALCULATIONS

	Unitary data	400 km domestic haul	Comments
	€ /l	€/128 l	
Basic diesel duty :	0.28	35.76	unchanged since 1993
Compulsory contribution for disposal:	0.01	0.86	unchanged since 1993
Supplementary diesel tax:	0.18	23.61	unchanged since 1993
		€/128 l	
VAT diesel	7.60%	4.69	
	€/year	€/day	
Vehicle tax:	2063.09	7.47	CH mean 32t, (min. 995 €/yr Wallis, max. 3061 €/yr Basle) fiscal year = 276 days
	€/year	€ /day	
1.5 x RTPL	3689.13	13.37	Vignette-like rate (28 t) x1.5 (40 t); fiscal year = 276 days [max 25 Euros/day]
		€/112 l	
Diesel VAT refunds:	7.60%	6.69	

proxi €/yr 40t

RESULTS

Total charges per trip	40t/400 km	61.06 €		
Total charges per vkm	40t / 1 km	0.20 €	€	
Total charges per tkm	1t / 1km	0.0051 € (40 t as gross weight)	0.0076	using 27 t as max net load

Ad valorem	191.80%	METR	13.99%

Switzerland 2000			In use: 2001 average pre-tax diesel price (EU)	0.33

DATA

Diesel prices 09.2000 (€)

	0.9995074	
litre incl. tax (TTC)	8	*Shell Suisse*
litre excl. tax	0.427	calculation

1 euro =	1.6284	CHF (mean '98)

Tax rates (%)

ad valorem equivalent of fuel and transport charges combined	199.62%	calculation
capital (1/LFDR)	6.10%	calculation
labour	10.00%	*OECD*
C depreciation rate (1998)	18.16%	data

Input shares (%)

diesel	5.11%	data
capital	40.40%	data
labour	54.49%	data

Country specific data
Attention: max. weight in 2000: 28 t. Fuel excise duties + vehicle tax + vignette-like rate however applied to a fictitious 40-t Euro I.

CALCULATIONS

	Unitary data	400 km domestic haul	Comments
	€ /l	€/128 l	
Basic diesel duty :	0.29	37.69	*unchanged since 1993*
Compulsory contribution for disposal:	0.01	0.66	*unchanged since 1993*
Supplementary diesel tax	0.19	24.64	*unchanged since 1993*
		€/125 l	
VAT diesel	7.60%	9.04	
	€/year	€/day	*CH mean 32£ (min. 995 €/yr Wallis, max. 3061 €/yr Basle)*
Vehicle tax	2083.08	7.47	*fiscal year = 278 days* prod €/yr 48t
	€/year	€ /day	*Vignette-like rate (28 t) x1.5 (40 t); fiscal year = 279 days (max 25 Euro/day)*
1.6 x RTPL	3850.35	13.95	
		€/112 l	
Diesel VAT refunds:	7.60%	9.04	

RESULTS

Total charges per trip	*400/400 km*	81.06 €		
Total charges per vkm	*40t / 1 km*	0.20 €	€	
Total charges per tkm	*1t / 1km*	0.0053 € (40 t as gross weight)	0.0076	*using 27 t as max net load*

Ad valorem	199.62%
METR	14.15%

Switzerland 2001

In euro 2001 average pre-tax diesel price (EU) 0.33

DATA

Diesel prices 08.2001 (€)

	0.9383058	
litre incl. tax (TTC)	8	Shell Suisse
litre excl. tax	0.356	calculation
litre excl. VAT	0.43	calculation

1 euro = 1.5123 CHF (mean '01)

Tax rates (%)

ad valorem equivalent of fuel and transport charges combined	592.12%	calculation
capital (1/LFDR)	8.19%	calculation
labour	10.00%	OECD
C depreciation rate (1996)	16.16%	data

Input shares (%)

diesel	5.11%	data
capital	40.40%	data
labour	54.49%	data

Country specific data
vignette-like rate replaced by a distance/weight charge in 2001.
Attention: 40t trucks used in as far as quotas are available (quotas were not exhausted in 2001)
HVF Euro 0 = 0.012 euro/tkm and
HVF Euro II & III = 0.008 euro/tkm.

