The Effects of Motorways on the National Economy

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Abstract

Motorways have a beneficial effect on the national economy. With the reduction in congestion and shortening of transport times businesses obtain savings in their transport costs. When they pass these savings on in the prices of their products, sales of the products increase, production expands and new jobs are created. Because of the relations of interdependency within trade and industry, road projects also benefit businesses which do not actually use the new roads themselves.

The effect for the national economy of development of the road network can be examined using the long-range model of the Finnish national economy, the FMS model, developed at the University of Oulu. The model is based on input/output tables describing the interactive relations between different fields of activity. The benefits obtained from motorways by each field of activity are fed into the FMS model, and the output from the model includes the increases in the gross national product and in employment. In total the motorway network will increase the gross national product by around FIM 10 billion by the year 2030. As the initial data only the savings of time for goods traffic were used. If passenger journeys during working hours are also taken into account, then an estimate of FIM 15 billion would be obtained for the increase in the gross national product.

The increase in the gross national product generated by the entire motorway network was allocated between the individual projects by dividing the total sum in proportion to the transport savings of the individual projects. The inclusion of the increase in the gross national product in the calculations significantly improved the profitability of the motorway projects, accounting for up to a third of the total savings achieved by a project.

All the motorway projects taken as examples were profitable according to the calculation, i.e. their benefit/cost ratio was greater than one. For five of the projects the benefit/cost ratio was over 1.5 and they would remain profitable even if e.g. the growth of traffic was considerably slower than forecast.

The socio-economic calculations for road projects should be further developed. Several benefit and cost items are omitted from the present calculations.

Preface

In connection with the development plan for the trunk road network, in summer 1991 a report "Trade, Industry and the National Economy" was issued concerning the effects of the motorway network on the national economy. In the present investigation the benefits of motorways to the national economy have been related to the individual projects.

Viasys Oy and the Department of Economics of the University of Oulu are responsible for the calculations concerning the national economy. The calculations have been carried out using a model of the Finnish economy, the so-called FMS model, developed at the University of Oulu. The report has been written by *Juha Parantainen,* M.Sc.(Eng.) of the Road Planning and Design of the Finnish National Road Administration. He has also prepared the section of the report which deals with the significance of the increase in the gross national product in the calculations of the profitability of motorway projects.

Contents

1 THE EFFECTS OF A ROAD PROJECT ON TRADE AND INDUSTRY

The effects of a road project on trade and industry are illustrated in Figure 1. The effects can be divided into direct effects and indirect effects. The direct effects are observable at once, as soon as the improved road link is opened to traffic. The indirect effects are the cumulative consequences of the direct effects and appear only years or decades afterwards. Indirectly a road project can benefit also companies and groups of people who do not actually use the road link themselves.

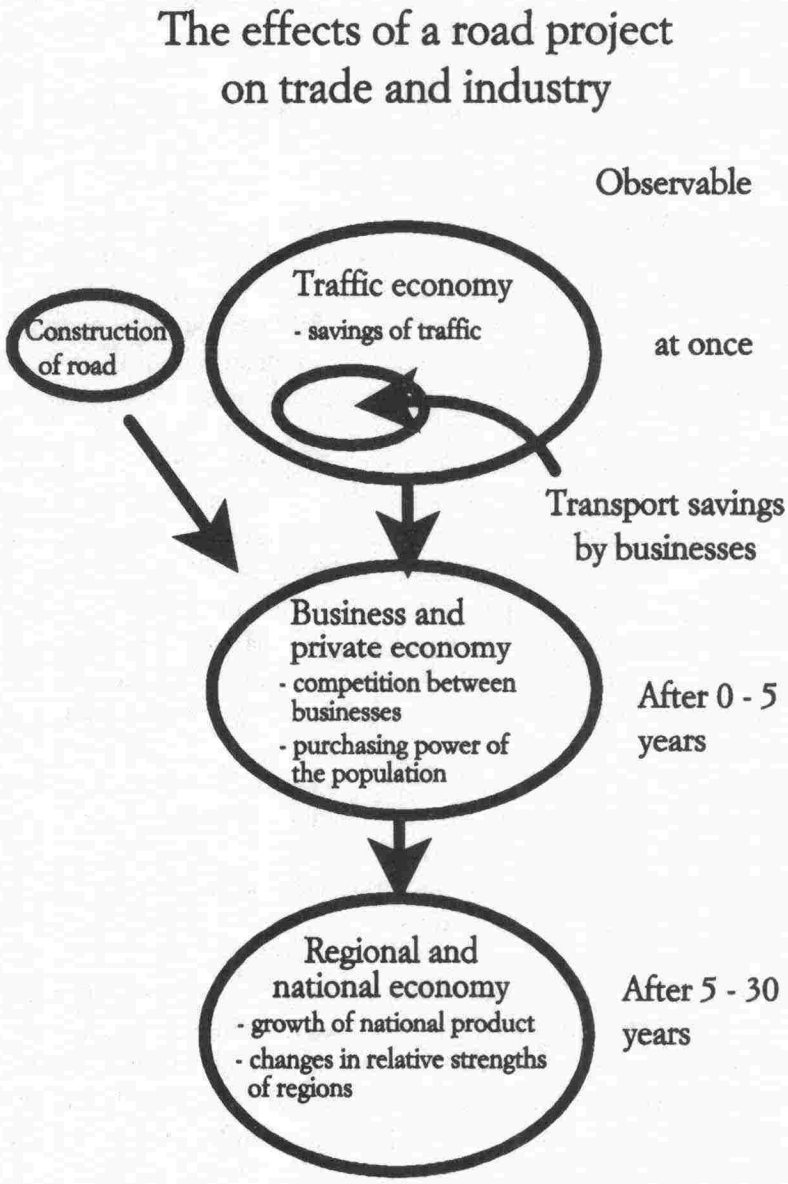


Figure 1. The effects of a road project on trade and industry

In the traditional traffic economy calculations account is taken of savings in vehicle, time, accident and maintenance costs. The time and accident costs are estimated with the aid of notional, socio-economic unit prices. The value of time varies according to the purpose of the journey: working time is most expensive, leisure time is cheapest. In the case of accident costs, besides medical expenses and damage to vehicles, account is also taken of the loss of the accident victim's labour input and the so-called loss of well-being.

The savings items to be taken into account in the socio-economic profitability calculations can be divided into two groups: actual monetary savings and notional savings based on valuations. The existence of savings in the former group is a precondition for the creation of cumulative indirect effects for trade and industry. A road project can stimulate business activities only if some companies or private persons derive real, monetary benefits from the project.

Businesses make savings as a result of improved road and traffic conditions in the following ways:

- Higher driving speeds and reduced congestion speed up transport. Faster transport also reduces the need for vehicles and personnel.
- Transport timetables are kept better. It is not necessary to reserve an extra time margin to allow for possible congestion. Storage costs are reduced because transport can be carried out according to the JOT principle precisely when the goods are actually needed.
- Damage in transport is reduced with a consequent reduction in insurance charges and packing costs. Damage in transport resulting from road conditions is relatively rare on main roads, so that the savings to be achieved in this way are not large.
- Passenger journeys in the course of work are faster and safer. As we move towards a society increasingly based on knowledge, contacts between businesses increase and thus the efficiency of transport on business trips is of growing importance to economic development.

In addition to the savings arising in transport, companies also benefit from the actual road construction work. These effects, however, are small compared with the transport savings and are of only temporary duration. The indirect benefits from road construction work are consequently also small.

A road project also indirectly benefits others and not only the users of the road connection. The savings made by companies as a result of road improvements may be passed on in the prices of their products, thereby increasing demand for the products. The suppliers and sub-contractors of these companies will receive additional orders and thus their turnover will also grow. The growth in the turnover of these businesses will in turn increase the tax revenue of the state and local authorities.

Similarly, private persons can use their increased purchasing power to increase consumption. Road projects, however, only slightly increase private consumption because the disposable income of a private person is not much increased by a road

project. The time saved in traffic cannot be converted into money. On the other hand the savings in motor fuel etc. are small.

Above the indirect net effects have been described. The savings in transport costs generate positive cumulative effects at the national level. A motorway can also have divisive effects. In this case development is accelerated in areas, communities and municipalities which are located favourably with respect to the new road, whereas areas which are remote from the road connection may start to decline. From the point of view of a given municipality a road connection may be beneficial, but viewed from a broader perspective it may only be a question of a shift in the relative strengths of the municipalities affected. Accordingly, divisive effects have not been taken into account in the profitability calculations for road projects.

2 DEVELOPMENT OF THE ROAD NETWORK AND THE NATIONAL ECONOMY

The gross national product is often employed as a measure of the prosperity of a nation. The gross national product means the total value of all the goods and services produced in all sectors. The gross national product can grow in two ways: a country can exploit new resources or can make more efficient use of resources which are already being exploited. The growth of production gives rise to new jobs and increases the tax revenue of the state and local authorities. Part of the increase in production goes for export, part is consumed at home.

Road projects make possible more efficient exploitation of existing resources and thereby increase the national product. Businesses are mutually interdependent. With the reduction in transport costs a company can reduce the prices of its products, which increases the demand for its products. This in turn increases the sales of the company's suppliers and sub-contractors. The matter can also be examined by industrial sector: an increase in production in one industrial sector increases sales in other industrial sectors too.

