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ROUND TABLE 45

INFRASTRUCTURAL CAPACITY PROBLEMS RAISED BY INTERNATIONAL TRANSIT

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

PARIS 1979

ECONOMIC RESEARCH CENTRE

**REPORT OF
THE FORTY-FIFTH ROUND TABLE
ON TRANSPORT ECONOMICS**

held in Paris on 8th and 9th February, 1979
on the following topic:

INFRASTRUCTURAL CAPACITY PROBLEMS RAISED BY INTERNATIONAL TRANSIT

EUROPEAN CONFERENCE OF MINISTERS OF TRANSPORT

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- *to co-ordinate and promote the activities of International Organisations concerned with European inland transport (rail, road, navigable ways), taking into account the work of supranational authorities in this field.*

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General Introductory Report

TRANSIT PROBLEMS IN EUROPE

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SUMMARY

1. FOREWORD

It is most difficult to focus the whole problem of transit so as to draw a clearly outlined picture of it. Transit does not embrace the same concept for all European countries since its contours vary considerably from one geographical context to another. Socio-economic conditions peculiar to each country or group of countries also have a pre-eminent bearing on the differing features of transit from one region to another.

It accordingly seems appropriate to select a few points among those which seem vital for a broad understanding of the problem of inland transit in Europe, and to confine oneself to freight transport, in other words, "exchange of goods", but it must still be borne in mind that the problem of transit cannot be disassociated from that of domestic transport generally and that the problem of freight transport in transit very closely depends on passenger transport conditions, the converse being, of course, also true.

2. INTRODUCTION

It is almost commonplace to say that since the beginning of mankind, factors such as "space", "time" and "exchange of persons and goods", precisely because of their interrelationships, have played an increasingly important role. Throughout the process of civilisation and cultural development, transport of goods, besides personal mobility, has grown on a dramatic scale whilst undergoing profound structural changes. The original main trade routes such as those used for the amber trade and the silk trade, the main routes followed by the Phoenicians or the Chinese, were the first transit arteries, doubtless catering for the early needs for contacts between peoples. The slow pace of travel along these routes, the almost complete absence of any environmental nuisance, and the opportunities for trade and contacts provided by the intermittent passage of caravans were such that it was greatly to the advantage of the countries crossed in this way to encourage the development of these transit routes and diversify their alignments from North to South and East to West, and they were delighted to see any increase in the flow of trade. These routes, originally somewhat streaky and thinly frequented, became more diversified as the centuries went by and gradually expanded into a veritable network up to the 19th century. Since the heyday of industrialisation, within a few decades, flows of trade between continents

became intense, international links developed in all directions, and this contributed very substantially to the structural "sophistication" of the economy and society. Transit routes which had heard the padded tread of camel hooves and later the creaking of wheelcarts, those which had seen the passage of increasingly elaborate sailing craft, soon began to hear the din of smokey locomotives: rail transport was being added to road and river transport. Steam propulsion spread to the inland waterways and its impact was increasingly felt throughout the transport sector. It was only the revolutionary effect of the motor car at the beginning of the 20th century, after railway electrification, which turned steam propulsion into something like a "grandmother" of the transport system. After the rationality of transport "lines" came the euphoria of private transport. The transit countries looked passively - and even with a sort of democratic and open-minded complacency - at the simultaneous development of parallel facilities for each of the three inland transport modes: road, rail and inland waterways. But this period of peaceful and utilitarian co-existence side by side did not last and soon gave way to a dangerous phase of inter-modal conflict. As the transit countries gradually became aware of the risks that this competition implied, they also realised that the economic benefits formerly accruing from their position on transit corridors were slowly giving way to disamenities and to a kind of "free for all" which was likely to be a serious hindrance to their own domestic traffic and to their import and export traffics. At the present time, they suffer more than they benefit from transit traffic and the higher speed of traffic in transit does not improve their plight. In addition, transit routes provided side by side for each mode of transport raise a serious problem of land use since available space is not unlimited. This indeed brings about a cumulative process working in the wrong direction, for as the transport system becomes more closely meshed, the more the transit area is permeable to traffic. Network density measured in carriageway km per 100 km^2 can be taken as a coefficient of this permeability. This coefficient must not exceed certain limits and varies with the topography of the area concerned.

The "transit problem" is thus engendered by the incredible expansion of transport demand over the last 75 years together with increased competition between modes of transport.

3. HOW TRANSIT TRAFFIC HAS DEVELOPED

3.1 General

Passenger and goods traffic has increased a thousandfold over the last three-quarters of a century. In most transit countries on the European mainland, the volume of transit traffic alone doubles

every four or five years. Since 1973, the tonnage of goods carried by rail has risen by about 300 per cent. On the other hand, the inland waterways' present share of freight transport is relatively modest and waterway fleet capacity has increased only slightly over the last ten years, but the completion of a truly European network will undoubtedly give more scope for this mode of transport. In actual fact, it is on the road system that the increase in freight traffic in transit is most conspicuous.

3.2 Development of road traffic in transit

An enquiry into the increase and changes in transport demand that are typical of European traffic patterns during the last five years shows that, at least where Western Europe and East-West traffic are concerned, the road-hauled share of this traffic has risen more quickly than that of other modes. This was bound to have a direct impact on transit traffic, one of the special features of which - in each of the countries concerned - is its concentration on relatively few transit routes, and this generally increases the bottlenecks commonly encountered on these routes.

The following table is given as an example. It refers to North-South traffic in transit between the highly industrialised areas on the northern side of Western Europe (including the United Kingdom) and Italy. The figures for freight transport are as follows:

	Total freight traffic in transit in millions of tonnes	
Year	Rail	Road
1965	15.8	2.38
1970	22.6	5.19
1975	19.7	12.26

In Austria, for instance, road freight traffic in transit in 1973 accounted for 85 per cent of the total for rail and road transit combined. In 1976, the corresponding figure had risen to 94.3 per cent and the yearly rate of increase for freight transport in transit is close to 20 per cent.

In Yugoslavia, lorries and trailers are found to account for 18 and 30 per cent of total road traffic in transit.

Existing or planned transport infrastructures between the points of origin and destination of the goods were often not prepared for a change of this kind. Each transit country is increasingly confronted with the tricky problem of the gap between the capacity limit of its transit routes and the upsurge of transport demand. Saturation of

these routes usually leads to bottlenecks and transit country authorities often have no other means available than those enabling them to find partial and provisional solutions.

Yet this question of transit deserves comprehensive long-term treatment: the growth of car ownership and tourism is an irreversible development and personal mobility is in itself a good thing. Governments should ensure that these benefits are not cancelled out by saturated infrastructures. They are concerned about ascertaining the main causes of congestion and traffic jams on major routes. But traffic restraints cannot be imposed erratically nor can this be done on a purely national basis. Politicians have less freedom of manoeuvre than one might think; on grounds of environmental protection or for other reasons, transit countries cannot purely and simply refuse any extension of transit traffic and leave all the disbenefits of the European transport market to their neighbours alone. It is above all necessary to channel transit traffic and this must be done in the context of closer international co-operation. The problem of transit is very much an international problem. National investments in this field are chiefly determined by transport output and demand in neighbouring countries, irrespective of whether they too are transit countries or peripheral ones to or from which the traffic concerned is carried.

4. THE DISTINCTION BETWEEN COUNTRIES OF ORIGIN AND DESTINATION OF TRAFFIC AND TRANSIT COUNTRIES

The questions raised by transit traffic and the different ways of dealing with them vary widely depending on whether they are seen from the standpoint of countries consigning or receiving freight (and even those to and from which passengers travel) or that of countries crossed in transit:

- Their geographic situation being peripheral or at some distance from main routes, and also because of the structure of their economy and international trade, some countries feel scarcely any direct impact from transport in transit. They are affected only insofar as their imports or exports may be held up by bottlenecks in transit countries. Where transit is concerned, they are more especially "claimants". Their object is the speedy flow of traffic in the countries through which their vehicles pass, a minimum price for transit and widest possible liberalisation of transport.
- Those "on the defence", where transit is concerned, are precisely the transit countries themselves since they are most affected by the implications of the increased flow of traffic

which may, at least for one mode of transport, reach saturation. In the Federal Republic of Germany and Yugoslavia, there is a sharp increase in the percentage share of total traffic carried by road as compared with rail, road transport being seen as better able to absorb the surplus traffic. The opposite case may also arise in certain countries where saturation of rail capacity is apparent.

The inland waterways are generally able to absorb an additional transport demand, but waterway traffic in transit where Western Europe is concerned is of significance for only a few countries such as Austria, the Federal Republic of Germany and Yugoslavia. In addition, it is more difficult to switch traffic from the other two inland modes to the waterways because in the latter case the type of goods carried is much more closely linked with the means of transport selected to carry them.

The roads used for transit in most transit countries are designed for lower axle loads and less frequent runs than those which have been a feature of the vehicles used for transport on main corridors in recent years. All this implies reallocation of the financial resources appropriated for road construction and maintenance in those countries. The general features of road traffic can also be deeply altered: the relative shares accounted for by lorries and private cars have changed considerably in transit countries and operating costs for both domestic and international traffic have increased accordingly. Since it is usually apparent that the load resulting from increased traffic flows is unevenly spread, some readjustment of the balance by proper international co-operation seems increasingly advisable.

5. VOCATION (NATURAL FITNESS) FOR TRANSIT AND THE PRINCIPLE OF MUTUAL BENEFITS

General welfare in Europe seems to depend increasingly on the facilitation and speedier flow of international trade. The Final Act of the Helsinki Conference is a token of this very present inclination to dissolve the barriers (usually artificial ones) formed by national frontiers. In the particular case of exchange of goods, international trade increasingly depends on the transit facilities provided by neighbouring countries; the foreign trade of a country often depends on the fact that its neighbours make available traffic transit routes that are safe and suited to market conditions. But it is clear that this "free" supply by one country or the other of transit routes suitable for international traffic is not conceivable except in an international context involving at least some reciprocity. Vocation or natural fitness for transit is not an abstract

concept since it is entirely geared to the geographical conditions of a country. The need to facilitate the flow of trade on the one hand and the existence of suitable transit routes to match this need on the other are indeed closely related and it is this relationship which conditions each country's scope for manoeuvre: if the economic viability of country X depends partly upon facilitation of the flow of its imports and exports, it is of great importance for that country to find adequate transit routes in its neighbouring countries Y and Z and beyond. As the same applies to countries Y and Z as regards their imports and exports through country X, the latter has everything to gain from maintaining its own transit routes in good condition. In a strict context of reciprocity and mutual advantage, the provision of a transit infrastructure system on its own territory constitutes, for country X, the tribute it pays for facilitation of its foreign trade. That certain countries should suddenly repudiate their "transit country" vocation and confine themselves to a strictly protectionist attitude in this respect is unthinkable. A country considered as such cannot reason exclusively in terms of amenity and refuse any increase in transit traffic, for this simply means transferring the burden to its neighbours. Such a policy is a two-edged weapon and the edge turned against the outer world is not necessarily the sharpest.

Each country is responsible for the smooth flow of foreign traffic in transit across its territory. Its policy cannot be limited to the imposition of bans; on the contrary, its aim must be to ensure more efficient transport by smooth and fast movement of traffic.

The macro-economic determinants of the "vocation" or "fitness" for transit may thus be summarised as follows:

Each country's investments and investment decisions concerning transit on its own territory determine its neighbours' decisions. This is by no means a negligible sphere of influence for each country and is of great value for the process of co-ordination aiming to optimise transport in Europe. The economies of transit countries must usually be geared to healthy reciprocity where transit is concerned.

6. THE PRINCIPLES UNDERLYING ANY APPROACH TO TRANSIT

Where "vocation" or "fitness" for transit is concerned, two principles which must underlie any policy decision can be traced:

6.1 The principle of non-discrimination

Encouragement for the development of international transport in transit across a given territory should imply the fair distribution of such transport on the basis of the principle of non-discrimination as to the consequent national and foreign benefits, due regard being paid to all the economic and social aspects of these benefits. Efforts to refrain from discrimination between national and foreign carriers stem from this principle.

6.2 The principle of perfecting transit technology

The construction and operation of transit routes should be inspired by a spirit of international solidarity. There should already be technical co-operation at the construction stage and even at the "investment" stage. In this way it should be possible to comply with another central principle regarding transit, namely, the principle of shortest transit route in terms of mileage and journey time. Compliance with this principle indeed saves a great deal of time and money from being wasted.

The principle of perfecting transit technology also underlies the principle of integrated transit which aims to encompass the possibilities offered by all modes of transport. A close look at the map of Europe shows, for instance, that railways and road transit arteries nearly always run side by side. In some cases, they have even been added to a pre-existing inland waterway. In practice, this juxtaposition of infrastructures which is more likely to lead to a competitive struggle for each mode of transport than to a rational system of transit, is rarely an essential component of an integrated approach to transit. Any transit policy should much rather aim to provide an "operational" range of transport services, each mode handling those it can best cope with in terms of economic efficiency and without pushing up transport rates; that is how modal split should really work.

7. THE NEGATIVE EFFECTS OF INCREASED ROAD TRAFFIC IN TRANSIT FOR THE EUROPEAN COUNTRIES THROUGH WHICH THIS TRAFFIC PASSES

The benefits of transit cannot be expressed in terms of money. The good side of general economic efficiency rather lies in the field of foreign policy and foreign trade, and it is from a political angle that the implications of transit on the international position of each country should be judged. It has to be determined whether the disadvantages of transit, i.e. the fact that costs (in the macro-

economic sense) are not covered at the start, and the pressure on land resources together with environmental nuisances do not outweigh the benefits.

The negative effects of transit traffic may be classified under three headings:

7.1 Negative effects as regards the covering of infrastructure costs

The economic costs to be covered in consequence of the use of infrastructures stem from two more or less quantifiable concepts as follows:

- marginal costs relating to operation of the infrastructures
- congestion costs (in the macro-economic sense) and other "external" costs relating, for instance, to environmental protection, road safety and energy consumption.

The problem of the financial viability of transit infrastructures is of primary importance for the economy of transit countries. Yet the constant increase in transit traffic, lorry traffic in particular, means that the authorities concerned are giving more and more attention to the share of infrastructure costs actually paid by those who benefit from this traffic. It is generally found that, with the existing financing system, foreign lorries most commonly contribute to the payment of infrastructure costs only if they refuel within the country whose infrastructure they are using. But as the price of diesel oil varies from one country to another this leads to a great deal of distortion at international level, the more so as small countries can be crossed without any refuelling at all. In any event, the tax burden borne by lorries in transit does not cover the cost of infrastructure use. In many cases these costs are indeed covered by other motor vehicles (for instance, vehicles registered within the country and passenger cars). From the standpoint of a sound competition policy or indeed financial policy generally, this is bound to raise problems. A sound competition policy is of course based on the postulate that each type of traffic bears its own infrastructure costs. There is even more justification for this at international level and should constitute the basis of any attempt towards harmonization. Lorry traffic should not receive privileged treatment which is in fact given at the expense of other types of vehicles and of the public purse.

7.2 The negative effects on traffic and on the national economy generally

The main effects in this respect are as follows:

- greater wear and tear of road infrastructure;

- worse congestion, notably on main roads, which inevitably reduces local transport efficiency;
- damaging effects on tourist traffic, tourism being an industry to which many countries are attaching growing importance. It is not indeed in the general interest that transit roads should be crowded with foreign lorries to the detriment of tourist travel;
- increased consumption of energy drawn from domestic stocks for transport which is of very little interest for the transit countries concerned: this is particularly keenly felt when there is an energy crisis.

7.3 Negative effects as regards social implications

The main effects under this heading are of three kinds:

- effects which run counter to the efforts made to improve road safety;
- substantial deterioration of the human environment generally (air pollution, noise, landscapes spoilt by new transit infrastructures);
- additional pressure on land resources, especially in the case of small countries.

8. BRIEF REVIEW OF SOME CONCEIVABLE MEASURES FOR A RATIONAL APPROACH TO TRANSIT

The axiomatic basis of any approach to transit is "vocation (natural fitness) for transit": it is necessary to bring about a European scheme of things designed to ensure that goods in transit are carried efficiently and on a sound economic basis, but without this implying that any transit country is left powerless to deal with the negative effects of traffic moving on its territory; it should also enable each mode of transport to handle the share of traffic for which it is inherently suited, with due regard to the rationality of transport on a given route and to conditions of healthy intermodal competition.

A distinction can be made between two types of measures for securing viable transit conditions:

8.1 Measures concerning the construction of new transit routes and the introduction of new technologies

- Such measures should cater for traffic needs, basic requirements concerning the general economy, planning (with due regard to financial viability) and policy, account being also taken of existing technical possibilities and financial resources. International co-ordination in this respect is of primary importance.

A co-ordinated investment programme can be a first step towards a formal approach to transit. It may be coupled with an international financing plan which could help to ease the excessive burden on the budgets of transit countries as compared with the countries of origin or destination of the goods. However, the provision of international transit routes is scarcely distinguishable from that of routes catering for domestic needs, and it is very difficult to strike the right balance for international financing. Investment programmes should in any event pay due regard to the complementarity of transport modes where transit is concerned and should not be directed exclusively to one mode or another. It must always be borne in mind that goods traffic in transit, whether by rail or road, accounts for only part of the traffic using each infrastructure. It is indeed the other components which make up this traffic together with the geographical conditions peculiar to each route that should determine by which road "goods in transit" should be carried. The principle of the shortest route mentioned earlier on should also be a fundamental element of investment programmes.

- The introduction of new techniques such as those concerning combined transport should be part of any transit investment programme. Piggy-back technology, for instance, is a way of disposing of goods traffic speedily on certain routes where road capacity is saturated, but without this involving any break of bulk and without the road haulier losing effective control of the haul. This is one of the ways of enabling the railways to take the full share of traffic they can handle and so ease the pressure on certain sections of congested road infrastructures. It also helps road transport - which has its own inherent suitability - to proceed under less hazardous conditions as regards time of delivery for the carriage of goods.

For some years, piggy-back transport has helped to relieve pressure on the roads in several transit countries by diverting lorry traffic. It also helps to make better use of rail capacity where this is available.

8.2 Measures concerning existing networks

These come under various headings: financing the cost of transit infrastructure use, organisation of traffic on main arteries and the legal and administrative aspects of transit. Modal split and the channelling of traffic are also an integral part of this series of measures and the strongest emphasis must be placed on their bearing on the search for optimum solutions.

Such measures can be roughly classified by reference to two basic policies. The increase in European transit traffic has indeed triggered off two kinds of responses which as a general rule, were successive.

8.2.1 Restraints and bans

When faced with road congestion on some routes, transit countries were above all inclined to take protective measures more akin to outright bans than to an open policy consonant with "vocation (natural fitness) for transit". In most cases, traffic - or at least that part of it exceeding a predetermined ceiling - was banned without providing any alternative for transit, and the immediate effect of this was to hold up the flow of trade. Measures based on this attitude were essentially administrative measures such as quota restrictions, levies at certain bottlenecks and "police" measures.

Such measures are of course likely to relieve road congestions appreciably and in most cases their effects are immediate. But they do not in themselves suffice to reach the prime objectives of a rationalised transit system and they most commonly end up by shifting the burdens temporarily lifted from national territory to neighbouring countries. They can possibly serve to correct disparities in the system of international reciprocity but they do in any event run counter to the general principles mentioned earlier on. They should be of limited duration or restricted to special geographical conditions.

Road safety measures are of course continuingly necessary, but cannot be counted among the specific measures for attaining the objectives of a suitable approach to transit. They are usually parallel to the latter. Restrictions on weights and dimensions can be regarded as lying astride the "road safety" and "traffic restraint" categories.

8.2.2 Measures suitable for a well-balanced approach to transit

The other policy stance is chiefly based on an open attitude to "vocation for transit" and it implies measures which have a much greater impact on facilitation of trade within a transit context inasmuch as they readjust the balance of competition both between the countries concerned and between the modes of transport available for transit, with due regard to the principle of their complementarity.

a) By a generally applicable system of levies, foreign traffic can be made to share the national costs of infrastructure use and so help to finance the construction of new infrastructures and the improvements of existing ones.

Infrastructure pricing is based on the idea that all costs relating to usage of infrastructures must be identified, allocated and charged to users. Its essential purpose is to help decision-making with an eye to a rational and economically viable approach to transit involving cost transparency. It should make for optimum use of infrastructures and harmonization of the terms of competition

for transport in transit: all costs attributable to each mode of transport must be taken into consideration. For each unit using the infrastructure, they may be divided as follows:

- First, marginal use cost, this being equal to the additional cost borne by the owner of the infrastructure in consequence of one additional traffic unit, and
- secondly, external marginal costs, i.e. those reflecting additional costs unrelated to the existence of the infrastructure as such but generated by its use.

External marginal costs include congestion costs and those due to noise, accidents and environmental insult.

As the operating characteristics of the three modes are not the same, the implications of infrastructure pricing are different. As the railways cover all their infrastructure costs, at least in theory, this means that, in sectors where they are in competition with rail or inland waterway transport, due regard must be paid to how far the last two competing modes cover their infrastructure costs. In the case of road transport it is quite clear that "heavy traffic" does not cover the usage costs it generates. Congestion costs are particularly substantial for transit traffic where geographical conditions are difficult. Careful accounting of highway costs where due regard is paid to costs due to actual usage of the infrastructure, including maintenance costs, will show exactly what has to be paid for. Tolls for the use of infrastructure must provide for the minimum amounts corresponding to infrastructure costs which are not already covered by revenues directly linked to this usage such as fuel tax and taxes on motor vehicles.

In practice, such levies should not be restricted to main transit routes for this could well lead to a disastrous transfer of traffic to the "secondary" road network. Such taxation should be internationally harmonized as widely as possible as this would ensure a competitive situation without price distortion between countries or between transport operators in those countries, together with a fair distribution of tourist traffic in each country.

b) Another conceivable procedure is to assign transit traffic specifically to <u>certain routes</u> in a given country. This type of measure more particularly applies to the road network. "Reserved roads" are very helpful in dealing with the difficulties due to the coexistence of cars and heavy vehicles on the same routes. From a financial angle, it also means that special expenditure on infrastructures catering for heavy traffic can be concentrated where required. Such infrastructures must comply with more stringent design specifications. On "reserved route" infrastructures, procedures for collecting tolls are also facilitated and simplified.

This special provision for transit roads should whenever possible be coupled with measures designed to liberalise and simplify the administrative procedures concerning transport and traffic.

c) However, the provision of new road transit corridors or road pricing, even if introduced simultaneously, are not usually sufficient to resolve the transit problems of the countries concerned and avert the difficulties they imply: the extension of transport networks is not a question of money alone. In several countries where land is scarce, it is increasingly difficult to find alignments for new routes. What is more, environmental protection and road safety problems (to which increased importance is being attached in every country) are left unsolved by the first two measures mentioned above. Transport is not an end in itself but part of a loftier scheme of things embracing national and international economic and regional planning objectives. A macro-economic approach to transit cannot take into account only one mode of transport or another. For instance, though the opening of new transit motorways does begin by relieving pressure on congested roads, it subsequently generates additional car traffic. Only a healthy system of modal split - which is already relevant at the stage of involving choice of infrastructures, and especially when decisions are made as to the conditions of their use - can the problem be lastingly dealt with. Modal complementarity (combined transport being one of its practical forms among others) should be substituted for the simultaneous and parallel development of different modes which is typical of this day and age and which leads to considerable economic waste. An approach to transit which integrates the different inland modes makes it possible to organise transit in a suitable manner from the economic and environmental angles alike. That is where the political authorities have a vital role to play.

We have come to a stage of "new awareness" and we can only hope that our governments will be able to go beyond this stage and leap forward into a period of rationality, possibly a new "Golden Age" where transit, stripped of its problems and fitted with easier procedures, will once again be a useful factor for trade and for the well-being of the peoples of Europe.

CASE OF TRANSIT IN AUSTRIA

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SUMMARY

1. FIELD COVERED

This study deals solely with the problems caused by international traffic in transit through Austria and its effect on road and rail infrastructures. Traffic for which Austria is the country of origin or destination, and internal traffic, is taken into account only to the extent that it affects general consideration of infrastructure capacity.

Infrastructure capacity, with special reference to transit traffic, is generally viewed from three angles: technical, or practical, capacity, economic capacity and macro-economic capacity.

1.1 Technical, or practical, capacity

This is the maximum attainable throughput within a given period of time. It is used as a design criterion and depends on engineering parameters such as direction and gradient, number and width of traffic lanes, number of tracks, safety constraints and, above all, the composition of the traffic (relative shares of fast and slow vehicles) using the same infrastructure.(1)

- Road capacity is determined by the definition given in "High-Capacity Manual 1965" allowing for different performance levels.

The capacity of a four-lane motorway in capacity class A may be put at 4,000 cars an hour, or 2,000 cars an hour in either direction. An ordinary two-lane road will have a capacity of 2,000 cars an hour in either direction.(2) For road engineering purposes, therefore, the capacity of a motorway is about 40,000-50,000 car units (40,000 cars or 20,000 trucks) a day and that of an ordinary main road about 15,000 car units a day.

In rail transport, capacity depends on many factors and has to be calculated separately for each section of track. As a rule, the capacity of a two-track section of appropriate technical quality and with trains travelling at 70-100 km/h, may be put at 100 trains per day.(2a)

Effective capacity is in fact much higher. It is common for 60-80 trains a day to be run on single-track sections, provided the track is appropriately built.

1.2 Economic capacity

The economic capacity of a transit infrastructure is attained once the steadily increasing volume of transit traffic, in comparison with internal traffic, entails building and maintenance costs that are out of proportion with the "value added".

1.3 Macro-economic capacity

If the environmental impact of traffic density caused by transit flows reaches the point of putting the habitability of the transit area and its ecological equilibrium at risk then it may be economically viable for a transit country either to restrict use of the infrastructures concerned or to build new ones.

An analysis of transport infrastructure capacity might be expected to result in proposing improvements and/or additions and also the optimum use of existing networks. Of the two it would seem more logical - for financial reasons alone - to be content with more effective use of available infrastructures.(3) As an alternative to the construction of new infrastructures the better use of existing facilities could be considered.

2. PRESENT SITUATION AND INFRASTRUCTURE

Because of their geographical situation in the centre of Europe, both Austria and Switzerland are classic examples of transit countries lying as they do between the industrial countries to the North and South of the Alps and the Balkans and the Near East, with the most important road transit routes passing mainly through Austria.

Because of Austria's topography, opportunities for building large-scale transport infrastructures are narrowly limited and result, automatically, in the concentration of traffic in the valleys of the Alpine range. The main settlement areas stretch out along these valleys and suffer from pollution from local industry as well as the effects of transit traffic. Transit is a kind of heavy industry with a vast space requirement, causing much pollution and consuming large volumes of energy. Transit routes attract heavier traffic which creates the need for extension and that, in its turn, again stimulates demand. With this concentration of transit routes, a country may acquire an economic significance that it by no means intended for itself, but which may be of considerable interest to other countries.(4)

Not that Austria does not want transit traffic. It does, to the extent that this is in its interest. However, Austria must remain free to decide on the nature of that transit traffic, and particularly, as far as possible, its distribution over various modes and routes.

