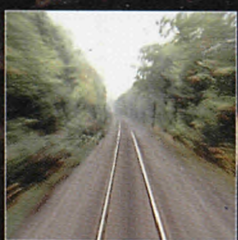
European Union
Regional Policy
and Cohesion

Regional development studies

The regional impact of the Channel Tunnel throughout the Community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Preface

Each year, the Directorate-General for Regional Policy and Cohesion of the European Commission launches a number of studies in the field of regional policy and regional planning. These studies mainly aim at providing a basis for policy formulation internally, as well as the preparation of programmes and initiatives and a basis for analysing the impact of current or planned activities. The most interesting or innovative of these are published in a series entitled *Regional development studies*.

With this series, the Directorate-General hopes to stimulate discussion and action in a wider sphere on the research results received. The publication of the studies is addressed to politicians and decision-makers at European, regional and local level, as well as to academics and experts in the broad fields of issues covered.

It is hoped that by publicizing research results the Commission will enrich and stimulate public debate and promote a further exchange of knowledge and opinions on the issues which are considered important for the economic and social cohesion of the Union and therefore for the future of Europe.

Readers should bear in mind that the study reports do not necessarily reflect the official position of the Commission but first and foremost express the opinion of those responsible for carrying out the study.

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1. Introduction

Following a resolution of the European Parliament of September 1988, the Directorate-General for Regional Policy of the European Commission commissioned a study on the regional impacts of the Channel Tunnel throughout the Community. The study purpose was:

'To examine the way in which different types of regions in the Community and different sectors in those regions will be affected by the development of a major new transport infrastructure and to assess ways in which policy can be developed to ensure that maximum possible benefits can be derived from this and that any negative effects are minimized.'

The study has been conducted jointly by ACT Consultants, Paris, France (ACT), the Institut für Raumplanung of the Universität Dortmund, Federal Republic of Germany (IRPUD) and Marcial Echenique & Partners Limited, Cambridge, UK (ME&P) under the project leadership of ACT. Work on the study commenced in July 1990 and was completed in July 1991.

The research design of the study is unique and innovative, by combining quantitative forecasting techniques with qualitative methods of futures exploration.

(i) In the qualitative part, the impacts of subjective and attitudinal factors and other aspects not included in the model are assessed using in-depth interviews with decision-makers and experts in selected typical regions.

(ii) In the quantitative part, a sophisticated spatial-equilibrium model of the interaction between transport infrastructure and regional development is used to predict the employment effects of the time and cost savings afforded by the Channel Tunnel for the regions throughout the Community.

(iii) In a concluding part, the results of the model analysis and of the regional analyses are brought together for synthesis and policy recommendations.

The present draft of the final report consists of six chapters. Chapter 1 is this introduction. Chapter 2 states the problem to be investigated in the study and summarizes the research objectives of the project. Chapter 3 explains the research methodologies applied. The two following chapters present the results of the research. Chapter 4 summarizes the analysis of the 13 case-study regions and provides the initial interpretations of the possible impacts of the Channel Tunnel on the development of each region, the potential response of regional policy-makers to this challenge and the related regional expectations from external action. Chapter 5 reports on the work performed to set up the quantitative analysis using the Meplan model and presents the model results. Chapter 6 tries a synthesis by comparing the results of the quantitative and qualitative approaches, and proposes conclusions and recommendations to the Commission.

Contributors

The model analysis is made in ME&P, Cambridge, by Tony Flowerdew, Marcial Echenique, Ian Williams, Jill Beardwood, Frances Jeanes, Charlene Rohr and Michael Salter.

The regional analysis is directed jointly by Pierre Metge (ACT, Paris) and Michael Wegener (IRPUD, Dortmund).

For each of the 13 study regions, the regional analysis has been made by the authors and contributors quoted below:

Kent: Philip Amison, Tony Flowerdew and Rachel Tinsley (ME&P), with the methodological support of Sonia Fayman;

Nord-Pas-de-Calais: Sonia Fayman (ACT);

West-Vlaanderen, Zeeland, Cologne, Bremen: Klaus Spiekermann and Michael Wegener with the contribution of Seungil Lee, Mechthild Sander, Simone Strähle, Dirk Varlemann, Birgit Venzke and, for maps, Meinhard Lemke, Brigitte Kiesslich and Annerose Rummel (all from IRPUD), and with the special help of:

Mr Marc François of Gresea ASBL in obtaining information and written material on West-Vlaanderen,

Professor Dr Rein Scheele of the Geografisch Instituut of the Rijksuniversiteit Utrecht for his valuable advice and information on Zeeland;

Hainaut: Pierre Meyer (ACT), with the contribution of Mr Carton of Gresea ASBL in obtaining information and written material;

Brittany: Lucien Jubelin (ACT);

Piemonte: Pier Giorgio Delpiano (ACT);

Pais Vasco: Juan Luis Llorens Urrutia (IKEI, San Sebastian);

Norte: Nuno Cabral (CODES, Lisbon);

Scotland: Gillian Miller (ME&P), with the methodological support of Sonia Fayman;

Ireland: Claire Lawlor (ME&P), with the methodological support of Sonia Fayman and with special help from Mr Tom Ferris, Head of Planning Unit, Department of Tourism and Transport, in providing a variety of background material and papers on Irish Channel studies.

The study is conducted under the effective coordination of Tony Flowerdew (ME&P), Pierre Metge (ACT) and Michael Wegener (IRPUD).

The authors express their gratitude to the interviewed partners who gave much of their time and have provided a wealth of information and points of view.

2. Problem statement

The prospective opening of the Channel Tunnel in conjunction with the emerging European high-speed rail system is stimulating the imagination of national and regional policy-makers in north-west Europe. After the launching of the single European market in 1993, the Channel Tunnel will bring down one of the remaining barriers to international travel and goods transport within Europe. In particular it promises to eventually make the British Isles a true part of the European continent — ending a thousand years of insular seclusion and turning the much-cited 'megalopolis London-Milan' from a conceptual idea into reality. Not surprisingly, hopes are especially high in the regions adjacent to the Tunnel terminals, Kent and Nord-Pas-de-Calais, where the first signs of land speculation can be observed.

It would only be natural if regional and national governments might have a strong interest in getting a clearer view of how much the Tunnel will benefit the economies of their regions: however, on the national level, this is much more pronounced on the continental side of the Tunnel. Accordingly there have been a number of studies commissioned to investigate the impacts of the Channel Tunnel for various regions in Britain and France. However, there also exist fears that the Tunnel may primarily benefit the large conurbations in Central Europe and that the growth generated there might be pulled away from more peripheral regions thus increasing spatial disparities in Europe. Therefore the European Commission decided to commission a study on the broader impact of the Channel Tunnel, in the Community as a whole and in the context of an examination of the regional implications of new large infrastructure plans in the Community.

2.1. Study objectives

The main purpose of the study is to examine the way in which different types of regions in the Community and different sectors in those regions will be affected by the development of a major new transport infrastructure and to assess ways in which policy can be developed to ensure maximum possible benefits and minimize any negative effects.

To achieve this purpose, the study will:

(i) focus on a subset of 13 regions selected as a function of distance from the Channel Tunnel, functional position and eligibility for Structural Funds from the Commission. All selected regions are NUTS (nomenclature of territorial units for statistics) level 2 regions except Scotland. Scotland is actually a level 1 region which is divided into four level 2 regions;

(ii) identify the principal sectors in each region (taking into account the likely impacts of the completion of the single European market) and examine both existing market areas and the way these could be changed by improvements in transport;

(iii) identify particular strengths and weaknesses within the regions in terms of the potential response of their existing industries to changes in transport and the potential for the development of new industries;

(iv) indicate how any changes in transport usage occasioned by the Channel Tunnel would be likely to affect existing transport sectors in the regions (e.g. the impact of any increase in through-rail freight on ports or of through-passenger traffic on airports);

(v) identify ways in which policy towards transport and regional planning can be used to maximize the benefits for each region and minimize any costs, considering both existing and potential new policy instruments;

(vi) relate the main findings to the Commission's current policy initiatives on both regional development and transport and make recommendations for amendments to these or new policy initiatives which would either ameliorate negative impacts or encourage the positive benefits deriving from the Channel Tunnel and associated infrastructure.

2.2. Transport and regional development

The important role of transport infrastructure for regional development is one of the fundamental, though often disputed, tenets of regional economics. In its most simplified form it implies that a region with better access to the locations of input materials and markets will be, *ceteris paribus*, more successful than a region with inferior accessibility. However, in countries with an already highly developed transport infrastructure, accessibility tends to become ubiquitous and further improvements of transport infrastructure bring only marginal benefits. Hence, transport infrastructure improvements have strong impacts on regional development only where they result in removing a former bottleneck.

Other recent trends combine to reinforce this tendency to diminish the impacts of transport infrastructure in the regional development of Europe. Increasing the value per tonne of nearly all commodities has reduced the transport cost component in typical production functions. Telecommunication has reduced the need for some goods transport and personal trips; however, telecommunication may also increase transport by its ability to create new markets. More importantly, with economic structural change, i.e. the shift from heavy industry manufacturing to high-tech industries and services, other less tangible location factors have come to the fore and have at least partly displaced the traditional factors such as availability of raw materials and transport costs. These new location factors include factors related to leisure, culture, image and environment, i.e. quality of life, and factors related to access, to information and specialized high-level services and to the institutional and political environment.

On the other hand, there are also tendencies that increase the importance of transport infrastructure. The introduction of totally new, superior levels of transport infrastructure such as the high-speed rail system envisaged for Europe may create new disadvantages, which will be perceived as bottlenecks in regions not served by the new networks. Another factor adding to the importance of transport is the general increase in the volume of goods movements (due to changes in the distribution system such as just-in-time delivery) and travel (due to growing affluence and leisure time). Both tendencies will be reinforced and accelerated by the completion of the single European market in 1993 and the ongoing normalization in the relations between Western and Eastern Europe.

Furthermore, there is a fundamental change in the way in which the transport system influences location patterns. In particular, for modern industries the quality of transport services has overtaken transport cost as the important factor. Infrastructure improvements which reduce the variability and increase the predictability of travel times, which increase travel speeds or which through increases in the frequency of services allow flexibility in scheduling are all valuable in improving the competitiveness of both service and manufacturing industries and are therefore highly valued in their locational decisions.

All the above deliberations need to be seen against the background of general economic growth which, in the absence of major political or economic disturbances, is likely to be larger than the relative changes in growth potential brought about by new infrastructure elements such as the Channel Tunnel. There seems to be widespread consensus that this general growth will be enhanced by infrastructure improvements such as the Tunnel; however, the precise nature and magnitude of such impacts remain a matter of speculation. To study these impacts, a study or model encompassing the comparative advantages of Europe as a whole on a global basis, i.e. in comparison with global competitors like the USA and Japan, would be required.

2.3. The Channel Tunnel and its services

The long story of ideas and construction schemes to erect a fixed link across the Channel in the form of a bridge, a tunnel or a combination of both can be traced back to the end of the 18th century. But all attempts failed because of technical, political, financial or environmental problems (see Bonavia, 1987). The current Channel Tunnel project is based on a political agreement between Britain and France towards a privately financed fixed link. In the competition between four consortia with different project proposals, the decision was made in favour of a British/French group, which later called itself 'Eurotunnel', for a fixed Channel link in the form of a tunnel. The construction of the Channel Tunnel started in 1987 and according to the timetable should be finished in mid-1993.

The Tunnel will be a railway-only tunnel. In fact there will be three parallel tunnels under the Channel: two running tunnels with a diameter of 7.6 m containing the railway tracks and one central smaller service tunnel with a diameter of 4.8 m, which will have passages to the main running tunnels at 300 m intervals and also two crossovers between the railway tunnels (see Figure 2.1). The total length of the Tunnel is about 50 km. But only 37 km of the Tunnel are under the sea, the remaining sections link the Tunnel terminals with the undersea section. In particular the terminal in Cheriton near Folkestone on the British side is 10 km from the shore. The Cheriton terminal, which covers an area of 140 ha, and the terminal in Coquelles near Calais, which covers an area of about 700 ha, are designed for quick transfer of road vehicles to specially designed shuttle trains (see Figure 2.2).

After implementation, the Channel Tunnel will be a new type of transport link in Europe. Two different kinds of trains will pass through the Tunnel: shuttle trains and through trains, both of which will have different rolling stock.

The shuttle trains will primarily link the road networks of Britain and the Continent and can, in this sense, be regarded as another kind of ferry. Two types of shuttles for road vehicles will be operated by Eurotunnel between Cheriton and Coquelles. One for cars, coaches and caravans and one for heavy lorries (see Figure 2.3). These shuttles will be larger than common rolling stock in order to accommodate big vehicles like coaches and lorries and cars in double-deck wagons. For cars and coaches, five to six shuttles every hour during the day and two shuttles every hour during the night will leave each terminal. Between three and four freight shuttles will run every hour during the day and two every hour during the night. This high frequency of shuttle services is to avoid the need for prior booking and early arrival at the terminals as is now necessary on most cross-Channel ferry services. The travel time through the Tunnel will be about 35 minutes.

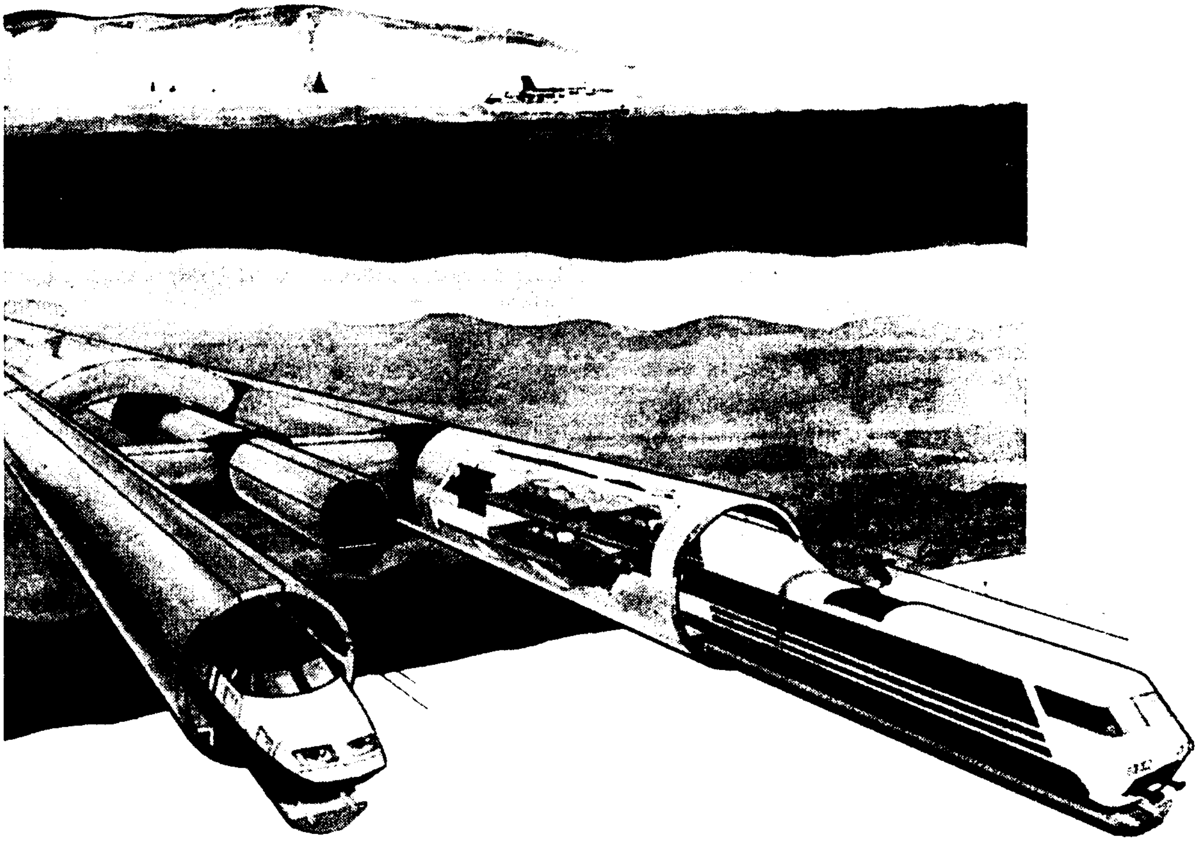
A through-rail service operated by the national railways will link the British to the European rail network. With its integration into the European high-speed rail network the Channel Tunnel will provide a major improvement over present cross-Channel rail services. The combined effect of the Tunnel and high-speed rail technology with speeds up to 300 kilometres per hour will afford travel times between London and major north-west European centres which are competitive with centre-to-centre air travel times. Between London and Paris and Brussels there will be hourly services during the day and two services per hour in peak times, which means up to 30 services per day during the summer. These services will be performed by purpose-built high-speed rolling stock, the so-called 'Three Capitals' trains which are similar to the French TGV (high-speed train).

Additional services will operate between London and other continental cities and regions, in particular Cologne and Rotterdam (see Figure 2.2). There will be about 30 freight trains per day each way through the Tunnel, most of them will travel at night as through-services between several British and European regions. However, on the British side, problems with the upgrading of the rail infrastructure may reduce potential impacts of the through-rail services, at least in the short term. The high-speed rail line between London and the Tunnel is still undecided and will not be implemented before the end of the century. Also, the upgrading of the UK rail system to the continental loading gauge in order to enable through trains to the Continent will require large investments, either in tracks or in rolling stock.

2.4. Existing studies on the Channel Tunnel

The Channel with its current ferry service today clearly presents a major transport barrier to the free movement of passengers and goods in Europe. If through the Channel Tunnel this bottleneck would be removed, significant impacts on regional development at either end may be expected. However, many questions are not easily answered: Will the impacts be limited to the regions directly adjacent to the Tunnel exits, or will they be spread out over a larger area? Will they be

Figure 2.1. The Channel Tunnel system



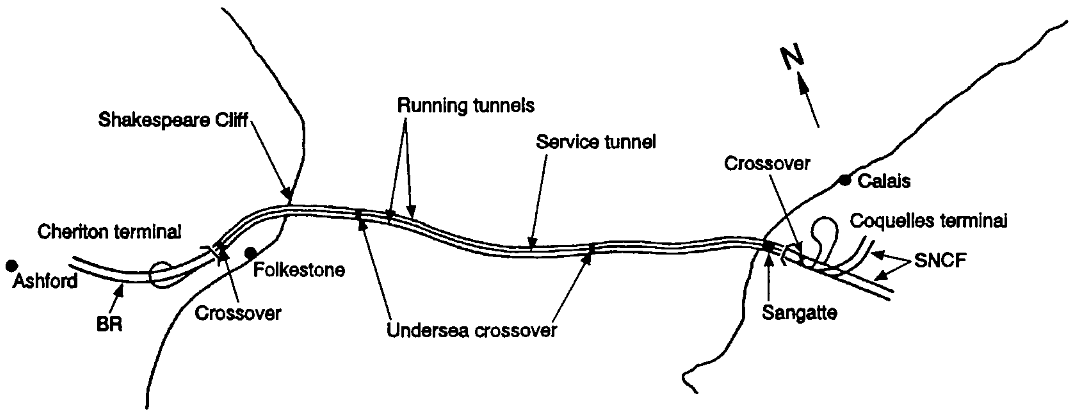
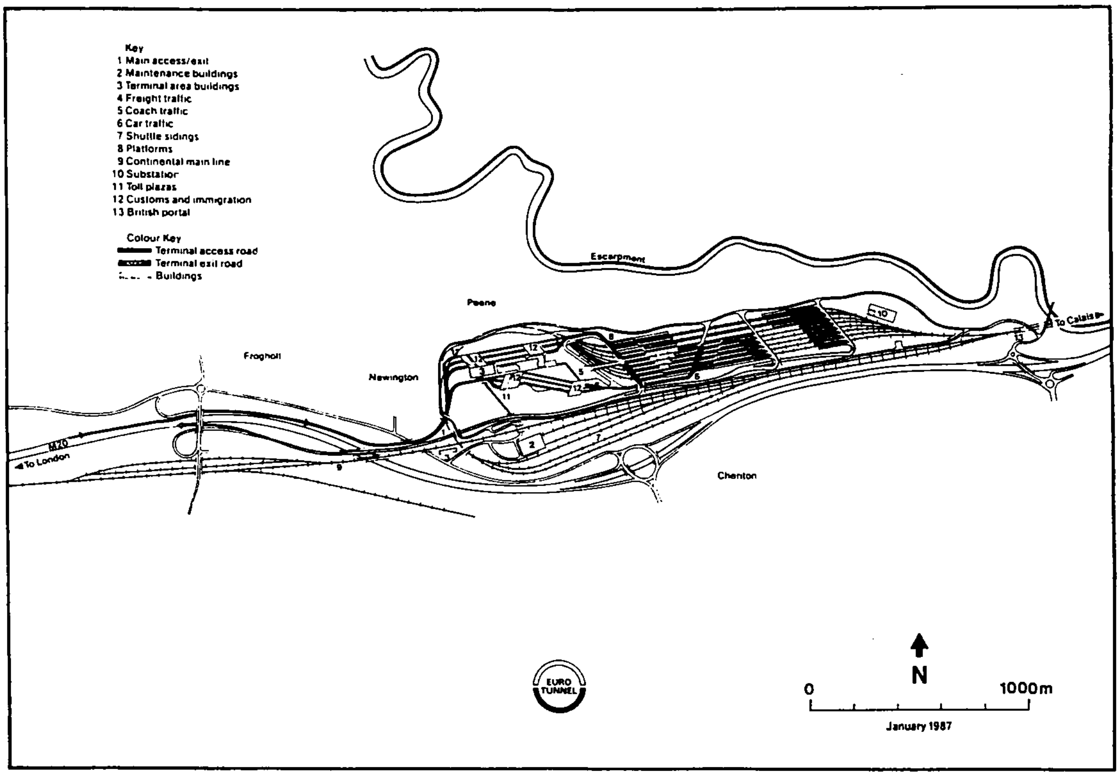


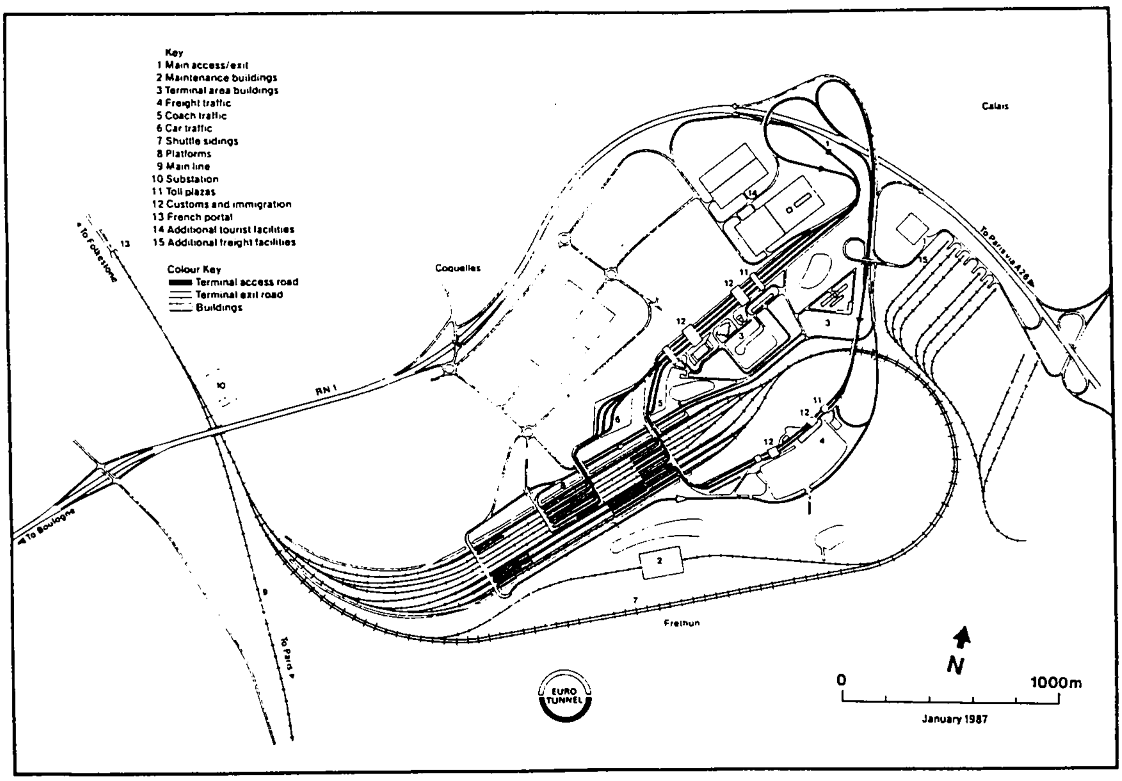
Figure 2.2. Cheriton and Coquelles Channel Tunnel terminals

Cheriton Terminal



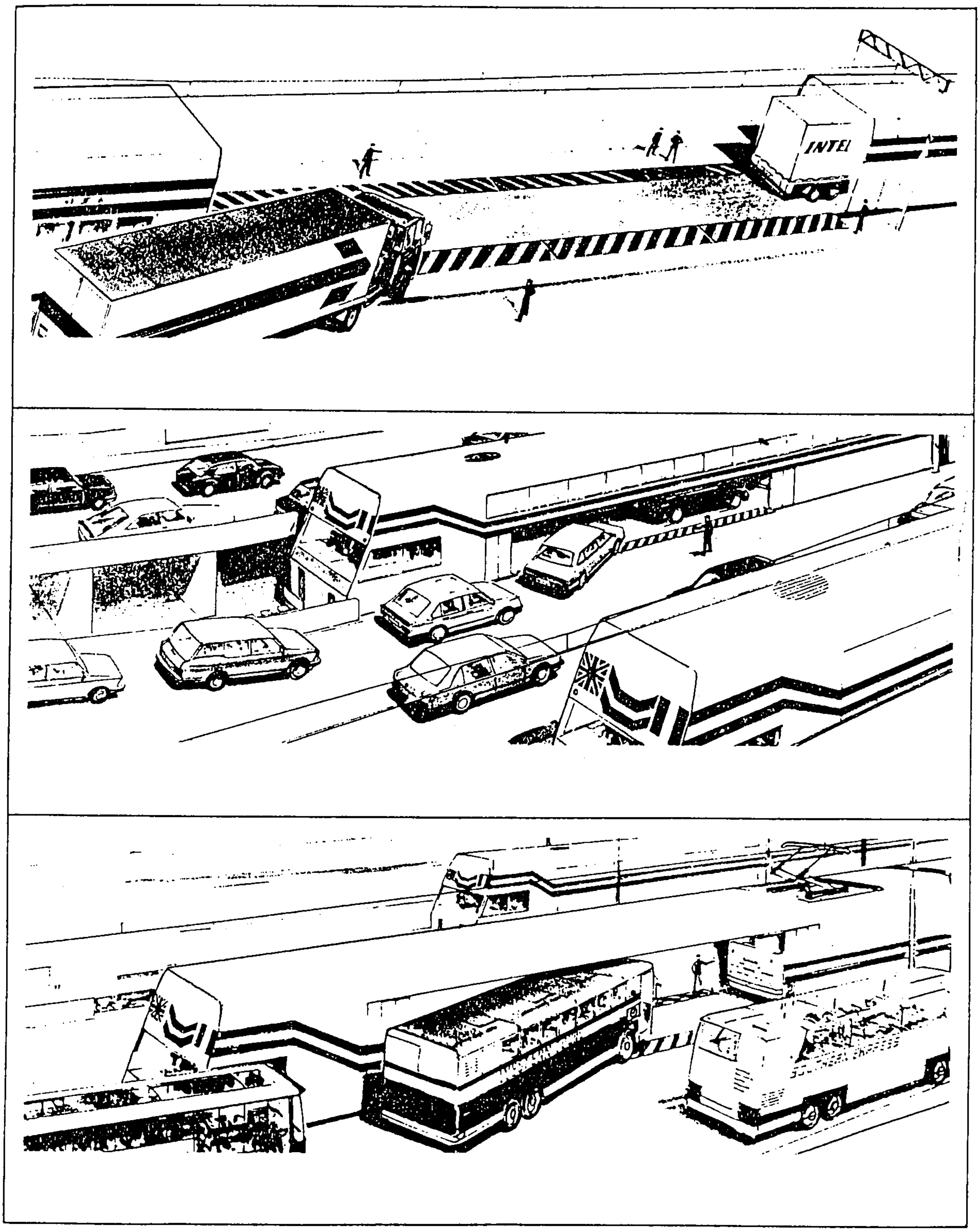
Source: Eurotunnel

Coquelles Terminal



Source: Eurotunnel

Figure 2.3. Channel Tunnel shuttles



Source: Eurotunnel

more pronounced at the British or at the continental end? Will the Channel Tunnel mostly benefit the already highly industrialized and urbanized regions in Central Europe and so increase concentration of activities and hence the spatial disparities in Europe, or will it tend to equalize the accessibility surface in Europe and hence have a decentralization effect?