Figure 2 illustrates the order of magnitude of the gross national product, the costs of road upkeep and the value of road transport. Finland's gross national product in 1990 was approx. FIM 400 billion. Of this the value of road transport accounted for about FIM 25 billion. Just over FIM 5 billion was used for road upkeep. Small changes in the financial allocation for road upkeep can cause much larger monetary changes in transport costs. Small changes in transport costs can in turn cause larger monetary changes in the gross national product. Although the effect of road projects on the national product is relatively small, the monetary sums concerned are nevertheless large.

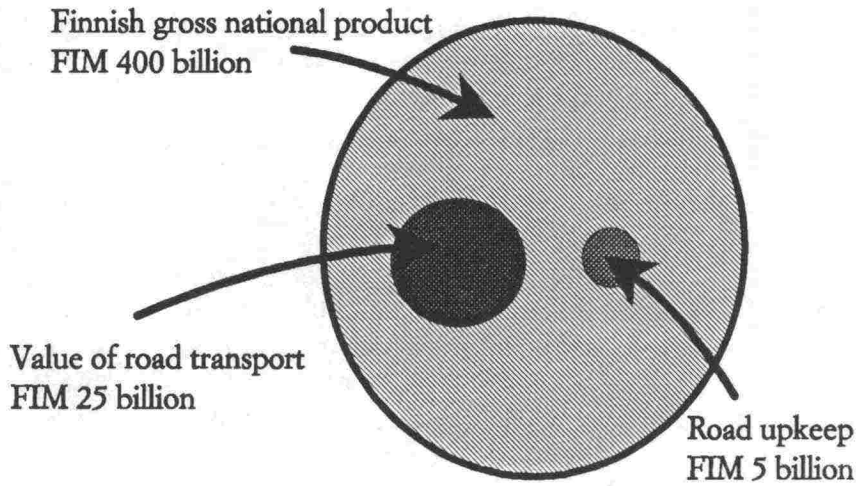


Figure 2. The order of magnitude of road upkeep costs, the value of goods traffic and the gross national product

The interactive relations between different sectors of industry can be estimated by means of so-called input/output tables. A transport saving for a particular sector can be interpreted as an increase of productive input. From the input/output tables it is possible to read the reflected effect which an input in one industrial sector has on production in other industrial sectors.

The Department of Economics of the University of Oulu has developed a long-range model for the Finnish national economy, the so-called FMS model (Finnish Long Range Model System). The model is based on input/output tables prepared by the Finnish Central Statistical Office in 1985. By means of the model it is possible to estimate e.g. the effects of road projects on the gross national product, on employment and on tax accrual for the state and local authorities. In the model production activities are divided into 30 industrial sectors, so that using the model it is also possible to estimate the effects of road projects for individual sectors of industry.

3 THE EFFECTS OF MOTORWAYS ON THE NATIONAL ECONOMY

3.1 Scope of the Investigation

In the investigation the effects for the national economy of the motorways proposed for construction by the year 2010 in the Development Plan for the Trunk Road Network are examined. A map of the motorway system in the year 2010 is given in Appendix 1. Non-motorway road projects are also of significance for the national economy. Because of the lack of initial data it has not been possible to estimate the order of magnitude of their benefits for the national economy which are outside the scope of the investigation. Motorways, however, are constructed for the most congested sections of the road network, so that the savings in driving costs from motorways account for a very substantial part of the total savings from road

projects. Accordingly, a large proportion of the benefits for the national economy arising from the development of the road network are included in this investigation. Outside the scope of the investigation, transport savings for businesses and thus significant benefits for the national economy are generated by projects in the metropolitan region and by other major projects in urban centres which are not classified as motorway projects.

In "Trade, Industry and the National Economy", a supplementary report to the Plan for Development of the Trunk Road Network, the total effects of the motorway network for the national economy are calculated. In the present investigation the previously calculated total benefits are divided between the individual motorway projects.

3.2 Research Methods

In the investigation use has been made of the statistics on goods transport compiled by the Research Centre of the Finnish Roads Administration, the EMME/2 traffic planning software, the Kehar software and the FMS model. The course of the investigation is outlined below.

1 The traffic flows between Finnish municipalities for a total of 44 classes of goods were obtained from the statistics on goods transport.

2 The flows of goods between municipalities were located by the EMME/2 software on the existing road network and on the road network supplemented by the motorways to be constructed by the year 2010. The flows were located on the fastest routes. For the journey times the speeds calculated by the Kehar programme for the year 2010 were used for the areas of the projects.

3 For the various classes of goods the total performance (ton-kilometres or ton-hours depending on the class of goods) was calculated for the existing road network and for the road network supplemented by the motorways. The saving in transport performance for each class of goods was obtained as the difference between the values for the existing and improved road networks.

4 The journey and time savings for the various classes of goods were converted to monetary values by multiplying the savings by the unit transport price. The unit costs were determined with the aid of cost calculations prepared by the Finnish Road Haulage Federation. Because the journey savings turned out to be small, they were omitted from the remainder of the investigation.

5 The savings for classes of goods were converted to savings for sectors of industry by attributing the transport savings to the recipient industrial sector.

6 The transport savings for each industrial sector were fed into the FMS model, giving the total effects of motorways for the national economy as a result.

7 The effects of motorways on the national economy were divided between the individual motorway projects in proportion to the transport savings. The benefit of a project for the national economy is accordingly greater the larger the transport savings obtained by businesses as a result of the project. The savings in goods transport from each of the motorway projects were calculated by the EMME/2 software.

For the savings of each industrial sector in the FMS model the savings in goods transport were used. Of these, only the savings in time resulting from faster transport were taken into account (Figure 3). It was not possible to take into account the improvement in the reliability of transport timetables or the reduction of damage during transport. Passenger journeys during working time were not included in the calculations either because the input data was inadequate.

With the exception of passenger journeys during working time, the direct savings items omitted from the calculations would probably have had only a slight effect on the final result. In the Development Plan for the Trunk Road Network it was estimated that because of the motorway network the savings on passenger journeys during working time would amount to about FIM 1.1 billion in 1991 - 93 (present value in 1990). The savings on goods transport were calculated at FIM 2.3 billion. Thus about a third of the actual direct savings were omitted from the calculations of the effects on the national economy. The benefit to the national economy of the motorway network is thus about 1.5 times the value (approx. FIM 10 billion) calculated in the Development Plan for the Trunk Road Network.

The savings for goods transport were calculated for the various classes of goods by multiplying the ton-hour savings of the motorway network by the time-dependent component of the transport costs (FIM/ton-hour). The costs which vary according to the transport time are the labour, capital, interest and other fixed costs. These account for about 67 % of the total costs.

The goods flow matrix used as input data includes only transport between municipalities, i.e. only long-distance transport. Approximately 66 % of all tonnage transported is included. Long-distance transport benefits relatively more from new motorways than short-distance transport (within one municipality), so that an estimated 80 - 100 % of the goods flows on motorways are included. The goods flows outside the investigation slightly ncrease the actual benefits of motorways to the national economy.

In the calculations the following assumptions have been made:

- The gross national product will grow at a uniform rate of 2.5 % per annum until at least the year 2030.
- The interactive relations in the national economy shown in the input/output tables will remain substantially unchanged also in the future.
- The location and production volume of the different fields of business in Finland will not significantly change.