Although uncontrolled growth of what is called mobility is already being described as undesirable the demand in most national and federal strategies is to push ahead, in other words to build the required road infrastructures, although the impact on the environment is at the tolerability borderline. The effect of traffic using trunk routes is so great that, apart from anything else, whole valleys are at risk as regards both their agricultural exploitation and their function as recreational areas.(5)

Transit traffic goes through Austria via clearly-defined corridors in the north-south and north-south-east direction:

Roads:

- Kufstein-Innsbruck-Brenner motorway to Italy;
- Tauern motorway via Salzburg and Villach to Yugoslavia and Italy;
- North-South-East route (migrant workers' route) via Passau, Salzburg, Ennstal and Graz to Yugoslavia;
- East-West route from Switzerland to Arlberg and Innsbruck with access to the North-South route and continuing in the direction of Vienna, Hungary and Czechoslovakia.

The following transit routes:

- Salzburg-Vienna motorway to Hungary and Czechoslovakia, and
- Czechoslovakia-Vienna-Yugoslavia route are unimportant by comparison with the main transit routes and are not further considered in this study.

Railways:

- North-South route from Germany via Kufstein, Innsbruck and Brenner to Italy;
- from Germany via Salzburg, Tauern and Villach to Yugoslavia and Italy;
- Passau, Linz, Selzthal, Graz to Yugoslavia;
- East-West crossroute to Austria from Switzerland, Arlberg, Innsbruck and Vienna with connection to the North-South route (see figure).

Fig. 1
Fig. 6

3. TRANSIT TRAFFIC FIGURES

3.1 Trends in total traffic

3.1.1 Road traffic(6)

Between 1961 and 1976 the volume of road traffic in Austria increased by an average of 103 per cent, the figure for goods traffic

only being 128 per cent. During the same period road freight tonnage increased from 0.8 to 6.2 million tonnes (+675 per cent).

Fig. 2,3 International Traffic

(1) Passenger traffic (17)

Out of total international passenger traffic between Germany and Austria, 95 per cent (418,700 passengers in 24 hours) in summer and 90 per cent (88,200 passengers) in winter go by road, and the remainder goes by rail.

International air traffic is not dealt with in this report.

Growth compared with 1961 fits in with the general trend except for the migrant workers route (Salzburg, Passau, Graz, Yugoslavia) where the increase was greater.

(2) Freight

Traffic to and from Austria and its neighbouring countries increased by 273.6 per cent between 1961 and 1976, the increase in road traffic being 701.5 per cent compared with 42.9 per cent for rail.

Fig. 4,5

Total freight transit on Austrian roads went up by 2,254.3 per cent between 1961 and 1976 and by a further 9.77 per cent by the end of 1977, making a total increase of 2,509.4 per cent compared with 1961. In 1971, modal split between rail and road was about 2:1 but since then there has been a shift in favour of road transport and by 1976 the latter was already attracting 58.8 per cent of total transit traffic.

In 1976, too, road transit already accounted for some 30 per cent of total freight traffic on Austrian roads. It should be stressed that, on individual routes, the ratio between inland trunk haulage, including international transport with Austria as the country of origin or destination, and transit traffic was even less favourable.

3.1.2 Rail transport

Passenger transport traffic for Austria as a whole hardly changed between 1961 and 1977 but some figures increased for individual transit routes.

Fig. 4 The total volume of goods traffic went up by only about 20 per cent between 1961 and 1977 whereas transit traffic increased from 4.9 to 8.9 million tonnes over the same period.

3.1.3 Other modes

International goods transport by the Danube waterway and via pipeline is not discussed in this study. The increase in international goods transport via the Danube (12.6 per cent between 1961 and 1976) is very small by comparison with the figures for land transport. At the moment there is no capacity problem but a steep increase in the volume of traffic is expected once the Rhine-Main-Danube canal is opened.

3.2 Traffic forecasts

In 1977, rail transit traffic through Austria totalled:

8.9 million tonnes (net)

and transit road haulage:

14.01 million tonnes (net).

Fig. 7 The breakdown by route for the latter figure is as follows:

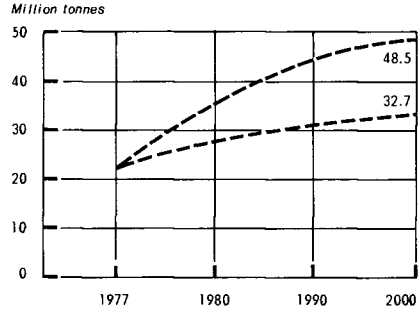
Brenner:	52.9 per cent
Tauern:	17.3 per cent
Arlberg:	12.6 per cent
Other routes:	17.2 per cent

The key factor in forecasting freight transport is the rate of economic development in Austria's neighbouring countries. This is estimated at an annual figure of 3 per cent for Italy and the Balkans and 2 per cent for the countries to the North.

A further point is that North-South transit traffic crosses both Austrian and Swiss territory and Switzerland has calculated that the total volume of her transit traffic will lie between 32.8 and 37.0 million tonnes (net) by the year 2000, of which 16.9 - 24 million tonnes would be North-South transit traffic.

Total North-South transit traffic through Austria and Switzerland will, on this basis, amount to a figure between 32.6 and 47 million tonnes (net) by the year 2000.

GROWTH IN TRANSIT TRAFFIC 1977-2000



The total volume of transit traffic through Austria is expected to increase to 32.7 - 48.5 tonnes (net) by the year 2000. The low and high figures correspond to high and low forecasts for economic growth in the neighbouring countries.

The breakdown of these figures by main corridors is as follows:

- Brenner 15.7 - 23.0 million tonnes
- Tauern 4.6 - 9.1 million tonnes (including Innkreis and Phyrn motorway)
- Arlberg 5.4 - 7.4 million tonnes
- Other transit routes 7.0 - 9.0 million tonnes

Thus the main transit routes - Brenner, Tauern and Arlberg - will have to cope with 25.7 - 39.5 million tonnes.

How badly forecasts can be wrong is clear from the study on traffic in the German-Austrian Border area(17) which predicted that goods traffic crossing the frontier by road in 1990 would have increased by a factor of 1.2-1.3 as compared with 1971. The volume of goods traffic in 1990, on this basis, would be 5.52 million tonnes (net) - a figure already exceeded by total freight traffic crossing the frontier between Germany and Austria in 1975. The growth factor for international passenger traffic between 1971 and 1990 is put at 1.58-1.87.

By and large, goods traffic does not vary during the year but international car traffic fluctuates considerably from season to season, with larger growth rates in summer.

The total car loading on roads between Germany and Austria is forecast at:

- 46,500 cars per day (24 hours) in spring;
- 131,500 cars in summer (24 hours).(17)

4. CORRIDOR STUDY

Fig. 1 As already stated, both rail and road transit traffic is concentrated on a number of well-defined routes:

Corridor 1:	Brenner route (rail and road)	
Corridor 2:	Tauern route (rail)	
	Tauern motorway:	Salzburg-Villach-Yugoslavia
	motorway and ordinary main road:	Salzburg-Ennstal-Graz-Spielfeld
Corridor 3:	Railway:	Passau-Linz-Selzthal-Graz-Spielfeld and Klagenfurt-Tarvis
Corridor 4:	Arlberg route:	Switzerland-Arlberg-Innsbruck

4.1 Brenner corridor

4.1.1 Preliminary note

The Brenner corridor runs from the frontier at Kufstein along the Inns to Innsbruck and there southward over the Brenner pass to Italy. The catchment area includes the major part of the Federal Republic of Germany, Belgium, the Netherlands, Denmark and Sweden in the North and Italy in the South.

The share of traffic accounted for by peripheral countries like France, the United Kingdom and Yugoslavia is slight and can be disregarded.

In the Tyrol, the corridor runs between steepsided mountains through the main settlement area where, apart from transport infrastructures, there is a concentration of industry, high voltage transmission lines and other supply facilities. The environment problem is therefore of significance.

4.1.2 Railways

The geographical structure of the railway network in the corridor has changed very little since the beginning of the century. A dual-track line runs from Kufstein via Innsbruck and Brenner to Italy. In the Inntal there are the following connecting lines:

- Dual-track: Wörgl - Schwarzach - St. Veit towards the East;
- Single-track, parts dual-track: Innsbruck - Landeck - Bludenz - Switzerland.
- Single-track (of no significance for transit traffic): Innsbruck - Mittenwald line to Munich.

With a few exceptions, conditions on the Inntal line from Kufstein to Innsbruck allow a maximum speed of 140 km/h. The dual-track section from Innsbruck to the national frontier at the Brenner pass is a mountain railway with the conditions that this implies:

- average gradient 2.5 per cent, minimum radius 257 m;
- total length 37 km, split into eight blocks;
- maximum section speed: 80 km/h.

a. Traffic growth

Fig. 8 The volume of passenger traffic hardly changed between 1960 and 1977 whereas that of goods traffic increased from 2.74 to 3.62 million tonnes over the same period as a result of economic development in the EEC countries. About 88 per cent of the total is transit traffic distributed among the different routes as follows:

- 83.6 per cent Kufstein - Brenner

- 8 per cent Lindau - Brenner
- 9.3 per cent Summerau (Czechoslovakia) - Brenner
- 3.9 per cent Scharnitz (Germany) - Brenner
- 0.6 per cent - Other transit links.

The 109 km transit section between Kufstein and the Brenner pass carries some 12 per cent of total freight transit output (in tonne-km) on Austrian railways.

Only about 6 per cent of North-South freight and 50 per cent of South-North freight needs high-speed transport.(7)

b. Future development

On a status quo basis, passenger traffic will increase from a figure of about 2.6 million passengers in 1971 to about 3.2 million in 2000.(1)

Given appropriate promotion measures for rail transport, improvements in service and some control over transport demand, there could be a 22 per cent increase in the volume of passenger traffic by comparison with status quo development. In other words, by the year 2000, the Brenner corridor could be used by about 3.7 million passengers a year.

The building of a new 200 km/h rail link as a new crossroute from Hamburg, via Cologne, Frankfurt, Stuttgart and Zurich to Milan and Bologna would, as a result of its greater attraction, syphon off traffic from the Brenner route and reduce the number of long-distance passengers to some 2.4 million a year.

The maximum effective increase in long-distance passenger traffic, as compared with 1971, would be about 1.1 million a year. This would call for an additional ten trains, or five trains in either direction. During the peak travel period, however, a further five trains in either direction would be necessary so that, to cope with the expected 3.7 million annual passengers by the year 2000, some 22 long-distance trains in either direction would be necessary.

Growth in goods transport by rail will largely depend on transport policy measures. Status quo development (trend extrapolation) suggests that the volume of traffic by the year 2000 will be about 7 million tonnes.

c. Capacity

The section between Wörgl and Innsbruck currently carries:

- 60 expresses
- 28 other passenger trains
- 81 goods trains
- 18 service trains
- 45 service trains between Innsbruck and Hall.

On the basis of the above mix of fast and slow trains, the capacity of the Kufstein-Innsbruck section is 260 trains a day.

That of the Innsbruck-Brenner section, with facilities at their present state, is 160 trains a day though peak capacity could, of course, be higher than this.

The capacity of the Brenner line is limited less by the gradients than by the inaccessibility of the rail installations at the Brenner customs post itself. Increasing the capacity of the Brenner line must therefore inevitably imply the development and extension of the frontier station between Austria and Italy.

4.1.3 The Brenner Road

The Brenner motorway from Kufstein to Brenner, with a link to Italy, was opened in 1969 and for most of the way runs alongside the railway (completion in Italy in 1974).

The volume of long-distance traffic has steadily increased.

The number of cars using the road went up from about 2.9 million in 1970 to 6.2 million in 1977 and total traffic, in car units, climbed from about 3.5 million in 1970 to 8.4 million in 1977. Particularly noteworthy is the substantially greater increase in lorry traffic which accounted for 17.2 per cent of the total in 1970 but 26.2 per cent in 1977. Since 1976, the level of passenger traffic has been more or less stationary whereas goods traffic is again increasing substantially in 1978.

Fig. 8 The volume of goods transport increased from 1.83 million tonnes net in 1970 to 7.71 million tonnes net in 1977, in other words a factor of 4.21 in 7 years. The figures given by the Brenner Autobahn AG are unrealistic and do not correspond to average use of vehicle capacity on a trunk haul.(8)

On a status quo basis, the volume of goods traffic on the Brenner motorway should increase to about 11 million tonnes net by the year 2000. This is equivalent to an additional load of 3,500 car units per day. Since there is unlikely to be any further increase in passenger traffic, particularly once the Gothard motorway is opened, the ratio between lorry and car traffic is likely to tilt even more in the direction of the former. The expected proportions of 35 per cent and 65 per cent car traffic will necessarily reduce capacity and, once saturation point is reached (about 1990) a new North-South Road will be needed.

Peak levels now occur mainly during the peak travelling times of July and August. The highest daily vehicle count has been 48,758 vehicles or about 52,000 car units. Average daily traffic is about 24,000 car units. The maximum capacity of the Brenner motorway may be put at about 40,000 car units per day.

4.1.4 Conclusion

- General development -

On the basis of foreseeable economic growth in neighbouring countries, North-South transit traffic will increase to 36-53 million tonnes net per year.

After deducting the North-South transit traffic that may be expected to go through Switzerland (Swiss Commission on General Transport Strategy, goods traffic in the year 2000) the volume of North-South traffic through Austria may be expected to lie somewhere between 15.7 and 23 million tonnes net. As already stated, modal split between rail and road will depend on transport policy measures.

The need for such measures is clear from the changes that have taken place in the volume of North-South transit traffic through Switzerland and Austria.

From 1974 to 1976 North-South transit traffic via Switzerland decreased by more than 4 million tonnes net whereas that via the Brenner motorway increased very steeply suggesting the conclusion that the drop in transit traffic via Switzerland has been made up almost completely by road transit traffic via the Austria North-South axis (see graph attached).

Fig. 9

Effective modal split between rail and road would have to be worked out on the basis of the effective use made of the capacity of both infrastructures. If the volume of transit traffic were to be reduced then the Brenner motorway would continue to have sufficient capacity, but that of the Brenner railway is limited.

To carry the expected increase in passenger traffic an additional ten trains a day would be necessary and a further ten during the peak travelling periods, in other words a total of 20 trains per day.

For the railways to have a capacity of 9 million tonnes net per year, assuming that a goods train carried 500 tonnes, 30 trains in either direction would be necessary, in other words a total of 60 trains in 24 hours. But empty trains and service trains also have to use the track so that about 160 trains in all would be needed to cope with the total volume of passenger and goods traffic.

In its present condition, the capacity of the Brenner railway will be at full stretch by the year 2000.

From the technical standpoint, the following local measures to increase the capacity of the Brenner line would be sufficient to cope with the volume of traffic in the year 2000:

- improvement of hand-over capacity at the Brenner station;
- extension of stations between Innsbruck and Brenner to accept longer trains;

- use of higher-powered locomotives to pull 1,000 tonnes gross trains;
- shorter block intervals.

With a view to faster transport services, particularly for passenger transport, the OECD study recommends an increase in speeds to 140-175 km/h. To be realistic, it seems to us reasonable, particularly in view of the ratio of 52 passenger to 60 goods trains, not to assess long-distance passenger traffic at over 3.7 million trips a year. As from about the year 2000, improvements will be necessary on the Brenner railway, in which particular attention will have to be paid to the ratio between fast and slow trains. Long-distance trains are hardly likely to exceed 20 per cent of total train traffic and the economics of future improvements will largely be conditioned by the volume of goods traffic to be expected, for which there is no need to build new high-speed sections. Care must also be taken not to create over-capacity by building new high-performance lines in competition with a high-quality road infrastructure since the high cost involved would have an adverse effect on the profit situation of the railways.

Shifting the customs station for transit goods traffic to Wörgl for both German-Austrian and Austrian-Italian clearance could make considerable time savings. In many cases transit time is a decisive factor in the selection of mode and better conditions on railway routes could well make rail transport more attractive.

With the measures referred to and certain line improvements to allow higher speeds, the capacity of the Brenner line could be increased to 220 trains a day.

The cost of improving the railway line from Wörgl to the Brenner has been calculated at about 900 million.

4.2 Tauern Corridor

4.2.1 Railway

a. Alignment

The Tauern Corridor begins in Salzburg and goes via Bischofshofen, Schwarzach-St. Veit, Bad Gastein and Villach, continuing in two directions to Rosenbach (Yugoslavia) and Tarvis (Italy). The section between Schwarzach-St. Veit and Spital/Millstättersee may be described as a mountain railway:

- gradient about 2.7 per cent;
- minimum bend radius 235 m;
- overall speed between 65 and 90 km/h.

The terminal sections from Villach to Jesenice and Tarvis are one-track.

b. Traffic figures

Total passenger traffic increased by 100 per cent between 1964 and 1973, although - and this needs to be stressed - the number of passengers has levelled off in recent years (from about 1974 onwards). The increase in road traffic is not the only reason, socio-economic aspects also play their part. The best that could be hoped for is an increase, on a status quo basis, from the present figure of 3 million passengers to 4.5 million by the year 2000. Suitably promoted, passenger traffic on the railway could be increased to about 7.5 million a year. The maximum total load on the Tauern section, including local traffic, would be 8 million passengers a year.

c. Goods traffic

Rail freight shows a similar downward trend.

Fig. 10
Fig. 11

Modal split between rail and road is dipping steeply away from the railways and, theoretically, if this trend goes on it would mean that, by the year 1985, all transit goods traffic would go by road. This downward trend in net tonnage contrasts with the gross figures which show an increase and therefore suggest that more empty wagons are returning from Italy to Austria via Tarvis and Tauern. The upward trend in traffic via the Villach-Tarvis route is due to an increase in transit traffic from Czechoslovakia, Hungary and the GDR to Italy.

A point worth noting is that the recession, although clearly perceptible on the railways, has hardly had any effect on the general trend of traffic volume on the "Tauern route" line.

d. Capacity of the Section

Fig. 12 The capacity of the individual sections is shown on the attached chart; the average use made of capacity is about 70 per cent.

Over the section between Rosenback and Jesenice (Karawanken tunnel), capacity is already fully used.

The single-track section between Villach and Tarvis, now 75 per cent used, has a capacity of 120 trains.

An additional twelve trains a day would be necessary for the expected increase of 1.5 million long-distance passengers.

Fig. 13 A further 16 trains could be put on before the capacity of the section, in terms of scheduled services, were fully utilised. An average load of 400 tonnes per train (because of the imbalance between North-South and South-North freight)

would give an additional volume of 2 million tonnes net making a total of 5.2 million. The number of trains could easily be larger on a non-scheduled basis but comfort criteria would be a constraint and delays could well occur.

The increase for the section Villach to Rosenback would be 20 trains daily, which would also mean maximum use being made of the capacity of the line.

Capacity could be increased to 250 trains per day if the following measures were taken and this would make it possible to shift traffic from road to rail and to cope with requirements up to the year 2000:(12)

- improvement of throughflow at Salzburg main station;
- three-track improvement to the Salzburg-Golling-Abtenau section (to accommodate local traffic);
- improvement to track to allow for speeds of 140 km/h;
- improvement to signalling equipment;
- closing-up of block intervals between Salzburg and Bischofshofen-Schwarzach-St. Veit;
- dual-track improvement to Tauernscheitel section with track improvement to increase train speed;
- building of a second graded section from Zell am See in the direction of Tauern. This would make it possible to shift goods transit traffic from the Brenner section to the Tauern line, crossing the frontier at Tarvis, and spread the use of capacity more evenly;
- closing-up of block intervals in the area of the Tauernscheitel section and between Spital and Villach;
- conversion to dual-track with line improvements between Villach and Jesenice;
- dual-track improvement to the Villach-Tarvis section (for reasons of transit traffic via Vienna-Bruck a.d. Mur-Tarvis).

The cost of these improvements is estimated at about 3.2 billion Austrian Schillings at 1978 prices.

4.2.2 Tauern Corridor - Road

a. Alignment, topography

There are several road routes for transit traffic from the North and North-West to the Balkans, all from Salzburg, as follows:

- the B 159, B 167, Tauernschleuse (railway boarding point), B 105, B 106, B 100 to Villach;
- the A 10 motorway now being built from Salzburg to Spittal a.d. Drau (Tauern motorway, completion date 1980);

- Salzburg, B 159, Liezen, B 308, St. Michael, B 113, Gleinalm motorway, Graz, Spielfeld, B 67, Yugoslav frontier;
- Salzburg, Bad Ischl, B 158, Liezen, B 145;
- Passau, Wels, Pyhrn Pass, Liezen (connection with the B 113), St. Michael.

The continuation of the Tauern motorway in Yugoslavia is already planned and the Karawanken road tunnel should be ready by 1981.

Part of passenger traffic (an average of 800 cars a day in either direction) goes via the half-finished Tauern motorway or the parallel ordinary main roads, but most passenger traffic, and the major part of goods traffic, goes via the Salzburg, Liezen, St. Michael, Graz, Spielfeld (migrant workers road) route. Between Graz and Spielfeld North-West/South-East transit traffic is joined by the North-South transit traffic between Czechoslovakia and Yugoslavia.

The ordinary main roads between Salzburg and Villach cross steep alpine passes and for that reason alone are unsuitable for transit freight. Preference goes to the route mentioned in the previous paragraph because of the few gradient problems and also because of the link-up with the roads in Yugoslavia.

b. Traffic trends

Between 1973 and 1977 the volume of goods traffic in transit on the routes referred to increased from 779,749 tonnes to 1,777,900 tonnes.

Car traffic over the same roads also increased from 10,000 to about 16,000 (a 60 per cent increase). The average growth in inland traffic, including foreign vehicles crossing the frontier, was only 30 per cent as compared with 1970 so that on these roads, transit traffic was responsible for the difference of 3,000 cars as compared with normal growth, an annual increase in traffic of 1.1 million vehicles.

The annual volume of goods traffic by road (1,778,000 tonnes) involves the use of 500-600 commercial vehicles or road trains per day, equivalent to a load of about 1,800 car units. Since 70 per cent of transit haulage goes via the Salzburg, St. Michael, Graz, Spielfeld route, commercial traffic (transit and internal) accounts for some 25 per cent of total traffic.(9)

If the present trend in goods transit traffic continues this share will climb to nearly 50 per cent of total traffic by 1982. If car traffic also increases, a likely assumption in the light of car use forecasts and the increased demand for passenger transport services, the capacity of this route will be at full stretch by 1982. Counts taken in Niklasdorf and Rothleiten - peak loads of up to

30,000 vehicles a day on two-lane ordinary main roads - illustrate traffic trends in recent years.

The Gleinalm motorway was opened in 1978 and this has eased the traffic situation considerably.

The perilous situation on the Salzburg, Graz, Spielfeld road corridor is apparent from its steadily increasing accident rate and density. The route is one of the most accident-prone in Austria.(13)

Fig. 14

The reconstruction of the Innkreis-Pyhrn motorway is planned, as part of the Federal road building programme, to serve as an international transit route between northern Europe and Yugoslavia for both commercial vehicles and cars. It will help to relieve the load on the migrant workers route.

4.3 Pyhrn Railway

The Pyhrn line, as a further North-South link from Linz via Selzthal, St. Michael, Graz, Spielfeld, with a connection from St. Michael via Klagenfurt and Villach to Italy, and via Jesenice to Yugoslavia, is connected to the international railway network in very unfavourable conditions as regards track layout. Trains travelling South-East from Germany would have to be halted in several stations. This uneconomic process means that, with the exception of South-Eastward transit traffic from Summerau (Czechoslovakia), the Brenner and Tauern routes are preferred, although, geographically speaking, the Pyhrn-Schober Pass section has more to recommend it as a transit route.

Conditions on the section as it is at the moment, namely:

- gradients of up to 2.5 per cent on the Pyhrn line;
- up to 1.6 per cent on the Schober Pass section;
- smallest curve radius 260 m;
- maximum speed allowed over the section: 65-120km/h,

limit working capacity which, at a rate of utilisation of about 80 per cent, may be put at 142 trains a day.

The daily volume of goods traffic - both international and internal - averaged 13,668 tonnes net in 1977, equivalent to an annual figure of some 4.1 million tonnes net.

If the rail system were completed between Wels and Traun there would be a new direct transit connection from Germany to Italy and Yugoslavia which would, if effective transport policy measures were taken, allow an increase in traffic (governed by capacity) because of its attraction. In addition, pressure on Linz station would be relieved freeing capacity there for the expected increase in East-West traffic.

The following measures would help to increase the working capacity of the whole section:

- Construction of Wels, Traun, Pyhrn railway connectiing loop;
- Dual-track improvement to the Zelzthal, St. Michael section, to give a design speed of 140 km/h;
- Construction of southern loop in Zelzthal;
- Closing up of block interval throughout the section;
- Line improvements to increase the speed over the section.

The cost of these measures has been estimated at about S.1.5 billion (1978 prices).

4.4 Arlberg East-West corridor

a. Alignment

By Arlberg corridor is meant the route from the frontier crossing at Buchs (Switzerland) to Innsbruck and Salzburg and then on towards the East. As regards infrastructure capacity, this study is confined to the Buchs-Innsbruck part with the crossing of the Arlberg.

At the moment the section is single-track and the part between Bludenz and Landeck is a mountain railway with typical mountain railway conditions:

- maximum gradient: 3.5 per cent;
- minimum curve radius: 254 m;
- maximum permissible speed between Bludenz and Landeck: 70 km/h.

Between Innsbruck and Telfs-Pfaffenhofen the section has been made dual-track and improved to allow speeds of up to 140 km/h. In the Arlberg-Scheitel section, 10 kilometres of the line before the Arlberg tunnel is to be converted to dual-track to make, together with the Arlberg tunnel, a 20 km section allowing higher speeds.

b. Traffic trends

Although no less than about 3.2 million passengers used this route in 1977, it does not appear in the OECD Project 33 study as a main route for future long-distance passenger traffic functions.

Fig. 15 Of particular significance is East-West goods traffic which increased, between 1965 and 1977, from 2.41 million to 3.1 million tonnes net, 1,288,000 tonnes (about 41 per cent) being transit traffic.

c. Capacity

The capacity of the section is governed by the mountain railway section between Bludenz and Landeck currently used, on average, by the following:

- 25 express trains;
- 10 other passenger trains;
- 15 service trains;
- 30 goods trains.

Maximum capacity has been worked out at 110 trains a day although the number could be larger on peak days. An additional 12 goods trains could be introduced to make full use of capacity, on an annual average, which would mean that the volume of traffic could be increased to some 1.5 million tonnes net.

On the present trend, maximum working capacity would be fully used by 1990.

If capacity is to be increased, primarily for piggyback trains, the Arlberg section will have to be improved.