There is already a long history of studies on the likely regional impacts of the Channel Tunnel. Keeble et al. (1982) showed that an index of economic potential would have its greatest increase in south-east England, but that the net gains would be distributed over the British Isles and north-west Europe. In more recent years a large number of regional studies have looked into the short-term and long-term impacts on individual regions both in Britain (Atkins, 1989; Centre for Local Economic Strategies, 1989; Channel Tunnel Joint Consultative Committee, 1988, 1989, 1990; Cornwall County Council et al., 1989; Harman, 1989; London Chamber of Commerce, 1989; Pieda, 1989; Serplan, 1989; South-East England and Development Strategy, 1989) and in France (Bechtel France, 1985; Metge and Potel, 1987). These studies tend to take a more cautious view. The time savings of a Tunnel crossing over a ferry trip of roughly one hour is considered too small to effect more than marginal changes in location behaviour, and in any event these savings are available to every region irrespective of its distance from the Tunnel.

Only few studies have so far discussed the broader impacts of the Channel Tunnel for the spatial structure of the British Isles and north-west Europe as a whole (see for instance Vickerman, 1987; Vickerman and Flowerdew, 1990; Simmonds, 1990). One important conclusion is that the Channel Tunnel cannot be seen in isolation but only as one element in the future high-speed rail system of Europe. In that perspective it seems likely that the Tunnel would reinforce the already strong position of major centres such as London, Paris, Brussels and Frankfurt. Evidence from the TGV in France and the Shinkansen in Japan points in that direction. However, this does not guarantee that all regions served by the high-speed trains will automatically prosper as additional preconditions are necessary for growth. So it may well be that both Kent and Nord-Pas-de-Calais rather than being the winners of the Tunnel game may become the losers once the short-term benefits in terms of construction activity have gone by. In a more serious way the peripheral regions of the Community which are not linked to the major conurbations may lose out as they cannot compete with the increased attraction and growth in the centres.

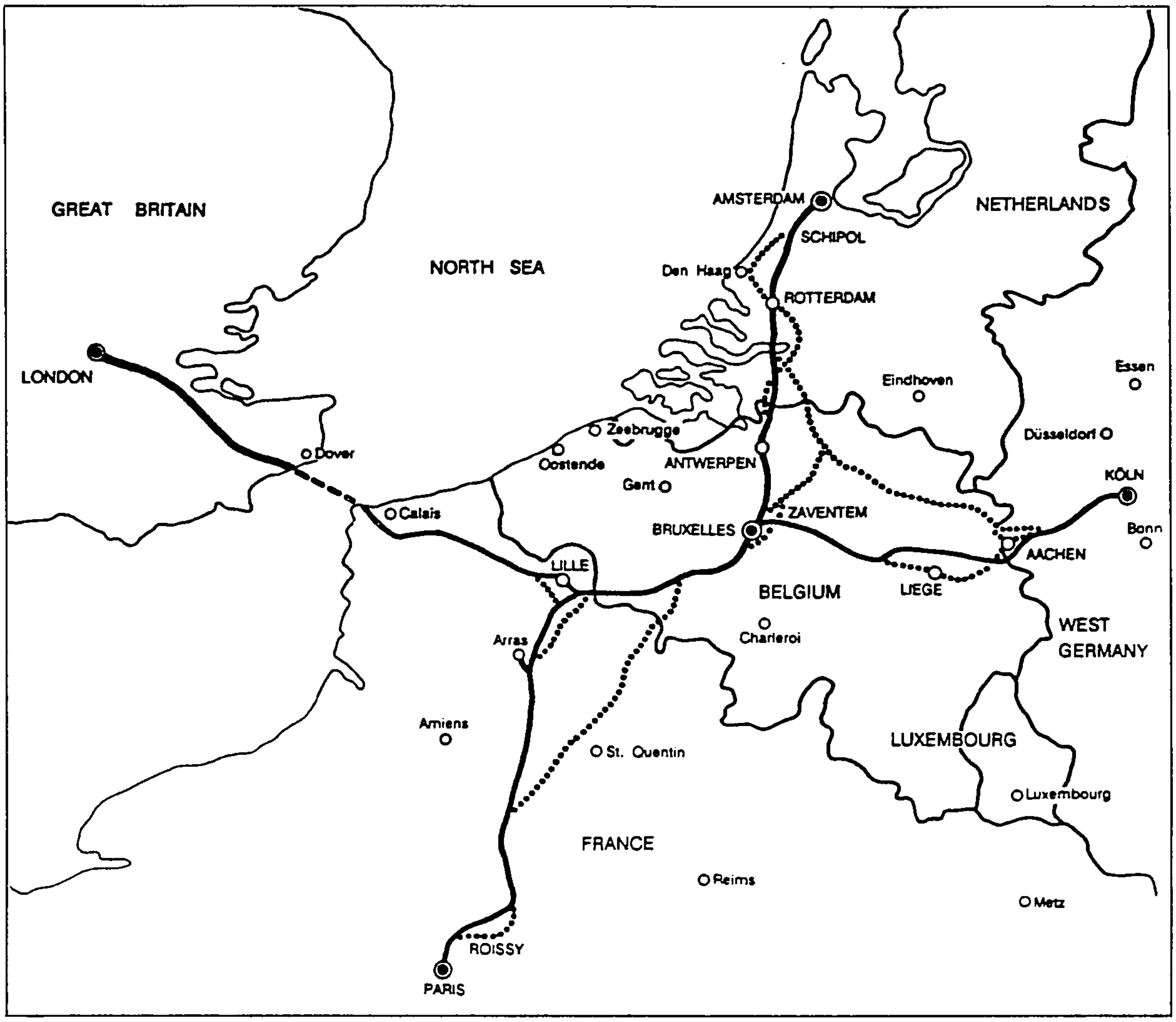
2.5. The need for a systemic study

In summary, despite the impressive range of existing studies on the regional impacts of the Channel Tunnel, important questions remain unsolved. In particular the issue whether the Tunnel will have a polarizing or decentralizing effect on the overall spatial structure in Europe has not been settled.

The Channel Tunnel when completed will form a part of the European transport networks. It will replace or supplement existing links and in so far as it is able to offer a better service and/or a better price it will benefit directly the traffic using the existing links. Wider benefits will depend to a very great extent upon the other parts of the European network.

Therefore the Channel Tunnel cannot be seen as an isolated project. Rather it has to be studied in a systemic way in the context of both the development of the European transport system at large and the socioeconomic, technological and political changes occurring in the Community. Therefore it is necessary not only to look at the impacts of the Channel Tunnel alone, but at various packages of investment in transport infrastructure of which the Channel Tunnel will form a part. However, it remains open whether those losses are absolute or relative, i.e. smaller gains compared with the centre.

Figure 2.4. Integration of the Channel Tunnel into the European high-speed rail network



3. Research methodology

3.1. Modelling impacts of the Channel Tunnel on regional development in Europe

3.1.1. Requirements from the model

The representation and assessment of the impact of a major infrastructure development such as the Channel Tunnel require a more comprehensive approach to modelling than that traditionally utilized. This need arises for a number of reasons.

Firstly, an assessment of the Channel Tunnel must analyse its impact over a substantial time horizon. The Tunnel will probably open in 1993, which is many years before the rail connections at the British side are fully upgraded to provide a high-speed, high-capacity line for passengers and freight. Accordingly, it is necessary to represent the evolution through time of the increasing quality of the supply of transport services that is offered by the Tunnel.

Secondly, the economic structure of Europe will have developed from the level at which it is now by the time the Tunnel is in use. In particular, the adjustment to the open market post-1992 will be under way. This implies that it is necessary to represent the evolution in the demand for transport through time and especially to be able to link changes in economic circumstances with the resulting changes in the demand for passenger and freight transport. For example, changes in the economic structure of a country imply changes in the volume of consumption of different commodities within the country and hence changes in the demand for transport of imports to the country. Similarly, increases in average income levels will lead to increases in personal mobility and to increasing demand for passenger movements between countries.

Thirdly, the demand for transport will itself be influenced by the existence of the Tunnel. The Tunnel will act as a stimulus to economic growth in some of the regions adjacent to it and will facilitate movement and hence trade between the British Isles and Europe.

Lastly, all of these developments will take place against a changing backdrop of transport technology and economics. The increasing availability of intermodal freight transport, the growth in the high-speed passenger rail network, the extensions to the national motorway networks, etc., will all have an impact on the choices by users of different modes and routes.

The approach to modelling that is embodied in the Meplan package allows all of the above aspects to be accounted for within a consistent framework. In this way it provides a tool for use in evaluating a wide range of potential scenarios and policy instruments.

3.1.2. Fundamental approach

To ensure that the modelling approach can successfully address the range of issues outlined in the previous subsection, the Meplan model is designed so as to integrate a number of key concepts from both economic and transportation theory.

The most important concepts used are:

(i) the Leontief input-output model structure;

(ii) the random utility theory as a basis for discrete choice models;

(iii) consumer-surplus-based evaluation using consistent measures of changes in utility.

The use of an input-output model with a spatial dimension allows both the spatial and the economic structure of the economies of countries to be represented realistically at any point in time. It provides a natural structure to produce detailed estimates of the patterns of trade by commodity type which in turn generate the demands for transport between regions.

Neither the transport model nor the regional economic model bases the estimates of the patterns of transport and of trade solely on the least monetary cost principle. Instead an integrated set of discrete choice models is used. The theoretical development of these models was first carried out by Domencich and McFadden (1975) and Williams (1977) who showed that discrete choice models can be derived from random utility theory. In essence, a hierarchical multilevel logit model is embedded within Meplan. This ensures that patterns of transport and trade are determined in part by random or non-modelled elements and in larger part by least generalized cost choices. The relative strength of these two is determined as part of the calibration of the parameters of the model through making the model results approximate the observed real world situation as closely as possible.

The adoption of a multilevel logit model structure has particular benefits for policy evaluation. The composite utility (or generalized cost) can be carried through each level of the hierarchy of logit models in a consistent fashion. This provides a unique indicator of the merits of a policy relative to some base case. It also allows a precise measurement of both the changes in the costs of production by sector and the changes in costs to consumers that arise from any investments or other changes in the characteristics of the supply of transport available.

Because the focus of this study is the linkage between economic development and a major improvement in transport infrastructure, it is necessary to have a tool which can represent this linkage in a clear and consistent fashion.

The Meplan transport and regional economic model has been developed and refined over the last 20 years to handle just such issues. It is a model which estimates the demand for transport, both passengers and freight, based on a regional input-output model framework. The demand for transport and the pattern of regional economic development are, in turn, influenced by the costs and characteristics of the supply of transport. The model comprises four main modules which are summarized below. More detailed information is contained in Chapter 5.

3.2. Impacts of the Channel Tunnel on regional development in selected regions

In a second part of the research, additional, more qualitative factors are addressed which cannot easily be incorporated in a modelling study. For this purpose, 13 in-depth studies are being conducted for regions which may be particularly affected by the Channel Tunnel.

3.2.1. Qualitative factors

Besides the 'hard' economic factors such as transport cost and transport time that are addressed in the modelling study, the impacts of the Channel Tunnel may be affected by other less tangible factors. These include attitudinal responses and subjective judgments which may influence the way regions adjust to changing transport opportunities, but also constellations of economic, technological and political developments which interact in a complex manner and cannot be forecast with certainty. For each selected region, questions such as the following will be addressed:

(i) What will be the position of the region in the future European transport network? How will the Channel Tunnel, alone or in combination with various alternatives of new transport infrastructure such as the new high-speed rail network, new motorways or new levels of service of ferry and air transport, affect that position, in absolute and relative terms compared with other regions in the Community?

(ii) How will firms respond to the new transport opportunities? Will they consider changes in production or distribution? Where will they go? Will firms from other regions or from abroad come to the region?

(iii) What will be the impacts on the regional labour market? Will there be a need for new training and qualification initiatives? Will there be immigration or emigration of labour?

(iv) How will local and regional governments respond? What are their decision margins? What new kinds of locational factors will become important? What will be the impacts on intra-regional transport and urban/rural form?

(v) What will be the impacts of the current policy initiatives of the Commission on regional development and transport from the point of view of the region? Which new policy initiatives of the Commission would be desirable to ameliorate negative impacts or encourage the positive benefits deriving from the Channel Tunnel and associated infrastructure?

As different industries are affected differently by the changes in transport infrastructure, each region study concentrates on a few key sectors which are of particular importance for the economic development of the region.

3.2.2. Data collection and interviews

Each study consists of two parts of which the first part has been completed for all study regions:

(i) In the first part, basic indicators of the social and economic development in the region have been collected with special emphasis on the key industries of the region. The expertise and local knowledge of the scientific collaborator have been instrumental in identifying the national and regional data sources necessary for this. The data collection has been conducted in a way which maximizes the comparability of the data across the regions and with the data collected for the modelling exercise. Preliminary results of this phase of the work are presented in Chapter 5 and in the separate regional analyses accompanying this report.

(ii) In the second part, in each region in-depth interviews have been conducted with policy-makers and experts from:

political parties

local and regional governments, agencies

regional firms or industry associations

trade unions, professional associations

local/regional newspapers, radio, TV

university research

national ministries, agencies

national/international banks.

When necessary, the interviews were held with the help (and if useful, language assistance) of the local scientific collaborators who also assisted in the selection of the persons to be interviewed.

3.3. Synthesis of model analysis and regional analyses

The modelling part of the study and the regional analyses have been interrelated as much as possible:

(i) the hypotheses generated in the preparation and in the course of the regional studies were a necessary input to the work phase in which the Meplan model was custom-tailored to the task, tested and calibrated;

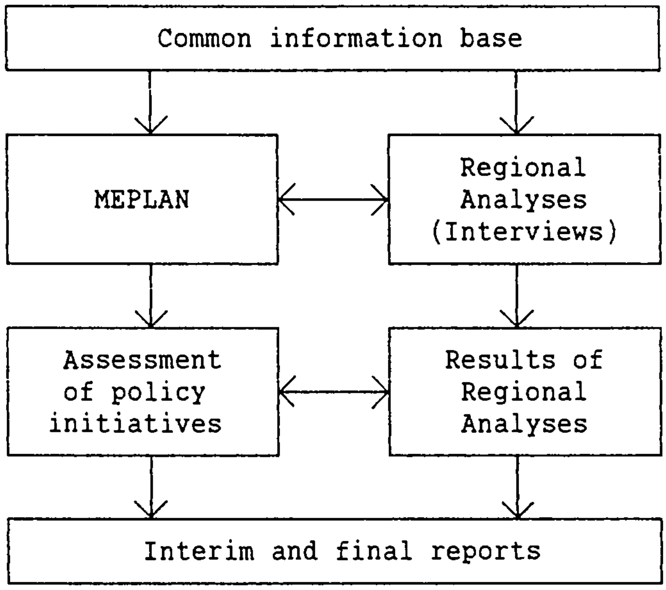
(ii) the data needed for the model and the data needed for the selected regions were similar except that more detailed data are required for the regional analyses.

It was therefore necessary to conduct the two parts of the study in close cooperation between the two research teams during the whole duration of the project. Figure 3.1 is a schematic representation of the main information flows between the project components.

In the final phase of the project, the results of the modelling study and the regional analyses have been brought together into a final synthesis. This is the subject-matter of Chapter 6, where it is examined where the model results are in line or in disagreement with the attitudes and expectations expressed by the policy-makers and experts in the regions.

Based on this examination, recommendations for future policies of the Commission will be made. These recommendations will be derived partly from the model results and partly from the statements of regional policy-makers and experts as to which policy initiatives are necessary or desirable from the point of view of the regions.

Figure 3.1. Synthesis between model analysis and regional analyses



4. Regional analyses

In the 13 case-studies the likely impacts of the Channel Tunnel on regional development and the potential policy responses of regional and supra-regional actors were assessed. In each region, between 10 and 15 interviews with representatives of industry, trade associations and government were conducted. In addition, experts from regional universities and research institutions were consulted. Other sources of information were published, statistics, policy documents and regional newspapers and journals, and personal visits were arranged.

The purpose of this chapter is to present the results of this intensive effort of information collection and analysis in a cross-cutting and comparative fashion. The chapter starts with a brief presentation of the 13 regions and of the reasons why they were selected as case-studies. The second section contains a comparative analysis of the present state of the 13 regions and of current trends in the fields of population, economy and transport. The main section presents the possible impacts of the Channel Tunnel on the 13 regions as they were revealed during the project from the documents studied and the interviews conducted. The section proceeds from the more certain consequences in the field of transport to the less easily predictable impacts on the regional economy and the competition between regions, and from there to the still-more intangible realm of attitudes, strategies and expectations. Wherever possible, it is attempted to confront the opinions voiced in the interviews with the initial hypotheses of the research team based on more general, theory-based considerations from the model analysis part of the project (Chapter 5) and on the empirical evidence available from other regions with projects of similar magnitude.

The chapter is based on the 13 regional analyses which accompany this report in separate volumes and on the first interim report of October 1990, which it supersedes. As the work phase of regional analyses is now coming to a close, it is also a draft for the respective chapter in the final report of the project. However, the final conclusions to be drawn out of the regional case-studies will be left for the final report where they will be combined in the synthesis between the two parts of the project.

4.1. The case-study regions

As case-study regions for the in-depth regional analyses, 13 regions, 12 European Community NUTS level 2 regions and Scotland as a level 1 region, were selected after consultation with DG XVI from four categories of regions based on the criteria: closeness to the Channel Tunnel, functional position in the European system of regions, and eligibility for EC structural assistance. The 13 regions are shown in Table 4.1 and Figure 4.1.

According to their location to the Channel Tunnel, the 13 regions can be classified into four groups.

(a) First group

In the first group of regions are the two regions at the British and continental ends of the Channel Tunnel: Kent and Nord-Pas-de-Calais. The impact of the Tunnel on these two regions is most obvious and direct.

Kent

Kent is the English county closest to the European continent. The Channel Tunnel terminus is there, as are four existing ferry ports (Dover, Folkestone, Ramsgate and Sheerness), and virtually all traffic to the rest of Britain must travel through the county. So the impact of the Channel Tunnel on Kent is inevitably immense. Kent is partly rural and has partly suburban character due to its closeness to the London metropolis. In recent years it has become a favourite location for both services and high-tech manufacturing industries profiting from its vicinity to London. Kent is eligible to receive assistance from the EC Structural Funds only in respect to the new Interreg programme.

Nord-Pas-de-Calais

Situated at the entrance of the Channel Tunnel and on the future TGV Nord high-speed railway line, Nord-Pas-de-Calais is at a crossroads of future north-south and east-west traffic in north-western Europe. Except for the port activities in Dunkirk, Calais and Boulogne, the northern coastal part of the region is still largely rural in character, while its central part consists of the industrial agglomeration of Lille-Roubaix-Tourcoing, a region undergoing rapid structural economic change. Because of its industrial heritage, Nord-Pas-de-Calais is partly eligible to receive Community ERDF assistance under Objective 2 ('to redevelop regions affected by the decline of industry') and is also included in the Interreg programme. Due to its strategic location, the impacts of the Channel Tunnel on Nord-Pas-de-Calais are expected to be substantial.

(b) Second group

The second group of regions comprises three regions which are very close to the two Tunnel access regions: West-Vlaanderen, Hainaut and Zeeland. These regions are likely to be affected by the Channel Tunnel as transit regions for traffic from and to the Tunnel.

West-Vlaanderen

The region of West-Vlaanderen (West Flanders) in Belgium was selected as a study region mainly because it has, with Ostend and Zeebrugge, two of the most important cross-Channel ferry ports. Although passenger ferry traffic from these two ports is much less than from the French ports of Dunkirk, Calais and Boulogne, Zeebrugge is first in cross-Channel ro-ro transport. The port industry is much more important for West-Vlaanderen than for Nord-Pas-de-Calais, so the impact of the Channel Tunnel may be more pronounced. In addition, West-Vlaanderen may be affected by the Tunnel not only as a location for industry, but also as a transit region between the Tunnel and the Netherlands and as an important tourist region. West-Vlaanderen is eligible to receive assistance from EC Structural Funds only in respect to the new Interreg programme.

Hainaut

The Hainaut region in Belgium, along with parts of West-Vlaanderen and Nord-Pas-de-Calais in France, form a large industrial agglomeration near the mouth of the Channel Tunnel. The opening of the Tunnel will certainly have an impact on the future of this region, which is located on the West-East route linking the United Kingdom to Germany, the eastern part of France and to Central Europe. So Hainaut is a good subject for this study. Depending on the infrastructure and economic development policies developed here, Hainaut should benefit from the opening of the Tunnel and gain in importance for a large part of Europe. Hainaut is part of the old industrial heartland of Belgium but has suffered seriously from the decline of the mining and iron and steel industries in the past. Only the Charleroi district in Hainaut is eligible for Community assistance under Objective 2. Hainaut is also included in the Interreg programme of the EC.

Zeeland

The region of Zeeland in the Netherlands was selected as a case-study because of its potential importance as a transit region between the Channel Tunnel and the 'Randstad Holland', the economic and population centre of the Netherlands. In contrast to other regions, e.g. West-Vlaanderen, Zeeland is far from eager to become a transit region because of the negative impacts of a major traffic corridor on its ecological situation and the quality of its recreation areas. Secondary reasons for the choice of Zeeland as a study region are the possible positive impacts of the Channel Tunnel on its economy, in particular the tourist industry and port-related activities. The potential impact on the daily ferry link with Sheerness in England may be a further point of interest. Zeeland is eligible for Community assistance only in respect to the Interreg programme.

(c) Third group

The third group of study regions consists of three regions of medium distance from the Channel Tunnel:

Figure 4.1. The 13 case-studies of the project

Table 4.1. The 13 case-study regions

Location of region	Study region	Functions of region	Community assistance[a]
Tunnel access regions	Kent	Rural/suburban/ modern industrial	Interreg
	Nord-Pas-de-Calais	Old industrial/ rural	Objective 2,[b] Interreg[b]
Short distance to Tunnel access regions	West-Vlaanderen	Rural/port/ tourist	Interreg[b]
	Hainaut	Old industrial	Objective 2,[b] Interreg[b]
	Zeeland	Rural/tourist	Interreg[b]
Medium distance to Tunnel access regions	Cologne	Services/media/ culture	Objectives 2[b] and 5b,[b] Interreg[b]
	Bremen	Port/shipbuilding	Objective 2
	Brittany	Rural/tourist	Objectives 2[b] and 5b[b]
Long distance to Tunnel access regions	Piemonte	Modern industrial	Objectives 2[b] and 5b,[b] Interreg[b]
	Scotland	Mixed peripheral	Objectives 2[b] and 5b[b]
	Ireland	Mixed peripheral	Objective 1, Interreg[b]
	Pais Vasco	Old industrial	Objectives 2[b] and 5b,[b] Interreg[b]
	Norte	Rural peripheral	Objective 1, Interreg[b]

[a] European Commission, 1991a; 1991b, 1989; Mellors and Copperthwaite, 1990.
[b] Partly eligible.

Cologne

The region of Cologne in the Federal Republic of Germany was selected as a case-study for two reasons. The first one is its economic importance as a centre of high-level services and communications. The second reason is its strategic location in the European railway and motorway network. Cologne will be a gateway between Central Europe and the approaches to the Channel Tunnel, so a substantial part of the Tunnel traffic will flow through Cologne.

It is generally expected that Cologne will be a winner of the emerging European high-speed transport infrastructure of which the Tunnel will be a part. The former mining areas in the western part of the region (Aachen and Heinsberg) receive Community assistance under Objective 2. The Eifel, the hill section of the Cologne region, is eligible for assistance under Objective 5b ('to promote the development of rural areas'). The western sections of the Cologne region bordering the Netherlands and Belgium are included in the Interreg programme of the Community.

Bremen

The region of Bremen in the Federal Republic of Germany was selected because of its particular economic situation, which depends for a great part on its function as one of the main North Sea ports. In the past decades, this economic sector has undergone a deep structural crisis. In the future the economy of Bremen will be in a more and more peripheral location within western Germany as well as the European Community. The Channel Tunnel, together with other infrastructure developments, may even reinforce and accelerate the marginalization process for Bremen. Because of its declining port and shipbuilding industry, Bremen receives ERDF funds under Objective 2 and from the Renaval programme.