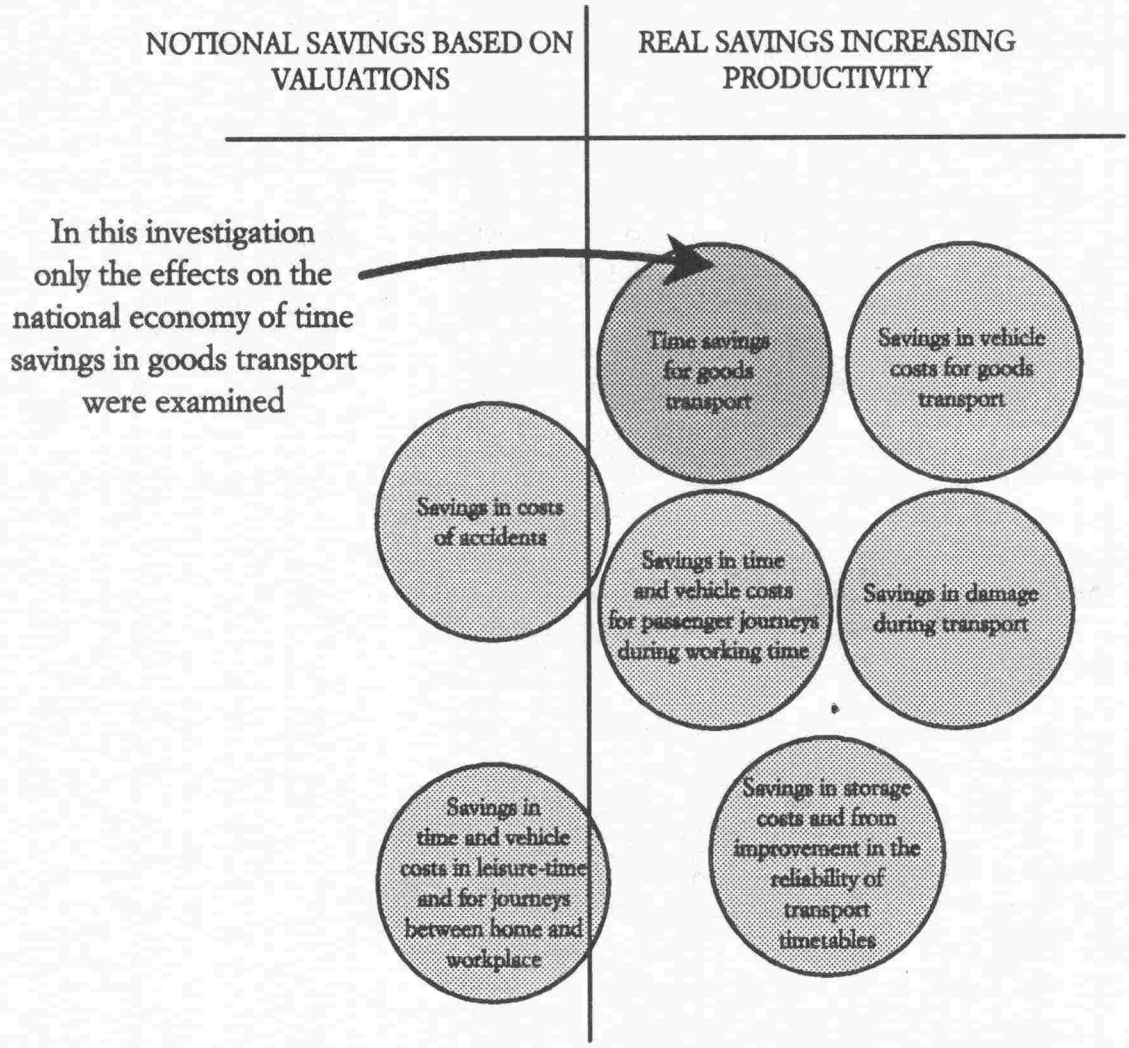


Figure 3. The direct savings for traffic taken into account in calculating the effects on the national economy

- Shifts from one form of transport to another will be small. There will be no essential changes in the unit sizes for the different forms of transport.
- Changes in the internal operation of businesses, e.g. more widespread adoption of the JOT principle, will not have a significant effect on transport.
- The motorway projects are assumed to be completed at a uniform rate over the period 1991 - 2010. The period of calculation was 2001 - 2030

The saving in transport costs obtained by an individual business as a result of a road project is generally relatively small. These small monetary savings nevertheless add up to a large sum at the national level.

3.3 Results

3.3.1 National Effects

For the motorways proposed in the Development Plan for the Trunk Road Network the following national economic effects were calculated using the FMS model (period of calculation 2001 - 2030, interest rate 6 % p.a. and 1990 price level, i.e. road construction index 130):

Increase in gross national product	FIM 9.2 billion
Increase in tax accrual	FIM 1.9 billion
Employment effect in year 2010	2 200 man years

The breakdown of the increases in production and jobs between the main sectors of industry are shown in Figures 4 and 5. Manufacturing industry accounts for the largest part of the increase in production, whereas the largest increase in employment is in the service industries.

The increase in the gross national product is in its nature an accumulative effect and appears gradually as the immediate effects, i.e. the transport savings for business, are realized.

The increase in tax accrual includes all forms of taxation and can be divided roughly half to the state and half to the local authorities. The increase in tax accrual is part of the increase in the gross national product.

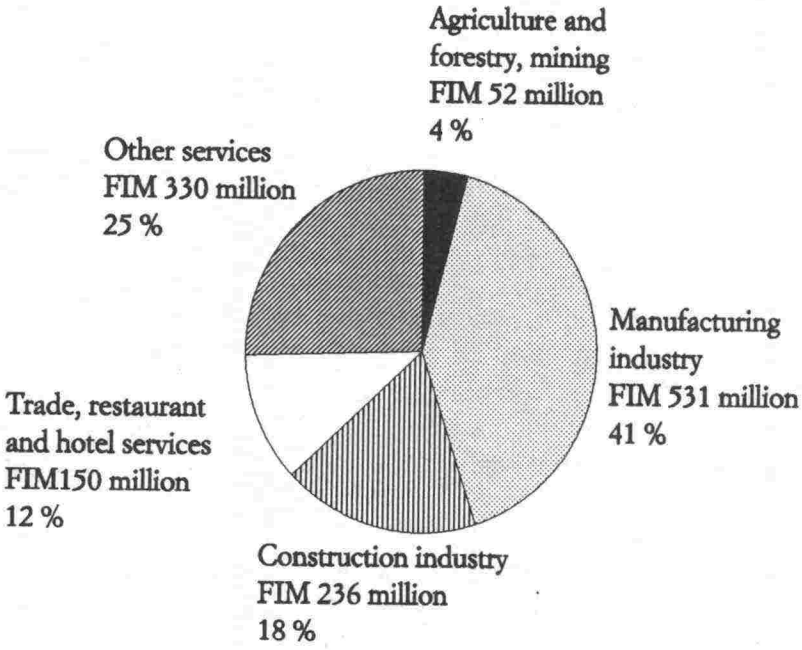


Figure 4. The increase in production by industrial sector

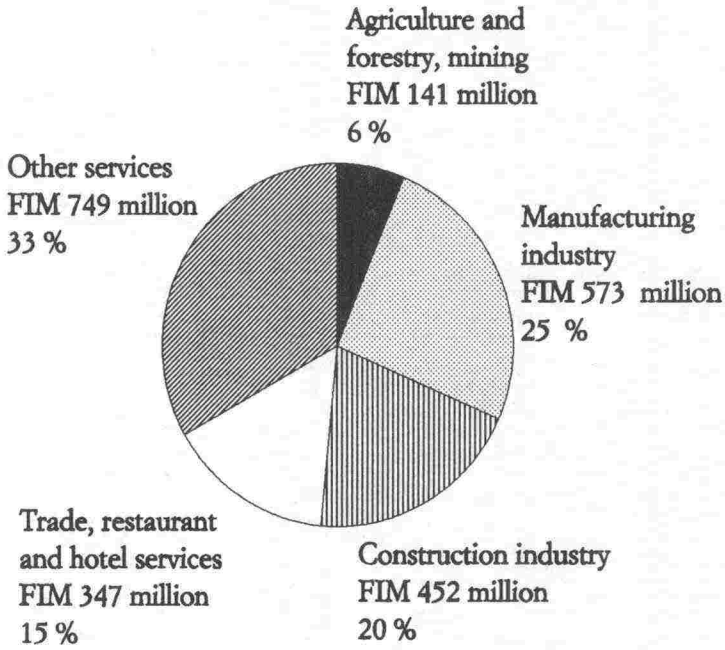


Figure 5. The increase in jobs by industrial sector

The employment effect measured in man-years is not strictly speaking the same as the number of jobs. The increase in the amount of work for a given business may be so small that it is not necessary to employ additional personnel. Simplifying slightly, however, it is possible to speak of the number of new jobs.

3.3.2 Effects of Motorway Projects on the National Economy

The total effects of the construction of the motorway network on the national economy have been divided between the indidividual projects in proportion to the transport savings.

A motorway project is significant for the national economy if

- the road carries a large amount of goods traffic and/or
- the savings achieved by the project are large (the existing road is of low standard with heavy traffic and a motorway would eliminate congestion).

The effects of sections of motorways on the national economy are given in the following table and in Figure 6 (at 1990 cost level, road construction index = 130). The increases in the gross national product and tax accrual for the period 2001 - 2030 have been discounted at a 6 % annual interest rate to the year 2000.

Road	Section	Increase in gross national product up to year 2030 (FIM millions)	Increase in tax accrual up to year 2030 (FIM millions)	New jobs in 2010
Trunk road 1	Helsinki - Turku	900	186	215
Trunk road 3	Keimola - Hämeenlinna	2 776	573	664
	Hämeenlinna - Tampere	145	30	35
	Tampere - Hämeenkyrö	193	40	46
	Laihia - Vaasa	58	12	14
Trunk road 4	Tikkurila - Lahti	445	92	106
	Korpilahti - Jyväskylä	232	48	56
	Jyväskylä - Äänekoski	252	52	60
	Liminka - Ii	648	134	155
	Maksniemi - Siikalahti	174	36	42
Trunk road 5	Vierumäki - Lusi	1 142	236	273
	Vehmasmäki - Jynkkä	261	54	62
	Vuorela - Pöljä	474	98	113
	Iisalmi Bypass	106	22	25
Trunk road 6	Koskenkylä - Lapinjärvi	46	10	11
	at Kouvola	19	4	5
	Lappeenranta - Imatra	319	66	76
Trunk road 7	Porvoo - Loviisa	135	28	32
	Kotka - Hamina	397	82	95
Trunk road 12	Hollola - Uusikylä	522	108	125
Total		**9 244**	**1 911**	**2 210**

In the socio-economic profitability calculations the above-mentioned increases in the gross national product attributable to the projects can be included in the savings for the projects. In the table the figures are given for fairly long stretches of motorway. When examining shorter stretches of motorway there is greater uncertainty in the calculations because of the approximate nature of the initial data. The order of magnitude of the increase in the gross national product for sections of motorway shorter than those shown in the table can, however, be estimated by multiplying the figure given in the table by the ratio of the savings in time costs for heavy traffic on the shorter section to the corresponding figure for the entire stretch of motorway.