The following measures would be necessary:

- conversion of the Feldkirch-Bludenz section to dual-track and an increase in maximum speed to 140 km/h;
- conversion of Arlberg gradient from Bludenz to Langen and from Schnann to Landeck to dual-track;
- conversion of Ötztel-Landeck section to dual-track (the Landeck-Telfs section will be completed by 1990);
- improvement to safety equipment.

These measures would step the capacity of the section up to some 250 trains a day.

The cost of these measures to improve capacity has been worked out at about S.3.0 billion (1978 prices).

d. Arlberg road route

There is an ordinary main road in the East-West direction crossing the Arlberg at an altitude of 1,700 m, with gradients of up to 15 per cent. The new, approximately 14 km, Arlberg road tunnel will be opened in the winter of 1978/79.

Trends in the volume of goods traffic are significant.(10)

On average, 1,300 commercial vehicles or road trains use the Arlberg section every day. At a net figure of 10.2 tonnes per haul, the volume of goods traffic on this road currently totals an annual 3,315 million tonnes net. Transit traffic (40 per cent, based on the transit share of rail traffic) works out at about 1,326 million tonnes net.

When the Arlberg road tunnel has been opened there is likely to be a shift of traffic from rail to road.

The capacity of the Arlberg motorway is about 30,000 vehicles a day and average traffic is unlikely to reach this figure by the year 2000 so that transit traffic will not cause any capacity problems.

5. SUMMARY AND CONCLUSIONS

Total goods traffic increased from 5.4 million tonnes net in 1961 to 22.9 million in 1977. The railways' share of this was 90.1 per cent in 1961 but only 38.9 per cent in 1977. The recession in 1974 and 1975 had no effect on transit traffic. The almost 30 per cent drop in North-South transit traffic through Switzerland was offset by an increase in transit road haulage through Austria.

By the year 2000, transit traffic will increase to 32.7-48.5 million tonnes a year, depending on the rate of economic growth in the neighbouring countries, and will be concentrated on the main corridors:

- Brenner: 15.7-23.0 million tonnes
- Tauern: 4.6- 9.1 million tonnes
- Arlberg: 5.4- 7.4 million tonnes
- Other transit routes: 7.0- 9.0 million tonnes

Modal split between rail and road will largely depend on three criteria:

- capacity;
- transit time;
- costs.

Road transport will largely satisfy all three conditions but the railways, particularly as regards transit time, will have to make a major effort.

If trends continue as they are, the volume of transit traffic on the roads will increase still further. Road infrastructures in existence in 1980 will have the necessary capacity to accommodate forecast traffic volumes in the East-West and North-South-East directions but by about 1990 the Brenner motorway will have no spare capacity left because of the continuing increase in transit traffic.

When the Tauern motorway is completed together with the motorway planned in Yugoslavia to connect up with the Karawanken road tunnel, south-eastward car transit traffic will increase. The Innkreis and Pyhrn motorway will help to take some of the pressure off the Munich-Salzburg motorway but, more particularly, will attract additional transit haulage in the south-east direction from northern

Europe. The maximum capacity of the Tauern and Innkreis-Pyhrn motorway will not be fully used by the year 2000.

The improvement of the Ulm-Milan express road planned in the transport strategy adopted by the Association of the Alpine countries does not seem to be so necessary since the San Bernadino Route is a considerably shorter link to Milan. Winning back any holidaymaker traffic flows lost because of this to the Alpine passes in east Switzerland should not be regarded as a vital objective in view of the high investment cost of further road improvement in the Austrian Alps.(18)

In Switzerland's Overall Transport Strategy (target projection SV2) only 0.4 million tonnes out of a transit total of 32.8 million tonnes is put down to road transport. This clearly implies that Switzerland will take transport policy measures to see that nothing is done to alter unused rail capacity to the advantage of road transport. This assumption is confirmed by the figure of 3 million tonnes traffic that the Strategy sees being carried by combined transport.(11)

In other words, before the idea of building a new road is considered the aim should be to achieve a balanced use of capacity on existing transit infrastructures. Even if no significant improvements were made to the Brenner, Tauern and Arlberg rail transit sections by the year 2000, apart from those already planned, road and rail transit traffic could be fully accommodated if full use were made of rail capacities.(14)

Breakdown of transit traffic in million tonnes (if rail capacity is fully used):

	Rail	Road
Brenner	7.7	8.0-15.3
Tauern	3.1	1.5- 6.0
Arlberg	2.8	2.6- 4.6
	13.6	12.1-25.9

Investment totalling S.8.6 billion would be necessary for the increase in railway infrastructure capacity that would be required to raise speeds and shorten transit time.

One highly-recommended project would be to build the Wels-Traun connection in order to make the Pyhrn-Schober pass section available as another North-South rail transit route.

Once the above measures were completed, the whole volume of transit traffic - given normal growth - could be handled by rail. If the upper figure for total transit traffic (25.9 million tonnes) is taken there would be some 6.3 million tonnes to go by road.

The economics of an investment of S.8.6 billion on rail infrastructure improvements would be completely justified if transport output on the railway were increased to full utilisation of capacity.

Road transit output in 1977 was about 2,100 million tonne/km as compared with 2,764.5 million tonnes/km by rail.

The additional output possible by rail if meximum capacity were used has been calculated to be 1,348 million tonne/km.

Investment necessary	S.8,600 million
of which, for goods traffic	S.5,160 million
Financing cost (6.344 per cent a year)	S.327.35 million
Maintenance cost,(15) (60 per cent goods traffic)	S.479.5 million
Annual costs	S.806.85 million

This works out at S.0.60 per tonne/km of transport output.

As against this, the increase in revenue would be S.0.80 per year per tonne/km net (comparable figures for Switzerland: 12.4 Rp. in 1974).(16)

On the assumption that the rolling stock to carry the additional 7.1 million tonnes net is available, S.0.20 per t/km would be sufficient to cover the additional cost for the increase in freight.

Further growth in transit traffic will depend on traffic policy measures which can, however, hardly be made effective unless - apart from improvements to infrastructure capacity on the railways - organisational measures are also taken to improve the attractiveness of railway freight services. To win road transit traffic back to the railways, increased use will have to be made of combined transport for which it will be necessary to provide not only the relevant transfer equipment but also the appropriate rolling stock because an old-fashioned piggyback service is not calculated - from the technical or the organisational standpoint - to offer an attractive transport facility with short transit times. Direct trains from Munich via Austria to Bozen, with a change of locomotive in Bozen, and centralised customs clearance in Wörgl would help substantially to reduce transit times.

The investment figures shown would given an infrastructure capacity that would leave a reserve of about 30 per cent, even if the upper limit were reached as regards the expected volume of transit traffic, and this would make the provision of new transit infrastructures in the Austrian Alpine area unnecessary up to the year 2000.

Bludenz, September 1978

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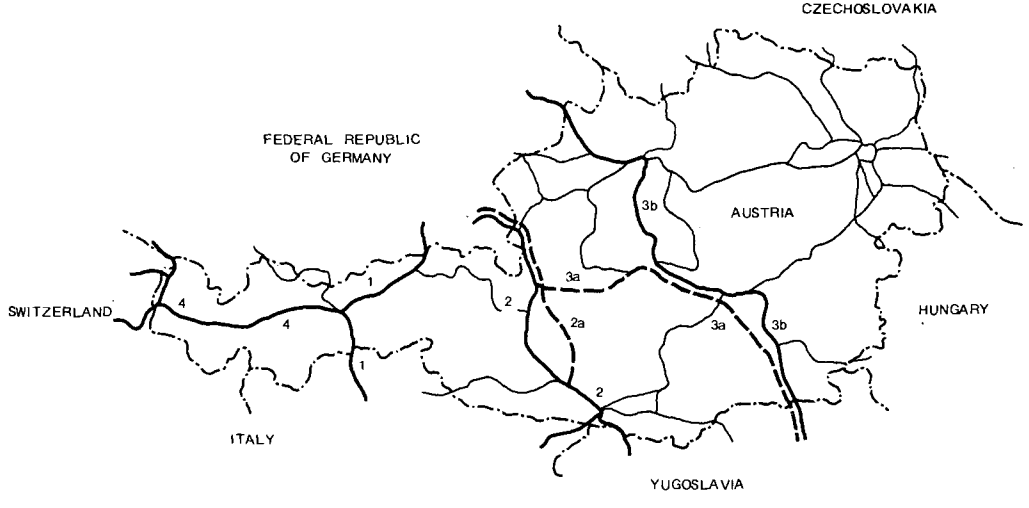
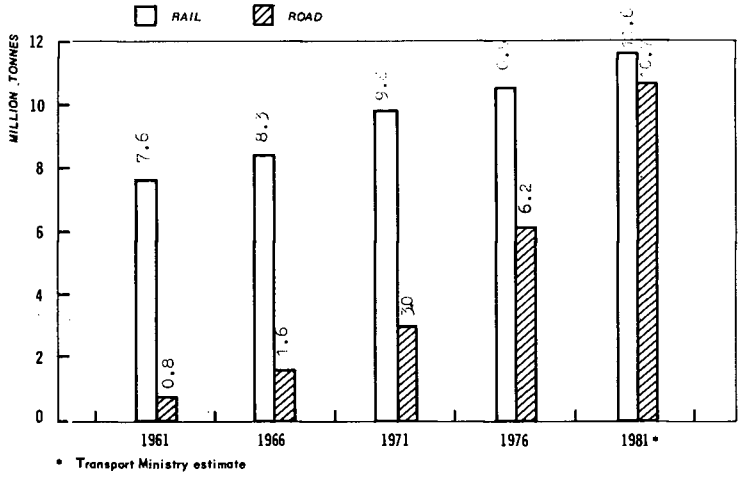
Figure 1



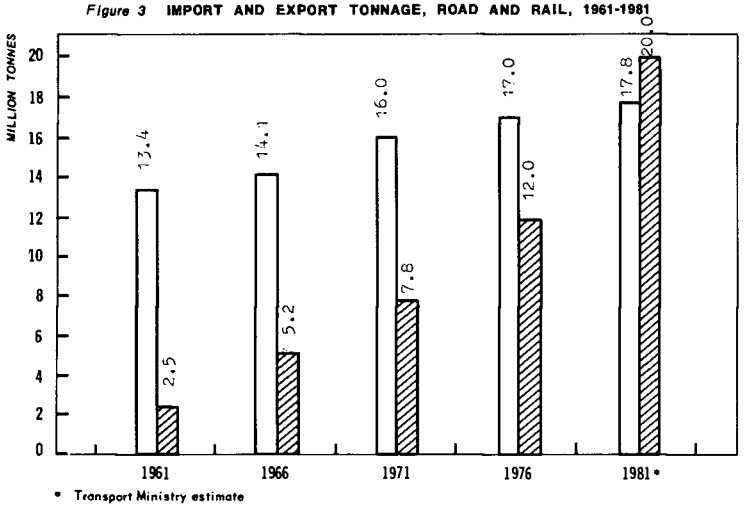
1 *Corridor*
2 *Tauern Railway corridor*
2a *Tauern motorway*
3a *Migrant workers route (road)*
3b *Pyhrn railway*
4 *Arlberg*

Figure 2 **TRENDS FOR ROAD AND RAIL FROM 1961 TO 1981**



* Transport Ministry estimate

Figure 3 **IMPORT AND EXPORT TONNAGE, ROAD AND RAIL, 1961-1981**



* Transport Ministry estimate

Figure 4 **TRANSIT TONNAGE, ROAD AND RAIL 1961-1977**

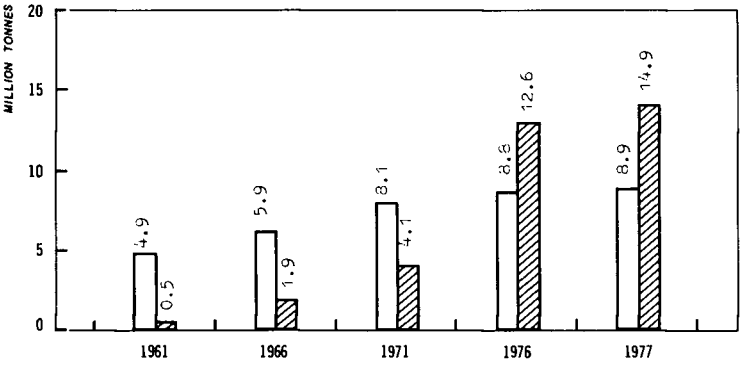


Figure 5 **AUSTRIA'S INTERNATIONAL FREIGHT TRAFFIC**

Trend of modal split in rail and road transit from 1961 to 1977

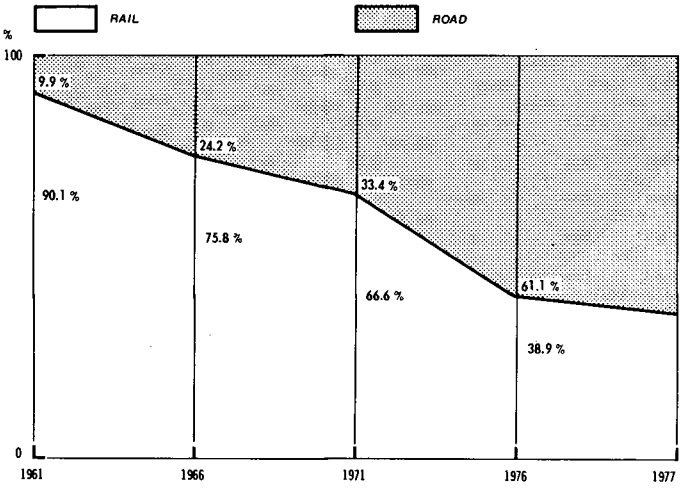


Figure 6 **TRANSIT TRAFFIC ON AUSTRIAN RAILWAYS**

Only routes carrying over 10,000 tonnes - All figures in '000 tonnes

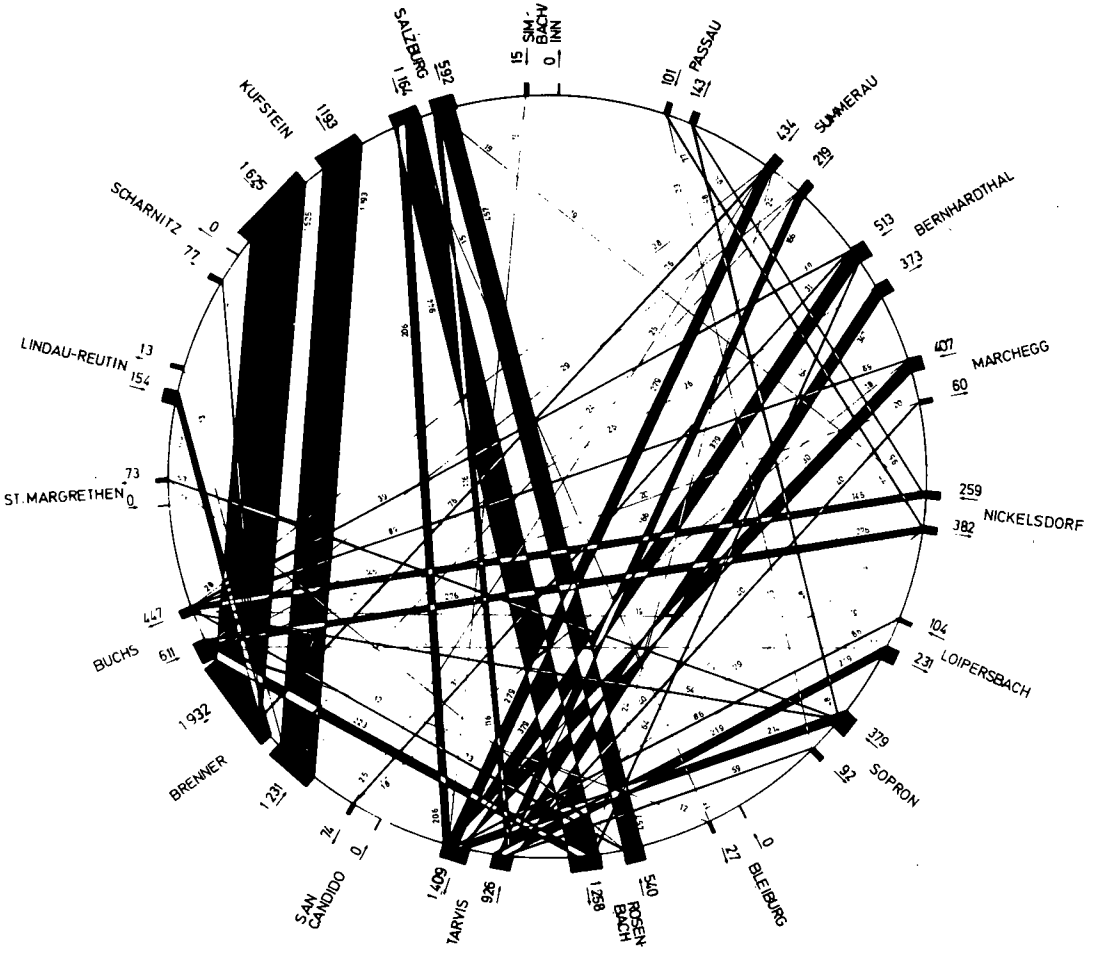


Figure 7 **BREAKDOWN OF FREIGHT TONNAGE**

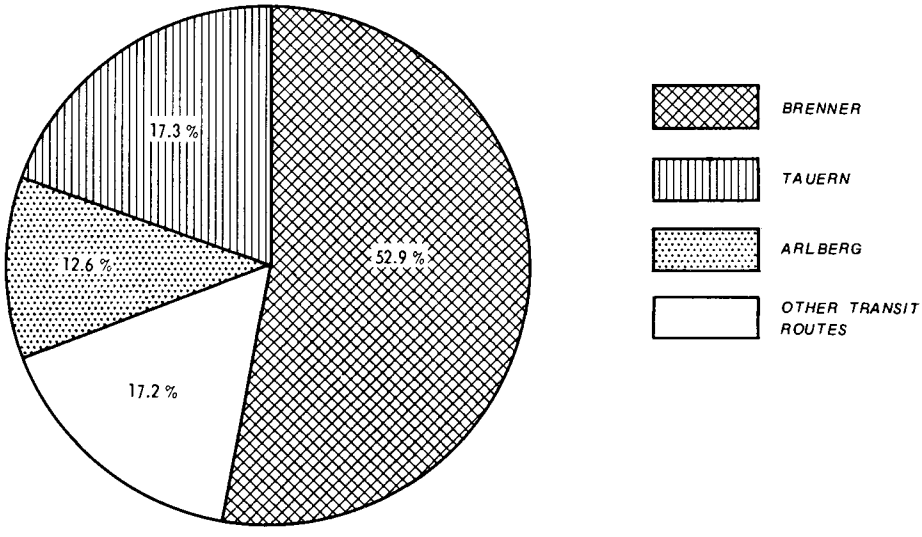


Figure 8 **BRENNER ROUTE - FREIGHT TRAFFIC TREND**
Tonnes (net)

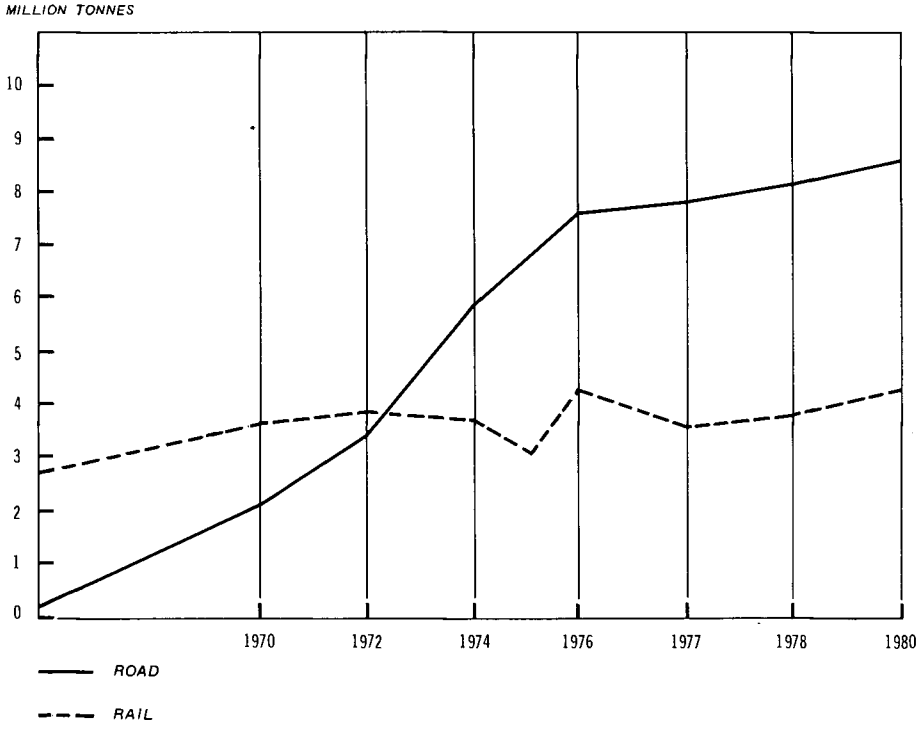
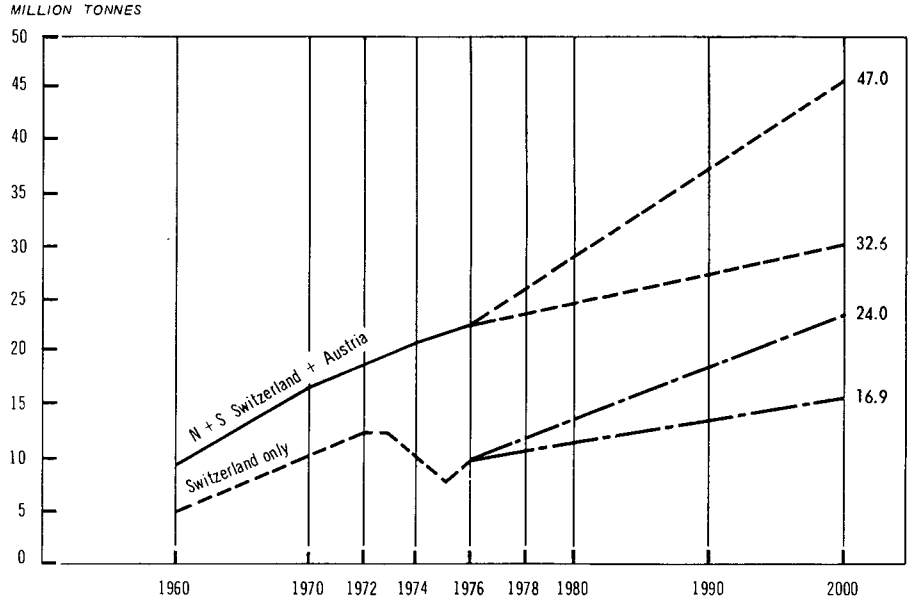


Figure 9 **TREND IN N-S TRANSIT TRAFFIC**



Source : ZA, Austria. GVK, Switzerland.

Figure 10 **TREND IN RAILWAY FREIGHT, TAUERN ROUTE**
(Schwarzach-Spittal)

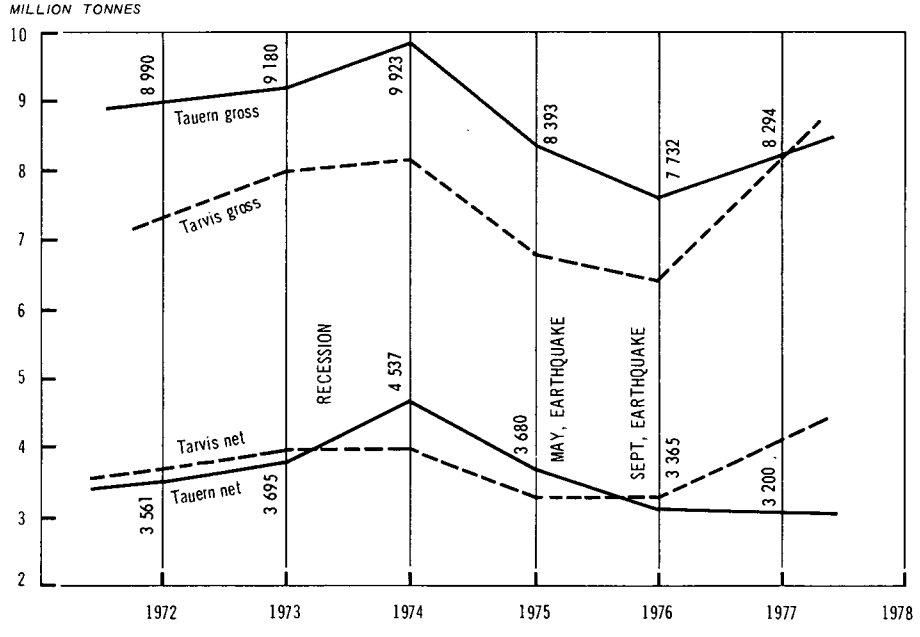
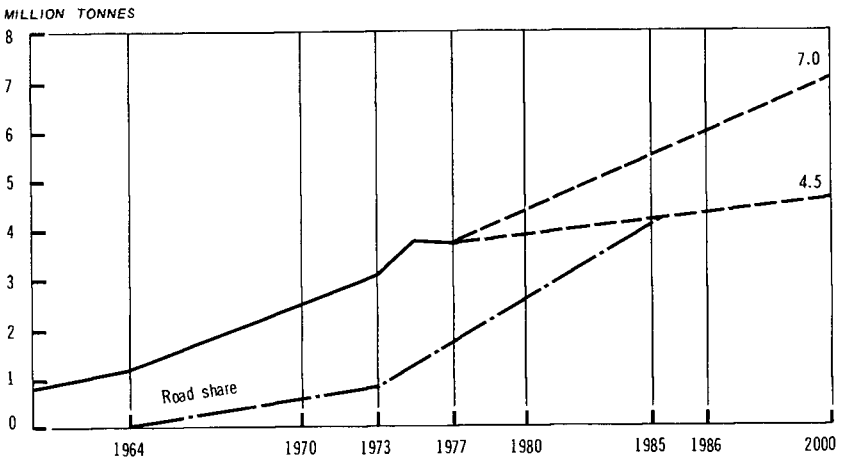


Figure 11 **TREND IN TRANSIT TRAFFIC (WITH BALKANS), ROAD AND RAIL**

Transit share of total traffic, imports and exports (with downward trend)



Source : Austria : ZA ; UIC - Tauern Route Study Group.