Brittany

The region of Brittany in France was selected as a case-study for two reasons. The first one is its location near the English Channel coasts but far from the Channel Tunnel. Here the question of interest is how much of the traditionally strong links between Britain and Brittany will be diverted from water- and air-bound traffic to the Tunnel. The second reason is the region's location in the European railway and motorway networks, which may become less peripheral with the completion of the Tunnel approaches. Despite its innovative farm-produce industry and recent considerable efforts in high-tech research and manufacturing, Brittany is still a predominantly rural region with a substantial tourist industry; parts of it are eligible for Community funds under Objectives 2 and 5b.

(d) Fourth group

In a final fourth group five regions are combined which are relatively distant from the Channel Tunnel. The selection of these regions as case-studies was determined by concerns that the Channel Tunnel may primarily benefit regions close to it, but that for more distant regions the overall impacts may tend to be negative.

Piemonte
The region of Piemonte (Piedmont) in Italy was selected as a case-study for two reasons. The first one is its economic importance, Piemonte coming just after Lombardia (Lombardy) in second place among the 20 Italian regions, and for its contribution to the Italian GNP and exports and imports. The second reason is its strategic location at the connection between the Italian and west and central European railway and motorway networks. A substantial part of the traffic between Italy and south-west Europe flows through Piemonte, which is also located on the main axis between south-west and south-east Europe. Piemonte's growing economy has a strong modern manufacturing base; the region is partly eligible for Community funds under Objectives 2 and 5b and is included in the Interreg programme.

Scotland
Scotland was selected as a case-study because probably for no other region the likely impacts of the Channel Tunnel will be both positive and negative. On the positive side are the cost and time savings afforded by the Tunnel which will help to make Scottish industry more competitive in the European markets. On the negative side may be long-range shifts of economic activity away from Scotland as the relative position of Scotland as an industrial location may worsen compared with places like south-east England or the north of France. The Scottish economy produces a wide range of goods, but has fared relatively badly recently compared with the rest of the UK. Parts of Scotland receive Community funds under Objectives 2 and 5b.

Ireland
Ireland was selected as a case-study region because after the completion of the Channel Tunnel, Ireland will be the only country in the EC without a land link to the European mainland. This is a serious disadvantage for Irish exporters who need to be able to compete with their European counterparts on the markets in the Community. Ireland's economy is still lagging behind the Community's average, so Ireland is eligible for Community funds under Objective 1 ('to promote the development and structural adjustment of underdeveloped regions'). The northern parts bordering Northern Ireland are included in the Interreg programme of the EC.

Pais Vasco
The Pais Vasco (Basque Country) region was selected as a case-study because of its position at one of the two 'gates' between the Spanish (and Portuguese) economy and Central Europe (the other being Cataluña (Catalonia)). In fact more than 60% of all international trade by road and railway goes through the customs checkpoint at Irun. In addition, the Basque Country has two prominent ports, Bilbao and Pasajes, which handle a significant share of the trade between Spain and the United Kingdom and northern Europe and thus may in principle be affected by a diversion of trade to the Channel Tunnel. As those of Hainaut and Bremen, the economy of Pais Vasco, which used to be based on steelmaking and shipbuilding, has suffered from industrial decline and hence has received Community assistance under Objective 2, and also under Objective 5b for parts of the region. Pais Vasco is also eligible for funds from the Interreg programme.

Norte
The region of Norte in Portugal is too far from the Channel Tunnel to expect major impacts from its completion. Nevertheless, the intensive relations between Norte and the UK and recent developments after Portugal's integration into the EC, as well as likely developments after the future improvement of the transport network in Portugal and of its links to other European countries, need to be investigated. Norte's economy still has a large agricultural sector, though industrialization is progressing faster than in other parts of Portugal. However, compared with the Community average, the region is still underdeveloped, so Norte, just as Portugal as a whole, receives Community

assistance under Objective 1. Norte is also eligible for assistance from the Interreg programme.

4.2. Current situation

In the following subsections, the population and economic development and the current transport situation of the 13 regions are briefly compared with special reference to those aspects which are most likely to be affected by the Channel Tunnel.

4.2.1. Location and topography

The 13 regions differ vastly in terms of size (see Table 4.2 and Figure 4.2). Scotland and Ireland have by far the largest area — they together amount to almost 7% of the total area of the Community. Bremen is the smallest of the study regions in size, covering just 0.5% of the area of Scotland. Together the 13 regions represent about 12% of the area of the Community. The regions also present a wide range of geographical features:

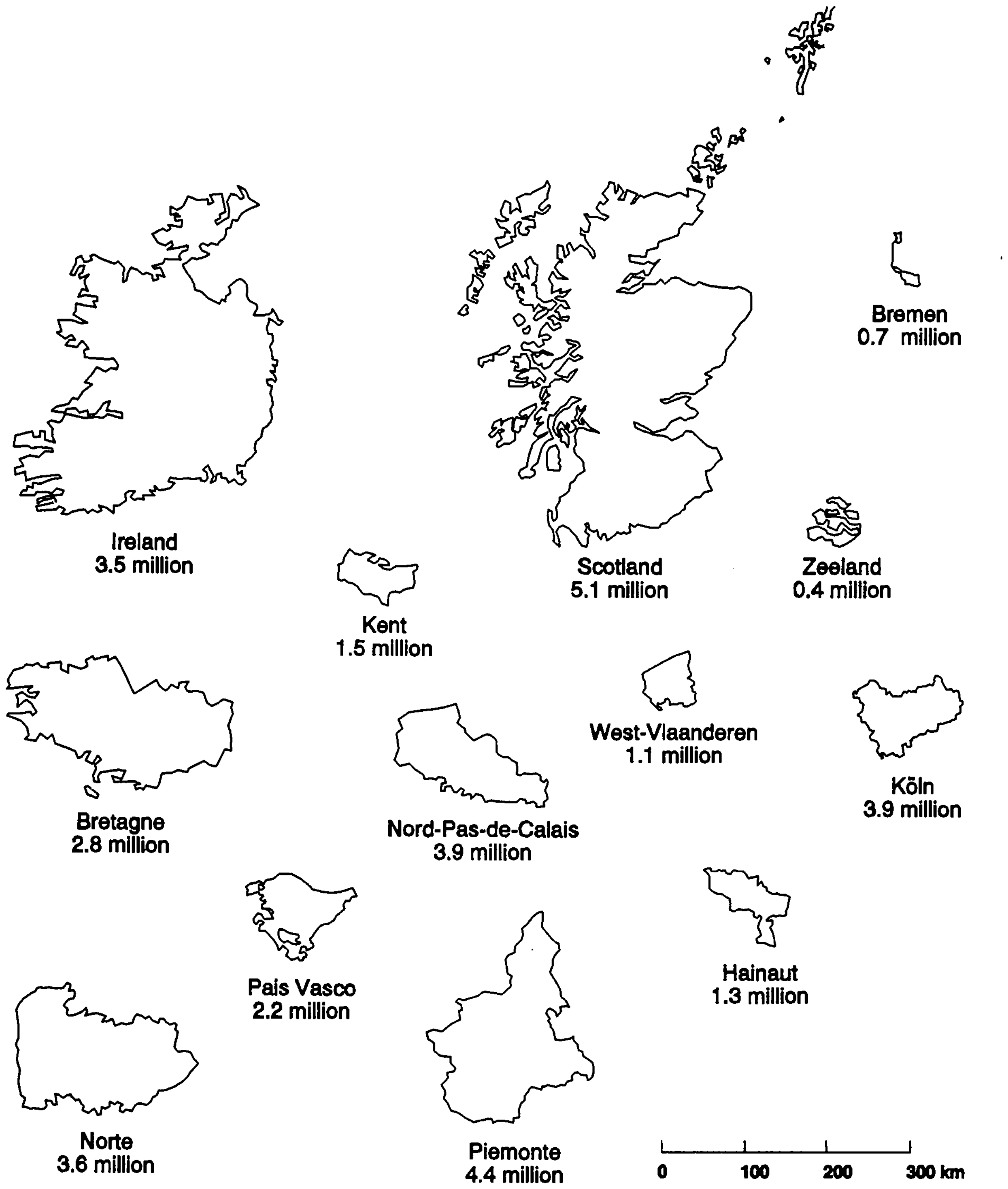
Kent. Kent is located on the south-eastern corner of England between the Thames estuary and the Channel Tunnel. Because of its vicinity to London, Kent is a commuter county with a high proportion of its employed residents working in London. Some employment previously located in London has moved out into Kent, following the pattern of exurban development familiar in large cities, and encouraged by the developments of rail and road services, notably the M25 motorway ring around London. Maidstone and Ashford are important commercial centres. Canterbury is a major tourist centre as well as a religious one. Kent has a high proportion of retired people, many located on the coast. As a holiday location, Kent is not as popular as it was in the days before the British holiday-maker discovered the joys of sunshine holidays in southern Europe. Kent is a fertile agricultural county — 'the garden of England' — and has several major industries, notably paper, brewing, pharmaceuticals and chemicals. There has, however, been a considerable loss of jobs in recent years, especially along the north coast, accelerated by the closure of the naval dockyard at Chatham.

Nord-Pas-de-Calais. Nord-Pas-de-Calais, consisting of the two French *départements* Nord and Pas-de-Calais, is the most northern of the regions of France. It extends from the Belgian border, where it neighbours West-Vlaanderen and Hainaut, to the Channel coast south of Boulogne, where it is adjacent to the Picardie. Topographically, Nord-Pas-de-Calais consists of three parts: the Lille basin in the east, the Artois hills in the west and the marshland areas along the Channel coast. The 'Métropole Nord', Lille-Roubaix-Tourcoing, is one of the most densely populated parts of France. It is the major commercial centre of the region and in the past has been the centre of one of the most important industrial areas of France with coalmining, steel and textiles as its major industries. Boulogne, Calais and Dunkirk together handle 70% of the cross-Channel passenger ferry traffic. Near Calais the new Channel Tunnel terminal at Coquelles is under construction.

Hainaut. Located in the south-western part of Belgium, Hainaut is the western part of the Wallonie region. It is bordered in the north by the Flemish provinces, in the east by the province of Namur and in the south-west by Nord-Pas-de-Calais in France. Hainaut is made up of seven administrative districts: Ath, Tournai, Mouscron, Mons, Soignies, Charleroi and Thuin. Charleroi is the main centre of the region with about 200 000 inhabitants. The population of the region is concentrated at an east-west axis stretching from Charleroi in the eastern part of the region to Tournai and Mouscron, which are part of the Lille agglomeration. The Hainaut coal basin made the region an early centre of mining and steel manufacturing. The location of the province in relation to northern France and the common language made it a crossroads of passage and trade between France and northern Europe. Its geographical location and its affiliation to the French-speaking culture could enable Hainaut to take the best advantage of the effects of the Channel Tunnel.

West-Vlaanderen. West-Vlaanderen is the western section of the Flemish-speaking part of Belgium. It occupies all of Belgium's 65-kilometre North Sea coast between France and the Netherlands. On its west side, West-Vlaanderen is neighboured by the French region of Nord-Pas-de-Calais, and on its eastern side by Zeeland in the Netherlands. Within Belgium, the region is adjacent to Oost-Vlaanderen (East Flanders) and Hainaut. Brugge is the major administrative centre of West-Vlaanderen and also a cultural and tourist centre of European importance. Other important centres are Kortrijk, Roeselare and Ostend. The nearest urban agglomerations outside of West-Vlaanderen are Gent, the administrative and cultural centre of Oost-Vlaanderen, and the French

Figure 4.2. The case-study regions: Area and population



Métropole Nord, Lille-Roubaix-Tourcoing, which is very close to Kortrijk and only 80 kilometres from Brugge. Knokke-Heist, Blankenberge, Ostend and De Panne are seashore resorts with a tradition dating back into the last century. Ostend and Zeebrugge are the two major North Sea ports of Belgium. With the exception of a small area of low hills in its south-western part, West-Vlaanderen consists mostly of flat greenlands with only small areas of forests.

Zeeland. Zeeland is situated in the south-western part of the Netherlands along the North Sea coast. The territory of the study region is the *Provincie* of Zeeland. The study region is formed by 30 municipalities. The city of Middelburg is the administrative centre of the Zeeland region. The northern part of the province of Zeeland consists of a group of former islands in the Rhine-Schelde delta region. Today, these former islands are connected by a system of bridges and dams connected in the 1960s and 1970s as parts of the Delta Plan. The Westerschelde, which has no barrier against the North Sea, separates these former islands from a continental strip of land forming the southern part of the region. This coastal region, called Zeeuwsch-Vlaanderen, is bordered by Belgium. In the east of Zeeuwsch-Vlaanderen, at the inner end of the Westerschelde, lies the city of Antwerp. The Westerschelde is the shipping route between the port of Antwerp and the open sea as well as a part of the route to Gent. The agglomeration of Rotterdam with Europoort, the largest seaport of Europe, is situated north of Zeeland.

Cologne. The region of Cologne is located in the west of the Federal Republic of Germany as part of the *Land* of North Rhine-Westphalia (Nordrhein-Westfalen). The territory of the study region is the *Regierungsbezirk* (administrative district) of Cologne. The study region is formed by nine counties and the four autonomous cities of Cologne, Bonn, Leverkusen and Aachen. Within Nordrhein-Westfalen, the Cologne region is situated in the south-west of the *Land,* adjacent to the large industrial agglomeration of the Ruhr area. On its west side, the region is bordered by the Netherlands and Belgium and Luxembourg. The region is divided by the Rhine river, which leaves the hills south of Bonn and flows into the Niederrheinische Bucht, a southern extension of the flatlands of northern Germany. With the exception of Aachen, all main cities of the region are located on the Rhine. The distance between Cologne and the Channel Tunnel is about 400 kilometres.

Bremen. The region of Bremen is located in the north-west of the Federal Republic of Germany. The territory of the study region is the smallest of the federal states *(Länder)*. The existence of the *Land* of Bremen is due to the historical fact that Bremen, like Hamburg, has a long tradition as an autonomous city and hence, together with Hamburg, was given the status of a *Land* when the Federal Republic was established in 1949. The city *Land* of Bremen is formed by the two cities, Bremen and Bremerhaven, Bremen's second seaport. Both cities are spatially not connected; they are embedded in the *Land* of Niedersachsen (Lower Saxony). With this spatial definition, the study region is not identical with the total metropolitan area of Bremen, which extends far into Niedersachsen territory. Within Niedersachsen, the Bremen region is located at the mouth of the Weser river at its northern seashore. Hamburg is about 100 kilometres to the north-east. Bremerhaven is located directly on the North Sea coast, whereas Bremen is located 50 kilometres upstream on the Weser river. The Weser is the natural link between the two parts of the region. The distance between Bremen and the Channel Tunnel is about 650 kilometres.

Brittany. Brittany, the most western region of France, forms a peninsula between the Channel Tunnel and the Atlantic Ocean. With the expansion of its hinterland beyond France to the European Community, Brittany reinforces its almost insular location and shares the advantage — or the inconvenience — of being, with Ireland, Cornwall, Galicia and Portugal, more Western than the other West European countries. Within France, Brittany is part of the 'Great West', a super-region extending from Caen in the north to Nantes at the mouth of the Loire. The map of this super-region shows the importance of Rennes, the capital of Brittany, as an interface to Paris and the rest of Europe. Brittany is also part of the 'Atlantic arc' of coastal regions from Ireland to southern Portugal, to which it feels more closely linked than to, for instance, Nord-Pas-de-Calais. In fact Brittany looks towards the United Kingdom not via Kent but via Cornwall through the western Channel. Brittany's topography distinguishes two parts: the Armorica along the rocky coast, which has only few marshland bays, and the Argoat, the hilly inland country. Rennes is the major commercial and industrial centre of the region, and Brest and St Malo its most important harbours. The distance between Rennes and the Channel Tunnel is about 500 kilometres.

Piemonte. Piemonte is the border region of Italy on the south-west side of the Alpine circle and strategically located for the transport connections between Italy and rest of the European Community. Historically linked with the other side of the western Alps (Nice and Savoie were part of Piemonte-Savoia until 1870, when the first tunnel opened the Alpine wall), Piemonte is oriented more to the European Community than other Italian regions. Piemonte is a highly industrialized region coming just after Lombardia in second place among the Italian regions for its contribution to the GNP and to Italian foreign trade. Three quarters of the territory of Piemonte are mountainous or hilly. Turin, the dominant industrial centre of the region is located at the eastern end of the Po river basin, where the Po river enters the north Italian lowlands. Genoa, and Savona in Liguria are the two ports for the Piemonte region. The distance between Turin and the Channel Tunnel is about 850 kilometres.

Scotland. Scotland forms the northern part of the British main island, of which it covers nearly 40%, and includes the Hebrides, Orkney and Shetland Islands. Scotland is the largest of the case-study regions; its area is more than 200 times that of the smallest region, Bremen. Scotland is mostly mountainous. Its major lowland area, located between the Highlands in the north and the Southern Uplands, also contains its major cities: Glasgow, the commercial and industrial centre of Scotland, and Edinburgh, its capital. Aberdeen is the main port for the Scottish North Sea oil industry. The distance between Glasgow and the Channel Tunnel is 750 kilometres.

Ireland. Ireland occupies the larger part of the Irish island off the British coast between the Irish Sea and the Atlantic Ocean. The northern part of the island, Northern Ireland, is part of the United Kingdom. The topography of the 'green island' consists of a vast inner plateau dotted with small hills and a multitude of lakes between the mountainous coastal rim. Seventy percent of the land is used for agriculture, and only 20% for raising crops, while the rest is grazing land. As a consequence of 300 years of British occupation, there is no large-scale industry in Ireland. Dublin, Cork and Limerick are the three largest cities, the former two are also port cities. The shortest distance between Dun Laoghaire in Ireland and Holyhead in England is 80 kilometres; however, the northern Channel between Northern Ireland and Scotland is only 40 kilometres wide. The distance from Holyhead to the Channel Tunnel is about 600 kilometres.

Pais Vasco. The Pais Vasco, or the Basque Country, consists of the three Basque provinces of Vizkaya, Guipuzcoa and Alava in northern Spain at the western end of the Pyrenees on the coast of the Gulf of Vizcaya. The topography of the Basque Country is mostly mountainous except the inland highlands south of the Cantabrian Mountains. Its major commercial, financial and industrial centre is Bilbao located on the Nervion river. San Sebastian is the centre of tourism-related services. Vitoria is the seat of the Basque Government. Bilbao and Pasajes (the port of San Sebastian) are the main harbours. Irun, one of the two main border checkpoints between Spain and France, is also in Pais Vasco. The distance between Irun and the Channel Tunnel is about 1 200 kilometres.

Norte. The Norte region is located in the north of Portugal. As regions are not yet political entities in Portugal, Norte is more of a planning concept due to the historical fact that districts north of the Douro river have formed the original territory of Portugal since the 12th century. The region consists of two different zones: a coastal zone (littoral), in which valleys and altitudes of up to 400 metres are predominant and conditions for irrigated agriculture are good, and an inland zone (interior), where altitudes are frequently higher than 400 metres and agriculture is poor. So the littoral is a zone of green orchards and vegetable production with small industry coexisting with agriculture. In the interior, however, agriculture and forestry are both scarce and industry does not exist. The main commercial centre of Norte is Porto, and Leixoes and Viana are its main ports. The land distance between Norte and the Channel Tunnel is about 1 800 kilometres.

4.2.2. Population

The 13 regions also differ greatly in terms of population (see Table 4.2 and Figure 4.4). Scotland, the region with the largest area, has also the largest population (5.1 million), but Piemonte (4.4 million), Nord-Pas-de-Calais (3.9 million) and Cologne (3.9 million) have larger populations than Ireland (3.5 million), which is second in area. Zeeland (356 000) is the smallest region in terms of population. Together the 13 regions represent about 11% of the population of the Community.

Bremen. A city *Land,* Bremen has the highest population density with 1 640 persons per km². Eight other study regions are above the Community average of 143 persons per km². Zeeland, Brittany, Scotland and Ireland have a lower density than the Community average. Bremen, of course, is also the most urbanized of the regions, but Turin in Piemonte (1.0 million), Cologne (937 000) and Glasgow in Scotland (734 000) are larger cities than Bremen (535 000). Zeeland has no city with a population of more than 50 000.

Eight of the regions have a growing population (see Figure 4.3). The fastest growing region is Ireland, the population of which grew by 9% between 1976 and 1987. In the same period, Zeeland grew in population by 6.6%, Brittany by 5.4%, Pais Vasco by 5.2% and Norte by 5%. Four regions declined in population during that period: Bremen by 8.2%, Hainaut by 3.7%, Piemonte by 2.5%, Scotland by 1.8% and Cologne by 0.3%. The reasons for population growth and decline are different in each region.

Kent. The population growth in Kent is mainly due to increasing suburbanization of London both in terms of population and jobs, as well as to growing retirement migration to attractive locations on the coast. This growth is partly offset by a local population decline due to a decline of heavy industry along the Thames estuary and of tourism in some coastal resorts.

Nord-Pas-de-Calais. The formerly growing population of Nord-Pas-de-Calais is leaving the region and migrating towards Île-de-France and southern France, so despite a growing birth rate the population today stagnates. Work on the Channel Tunnel has not yet produced population growth, not even in the Calais metropolitan area.

West-Vlaanderen. The population gains in West-Vlaanderen have occurred in the more urbanized counties and along the coast, mostly through migration from rural areas and other provinces in Belgium as well as through an increasing tendency of retirement migration to the attractive seashore.

Hainaut. The population decline in Hainaut is a consequence of the decline of its coalmining and steel industries. Especially younger people migrate to cities outside the region. Low fertility and emigration result in progressive population decline and ageing of the population.

Zeeland. Population growth in Zeeland is due to the overall natural population increase in the Netherlands. Zeeland had net migration gains until the mid-1980s, but net migration losses in the last few years. The region has lost people to other provinces of the Netherlands, whereas net immigration from foreign countries to Zeeland has continued.

Cologne. The population of the Cologne region increased by more than 200 000 people during the 1970s and has stabilized during the 1980s. Despite substantial suburbanization, the share of population in cities has remained nearly constant because the cities gained population through immigration from outside the region, in particular from abroad.

Bremen. The main reason for the negative development of population in Bremen is suburbanization to its hinterland in Lower Saxony. However, in recent years suburbanization has slowed down, while net migration to other regions in western Germany has increased. Without immigration of foreign workers population decline in Bremen would be even stronger.

Brittany. Brittany is young: 30% of its people are under 20 years old and only 19% over 60. These two age groups grow, whereas the age groups in between stagnate owing to the traditional emigration to Paris (one Breton out of ten lives in Paris). Secondary or permanent homes for British nationals contribute to a renewed population growth of villages in central Brittany.

Piemonte. After the 'economic miracle' of the 1960s, the population of Piemonte has decreased since 1976 due to declining fertility and net emigration. With the second oil crisis and the restructuring and robotization of the car industry, many worker families that had been attracted to the industrial north of Italy during the economic boom returned to the south.

Scotland. Scotland's population declined due to emigration to England, mainly to the south-east of England, because of a lack of economic opportunities. The short boom of North Sea oil has not been able to compensate for this drift. As mostly young adults leave the region, the population tends to get older.

Ireland. Ireland's rapid population growth was due to its high birth rates. However, after many years of growth, Ireland's population has declined since 1987 due to a combination of decreasing birth rates (from 18.2 births per 1 000 population in 1984 to 14.7 in 1989) and a dramatic increase in net emigration (from 9 000 in 1984 to 46 000 in 1989).

Table 4.2. The case-study regions: Population and density

	Area	Population (1 000)		Annual change 1976-87	Density[a]
Region	km²	1976	1987	%	Pop./km²
Kent	3 731	1 456[b]	1 495[c]	+ 0.44[d]	405
Nord-Pas-de-Calais	12 414	3 916	3 928	+ 0.03	316
West-Vlaanderen	3 135	1 073	1 094	+ 0.18	349
Hainaut	3 786	1 320	1 273	− 0.33	336
Zeeland	3 040	334	356	+ 0.58	117
Cologne	7 368	3 868	3 856	− 0.03	523
Bremen	404	714	660	− 0.71	1 633
Brittany	27 208	2 618	2 768	+ 0.51	102
Piemonte	25 399	4 491	4 383	− 0.22	173
Scotland	78 783	5 205	5 112	− 0.16	65
Ireland	68 895	3 228	3 542	+ 0.85	51
Pais Vasco	7 261	2 077	2 191	+ 0.49	302
Norte	21 194	3 410	3 591	+ 0.47	169
EUR 12	2 253 497	313 390	323 754	+ 0.30	144

[a] 1988.
[b] 1979.
[c] 1985.
[d] 1979-85.
Sources: European Commission, 1991a; Eurostat, 1990a.

Table 4.3. The case-study regions: Population by age, 1986

Region	Births/1 000 pop.	Deaths/1 000 pop.
Kent[a]	12.7	9.6
Nord-Pas-de-Calais	17.0	10.3
West-Vlaanderen	11.5	10.7
Hainaut	11.7	13.1
Zeeland	12.7	10.1
Cologne	10.1	10.7
Bremen	8.7	13.3
Brittany	13.3	11.2
Piemonte	7.5	11.5
Scotland	12.8	12.4
Ireland	17.3	9.5
Pais Vasco	9.3	6.9
Norte[b]	14.2	8.5
EUR 12	11.8	10.2

[a] 1981.
[b] 1985.
Source: Eurostat, 1989; 1990a.