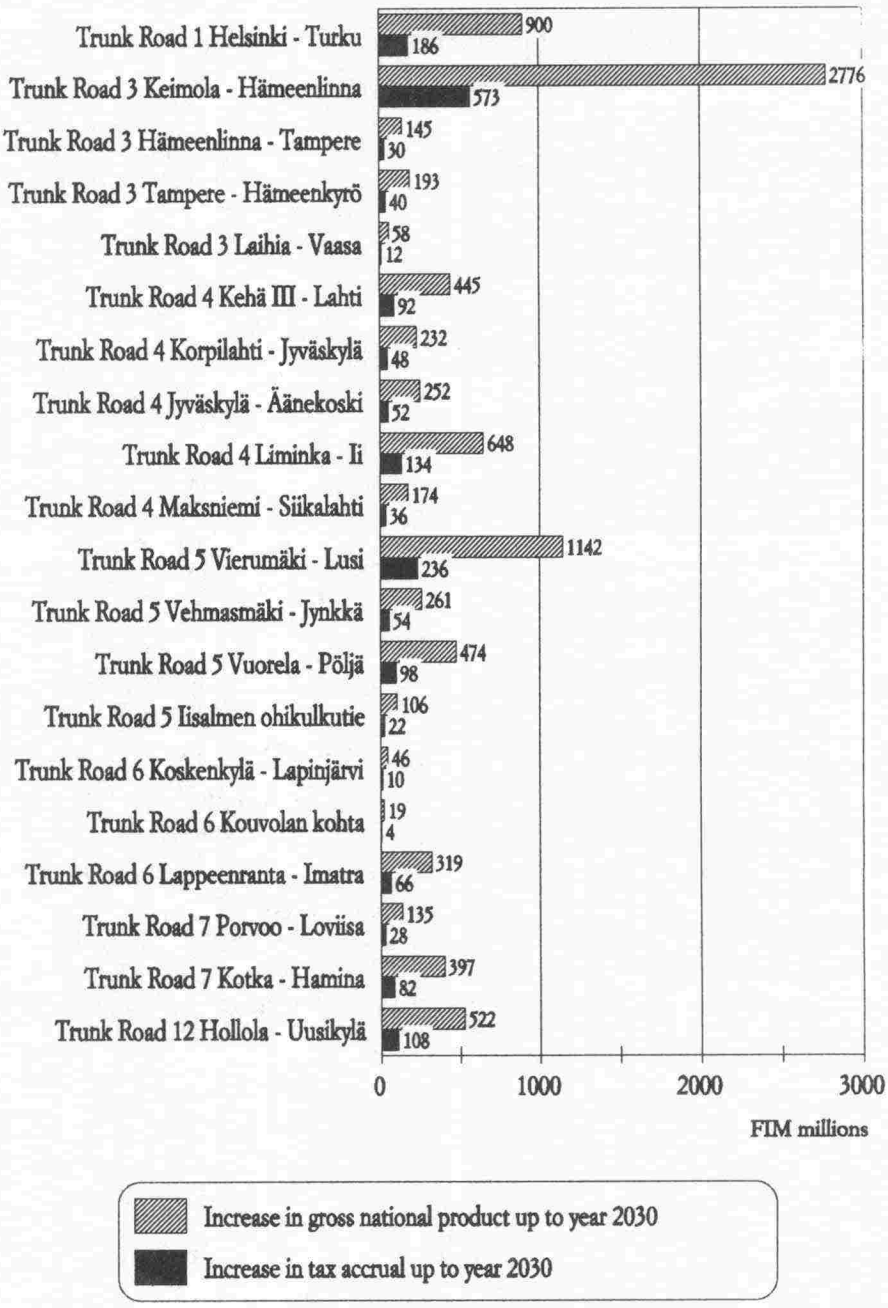


Figure 6. The effect of motorway projects on the growth of gross national product and tax accrual (at 1990 price levels)

In the Development Plan for the Trunk Road Network only projects outside the metropolitan region were examined. The effect of projects in the metropolitan region on the national economy was therefore roughly estimated separately. The calculations are based on the assumption that for projects in the metropolitan region the ratio of transport savings (= savings of time for heavy traffic) to the increase in gross national product, tax accrual and jobs is the same as the average for motorway projects in Finland. The breakdown between different classes of goods and vehicles is assumed to be approximately the same for the metropolitan region as on the main road network. The results are only approximate, and have not been

used in the estimation of the profitability of projects. The results of the calculations are given in the following table:

Project	**Increase in gross national product up to year 2030 (FIM millions)**	**Increase in tax accrual up to year 2030 (FIM millions)**	**New jobs in 2010**
Pasilanväylä	357	73	85
Ring Road II	271	56	64
Trunk road 50 Vantaankoski - Tammisto	56	11	13
Trunk road 51 Kivenlahti - Kirkkonummi	49	10	12
Total	**733**	**150**	**174**

Inclusive of the projects in the metropolitan region, the development of the road network will increase the gross national product by approximately FIM 10 billion. If the savings in passenger traffic during working hours, which are not included in the calculation, are also taken into account then the actual increase in the gross national product is about FIM 15 billion, which is of the order of 3 - 4 % of the gross national product.

In Figure 7 the growth in the gross national product created by motorway projects is shown per road kilometre. The largest relative increase in the gross national product would be achieved by building the Keimola - Hämeenlinna and Vierumäki - Lusi motorways.

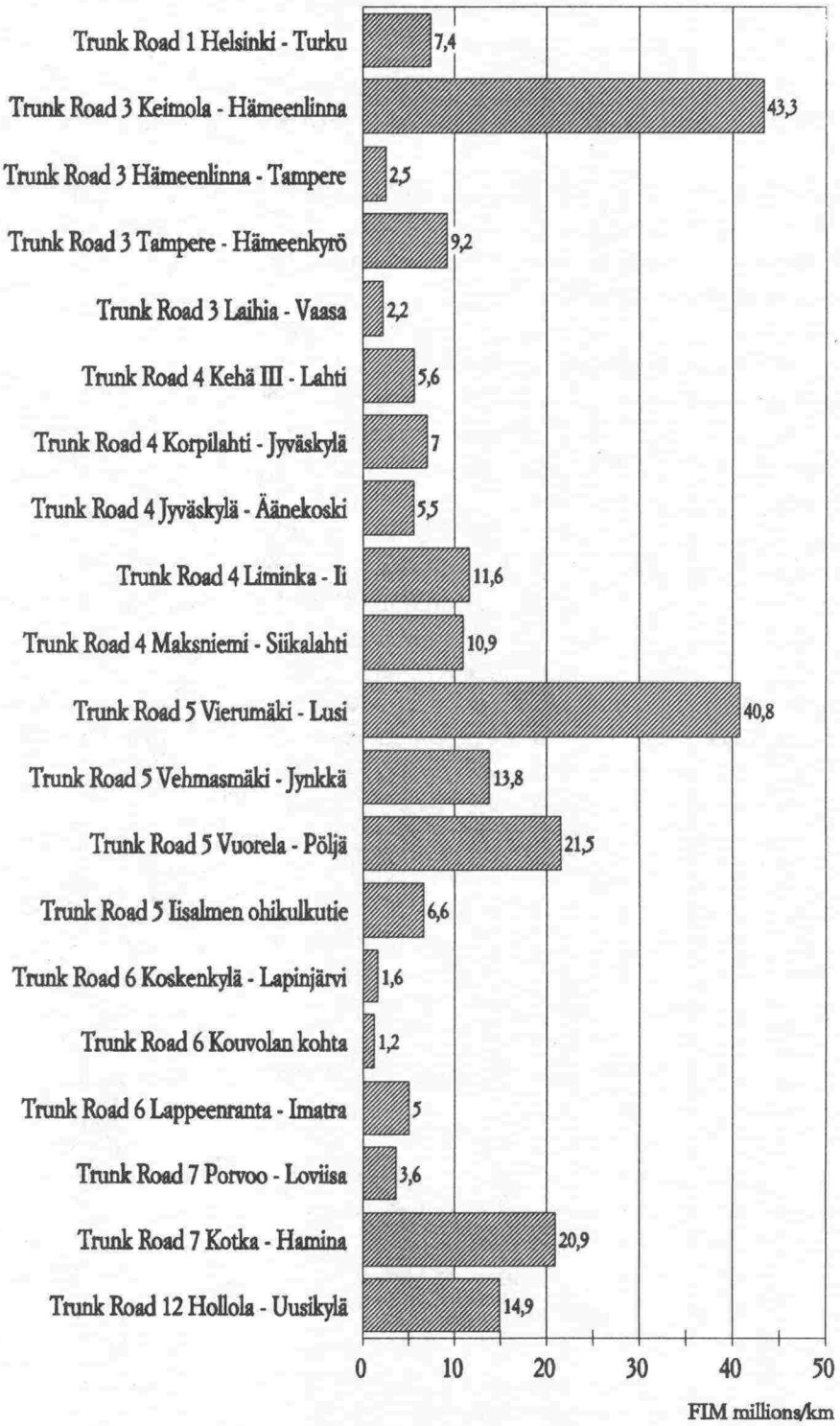


Figure 7. The growth in the gross national product shown per road kilometre in various projects

4 THE SOCIO-ECONOMIC PROFITABILITY OF MOTOR-WAYS

4.1 From Traffic Economy to a Socio-economic Calculation

The profitability of a road project can be described by its benefit/cost ratio. This number expresses the ratio of the benefits and drawbacks of the road project in monetary terms discounted to the time of examination. A project is profitable if the benefit/cost ratio is greater than one.