Figure 12 **TAUERN ROUTE SALZBURG-ROSENBACH (RAIL)**

Capacity and Utilisation

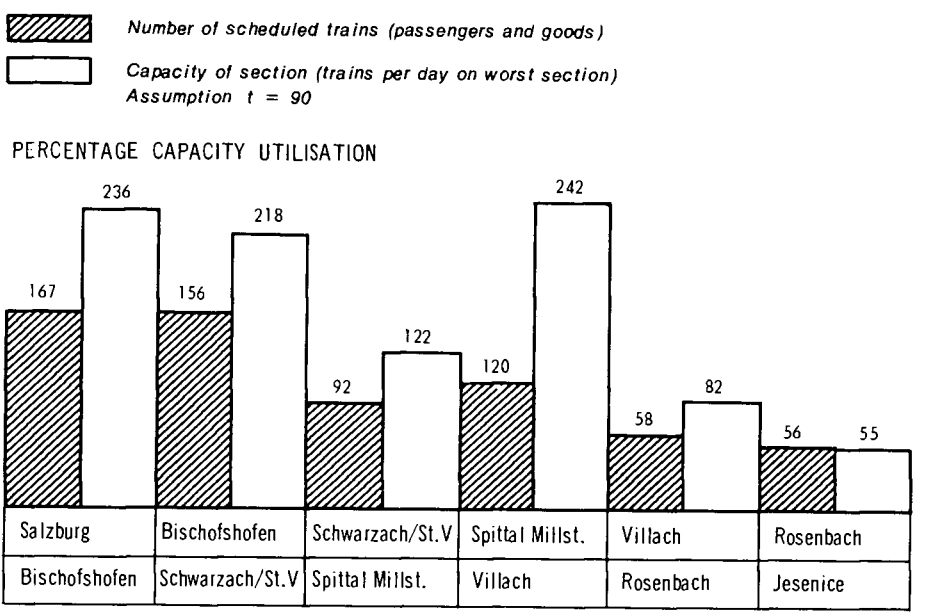


Figure 13 **AUSTRIA'S INTERNATIONAL FREIGHT TRAFFIC**
Section : Schwarzach/ St. Veit - Spittal/ Millstättersee
Tonnes (net)

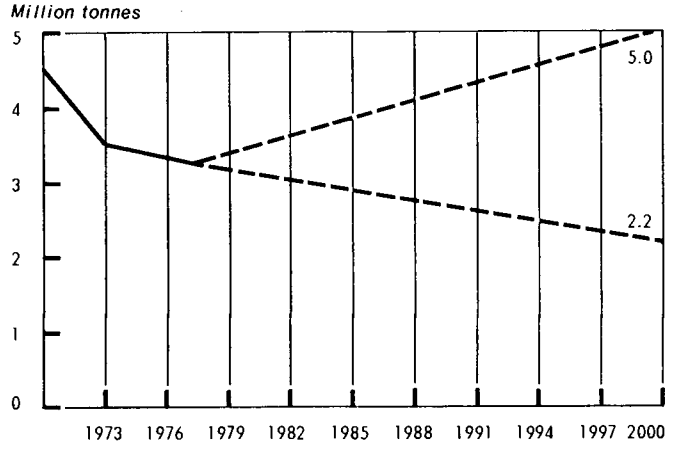
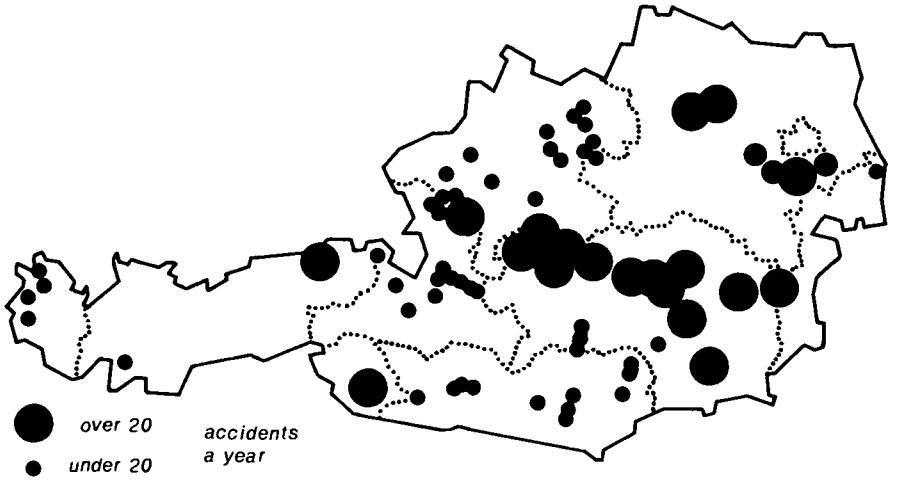
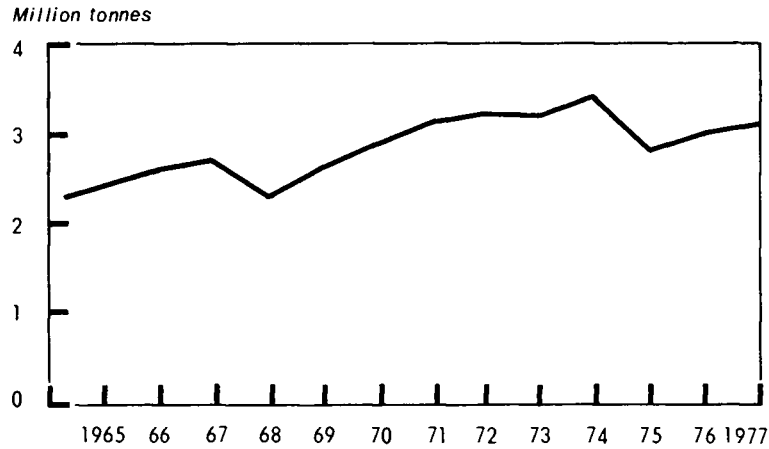


Figure 14 **ACCIDENT BLACKSPOTS IN AUSTRIA**



Source : Safety on Styrian Roads.

Figure 15 **TONNAGE TRANSPORTED ON ARLBERG SECTION**
Tonnes (net)



CASE OF TRANSIT IN DENMARK

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SUMMARY

1. GENERAL

Transport has become a basic factor in society through the high level of integration which exists in society's industrial and social relations.

A future society will not necessarily be dependent on physical transportation to the same degree as we are now. Commuter traffic with its demand for resources will possibly be decreasing in the society of year 2,000. An advanced system of telecommunication and transmission will render it possible for the human being again to work and live with his family.

However, today's need for transport for overcoming the demands of economic and social life clearly dominates visions of a possible future world.

The growth of national - and the accelerating rate of growth in international - transport is a function of a development that started more than 100 years ago.

At that time agriculture, commercial and small-scale industrial activities were the main activities. Each region had its special pattern depending on the basic geographical and environmental possibilities.

Economically and commercially the region was very often a fully integrated area having only weak relations to neighbouring areas. At that time transit traffic of any importance was observed only in very few regions.

A fundamental change in this situation was observed around and before the year 1900 when industrial and economic growth began in western Europe, and when specialisation and differentiation in production life accelerated. The economic activities became orientated towards light industries and service activities. In parallel to a growth in BNPs a change in composition of BNP was observed. Production of goods became still less important in relation to service activities that concentrated around urban centres which were rapidly growing everywhere, and which attracted the worker potential in the rural areas.

The urban areas gave life to newcoming and still more specialised industries, attracted also by the infrastructural conditions of the areas. The general economic growth explained by a differentiation in production structure meant primarily a growth in city size and in the volume of transport work.

Compared to the situation in the start of the process an important differentiation of the production is observed, and the number of transformations which raw material is exposed to before it reaches the state of final demand is multiplied. In the start of the period raw material was in general totally manufactured and consumed within a limited geographical area. Now the way from raw material to final demand often passes through several geographical regions and industrial sectors, and therefore give rise to a still more important international transit traffic.

This development is far away from the classical localisation theories which required that localisation took place where the primary production factors were found. There is, however, still a localisation pattern because localisation is now dependent on the communication structure of the immediate higher and lower level in the highly differentiated production process.

The development has by the labour-saving differentiation of the production process meant a substitution of labour as well as of other production factors by transportation. Linked together with this development a rapidly growing demand for investments in the transportation infrastructure was observed.

The value of the final product of the high ranked industrial process is composed of the price for raw material and the single "value added" elements in the differentiated production process. Because of the advantages of economics of scale and specialisation transportation has become a still more important production factor.

The role of transportation in the manufacturing process is highly dependent on the costs of transportation and the economics of scale and specialisation. The growth in the transportation sector and the related infrastructural capacity problems is therefore to a high degree explained by the decrease in transportation costs.

As international transit is the main topic of this paper it must be stressed that international traffic is to a high degree regulated by the communication and information structures between countries. This fact will be further explained later in the paper.

Transportation work could generally be classified in one of three types of transportation.

1. Transport of raw material from its in situ position to the area where the initial manufacturing process takes place. Talking of international transit this type of transport is mainly of importance for crude oil.

2. Transport of semi-manufactured products between the different levels in the production process. As the degree of manufacturing - and value/weight relation - is going up, the demand

for high quality transport rises. It is inside this category of freight transport that the important growth of transportation has taken place. This is related to the production structure in society. Transport is often introduced in the production function resulting in specialisation and economics of scale in the industries and is adding to the capacity problems also of international transit.

3. Distribution of goods from industry to the commercial links before the product finally goes to the consumer represents the third category of freight transport. Very often these transports bring the product to the city centre with its difficult transport structures. Measured in t.km this type of transport is only important for very special types of industries.

Of course an important amount of transport cannot be classified in the above structure. For example agricultural products represent a very high degree of irregularity with regard to transport due to the fact that certain parts of the production are transferred to industry for further manufacturing whereas other parts such as fruits and vegetables go directly to the consumer.

Thus it is seen that technical innovations through economies of scale and the advantages of specialisation is an important factor in the explanation of society's rapidly growing demand for transport, and in the explanation of national and international capacity problems.

An understanding of the basic transport-generating factors is fundamental for the planning of future transport infrastructure systems, and is a necessary basis for political decisions concerned with transport investments whether those investments refer to infrastructure or hyperstructure or whether they are caused by regional, national, international or transit traffic.

It should be recognised that transportation problems because of lack of convenient infrastructure in theory may act as a barrier to the formation of free markets in spite of the withdrawing of existing customs regulations or liberalisation of other regulations.

The level of transportation whether it concerns national, international, or transit traffic is dependent on political judgements. Special regards to certain groups of the population or aims like a certain national or regional development could be realised by investments in the transport infrastructure. The Great Belt Bridge between Jutland and Funen in Denmark thus for political reasons must be established before a bridge or tunnel to Germany or Sweden.

The tools that could be taken into consideration by society for the management of the capacity problems in the transport sector could be classified into three different groups:

1. Investment policy. There is no doubt that an important regulation factor is found directly in the infrastructure system because of the relation between infrastructure standard and generalised transportation costs (waiting time).

2. Taxation has long been used for society's co-ordination of the development inside the transport sector in general and especially for handling the modal split problem.

3. General economic policy is of importance for the development in transport work. For national traffic the policy of regional development is important. For international and transit traffic, the commercial patterns between countries which again are heavily dependent on international economic markets are very important.

Investments in infrastructure is an active and long-termed tool. The requirements for capital of this method have caused the development of sophisticated optimising models for choosing between alternative investments. The optimality of an investment, however, must always be dependent on the development of future demands - and traffic.

As investments in the infrastructure generally are nationally financed and therefore of course nationally decided, and often nationally paid there is often no direct argument for national investments in the infrastructure if the need for the investment is to a high degree formed by international transit capacity problems.

Capacity problems could be overcome by other methods than investments in transportation infrastructure. A capacity problem is always a function of demand, i.e. tons of goods, number of vehicles, etc. that wants to pass a given traffic link as well as a function of physical capacity of the traffic link. Therefore capacity problems might simply be overcome by rendering it less attractive to pass the traffic link. This "decrease in attractiveness" could be reached by high tolls for the use of the infrastructure - or by taking away the basis for commercial activities between regions. The amount of goods crossing the borderline between France and Germany is for example much more important than the amount passing from Western to Eastern Germany.

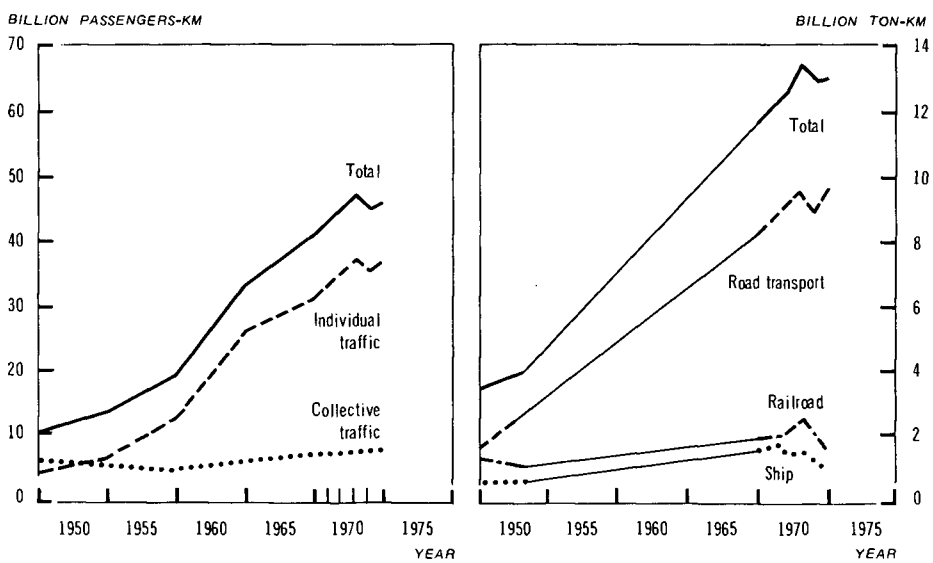
It is therefore an important point to note that capacity problems could not always be exposed to visual observation.

Capacity problem for the traffic between Scandinavia and the continent - or between the Eastern and Western parts of Denmark - is the case to be studied in this paper. The main part of this traffic would pass the Great Belt between the two main islands of Denmark if the conditions on this traffic link were reasonable. Today the traffic on this link is heavily taxed, meaning that even if there are not very often physical capacity problems at the ferry route today at the Great Belt, the general capacity problem is serious.

Public investments in the transportation sector is in Denmark an important part of the public investments. In 1977 the public investments in Denmark were D.Kr.15 billion (US$2.5 billion), and the investments in the transportation sector were D.Kr.3 billion, i.e. the most important element in the investment bill. Talking about the central government (The State) more than one-third of its investments is reserved for traffic goals.

A background for this important amount of money is that the establishing and operation of the main part of the transportation network is in Denmark a public affair.

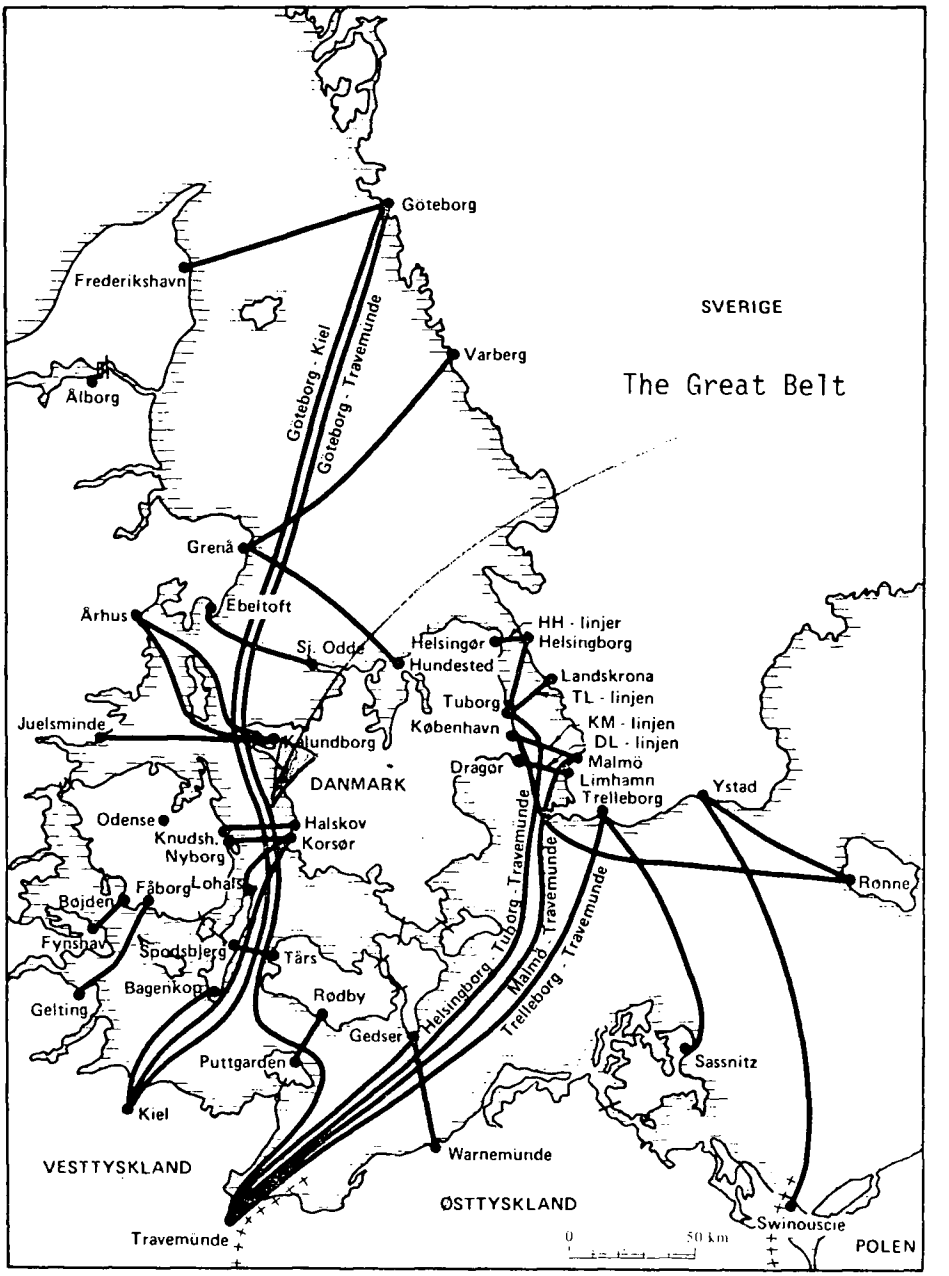
The need for these important investments is made by the transportation figures which again is a result of the economic and industrial development.



It is seen that transportation work has been rapidly growing since 1950 and that this growth primarily has taken place in the road sector.

Individual transportation, which in Denmark mainly takes place in private cars, is thus 9-doubled from 1950 to 1975. In 1950 individual transportation by private car amounted to 40 per cent of the

Figure 1 **FERRY ROUTES BETWEEN FENOSCANDIA (FINLAND, NORWAY, SWEDEN) AND THE CONTINENT**

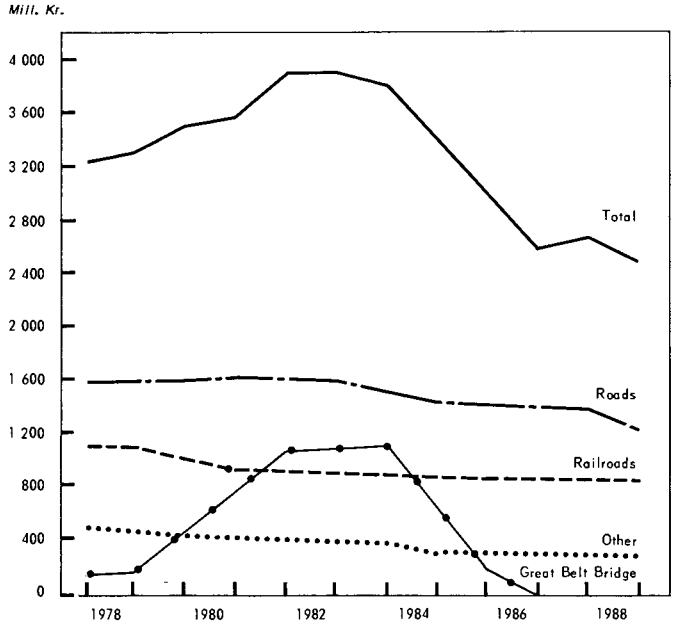


total passenger traffic. In 1975 this figure was more than 80 per cent when only motorised transportation is regarded. Only about 25 per cent of the passenger transport is commuter traffic or pure professional transportation. Seventy-five per cent is concerned with shopping or leisure time.

Freight transport by road is almost 6-doubled in the 25 year period, and is today accounting for 80 per cent of the freight transport market. This figure was 50 per cent in 1950. The energy crisis in 1973 was clearly observed in the transportation sector, as almost no growth was observed at that time. However, the situation today is almost like the situation just before 1973.

The traffic investment in Denmark in the period 1978 to 1989 is shown in figure 2.

Figure 2 **PUBLIC INVESTMENTS IN THE TRAFFIC SECTOR 1978-1989**



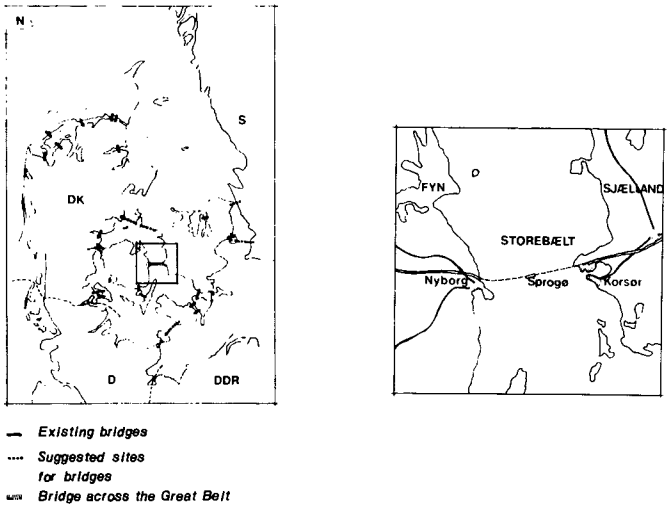
In the period the total amount of money invested will be D.Kr.40 billion or 3.3 billion per year. The time profile for these investments shows an increase in the first years until 1983. After that time a decrease is expected. This development is primarily explained by the expected investment in the Great Belt bridge which requires a total amount of D.Kr.5.8 billion invested in an eight year period.

The above-mentioned investments plans that was generally anticipated in the Danish Parliament in the early summer of 1978 is now being revised especially because of the Great Belt bridge which is decided postponed by 1st September, 1978 for some years.

In the next section of this paper we would go through the Great Belt bridge project.

2. THE GREAT BELT BRIDGE PROJECT

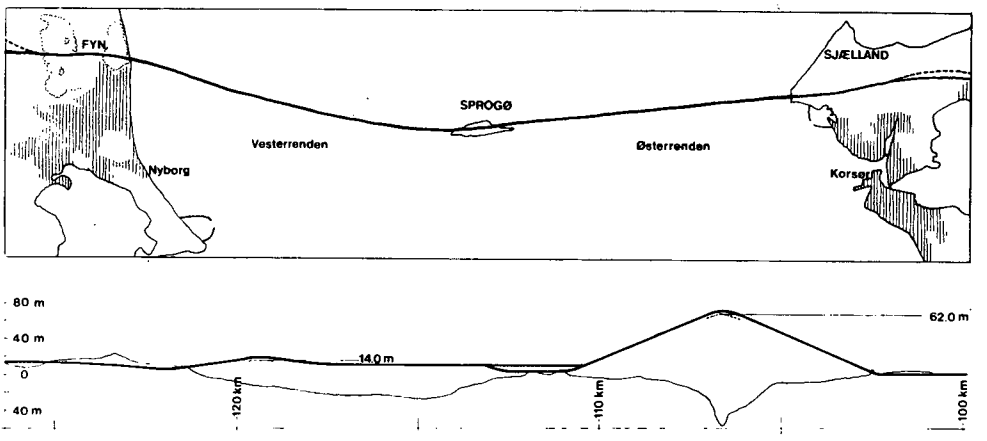
A permanent traffic link across the Great Belt will be important for the traffic from Scandinavia to the continent, will connect Denmark crosswise, and connect Copenhagen, the capital, with the main provinces. A bridge across the Great Belt will be the greatest man-created structure in the country.



Today about nine million passengers, about two million cars, and about five million tons of goods are conveyed annually across the Great Belt between Zealand and Funen, by ferry boats making a total of approximately 25,000 return trips.

The first plans for a permanent traffic link across the Great Belt were prepared 100 years ago - a tunnel being proposed. Since then many other possibilities have been studied, such as bridge or tunnel throughout.

The Danish Folketing (Parliament) decided in 1973, to have a bridge built across the Great Belt, as a combination of a railway and motorway bridge, this decision was confirmed in 1976, and again in 1978, then in August 1978 it was decided not to start the construction works - as planned - in September 1978.



Siteplan approx. 1:135,000. Hight approx. 1:54,000.

	Road	Rail
Length, West channel	9.5 km	9.5 km
" East channel	8.2 km	8.2 km
Gradient, maximum	35 o/oo	17 o/oo
Design speed	120 km/h	160 km/h

Navigable passages

West channel: clear widths minimum 2 x 65 m

East channel: clear widths minimum 2 x 360 m

The cost of the bridge, including embankments and approach systems, is estimated at about D.Kr.5.8 billion, in 1977 prices, exclusive of value added tax.

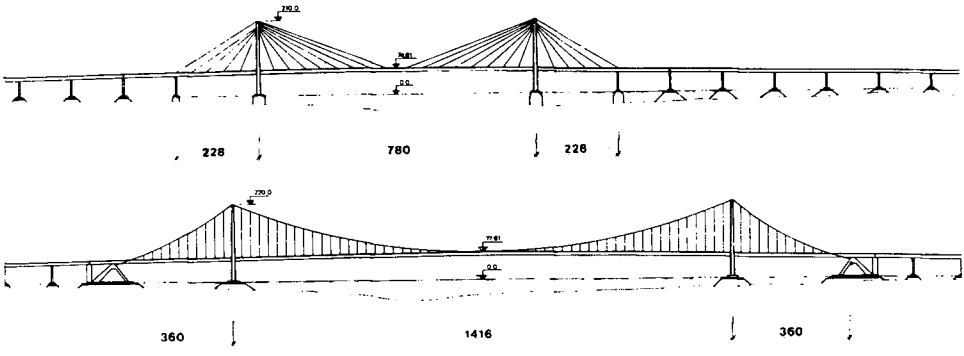
The State is the owner, and the expenses are to be covered by bridge tolls; the actual rates to be applied have not been fixed, as yet.

The Great Belt is navigated by more than 10,000 large ships, from many countries, each year in either direction. Therefore, the Danish State issued a notification in May 1977, and sent it to all seafaring nations in the world. The notification furnishes information on the decision to build a permanent traffic link across the Great Belt. Across the East channel, which is an international fairway, there will be two passages having a clear width of 360 metres in the bridge line, and a clear height above the sea of 62 metres.

The bridge section of the West channel will be at least 5.5 km and 5 km at the East channel, which will assure that the flow of waters between the Kattegat and the Baltic can take place unimpeded.

SSB has planned to have prepared two tender projects for the Eastern bridge, deviating in regard to the design of the navigation span, in particular.