Figure 4.3. The case-study regions: Population change, 1976-87

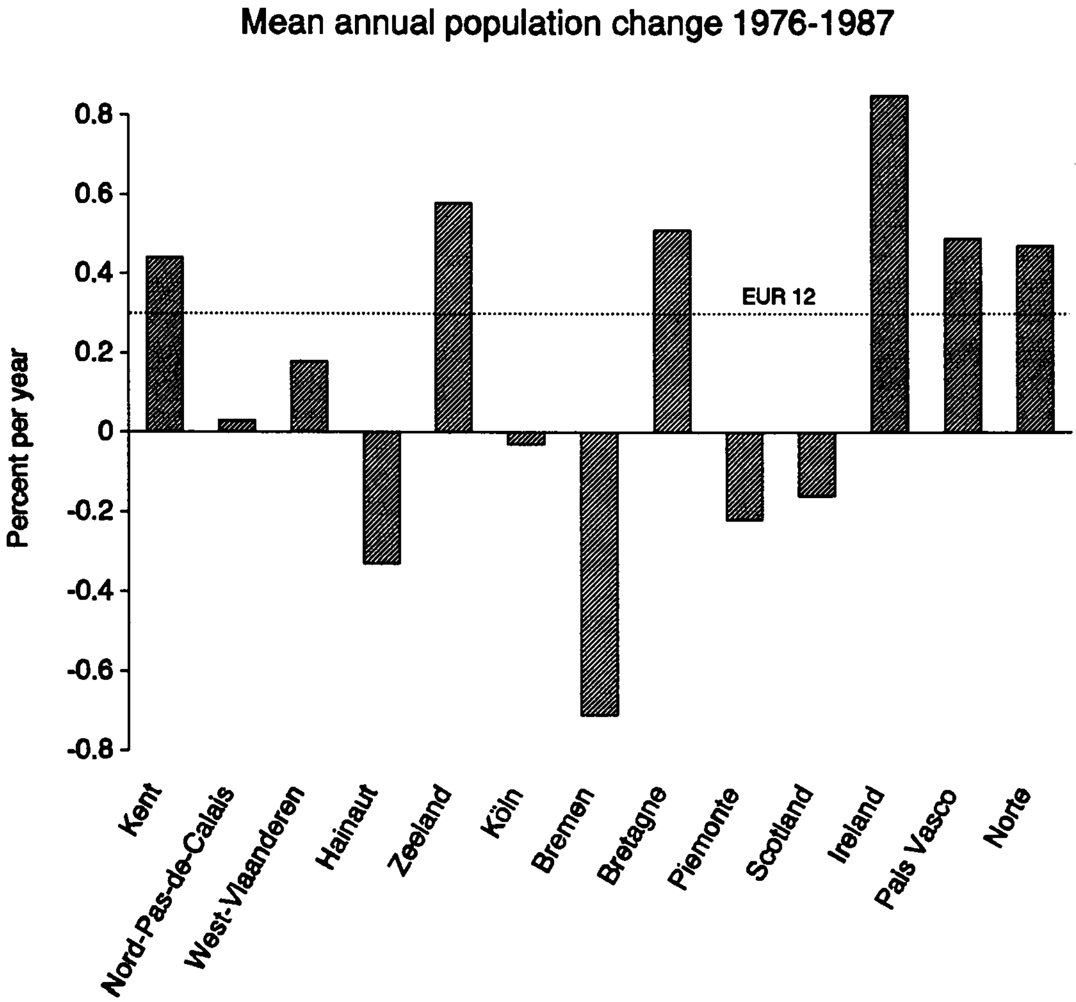
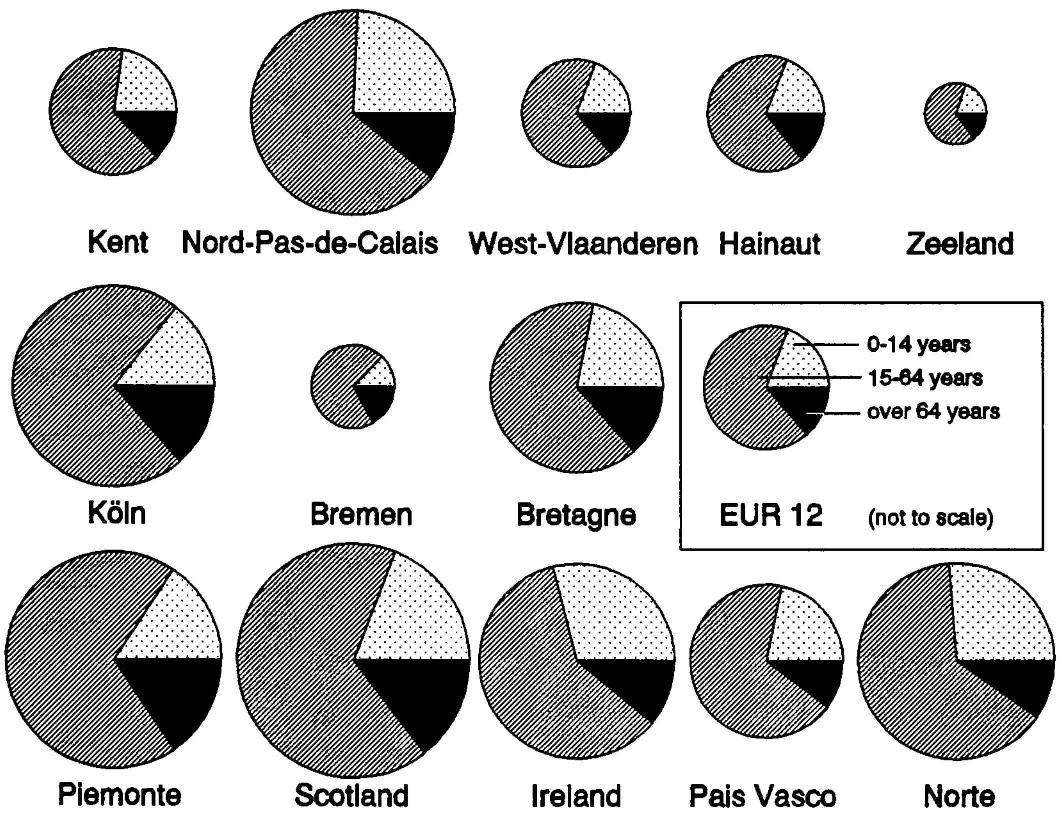


Figure 4.4. The case-study regions: Population by age, 1986



Pais Vasco. Population growth had been very rapid up to 1975 when the crisis of the steel and shipbuilding industries put an end to migration from the rest of Spain. Birth rates have declined very sharply. Today net emigration consists of retired former immigrants returning to their native regions and young adults going to more dynamic areas such as Madrid or the Mediterranean coast.

Norte. Population in Norte grows, despite emigration for economic reasons, due to its high birth rates, though birth rates are falling.

Table 4.3 and Figure 4.4 summarize the effects of fertility, mortality and migration on the age structure of the regions. It can be seen that Cologne, Bremen, Piemonte and Pais Vasco have relatively low birth rates and, with the exception of Pais Vasco, relatively low shares of young people and high shares of old people. The populations of Kent, Nord-Pas-de-Calais, Brittany, Ireland, Pais Vasco and Norte, on the other hand, are still relatively young.

4.2.3. Economy

Also in economic terms, the 13 case-study regions represent a cross-section through the regions of the Community. They differ widely in economic size, sectoral composition and prosperity.

If economic output in terms of value-added is considered, Cologne, Piemonte and Scotland are the most important regions (see Table 4.4 and Figure 4.5). However, it needs to be kept in mind that Scotland is not only the largest in terms of population, but that much of its value-added is due to North Sea oil, whereas in Cologne and Piemonte the value-added is produced by a variety of manufacturing and service industries. Zeeland and Norte are the smallest regions in terms of value-added, with Zeeland producing less than 10% of the output of Cologne, Piemonte or Scotland. Taken together, the 13 regions generate about 10% of the value-added produced in the Community (compared with their 11% share of the Community population).

Table 4.4 and Figure 4.5 also show the contribution of the primary, industrial and services sectors to the total value-added. Table 4.5 and Figure 4.6 show the same breakdown for employment. Three groups of regions emerge:

(i) Kent, Hainaut, Cologne, Bremen and Scotland today are already service economies in which two thirds of employment and output are in the service industries, one third in manufacturing and only very little in agriculture.

(ii) Piemonte and Pais Vasco are industrial regions, which still have some agricultural but little service employment.

(iii) Ireland and Norte still have a substantial share of agricultural employment (24% in Norte), with both industry and services underdeveloped.

West-Vlaanderen, Zeeland and Brittany are regions in transition that move directly from their former agricultural base to a service-based economy without a major and extended industrial phase. In Nord-Pas-de-Calais the economic restructuring from industry to services is under way, with some agriculture remaining in the northern part of the region.

Beyond these distinctions, there are substantial differences between the 13 regions in terms of economic 'success' measured by indicators such as labour force participation, unemployment rate or gross domestic product (GDP) (see Table 4.6 and Figure 4.7). High unemployment rates (combined with low labour force participation) are found in the old industrial regions of Nord-Pas-de-Calais, Hainaut, Bremen and Pais Vasco, but also in Scotland and Ireland. The low unemployment rate in Norte is not an indicator of economic success but is partly an artefact of the Portuguese labour statistics and partly underlines the low productivity of the Norte economy, in which 1.3 million workers generate only one sixth of the value-added produced by 1.6 million workers in Cologne. The column 'GDP per worker' indicates the enormous differences in productivity existing among the case-study regions.

The column 'GDP per capita' shows the equally enormous differences in affluence resulting from these economic differences. Cologne, Bremen, Zeeland and Piemonte are clearly above the Community average, West-Vlaanderen and Scotland are about average, whereas all other regions are lagging behind. A similar picture is drawn by the 'synthetic index' of the EC, a measure combining GDP per head and per worker, unemployment and prospective labour force change (European Commission, 1987). Again Cologne, Bremen, Piemonte and Zeeland stand out significantly above the EC average, whereas Norte, Ireland and Pais Vasco are identified as problem regions.

Behind the statistical overview given so far, each region has very specific economic problems in relation to the Channel Tunnel, usually connected with the key industry (or industries) of the region.

Kent. Kent is a commuter county with a high proportion of its employed residents working in London. However, some employment previously located in London has moved out into Kent. Kent is a fertile agricultural county, but has several major industries, notably paper, brewing, pharmaceuticals and chemicals. Employment decline occurred in the naval industry along the Thames estuary. A major issue for Kent in relation to the Channel Tunnel is what will happen to the ferry services, and how will this affect people who currently use them, and those who work in them or provide goods and services to their customers. About 13 000 jobs in Kent are dependent on the ferry industry.

Tourism is another important part of Kent's economy, supporting around 75 000 jobs that may be affected by the Tunnel. Canterbury is a major tourist centre yet tourist activity has declined in Kent's seaside resorts. Unemployment in these areas is above the average for Britain as a whole.

Nord-Pas-de-Calais. After the decline of the industrial framework specialized in coal, steel and textiles, alternative forms of activity are now being developed. In 1986 the three leading industrial employers in Nord-Pas-de-Calais were textiles, automobiles and land-transport equipment, mining and non-ferrous metals. New companies are mainly founded in the fields of materials and equipment, agrifoods and consumer goods and transport. Business services grow in Lille-Roubaix-Tourcoing. Although approximately 10 000 service jobs were created in 1989, the services sector is unable to compensate for losses accumulating in industry. So unemployment in Nord-Pas-de-Calais is among the highest of the case-study regions. Since 1987 the decrease in jobs has continued at a slower rate. Employment has increased in Calais because of the Channel Tunnel construction and in Boulogne, Lille and Béthune-Bruay because of services. The region is progressive in high-tech industries such as plant breeding and seed improvement, microcomputers, lasers, infrared technology, hygiene products, composite materials and surgical instruments. The Lille-Roubaix-Tourcoing metropolis is the home of 10 of the 17 largest regional branches of national banks, the six regional bank head offices and two thirds of all investment banks, foreign banks and credit institutions.

West-Vlaanderen. Transport and tourism are the key industries of West-Vlaanderen potentially affected by the Channel Tunnel. The transport

Table 4.4. The case-study regions: Gross value-added, 1986

Region	Gross value-added			
	Primary (%)	Industry (%)	Services (%)	Total (million ECU)[a]
Kent	–	–	–	10 700[b]
Nord-Pas-de-Calais	2.5	35.8	61.7	36 689
West-Vlaanderen	6.0	34.8	59.2	9 573
Hainaut	2.5	36.2	61.3	8 641
Zeeland	6.8	40.6	52.6	3 647
Cologne[c]	1.0	39.8	59.2	44 200[b]
Bremen	0.3	35.0	64.7	10 483
Brittany	8.7	25.4	65.9	25 373
Piemonte	3.5	43.4	53.1	47 424
Scotland	2.1	38.6	59.2	45 156
Ireland[c]	10.6	34.9	54.5	21 803
Pais Vasco	1.9	51.1	47.0	14 917
Norte	6.7	41.8	51.5	7 694
EUR 12[c]	3.2	36.7	60.0	2 800 000[b]

[a] 1985.
[b] Estimate.
[c] 1984.
Source: Eurostat, 1989; 1990a; 1990b.

Figure 4.5. The case-study regions: Gross value-added, 1986

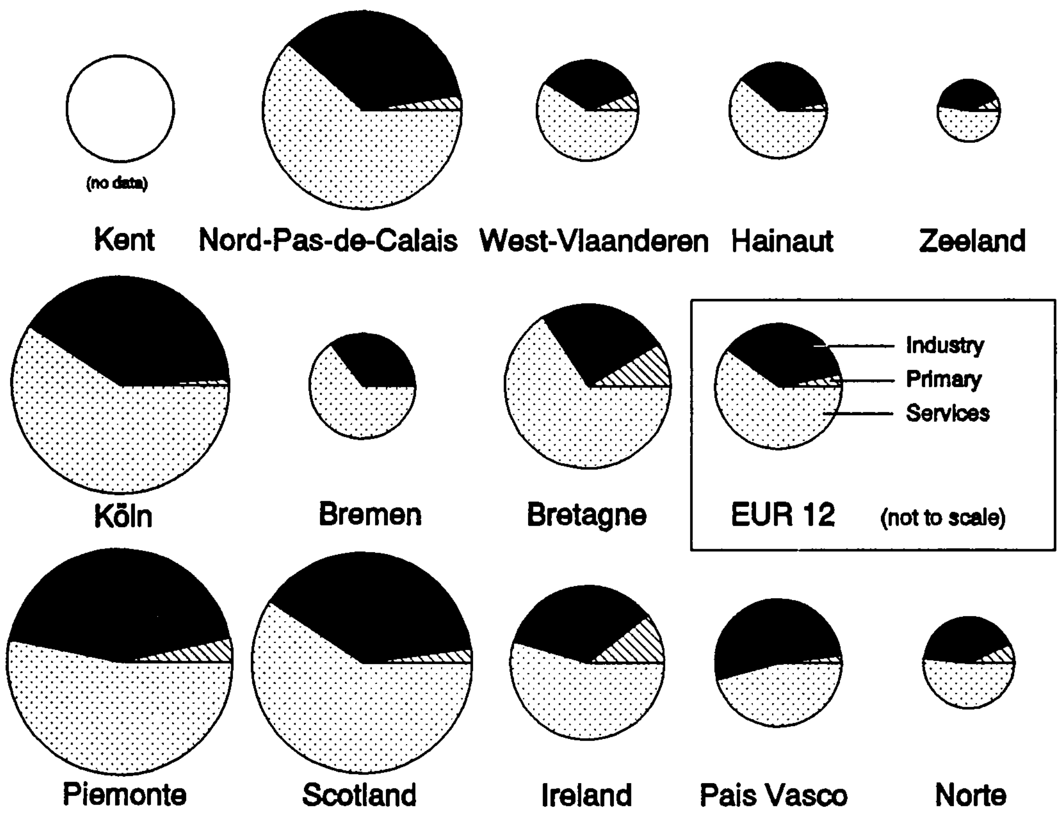
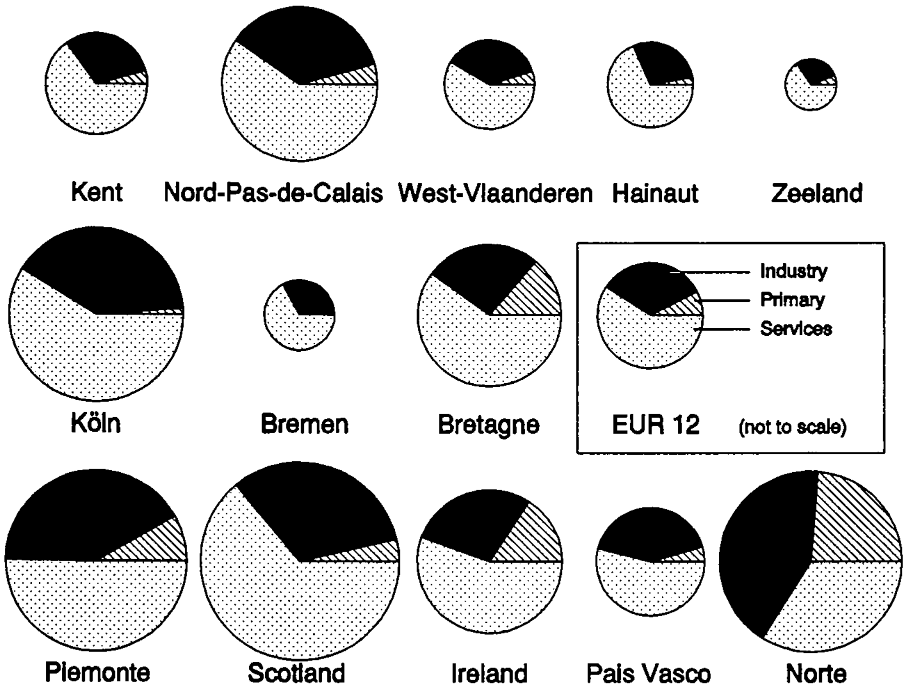


Table 4.5. The case-study regions: Employment, 1988

Region	Primary (%)	Industry (%)	Services (%)	Occupied persons (1 000)[a]
Kent[b]	4.3	30.8	65.0	546
Nord-Pas-de-Calais	4.3	36.0	59.7	1 266
West-Vlaanderen	5.0	36.5	58.5	420
Hainaut	2.9	28.5	68.5	387
Zeeland	6.2	28.0	65.8	138
Cologne	1.2	39.8	58.9	1 603
Bremen	0.3	32.6	67.2	257
Brittany	13.9	26.1	60.0	1 065
Piemonte	8.3	41.5	50.7	1 735
Scotland	3.6	32.4	64.0	2 078
Ireland	15.8	28.7	55.6	1 084
Pais Vasco	4.4	41.6	54.0	619
Norte	23.8	42.3	33.9	1 731
EUR 12	7.6	33.2	59.2	125 913

[a] 1985.
[b] 1981.
Sources: European Commission, 1991; Eurostat, 1990b.

Figure 4.6. The case-study regions: Employment, 1988



industry is concentrated in the seaports Ostend and Zeebrugge. In particular Ostend heavily depends on the transport economy. The agricultural and fishery sectors of West-Vlaanderen generate more than 25% of all agricultural and fishery products of Belgium, in part due to the concentration of the Belgian fishing fleet in the study region. Structural change towards a service economy has progressed less in West-Vlaanderen than in Belgium at large. Most of the tourism and recreation-related jobs are situated at the coast in the region's famous sea resorts De Panne, Ostend, Blankenberge and Knokke-Heist and in the visitor-attracting medieval city of Brugge. During the 1980s, the situation on the regional labour market improved significantly.

Hainaut. In 1984 the last coalmine in Hainaut was closed. At the same time, the area's steel industry irreversibly declined, in spite of a series of reorganization plans, and finally collapsed. All efforts to restructure the economy have had limited success. Despite some growth in the services sector, more jobs disappear than are created. Factors explaining the difficulties encountered are the ageing population, insufficient levels of training and the high proportion of industries with foreign investment, whose research centres are often located outside the country. So employment in Hainaut has decreased since 1973 and unemployment is the highest in Belgium.

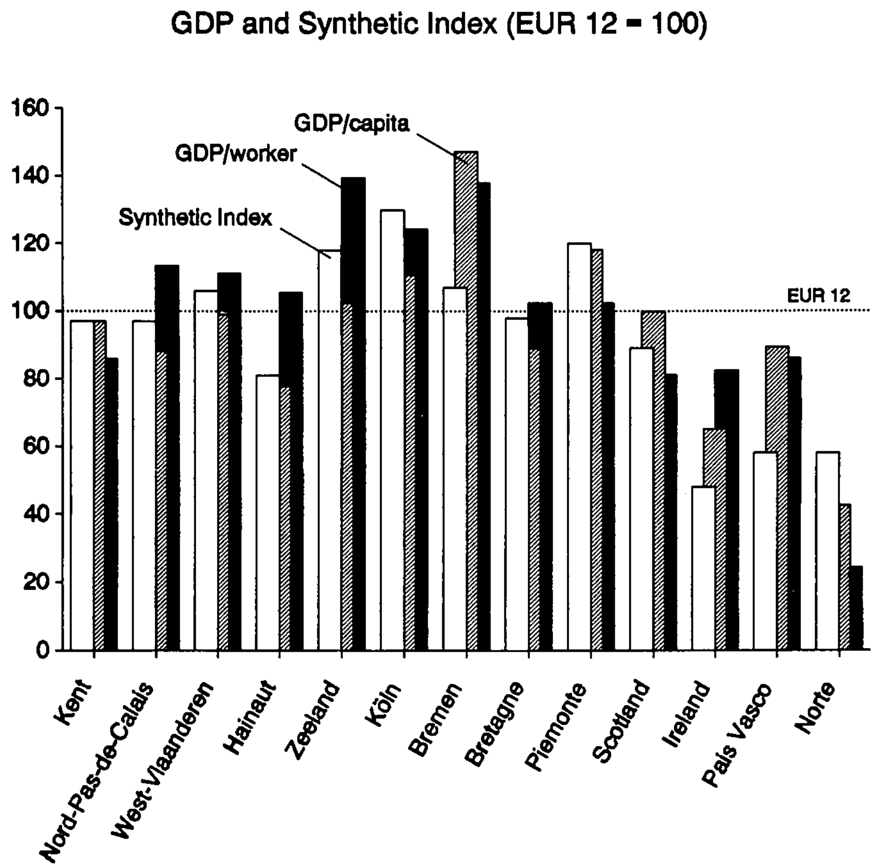
Zeeland. Because of its geographical situation on the coast, the economic development of Zeeland has always been closely linked to maritime activities. In the last two decades, the region has been successful in attracting some subsidiaries of international companies. The construction industry experienced a veritable boom in the 1970s due to the regulation and transport infrastructure projects of the Delta Plan and to the exploding demand for second homes. The fastest growing industries are port-related activities and tourism, which together account for about 20% of all jobs in Zeeland. Employment in port-related activities has more than quadrupled since 1960, whereas the number of people employed in tourism increased by a factor of six. The modernization of the transport infrastructure in the course of the Delta Plan, which greatly improved the accessibility of the former islands of Zeeland in particular for visitors from the Netherlands and Germany, has vastly stimulated tourism in the region. Unemployment is lower than in the rest of the Netherlands. There is no airport in Zeeland. The nearest international airports are Rotterdam, Amsterdam, Antwerp and Brussels.

Table 4.6. The case-study regions: Unemployment and affluence

Region EUR 12 = 100	Labour force participation 1989 (%)	Unemployment 1990 (%)	GDP/ worker[a] 1986-88 (EUR 12 = 100)	GDP/ capita[b] 1986-88 (EUR 12 = 100)	Synthetic index 1984
Kent	–	3.9	86[c]	97	97
Nord-Pas-de-Calais	39.5	11.8	114	88	97
West-Vlaanderen	40.9	3.8	111	99	106
Hainaut	37.7	13.1	105	78	81
Zeeland	41.0	5.6	139	103	118
Cologne	45.0	6.5	125[c]	111	130
Bremen	46.4	10.4	138	147	107
Brittany	44.5	8.4	102	89	98
Piemonte	44.5	6.0	102	119	120
Scotland	49.1	9.2	81	100	89
Ireland	38.0	16.4	82	65	48
Pais Vasco	38.4	19.0	86	89	58
Norte	47.4	3.1	24	42	58
EUR 12	44.8	8.3	100	100	100

[a] ECU.
[b] Purchasing power standard (PPS).
[c] 1985.
Source: European Commission, 1987; 1991.

Figure 4.7. The case-study regions: GDP and synthetic index



Cologne. Through its 2 000-year history, Cologne has always been the dominant economic and cultural centre of the central Rhine region. In the 19th and 20th centuries, it became a centre of the chemical industry and vehicle production and today it is turning into a major centre of services and communications with substantial employment growth in banking, private services, non-profit making organizations and government. Employment in consultancy services more than doubled, a good indication of the change going on in the Cologne economy. The manufacturing industry is dominated by two industries, chemicals and vehicles, and these by two large companies: Bayer in Leverkusen with nearly 64 000 employees and Ford in Cologne with about 27 000 employees. Although between 1970 and 1987 employment in the region grew twice as fast as population, unemployment (which was almost zero in 1970) increased to about 10% during the early 1980s and has only recently fallen to 7%, slightly more than the national average of Germany.

Bremen. The economic development of Bremen has always been closely linked to the shipping and shipyard activities of its ports. But during the worldwide crisis in shipbuilding in the last decades, the dominance of the port industry in Bremen has been reduced. Especially in the 1980s, economic output in the region increased more slowly than in the rest of West Germany, and resulted in a loss of 20 000 workplaces. Employment declined in manufacturing, construction, trade and transport and communications. The structural adjustment in the shipbuilding industry resulted in a loss of nearly 12 000 jobs in shipyards between 1970 and 1988. However, this loss has been compensated by an increase in jobs in the aircraft, space and car industries. On the other hand, service employment increased only insignificantly. Consequently, unemployment in Bremen has been much higher than in western Germany as a whole. While there is a new worldwide cycle of demand for ships, a new economic crisis for the Bremen region may emerge through the foreseeable global disarmament. Such a development would hit Bremen as one of the four major arms production centres in western Germany more severely than other regions.

Brittany. A long time deeply rooted in its land, Brittany entered the industrial world in the 1960s. Small and medium-sized firms in a few sectors (agricultural and food products, motor industry) drive the regional development. Its low level of industrialization protects Brittany from economic crises, but it slows the development of high-level technical education and causes the departure of the best trained technical staff. Between 1982 and 1985 employment growth in industry and services proved insufficient to compensate the decline in agricultural employment. After 1985 a positive evolution began, and unemployment has decreased in the region.

Piemonte. Piemonte and Lombardia were the first regions of Italy to become industrialized after the country had been unified in 1870. With the beginning of the 20th century, the vehicle production industry became the motor of industrial growth in the region with a development of the metallurgy and mechanical industries. In the 1970s there was a decline, which worsened in the 1980s after the second oil crisis. Between 1980 and 1987 employment in manufacturing declined by 23%. The recovery since 1987 was possible through management reorganization, increases in productivity and technological innovations. Public service employment doubled between the 1960s and early 1980s. Unemployment in Piemonte is below the national average.

Scotland. Despite the extra income earned through North Sea oil, in terms of recent economic performance, the region has fared relatively badly compared with most of the rest of the UK. The key sectors of the Scottish economy are food, mechanical engineering, electronics, chemicals and office machinery, which together made up over half of total gross value-added in 1987.

Since 1980, the chemicals, office machinery and electronics sectors have grown in significance, while mechanical engineering and, to a lesser extent, the manufacture of metal goods and textiles have declined. Both the electronics and the food industries are of substantial importance to the export-earning capacity of the Scottish economy. However, much of the electronics sector is foreign-owned and represents for the main part branch plant manufacturing capacity, which could constitute a less-stable employment base for the longer term. Unemployment in Scotland is higher than in all other regions of the UK apart from the north of England.