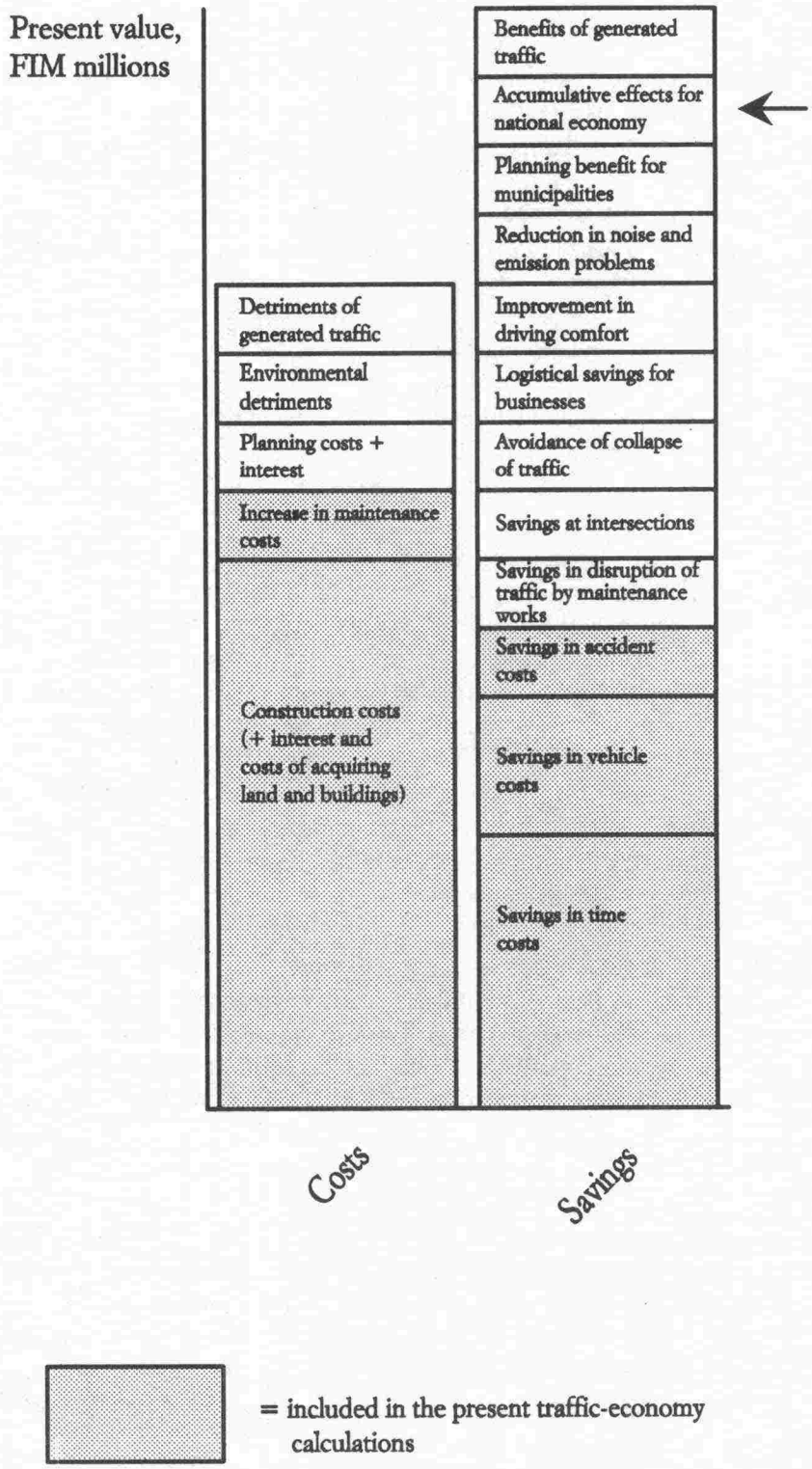
Profitability calculations until now have mainly been based on traffic economy, i.e. the benefits taken into account have been the savings of time, vehicle and accident costs for road-users, and the drawbacks the increase in the costs of road construction and upkeep paid by the road authority. The goal is a socio-economic calculation, which besides the above savings and costs also takes into account as comprehensively as possible the other benefits and drawbacks associated with the project. The Parliamentary Committee on Traffic has in its report required that extensive socio-economic profitability calculations should be made for all major traffic investments.

Figure 8 shows the structure of the socio-economic savings and costs associated with motorway projects. Besides the traffic-economy items, the calculations could include the following new benefits and drawbacks:

- Savings from reductions in delays at intersections. The present calculations only take into account the savings in time and vehicle costs on the sections of road between intersections. The effect of traffic lights is not taken into account either. For long stretches of road the effect of intersection delays is usually small, and their omission from the profitability calculations does not significantly affect the final result. The effect of intersection delays can, however, be significant if the traffic volumes in both the principal and lateral directions are large.

- Avoiding the "collapse" of traffic. When because of the large volume of traffic and/or outside disturbance the flow of traffic begins to stop and crawl, traffic jams can build up which take several hours to disperse. The jam grows as long as vehicles are arriving at the tail of the queue faster than they are dispersed from the head of the queue. The rate of dispersal of a standing queue is considerably lower than the normal carrying capacity of the road. The costs of the "collapse" of traffic are not at present adequately taken into account in the calculations.

- Improvement in driving comfort. In the present calculations no account is taken of the discomfort and stress of driving on hilly, twisting and narrow roads. On such roads even during periods of low traffic queues form behind slow-moving vehicles. In some countries driving comfort is taken into account in the calculations by adopting a higher hourly price for driving in uncomfortable conditions.



= included in the present traffic-economy calculations

Figure 8. The socio-economic saving and cost items of motorway projects

- Business savings in storage, transport and production costs as transport timetables become more reliable with the reduction of traffic congestion. Transport can be handled by fewer vehicles, time saved, intermediate storage can be reduced and production made more efficient. According to logistics research by the Finnish State Technical Research Centre (VTT), however, traffic conditions on the main roads are not at present one of the major factors of uncertainty in the transport chain for raw materials and products. In future, however, the significance of these savings may grow with the increase in traffic and the growing adoption of the JOT principle in manufacturing.

- Business savings by reduction of damage in transport with a consequent reduction in insurance costs. These savings, however, are small because even on existing roads damage is relatively rare.

- Accumulative effects for the national economy. Part of the calculated savings in driving costs represent direct savings in transport costs for some business. When these businesses by reduction of their production costs are able to reduce the prices of their products, sales increase. Suppliers and sub-contractors to these businesses also enjoy an increase in production. As a consequence of the relations of interdependence within trade and industry, there is a growth of the country's gross national product. The effects of motorway projects on the gross national product are presented in this report.

- Benefit for municipal land-use planning. A motorway project may make it possible to take alternative new land areas into use which are more advantageous from the point of view of planning economy. A new area taken into use as a result of the motorway may require the construction of fewer services and less municipal engineering work than the area to which growth would otherwise be directed.

- Savings or increases in driving costs during the construction period and later during maintenance work. Maintenance work on motorways causes less disturbance to traffic than on ordinary trunk roads because the traffic arrangements at the site of the works are better on the wider motorway. On ordinary trunk roads there may also be a more frequent need for maintenance works than on motorways.

- Reductions or increases in noise and pollution. Guidelines will shortly be issued for the valuation of noise and pollution. Contrary to popular opinion, a motorway usually has a beneficial effect in respect of noise and pollution. In other words, the problems are less when there is less habitation adjoining the road.

- Other environmental detriments. E.g. possible detriment to landscape for habitations.

- Obstruction effect. The new road may break lateral connections and lengthen local journeys for vehicles, cyclists and pedestrians.

- Benefits and detriments of traffic generated by the project. As traffic conditions improve, more journeys are made. The savings of this traffic, generated by the project itself, are taken into account at half the rate per vehicle compared with the savings of other traffic. With the growth of traffic there is also an increase in accidents and other detriments. These should also be taken into account in the calculations.

- Planning costs of the project and the costs of acquiring land and buildings. For large projects the planning costs can constitute a considerable proportion of the total costs of the project. Planning work may start decades before the implementation of the project, even though the use of resouces is greatest in the years before construction. Interest charges should also be added to the planning costs. The same also applies to construction costs when construction is spread over several years. The costs of acquiring land and buildings can also be considerable in built-up areas, and can even amount to a third of the construction costs.

4.2 Use of the Profitability Calculations

The profitability calculations for road projects are used for two main purposes:

- To determine whether implementation of a road project at the planned point of time would be profitable. Considered theoretically, a project is profitable if the benefit/cost ratio is greater than one.