One of these projects provides a navigation span of 780 m, and the bridge is cable-stayed. The pylons on the two main tower piers reach a level of about 210 m above the sea level; the main tower piers, as planned, stand in 35 m of water.



Cable-stayed Bridge
Suspension Bridge

The other project provides a free main span of 1,400 m, and it is proposed built as a suspension bridge. The pylon tops are also in this project at a level of 220 m above sea level, but the main tower piers stand in only 25 m of water. The anchor blocks for the main cables stand in approximately 15 m of water; they have an overall length of about 130 m.

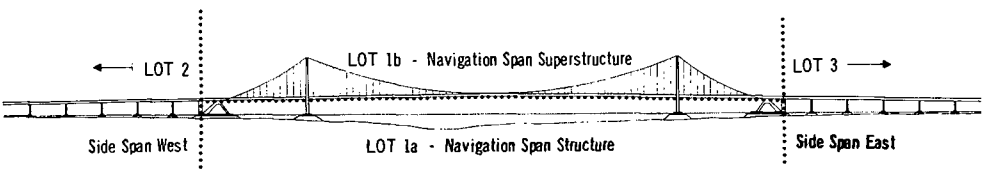
In both projects it is avoided to have a central pier in the navigation channel.

The piers for the suspension bridge are located at places with a relatively moderate depth of water. This involves, at the same time, that the pier sites are at rather considerable distances from the lane navigated by large ships. Moreover, the heavy load from the superstructure involves high stability of the piers, so that, even in the case of a ship colliding with a pier, the pier will not be destroyed. Another feature is that the erection of the superstructure is a relatively simple operation, based on well-known and tried-out construction principles.

The construction of the cable-stayed bridge may be more difficult, in that the construction of the main piers is a rather demanding task, and in that the erection of the superstructure must be done by successive cantilevering from the pylons, until the two cantilever arms can be interconnected at mid-span.

The tenderers will, however, be allowed to propose alternative designs, which, of course, must satisfy certain functional requirements, such as adequate clear passage for navigation, etc. Moreover,

in regard to evaluation of such alternatives, particular interest will be directed towards satisfaction of the very considerable requirements in respect of aesthetic features of the design which are mandatory seeing that the bridge will be the greatest structure ever built in Denmark. And also purely technical, safety, and financial aspects will be evaluated. In May 1977, SSB invited contractors which considered themselves to be in a position to build the Eastern Bridge - the first stage of the project - in its entirety, or sections thereof. Twenty-nine contracting companies - or groups consisting of several companies of various nationalities - accepted the invitation.



Division into Lots

The many approaches have now been subjected to perusal, and 14 companies - or groups - have been invited to submit tenders.

The construction of the Eastern bridge has been divided into four lots, viz.: Substructures for navigation spans; superstructure for navigation spans; side spans east, and side spans west, including embankments, if any. Through this division is created a possibility of Danish contractors being in a position to join the competition together with large foreign groups of contracting companies.

To tender for the substructures for the navigation spans seven contractorgroups have been selected, one of them being Norwegian, and one being American. The other groups are of international set-up - all of them comprising Danish contractors. To tender for the superstructure nine groups have been selected, one American, one British, one Danish, one Japanese, one West German, and four international groups with Danish participants.

To tender for the two side spans eight groups have been selected, two American, one French, and the rest are international groups with Danish participants.

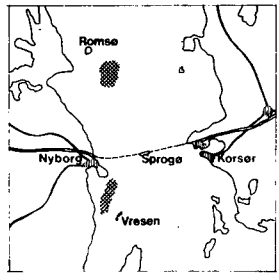
It appears from this that a group may tender for one or more lots.

To tender for all of the four lots, i.e. the Eastern bridge in its entirety, five groups have prequalified themselves, viz. one American, and four international groups, all of them co-operating with Danish companies.

To the embankments, large quantities of filling materials will be required. According to the estimates now available, about 10.0 million m^3 sand will be required for the filling proper, and about 1.3 million m^3 of stone materials for protection of the slopes of the embankments.

The Danish Geotechnical Institute has carried out comprehensive seismic investigations, taken soil samples from borings, and undertaken pumping tests in the Great Belt over a region covering more than 1,000 km^2.

These investigations have been concentrated on a zone reaching about 20 km north and 20 km south of the selected bridge line, and large quantities of suitable sand have been found, particularly in two areas.



Filling Materials

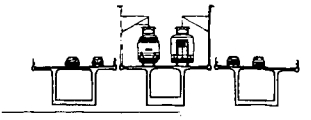
One of these areas is located 6-10 km south-east of Romsø and is about 3 x 5 km. It is estimated that there is about 10-15 million m^3 of sand at 30-40 m below sea level.

The other area is located at "Vresen Puller", about 10 km south of the bridge line and there are deposits of 5-7 million m^3 of sand at approximately the same depth as near Romsø.

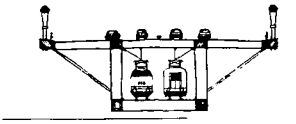
The deposits are fine grained sand which is well suited for filling of the embankments, but it is not suitable for concrete, because of its high content of calcareous matter, 7-12 per cent, and the deposits are located at depths from which sand is usually not taken.

Supposing that the filling materials be pumped in from the sea, it is avoided that sceneries be ruined or unfavourably changed, and the Nature Conservancy Board has now granted the necessary permissions to take the materials from the sea. In regard to "Vresen Puller" the permission is, however, subject to no shipwrecks of archaeological interest being found in the area, and with a view to clarifying this aspect of the matter, a detailed seismic investigation has been carried out, with a view to localising ships that might have foundered there.

The construction of a Great Belt Bridge Act provides that the bridge shall carry a six-lane motorway and a double-track railway.



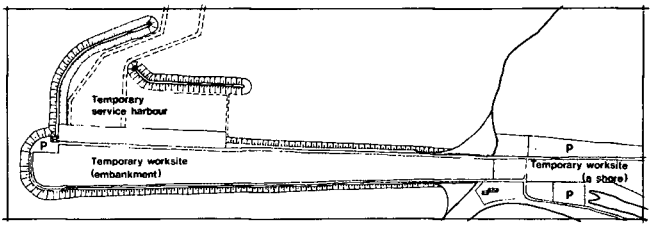
Western Bridge



Eastern Bridge

SSB has made an analysis of advantages and disadvantages of building the entire bridge - or part of it - with one or two decks. In the latter case it is assumed that the railway be placed on the lower deck, which solution is considered to be preferable to a single-deck bridge, in any case for the East channel.

Concerning the worksite installation and the construction of a temporary service harbour at the Eastern end of the bridge, tenders were invited in July, 1978.



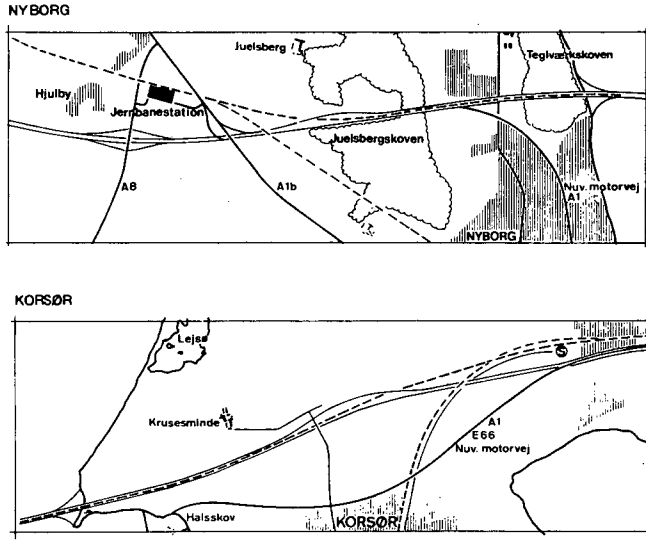
Temporary Service Harbour near Halskov

North of the planned embankment is planned a temporary service harbour for worksite purposes, such as unloading of materials delivered by ship, and shipping of components for the bridge structures. When the function of the service harbour has come to an end, the sand and stone materials could be re-used for the embankment.

As well in Nyborg as in Korsør the alignments of road and railway have been selected. In both locations the alignments are deviating considerably from the original ones, showing the greatest possible consideration for the local inhabitants and for town planning and scenery.

For some years a series of investigations have been going on in regard to such factors as will affect the project. Among these investigations could be mentioned: the comprehensive subsoil investigations, in the seabed of the Belt, which were commenced as early as in 1962, and which have been followed up by more detailed borings at the pier sites; investigations directed towards resources, implemented by the Danish Geotechnical Institute; observations of currents

in the Great Belt, carried out by the Danish Hydraulic Institute; wind observations at Sprogø, carried out by the Meteorology Section, Risø National Laboratory; wind tunnel tests on bridge models, carried out by the Technical University of Norway; investigation of features relating to navigation, with the assistance of navigation experts, etc.



A working group, with representatives of the Counties of Funen and West-Zealand, the Municipalities of Nyborg and Korsør, DSB, the Ministry of Labour, and SSB, produced in December, 1977, a memorandum on the consequences of the realisation of the project from a labour market point of view.

The labour requirements for the construction of the bridge - including construction works on land, such as railways, roads, etc., are approximately 16,000-17,000 man-years. In addition hereto the construction works will, indirectly, involve labour requirements by suppliers of materials and various services, estimated at approximately 11,000 man-years.

The employment level would reach its peak in 1983 and 1984, because at that time not only the Eastern bridge but also the Western bridge would be in course of construction. At that time the estimated labour requirements would be approximately 3,500, employed with the bridge works as such, and approximately 2,000 which would be directly employed.

Provided that part of the manufacturing processes could be located elsewhere in Denmark, it would be possible to prevent certain undesirable consequences in the Korsør and Nyborg areas. If, for

example, 6 or 7,000 of the estimated 16,000-17,000 man-years could be performed outside of the Great Belt-region, the local worksites, for the bridge construction, at Korsør and Nyborg would not be larger than has been seen previously.

Piers could thus be manufactured in suitable units, in the Eastern part of Jutland, for example, and be shipped from there to the Great Belt. SSB is now investigating whether suitable localities are available - with satisfactory roads, harbour facilities, and with available labour. It is thought that the superstructure for the Eastern bridge could be a steel structure, to be fabricated possibly by the Danish shipyards.

It is anticipated that 95 per cent of the labour force directly employed with the works will be Danish. This is based on experience from the construction of the large bridges across "Lillebaelt", "Sallingsund" and "Vejlefjord" - where foreign contractors have been involved - which shows that such high percentage of Danish labour is a realistic assumption.

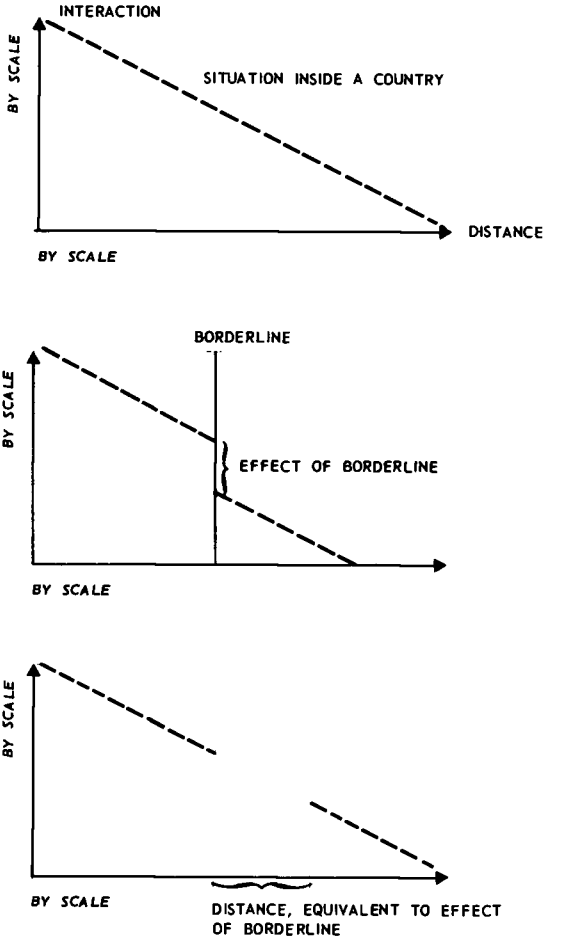
At this moment the DSB have approximately 2,000 employees, at Nyborg and Korsør combined. The labour force required for the operation and maintenance of the bridge and accessory constructions is estimated at 400. Of the 1,600 thus remaining one-half will find other work within the DSB organisation, or they may be pensioned off earlier.

3. THE POTENTIAL DEMAND FOR TRANSPORTATION ON THE GREAT BELT

It was noticed in the beginning of this paper that transport should be regarded as a production factor. Transport is only put into the production function of a product if it is in some way good economy, i.e. transportation could substitute other production factors, s.a. due to economies of scale.

Discussing the role of transportation and the basis for interaction between industries it is noticed that generally commercial activities drop much faster when they have to cross borderlines between nations than when just geographical distances are separating industrial areas. As an example and supplement to the one mentioned above could be mentioned the reducing effect of the borderline between Canada and the United States on the commercial activities between the two countries. Even if the physical conditions for transportation between nations is fully acceptable there might - because of other factors - be less interaction between two regions placed in different countries than between two regions with the same distance between them, but placed in one nation.

The effect could be visualised in a diagram:



International traffic and transit traffic has in the last ten years been exposed to a much more important growth than national traffic, meaning that the economic markets are widening. This means in other words that the effect of borderlines in the geographical landscape on interaction and transportation is being reduced. Therefore traffic links carrying international or transit traffic will be exposed to a still higher traffic load in the coming years.

Transit traffic in Denmark is caused by freight transport from Sweden, Norway and Finland to the continent and the opposite.

The ferry routes that take care of this traffic could be divided in three groups:

1. Routes from Sweden, Norway and Finland to Denmark.
2. Internal routes in Denmark.
3. Routes from Denmark to the continent.

The table on page 71 shows the development in the flow of goods from Sweden, Norway and Finland to Denmark and the European continent. Import and export to and from these countries is not included in these figures.

An important part of the total figure of more than 11 million tons of goods transported by road and rail between Sweden, Norway, Finland and Denmark and the continent could be foreseen to pass by the Great Belt bridge when it is constructed.

Import/export by road and rail from Norway and Finland that could be expected to pass the Great Belt would be a supplement of about 25 per cent of these figures.

Table 1

GOODS CONVEYED BETWEEN SWEDEN, NORWAY, FINLAND AND DENMARK AND THE CONTINENT (MILLION TONS):

	Rail	Road	Total
1961	2.2	0.5	2.7
1962	2.4	0.7	3.1
1963	2.7	1.0	3.7
1964	3.0	1.2	4.2
1965	3.1	1.3	4.4
1966	3.3	1.7	5.0
1967	3.1	1.9	5.0
1968	3.5	2.3	5.8
1969	4.1	2.8	6.9
1970	4.7	3.1	7.8
1971	4.2	3.6	7.8
1972	4.7	3.9	8.6
1973	5.5	4.9	9.8
1974	6.1	4.6	10.8
1975	5.2	4.8	10.1
1976	5.3	5.6	10.9

The 10.9 million tons of goods conveyed by train and road should be compared to the 5 million tons conveyed today on the Great Belt.

AMOUNT OF GOODS EXPORTED FROM SWEDEN TO DENMARK/
THE CONTINENT BY ROAD AND RAIL IN MILL. OF TONS

AMOUNT OF GOODS IMPORTED TO SWEDEN FROM DENMARK/
THE CONTINENT BY ROAD AND RAIL IN MILL. OF TONS

4. CONCLUDING REMARKS

Of course the main part of the import/export to/from Fenoscandian countries is conveyed by ship (80 per cent).

In spite of this very high percentage when talking of tons of goods the value of the import carried by ship is about the same as the value of the import carried by road and rail. Transport by road and rail is used for commodity groups which are manufactured to a certain degree and therefore have a high value/weight relationship, meaning that the commodity is able to pay for the more expensive transport by road and rail.

Those relationships are very important for the evaluation of the future demand for transit traffic through Denmark and for taking care of - in due time - the capacity problems involved when deciding the construction period for the semi-solid link between Fenoscandia and the continent.

CASE OF TRANSIT IN GERMANY

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SUMMARY

I. INTRODUCTION

The growing volume of road freight transport in transit * through European countries and its associated financial and technical demands have recently enlivened the discussions regarding a solution of transit problems. There were spectacular reactions to Austria's introduction of a transit "tax" in the summer of 1978 and to the boycott imposed by the drivers concerned. The basis of the arguments for introducing so-called transit charges or dues is the burden on the infrastructure, especially the road system, of the transit countries, which have to meet the cost themselves, although they derive no direct benefit from the traffic. Infrastructure overloading is seen in capacity bottlenecks which as a rule can only be overcome at considerable expense and by accepting increased external effects.

This situation is sufficient reason for considering whether and how the problem can best be solved. The first point to check is whether the overloading is of the same nature in all the European countries affected, i.e. whether their geographical features determine the effects on them of transit traffic through them. Countries can be divided into three categories, each affected differently by transit traffic:

1) countries geographically on the fringe of Europe which are consequently little affected by transit traffic, but originate such traffic through other countries (e.g. the Netherlands and Norway);
2) countries geographically in an intermediate position containing one or more considerable geographical barriers such as mountains or water (e.g. Denmark and Austria);
3) countries geographically in a central position, but with no considerable geographical barriers in them (e.g. Germany and France).

It can be seen straight away that category (1) should have least difficulty in providing infrastructure capacity for transit traffic, while category (2) should have the most obvious difficulties. The latter countries' geographical features cause bottlenecks which should be accurately calculated, i.e. the overloading of capacity should be accurately quantified so that measures for overcoming

* Transport in transit here means the transport of goods across frontiers and through a country without the goods being traded in it.

bottlenecks can be taken against the transport which causes them, including financial levies. Allocation of responsibility is simplified by the fact that there are hardly any problems due to choice of routes.

Under the above classification the Federal Republic of Germany, whose transit traffic problems are to be investigated and assessed, comes within category (3), but owing to the area of land it offers for North-South transport and also for West-East transport it has to provide considerable transport infrastructure capacity. In addition, the Federal Republic has a well-developed road network, all of which can be used without paying any direct tolls, so that it attracts traffic (in this case transit traffic). This fact led the Federal Minister of Transport, Mr. Gscheidle, in December 1976 to send a circular to the EEC Commission and to the Ministers of Transport of the EEC countries pointing out that the steady increase in road transport in transit was imposing ever greater financial and technical burdens on the transit countries, while available railway capacity remained unused and the railways' trading results were influenced unfavourably by declining quantities of freight.(1)

The question now is to what extent freight transport in transit uses up existing transport infrastructure capacity, i.e. whether it leads to bottlenecks which necessitate appreciable investment in infrastructure.

To answer this question requires a study of four subsidiary questions:

1) the Federal Republic's capacity for transporting freight in transit
2) the distribution of this capacity between the different modes
3) the choice of routes for freight in transit
4) openings for a rational substitution of modes.

After that it will be possible to say how sound the arguments for transit charges or fees are and whether there may be more appropriate solutions.

2. DEMANDS OF DIFFERENT MODES ON TRANSPORT INFRASTRUCTURE CAPACITY

The following paragraphs discuss road, rail and water transport with reference to the development of transit transport capacity.(2)

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1) Interview in the daily newspaper "Die Welt", No. 182 of 8.8.78.

2) The data used come from "Verkehr in Zahlen", volume 6, 1977, issued by the Federal Minister of Transport, Bonn. The Deutsches Institut für Wirtschaftsforschung (DIW) in Berlin is responsible for the contents.

It seems necessary to consider carrying capacity in order to be able to estimate the relative importance of the different modes in total transit traffic and total traffic of all kinds. In doing so it should be noted not only that present-day figures are of importance, but also that the trend over time of the volume of transit traffic carried by each mode is very relevant.

Table 1 gives a general picture of recent (1976) shares of transit traffic.

Table 1

Proportion of transit traffic carried in 1976 by each mode in the Federal Republic of Germany

Mode	Share in t million	Percentage of total traffic
Road	8.118	33
Rail	6.418	26
Water	9.991	40.6
Air	0.089	0.4
	24.617	100.0

Air transport will not be considered, because its share of transit traffic is insignificant and cannot be fully assessed.(1)

Although opinions differ widely regarding the importance of inland water transport and the desirability of promoting it, water transport will not be investigated in the present context.

Its importance seems largely determined by the special conditions governing its suitability for transporting various types of freight. Nevertheless, two facts are worth noting:

1) Water and rail transport are best suited for bulk freight and therefore have to compete keenly for that type of freight.
2) The share of water transport in transit traffic decreased almost continuously from 1950 (68.9 per cent) to 1976 (40.7 per cent).

Table 2 compares the shares of the three modes in different categories of freight.

It is striking how much bigger a proportion of the bulk freight items coal, mineral oil products and ores is carried by water than by rail. This might be one reason for the excess rail capacity. In the other categories of freight the shares carried by road and rail are approximately equal, which may indicate that these modes compete

1) A full assessment would only be possible for mixed-mode transport, if there were any statistics for it.

keenly for them. The freight category in which water transport has the biggest share (23.1 per cent) is mineral oil products, while for rail transport it is chemicals (20.1 per cent) and for road transport it is foodstuffs (20.7 per cent).

Table 2

Shares of the three modes of transport in different categories of freight

Category of freight	Water(1)		Rail(1)		Road(2)	
	Share in 100 t	%	Share in 1000 t	%	Share in 1000 t	%
Live animals	-	-	84.18	1.3	47.33	0.5
Cereals and fruit	875.03	8.8	640.31	10.0	508.5	6.3
Vegetable and animal raw materials	76.42	0.8	301.02	5.9	557.35	6.9
Foodstuffs	459.18	4.6	370.39	5.8	1684.0	20.7
Coal	744.08	7.4	58.55	0.9	10.8	0.1
Mineral oil products	2308.92	23.1	240.37	3.7	103.77	1.3
Ores	1305.56	13.1	44.08	0.7	31.69	0.4
Metal semi-manufactures	1748.28	17.5	513.1	8.0	572.56	7.1
Mineral building materials	1167.11	11.7	164.03	2.6	353.77	4.4
Fertilizer	453.64	4.5	26.42	0.4	3.64	0.0
Chemicals	660.82	6.6	1293.17	20.1	1478.3	18.2
Vehicles	3.76	0.0	358.16	5.6	176.1	2.2
Machinery	47.01	0.5	265.01	4.1	630.17	7.8
Constructional materials	48.49	0.5	98.37	1.5	162.97	2.0
Glass, textiles, paper and wood	58.96	0.6	628.38	9.8	1480.65	18.2
Special freight	32.93	0.3	1252.7	19.6	314.83	3.9
Total	9991.2	100	6418.14	100	8116.43	100

1) Statistisches Bundesamt, Wiesbaden 1976.
2) Kraftfahrtbundesamt, Flensburg 1976.

It remains to examine more closely the two modes, road and rail transport, which are at the heart of the discussions on transport policy in the Federal Republic.

The quantitative importance of transit traffic can only be grasped, if it is related to other types of traffic. Relevant information is given in Tables 3, 4 and 5.

Table 3

Share of transit traffic by road in total road freight transport, in long-distance road freight transport and in transfrontier freight transport by road (1976)

	t million	Percentage held by transit traffic
Transfrontier transport	91.4	8.9
Long-distance transport	262.2	3.1
Total transport	2215.5	0.4

Table 4

Share of transit traffic by rail in total rail freight transport and in transfrontier freight transport by rail (1976)

	t million	Percentage held by transit traffic
Transfrontier transport	59.8	10.7
Total transport	312.7	2.1

Table 5

Share of transit traffic carried by road and rail in total freight transport and in total transfrontier freight transport

	t million	Percentage held by rail transport	Percentage held by road transport
Total transfrontier freight transport(1)	277.1	2.3	2.9
Total freight transport(2)	2829.9	0.2	0.3

1)2) excluding transport by sea, air and pipeline.

It is clear from Tables 3, 4 and 5 that in terms of volume, transit traffic plays a relatively minor part. Quite apart from its marginal shares of total traffic, it is seen to account for only a small proportion of the total freight traffic carried by each mode. Only its shares of transfrontier freight traffic are not insignificant, but this is not a decisive factor. Consequently in discussing

the subject of transit traffic further, the magnitudes represented by the above figures must always be kept in mind.

A discussion of figures for transit traffic would not be complete if it did not include their trend over time and distribution between the different modes. In the case of water transport these factors were mentioned at the beginning of this section. Table 6 shows the trend over time of transit freight traffic carried by rail, road and water.

The most striking change is seen in road transport. Its continual upward trend since the war is due to the post-war development of the road system and the restart of industrial production, and is to that extent a result of catching up with the post-war backlog of road transport facilities. However, the increase in its share from 11 per cent (1970) to 33 per cent (1976) is surprising. This rapid growth is also the reason why transit traffic has recently attracted so much attention.

Rail transport, perhaps for the same reason, followed a different trend. From 1950 to 1972 its share fluctuated between 30 and 35 per cent, after which it declined to 26 per cent in 1976 (and to even 23 per cent in 1975).

To sum up, the total volume of transit traffic is relatively insignificant, but two facts must be realised. First, the shares of rail and water transport have fallen sharply, which in the case of rail transport is disquieting, because its declining share - despite its relative smallness referred to above - can lead to increasing excess capacity which then has to be paid for dearly. Secondly, assuming that the steep increase in transit traffic by road continues and that total transit traffic keeps increasing in absolute terms, these trends will lead to more and more overloading of road capacity in the future.

3. THEORETICAL ANALYSIS OF BOTTLENECK SITUATIONS

As already stated, the above-mentioned rapid growth of road traffic in transit is an increasingly frequent reason, or at least a contributory reason, why bottleneck situations on particular routes are blamed on transit traffic. It therefore seems necessary to analyse such situations in relation to transit traffic, i.e. to investigate whether expenditure due to overloading or investment in infrastructure capacity should be blamed entirely or partly on transit traffic.