Ireland. The country is now enjoying a period of economic growth. In 1989 there was a 5% growth in national output, and growth in the range of 3 to 4% per year is expected for the coming years. In recent years Ireland's industries have switched from the more traditional ones like agriculture to the production of high-value goods such as electronics and chemicals. Today the key sectors of Ireland's economy are agriculture, machinery, textiles and chemicals. As a small open economy, Ireland is very dependent on foreign trade, both exports and imports. For example, in 1989 exports represented over 60% and imports over 50% of Ireland's gross domestic product. Despite its economic growth, Ireland's unemployment rate of 16% is second only to Pais Vasco among the case-study regions.

Pais Vasco. Based on its important iron ore deposits and its strategic location to the flourishing British industry, the Basque economy started a rapid industrialization process in the last quarter of the 19th century, spreading to all industrial sectors and stimulating the establishment of strong financial institutions — the leading Spanish bank, the Banco Bilbao Vizcaya, has its headquarters in Bilbao. However, the industrial crisis of the 1970s hit the Basque economy seriously. Two thirds of all industrial jobs, more than 150 000, were lost from 1975 to 1985. After the crisis, technological innovation and adjustments have led to a reduction of industrial, and an increase of service, employment. Key sectors in manufacturing are metals and metal products and machinery, shipbuilding and other transport equipment and electrical engineering and equipment. At 19%, the unemployment rate in Pais Vasco is the highest among the case-study regions.

Norte. With one quarter of the labour force working in the primary sector, Portugal is still largely an agricultural country. Nevertheless, since the 1960s, manufacturing has become the leading economic sector in Norte, and, among manufacturing industries, textiles, clothing and footwear have become dominant. The tertiary sector is weak; with only 34% of all employment, its share of employment is by far the lowest among the case-study regions. The tertiary sector reflects the development pattern of the region, with wholesale and retail being predominant. The low unemployment rate in Norte is not an indicator of economic success, but is partly an artefact of the Portuguese labour statistics and partly underlines the low productivity of the Norte economy.

4.2.4. Transport

A comparative view of the transport situation in the 13 case-study regions meets the same variation between highly urbanized and industrialized and less-developed still partly-rural regions. Here the differences become more obvious between the regions in the European core, which are well integrated into the European transport networks and the more peripheral regions, which are in many cases not only remote but also poorly linked to the European transport infrastructure.

(a) Transport infrastructure

One, but not the most important, indicator for the quality of the transport situation of a region is the transport infrastructure on its territory. Table 4.7 shows the density of various kinds of transport infrastructure in the case-study regions. It is clearly noticeable that the more urbanized and more industrialized regions have more developed railway and motorway systems and a denser network of other roads. In particular Zeeland (because of its insular territory), Brittany, Scotland and Ireland have less-developed railway networks, and in Brittany and Ireland only a small percentage of all railways is electrified. Also the limited provision of motorways in Scotland, Ireland and Norte is noted.

More important for regional development is the integration of the transport infrastructure into the national and European railway, inland waterway, motorway and air transport networks. In this respect each region is a special case.

Kent. Situated between London and the Channel coast, Kent commands a key position in the British and European transport network. Four Channel ferry ports (Folkestone, Dover, Ramsgate and Sheerness) are in Kent. The M20 and M2 motorways are the primary approaches from the Channel coast to London and to northern England.

The network of British Rail's Network South-east is dense but not suited for fast modern trains. Besides moderate access to the four London airports (Gatwick, Heathrow, London City and Stansted), Kent has two airports of its own which provide a few continental services. Yet despite its strategic position, Kent remains very much a transit region to the dominant London metropolis.

Nord-Pas-de-Calais. Due to its location on the French Channel coast, Nord-Pas-de-Calais is the gateway for all surface traffic between Britain and France. The region has three major Channel ferry ports (Dunkirk, Calais and Boulogne), excellent road, rail and water connections and is linked to

Belgium and to the Île-de-France by two motorways, the A25 and A26/A1. Train services exist between Calais and Amiens-Paris and Calais and Lille-Brussels. Nord-Pas-de-Calais has one airport, at Lille-Lesquin, and two smaller ones at Calais and Le Touquet.

West-Vlaanderen. The importance of West-Vlaanderen in the European transport network is based on its two seaports at Ostend and Zeebrugge and their ferry services to the United Kingdom. Ostend and Zeebrugge are the gateways for surface transport between the United Kingdom and northern Europe, in particular Belgium, the Netherlands, north-west Germany and Scandinavia. The A10 (E40) motorway links Ostend to the Belgian motorway network. In addition, the port has a direct rail access and is linked to the inland waterway system.

The importance of Zeebrugge is based on its excellent ro-ro (roll on/roll off) services. The rail network in West-Vlaanderen is not very extensive. Most foot passengers for the ferries at Ostend arrive on trains from Cologne via Brussels and Gent or from Antwerp via Gent directly at the ferry terminal. There exists only a tramway line along the coast. The motorway network in West-Vlaanderen is still incomplete. The coastal motorway which is supposed to link the seaside cities and ports and provide access to the French Channel coast has been completed only from a point on the A10 between Ostend and Brugge to Veurne. The region has its own airport in Ostend.

Hainaut. Hainaut's position at the intersections of the Paris-Brussels and Lille-Liège-Cologne railways makes it a real crossroads region centred at Mons and Charleroi. Near Mons the French motorway A2 (E19) from Paris meets with the Belgian A16 (E42) from Lille and continues as the A7 (E19) to Brussels and as the A15 (E42) to Liège and Cologne. Hainaut has no airport, but the airport at Brussels is relatively close (60 kilometres).

Zeeland. Today Zeeland plays a role in the European transport network only through its two seaports Vlissingen and Terneuzen. The Westerschelde is the principal waterway for the port of Antwerp, the largest Belgian seaport. Two canals serve mainly Belgian ports. The Terneuzen-Gent canal links Gent to the Westerschelde, whereas the Schelde-Rhine canal provides the shortest inland waterway connection between Antwerp and Europoort of Rotterdam. The A58 motorway is the main road link to the motorway network in the Netherlands. There is no direct link to the motorway network in Belgium, so the Belgian

Table 4.7. Transport infrastructure, 1986

Region	Electric railways (m/km²)	Other railways (m/km²)	Inland waterways (m/km²)	Motorways (m/km²)	Other roads (m/km²)
Kent	–	–	–	–	–
Nord-Pas-de-Calais	51.0	61.5	51.8	36.2	1 997
West-Vlaanderen	59.0	36.7	80.4	53.6	4 194
Hainaut	94.3	59.2	69.7	58.1	4 088
Zeeland	18.2[a]	9.3[a]	38.8	18.8	1 816
Cologne	–	–	–	75.6[a]	848[a]
Bremen	344.1	17.3	–	113.9	4 124
Brittany	1.8	50.5	0.0	–	1 758
Piemonte	42.0	33.0	0.0	23.9	1 184
Scotland	–	–	–	3.1	641
Ireland	0.5	27.7	0.0	0.0	1 340
Pais Vasco	62.5	13.2	0.0	25.9	–
Norte	–	–	1.7	1.5	–
EUR 12	21.0	35.3	8.8	13.2	1 158

[a] 1985.
Source: Eurostat, 1990b.

Channel coast and northern France can only be reached from Zeeland on secondary roads. Car traffic from the northern parts of the region has to go via Antwerp or across the Westerschelde by ferry. The southern part of Zeeland, Zeeuwsch-Vlaanderen on the other side of the Westerschelde, has no road access to the northern part of the region or to rest of the Netherlands. All road traffic from or to Zeeuwsch-Vlaanderen has to go via Belgium. Mid-Zeeland has one passenger rail line of little importance. There is no airport in Zeeland. The nearest international airports are Rotterdam, Amsterdam, Brussels and Antwerp.

Cologne. Cologne's favourable location in the European heartland is underlined by its unique position in the European transport network at the intersection of the two major east-west and north-south transport corridors in Europe. Cologne is one of the main hubs in the German and European rail network with distribution functions for West European traffic to destinations in Central and Eastern Europe. Cologne is a midpoint of international east-west connections, for example from Paris or Ostend via Brussels to Berlin and Warsaw, and also of north-south connections, for example from Amsterdam to Switzerland and Italy. Also Cologne's position in the German motorway system is excellent. From the Cologne motorway ring, motorways radiate out in all directions, for example to the Ruhr area and to northern Germany and Scandinavia, to the Netherlands, Belgium and France and in all southern directions. Cologne has its own airport conveniently located beyond the Rhine river midway between Cologne and Bonn. In addition, Düsseldorf airport is located only 40 kilometres north and Frankfurt airport can be reached by direct trains in less than two hours. The Rhine river passing through the region is the most important European inland waterway for the transport of bulk goods to and from Rotterdam and Antwerp to southern Germany and Switzerland.

Bremen. Despite its slightly peripheral location, Bremen is one of the major seaports along the North Sea coast. The container terminal in Bremerhaven is the largest in Europe, and the Cargo Traffic Centre of Bremen is one of the first operational examples of this new kind of logistics nodes in western Germany. Within the German railway network, Bremen is no dominant traffic junction, but one main stop in the international north-south connections between Scandinavia and Central Europe. Bremen's position in the German motorway system is sufficient for its needs. It is located at one of the two major north-south motorways, linking central and southern Germany with northern Germany and Scandinavia. As a motorway meeting the eastern north-south motorway at Hanover also exists, all main destinations within Germany are easily reachable from Bremen. Bremen has its own international airport. However, its importance is much less than, for example, Hamburg airport, located only 100 kilometres north-east.

Brittany. Brittany has neither a great river nor real international airport, but it profits from a good regional motorway network which was recently completed and is linked with the European motorway network via Le Mans and Paris. As regards railways, the most important aspect was the TGV Atlantique which links Paris with Rennes in two hours and with Brest in 4.5 hours. The region is still not equipped with logistic nodes for goods transport, except for the multimodal nodes at Chantepie near Rennes and at Morlaix. Other important infrastructures are the seaports on the Atlantic and Channel coasts and the eight regional airports. The location of Brittany has been unfavourable for transport with Paris and Central Europe. Only the cross-Channel navigation and more recently international airlines have brought its neighbours, the United Kingdom and Ireland, nearer.

Piemonte. Piemonte is the main transit region for goods and passengers travelling by rail or road between Italy and south-west European countries, for instance from London via Paris to Rome or from Barcelona via Lyons and Milan to Trieste. The road network is highly developed, with the exception of certain Alpine zones. Turin is linked by motorways with Milan, Aosta, Savona Piacenza, Ivrea, Genoa and Sempione. Recent openings of road tunnels have considerably increased transit road traffic through Piemonte — a result of the road-oriented transport policy of the Italian Government. However, access to some Alpine tunnels is still not satisfactory, above all to the Mont Blanc Tunnel, to Frejus and to the Simplon Tunnel. Also the motorway ring around Turin needs to be completed. The rail network in Piemonte is excellent for international travel, with the lines Turin-Modane, Novara-Domodossola and Turin-Savona-Ventimiglia, but the network needs a great deal of modernization and rationalization. The main political problem is to make the Italian State railways more efficient. Piemonte has an international airport at Turin-Caselle. However its importance is much less than those of Milan. Regarding transport by sea, Piemonte depends on the Ligurian ports of Genoa, Savona and Vado. These ports are mainly used for trade of bulk goods with countries outside Europe.

Scotland. The most important feature of Scotland's position in the European transport system is its remoteness. The 650-km distance between London and Glasgow still takes six hours by car and there is still a non-motorway gap between the M6 and M74. By intercity train it takes five hours from London to Edinburgh (on the east coast main line) or to Glasgow (on the west coast main line), and the rail service beyond Edinburgh and Glasgow is poor. So air transport from Scotland's four main airports (Edinburgh, Glasgow, Prestwick and Aberdeen) is an essential link between Scotland and the rest of the world. However, for the most part, travellers from Scotland on flights to Europe are required to change at an English airport such as Birmingham or Heathrow.

Ireland. Surface transport between Ireland and the rest of Europe depends on ferries. The most important ferry link is the three-hour connection between Dublin or Dun Laoghaire and Holyhead. From Holyhead there is a two-hour rail connection to Crewe on the London-Glasgow intercity line, but the whole rail journey to London takes at least five hours. Road connections to Holyhead are even worse as the 150-kilometre distance to the M6 near Chester is only partly motorway. Other ferry links exist between Rosslare and Fishguard (three hours). There are direct ferry services between Rosslare and Cherbourg (17 hours) and Le Havre (21 hours); other continental services leave Cork. More recently, the route via Northern Ireland and Scotland has become a favoured alternative. Ireland has three main airports at Dublin, Shannon and Cork and several regional ones. As to Scotland, the dominant mode of travel to Ireland is by air via Dublin.

Pais Vasco. The region has two of the main Spanish ports, Bilbao and Pasajes, strategically located in connection with sea trade bound to or from northern Europe, especially the United Kingdom. In fact the export of iron ore and coal from Bilbao to England played a major role in the early industrialization of Spain. Today the port of Bilbao is poorly served by rail and road transportation. The motorway network is part of the main European network even though there are some missing links towards the rest of Spain and Portugal. There are two main road connections: along the coast connecting the French border with Bilbao and towards Madrid, the Mediterranean basin and Portugal. The railway system, however, is cut off from the European network because of the different gauge of the tracks. There is no railway connection along the Cantabrian coast. Bilbao and its harbour have no meaningful rail connection with continental Europe. The Basque Country has three airports near its three main cities, and, in addition, there is the airport of Biarritz in France, 40 kilometres east of San Sebastian. Only Bilbao has regular international connections.

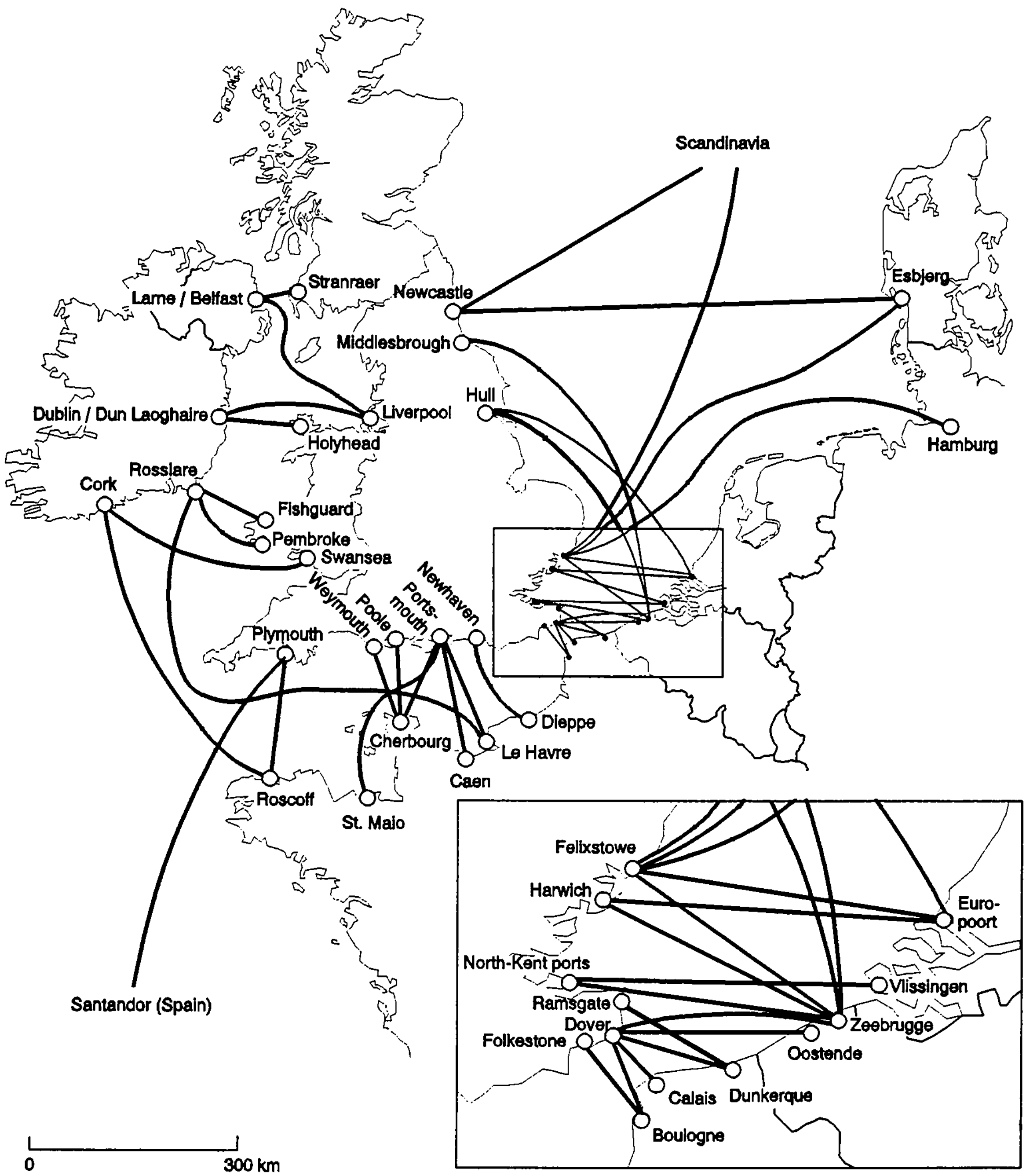
Norte. The transport infrastructure of Norte is still inadequate. Except for the motorway between Oporto and Coimbra, the roads are narrow and poorly maintained. In particular, the connections to the Spanish border, the N13 (E1) to Vigo and the N15 (E82) to Bragança, require improvement. The ports (Viana do Castelo and Leixoes), which are essential for exports of the region, have poor road connections to their hinterland and have no rail connection. The same is true for important industrial areas such as Vale do Ave and Vale do Sousa. There exist severe restrictions on the rail network with respect to tonnes per axle. Only the railway between Oporto and Lisbon is electrified. Many railway lines are single-track, narrow-gauge. The region has one international airport at Oporto with flights to London and other European cities. The airports at Braga, Vila Real and Bragança have only domestic flights.

(b) Transport flows

Transport activities between the 13 case-study regions across the Channel are, of course, of very different magnitude depending on the location of the region. Obviously the two Channel Tunnel access regions, Kent and Nord-Pas-de-Calais, have the highest volumes of cross-Channel traffic. However, the regions of the next group of regions, which are close to the Channel Tunnel, also have substantial exchange with the British Isles in terms of passengers and goods traffic. Figure 4.8 shows the British and Irish ferry links including pure freight ferries. Below, the cross-Channel components of regional traffic volumes in each of the 13 case-study regions is assessed.

Kent. Traffic through Kent ports has been increasing both in number of passengers, accompanied passenger cars, and commercial traffic. Between 1980 and 1989, the number of ferry passengers increased from 14 million to 17 million. This is about 80% of the 20 million annual ferry passengers between the United Kingdom and the European continent.

Figure 4.8. British and Irish ferry links



About 80% of all passengers passing through Kent arrive or depart in Dover. Accompanied passenger vehicles increased from 1.8 million to 2.3 million, and here the dominance of Dover is even greater: 85% of all passenger vehicles go via Dover. Commercial road vehicles almost doubled from 538 000 in 1980 to 1026000 in 1989. About 60% of all lorry traffic between Britain and the Continent passes through Kent, and again 80% of this goes via Dover.

Nord-Pas-de-Calais. The vast majority of ferry travellers use the shortest cross-Channel route between Dover and Calais. Between 1975 and today the number of passengers going through Calais has increased from 4 million to 10 million. The two other ferry ports in Nord-Pas-de-Calais, Dunkirk and Boulogne, attract 1.5 million and 2.7 million passengers, respectively. Port trade in Calais increased by more than 20% between 1988 and 1989. Dunkirk, despite efforts to make it a major container port, remains far behind Rotterdam, Antwerp and Zeebrugge and even behind Le Havre, mainly because of the better freight services at Belgian ports. Boulogne, the main French fishing port, maintains a modest position for loading and unloading mineral, forest and food products. At present, all three ports of Nord-Pas-de-Calais together accommodate 774000 lorries per year or about one third of all lorry traffic between Britain and the Continent. Passenger traffic at Lille-Lesquin increased by 26% between 1988 and 1989. If this goes on, new lines could be opened, which would be useful for the broad hinterland, including part of Hainaut and of West-Vlaanderen in Belgium.

West-Vlaanderen. Ostend and Zeebrugge together account for about 3.5 million ferry passengers annually. This is only little more than a quarter of the 16 million passengers using the French Channel ferry ports. In addition, the number of cross-Channel passengers in Belgium has declined over the last 10 years. If Ostend and Zeebrugge are compared in respect to goods transport, Zeebrugge is much more successful. The total goods volume of Ostend is only five million tonnes however, 80% of this is ro-ro traffic from or to the United Kingdom. Zeebrugge handles 26 million tonnes per year and so is much larger than Ostend. With 12 million tonnes of ro-ro traffic, it is the largest ro-ro ferry port in cross-Channel freight transport. Only 40% of its incoming freight comes from the United Kingdom, but 85% of its outgoing goods go there. Ostend and Zeebrugge together accommodate 944 000 lorries per year between Britain and the Continent, which is more than all French Channel ports taken together. With only 100000 passengers annually, the Ostend airport is small, and two thirds of its passengers travel to or from England, but the regular flight service to the UK was recently cancelled.

Hainaut. Given the strategic position of Hainaut on the rail and motorway approaches to the Channel ferry ports, a large, however unmeasured, share of passengers and goods coming from the ferries passes through Hainaut. However, as they only pass through the region, Hainaut does not benefit very much from being a transit region. Nothing is known about the share of the region's exports and imports going to or coming from Britain.

Zeeland. The Westerschelde is a barrier for car traffic. Only 17% of the cars crossing the Westerschelde by ferry travel to or from Belgium. Obviously, Zeeland is not a transit region between the Netherlands and the Channel ferry ports in Belgium and France. For passenger transport to and from the United Kingdom, the ferry between Vlissingen and Sheerness had only 630000 passengers in 1989 (compared with more than four million in Ostend and Zeebrugge). The line is, however, flourishing; the number of passengers is continuously increasing. The ro-ro terminal to and from Sheerness handles more than 80000 lorries and 50000 new cars per year. So the port of Vlissingen may well have a future as a freight distribution centre for goods transport to and from the British Isles. British and French tourists together account for less than 3% of foreign visitors in Zeeland.

Cologne. For passenger transport between the Cologne region and the United Kingdom, only data on air travel and tourism are available. About 10% of all passengers from the Cologne/Bonn airport travel to the United Kingdom. The city of Cologne attracts more than one million visitors per year, more than 40% from abroad. By far the largest contingent of foreign guests come from the United Kindgom and Ireland (16%). The number of passengers travelling by rail from Germany to the UK is declining; however, most of them pass through Cologne because of the direct international rail service between Cologne and Ostend. The United Kingdom today plays no significant part in goods transport by rail to and from the Cologne region, and even this small freight volume (most of which goes via the port of Zeebrugge) is decreasing. Road exports to the United Kingdom represent about 1% of all road exports of the region, but about 13% of all German road exports to the United Kingdom; about 11% of all German imports from the United Kingdom are destined for the Cologne region. As the region represents only about 6% of the west German population, road transport to the British Isles is more important for the Cologne region than for western Germany as a whole. In absolute terms, exports from the region to the United Kingdom by road tripled between 1980 and 1988. About 10% of all passengers from Cologne/Bonn airport travel to the United Kingdom. For goods transport by air from Cologne/Bonn, the United Kingdom is by far the most important destination country in Europe: 24% of all exports by air from western Germany to the United Kingdom go through Cologne/Bonn and 18% of all imports.

Bremen. More than half of Bremen's imports originate in European countries with Norway, the United Kingdom, Sweden and Finland as the main sources. Both exports and imports to and from the United Kingdom have increased in recent years. The exchange of goods by rail with the United Kingdom has never played an important role. Imports and exports on roads to the United Kingdom are insignificant for Bremen. The number of passengers between Bremen's airport and the United Kingdom is growing, but accounts for only 2% of all passengers travelling between the United Kingdom and west German airports. Goods transport by air to and from the United Kingdom is minimal.

Brittany. Traffic between Brittany and the United Kingdom is insignificant compared with Nord-Pas-de-Calais. Only 800 000 passengers annually arrive in, or depart from, St Malo by boat from or to the United Kingdom, and about 300 000 in Roscoff. There are seasonal tourist flights to Rennes and Brest. However, although national and regional airlines are busy expanding their activities, except for business trips, the most practical travel mode between Brittany and the United Kingdom will remain the sea passage. Passengers in Breton ports come from all parts of western and south-western France and even from Spain and Portugal.

Piemonte. International railway traffic is very important for Piemonte. More than a quarter of all Italian imports by rail arrives through Piemonte. However, goods traffic by rail is decreasing in importance. Goods traffic by rail between Italy and the UK goes mainly via Modane or Domodossola, but its flow is not significant. Only 1.2% of Italian imports from other EC countries comes from Britain, and only 6% of exports by rail go to the UK, mostly via Piemonte. Goods transport by road is dominant for Italy's trade with other EC countries, except for the UK. About 90% of all trade between Italy and the UK (by volume) goes by sea. For business travel between Piemonte and the UK, air becomes the favourite mode. At Turin-Caselle airport, traffic with the UK has increased by about 50% over the last five years (a growth of 124% for business travel and of 9% for tourist travel) and today represents one third of the international air traffic at that airport. British tourists represent about 17% of all foreign tourists in Piemonte.

Scotland. The Scottish ports chiefly handle bulk goods including fuel, metals, wood and paper products together with other basic materials. Higher value freight, carried in containers and on ro-ro services has increasingly shifted to English ports. In 1986, 53% of imports, by value, coming in through Scottish ports originated in Scandinavia and the Baltic. Only 10% of exported goods through these ports went to Scandinavia and the Baltic, with 52% destined for EC countries. At present there are no ro-ro services operating between Scotland and the European mainland, except from Aberdeen and the Forth ports to Scandinavia. Rail transport is chiefly used for bulk goods — most notably iron and steel. In terms of tonnage, only 4% of goods lifted in Scotland, in 1988, travelled by rail, whereas some 70% moved by road.