- For assigning an order of priority to road projects so that the best possible return is obtained on the capital invested in the projects. In principle the most urgent projects are those which have the best benefit/cost ratio.

In practice the profitability calculations are not entirely unambiguous. However well the calculations are performed technically, there is always uncertainty associated with the result: the traffic forecast or cost estimate may be incorrect, it may not have been possible to place a monetary value on all the benefits or drawbacks, valuations may change, the time of implementation may be changed, etc. Because of this some latitude is called for in interpretation of the cost/benefit ratio. A difference of one or two tenths in the cost/benefit ratio does not necessarily make one project more profitable than another. Only projects of similar type should be compared with each other.

The benefit/cost ratio can be used in assessing the profitability of a project, for example as follows:

Benefit/cost ratio	Interpretation
under 0.6	The project is probably not profitable. There should be good grounds to justify implementation of the project, e.g. an exceptionally expensive engineering solution is justified for environmental reasons.
0.6 - 1.5	The project may be profitable. Advisable to examine the sensitivity of the benefit/cost ratio to changes in the initial data.
over 1.5	The project is probably profitable.

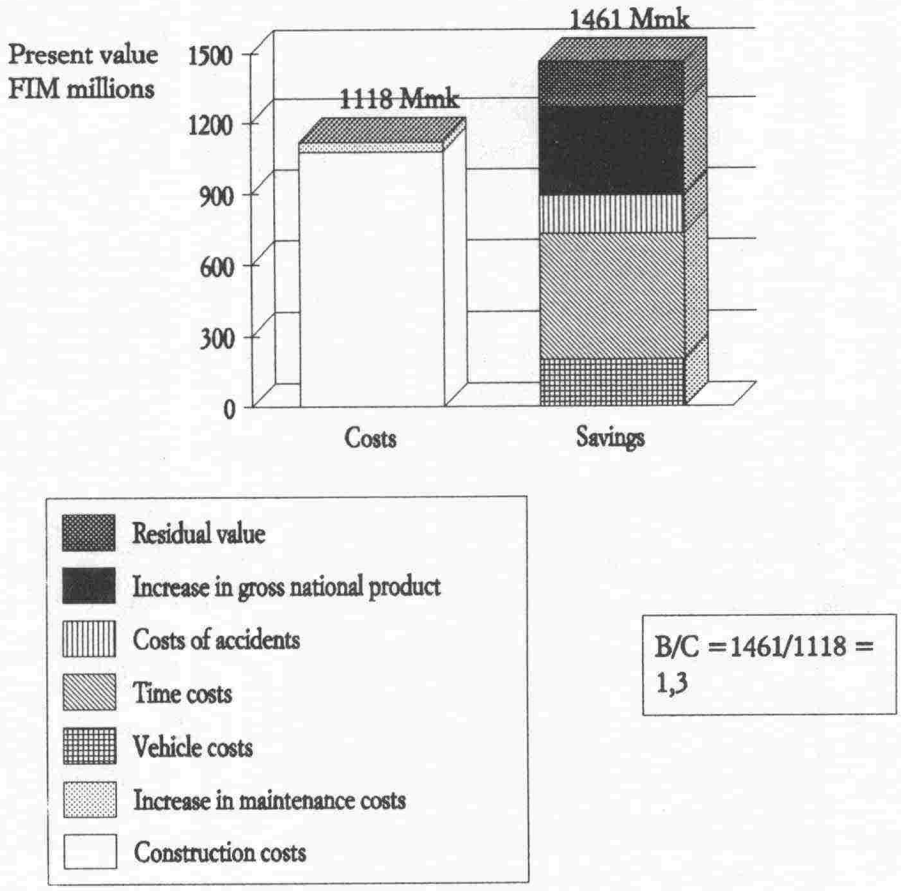
The exact manner in which the profitability calculations are performed depends somewhat on the intended use. When comparing projects with each other it is important to adopt equitable standards. In order that the projects "start with the same handicap" in the comparison, the same year of examination etc. should be used in the calculations for each of the projects. If, on the other hand, the profitability of a particular project is being examined, the year of examination should be the year in which the project is expected to be opened to traffic. In this case the other initial data should also be as realistic as possible.

4.3 Examples of the Profitability of Motorway Projects

On the following pages the profitability of various motorway projects has been estimated on the basis of available data. Compared with traditional traffic-economy calculations, the saving items have been supplemented by the effect on the increase of the gross national product. The increases of national product have been allocated to the sections of the projects roughly in proportion to the transport savings. For the residual values of the investments the values used are those given in the draft guidelines of "The Examinations of Effects in Road Planning": 60 % for motorways and 33 % for other roads at the end of the 20 year period of calculation. Interest charges during the construction phase have not been taken into account.

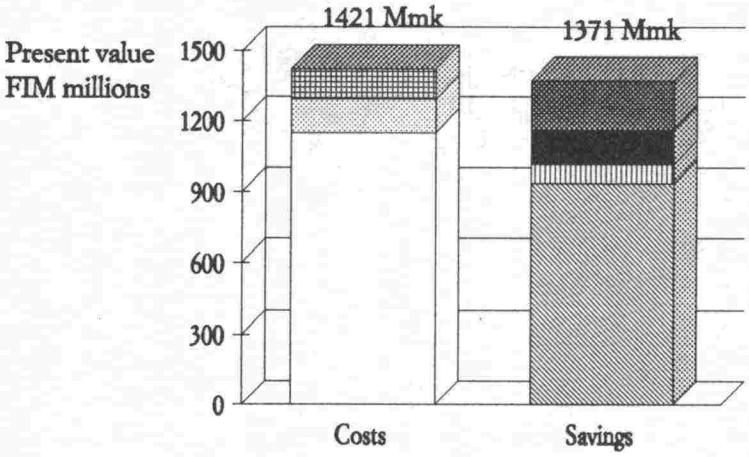
The costs are expressed in terms of the 1991 cost level, road construction index 138 (TTS: 1992 - 95 cost levels).

Trunk road 1 Turku - Paimio



The motorway between Turku and Paimio is currently under construction. The cost estimate for the project is FIM 1076 million. The project is profitable, the benefit/cost ratio is 1.3. The increase in gross national product accounts for about a third of the total savings.

Trunk road 3 Hämeenlinna - Tampere

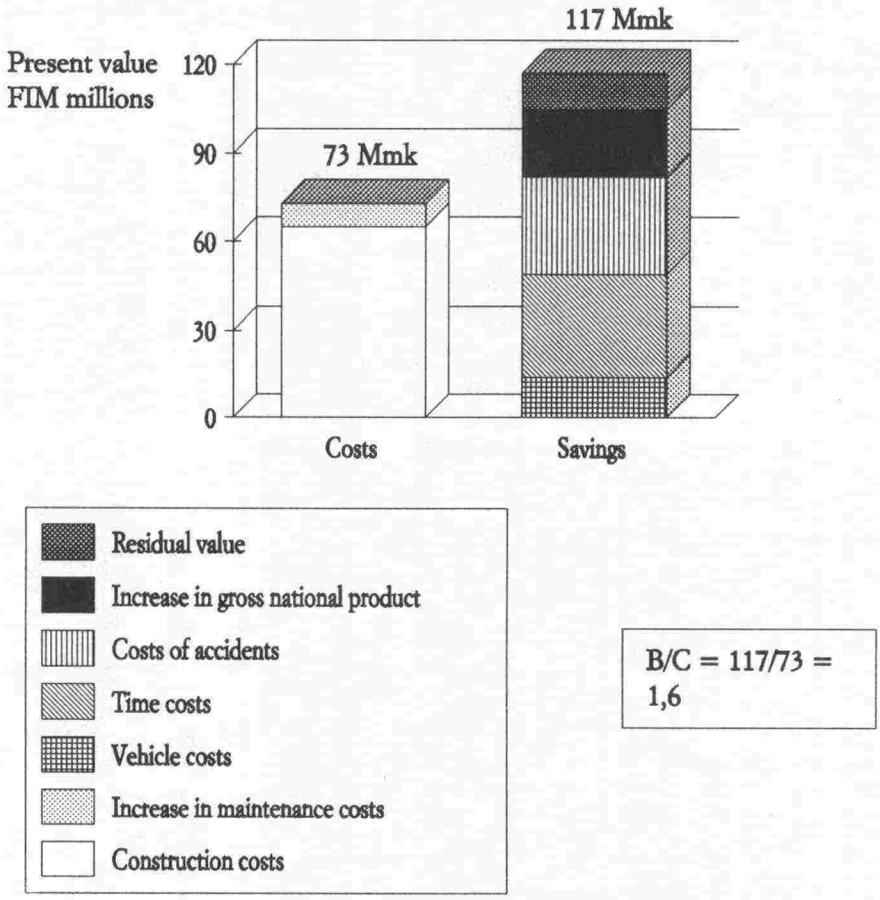


- Residual value
- Increase in gross national product
- Costs of accidents
- Time costs
- Vehicle costs
- Increase in maintenance costs
- Construction costs