Table 6

Trend of transit freight traffic from 1950 to 1976

Year	Total traffic in t million	Percentage increase	Carried by rail		Carried by water		Carried by road	
			%	t million	%	t million	%	t million
1950	7.4	= 100	31.1	2.3	68.9	5.1	-	-
1951	8.7	117.6	33.3	2.9	66.6	5.8	-	-
1952	8.3	112.2	33.7	2.8	66.3	5.5	-	-
1953	8.5	114.9	35.3	3.0	64.7	5.5	-	-
1954	9.0	121.6	34.4	3.1	65.6	5.9	1.1	0.1
1955	10.1	136.5	32.7	3.3	66.3	6.7	1.0	0.1
1956	11.0	148.6	30.0	3.3	69.0	7.6	0.9	0.1
1957	10.5	141.9	31.4	3.3	67.6	7.1	0.9	0.1
1958	9.9	133.8	31.3	3.1	66.7	6.6	2.0	0.2
1959	9.3	125.7	33.3	3.1	63.4	5.9	3.2	0.3
1960	10.7	144.6	32.7	3.5	64.4	6.9	2.8	0.3
1961	10.8	145.9	35.2	3.8	61.0	6.6	3.7	0.4
1962	11.0	148.6	36.3	4.0	58.2	6.4	5.5	0.6
1963	11.5	155.4	36.5	4.2	56.5	6.5	7.0	0.8
1964	11.6	156.8	38.8	4.5	52.6	6.1	7.8	0.9
1965	13.8	186.5	32.6	4.5	58.7	8.1	8.0	1.1
1966	15.3	206.8	30.7	4.7	60.1	9.2	9.2	1.4
1967	16.5	223.0	29.7	4.9	60.0	9.9	10.3	1.7
1968	18.0	243.2	28.9	5.2	59.4	10.7	11.1	2.0
1969	19.3	260.8	32.6	6.3	56.5	10.9	10.9	2.1
1970	21.3	287.8	31.0	6.6	57.7	12.3	11.3	2.4
1971	18.9	255.4	33.3	6.3	51.3	9.7	15.3	2.9
1972	18.4	248.6	34.8	6.4	45.1	8.3	20.1	3.7
1973	20.8	281.1	28.4	5.9	47.6	9.9	23.6	4.9
1974	24.9	336.5	25.7	6.4	49.0	12.2	24.9	6.2
1975	24.3	328.4	23.0	5.6	49.4	12.0	27.2	6.6
1976	24.6	332.4	26.0	6.4	40.7	10.0	32.9	8.1

In order to be able to attribute the cost of bottleneck situations(1) to one particular section of traffic, one must first find out whether a particular sum can be attributed to a particular class of carrier. This can only be done properly, if bottleneck problems either disappear or are at least greatly reduced when these carriers are absent. First, the situation must be such that bottlenecks are created when these carriers are added, i.e. that the remaining traffic has reached a particular capacity threshold which is exceeded as a result of the additional carriers, so creating bottleneck situations. Secondly, these additional carriers must have a large share of the traffic, if its removal is to improve bottleneck situations perceptibly.

However, the hardest problem is to identify a particular class of carriers as responsible for the additional traffic which causes bottleneck situations. From a purely theoretical point of view, is it justifiable to identify the traffic causing the additional costs (i.e. the marginal traffic responsible for marginal costs) with transit traffic or, for example, with freight carried in its owners' vehicles? Even if one (or both) of these two conditions apply, or if for example the traffic causing additional costs is identified from a policy-making point of view,(2) there is a further difficulty, namely how to distribute the costs of bottlenecks fairly between those who cause them. The problems here are basically the same as those discussed in connection with the principle of debiting expenditure on roads to their users. This mainly involves the problems of calculating the external effects and allocating responsibility for them.

The conclusion of this brief theoretical discussion of the problem of bottlenecks is that:

1. it is at least questionable whether a particular class of carriers should be held responsible for bottleneck situations because they produce additional traffic leading to bottlenecks, and
2. it is theoretically very problematical how responsibility for bottlenecks can be allocated in an equitable way.

As regards point 1, however, it should be pointed out that what is meant is blaming only a <u>particular</u> class and not justification for blaming additional traffic as such. As regards point 2, there

1) A bottleneck situation here means traffic on a route beyond its designed capacity, creating effects (especially external effects) which involve additional costs due to congestion, accidents, environmental damage and wear and tear.

2) Policy-making identification means here that transit traffic, for example, is regarded as responsible for additional traffic according to a policy-making assessment.

is the reservation that despite the theoretical problems of allocating responsibility fairly, it is necessary and desirable to debit the additional costs to those responsible.

4. STUDYING BOTTLENECKS BY DIVERTING TRAFFIC

In order to see whether the foregoing theoretical considerations are of practical value, transit traffic has to be diverted onto a transit road system. This makes it possible to find out the proportion of transit traffic in total traffic (freight and passenger traffic) at particularly critical points (bottlenecks). A rough test on these lines was made for the present report, when the following three limitations had to be accepted, although they should hardly affect the value of the test for the problem concerned:

1) Different types of vehicle (private cars and trucks) were not converted into standard vehicle units by means of equivalence figures.(1)
2) No transit road system officially described as such could be identified in the Federal Republic of Germany. Consequently a transit network was chosen for the present report based on the shortest routes (Federal motorways and network roads).
3) In the case of parallel routes, total transit traffic along them was taken as flowing along one route.(2)

The conclusion from this traffic diversion test is that the share of transit traffic in total traffic on transit routes varies between 2 per cent (maximum) and 0.02 per cent (minimum). In absolute terms this means that it averages between 30,000 and 200,000 trucks per year. The highest figures are found where bottlenecks occur in total traffic also. It is noteworthy that in some conurbations where bottlenecks are usually found, the proportion of transit traffic is average or below average (e.g. in the Stuttgart and Bremen areas). It may therefore be assumed that on the routes in question in the Federal Republic of Germany transit traffic is a relatively small proportion of total traffic. This conclusion is also supported by the fact that, if one disregards the above-mentioned problem of

1) It is doubtful whether a conversion by means of equivalence figures would be valid in this case, because different figures would have to be used for each case studied. For example, an equivalence figure for environmental purposes is not the same as an equivalence figure for road wear or for different road loading values.

2) The data were taken from the 1975 road traffic census by the Federal Ministry of Transport.

equivalence figures, the proportion of transit traffic has been overestimated rather than underestimated by excluding parallel routes.(1) In addition, the use of an annual average has smoothed out the traffic peaks in the holdiay months. If one took total traffic in peak holiday periods, the share of transit traffic in total traffic would be even less.(2) In comparison, passenger traffic in transit, especially at weekends, should be relatively greater than freight traffic in transit. With reference to the levying of charges on freight in transit, passenger traffic in transit should be made to pay rather than freight traffic.

The conclusion is that the share of road traffic in transit through the Federal Republic of Germany is not large enough to justify asking it alone to make an appreciable contribution to the expenditure caused by bottleneck situations in transport infrastructure. This fact should be central to further discussions on the levying of special charges on transit traffic. It does not mean that transit traffic is not a burden on the road system, but only that the weight of the burden is often overestimated so that transit traffic is given too much blame for overloading road capacity.

5. CONDITIONS IN WHICH COUNTRIES COMPETE FOR ROAD TRANSPORT IN TRANSIT

It would exceed the scope of this report to try to give a complete picture and quantitative analysis of existing conditions of competition in terms of comparable figures in different countries for the various costs payable by road freight. Nevertheless it seems desirable to make at least a rough comparison, in order to be able to assess the effect of any transit dues on the volume of road transport in transit, quite apart from the question whether they are justifiable.

The following outline of the reasons for differences in conditions for competing for transit traffic should illustrate the problem. These reasons are:

- differences in cost factors
  - . production facilities
  - . tyres
  - . repairs
  - . insurance premiums

1) Transit traffic on two or more routes was lumped together on one route, so that the proportion of transit traffic on the selected routes was greater.

2) The multiplier for holiday periods can be as much as 3.4 and averages considerably more than 1, taking the weekdays Tuesday, Wednesday or Thursday in July and August.

  . wages
  . general costs
- differences in technical regulations
- differences in employment legislation
- differences in price controls
- monetary influences
- differences in charges for using roads
- differences in fiscal charges
  . petroleum tax
  . motor vehicle tax
  . value added tax

The following table is intended to give a quantitative example of differences in conditions of competition based on the taxation of motor vehicles and petroleum (Table 7). It is designed to show how much the different costs vary from one country to another. It should of course be remembered that these differences may partly cancel each other out, but this does not alter the conclusion that any transit dues charged would only be an additional factor in such differences. They would probably not be high enough to play a significant part compared with the other differences.

When the influence of these factors on the pattern of competition is considered, it may at least be concluded that transit dues levied by countries in order to switch transit traffic to other modes would probably not have the desired effect. Either they would have a negligible effect on cost structures, or they would only hit those who have little or no cost advantage over others, or they would have to be increased to an extent which would be politically unrealistic.

This means that transit dues in the form in which they are discussed would most probably only add to the existing distortion of competition, without bringing about any desirable effects (e.g. switching transit traffic to other modes).

6. POSSIBILITY OF SWITCHING TRANSIT TRAFFIC FROM ROAD TO RAIL

The rapid increase in transit traffic by road in recent years and the simultaneous decrease in transit traffic by rail has recently kept directing discussion on this subject to the possibility of switching freight transport from road to rail. One reason why this possibility seems particularly attractive is that the railways have a growing deficit and unused capacity. However, switching freight traffic in transit from road to rail could do little to improve the railways' overall trading results. This is already clear from the magnitude of the figures for traffic, because total road freight in

Table 7(1)

Taxation of truck transport in Europe

Country	Motor vehicle tax on lorry-trailer combinations				Petroleum tax on diesel	
	32 t total weight		38 t total weight			
	DM/year	%	DM/year	%	Pf/litre	%
Belgium	2700	39.6	3150	33.6	18.7	44.5
Germany	6815	100	9365	100	42.0	100
Denmark	9948	146.0	10570	112.9	-	-
France	234	3.4	234	2.5	31.6	75.2
United Kingdom	2770	40.6	(2770)	(29.6)	27.3	65.0
Ireland	2195	32.2	2195	23.4	26.3	62.6
Italy	835	12.3	835	8.9	13.8	32.9
Luxembourg	1395	20.5	1622	17.3	7.6	18.1
Netherlands	2910	42.7	3355	35.8	18.5	44.0
Non-EEC countries						
Finland	972	14.3	972	10.4	11.9	28.3
Austria	512	7.5	512	5.5	30.5	72.6
Portugal	5770	84.7	6840	73.0	7.0	16.7
Sweden	4620	67.8	4770	50.9	-	-
Switzerland	800	11.7	800	8.5	45.0	107.1
Spain	1911	28.0	2294	24.5	11.9	28.3

1) Verkehrswirtschaftliche Zahlen (transport economy statistics) 1977, issued by the Bundesverband des Deutschen Güterfernverkehrs (BDF) e.V., Frankfurt/Main.

transit is only about 2.6 per cent of total freight carried by rail. Nevertheless it is a possible way of slowing down the decline in transit traffic by rail and sending more freight by rail. In addition, the nature of transit traffic involves long distances and no time is spent in handling the freight,(1) which makes this traffic attractive for the railways. However, two questions arise in this connection:

1) Have the railways the personnel and capacity to handle this traffic? and
2) Can the railways improve their image in this sector so as to be able to attract and keep the traffic?

The first question is often answered too hastily in the affirmative. Admittedly the small volume of transit traffic compared with total freight traffic by rail favours such an answer, especially because there is an overall surplus of capacity in goods wagons. However, the question arises whether the kinds of goods wagons available, e.g. special freight cars, match the demand and whether other types of transport such as combined or container transport(2) need not be stepped up in order to attract this potential demand to the railways. As regards personnel, the railways may be expected to be able to deal both qualitatively and quantitatively with the extra load resulting from taking over transit traffic. With reference to the second question above, the trend of the figures for transit traffic by rail gives grounds for misgiving and to that extent one has to be very sceptical in judging whether this traffic can be switched from road to rail.

For both questions to be answered in the affirmative, several requirements would have to be satisfied:

1) An analysis by categories of freight would have to be made to establish which categories are best suited for rail transport by virtue of their nature and the time element.
2) International co-operation between railway systems in dealing with transit traffic would have to be considerably improved, because it is hardly possible for one country alone to attract transit traffic to its railway system.
3) A direct corollory of requirement (2) is that transit trains would have to be arranged and operated to a suitable timetable (timing and reliability argument).
4) New forms of transport such as container and combined transport, which offer an opportunity for co-operation between

1) i.e. the freight does not need to be loaded or unloaded.
2) Efforts in this direction have recently been increased.

road and rail, would have to be stepped up with international co-operation.

5) Marketing and pricing would have to be competitive.
6) Railway management would have to be decentralised so as to be able to react more flexibly to the market.

These requirements would involve a vast amount of work, but it seems necessary to meet them if it is desired to dispense with active or passive subsidisation - by which is meant State interference to the disadvantage of other transport modes - in order to achieve an optimum allocation of resources with the aid of the market, i.e. through the operation of competition. This is also true of such a quantitatively unimportant sector as transit traffic.

7. ANALYSIS OF POLICY AIMS

It is necessary to analyse policy aims, if it is desired to find out what principles of economic policy ultimately determine the nature of transport policy decisions. This involves answering a fundamental question: in its transport policy does the State lean more towards interventionist measures or towards controls on competition? This question is of particular interest in the case of the railways or of traffic produced by foreigners. The issue is mainly of relevance to the pursuit of government objectives.

In this connection two major aims of German transport policy are of importance:(1)

1) equal conditions of competition for all modes
2) a rational distribution of traffic between modes as required by the overall economy.

Each of these aims if of course sensible, but they may clash, which may have all the more serious consequences, because the State is the sole provider of transport infrastructure and in addition is the virtual owner of one of the modes (i.e. the Deutsche Bundesbahn, if one excludes air transport). There is of course so far no flat contradiction between the aim of equal conditions of competition and the fulfilment of subsidiary conditions such as maximum environmental protection or that road costs should be covered. However, there might be a clash, if for example, demands for more environmental protection or conservation of energy were used as an excuse for improving the railways by means of interventionist measures at the expense of other modes, instead of achieving the objective of "a

1) Koordiniertes Investitionsprogramm für die Bundesverkehrswege bis zum Jahre 1985 (co-ordinated investment programme for Federal transport routes up to 1985), issued by the Federal Minister of Transport.

rational division of traffic between modes as required by the overall economy" by means of market instruments (see Section 6).

The principle deserves unreserved support that our transport economics should be based on a choice of modes which is normally free and on a pricing policy in which the rates charged under a system of controlled competition should normally cover costs.(1) However, this also means that the principle involves a fair distribution of costs which must be applied to all modes and therefore to all classes of carrier, which brings us back to our original subject of transit traffic. With reference to the objective of a European solution for transport problems which is stressed at every opportunity by responsible politicians, the above principle must also apply to transit traffic. This traffic also must meet the expenditure it causes, but must not be charged more than that for the benefit of other traffic. It seems clear that isolated national solutions cannot be the only ones, which is why in the German view European solutions should be sought on the basis of the above principle. European solutions should be designed so as not to promote more serious distortions of international competition due to independent action by individual countries, but this does not mean that such action, when taken under pressure of circumstances, should be condemned. The need for it as an interim solution is fully understandable and should be accepted. However, European solutions would help to avoid such pressure of circumstances in the future.

8. POSSIBLE SOLUTIONS FOR THE PROBLEM OF TRANSIT TRAFFIC

It was shown in the previous sections that transit traffic in the Federal Republic of Germany forms a relatively small proportion of total traffic and total freight traffic, but it is to be feared that transit traffic by road will continue its rapid growth and so may increase its share. This fact and the more serious situation in other countries makes it necessary to propose satisfactory all-European solutions.

One solution which has been discussed in some countries and has already been put into practice in others should definitely be rejected, namely the introduction of national transit dues. This measure would tend to distort international competition even further and

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1) Meyer, W.: Die Zukunft des Güterverkehrs - Vorstellungen und Anforderungen der Wirtschaft, Vortrag im Rahmen der Jahrestagung der DVWG (Deutsche Verkehrswissenschaftliche Gesellschaft) 1977 (future of freight transport - industry's concepts and requirements; lecture in connection with the annual conference of the DVWG, 1977), in Zukunft des Güterverkehrs (future of freight transport), annals of the DVWG, 1341, Series B.

promote a nationalistic protectionism which the "pan-European ides" is designed to abolish in the economic interest of all countries.

Nor is the monetary argument particularly cogent in the discussion on transit dues, because a rough calculation of the potential annual revenue from transit dues in the Federal Republic gives a figure of between DM.80 and 120 million, excluding administrative costs.(1) When this sum is compared with the cost of roadmaking or of covering the deficit of the railways, it is seen to play no very important part.

The question now is what form an acceptable all-European solution might take. The following answer is proposed:

1) A European system of transit routes must be established which is internationally binding.
2) In suitable sectors rail transport would be competitive as a substitute for road transport and should be adopted with the aid of international co-ordination. This measure should pay special attention to new transport techniques such as combined and container transport (the conditions for success were stated in Section 6 and should apply to most European countries in the same or a similar form).
3) European countries must adopt a uniform system for allocating expenditure on roads. It will then be possible to compensate fairly for differences in transit traffic through different countries by means of equalisation payments which would be calculated and managed by an all-European institution.

These proposals could eventually solve the problem of transit traffic, if it is remembered that in practice they would only succeed if overall transport policy were co-ordinated internationally so as to prevent distortions of competition which have a greater impact today than any transit dues, of whatever nature.

9. SUMMARY

The following summarised facts should be remembered:

1) Countries can be divided into three categories, each affected differently by transit traffic (Section 1).
2) The proportion of transit traffic in total traffic in the Federal Republic of Germany is relatively small (Section 2).
3) However, road transport in transit has grown considerably

1) This calculation is based on the following data: annual volume of traffic, 400,000 to 600,000 trucks; average trip distance about 650 km; maximum payload 20 t; transit dues per tonne kilometre, DM.0.015.

in importance and will presumably continue to do so, whereas rail transport has shown a marked percentage decrease in recent years (Section 2).

4) It is not possible to apportion to road transport in transit an appreciable part of the blame for bottleneck situations in road infrastructure (Sections 3 and 4).
5) Existing distortions of competition make the levying of transit dues seem unrealistic as a means of traffic control (Section 5).
6) It seems very problematical in present circumstances whether rail transport could replace road transport (Section 6).

In the light of the situation described and on the understanding that the Federal Government's policy regarding competition is pursued consistently (Section 7), the following is suggested as a possible solution for transit traffic (Section 8):

Assuming that an internationally binding European system of transit routes (rail and road) is established, a European system for equalising road expenditure should be set up. At the same time road transport should be replaced in suitable sectors by rail transport (with the aid of modern transport techniques such as combined and container transport), but this can only be successful if there is international co-operation and railways are reorganised, as indicated in Section 6. A background condition for such a solution is that the various transport policies of the different countries must be harmonized.

SUMMARY OF THE DISCUSSION

1. INTERNATIONAL TRANSIT TRAFFIC: GENERAL SURVEY

1.1 The problem raised by international transit

The question of international transit, though a long-standing one, is unquestionably topical. While transit has always posed an economic problem there can be no doubt that its difficulties now are twofold and the Round Table, going somewhat beyond its frame of reference, considered both the aspects involved. Today international transit is facing problems of two kinds:

a) infrastructural (or technical) problems

A number of physical bottlenecks have recently bedevilled transport infrastructures used by international traffic. The growth of traffic with the Middle East and the attendant research have been revealing in this respect. The problem has come to the fore because of the increasingly international nature of the world today(1), and the redeployment of economic activity which has led to a considerable increase in traffic between all countries, and hence in international transit.

The effect of the bottlenecks has been particularly conspicuous because the growth in traffic has not been spread evenly over all modes of transport. While international freight traffic by road has increased sharply, quite often by over 20 per cent per year, the volume of rail transport remained stable until 1972 and since then has in fact fallen. This has led to costly surplus capacity on the rail and inland waterway systems. Meanwhile, road transport has been confronted with an increasing number of infrastructural bottlenecks as a result of its expansion. The infrastructural difficulties encountered by international road transport have been exacerbated by the fact that the highest rates of traffic growth occurred in countries inherently fitted for transit which, because

1) What J. Lesourne terms "the emergence of a multi-polar world and the increasing interdependence of the world's various societies and the resultant growth of flows of all kinds between those societies", in Long-Term Trends in the World Economy and Developments in the Transport Field. Eighth International Symposium on Theory and Practice in Transport Economics, ECMT, Istanbul, 24th-28th September, 1979.

of their topography and a number of special circumstances, were already finding it hard to cope with road traffic flows.(1)

1) The tables below illustrate the scope of the problem:

a) Transit traffic: rate of increase in road and rail traffic

Country \ Mode of transport	Road: index 77/72	Rail: index 77/72
Austria	259	105
Belgium	149	114
France	158	106
Germany (FR)	227	94
Switzerland	179	88
Yugoslavia	260	160

b) Road transit traffic: recent trends in selected countries

Country \ Annual trend	1975/1974	1976/1975	1977/1976
Austria	+ 22.4%	+ 21.2%	+ 11.1%
Greece	-	+ 23.1%	+ 35%
Switzerland	- 2.6%	+ 27%	- 8.5%
Turkey	+ 200.8%	+ 28.3%	+ 35.6%
Yugoslavia	+ 56.3%	+ 28%	- 2.4%

c) Modal split of transit traffic(%)

Country, year \ Mode of transport		Road	Rail	Inland waterway	Total
Austria	1972	36	57	7	100
	1977	58	37	5	100
Belgium	1972	21	52	27	100
	1977	29	55	16	100
France	1972	28	38	34	100
	1977	33	30	37	100
Germany (FR)	1972	20	35	45	100
	1977	29	21	50	100
Italy	1972	19	81	-	100
	1977	44	56	-	100
Switzerland	1972	2	98	-	100
	1977	4	96	-	100
Turkey	1974	27	73	-	100
	1977	59	41	-	100
Yugoslavia	1972	11	40	49	100
	1977	18	40	42	100

Source: Report on Freight Transport in Transit: Current Problems in European Countries and Possibilities for Improvement, ECMT, 1979.

Experts are unanimous in pointing out that unless steps are taken serious capacity problems might well arise very shortly on the international road system, especially on the North-South routes. But it should be emphasized that purely physical or technical cannot suffice. In some countries, land use is so intensive that further infrastructure cannot be built without sacrificing the environment and the countryside, which themselves generate substantial revenue, in particular from tourism. The aim must accordingly be to achieve more rational use of the existing transport infrastructure.

b) Infrastructure pricing problems, and, more generally, the financial problem.

The recent introduction by some countries of tolls or levies, in particular, for road freight vehicles crossing their territory, has brought this aspect of the transit question to the fore. Obviously, pricing is closely tied up with the technical question of infrastructural saturation; the two are simply the most salient present-day aspects of one and the same problem, viz. the hardships that international transport causes in transit countries. Underlying the financial questions raised by international transit is in fact the notion that the countries crossed should obtain some monetary compensation from transit traffic, which brings them little reward yet generates considerable expenditure on the provision and management of transport infrastructure. Like the technical difficulties related to bottlenecks, the financial problems stemming from transit are particularly acute in the case of road transport, even though questions concerning international rail transport rates are far from satisfactorily resolved by treating them as the sum of domestic rates and not as a single entity.(1) Agreements have indeed been reached on major international road transit routes and the technical standards with which they must comply (negotiations here were not always easy and in some cases bilateral groups had to be established to settle certain discrepancies between countries) and some progress has been made on vehicle weights and dimensions, due in particular to the efforts of the United Nations. But the problem of payment for the use of road infrastructure has not so far been settled internationally, the Common Market countries being more or less in agreement only in considering that taxation for the use

1) One of the most insidious causes of the expansion of road transport and the stagnation of rail traffic lies in the different implications of choosing one or other mode for the generating country's balance of payments. Whereas revenue from international rail traffic is shared among the railways concerned, the road haulier appointed at the start remains in charge of the operation throughout and collects all the takings.

of infrastructure should be a domestic issue. This stance in fact leaves entirely unsolved the problem of vehicles in transit paying only fuel taxes, which certainly fail to cover the use costs that they generate. Experts calculate that the financial contributions of road vehicles in transit at best cover only 18 per cent of the expenditure they account for.

In view of the recent unco-ordinated steps taken by various countries to levy charges, calculated on a somewhat doubtful basis, on vehicles in transit, or to introduce transport quotas, the experts unanimously agree that the problem of infrastructure for pricing needs to be settled. So both on the technical side (bottlenecks) and from the financial or fiscal standpoint there is an urgent need for an international solution, especially for road transport, to prevent a proliferation of national measures that may finally lead, for lack of consultation among the countries concerned, to distortions that would seriously affect traffic flows in Europe.

1.2 Difficulties encountered in seeking solutions

The search for solutions here is a complicated matter, largely because countries react differently to the problem of international transit, depending on whether they are transit countries or generating countries. The distinction is not an absolute one, however (the Netherlands, for instance, does not simply generate international traffic, it also has not inconsiderable transit traffic on account of the port of Rotterdam) and the concept of transit country needs clearer definition. For instance, a distinction should be made between transit countries with acute land use problems, in particular because of major geographical barriers, where questions of physical capacity consequently arise, as is the case in Switzerland and Austria, and transit countries where the financial aspects are undoubtedly of greater weight - Germany for instance. It may be noted incidentally that the cost of extending or improving infrastructure can be determined more easily in countries in the first category as in their case geographical constraints leave little scope for variants such as alternative alignments.

In any event, it is quite clear that the specific situation of each individual country in relation to the transit problem very largely accounts for the conflicts of interest that have appeared, and this makes it more difficult to devise an international solution, unanimously recognised as necessary though it is.

1.3 The frame of reference

Before examining the various conceivable solutions at European level, the problem of international transit should be clearly identified and placed in proper perspective. The context in which the Round Table approached the question should also be defined.

- In most countries, international transit accounts for only a small proportion of the overall freight traffic by each mode of transport. Transit traffic amounts to only 3 per cent of long-distance freight traffic in Germany, 4.6 per cent in Belgium (road 1.9 per cent, rail 21.6 per cent), 5 per cent in France (road 5 per cent, rail 8 per cent), 7 per cent in Greece and 15.8 per cent in Yugoslavia (road 7.2 per cent, rail 18.7 per cent). It does, however, account for 45.10 per cent of long-distance traffic in Switzerland (road 10.9 per cent, rail 53.3 per cent). In such circumstances one can hardly say that bottlenecks and the associated costs are due to transit traffic alone; it must be admitted that the degree of congestion caused by transit traffic as compared with other types of traffic is most usually exaggerated. Speaking more generally, to blame a specific group of users for the additional traffic which produces bottlenecks is at least open to question as a theoretical proposition since it is most difficult to establish any causal relationship. Selecting a method of allocating costs according to the damage inflicted is thus an extremely problematical exercise, and it is therefore difficult to treat road transit in isolation; it seems necessary to look to a more comprehensive solution, with a single method of determining the use costs of transport systems in Europe. It is accordingly clear that the question of transit traffic, the subject of considerable discussion at present, is eminently a political issue. Freight transit is in fact, simply one of the components of international traffic, another prominent one being freight traffic originating or ending within the country concerned. As separate systems are not used for these different hauls, traffic conditions on a given system are the outcome of the simultaneous presence of all types of international traffic as well, of course, as the purely domestic hauls within the country referred to. The harmful effects of road congestion, environmental nuisance, wear and tear on rail and road systems, etc., which are borne by the countries concerned cannot be attributed solely to freight transit alone. Political authorities are inclined to regard this last type of traffic as far less attractive than the others because, from a purely national standpoint, it does not as a rule make any significant contribution to the economic and social well-being of the transit country. From a European angle, on the other hand, it

cannot be overlooked that transit traffic has important social and economic implications for the country or countries of origin and destination of the goods conveyed.