CALCULATIONS

	Unitary data	400 km domestic haul	Comments
	€ /l	€/128 l	
Basic diesel duty:	0.30	38.82	unchanged since 1993
Compulsory contribution for disposal:	0.01	0.68	unchanged since 1993
Supplementary diesel tax	0.20	25.39	unchanged since 1993
		€/128 l	
VAT diesel	7.60%	8.48	
	€/year	€/day	
Vehicle tax	2053.06	7.47	CH mean 32t, (min. 895 €/yr Wallis, max. 3061 €/yr Basle) fiscal year = 275 days
	€/km	€ /400 km	
HVF: NEW user charge (40t, Euro I)	0.011	177.74	Charge calculated on a distance/weight basis
		€/128 l	
Diesel VAT refunds:	7.60%	8.48	

proxl €/yr 40t

RESULTS

Total charges per trip	40t/400 km	250.11 €		
Total charges per vkm	40t / 1 km	0.63 €	€	
Total charges per tkm	1t / 1km	0.0156 € (40 t as gross weight)	0.0232	using 27 t as max net load

Ad valorem	592.12%

METR	19.13%

FRENCH-ENGLISH GLOSSARY

AD VALOREM (SUR LE PRIX HT DU GASOIL)	AD VALOREM (BASED ON PRE-TAX FUEL PRICE)
ACCISES SUR LE GAZOLE (OU SUR LE DIESEL)	FUEL EXCISE DUTIES
COMPTES ROUTIERS/FERROVIAIRES	ROAD/RAIL ACCOUNTS
DEGREVEMENTS	TAX EXPENDITURES
DIESEL,GASOIL, GAZOLE	DIESEL
EXONERATION	EXEMPTION
PEAGES, VIGNETTES AUTOROUTIERES	TOLLS, MOTORWAY ACCESS CHARGES
PRIX/TARIFICATION DE L'USAGE	ROAD PRICING
REDEVANCES, DROITS D'USAGE	ROAD USER CHARGES
REFACTIONS, EXEMPTIONS	RATE RELIEFS, EXEMPTIONS
REVENUS MANQUANTS(METHODE DES)	REVENUE FORGONE METHOD
SUBSIDES, SUBVENTIONS	SUBSIDIES
TAUX DE TAXATION	TAX RATE
TAUX MARGINAL EFFECTIF DE PRELEVEMENT (TMEP)	MARGINAL EFFECTIVE TAX RATE (METR)
TAXE SUR LE VEHICULE	VEHICLE TAX
TARIFICATION AU COUT MARGINAL SOCIAL	MARGINAL SOCIAL COST BASED PRICING
TERRITORIALITE (CRITERE DE)	TERRITORIALITY CRITERION
Nationalité : ex. Taxes sur le véhicule	*National : e.g. vehicle taxes*
Territorialité faible ex : Accises sur le gazole	*Weak territoriality e.g. fuel excise duties*
Territorialité forte ex : Redevance d'usage, péages t-km	*Strong territoriality : e.g. user charges, tolls ton-kilometre*
TRANSFERT	*TRANSFER, SUBSIDY*
Transferts "comptables"	*"Book" transfers*

GLOSSAIRE

Ad valorem net effective taxation:	Net charges paid for some specific haul related to the pre-tax price of fuel.
Book transfer:	Positive or negative difference between chargeable expenditure and chargeable income.
Book transfer rate:	Book transfer over chargeable expenditure/costs (in percent).
Capital account:	Balance between capital infrastructure costs and revenues from freight transport.
Capital infrastructure cost:	Estimated using an empirical 1.3 ratio for the relationship between current and capital infrastructure expenditures.
Charge:	Generic term including all kinds of taxes, duties, charges, fees… levied on the freight transport by road.
Composite:	Embodying all territorial categories.
Decomposed:	Differentiating all territorial categories.
Distortion:	Difference relative to some defined optimum.
Duty :	Charge levied on fuel (on diesel). Also called fuel excise duty.
Earmarked:	Revenues attributed to some special tasks or fund.
Economic criterion:	Principle used to define fiscal structures, ranging charges from the most fiscal to the most price-like.
Eurovignette:	European flat rate road use charge.
Exemption:	Full release from the payment of a tax, charge or fee.