Ireland. The United Kingdom continues to be Ireland's main trading partner absorbing 46% of Ireland's foreign trade. The other EC countries account for 28%. However, trade with the United Kingdom is declining, whereas trade with continental Europe is growing. Western Germany is the second largest export market with 11% of export value going there, 9% going to France and 7% to the Netherlands, while 19% of trade is with Northern Ireland. In 1988, the total number of freight units to and from Ireland and Northern Ireland ports was 923 000 units, of which 58% went through Northern Ireland ports — more than twice as much as would be expected on the basis of the relative scale of GDP in both countries. This is due to cheaper transport and port charges in Northern Ireland. Three quarters of freight transport to the UK is by ro-ro via Dublin, Dun Laoghaire and Rosslare, whereas more than 90% of sea transport to continental Europe is container transport, mainly from Dublin, Waterford and Cork. Goods transport by air accounts for less than 1% of trade in tonnage but for 15% in value. This share should increase with the expansion of the electronics industry and other high-value, low-volume goods.

Pais Vasco. Goods are transported in Pais Vasco mainly by road because of a lack of connections between the Spanish and French railway networks and poor services by the Spanish railways. Goods transport by air is almost non-existent. On the other hand, seaborne trade through Bilbao and Pasajes ports is quite intense and is basically international trade. Of this, traffic with the UK is important, both in Bilbao and in Pasajes. Both exports and imports to and from the United Kingdom show a rising trend. One third of the imports from Britain and 17% of the exports to Britain go through the port of Bilbao. The three Basque airports carry over one million passengers annually, of which 15% travel to or from abroad. The numbers of passengers have increased rapidly in the last two years. Only Bilbao's airport has regular international flights connecting the Basque financial and industrial centre with four other European cities, London being the main destination. Goods transport by air is negligible and declining.

Norte. Sea transport is the dominant mode for international trade in Norte, with 75% of all exports and 90% of all imports carried by sea through the two ports of the region, Leixoes and Viana do Castelo. Goods transport by rail and air is insignificant. Road transport is becoming more important since the accession of Portugal to the European Community. International trade between Portugal and the United Kingdom is about 1.5 million tonnes per year, carried almost exclusively by sea. Norte's share of this trade is estimated at 300 000 tonnes of imports and 700 000 tonnes of exports. Trade between Portugal and the UK tends to decline in favour of other EC Member States. This has resulted in a growth of road transport versus sea transport. International traffic to Portugal by road more than tripled between 1977 and 1987. In 1988 export by road reached a share of 20%. Passenger traffic between Oporto airport and major European centres such as London, Paris and Frankfurt has increased sharply but is small in absolute numbers (352 000 arrivals, 362 000 departures in 1987). International passenger traffic by road and rail essentially consists of border movements between Spain and Portugal and automobile tourists.

4.2.5. Regional autonomy

The 13 case-study regions are also very different with respect to their autonomy, i.e. the degree by which they are able to develop and implement their own policies independently of their national governments. These differences reflect the different degrees of centralization/decentralization of government in the respective countries. In addition, there are other forms of dependency which may be based on economic influence, industrial links, transport connections or just the attraction of a neighbouring large agglomeration. Such dependencies may even exist across borders.

Kent. In the United Kingdom, regional bodies have in general only advisory functions. They may bring pressure to bear on the national government, or on the local government authorities with jurisdiction within the regions they represent. Kent is one of the largest of the Shires, or rural, counties in the UK. Because of its size, it is able to exert considerable influence on the central government. However, its ability to influence events directly is limited because of the control exercised by central government over the amount of revenue that it can raise. In addition, Kent depends to a large part on decisions made in the overpowering London metropolitan area, which it has as its northern neighbour.

Nord-Pas-de-Calais. Although France has essentially remained a centrally organized country, it has introduced some sort of regional self-government. Nord-Pas-de-Calais with its conseil régional located in the Métropole Nord, Lille-Roubaix-Tourcoing, has developed a strong profile of future-oriented regional policy-making and planning.

West-Vlaanderen. For the last 20 years the Kingdom of Belgium has been undergoing a federalization movement in three regions: Vlaanderen (Flanders), the Brussels region and Wallonie (Wallonia). Each of these regions has a regional executive council comparable to a government. West-Vlaanderen is part of the Vlaanderen region which has Brussels as its capital. As a province, West-Vlaanderen therefore depends very much on both regional and the central government and has only limited possibilities to make important policy decisions regarding its own future. The south-western part of West-Vlaanderen, the Kortrijk area, depends very much on its economic ties with the Lille agglomeration across the French border. Brugge is the seat of the provincial government.

Hainaut. Wallonie selected Namur as its capital. Its administration is located in Namur, but for easier relationships with the central government, most ministers and their cabinets remain in Brussels, which does not make for easy contact between the administration and politicians. Hainaut is one of the five provinces of Wallonie, which are very heterogeneous. So the possibility of actively conducting its own policies may be even more restricted than in West-Vlaanderen. Like the Kortrijk area in West-Vlaanderen, Hainaut has strong cross-border ties with Lille.

Zeeland. The Netherlands is a country with a relatively high level of centralization of government. Zeeland must therefore be considered primarily as a province which depends almost exclusively on central government decisions, policies and trends and has little margin for influencing its own future except by lobbying at the capital and mobilizing private initiatives and the public. Middelburg is the seat of the provincial government.

Cologne. Although Germany has a highly decentralized system of government, the Cologne region is formally a province without political power. The *Regierungsbezirk* is merely an administrative district of the *Land* of Nordrhein-Westfalen but has no regional parliament. However, the region is dominated by the city of Cologne, which has a strong local government and actively lobbies for its interests with the national government and the European Community.

Bremen. Bremen is one of the three city *Länder* of the Federal Republic of Germany and so has its own parliament and a seat in the Upper House of the Federal Parliament. Nevertheless its political power is limited both because of its smallness and of its depressed economic situation. In Bremen both regional and local government are identical.

Brittany. As Nord-Pas-de-Calais, Brittany is one of the French regions and enjoys limited autonomy. It is formed by four *départements*, the most important of which is Ille-et-Vilaine with Rennes the regional capital.

Piemonte. Piemonte is one of the 20 regions of Italy which, in principle, enjoy a certain administrative autonomy. In reality, however, 16 of the 20 regions, including Piemonte, do not have financial autonomy. Therefore the investment and infrastructure decisions for the region continue to depend on decisions made and resources provided by the central government.

Scotland. Scotland is a region in relation to Europe but is historically a country in its own right and remains so according to many of its inhabitants. It has a separate educational and legal system from England and Wales, and in many ways more devolved powers than other regions of the UK.

Ireland. Ireland is a case by itself as it is a national State.

Pais Vasco. Pais Vasco is one of the regions of Spain, but because of its particular ethnic identity and long particularist history has been given more extensive rights to organize its own affairs including fiscal autonomy. Therefore the Basque Government has more autonomy than other regions in Spain.

Norte. Portugal has a centralized government system. Therefore Norte is very much dependent on funds from the national government in Lisbon and has only limited autonomy to develop its own strategies and policies.

These differences between the case-study regions will become of relevance later when the response of the regions to the challenges by the Channel Tunnel will be discussed.

4.2.6. Summary: A typology of the regions

Together the 13 case-studies represent a wide range of regional characteristics in terms of location and size, social and economic conditions and positions in the European transport system — and hence degrees of being affected by the Channel Tunnel. In addition, regions are classified by their 'strategic capacity', i.e. their ability to develop and implement their own policies independently of their own national government and other influences (see Subsection 4.2.5).

If one groups the 13 regions according to these dimensions, a new 'topography' of the case-study regions emerges. In Table 5.8 the regions are arranged in a two-dimensional matrix, the dimensions of which can be associated with 'prosperity' (vertical) and 'centrality' (horizontal). A clear hierarchy of regions becomes visible:

(a) Seven of the 13 case-study regions are part of the urbanized belt extending from south-east England to northern Italy which, after the study by Reclus (1989), everybody calls the 'Blue Banana' (see Figure 4.9).

Of these, four are in good economic condition:

(i) Cologne is not only within the Blue Banana but occupies a strategic position at one its major transport and communications hubs and seems prepared to take advantage of the new opportunities arising out of this;

(ii) Piemonte enjoys a favourable position between Italy and the rest of the EC, but has little regional autonomy to control its own development;

(iii) West-Vlaanderen may lose some of its cross-Channel ferry traffic to the Channel Tunnel without being able to do very much about it;

(iv) Zeeland may become a new transit region for the Tunnel and may not be too happy about it either.

Three regions are within the Blue Banana, but have faced serious economic difficulties in the recent past:

(i) Nord-Pas-de-Calais occupies a strategic position at one of the Tunnel exits and seems resolved to exploit the opportunity of this position to accelerate its already ongoing economic restructuring process;

(ii) Kent might benefit from becoming almost a part of the European continent, but may also become even more than today a transit region for London;

(iii) Hainaut, despite its position in the Blue Banana, still suffers from the recent decline of its iron and coalmining industries and faces the prospect of becoming a TGV region without a TGV station. Its strategic capacity is low.

(b) The remaining six regions are outside the Blue Banana and so in a sense peripheral. But there are two degrees of peripherality.

Two regions are presently not linked to the European core regions nor to the emerging high-speed rail network but have a good chance to be connected to them in the not too distant future:

(i) Bremen has a developed industrial structure undergoing rapid economic change; due to

Table 4.8. Classification of case-study regions

Prosperity		Centrality			
		Inside 'Blue Banana'		Outside 'Blue Banana'	
Economic state	Strategic capacity	at a hub	along a pipe	easily linkable	separated
good	high	Köln		Bremen	
			Zeeland		
	low	Piemonte	West-Vlaanderen		
difficult	high		Nord-Pas-de-Calais	Bretagne	Ireland
					Scotland
			Kent		Pais Vasco
	low		Hainaut		Norte

the decentralized government system in Germany, Bremen may be able to develop strategic options to cope with change;

(ii) Brittany has been linked to the high-speed rail network recently by the TGV Atlantique and is actively seeking to overcome its peripherality despite its dependence on the national government.

The remaining four regions are truly peripheral and will remain so simply by their remote location. All of them have some kind of economic problem:

(i) Scotland and Pais Vasco both have to transform their industrial structure to the requirement of the wider European market and both have been only partly successful. Both regions enjoy a certain degree of regional autonomy;

(ii) Ireland and Norte still suffer from their underdeveloped industry and struggle to catch up economically with the other regions of the European Community; however Ireland as a national State has more strategic options.

Needless to say that, like all classifications, this typology cannot do justice to all features of the objects under study and should therefore be taken only as an attempt to identify the most important characteristics of the case-study regions seen from the perspective of this project.

4.3. Possible impacts

The opening of the Channel Tunnel in June 1993 will more or less coincide with the completion of the single European market, including at least the partial deregulation of road haulage throughout the Community. It is generally expected that these events will increase the volume of trade moving between the European countries. One could view the opening of the Tunnel simply as the removal of one more barrier to trade in Europe and as such likely to compound the effects of the single European market.

The results of the interviews with experts and policy-makers in the case-study regions revealed a more complex picture. According to some views expressed in the interviews, the Channel Tunnel is indeed seen as nothing more than a more efficient form of ferry. However, others see it as a major element in the fundamental restructuring of the European spatial landscape propelled by the emerging high-speed railway network, sophisticated intermodal logistics developments and advanced communications technologies. Between these two extremes, the interviews showed a wide range of perceptions about the likely impacts of the Channel Tunnel, of awareness of the critical issues arising out of it and of the consequences for policy response.

In this section of the report, a first condensed presentation of the parts of the interviews addressing the most likely developments after the opening of the Channel Tunnel will be given. Policy aspects will be discussed in the following two sections of the chapter. Wherever possible, the opinions and judgments collected will be confronted with the information compiled from other sources and with the initial hypotheses made by the research team at the outset of the project before the interviews were conducted.

This section consists of four subsections. The first subsection addresses the position of the case-study regions in the future European transport system after the opening of the Channel Tunnel. In the second subsection the expected impacts of the Channel Tunnel on the transport flows in each region will be discussed. The third subsection looks into the expected impacts of the Tunnel on regional development including not only economic but also social, spatial and environmental effects. The fourth subsection deals with impacts of the Tunnel on the intra- and interregional balance.

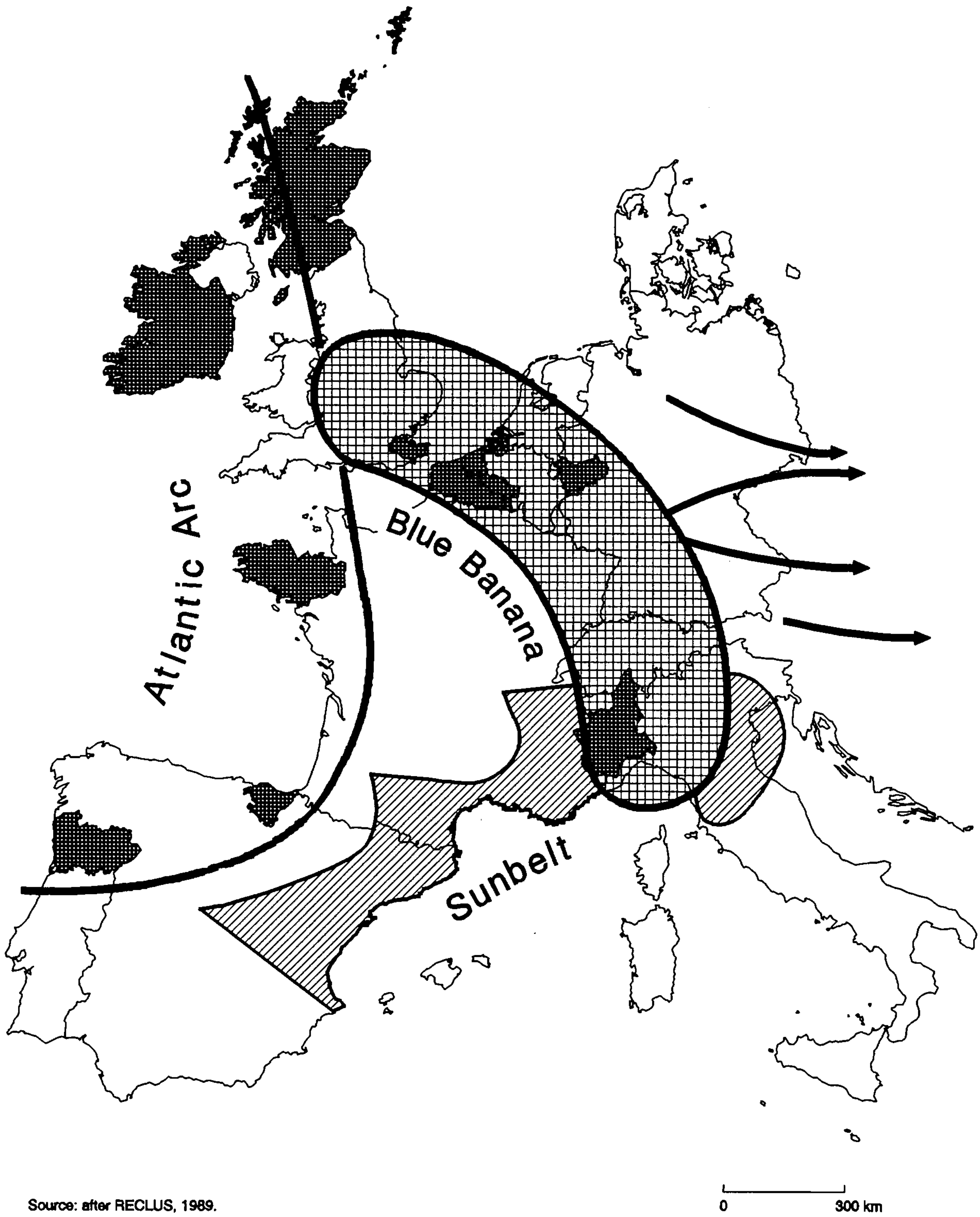
4.3.1. The regions in the future European transport network

The Channel Tunnel is but one, however important, element in the changing transport and communications environment of Europe. It is therefore necessary to briefly review the expected evolution of the entire transport infrastructure in Europe and in a comparative way assess the position of each region in the future European transport network after the completion of the Tunnel.

(a) Rail

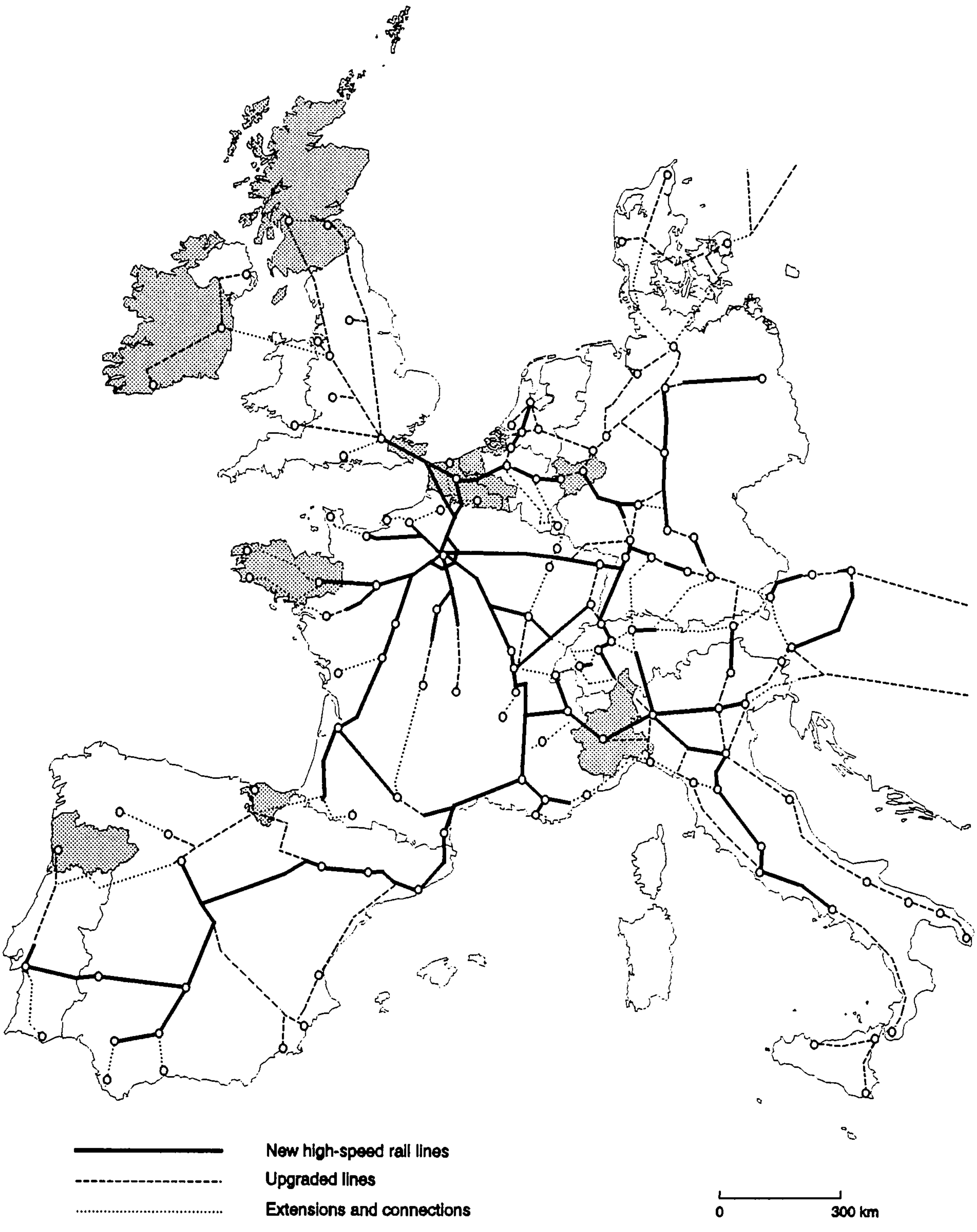
There will be a major evolutionary transition in the European railway network through the gradual implementation of the European high-speed rail network (see Figures 4.10 and 4.11). The Channel Tunnel will be a link in this new high-level infrastructure network, so its impacts will be largely transported over this new network, and without

Figure 4.9. Case-study regions and the 'Blue Banana'



Source: after RECLUS, 1989.

Figure 4.10. The future European high-speed rail network



Source: Deutsche Bundesbahn, for France: Le Monde, May 16, 1991

Figure 4.11. High-speed trains: The French TGV and the German ICE

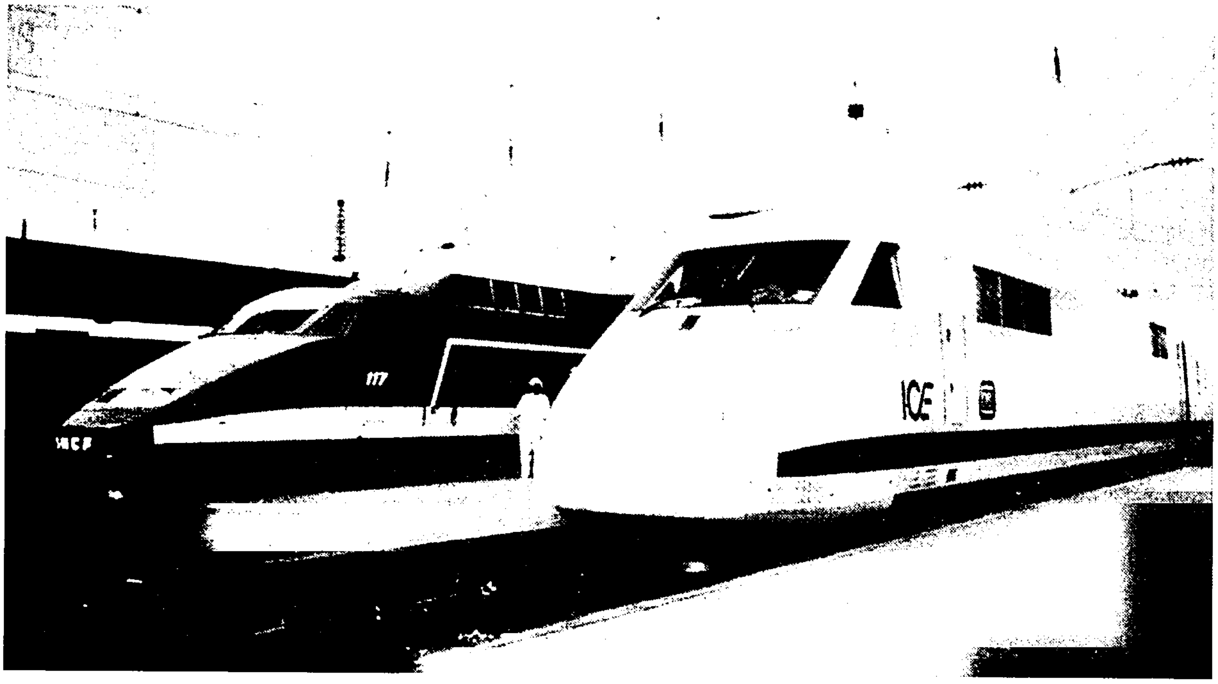


Figure 4.12. Alternative high-speed rail lines through Kent (1988 British Rail proposal and route selected by the UK Government)

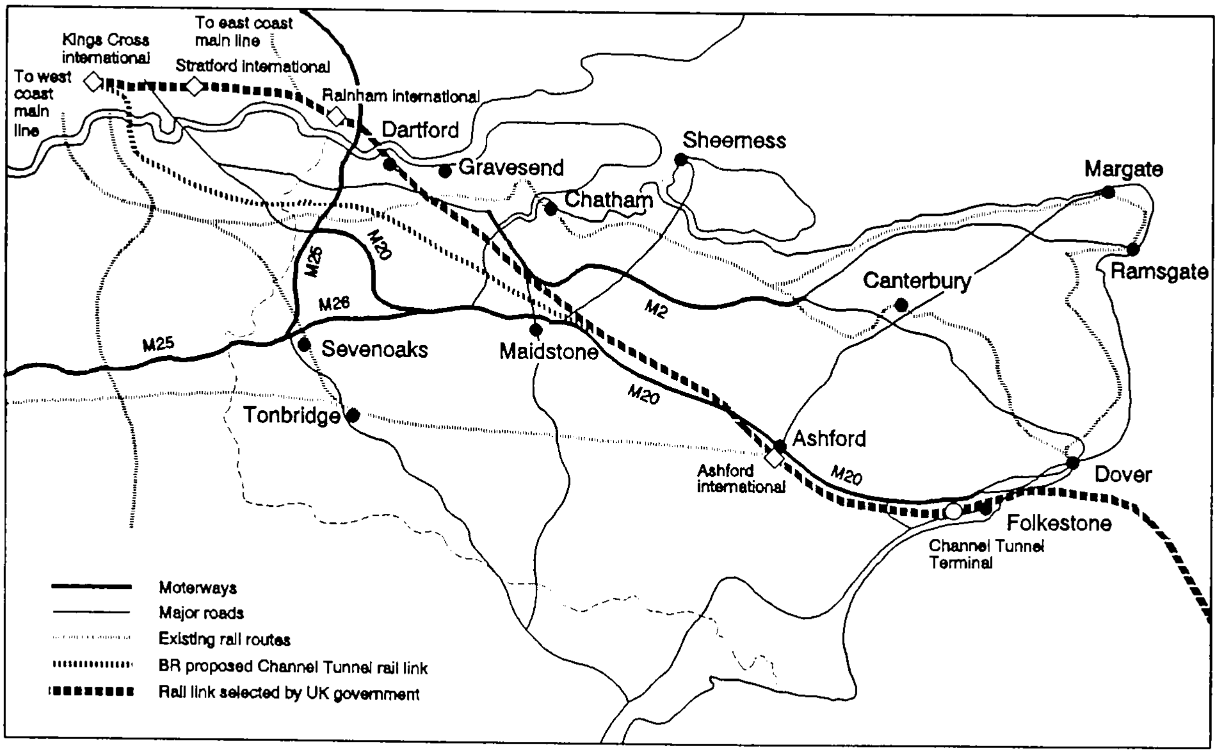
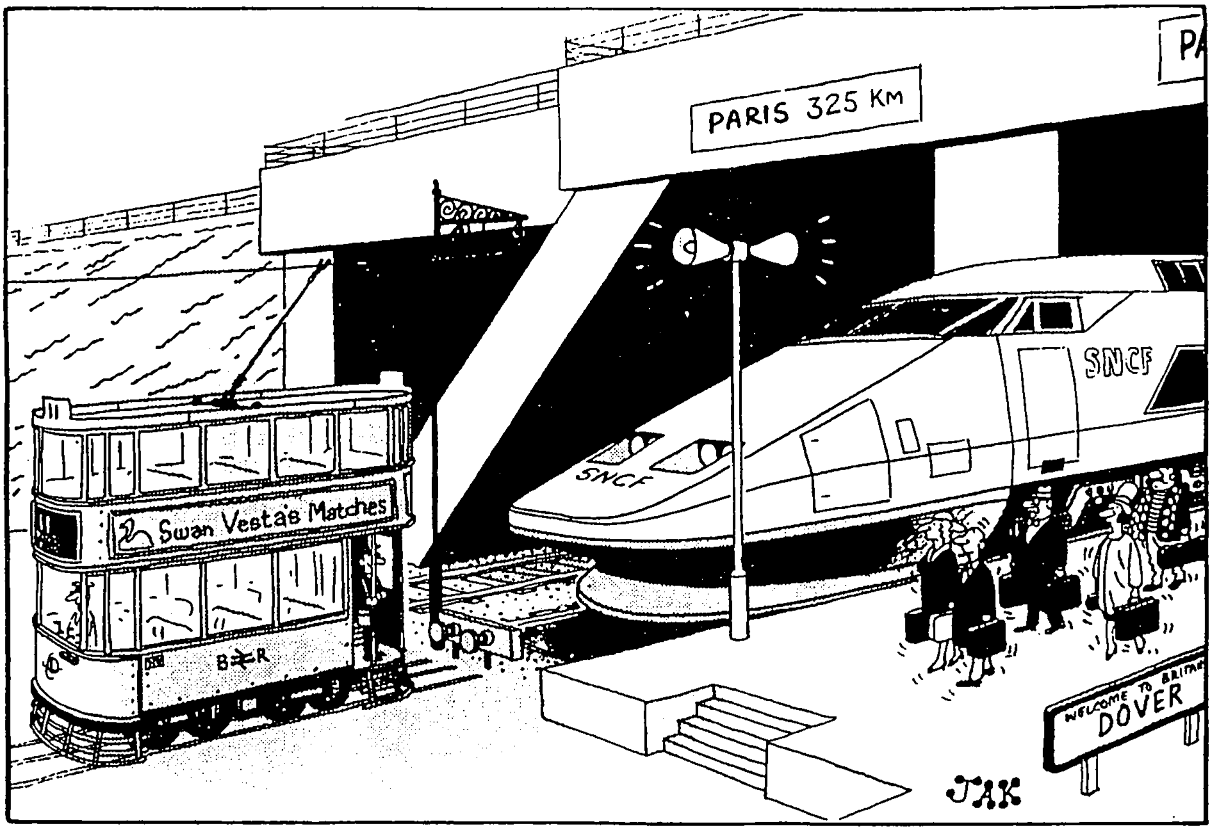


Figure 4.13. The Channel Tunnel and British Rail access



"Will the passengers from the French High-Speed Train arriving from Paris transfer to the number 11 tram for Kings Cross!"

the new network, its impact will be not nearly as strong. However, the implementation of the high-speed rail network depends on policies and decisions of many national governments and is far from certain in some countries. It is therefore essential to describe for each case-study region its position in or with respect to the future high-speed rail system and the probability and likely time schedule of its implementation.