Accordingly, it seems fair to say that, at European level and for each mode of transport, all types of international traffic should be regarded as equally desirable and should consequently be subject to the same rules and the same standards. Steps to resolve conceivable measures to deal with current problems of international traffic should not therefore apply to freight transit alone but be devised as parts of a general solution covering the whole of international transport in Europe.

- In this connection it should be noted that the problems raised by international traffic are not due solely to freight. Passenger traffic contributes substantially to the saturation of transport systems, if only because its timing involves very high peaks, so it is most important that Europe-wide solutions should embrace not only all categories of freight transport but also all categories of passenger transport, especially tourist traffic which is on an expanding scale and, being unevenly distributed in time and space, produces traffic flows of incredible density. In this connection, there are grounds for considering whether it is really economic to scale up infrastructure to cater for such high-density traffic over short periods. Any European solution that disregarded this type of traffic would certainly be insufficient to overcome the difficulties currently facing international transport in Europe.

However, the Round Table did not consider it appropriate to discuss the problems raised by international passenger traffic, for three reasons:

i) The matter had been discussed at an earlier Round Table, on holiday traffic;(1)

ii) Individual countries take their own particular stances on this point, even more so than for international freight transport. Some transit countries for freight are also specially attractive for tourists and are anxious to benefit from the "bonus effects" passenger transit which, unlike freight traffic, is often advantageous for the country crossed. As a result, some countries have even openly declared their intention to facilitate passenger traffic by penalising freight transport. This view of things calls for some qualification, however, for it is not clear that all types of tourist traffic are beneficial to the country

1) Holiday Traffic, Round Table 44, ECMT, 1978. See also Economic Problems of Traffic Peaks, Round Table 29, ECMT 1975.

crossed: there is currently an increasing volume of movements by emigrant workers, with a low return to the transit countries and a high accident rate, and tourism with a small consumption component of little value to the countries visited. These considerations point to the need for some caution when assessing the overall value of holiday traffic. In any event, they show why countries' positions differ widely, especially according to their geographical situation and the characteristics of their international passenger traffic.

iii) Including passenger traffic in the analysis would raise the whole problem of road pricing for private cars and ultimately raise the highly controversial question of car taxation, which goes far beyond the scope of the Round Table.

- Furthermore, an examination of the questions raised by international transit cannot be confined to road transport. Given that road, rail and inland waterway transport should be treated as a single entity when freight transit is under consideration, it is indeed essential to encompass all modes of transport, including maritime transport, if the best possible solution to the difficulties facing international transport is to be found. A comprehensive survey should give serious consideration to the sea transport alternative that is often available for international freight traffic. One advantage of maritime transport lies in avoiding many of the complications involved in crossing frontiers. It also extends the length of haul for the generating country, which keeps control of the operation and almost the revenue earned from it. In this respect, maritime transport is certainly a very effective means of increasing the charge distance for rail transport, and combined transport methods offer interesting prospects in this field. This aspect of the problem of international transport is clearly of interest, but the Round Table preferred not to examine it in great detail, in order to preserve the main focus of its work.

As the discussions at the Round Table showed, the problem of competition between rail and road lies at the heart of the debate concerning international transit. In the light of the physical and financial difficulties confronting international freight transit and the changing respective shares of each modes, the fundamental question everywhere is to determine whether the conditions required for a suitable modal split actually exist.

Consideration of this point leads naturally to the two main types of action which are under consideration at international level to overcome the problems of international traffic:

i) direct action on modal split by encouraging a transfer of traffic from road to rail where capacity is under-employed and developing combined transport. At the same time, other measures should be taken for better use (in time and in space) of existing infrastructure by international traffic, but without this saturating secondary system intended to serve a different purpose. In this connection, attention should be given to the possibility of establishing an international management and clearing agency for international inland traffic;

ii) action in the form of charges for the use of transport infrastructure. Considering that certain modes of transport, in particular road haulage, were not covering the costs that they generated, if only the infrastructure use costs, some countries have accordingly introduced tolls, levies or specific charges paid, in particular, by international road freight vehicles. Fiscal or tariff levies of this type in fact have two aims, acknowledged or not:
   . to bring the countries crossed, and particularly the transit countries, financial compensation to cover the costs caused by such traffic and the provision of transport infrastructure;
   . to improve the railways' market position vis-à-vis road transport in order to ensure better use of rail capacity, this being often under-employed.

   In theory, measures of this kind are unquestionably in line with the general desire for equalisation of the terms of competition, but so far the way they have been put into practice has only led to further distortion. The charges or levies were established on a national basis and without consultation between governments, and as a rule have been aimed solely at international transit traffic by road, and this in itself distorts the choice of modes of transport and routes. A comprehensive international solution must consequently be sought in this field; it would be extremely desirable to harmonize methods of charging for infrastructure use at European level, so that each haul, whether in transit or not and whatever the mode of transport, bears the actual costs that it generates.

At all events, the two solutions thus available at European level to the problems related to international traffic, and examined in succession below, are not mutually exclusive or independent but

complementary. They certainly represent the two most important fields of possible action, but cannot be regarded as sufficient in themselves; without question, they call for other concomitant measures if they are to be fully effective.

2. BETTER MODAL SPLIT IN INTERNATIONAL TRAFFIC

The need for a better modal split stems largely from the fact that it seems sensible on grounds of economic efficiency to make maximum use of the potential of all the existing infrastructure, whatever the mode of transport, before planning or building additional infrastructure for any given mode. When one mode has substantial surplus capacity for goods transport, as is at present the case with the railways, a sound economic approach seems to call for a thorough multi-modal evaluation of all infrastructural investment projects concerning other modes of transport. In particular, any decision to build new infrastructure for road transport suffering from bottlenecks should be considered against the alternative of a different modal split through the transfer of part of road freight traffic to the railways.

With the current modal split and the undeniably limited resources available, it is thus essential to consider the advisability, effectiveness and feasibility of a better distribution of international traffic between rail and road(1) before embarking on costly infrastructural investment. Such changes in modal split nonetheless raise a number of questions.

2.1 Advisability of transferring traffic

When the problem of transferring part of road freight to the railways is considered, it must first be asked whether the substitution of rail for road for part of international traffic is in fact desirable.

Economists and politicians do not see this question in the same light, and there are clearly two different approaches - micro-economic and macro-economic. In assessing the advisability of a different modal

1) While recognising the possibilities of transferring freight from road to inland waterways, where there is surplus capacity, the Round Table preferred to focus on road/rail competition. This is far more widespread and is not confined to a few routes or commodities. Moreover, action in this field seems far more capable of settling the main problems currently facing international freight transport on the main routes concerned.

split, quite a number of experts emphasize the need for careful cost-benefit analysis. In their view, before implementing a policy designed to change the existing scheme of things, all the costs and benefits of transferring freight between road and rail should be closely and objectively evaluated. These costs and benefits should be appraised at European level, not from the national standpoints of individual countries. As a general rule, moreover, any solution affecting international traffic should include computation of the Europe-wide rate of return for each variant. Hence, any policy seeking a well-balanced modal split should seek to identify clearly the technical and economic possibilities of each mode and endeavour to make full use of them with due regard to the type of goods carried.

Many experts thus consider that political decisions on freight transfers should first be enlightened by careful appraisals, and that general studies do not suffice. There should be more case studies paying due regard, in particular, to changes in the terms of competition and in the competitiveness of each mode.

It must be borne in mind, however, that the longstanding deficit of the railways, to which no policy solution has yet really been found, is a major complicating factor. Many people concerned with the question of international modal split consider that elaborate appraisals in purely economic terms are something of a luxury here, especially as cost-benefit analysis is particularly difficult in this sphere where findings sometimes vary considerably depending on whether the standpoint is national or international. In present circumstances, many people consider that the problem of international transit and transferring freight from road to rail is first and foremost a political issue. Political criteria should hence be decisive in any evaluation of a change in modal split. Indeed, from the political standpoint there is an obvious and sufficient argument in favour of transferring traffic to the railways: some of their capacity is unused and they are heavily subsidised from public funds, at the very time when road transport is encountering serious bottlenecks and calling for new and expensive infrastructure.

2.2 The possibility of transferring traffic

Once the political premises are thus made clear, the obvious next question is whether the rail-for-road substitution is actually feasible. The problem here is fundamentally of the same kind as the conflicting claims of public transport services and the private car in urban areas. While transfers of car users to public transport are desirable, they are very difficult to achieve because cars provide a far higher quality of service (flexibility, door-to-door travel, etc.) than other modes.

In the case of international freight transport, the substitution of rail for road transport is possible only to a small degree. Extensive transfers of road traffic to the railways are ruled out by the routes involved and by the requirements laid down by shippers. With Middle East traffic where numerous difficulties are encountered, for example, consignments must usually be escorted in order to speed up Customs formalities and see to final delivery, and the railways find it very difficult to meet such requirements.

Experts unanimously agree that although the international modal split can be changed to some extent, the volume of traffic that can be transferred will be somewhat marginal. Some types of freight are tied to road haulage (i.e. "captive" demand). Detailed analysis of demand is needed to decide whether modal split for some types of international traffic can be altered, in particular studies of various categories of freight to identify those where intermodal transfer is feasible, and origin-destination studies to determine whether theoretically feasible transfers will work out in practice.

2.3 Ways and means of achieving a different modal split in international traffic

When considering a better modal split in international traffic, the third question that arises is how a transfer of freight from road to rail can be encouraged while still remaining faithful to free market principles generally regarded as inviolate. It is essential here to concentrate on the circumstances in which rail transport might partly replace road transport. Two questions have a particularly keen bearing on this:

i) can the railways (i.e. their capacity, labour force, etc.) cope with additional international traffic?

ii) can they prove sufficiently attractive for a lasting improvement in modal split?

Experts unanimously consider that the railways cannot take the place of road transport, even partly, in their "conventional" form. To date, every attempt to transfer traffic to the railways has gone astray because human ingenuity has always devised other alternatives the railways having failed to keep up with developments. By clinging to traffic that they can no longer handle economically because of poor productivity, the railways have been precluded from offering services where their market position was strong. If there is to be a chance of transferring international traffic to the railways in the free market conditions prevailing in most European countries, rail transport must change and become more attractive. In particular, steps must be taken and certain conditions fulfilled so that the two foregoing questions concerning the railways can be

answered in the affirmative. Possible measures at European level to improve the services offered by the railways and attract traffic to this mode include:

i) first, various measures to overcome the problems of insufficient capacity that arise at some points on the international rail network. In Austria and Switzerland for instance, capacity investments are undeniably needed to improve rail infrastructure. The striking development of international road traffic in both these countries is quite plainly related to shortcomings in rail infrastructure investment.

At the same time, when considering investment there is a need for an integrated policy encompassing all modes of transport, for an unduly sectoral approach is bound to be wasteful. The construction of the Dunkirk-Valenciennes canal is a striking example: ultimately, the chief consequence of this investment was an appreciable drop in rail rates on the same route. This has undoubtedly been profitable for shippers but expensive to the taxpayer, who has had to finance a big-scale transport infrastructure which would have been dispensed with if there had been multi-modal analysis of existing transport supply and its characteristics, especially freight rates. But the problems involved in comparative cost-benefit analysis of this kind must not be overlooked. It is very difficult, for instance, to measure exactly the cost of a rail link taken singly since all rail links are in fact closely inter-related. In addition, returns on new infrastructure are generally calculated from a national standpoint, not an international one, yet with projects of European interest the international aspect has to be taken into account when assessing costs and benefits. Unfortunately, analysis of this kind is found to be especially difficult, in particular when assessing the social benefits to the countries involved. Nor is it easy to work out estimates for the diversion or re-routing of traffic flows: are these benefits, or not? These difficulties in evaluation should not be underestimated, the more so because it is undeniable that at European level optimum utilisation of existing infrastructure must go hand in hand with a co-ordination of further infrastructure plans and that the preparation of detailed analyses of the real effects of international investment is essential if arrangements for "compensation" from country to country are to be introduced when new transport infrastructures are built;

ii) conventional rail transport will never be sufficient or attractive enough to win over a significant share of international traffic. A wide range of action must accordingly be taken to improve the quality of rail services, and in

particular the flexibility of international rail traffic, to meet shippers' requirements more fully. For this purpose there is a special need to encourage the development of international combined transport - especially swap bodies and piggy-back services - that reduce journey times and efficiently avoid those parts of the system that are congested. Various steps may be considered in this respect:

a) forms of combined transport must be investigated and developed that preserve and exploit the advantages of road transport, in particular by providing for the carriage of accompanying crews who are so useful for international hauls. Recent modal split studies using simulation models show particularly good prospects for road transport, its relative costs and quality of service seeming likely to remain far superior to those of rail transport. In its conventional form, rail transport has accordingly no chance of improving its competitiveness for international traffic. The same studies reveal that the railways' international transport outlook is bleak unless they move into combined services of the piggy-back type working on the same lines as roll-on/roll-off ferries, with the lorry crews accompanying their loads.(1) Combined transport services making extensive use of the railway should be introduced on some international routes, with escorted loads, as in the case of sea ferries. Shippers generally prefer loads to be accompanied on trips to countries where the reception infrastructure is not highly developed, as this helps loading and unloading operations and the crossing of frontiers; it also saves time on terminal hauls. The development of such combined transport techniques, by which congested road systems can be avoided and modes switched to match geographic and economic conditions, should accordingly be encouraged for international transport. But it cannot be denied that piggy-back transport does not provide a blanket solution. It is conceivable only on certain international routes where traffic is particularly dense and produces significant bottlenecks in the road infrastructure, or for certain destinations where there are acute problems with terminal hauls. It is obvious, too, that the promotion of such methods involves close co-operation between road and rail, and government incentives for such co-operation;

1) The advantages inherent in ferry services suggest a promising future; once the problems of developing terminal ports have been disposed of it may prove the most effective mode of transport for international traffic with the developing countries, and particularly for trade with the Near and Middle East.

b) in order to develop combined transport services involving the railway, a number of steps must be taken concerning rolling stock. There are various techniques for combined transport, and in particular numerous methods of carrying lorries by rail. This range of techniques clearly hampers the development of combined transport services, especially international ones, each country being inclined to adopt its own technology.
There is thus an urgent need to harmonize methods so that the railways may be able to offer an international combined transport service which is attractive. To promote such harmonization and enable the railways to be suitably equipped, international financing schemes should also be devised for the purchase of combined transport rolling stock and ancillary facilities on the uniform basis that is essential for international traffic;

c) to improve rail's competitiveness on the international transport market, in particular through the development of combined transport, there must be far greater co-operation among national railways and existing rates must be changed: as matters stand at present, the railways are virtually the only hauliers which cannot export their services. To date, unfortunately, there has been manifest lack of co-operation between railway authorities in managing international traffic. The railways are also open to criticism for showing little enthusiasm for going into the international combined transport business wholeheartedly, in particular by refraining from acquiring the equipment and rolling stock needed for this purpose. This is in fact largely due to the railways' traditional unwillingness to carry vehicles or unit loads which compete with conventional rail transport. The concept of railway systems that has hitherto prevailed has been far too nationalistic, and has caused numerous problems for smaller countries, where rail distances are necessarily short. The same blinkered approach underlies the difficulties that international traffic encounters in marshalling yards near frontiers. The absence of a truly international approach to European transport has meant in many cases that railways have not set up shared facilities at frontiers but established their own marshalling yards on either side. This is bound to extend international journey times considerably. Since the above factors are bound to restrict the

railway's international competitiveness, a change in their attitude is needed. Besides greater co-operation among national railways than in the past, it is desirable that international rail traffic should be controlled by a single authority and the International Convention on the Carriage of Goods by Rail (CIM) should be amended to establish a genuine international system for rail traffic from country to country instead of the hybrid system that is simply the combination of domestic operating arrangements. On the technical side, through train services for international transit should be developed, and Customs formalities streamlined. If these aims are to be achieved, however, co-operation between the railways must be backed by government co-operation; only then will it be possible, for instance, to implement direct clearance procedures, which will save a great deal of time for international traffic. Governments should in any case play a still more fundamental role if, as appears desirable for the efficiency of international transport generally, proper attention is one day given to the broad concept and operating principles of an integrated European transport system;

d) lastly, to promote the development of international rail traffic there should be a proper marketing policy for combined transport services and all operations on the "commercial" side should be decentralised so that they may always be adjusted to market requirements. Such decentralisation is essential if there is to be any hope of some transfer of freight to the railways, but it is still more important to remove combined transport involving rail techniques from the legal control of the railways, which is considerably inhibiting the development of such traffic. International combined transport services should not be organised solely on the basis of the railways, and should not be planned solely in terms of large terminal yards; in any case it would be materially impossible to construct these at sufficiently short notice.

- For an efficient international combined transport service to be developed in the future, it seems essential that road transport should be far more deeply involved in the organisation and management of the system. It has hitherto been strongly imprinted by railway influence, so it should in future be planned far more with an eye to road transport and its characteristics. The key problem in combined

transport, both nationally and internationally, is that of co-operation between road and rail haulage. Although most governments do not wish to take too interventionist or dirigiste a line, they have to realise that the introduction of a rational system of international combined transport services, once the technical and tariff difficulties have been overcome, is ultimately a matter of political choice. To allow the development of combined transport, the public authorities will be bound to encourage a change of attitude and approach among rail and road hauliers. In particular, the railways must relinquish the notion that they should have overall control of combined transport services, and play a pre-eminent role; railways have to accept that their contribution here is largely as the supplier of motive power. It must also be admitted that road hauliers treat combined transport systems with some suspicion. This attitude, one which will not easily be changed, has two main causes that the public authorities must tackle:

- business rivalry: as combined transport is organised at present, road hauliers are apprehensive about losing control over their operations if they entrust their vehicles or loads to the railways for part of the journey. They also fear that once involved in the combined transport business the railways' sales staff may try to deal directly with their clients and win their patronage. One precondition for the future success of combined transport is consequently a clear ruling as to who actually takes charge of this type of traffic;
- legal obstacles: as a general rule, international conventions cover only single modes of transport. In the case of accident or loss during combined transport, the last carrier (usually the road haulier who delivers the load to the consignee) is normally held responsible and it then lies with him to seek redress from the other carriers, but these are generally railways or shipping lines whose size and financial resources make them formidable opponents in litigation. This defect in the legal provisions concerning carriers' liability in international traffic undeniably makes road hauliers feel in an inferior position when operating combined services with other modes. It certainly accounts to some extent for the road hauliers' reluctant attitude to combined international transport.

The lack of enthusiasm which road hauliers show towards combined transport, and piggy-back transport in particular, is also linked to the widespread practice of overloading road vehicles. Piggy-back transport entails systematic weighing of vehicles, and there is no exemption from the regulations in this respect. This is definitely a sphere where governments should intervene: if they really wish to encourage the development of international combined transport, the authorities concerned in each country should take steps to supervise very carefully the tonnage of road vehicles crossing their frontiers, in order to prevent overloading which further weakens rail's position in terms of productivity on the international transport market.

More generally, governments should recognise that the introduction of an integrated transport system is a challenge. Once the decision is taken, they should give determined backing to this technology that will promote a better modal split for international traffic. As things stand, no carrier seems ready to accept this solution, even though it is undoubtedly justified from the macro-economic standpoint.

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These considerations should be borne in mind by public authorities especially because whatever the railways could conceivably do, in particular for providing better standards of service, there is fairly widespread scepticism about the possibilities, on a "free market" basis and given the present-day non-dirigiste context, of achieving any really significant transfer of international freight traffic from road to rail. This scepticism is due in particular to the railways' rising labour costs and their lack of flexibility, which is liable to remain a serious handicap in competition with road haulage. In addition, the current operation of the European transport market, particularly with the well-nigh free provision of road infrastructure for international transit, definitely does not favour any substitution of rail for road. Nor should it be forgotten that even, in "free market" conditions, the possibilities of transferring traffic from road to rail are full of complications and - to say the least - doubtful at national level, this is even more true at international level where the transit countries, for instance, are little equipped to change the modal split of a type of traffic which is outside their control.

Despite these circumstances, the political authorities of European countries are very largely unwilling to resort to all-out dirigism, i.e. extreme or radical measures, to alter the modal split

of international traffic. They consider that any action to encourage a transfer of road freight to the railways should preserve the basic principle of the consignor's freedom of modal choice: mandatory allocation of traffic to a particular mode is thus ruled out. In other words, the only way to change modal split for international freight traffic is by policies designed to improve the railways' quality of service and better harmonize the terms of competition of transport operators. But such measures aiming to foster a different modal split for international traffic must be comprehensively conceived on a European scale and applied uniformly to prevent any discriminatory effects for international trade, notably with reference to the origin of the goods carried.

Seen in this light, the introduction of quotas for road vehicles(1) cannot be regarded as a solution to the problems of international transport. Measures of that kind, like in fact the transit levies unilaterally imposed by some governments, would undoubtedly distort the market. Several objections can be raised to physical restraints of this kind:

i) introducing quotas does not necessarily transfer freight from road to rail. Such measures are in fact much more likely to encourage the establishment of substitute roll-on/roll-off services on international maritime routes.

ii) a system of physical restraints might very quickly give rise to discriminatory application according to the origin, destination or kind of goods carried and would open the door to bargaining between one country and another;

iii) the introduction of road transport quotas by one government may well have ill effects on neighbouring countries. With the diversions of traffic that are bound to follow, the load on these countries' network would increase, with all the attendant harmful consequences. The main result of international transport quotas for road vehicles might thus be the distortion of trade, increased transit in some countries because of re-routed traffic and ultimately this might lead to retaliation which would distort competition even more;

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1) Certain limits placed on vehicle weights and dimensions in some countries may, because of highly restrictive nature, have similar effects. Experts accordingly consider that such measures applied to freight transport in transit should be regarded essentially as stopgaps and should give way to a better balanced European policy based on equalisation of the terms of intermodal competition.

iv) lastly, many people consider that quotas run counter to the principle of free market access and hence free competition.

- On this last count one fundamental observation may be made. When things are going badly there is a common tendency to invoke the vague concept of the market economy. Its use, in fact to preclude any action, is highly disputable, especially in relation to the problems of international transit. It should be recognised that current difficulties concerning international road transport in transit, and the problems facing some countries, are in fact due to faulty operation of the market economy, in particular failure to take account of external effects or additional costs which meant that prices did not reflect the social cost. Accordingly it would be fallacious to take the market economy as an argument for rejecting measures that may help to transfer some road freight to the railways. Market economy principles should not stand in the way of intervention to ensure that the market operates properly, making sure for instance that prices reflect true social costs. Close analysis in fact shows that the current difficulties of international transit are due chiefly to market prices for transport taking insufficient account of true costs. Although the transfer of some road freight to the railways is economically profitable for the community, it cannot happen spontaneously as long as road transport continuing to use infrastructure that is provided free of charge sets its rates without including some of the costs so incurred, and so has no incentive to contribute to the development of combined transport since the market position is distorted in its favour. The principle that consignors should be free to choose the mode of transport they prefer is no doubt fundamental but this choice should not be distorted by underpricing and unequal terms of competition for the transport operators concerned.

To encourage a better modal split and settle the problems raised by international transit, it accordingly seems essential at European level to harmonize the terms of inter-modal competition. It is of prime importance to achieve a fair allocation of costs, in particular the infrastructure costs borne by each mode. Experts have accordingly sought how to ensure that each mode actually pays the costs it imposes on the community. Thinking on these lines began in individual countries; at international level it has led to a search for measures aiming to:

i) induce consignors to use railways and combined transport by bringing prices and costs, viewed from a macro-economic standpoint, more closely into line, and

ii) provide financial resources for the transit countries seriously affected by international traffic.

As this was an area where the terms of competition were quite plainly unequal, attention focused very quickly on the principle of introducing special infrastructure pricing systems for the various modes of transport, and road transport in particular. This form of government intervention will be analysed below. However, in view of the present market position and combined transport rates, the experts unanimously stressed the need for railway modernisation to be conducted hand in hand with the introduction of infrastructure pricing. The two together condition the success of policies designed to overcome the difficulties concerning international transit. Unfortunately, while the experts were more or less in agreement on the first course, viz. modernising the railways, there was very lively discussion about the way in which the second, viz. infrastructure pricing, should be applied. This being so, it comes as no surprise to find that aspect at the very centre of recent discussions concerning international traffic.

3. A PRICING SYSTEM FOR THE USE OF TRANSPORT INFRASTRUCTURE

The emergence of large-scale international road traffic in transit is to a large extent due to the unreliability of the railways - in particular south of the Alps - and their State-controlled organisation which does not enable them to adjust the services they supply quickly and accurately in line with market requirements. The rapid growth of this traffic has coincided with the recent development of bottlenecks in the road networks of certain countries which have been obliged to allocate often substantial resources to deal with them. However, the answer to this problem is not purely technical nor is it entirely limited to the realm of civil engineering. Some countries, unlike others, could well afford to carry out such work, but are not in fact prepared to spoil a magnificent environment for the sake of new transport infrastructure. The solution to the problem of bottlenecks must therefore be sought primarily in a partial transfer of road freight to other modes of transport, rail in particular, where capacity is often under-employed. Unfortunately, as the foregoing analysis has shown, the present operation of the market and prevailing competitive conditions are not inherently conducive to a switch of this kind to rail transport, even if the quality of service provided by the latter were to improve substantially in future.

Since the concern not to hinder the flow of trade or cause diversions of traffic which would be prejudicial on a European-wide basis precludes any dirigiste intervention such as quota

restrictions and, since the principle of freedom of choice for users must be complied with, the possible solutions to the problems posed by international traffic can therefore only stem from policies designed to give greater encouragement to a different modal split by harmonizing the terms of inter-modal competition and by measures aiming to bring transport tariffs and social costs more closely into line.

To this end, a particularly effective means of encouraging a new modal split in favour of rail and piggy-back services in particular, would seem to be a system for road transport taxation whereby one can influence the final cost of transport and make it more consonant with the true social cost. Amongst the wide range of possible fiscal and tariff measures, the most appropriate in this respect would seem to be an infrastructure pricing system; this should contribute substantially to harmonizing the terms of inter-modal competition. The result of making traffic bear the infrastructure use costs it accounts for should in fact be to encourage a more rational use of existing networks without interfering with the users' freedom of choice. Moreover, in addition to charges designed to cover the real costs of providing infrastructure - maintenance, operating costs, amortization, etc. - an additional tariff system can be introduced at the same time to cover other important aspects such as compensation for social costs. There can be no doubt that a broadly based infrastructure pricing system of this kind would provide governments with a powerful means of intervention on the transport market.

In order to solve the problems raised by transit traffic in Europe it would seem therefore essential to devise an infrastructure pricing system based on internationally determined principles. Such a system should also fall within the broader framework of a general reshaping of road vehicle taxation aiming to reduce fixed taxes determined independently of the mileage covered and increase variable costs related to the actual use of the vehicle, the reason being that the present system of taxation, which is primarily based on fixed taxes, is in fact an inducement to long mileage once the lorry or car is paid for.