B/C = 1371/1421
=1,0

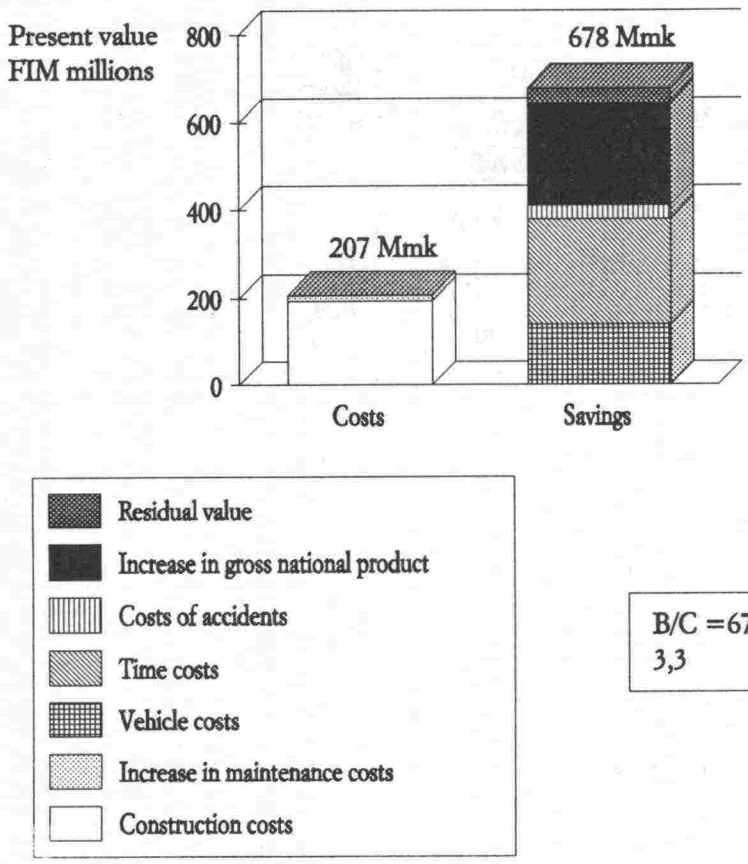
It is intended to build a motorway between Hämeenlinna and Tampere in the period 1993 - 99. The cost estimate for the project is FIM 1150 million. The calculation shows that the project is barely profitable. The benefit/cost ratio is sensitive to errors in e.g. the traffic forecast or cost estimate. The savings are mainly savings of time. Compared to the costs the savings achieved are relatively minor because the standard of the existing road is quite high and for the traffic volumes forecast the motorway would not yield very large savings in costs of congestion. The project would be more profitable if the alternative and shorter routing through Valkeakoski had been chosen.

Trunk road 4 Linnanmaa - Kello



In Oulu it is intended to upgrade the stretch of semi-motorway between Linnanmaa and Kello to a full motorway in the period 1992 - 94. The cost estimate is FIM 65 million. The project is profitable with a benefit/cost ratio of 1.6. A fifth of the benefit is in increase of the gross national product.

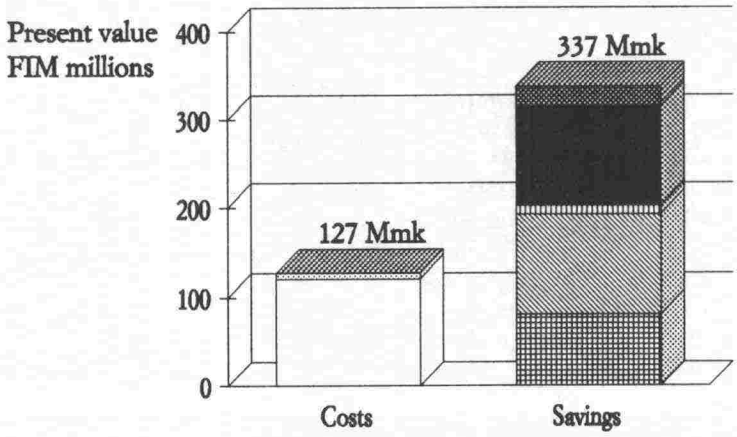
Trunk road 5 Heinolankylä - Lusi

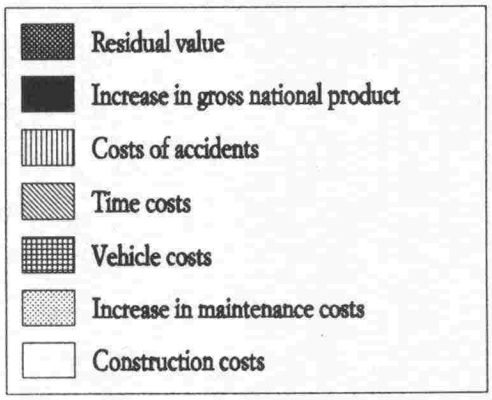


B/C =678/207 = 3,3

It is intended to build a motorway between Heinolankylä and Lusi in 1992 - 95. The motorway will cost FIM 193 million and will be the final section of a continuous motorway between Helsinki and Lusi. The project is highly profitable with a benefit/cost ratio of 3.3. Almost a third of the savings are in increase of the gross national product.

Trunk road 5 Hiltulanlahti - Pitkälahti

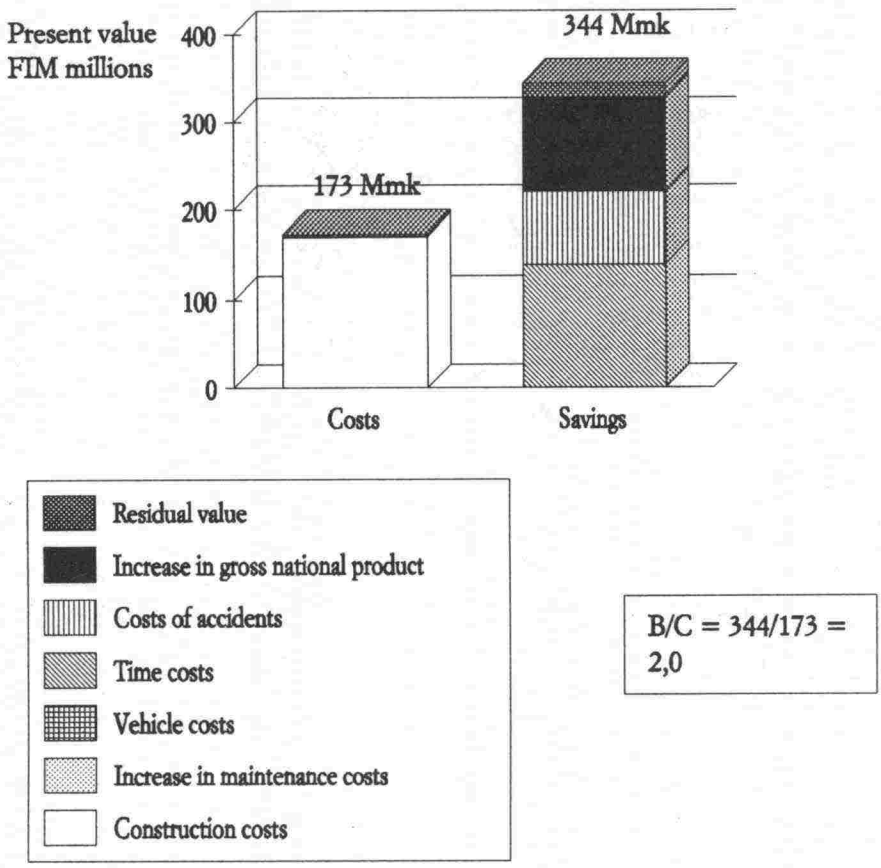




B/C =337/127 = 2,7

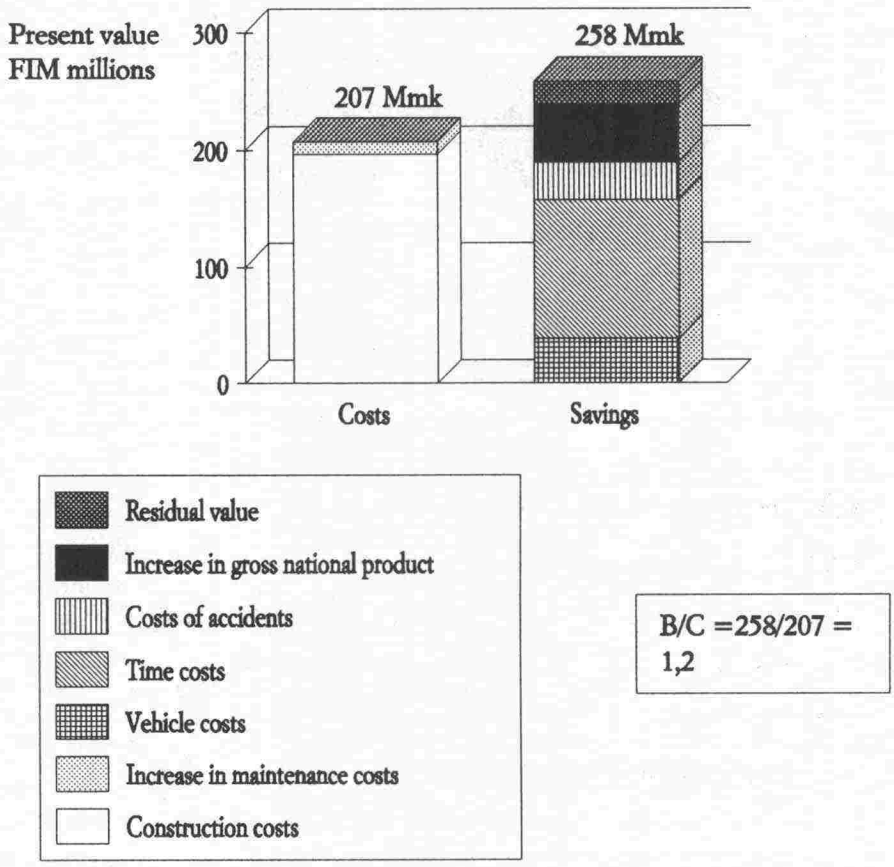
It is intended to build a motorway to the south of Kuopio between Hiltulanlahti and Pitkälahti in 1993 - 95. The construction costs are FIM 121 million. The project is clearly profitable with a benefit/cost ratio of 2.7. The increase in the gross national product accounts for about a third of the total savings.