Kent. After the opening of the Tunnel, trains will go by existing track to London Waterloo. However, due to different loading gauge standards, continental trains will not be able to travel on British rail tracks to London after completion of the Channel Tunnel with the exception of the Trans-Manche Super Train (TMST), which is being specially built to run between London and Paris/Brussels. British Rail (BR) announced in 1989 that they proposed constructing a passenger-only rail link to connect the Tunnel to an international terminal at King's Cross, with an intermediate station at Ashford. However, in October 1991 the UK Government announced that the BR proposal would not be followed, but that one of the northern alternative routes had been selected. This line will enter London from the east arriving at King's Cross (see Figure 4.12). This high-speed rail link will be in place only in the first years of the next century, many years after the opening of the Tunnel in 1993 (Figure 4.13 visualizes some exaggerated consequences). The situation has been compounded by the provisions of the 1987 Channel Tunnel Act which precluded any public subsidy to international rail services and would thus require British Rail to meet its normal commercial rate of return target. The new rail link will have a significant impact on Kent, and the Kent authorities are keen that the link should be well planned and be given sensitive environmental treatment. Kent seems most concerned at the levels of noise likely to be produced by the large number of trains using the proposed high-speed link.

Between London and the Tunnel, British Rail is developing two through-freight routes. British Rail expect to be able to carry six million tonnes of freight a year which they suggest will result in up to 400 000 fewer lorry movements per year on the roads in the south-east and Kent. They are planning to invest UKL 310 million in electric locomotives and freight wagons and to upgrade existing lines. Kent also stands to gain from an improvement in the outdated existing commuter services on existing track.

Nord-Pas-de-Calais. The Tunnel terminal will be located in Coquelles, south of Calais. The station at Frethun will link the Tunnel to the European TGV network. The TGV will cross Nord-Pas-de-Calais on two main lines, one from the Channel Tunnel and the other from Paris. The two lines will meet in Lille and continue towards Brussels. There will be an increase and reorganization of the railway network, with arrangements for connections between the regional network (TER) and the TGV on the Boulogne-Calais, Maubeuge-Valenciennes, Cambrai-Arras and Douai-Arras lines; rail service to the Tunnel will require electrification of the Calais-Hazebrouck and Calais-Boulogne lines. Within the region, TGV stations will be at Calais-Frethun, Dunkirk, Boulogne, Lille, Cambrai and Valenciennes. In early 1994, soon after the opening of the Tunnel, there will be 18 TGV return trips between Paris and London using the TGV network in France and the conventional network in Britain. Altogether, about 80 TGV trains per day will pass through Nord-Pas-de-Calais, and most of them will stop in Lille.

Regional rail transport is being renovated (fast freight trains and new systems for dispatching and storing wagons) to integrate the Lille region into the new national freight strategy. Multimodal platforms will be built in Dunkirk, Béthune, Lille, Lille-Lesquin, Roncq and Denain. The Métropole Nord will become a major logistic centre with three multimodal platforms.

West-Vlaanderen. West-Vlaanderen will have no direct access to the emerging European high-speed rail network. The proposed line from London will run from the Channel Tunnel exit at Sangatte near Calais via Lille to Paris and Brussels, and from Brussels to Amsterdam and Cologne. The nearest access from West-Vlaanderen to the high-speed rail system will be at Lille or Brussels, or possibly at Antwerp for people going to Amsterdam. Even conventional rail access to the Channel Tunnel from the region is only possible via Lille, as there is no railway line along the Channel coast. So the improvement of rail service will bypass West-Vlaanderen and make its position more peripheral, despite its central geographical location in Europe. Passenger and goods transport by rail to the British Isles, mainly from western Germany and other mid-European countries, will after completion of the Channel Tunnel be faster and more direct. This will affect the ferry ports of Ostend and Zeebrugge. The magnitude and direction of these impacts will to a large degree depend on whether and when the Tunnel will be integrated into the emerging high-speed rail and road infrastructure in Europe. Already without such integration, direct competitive effects will originate from the shuttle trains in the Tunnel as another faster and more reliable kind of ferry. However, more indirect but no less-serious effects can be expected from the future position of West-Vlaanderen in the European high-speed rail and road networks, in which the Channel Tunnel will be a vital element.

Hainaut. The Channel Tunnel has given new life to the debate about the planned TGV line between Lille and Brussels, which will pass through Hainaut. The TGV will place Hainaut in the 'vicinity' of all the major European centres which will eventually be connected to the high-speed train network. However, the TGV across Hainaut is not likely to contribute much to its internal development as no station is planned for the province. The nearest stops would be Lille or Brussels. After the introduction of the TGV, Mons and Charleroi, which today are stops on the Paris-Brussels-Amsterdam and Paris-Liège-Cologne express train lines, respectively, would be served only by regional trains. Therefore compensation through the improvement of existing lines and local development aid seems to be a necessary condition for Hainaut to benefit from the TGV.

There is also a debate about the route for the Belgian TGV. After environmental concerns were voiced by both Vlaanderen and Wallonie, a route following the border between the two regions seems to be least controversial, implying that it would pass through Hainaut. However, even today no final decision about this has been made, which means that the completion of the Belgian TGV will be delayed until well after the opening of the Tunnel. This accentuates Hainaut's dependence on Nord-Pas-de-Calais.

Zeeland. In the future Zeeland will have no direct access to the emerging European high-speed rail system. The region will be connected to this new network only via Rotterdam or Antwerp. This means that a long train journey is necessary to reach high-speed trains, so that, compared with car travel times, the time savings provided by faster rail service is of relatively little importance for passengers between Zeeland and the UK.

Cologne. Cologne will be the gateway between the German intercity train network and the north-west European high-speed rail network linking Paris, London, Brussels, Cologne and Amsterdam. After completion of the network, travel times from Cologne will be:

City	Present travel time	Future travel time (maximum/minimum)
Cologne-Paris	5h 20m	3h 00m/2h 30m
Cologne-London	7h 10m	4h 30m/3h 10m
Cologne-Brussels	2h 13m	1h 45m/1h 05m

The shorter travel times will be the most probable after completion of the high-speed rail lines after the year 2000, the longer times are the travel times expected for 1995. In that year only the high-speed rail connections between Paris and the Channel Tunnel will be fully operational, whereas the German and Belgian sections will still be under construction or being upgraded. But also after completion of these sections, the maximum speed between Cologne and Brussels will be only 200 km/h.

In the long run, however, the travel time to and from London will be more than halved through the combined effect of the Channel Tunnel and the high-speed rail link and will be less than air travel time plus access to city centres. Moreover, the passage through the Tunnel will be far more reliable than, for instance, the Jetfoil, which is affected by weather conditions and thus reliability may well turn out to be the most important advantage of the Tunnel.

As long as the envisaged connection between the French TGV Est and the German intercity system at Karlsruhe or Mannheim is not implemented — and this will not occur before well after the year 2000 — Cologne will be the only gateway between the west European high-speed rail network and Germany and all points further north and east, including Scandinavia, Poland and the former Soviet Union. However, even the completion of this first configuration of high-speed rail links has long been far from certain. While construction on the TGV Nord and the French Tunnel approach is well under way, decisions and implementations on the British high-speed link between Folkestone and London and the Belgian and German sections between Brussels and Cologne have been delayed. Only in 1990 did the Belgian Government make a decision for a high-speed connection to the Belgian-German border. As a result it is already now certain that when the Channel Tunnel opens in 1993, the high-speed rail connection to Cologne will not be finished. In that case the time saving between Cologne and London will be much less, only approximately one hour compared with the present rail plus Jetfoil service.

The implementation of a second type of high-speed rail system under discussion in the Cologne region, the transrapid magnetic levitation link between the Düsseldorf and Cologne/ Bonn airports, is extremely uncertain. The second new German high-speed rail line between Cologne and Frankfurt is still in the project phase. The German Railways (DB) intends to put this line in operation in 1998, which seems a rather optimistic target as still time-consuming legal procedures need to be overcome. Other developments in railway infrastructure such as the introduction of inter-modal freight nodes will be evolutionary.

Bremen. In the next decade, Bremen will have no direct access to a high-speed rail line. So Bremen will be connected with the new rail infrastructure only through the present German intercity network. The access to the high-speed rail network will be via Hamburg or Cologne. The German Railways (DB) plan to upgrade the existing line between Bremen and Cologne for a commercial speed of 150 km/h, which is only a little more than the current commercial speed. The Ruhr agglomeration, in which the maximum speed will be 160 km/h, will be an additional barrier for the reduction of travel time. Consequently, the reductions in travel time from Bremen to the Channel Tunnel in absolute terms will be similar to those from Cologne. The travel time to and from London will be reduced from more than 10 hours to only six hours after the year 2000. But this will still be longer than air travel time plus access to city centres.

Brittany. After the inauguration of the TGV Atlantique, Brittany cannot expect any further revolutionary improvements of its position in the rail network. Despite its good connections to Paris, Brittany remains far from the Channel Tunnel. To give an example, the northern coast of Brittany and Cornwall are practically neighbours across the Channel; but going from Rennes to Plymouth via the Tunnel would mean to cover the same distance as from Calais to Gijon in Spain. Brest, the most western city in Brittany, is as far from the Tunnel as Basle or Newcastle.

Piemonte. Due to its strategic location as a border region between Italy and its northern European neighbours, Piemonte has a strong interest in improving its links with the European high-speed rail network which is now spreading from France. This directly concerns Piemonte with three projects: the French TGV and the transversal Lyons-Turin-Milan-Venice link (with a base tunnel under Mont Cenis), the second Simplon Tunnel linking Milan with Lausanne-Dijon and Basle, and the new connection Santhia-Aosta-Martigny, considered to be a better alternative to a second road tunnel under Mont Blanc. The regional actors in Piemonte believe that if the Italian Government does not give first priority to these projects, the Italian economy would carry a heavy handicap in the future single European market and that the Piemonte region would be completely blocked by the increasing transit traffic using this road and rail network by the year 2000. The completion of the Channel Tunnel is considered an important step towards an integrated transport and communication network in Europe underlining the urgency of promoting new transborder connections.

Scotland. The opening of the Channel Tunnel will for the first time allow direct passenger through-services to mainland Europe. It has been estimated that the through-train trip from Edinburgh to Paris might take about eight hours, compared with a total transit time by air of five hours. Travellers with origins and destinations in southern England will experience a greater time and cost saving than will those in the north.

Freight journey times to continental destinations could be minimized by running direct rail services from Scotland; however, freight volumes are not likely to be sufficient for this. It is therefore likely that traffic from a number of regions will be combined at various locations throughout the UK network. British Rail is developing two through-freight routes from London to the Tunnel and has recently announced that the first of seven freight marshalling terminals will be set up in Yorkshire. Also, in Scotland a 'freight village' will be developed, providing road-rail interchange, a major distribution centre and industrial sites with rail access.

Channel Tunnel services may also be hampered by congestion in the south-east region. Initially it is planned to make use of existing tracks from the Tunnel to the international terminus (or termini) in London, which would mean that through-trains will not be possible. The key problem for rail freight services lies in the low UK loading gauge. Low bridge and tunnel clearances and difficulties passing through stations mean that very little European rolling stock could travel on UK lines. A number of groups have called for the conversion of a spinal route between the Tunnel and central Scotland to the larger Berne gauge. However, the conversion of only a part of the projected spinal route — say from the Tunnel to the Midlands — would probably be worse for Scotland than not converting any of it. Because of the high costs involved, British Rail's suggested solution is the development of new types of small-wheeled rolling stock that could accommodate suitably sized trailers. Other serious bottlenecks might be the transfer of people and goods around London and congestion on the east and west coast main rail lines and within Scotland.

Ireland. After the completion of the Channel Tunnel, Ireland will be the only country in the EC without a land link to the European mainland. Just as Scotland, Ireland may benefit from the Channel Tunnel depending on the quality of the Tunnel approaches on the British end, and, just as Scotland, Ireland will be affected by the bottleneck problems in south-east England and on the British main rail lines. Since it is unlikely, at least initially, that the traffic demand for dedicated continental train services to Holyhead or Fishguard would be sufficient to justify such services, it will be necessary to develop an alternative coach/rail system linking these ferry ports with the UK main line services. The Holyhead-Crewe feeder line needs to be upgraded to provide an attractive passenger rail service to Ireland. As regards freight transport, given that through-train freight services to Holyhead and Fishguard are not feasible, it is likely that feeder traffic from Ireland will be combined at Crewe into viably sized trainloads or train sections. In the long term this service is likely to produce very good opportunities for container shipping operations from Ireland. However, in the initial years of operation, the Tunnel is unlikely to be an attractive option for Irish freight transporters. There has been some talk of a possible rail ferry service between Ireland and the Continent in the future. This should be able to compete well with the Tunnel service; however, the different track gauges on the Continent could cause problems.

Pais Vasco. The Basque Country is seriously concerned about its integration into the future European transportation system and has made it one of the priorities of its regional economic plan ('Europa '93'). The Spanish rail network is not easily linked to the European high-speed rail system because of its different track gauge. Only the conversion of the Iberian tracks to the European standard may change the position of the railway and make it the transport mode of the future both inside the region (linking the three Basque capitals with intercity trains) and with the outside world (Madrid, Barcelona and Paris). These are the objectives of the so-called 'Basque Y' project. The Basque Y could become part of the high-speed rail connection Madrid-Irun-Paris (the Basque connection), which would reduce travel time between Madrid and Paris from 11 to 6 hours. The travel time to London (allowing one hour for changing trains in Paris) would be reduced from 19 to 9 hours. However, this project has not officially been incorporated into the plans of the central government, and it will not be finished before the year 2000, although it is included in the priority plan of the European Community.

Norte. Immediate prospects for significantly improving the quality of rail services within Norte are expected from the Oporto-Lisbon railway and its connection to Spain and the rest of Europe via Beira Alta-Valladolid-Irun. This line will have European standard track and allow high-speed traffic between Lisbon, Oporto and the rest of Europe by 1995. The chambers of commerce of the Atlantic arc (see Subsection 4.2.5) stressed the need for this connection. The magnitude of the impacts of the Channel Tunnel on Norte critically depends on the completion of this project. If it is implemented, significant gains in travel time between Portugal and the other European countries, including the UK, can be achieved.

(b) Road

A large proportion of the Channel Tunnel traffic will go by car or lorry on the Eurotunnel shuttle trains. So the Tunnel will also be linked to the European motorway system. Hence it is equally important to assess the integration of the case-study regions into the future European motorway network and the potential time savings afforded to them by the Channel Tunnel. However, the analysis has also shown that for regions on either side of the Channel the Tunnel is but one important element of the future European road system and that many of them are more concerned about their future integration into that system than their link with the Channel Tunnel only.

Kent. Although south-east roads are on the whole more congested than many in Europe, this is not seen as a problem which can easily be solved simply by the construction of more roads. A shift of some traffic from road to rail would provide limited relief for Kent roads but the extent to which this shift will occur depends very much on the quality and type of rail services which are to be offered. Nevertheless, a major programme of road improvements is proceeding within Kent. The Tunnel approaches, the completion of the M20 motorway and the third Thames crossing at Dartford are the major road projects in Kent for the next decade, but important links are also planned to take traffic north (towards Thanet) and west (towards Sussex) from the Tunnel. In particular, these road links to the rest of the UK are more important for most business located in Kent than those to the Tunnel.

Nord-Pas-de-Calais. After leaving the French Tunnel terminal at Coquelles south of Calais, cars, coaches and lorries take the motorways A1 to Paris, A26 (Calais-Reims-Dijon-Lombardia) or the A16 coastal ring motorway to Dunkirk and Boulogne (to be extended further south in 1995). Work carried out under the 10th national plan will complete the road network linking them to other regions, particularly to the east and south-west. The coastal motorway will link Nord-Pas-de-Calais with northern Europe via West-Vlaanderen. The A1 will be widened, and by 1996 the A1b will be completed between the Belgian border and Béthune at the crossroads of the A1 and A26. Multimodal platforms will be built in Dunkirk, Béthune, Lille, Lille-Lesquin, Roncq and Denain besides various road freight centres. The Métropole Nord will become a major logistic centre with three multimodal platforms.

West-Vlaanderen. In West-Vlaanderen important new motorway projects are under way. The motorway A18 (E40), today running along the Flemish coast from Brugge to Veurne near the French border, will be extended into France as far as Calais and the Channel Tunnel. This will be the major access by road from northern Belgium and the Netherlands to the Channel Tunnel. The Netherlands will most likely be connected with the coastal motorway A18 by the projected motorway across the Rhine-Schelde delta to Rotterdam. Yet most of the traffic from Germany to the Channel Tunnel will not pass through West-Vlaanderen but via the projected motorway A8 between Brussels and Lille. In summary, the future motorway network in West-Vlaanderen will be dense and provide excellent links to the European motorway system and perfectly enable the region to serve as a transit region between the Channel Tunnel and northern Belgium and the Netherlands.

Hainaut. The road network in Hainaut should soon be extended by the motorway A8 that will link Tournai to Brussels and open a new route between northern France and the north of Europe. The existing network and scheduled developments should therefore confirm Hainaut's role as a European hub.

The Tunnel opening will revive the question of the motorway A8 between Lille and Brussels, which has been partially built and only lacks some 30 kilometres. Another link that has been discussed for a long time and has again become the subject of renewed interest with the appearance of the Tunnel is the motorway between Tournai and Kortrijk. This section will link Hainaut to the port of Zeebrugge and will reinforce Zeebrugge's role as a competitor to the Tunnel.

Zeeland. The main infrastructure project in Zeeland of the next decade is the cross-delta motorway crossing the Westerschelde. The defenders of the 'Westerschelde Oeververbinding' (WOV) stress its likely economic impacts especially for the northern parts of the region, while the opponents fear that it may endanger its sensitive environment and recreational quality. However, the provincial government has recently announced that it will make a decision towards the WOV in 1991. A possible new motorway would cross the Westerschelde at Terneuzen and would link Rotterdam with Gent and Brugge, where it would connect to the new Belgian motorway along the Channel coast. With this new infrastructure, the northern part of the Zeeland region would also have direct access to Belgium, France and the Channel Tunnel.

However, today the implementation and the routeing of this road link are still uncertain. The national government in The Hague has not included it in its national infrastructure plan until now, but there are signs that this may happen in the near future. Therefore it is necessary to distinguish between future impacts of the Channel Tunnel with and without the cross-delta motorway. Furthermore, it is useful to distinguish between the impacts for Zeeuwsch-Vlaanderen and for the other parts of Zeeland, in particular in the case in which there is no direct new road link across the Westerschelde. The fact that the new road link can only be finished several years after the inauguration of the Channel Tunnel underlines the importance of this distinction.

Cologne and Bremen. There will be no dramatic changes in the position of the Cologne region in the road network. The motorway system within the region and its links to other regions including Belgium and the Netherlands are excellent, and no major network extensions are planned. Also for the Bremen region no revolutionary changes are to be expected.

Brittany. In 1993 the motorway system of Brittany will be very well linked with the other European motorways. Rennes will serve as an interface between Brittany and Central Europe when the coastal motorway A16 is completed. This new motorway will link together cities which traditionally were connected first to Paris and will be a first step towards a motorway network in the southern and the south-western part of Europe. This evolution will come more from the desire to counterbalance the dominance of the European core than from the will to reach the Channel Tunnel more easily, though in fact the coastal motorway will achieve this for Rennes. Yet despite its good motorway connections, Brittany will remain far from the most active and productive regions of Europe. Its chance is to be included in a new north-south traffic corridor along the coastal motorway.

Piemonte. The Channel Tunnel and the prospect of further fast growth of transborder traffic between Italy and the northern and western part of the Community in the wake of the single European market has renewed the interest of the region in the implementation of missing motorway links to the Fréjus and Mont Blanc road tunnels as parts of the Turin-Fréjus and Aosta-Mont Blanc motorways, but besides that Piemonte is more interested in a future east-west motorway linking the Iberian peninsula via Provence, the Côte d'Azur and the Po valley with the Balkan countries and Eastern Europe.

Scotland. The time and costs involved in travelling by road to and from mainland Europe should be reduced by the Tunnel; however, travellers with origins and destinations in southern England will experience a proportionately greater time and cost saving than will those in the north. For Scottish hauliers travel time and cost savings will form only a small proportion of total trip time and costs on long haul journeys to Europe.

The effects of the liberalization of the road haulage market in 1992 are as yet uncertain. Scottish hauliers will continue to suffer from the maximum loading weight differential when compared with their European counterparts. The maximum weight for most of Europe is now 40 tonnes. As a result of the need for bridge strengthening, the UK is being allowed to maintain its current limit of 38 tonnes until 1998/99.

Current plans to upgrade the A1 to motorway standard have stopped at Newcastle, perpetuating a major bottleneck in Scotland's links to the rest of the UK. Fears remain that current plans to upgrade the A74 south of Glasgow to motorway standard will not be implemented quickly enough for the benefit of the region. It is also felt that better east-west road links to feed into the rail or shipping networks are required.

Ireland. As Scotland, Irish road traffic needs good access to the British motorway system to make the best use of the new shuttle service through the Tunnel. Major bottlenecks are the lack of motorway connections to the two ferry ports on the UK side, Fishguard and Holyhead. However, also within Ireland improvements of the access roads to ports and airports are urgently required. In 1989 the Irish Government published a national development plan which outlined structural measures Ireland proposes to implement over the next five years in conjunction with Structural Funds from the EC including road improvement projects for IRL 875 million.

Pais Vasco and Norte. With respect to the road network in Pais Vasco, improvements are under way to extend the Cantabrian motorway westwards as well as to turn the main roads to Madrid and the Mediterranean basin into motorways. The most important road project in Norte is the extension of the IP4 motorway (E82) from Oporto to the Spanish border near Bragança. Due to various delays, this connection, which is essential for linking Portugal to the other regions of Europe, is not expected to be fully operational before 1995. With this road link, in conjunction with the Channel Tunnel, significant time savings for journeys to the UK can be achieved.

(c) Ferries and ports

In a sense the Channel Tunnel can be viewed as a more efficient kind of ferry, so it will compete with the existing ferry services both in passenger and ro-ro freight transport. Also, some ports handling container and conventional freight traffic to and from Britain may be adversely affected by the competition of the Tunnel. In this section the likely changes in ferry services and sea transport infrastructure in the study regions are assessed.

Kent. Port and ferry operators in Kent are investing in new infrastructure in anticipation of the competition from the Tunnel. The port of Dover has invested UKL 50 million in recent years in improving efficiency and providing capacity for future growth. Important investments in new facilities for general cargo traffic have also been made in Dover. Sealink and P&O European Ferries, the two largest ferry operators, both based at Dover, are investing in new larger ferries and concentrating on providing an improved on-board service for passengers. For a long time Folkestone has had to face a serious situation over the future of the the ferry service to Boulogne. Unexpectedly, Stena Sealink withdrew this service at the end of 1991, rather earlier than expected, although this has been partly mitigated by the decision of Hoverspeed to transfer some SeaCat catamaran services to this route, given the better rail connections at Folkestone from summer 1992, and attempts are being made to find a new operator for the traditional ferry service. Ramsgate suffers limitations to growth due to problems of road access and the need for more land.

Nord-Pas-de-Calais. Being closest to the Channel Tunnel, the French ferry ports are most likely to suffer from the competition of the Tunnel. However, none of them expect that the ferry companies, most of which are British, will go out of business. Nevertheless Calais, Boulogne and Dunkirk are redirecting their port activities towards container traffic in order to become less dependent on the ferry business.

West-Vlaanderen. There will also be substantial improvements of the seaport facilities in West-Vlaanderen. Both Ostend and Zeebrugge, but particularly Zeebrugge, are on the way to modernizing and enlarging the capacity of their port infrastructure. New ro-ro and container terminals will substantially increase the volume of goods that can be handled and hence reduce the times that vessels are in port. In particular in Zeebrugge, improved port facilities have been developed to expand the non-cross-Channel port activities. At the same time, the ferry companies invested in new 'jumbo ferries' and new ferry terminals to prepare themselves for the competition of the Tunnel.