Expenditure account:	Balance between chargeable infrastructure expenditure and chargeable income from freight transport.
Fiscal charge:	Charge based on vehicle ownership (vehicle tax); a fiscal charge is a national charge according to the territoriality of application.
Fiscal structure:	Revenue share structure based on the economic criterion.
Flag:	Nationality of the truck.
Flat rate:	Set price.
Full cost coverage transfer:	Difference between full social costs and chargeable income.
HDV:	Heavy duty vehicle (in a freight context this is interchangeable with HGV but otherwise includes busses).
HGV:	Heavy goods vehicle.
HVF:	Heavy vehicle fee, the new Swiss use charge calculated on a distance/weight basis (known also by its French and German abbreviations RPLP and LSVA).
Infrastructure account:	Balance between chargeable infrastructure expenditure or capital costs and chargeable income.
LDV:	Light duty vehicle (cars and vans).
Marginal cost:	Cost of the last unit produced.
Marginal effective tax rate (METR):	Combines all inputs (labour, capital and fuel), their respective shares and individual tax rates into a single cost function.
METR:	See marginal effective tax rate.
National tax:	Charge on a vehicle depending upon ownership nationality (flag) and truck characteristics.
Net taxation:	Amount of charges paid on a haul, less rebates, refunds (VAT) and exemptions.
Operating account:	Balance between costs related to freight services and commercial revenues (as opposed to infrastructure account).
Paired flags:	Scenarios by flag over 200 km that allow crossed hauls relative to two different countries.
Rebate:	Reduction of the amount of a tax, charge or fee.
Refund:	Repayment of part or of all the amount of a tax, charge or fee paid.
RTPL:	Swiss flat rate road use charge (replaced in 2001 by HVF).
Scenarios by country:	Standard haulage scenarios, involving 40-t semi-trailers over 500 km within the country of registration.
Scenarios by flag:	International haulage scenarios involving 40-t semi-trailers of different nationalities over two itineraries: Manchester-Milan and Manchester-Zaragoza.
Scenarios:	Different "scenarios" were built up and used in this study, with various parameters (km travelled, itinerary, country or countries crossed …). See scenarios by country, scenarios by flag and paired flags.
Social costs:	Full costs, external costs included.
StraBA:	Austrian flat-rate road use charge.
Subsidy:	Transfer defined as a difference between chargeable income and the full social costs of freight transport.
Territorial charges:	Charges defined according to a geographical application criterion.
Territorial criterion:	Geographical principle used to define territorial structures, ranging charges from the most national to the most territorial ones.
Territorial structure:	Share structure for charges paid based on the territorial criterion.
tkm:	Ton-kilometre.
Tank tourism:	Driving vehicles into adjoining countries for the sole purpose of obtaining cheaper fuel. This only applies to domestic haulage operations. On international hauls, the refuelling of vehicles can be phased to exploit national

	differences in fuel taxes. The term 'tank tourism' is inappropriate in this case.
Toll:	Km based use charge.
Transfer:	Difference between chargeable infrastructure expenditure/costs and chargeable income (see also book transfer and full cost coverage transfer).
Use charges:	Charges paid in relation to usage. Some are paid on a flat rate basis (vignettes), others are strictly determined by km travelled and/or tons transported (tolls, distance/weight related charges).
Vignettes	In this report the term vignettes is used as short-hand for the following moderately territorial charges levied in the form of an entry ticket to use a road network: – the Eurovignette (although in Belgium the way scheme is administered corresponds more to an annual vehicle charge); – the StraBA in Austria; – and the RTPL applied in Switzerland until the end of 2000. Note that in contrast the term vignette is also employed in some countries to designate annual vehicle charges.

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