Trunk road 5 Iisalmen ohikulkutie



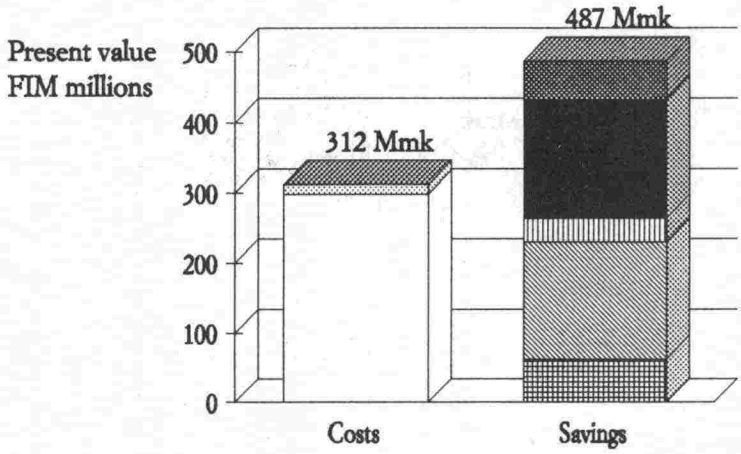
Iisalmi bypass will be built in 1993 - 97. The bypass will cost FIM 170 million. The project is clearly profitable with a benefit/cost ratio of 2.0. The major savings are in time costs and in increase of the gross national product. The profitability would be improved if the reduction in noise and pollution in the town centre were to be taken into account.

Trunk road 6 Koskenkylä - Lapinjärvi



The Koskenkylä - Lapinjärvi semi-motorway should be completed around 2010. The construction of the road will cost FIM 196 million. The profitability of the projects is dependent on the future traffic growth and validity of the cost estimate, etc. If the traffic growth corresponds to the forecast used, the benefit/cost ratio is 1.2. Particularly for this type of project scheduled for completion in twenty years' time, estimation of the profitability is uncertain.

Trunk road 6 Imatra - Kaukopää



- Residual value
- Increase in gross national product
- Costs of accidents
- Time costs
- Vehicle costs
- Increase in maintenance costs
- Construction costs

B/C =487/312 = 1,6

The Imatra - Kaukopää motorway will be build in 1993 - 96 and will cost FIM 298 million. The savings are greater than the costs and the project is thus profitable: the benefit/cost ratio is 1.6. About a third of the benefit will come from the increase of the gross national product. The project is an expensive one at about FIM 29 million/km.

5 CONCLUSIONS

The development of the socio-economic profitability calculations should be continued. At present numerous savings and costs are omitted from the calculation. The calculations must also be used correctly. The benefit/cost ratios of different projects should only be compared for projects of the same type. The uncertainty which is always present in the calculations must also be accepted. A difference of one or two tenths in the benefit/cost ratio does not necessarily mean that one project is more profitable than another.

Motorways offer significant benefits for the national economy and the inclusion of these benefits in the profitability calculation generally improves the profitability considerably. In the projects examined the increase in the gross national product amounted at most to about a third of the total savings. Although the manner in which the examination was performed was rather approximate, the results show the order of magnitude of the benefits to the national economy as a proportion of the total savings achieved by the motorways.

Motorways are profitable from the socio-economic viewpoint. For all of the eight example projects the benefit/cost ratio was greater than one, for five projects the benefit/cost ratio was over 1.5 and for two projects over 2.5. The projects for which the benefit/cost ratio is over 1.5 would remain profitable even if e.g. traffic growth is considerably less than forecast.

The gross national product will grow as businesses derive real monetary savings from the road project and pass these savings on in the prices of their products, thereby increasing sales. In calculating the effects of transport savings for the national economy only the savings of time for goods traffic have been taken into account in this investigation. Accordingly the estimates of the significance of the increase in the gross national product for the profitability of the example projects (Section 4.3) are probably too low. If passenger journeys during working hours are included in the calculations, the effect of the entire motorway network in increasing the gross national product is increased by about a third to approximately FIM 15 billion. For the individual projects the effect is similar.

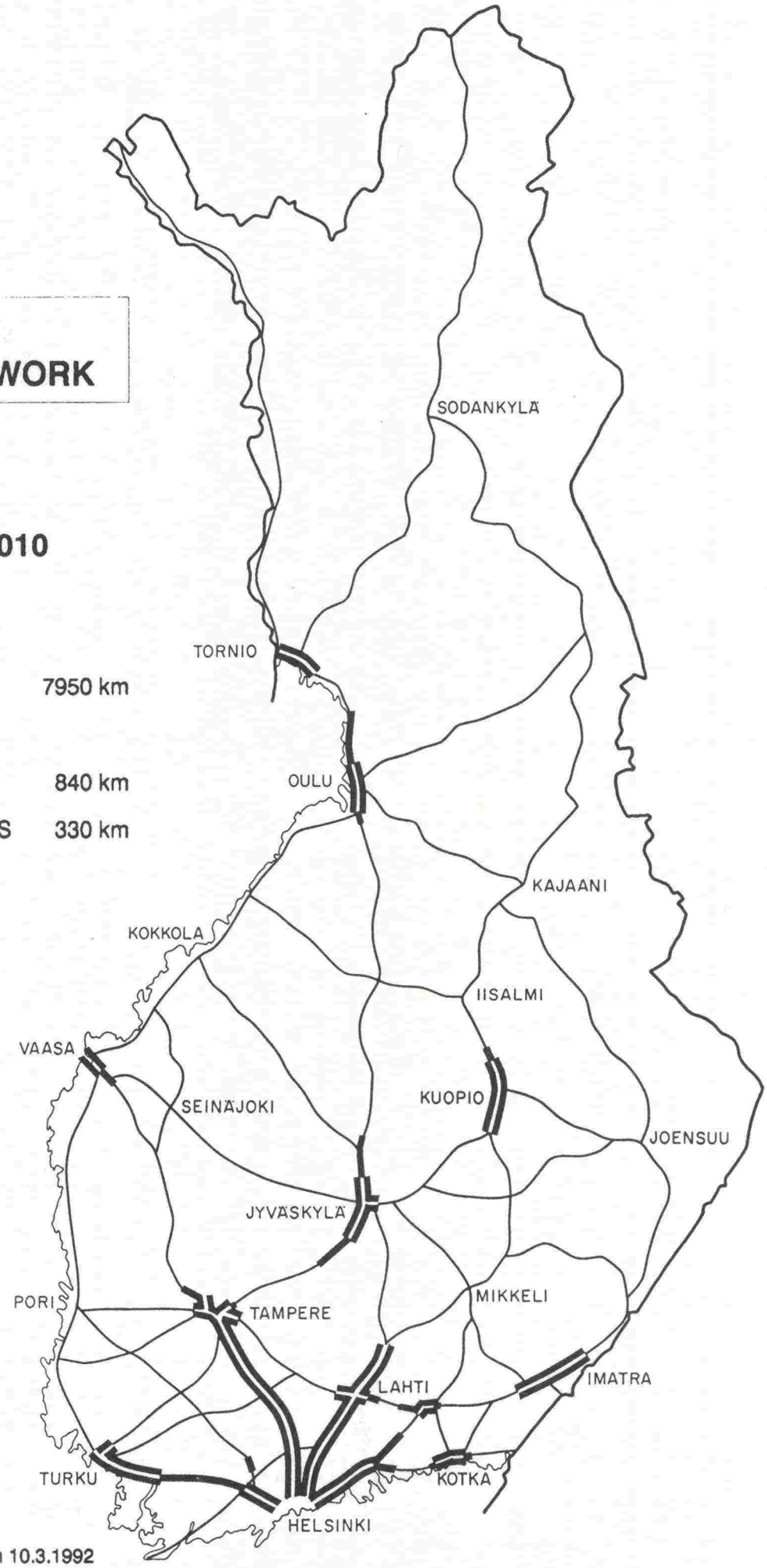
FINLAND'S MAIN ROAD NETWORK

DRAFT

MAIN ROADS 2010

———	MAIN ROADS	7950 km
	OF WHICH	
═══	MOTORWAYS	840 km
———	SEMI-MOTORWAYS	330 km

0 50 100 km



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