There are however many difficulties involved in setting up an international system of infrastructure pricing, and views on this subject are far from being identical. The present situation, with its variety of unco-ordinated national projects, makes this abundantly clear.

3.1 The present situation

The procedures adopted so far to allocate to hauliers the real costs for which they are responsible are either inadequate or ill-adjusted to the problem of transit.

- Fuel tax. As fuel consumption depends on mileage and tonnage carried, fuel tax is at first sight a rather attractive means of making hauliers pay the variable costs they impose on the community. Unfortunately, this approach in no way solves the problem of international transit; it would not seem even capable of providing fair compensation to transit countries particularly if they are small and the hauliers are not therefore obliged to refuel within them. It would admittedly be conceivable to have an international system of compensation or re-allocation but this is found to be most difficult to achieve in practice.

- The infrastructure pricing as envisaged by the European Communities is based on the principle of taxing vehicles in the country of registration and exempting them in other countries on a reciprocal basis. It constitutes a serious attempt to harmonize the terms of competition by introducing charges which reflect actual costs This system assumes that, for the volume of traffic involved, compensation from country to country is automatic and that there is therefore no problem with regard to transit as such. Although such a solution is perhaps acceptable at the Common Market level between countries with a similar economic structure and geographic situation, it cannot be satisfactory for other European countries so situated on the map, particularly with reference to traffic with the Middle-East, that they have to cope with dense flows of international transit traffic and, having regard to their type or stage of economic development, are afraid that a system of compensation commensurate with these traffic flows (i.e. an even-handed balance between outgoing and incoming traffic) will not operate automatically. So although this system may solve the problem of infrastructure pricing at national level and, no doubt, between countries with similar economic and geographic situations, at an overall European level it would not seem to be a sufficient remedy for the difficulties connected with international transit.

- The transit fees or charges which some countries have been levying for some time at their borders on international road freight vehicles are the beginnings of a solution to the problem of transit but could not be retained in their present form because:

  . Levies are not calculated on a consistent basis from country to country and rarely take into account problems concerning the regulation of international traffic. These levies, based for the most part on length of haul and/or tonnage carried, are generally of a purely fiscal nature and not geared to the true costs incurred.

. Levies determined unilaterally in this manner by certain countries may therefore vary considerably from one country to another. Being neither standard nor general, they are likely to cause distortions in international trade or changes of route.
. The present situation is in fact discriminatory. The fees levied by certain national authorities apply in most cases only to transit traffic and not to other categories of international transport, particularly international traffic originating or terminating within the country in which such fees are levied.

Thus, in the present circumstances, with regard to the infrastructure pricing system applied in certain countries, one can only regret:

- that no agreement has been reached, particularly within the framework of the European Communities, on methods for road transport taxation;
- that the solutions so far adopted by certain countries (transit fees, etc.) do not fit into an overall transport policy;
- that the measures adopted have not been harmonized between the countries concerned or determined within the context of of a European transport policy, itself clearly defined.

Before examining the various alternative solutions in detail, it is important to define the general principles which should govern the institution of a European infrastructure pricing system and so remedy the shortcomings of the present situation.

3.2 General principles for a European infrastructure pricing system

Unco-ordinated action by individual countries and its implications for the international transport market shows it clearly necessary to devise a European transport policy providing for an infrastructure pricing system, and for road pricing, in particular. Such a system must however comply with a certain number of principles in order to achieve fully the objectives assigned to it. In particular it must:

- cover all international transport and not just transit traffic which cannot be considered as solely responsible for the disamenities caused by road congestion and wear and tear of road surfaces.

- apply to all modes of transport so as to put all transport operators on an equal footing once the costs they should bear have been determined jointly at European level;
- be based on true costs attributable to vehicle traffic so as not to distort competition. It would be useful to achieve some degree of transparency for infrastructure user charges, which should not be seen as a tax measure but be calculated on the basis of true costs and should, in principle, be equivalent to the costs inflicted on the infrastructure by each category of vehicle, and also include surcharges to compensate the more general effects of traffic on the environment and other external factors. Although it is difficult to allocate capital costs as such, since these are spread over a fairly long period, it is however fairly easy to define and quantify a substantial proportion of use costs. A distinction must be made between direct or directly attributable utilisation costs, which are relatively easy to calculate, and external costs which can be substantial, particularly in mountainous countries, e.g. damage to the environment, scarcity of land resources, etc., but which are very difficult to assess as they largely depend on subjective criteria. But since a second best solution is better than none, due allowance should doubtless be made for these external costs by taking them as a fixed percentage of direct use costs. Co-ordination of these percentages being agreed between the countries concerned beforehand. In any event, having regard to the current situation, it would seem most desirable to reach agreement at European level on the definition of at least a basic element such as use cost to provide a criterion for fixing infrastructure user charges. Such an agreement would without doubt be a most useful first step towards the institution of an efficient infrastructure pricing system.
- Be defined on a European basis so as to avoid distortion of trade patterns. It is in fact essential to achieve an internationally co-ordinated infrastructure pricing system and, in particular, to reach international agreement at least on common standards for calculating use costs for each type of vehicle. In this connection, the work of the European Communities could provide a useful starting point.

3.3 The solutions

In view of the magnitude of the problem and the increasing number of national initiatives which are causing further distortion of the international transport market, all the experts are unanimous

in emphasizing the need to find very rapidly an international solution with regard to infrastructure pricing. A European solution, even if imperfect, is needed soon and would in any case be better than the continuance of the present situation, and if such a solution is to be easily and rapidly applicable, it must be as simple as possible from an administrative viewpoint, even if it might perhaps deviate to some extent from a theoretically optimal system.

Two methods(1) seem likely to provide a fairly satisfactory answer to the problem of a European infrastructure pricing system. As things stand at present, experts are still very divided in their opinion as to which of these two methods is preferable.

- The first method would involve setting up an international system of tolls, calculated on the basis of infrastructure use costs. In certain respects, this system would be somewhat similar to the transit charges currently levied by some countries, but would be designed on an international basis, the toll charges(2) being agreed

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1) No reference will be made here to solutions of a purely fiscal kind such as the payment of a road licence. Their major disadvantage in fact is that they fail to make hauliers aware of the real costs they incur. Since they imply a fixed cost they cannot be a strong incentive to a better modal split and increased use of piggy-back services.

2) The Round Table did not judge it appropriate to discuss the ways of calculating infrastructure user charges. The theoretical and practical aspects of this point have been dealt with in many studies which it would be pointless to rehearse here. The following for example, are relevant:

- SMEED Committee: "Road pricing: the economic and technical possibilities". Report of a panel set up by the Ministry of Transport, London, HMSO, 1964.
- R. Malcor: "Problèmes posés par l'application pratique d'une tarification pour l'utilisation des infrastructures routières". Commission des Communautés Européennes, Série Transports No. 2, 1970.
- A.A. Walters, "The economics of road user charges". World Bank Occasional Papers 5, 1968.
- "Rapport sur l'imputation des charges d'infrastructure aux véhicules routiers de marchandises". Commission d'étude des coûts d'infrastructure presidée par D. Laval, Paris, April 1970.
- Costs of the road track. Second Report: "The method of apportionment of costs of the road track to the categories of motor vehicle". Report of a working group under the chairmanship of C.J. Bunnik, Netherlands, 1970.
- C. Guillemin: "Le prix de la route. Essai sur la tarification publique". Economica, Paris, 1976.
- Cherington: "Present state of theory concerning transport economics: allocation of infrastructure costs." First International Symposium on Theory and Practice in Transport Economics. ECMT, 1964.
- A. Devreker: "Allocation of infrastructure costs. Second International Symposium. ECMT, 1967.
- M.E. Beesley: "Technical possibility of special taxation in relation to congestion caused by private users". Second International Symposium. ECMT, op. cit.
- "Pricing the use of infrastructure". Report of the Seventh Round Table. ECMT, 1971.

between the various countries. The details and procedures would thus be decided at international level and the tolls would be levied whenever an international transport vehicle, whatever its nationality, entered a country.

Tolls are doubtless not a universal remedy and, in particular, are difficult to apply to a fairly dense road network, but in the case of international traffic, the trunk routes are fairly well traced. Two maps outlining the main axes of international transit traffic in Europe (ECMT Member countries) are shown in Annex.

The setting up of an internationally defined system of tolls has three advantages:

- The toll charge is a directly perceived cost on each trip since it has to be paid whenever the transport operator's vehicle enters a country. It is accordingly far more noticeable for road users than a "lump sum" revenue tax determined more or less independently of the number of hauls carried out and generally paid at a fixed date. The institution of a toll system could thus have a fairly direct effect on modal split and, more generally, on demand, since users would be more strongly induced to adapt their strategy to match the costs actually incurred.
- The charges levied at toll booths could be paid into special funds for road construction and maintenance; in this way they would be directly used to provide better facilities.
- Lastly, a system of tolls provides fairly simple solutions to the problems of allocating costs to different types of vehicle. It has the additional advantage of not being discriminatory and applying to all vehicles - passenger and goods transport - whatever their nationality.

Tolls are often criticised on the grounds of their high cost of collection, but much progress has been made in this area and it is not certain that the cost of collection is higher than for other types of fee. The fact remains, however, that the introduction of a Europeanwide system of tolls faces one major difficulty: the collection of tolls would undoubtedly cause serious problems for small countries with a very high population and road network density and which, as a result, have a very large number of access roads to their main transport routes.

- The second conceivable method would be an international infrastructure pricing system involving an equalisation or cross-subsidisation fund which would redistribute revenue and thereby solve the transit countries' problem, or at least its financial aspects. An international fund managed on the same lines as Eurocontrol does for air transport would centralise the payments which all international

transport vehicles would have to make before their departure; the amount paid could be based primarily on the number of tonne-kilometres involved. Each year, the amounts paid in this way by the various countries participating in the system would be pooled and then redistributed in accordance with a formula agreed on a European basis and designed, in particular, to give satisfaction to transit countries. To establish a correct basis for such compensation, it would doubtless not be necessary to carry out a systematic count of vehicles, as this is certainly a very cumbersome procedure; sample surveys and spot-checks would probably suffice.

Such a system would be undeniably more complex to implement than the first but would doubtless cater for the problems of small transit countries more effectively and would be more international in character.

Finally, whatever solution is adopted, the experts emphasized that it must be applicable to all categories of international freight transport and not solely to transit traffic. This would avoid the latter form of traffic having to pay disproportionate charges in relation to its true scale and effects. Passenger transport should also be taken into account in the pricing system adopted; in particular, it would be necessary, if a European equalisation fund were to be set up, to take tourist traffic into account in the international redistribution of the proceeds, due regard being paid to both the positive and negative aspects of such traffic.

4. CONCLUSIONS

There is certainly no single solution to the problems raised by transit traffic and international traffic generally. Such a solution can only be the result of a series of simultaneous measures whose combined effect may be expected to have some chance of overcoming the present difficulties. No one measure would appear to be decisive in itself.

The analysis has indeed made it clear that action concerning international traffic should be taken in several directions.

- It should first of all have as its objective <u>better utilisation of existing infrastructure</u> by means of co-ordinated measures aimed at:

  . Improving rail services in such a way as to encourage the transfer of freight from congested roads to rail transport where there is still underemployed capacity. The impact of such action should not however be overestimated because, in terms of the quality and flexibility of service provided, rail is obviously inferior to road transport whose door-to-door service is very difficult to equal. It must also

be admitted that combined transport techniques, piggy-back systems for instance, which could be very attractive for international traffic, might well for a number of reasons - not least the lack of international harmonization - be handicapped by their high cost for a long time yet. A better allocation of infrastructure costs to each mode of transport so that all transport operators are put on an equal footing and competition is no longer distorted. Here again, one should not be too optimistic about the real effect of setting up an infrastructure pricing (in particular, road pricing) system. Some reservations as to the effectiveness of such a system are justified having regard to what its proceeds are likely to be; the figures calculated by the experts show that, short of adopting a scale of charges which would be altogether unacceptable for political reasons levies for the use of infrastructure would be unlikely to have any appreciable effect on road transport rates and their influence on road hauliers' cost structure would be very slight. Compared with all the other factors which determine the relative competitiveness of road and rail, they would ultimately have only a slight impact on the position of road transport in relation to rail.

- Measures aimed at more efficient use of existing transport networks must certainly be backed by much closer European co-operation in the planning and financing of transport infrastructure. The attempt to achieve optimal use of the present infrastructure must be combined with close international co-ordination of new infrastructure planning. It would no doubt also be useful if the measures aimed at achieving a better modal split and greater cohesion between national investment programmes were to be accompanied by some channelling of traffic and, in particular, the designation of a few specialised trunk routes for international transport, which would thus be speeded up and kept away from inadequate routes. Seen in this light, the problem at issue is clearly once again that of defining and administering an international transport system together with the underlying question of a European investment fund for infrastructure projects of international scope.

In any event, the difficulties confronting international traffic can be overcome only within the context of an overall approach:

. covering all modes of transport, passenger as well as freight, by land and sea. In this connection, bearing in mind the relief of Middle East seaport congestion, the development of roll-on/roll-off services, the slower growth rate in industrialised countries and the re-adjustment of

industrialisation policies in certain oil producing countries, it may well be that the most critical phase of the problems of international land transport has already passed.

- embracing every country and integrated within a European transport policy; to avoid any distortion in the pattern of trade, the search for a solution to the problems of international transport essentially requires multilateral co-operation between European countries within the framework of a common general transport policy.

Nonetheless, in view of the gravity of the situation, all the experts agree in emphasizing the need for speedy action even if this were to provide only a partial remedy to start with. If broad action of this kind on a European scale were slow to materialise, there is no doubt that decisions would soon be taken on a purely national basis by certain countries to encourage the transfer of freight traffic from one mode of transport to another or restrict access to certain routes. In the absence of concerted action, the process thus set in train could only distort competition on the European transport market even more and provoke retaliatory measures.

5. ANNEX

TENTATIVE ILLUSTRATION OF THE MAIN INTERNATIONAL TRANSIT ROUTES IN EUROPE

Figure 1 : Main Transit routes in ECMT Member Countries

Figure 2 : Main routes across the Alps

FIGURE 1

MAIN TRANSIT ROUTES IN ECMT MEMBER COUNTRIES

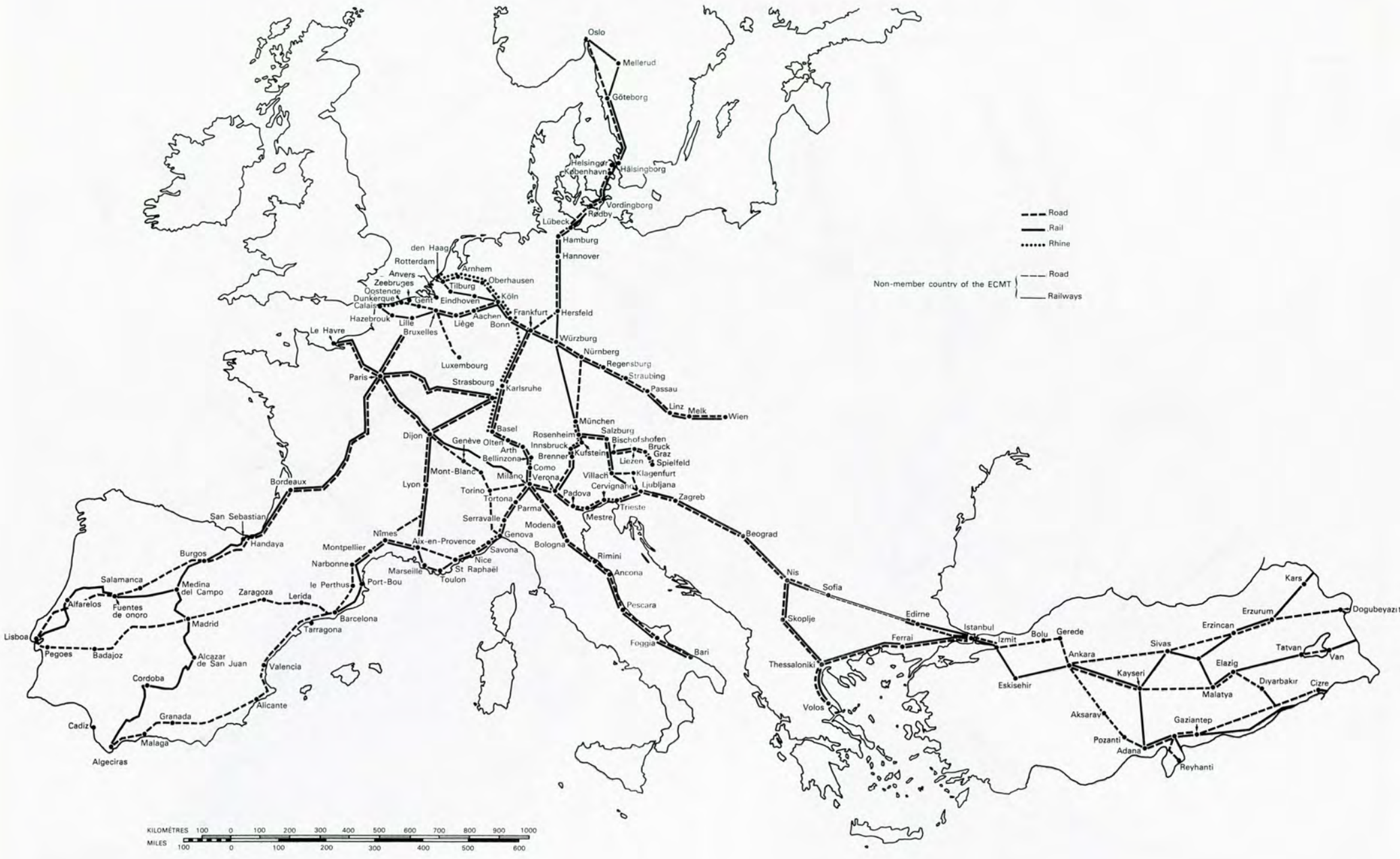
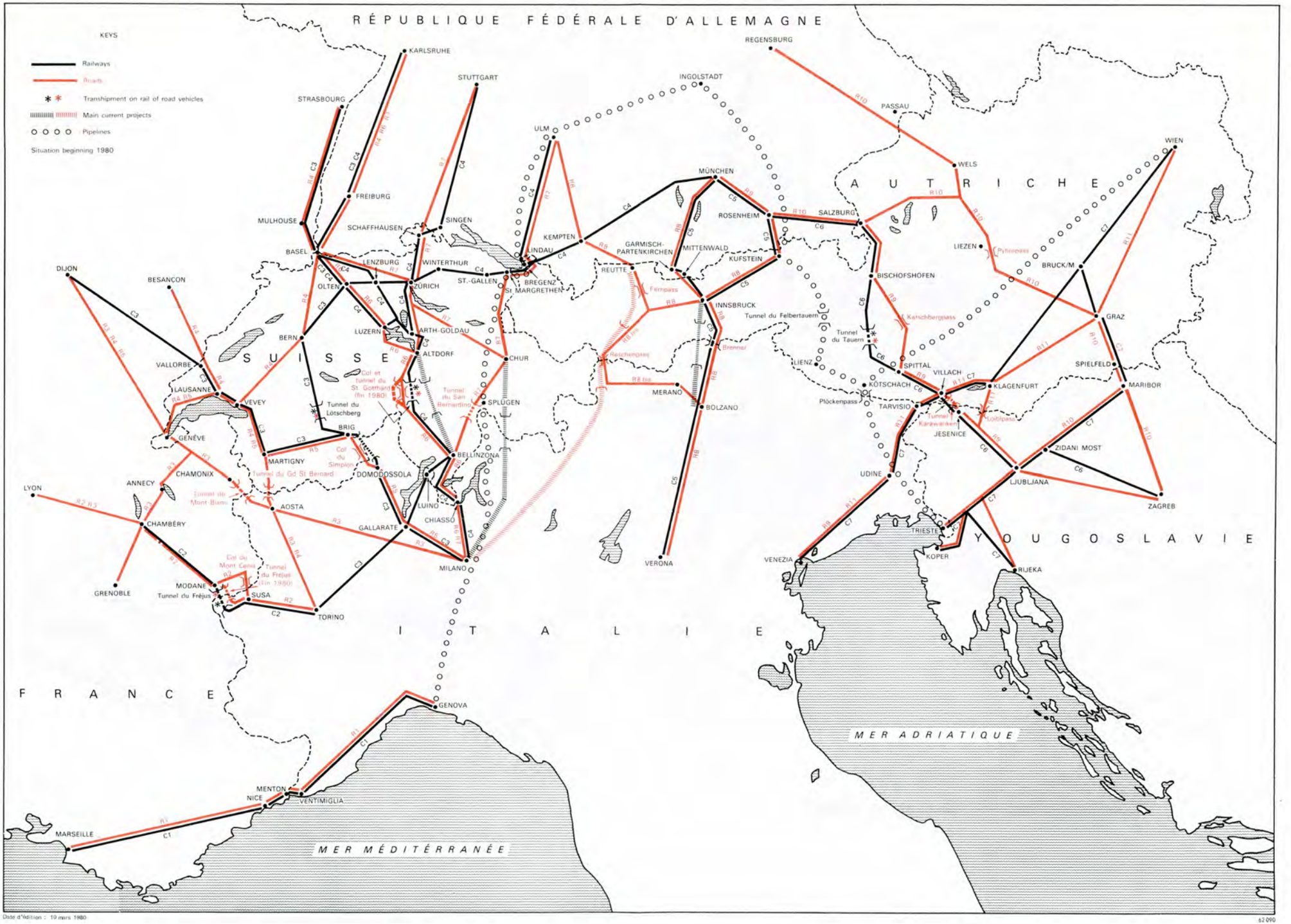


FIGURE 2

MAIN ROUTES ACROSS THE ALPS



Date d'édition : 10 mars 1980

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6. SUMMARY

6.1 International transit transport: overview

The question of international transit is undoubtedly a current issue. While it has also been an economic problem, there is no doubt that today this kind of traffic raises:

- a problem of infrastructure, i.e. a technical problem. Bottlenecks have recently begun to occur in transport infrastructure used by international traffic and in this connection traffic with the Middle East has brought the problem to the surface. These bottlenecks have been made more acute by the fact that traffic growth has not been even over all modes of transport;
- a problem of infrastructure pricing and more generally a financial problem. Underlying this question, whose importance is shown by the introduction of transit charges by certain States, is the idea that transit countries should be entitled to fair compensation for transit traffic through them, which brings them little benefit.

Difficulties of this kind have been experienced particularly by road hauliers in international traffic, but it is very difficult to find solutions for them because countries' sensitivity to this question varies depending on whether they are transit countries or countries where traffic is generated.

Actually the problem of competition between rail and road is at the heart of the discussion on international transit. In face of the physical or financial difficulties encountered by international freight transport in transit and of the trends in the different modes' shares, the basic question in every country is whether those conditions are obtained which would enable traffic to be distributed in the optimum way between the various transport techniques.

6.2 A better modal split for international traffic

When as now happens a transport system, namely rail transport, has considerable surplus capacity, it seems necessary, before embarking on expensive investment in infrastructure for other modes of transport, to consider the desirability, effectiveness and possibility of distributing international traffic better between rail and road.

As regards international freight transport, the substitution of rail for road transport is only possible to a limited extent. Any massive transfer of road freight to the railways is ruled out by geographical features and by conditions stipulated by consignors.

Not even a marginal substitution of rail for road transport is possible with a railway run in the traditional manner. For any hope of a significant transfer of international traffic to the railways in the conditions of free competition prevailing in most European countries, rail transport will have to change and become more attractive. Measures which might improve the supply of rail services in Europe include:

- action to solve the problems of insufficient capacity found at certain strategic points on the international rail network;
- schemes for improving the quality of the service provided by the railways:
  - . development of forms of combined transport such as piggy-back services
  - . harmonization of the techniques for combined transport by rail and investment by Europe in suitable equipment
  - . closer co-operation between national railway undertakings
  - . suitable policy for marketing combined transport
  - . more co-operation between road and rail transport in promoting traffic using swap bodies, piggy-back services, etc.

In spite of all the efforts which can be envisaged to improve rail services, one has to admit that there is fairly general scepticism regarding whether it is possible, by liberal policies, to bring about a really significant transfer of international freight traffic from road to rail. This scepticism is connected mainly with the railways' rising labour costs and the inflexibility of this mode of transport. In addition, the present operation of Europe's transport market, in which the road infrastructure for international transport is made available almost free of charge, certainly does not tend to favour the substitution of rail for road transport.

In spite of such a situation there is a general refusal by political authorities in European countries to resort to extreme measures such as a quota system, and there is a desire to allow users to choose their mode of transport freely. If in these circumstances there is to be a better modal split for international traffic, it seems essential for Europe to harmonize conditions of competition between the different transport modes on the market and especially to arrive at a fair distribution of infrastructure expenditure between carriers.

6.3 A system for charging for the use of infrastructure

By enabling the end cost of transport to be adjusted and brought closer to its real cost to the community, the levying of charges on road transport and especially the introduction of charges for the use of infrastructure would seem to be particularly effective courses of action for promoting a new modal split.

Fuel taxes, transit dues recently charged on entry into certain countries, and charges for the use of infrastructure as envisaged by the European Communities are either insufficient or unsatisfactory for dealing with the problem of international transit.

In order to achieve fully the objectives assigned to it, a European system of charges for the use of infrastructure should:

- apply to all international transport and not only to transit traffic, which cannot be regarded as solely responsible for the harm done by overcrowding and wear and tear of the road system;
- be applied to all modes of transport;
- be calculated on the real costs due to vehicular traffic;
- be planned on a European basis so as not to lead to distortion in international trade.

Two methods would seem able to provide a fairly satisfactory solution:

. an international system of tolls whose amounts would be based on the costs of using infrastructure. This arrangement would have the advantage of being felt keenly by the user, but there would be some difficulties in applying it in countries where there are a great number of points of access to the main traffic corridors;

. an international system for levying charges for the use of infrastructure, together with the establishment of a compensation and equalisation fund for solving at least the financial problem of transit countries by redistributing the proceeds from the charges. However, while this arrangement is undeniably international in character, it it complicated to put into practice.

6.4 Conclusion

There is no single solution for the problems raised by international traffic. The solution must consist in a series of parallel actions aimed at making better use of existing transit corridors and at achieving closer European co-operation in planning, financing and managing transport infrastructure. No single measure can be

decisive. The difficulties experienced by international traffic can only be overcome as part of an overall plan of action covering all modes of transport, both passenger and freight traffic, and both land and water transport, involving all countries and forming part of a European transport policy. At all events, in view of the gravity of the situation, concerted action on a European scale cannot be long delayed, even if initially it were not perfect. Unless it were taken, some countries would not fail to take early decisions on a purely nationalist basis which would tend to promote transfers of freight between transport modes or to restrict access to certain communication routes. Such a development could only distort competition even more in the European transport market and give rise to retaliation.

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PRINTED IN FRANCE
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