Zeeland. After recent thorough modernization of the ferry terminal facilities in Vlissingen, no major changes in the field of maritime infrastructure in Zeeland are to be expected.

Bremen. The modernization and computerization of the Bremen seaports and their related distribution facilities will continue to come under increasing competitive pressure from major North Sea ports such as Rotterdam and Hamburg. The outcome of this competition is uncertain. It may be that the superior location and overwhelming dimension of Europoort will eventually lead to an extinction of port activities in smaller ports along the North Sea and Channel coasts. However, it is also possible that a regional specialization combined with advanced logistics and the increased demand created by a growing German economy may more than offset the effects of location and size.

Brittany. The shortest and most convenient transport links between Brittany and the UK will remain the sea passages from the ports of the north Breton shores or the coasts of the Basse-Normandie (Lower Normandy).

Scotland. As the Scottish ports chiefly handle bulk goods, they do not see much reason to adjust their port infrastructure or services in connection with the Channel Tunnel. However, the ports in mid-England handling much of Scotland's ro-ro traffic to the European continent may have to diversify in order to keep their client base. Recently, the establishment of a ro-ro ferry service between Leith (on the Scottish east coast) and Rotterdam was proposed. However, this proposal has not yet been put into practice and there is as yet no firm policy for the establishment of the service although feasibility studies have been carried out.

Ireland. For Ireland to be able to compete successfully in the more competitive European markets after the opening of the Tunnel, certain steps will have to be taken to reduce transport costs and transit times, such as improvements in port services including expansion of hours of operation, improvement in dock/labour productivity and performance to reduce costs and improve quality of service and a reduction of port charges to encourage redirection of traffic from northern routes. The shipping lines which operate directly to the Continent are planning to develop services through investment to improve door-to-door transit times so that services via the Tunnel to the Continent will not be significantly faster. Investment in ships capable of 15 knots compared to the present 13 knots would reduce transit time on direct service by about 14% on the main routes. On the assumption of improved access to main Irish ports and faster turnaround time in ports for vehicles and containers, a reduction in door-to-door transit times of 20% is well within reach. In addition, the potential port-to-port transit would compare favourably with expected time via the Tunnel. As an example, the transit times from Dublin to Paris by lo-lo (load on/load off) services via the Tunnel and direct are about the same. At the ferry ports, Dun Laoghaire, Holyhead and Fishguard, passenger terminals should be upgraded to provide facilities similar to those at international airports.

Pais Vasco and Norte. Bilbao and Pasajes, the two main ports in Pais Vasco, have not shown any significant activity to modernize their facilities or services in connection with the Channel Tunnel, even though extensive development schemes are contemplated, especially in Bilbao. No particular developments in connection with the Channel Tunnel could be observed in Leixoes and Viana do Castelo, the ports of Norte.

(d) Air

As ferry services between the British Isles and the European continent have increasingly felt the competition of passenger air travel, the likely tendencies in air transport in the case-study regions also need to be examined.

Nord-Pas-de-Calais. At Lille-Lesquin airport, work has begun to double the capacity of the air cargo terminal, to enlarge the aircraft parking area and to lengthen the main runway to 3 100 m to prepare the airport for its function as a regional air platform for the north-western part of the European Community. If the increase of passengers continues, new lines could be opened, which would be useful for the broad hinterland including Hainaut and West-Vlaanderen in Belgium. A combined air-road platform was recently planned in Calais-Marck between the Channel Tunnel terminal and the airport next to the Calais interchange of the A26 motorway. With its important links to Paris-Charles de Gaulle airport, Nord-Pas-de-Calais is much better integrated in the international air routes than Kent on the other side of the Channel.

Cologne. There are various proposals to integrate the Cologne/Bonn airport into the German intercity network or even the future high-speed rail connection between Cologne and Frankfurt. In addition, an S-Bahn, a metro or a tramway connection between the airport and Cologne and Bonn respectively were discussed. The transrapid link between the Düsseldorf and Cologne/Bonn airports was proposed with the idea in mind to utilize idle airport capacity at Cologne/Bonn to relieve congestion at Düsseldorf, where further expansion is limited by surrounding residential areas. However, due to the controversy about the high-speed rail line, no progress has been made with respect to any rail connection for the airport.

Scotland. During the interviews, a lack of direct flights to European capitals and major cities from Scotland was pointed out. Although there are some direct flights to Brussels and Paris, in most cases people are required to change planes in England, often Birmingham or Heathrow, where delays are liable to occur. Also the inconvenience of crossing London by underground with luggage to or from airports was quoted as a significant disincentive to people travelling by train to London and thence by air from Heathrow.

Other regions. Expansion and modernization schemes going on in the airports of Bremen and Bilbao are not directly related to the Channel Tunnel. No major new developments in air transport are observed in the remaining case-study regions.

Interpretation

Table 4.9 summarizes the position of the 13 case-studies in the European transport network after the completion of the Channel Tunnel. These findings show that each region has very specific views and concerns about its position in the future European transport system. Nevertheless, there are certain commonalities between the assets and problems of the regions and how they are perceived in the regions. The following paragraphs highlight the commonalities — and differences — between the regions and try to explain them by associating them with the basic geographical, economic, and political variables characterizing each region.

Variables

The position of the 13 case-study regions in the future European transport system will be codetermined by a set of geographical, economic and political variables.

(i) Obviously, distance to the Channel Tunnel and to the European core region of the Blue Banana will largely determine the quality of the integration of a region into the European transport system. In fact this distinction is almost redundant as centrality and peripherality in the European context more and more tend to be defined with reference to that core region which itself is almost a synonym for the zone of highest concentration of high-level, high-speed transport (and communications) infrastructure.

(ii) Exposure to sea transport. Clearly coastal regions are a different type among the study regions in as much as they have port cities with their special problems. In addition, one has to distinguish between regions on the Channel coast and other coastal regions.

(iii) Affluence and economic size. Although decisions on large-scale transport infrastructure are not normally made on the local level, it is important whether a region can generate enough traffic itself to justify a transport connection.

(iv) Awareness and political influence. It makes a great difference whether a region is aware of the problems it is facing and has the resolution to do something about it.

Using these variables, tentatively, as explanatory indicators, the following groups of regions with similar constellations with respect to their position in the European transport system emerge (see also the typology of the regions in Subsection 4.2.6).

Hubs in the Blue Banana
To be in inside the Blue Banana is not enough. In order to fully take advantage of the synergies afforded by the concentration of talents and economic and cultural opportunities in the European core regions, a region needs to be at a node of one of the great corridors of transport and communications of the European core: the north-south corridor along the Rhine or the east-west corridor linking Paris and London with the east. The Channel Tunnel will become a part of the latter. But of the two Tunnel access regions, only Nord-Pas-de-Calais will become a hub as the TGV lines and motorways radiate out in all directions throughout Europe from Lille transforming it from an industrial city into a true Métropole Nord.

Cologne's rank as a hub in the European transport network does not need to be established by

Table 4.9. The regions in the future European transport system

Region	Assets	Problems
Kent	Integration into the European transport system, if Ashford international station is implemented.	Delay in Tunnel rail and road connections. Congestion on Kent motorways. Loading gauge and loading weight problems. Tunnel competition for Kent ferry ports.
Nord-Pas-de-Calais	Tunnel exit will be in Nord-Pas-de-Calais. The region will have 80 TGV trains per day. Tunnel access motorways will connect the region with east, south-east and north Europe.	Delay on British side of Tunnel. Competition by Tunnel for ferry ports.
West-Vlaanderen	New coastal motorway will link West-Vlaanderen to Calais and the Tunnel.	Competition by Tunnel for ports. No direct link to high-speed rail system.
Hainaut	Indirect benefits through TGV access via Lille.	Ecological impact of TGV. Lille-Brussels and Tournai-Kortrijk motorways delayed.
Zeeland	Possible better access with WOV.	Westerschelde is barrier; WOV still undecided. No direct link to high-speed rail system.
Cologne	Gateway from France, Benelux and Britain to Germany and north and east Europe. Strategic position in rail and motorway system.	Delayed implementation of high-speed rail system in Germany, in particular of Cologne-Frankfurt connection.
Bremen	Bremen port has an interesting option for relations with Eastern Europe.	Channel Tunnel and high-speed rail system may reinforce Bremen's peripherality.
Brittany	Tunnel may accelerate implementation of regional transport infrastructure.	Competition of Tunnel for ferries to England.
Piemonte	Strategic position in border region between France, Switzerland and Italy.	Heavy transit traffic; inefficiency of Italian transport system; transborder rail and road connections delayed.
Scotland	With a direct land access Scotland will be closer to European markets.	Delays in implementation of Tunnel access links from London. Difficulty of circumventing London area. Insufficient rail and road connections between Scotland and south-east England and in Scotland.
Ireland	No assets.	Ireland is the only country without a land link to continental Europe. Tunnel and high-speed rail system may increase Ireland's peripherality. Connections to main British rail lines and motorways need to be upgraded.
Pais Vasco	Pais Vasco is gateway between the Iberian countries and Western Europe.	No decision yet on linking the Spanish railway system to the TGV (different rail gauges).
Norte	No assets.	Insufficient rail and road systems. No good connections to Spain.

the Channel Tunnel; it is almost 2 000 years old. But Cologne's position will become even more strategic through the Tunnel; it will become the gateway between the Atlantic west and the continental east of Europe. If there is a risk involved for Cologne, it is that its historic rival, Frankfurt, may be connected to the 'TGV zone' earlier.

Central transit regions

To be a hub requires some own weight, or the fast trains will pass by without stopping, and the faster the train the less likely it will stop. Kent runs the greater risk of becoming a transit region for London. A region could not be more centrally located in the Blue Banana than Hainaut, but with the formation of the high-speed rail network, Hainaut, once part of Europe's industrial heartland and at a crossroads of the 'old' European express trains, will be cut off from the world. West-Vlaanderen, due to the competition of the Tunnel, will find itself on a secondary road to London, and, like Hainaut, will have to look to Lille. Zeeland, though in the centre of Europe, was remote, but now it has the option to be linked, but only as a 'pipe' and at a high price, so it cannot decide.

The 'Banana Skin'

Not to be in the Blue Banana may become a disadvantage the more the polarizing tendencies of current spatial development come into effect. Transport infrastructure can work both ways: while it reinforces the dominance of the core, it can also link a region to it if it is not too far. That makes the 'Banana Skin' attractive: it is the intermediate zone in which a region can be connected without sharing the diseconomies of the core. Bremen and Piemonte fall into this transition zone; Brittany has only recently joined due to the TGV Atlantique. Yet in order to take part in the general increase of accessibility, these regions need to be more alert and more active than others. Bremen and Brittany, though on quite different levels of affluence, have been successful in this respect: Piemonte has the awareness, but finds it difficult to persuade its government of the urgency of the transalpine links.

The European fringe

If distance from the centre becomes too great, even high-speed transport cannot compensate for remoteness. Scotland, Pais Vasco, Ireland and Norte are too far away from the Channel Tunnel to benefit from it. So even if they make progress, the centre will grow faster, so their relative position declines. Moreover, these regions tend to be neither rich nor influential enough to successfully lobby for their interests; this often leads to resignation. For the two remote regions on the northern side of the Tunnel, paradoxically by getting better, things get worse. Of course Scotland and Ireland will be closer to continental Europe after the completion of the Channel Tunnel, yet at the same time they will be affected by the Tunnel, and their dependency on the country in between, England, will increase, so their situation in relative terms may become worse.

4.3.2. Impacts on transport flows

The new transport infrastructure described in the previous subsection will change the spatial pattern of the European continent by reducing travel distances and times and hence total transport cost. This will give rise to substantial shifts in transport flows and, together with other developments such as the single European market, will induce a further intensification in exchange of people and goods between the regions of Europe. However, these changes will not be uniform; depending on their position in the European transport network and the quality of their connection to the new infrastructure, the regions will be differently affected.

Some regions, in particular the more central regions in Europe will experience more growth in transport than peripheral regions that are only indirectly linked to the high-speed rail trunk lines, and this could mean more economic opportunities — and possibly more congestion and agglomeration costs — for the central regions and less growth, that is relative decline for the peripheral regions.

These differences between central and peripheral regions will also become visible in the case-study regions. In the following subsection the expected impacts on transport flows in terms of volume, direction and intermodal competition will be assessed based on the interviews conducted in the regions.

Kent. The Tunnel represents one more link across the Channel dividing the UK from the rest of Europe. For both road and rail links, the Tunnel will provide faster and more reliable services than are currently available. Tunnel crossings may be priced to compete with the ferry market, but at current rates this might not produce an adequate servicing of Eurotunnel's debts. Possibly ferry costs may be increased to cover a proposed upgrading of ferry safety. However, it is probably not in the ferry companies' interest to drive Eurotunnel into bankruptcy. The result would be that a new company would take over the assets at a much lower price and could then compete with the ferries very effectively, probably putting them out of business. The ferries' marginal costs are never likely to reach the level of the Tunnel's marginal costs.

According to recent forecasts, the transport volume of the Channel Tunnel in respect to passenger and goods traffic will develop as follows (through-rail traffic only):

Passengers (million passenger trips per year)

Source	Year			
	1993	2003	2013	2023
MVA for British Rail	13.4	17.4	21.2	25.9
SETEC for Eurotunnel	15.4	19.8	22.4	–
SNCF	16.5	21.4	26.2	31.9

Freight (million tonnes per year)

Source	Year			
	1993	2003	2013	2023
MVA for British Rail	6.1	7.0	7.7	8.5
SETEC for Eurotunnel	7.4	11.4	16.4	–
SNCF	7.2	10.6	13.4	16.4

A key issue for Kent will be the Tunnel's impact upon eventual mode shifts in freight flows between the UK and the Continent. Given that for greater trip lengths, rail has a comparative advantage over road as a means of transporting freight, the establishment of through services to the Continent from other parts of the British Isles should give rise to some shift of freight from road to rail.

This will be important for the question whether the rail network and the already congested roads in Kent will be able to cope with the growing traffic. Many groups have argued that the existing rail network will quickly become over congested thus further reducing the quality of rail services. Kent County Council hopes that a significant amount of freight will transfer from road to rail thus easing the pressure on the roads and the environment. British Rail expect to be able to carry 6.1 million tonnes of freight a year which they suggest will result in up to 400 000 fewer lorry movements per year on the roads in the south-east and Kent. Eurotunnel predict that 90% of the road traffic on their shuttle trains will have been transferred from the ferries. In this case, measures such as the completion of the M20 link should be sufficient to cope with the 10% growth in road traffic.

The future of the ferry industry is an important factor for Kent. Some ports are more vulnerable than others to competition from the Tunnel. Dover, which is by far the largest, stands to lose most due to its location and the nature of its trade. Port operators at Ramsgate do not expect to suffer traffic losses due to the Tunnel. The north Kent ports, which include Sheerness, Grain, Dartford and Chatham, anticipate only a marginal effect on trade from the Tunnel since cross-Channel services from these ports are mostly for unaccompanied lorry trailers, which the Tunnel will not provide for.

Nord-Pas-de-Calais. The Nord-Pas-de-Calais regional council anticipates in a forecast for 1993 that 29.7 million passengers and 13.2 million tonnes of goods per year (or one quarter of all ro-ro traffic from England to continental Europe) will be transported through the Tunnel. In Calais, and even more in Dunkirk, forecasts tend to be less optimistic about the Tunnel. The Calais Chamber of Commerce expects 10 million passengers still crossing on ferries. The Comité d'expansion follows Eurotunnel's hypothesis of almost 30 million passengers, half on trains, the other half on shuttles. But they think that freight traffic in the port of Calais will not be harmed by the Tunnel, as 90% of this freight consists of containers which are not likely to be carried on Tunnel shuttles. Only 5% of port traffic in Dunkirk is Channel traffic. There is the widespread opinion that the Tunnel will predominantly attract long-distance travellers and freight.

Of the three ports in Nord-Pas-de-Calais, Calais should derive the greatest benefits from the Tunnel, whereas Boulogne is likely to lose most of its passenger traffic.

West-Vlaanderen. The most obvious and probably most serious impacts of the Channel Tunnel for West-Vlaanderen will mainly affect its two ports, Ostend and Zeebrugge. Under the circumstances of the current road and rail approaches to the Tunnel, the time savings afforded by the Tunnel are small if compared with the ferry, and nil if compared with the hydrofoil. However, if the motorway and high-speed rail approaches to the Tunnel were completed, the time savings would become more substantial. But a clear distinction has to be made between the impacts on Zeebrugge and those on Ostend.

The general assessment in the region is that the transport flows through Zeebrugge will be only slightly affected by the Channel Tunnel. The assets of Zeebrugge are its wide range of destinations, in particular to regions in the UK not located on the Channel coast.

With respect to passenger transport, Zeebrugge is likely to lose some passengers on the Dover service, but none on the mid-England services. The main reason for the slight impact on the Dover route is that, unlike in Ostend, there are only few rail passengers in Zeebrugge, as rail access to Zeebrugge from the national and international passenger rail network is very inconvenient. P&O expect to lose passengers to the Channel Tunnel for the first three years after its introduction, but expect that most travellers will come back to ferries once the attraction has faded out. With respect to the mid-England destinations, studies of the Zeebrugge port authority show that subject to origin and destination of passengers, journey motive and route and mode choice, only an insignificant number of passengers will shift to the Tunnel. On their Hull service, North Sea Ferries anticipate no loss of passengers but also no growth in the first year of the Channel Tunnel, but after that growth for all modes of cross-Channel transport with a new market equilibrium. In addition, the service to Hull has advantages the Channel Tunnel cannot provide. The daily night ferries allow holiday makers and lorry drivers to rest during the night and at the same time circumvent the congested London area.

With respect to freight transport, most Zeebrugge ro-ro services are not affected by the Channel Tunnel as they serve primarily the industrial regions in central and northern England and Scotland. For these destinations the Channel Tunnel provides no real time saving for lorry drivers who have to go on congested British motorways and through the London agglomeration. Besides, for most origin regions, the route via the Channel Tunnel would mean a longer period on the road for several hundred kilometres, whereas the time on the ferries can be used as the required rest time for the drivers. The ro-ro freight mostly carried in Zeebrugge, unaccompanied trailers, is not likely to change to the Tunnel as the Tunnel terminals seem not to be prepared to handle this kind of freight. Still open is the future of container services between Zeebrugge and the UK. Much depends on the future of Zeebrugge's deep-sea container activities. However, it is even possible that the Channel Tunnel will be used for hauling containers to the UK after they are transshipped in Zeebrugge from other container ships.

Quite different is the emerging competitive situation for the Belgian company Régie voor Maritime Transport (RMT) in Ostend. As they operate only on the route to Dover, RMT and the port of Ostend will be most seriously affected by the Channel Tunnel. RMT expects a loss of transport volume for all modes of transport. With respect to rail passengers, there will probably be a total decrease of about 55% because most international rail lines now serving Ostend will disappear. RMT expects to keep between 40 and 50% of Belgian and British passengers, as both national railways will continue to serve the cross-Channel ports, and only 25% of all other countries. The impact on RMT profits will be even stronger as revenues from rail passengers are much higher than from car passengers. In the growing markets of car and coach and ro-ro freight transport, RMT expects a loss of 20 to 25%, or, expressed in their terms: 'We can keep about 80%'.

In summary, a number of circumstances such as concentration on the destinations most affected by the Channel Tunnel, high shares of rail passengers and accompanied freight transport, the outdated port infrastructure, a port management unable to handle these problems and the lack of viable alternative port functions to ro-ro transport to the UK, reinforce this pessimistic view of the future of the Ostend port.

West-Vlaanderen will also remain a transit region for traffic shifted from the ferries to the Channel Tunnel, as there are several reasons to take the route through West-Vlaanderen such as the congested motorways around Lille, the toll motorways in France and the fact that the motorways in Belgium are illuminated at night. Even today many cars and lorries to the French Channel ports use the coastal route, although it is partly non-motorway. So it is expected that not only Belgian and Dutch traffic to the Channel Tunnel but also most of the traffic from Germany and north and east Europe will go through West-Vlaanderen with the effect that traffic on the motorways will increase.

Hainaut. If the TGV Lille-Brussels through Hainaut were implemented, rail traffic that currently crosses Hainaut on the Paris-Amsterdam and Paris-Cologne lines will be effectively replaced by traffic between Lille and Brussels that passes through the region without a stop. Besides these negative effects, the TGV will reinforce the role of the railway.

There is no clear vision of the role of rail transport in moving freight. Belgian carriers have specialized in road transport and are not interested in rail transport at the current time. One unanswered question is which route will be used for rail transport between the Tunnel and Germany. There are two possible routes, one crossing through Hainaut and the other through Kortrijk, Gent and Brussels avoiding Hainaut. Experiences with intermodal freight transport have not been successful.

Zeeland. As there will be no significant improvement in rail access of the region, most possible impacts of the Channel Tunnel will be related to road traffic. Hence in transport terms the importance of the Channel Tunnel for Zeeland will consist in its function as a more reliable alternative to today's ferries. This advantage, however, will very much depend on the decision whether the fixed link across the Westerschelde will be built. If there will be a WOV in future, then a considerable share of the road transport from the Netherlands to the Channel ports and the Tunnel will pass through the Zeeland region. Consequently, the Channel Tunnel will only have an impact on the transport volume on Zeeland's roads if there were an international road connection through the region.

No impact of the Channel Tunnel on the port activities in the region is expected. There is even the idea that Zeeland's ports could take advantage of the growing congestion in larger ports between Le Havre and Rotterdam. The ferry line between Vlissingen and Sheerness will not suffer. As the passengers of this ferry today accept the seven-hour sea journey, time savings through the Tunnel are not likely to play a significant role for this connection. This is particularly true for lorry drivers who use the journey time as their required rest period.

Cologne. Impacts of the Channel Tunnel on transport flows in Cologne will only emerge if the Tunnel is really integrated into the new European high-speed rail network. Only as a part of the high-speed rail system will the Tunnel contribute to a, however limited, shift from road to rail.

In general, the position of Cologne in the future European transport system will be even better than it is today. In the short-term perspective, Cologne will be the gateway between the high-speed rail systems of France with its extension via the Channel Tunnel to England and Germany. In the long-term perspective, Cologne will be the major interchange at the junction of the two most important agglomeration corridors in Europe, the north-south corridor stretching from Amsterdam to Milan and the east-west corridor extending from the triangle Paris-London-Brussels to Berlin and beyond. However, this will be true only if the TGV Est is not linked to Germany earlier than the completion of the high-speed link to Brussels. The *Land,* Nordrhein-Westfalen, wishes that as many as possible of the high-speed trains continue from Cologne to Düsseldorf and the Ruhr area, in order to integrate the whole Rhine-Ruhr agglomeration into the high-speed network. From this perspective, not Cologne alone but the whole Rhine-Ruhr agglomeration would be one single transport hub at the junction of the most important European transport corridors. It remains to be seen whether actual demand will make this ambitious scheme feasible.

All persons interviewed expect increased use of rail by passengers to London and an even larger increase of rail passengers to Paris; however again only if the high-speed rail line is completed. With respect to freight transport, it is expected that the new rail link will take over most of the additional freight volume expected for the future, which means that there will be no reduction in freight transport on roads. For short-to-medium distances, rail through the Tunnel will be more attractive than the aeroplane; although Lufthansa and the Cologne/Bonn airport hold a different view. In spite of this, it is expected that the somehow retarded development of the Cologne/Bonn airport will accelerate, mainly because of increasing congestion at the Düsseldorf and Frankfurt airports.

Bremen. With the opening of the Channel Tunnel, goods transport between Bremen and the British Isles will have a fast and highly attractive alternative to shipping by sea. However, because of the small volume of goods shipped between the UK and the Bremen ports and the high affinity of these goods to sea transport, the loss of freight volume might not be felt very seriously and may be more in terms of lack of growth potential. Air transport from and to Bremen will be only marginally affected. Even after completion of the Channel Tunnel, travel times by rail or car would be substantially longer from Bremen than by plane.

Brittany. There is some concern in the region that railway or road traffic flows from Brittany or from Spain and the French south-west towards the United Kingdom by the ports of Roscoff or St Malo could be diverted to other Channel ports or the Tunnel. It was also considered possible (but unlikely) that the western cross-Channel navigation would then lose enough passengers, cars and lorries to become unprofitable.

Piemonte. There is general agreement in Piemonte that the opening of the Channel Tunnel is not likely to have direct impacts on the transport flows at regional level. It was pointed out that the UK is not a major trade partner of Italy and that 90% of all goods transport between Italy and the UK is by sea. However, road transport is increasing and may be affected by the Tunnel. Passenger traffic between Piemonte and the UK is mostly business traffic by air and will be little affected.

Scotland. The key issue for the Scottish economy after the opening of the Tunnel will be its impact on freight traffic flows to the Continent. Since the benefits of using rail for freight compared with using road increase with distance, through-freight services to the Continent and some shift of freight from road to rail might be expected; however regular scheduled services to the Tunnel would be essential. However, it is still doubtful whether demand for such services would be sufficient to justify through-freight trains. In practice it is likely that traffic from a number of regions will be combined at various locations throughout the UK network. Marshalling time (for the assembling of trains) would detract from reductions in other elements of the journey time. Other factors that might affect the shift from road to rail are the location of marshalling yards and where customs facilities will be set up.

Perhaps the key problem for rail freight services, however, lies in the low UK loading gauge. Low bridge and Tunnel clearances and difficulties passing through stations mean that at the moment continental-type trains cannot be used to transport goods throughout the country. If freight needs to be taken, say, from Lille to Glasgow, then the goods would have to be transhipped to alternative vehicles either on the south coast or in northern France. This could easily wipe out any theoretical cost savings from rail freight transport. The loading gauge issue has been called 'the largest single obstacle to the free movement of wagons by rail in the Community'.

Most Scottish road freight today goes through the north-east and Humberside ports. It is not thought likely that the time and cost savings provided by the Tunnel will prove sufficient to attract much of this traffic away from these routes. The Tunnel is most likely to affect road freight currently travelling on the Dover route. Even on this route, however, for Scottish road hauliers travel time and cost savings through the Tunnel will form only a small proportion of total trip time and costs on long haul journeys to Europe. In fact, any such benefits may be totally extinguished by drivers' hours regulations. At present hauliers schedule their service so that drivers drive during the day to the south coast and then sleep on the ferry, a possibility ruled out by the shorter Tunnel crossing.

One thing that may be more significant than the opening of the Channel Tunnel for hauliers in general is the proposed liberalization of road haulage in 1992, including removal of restrictions on 'cabotage' — foreign drivers picking up domestic haulage jobs. However, the impacts of these developments on freight transport from Scotland are difficult to predict.

The Scottish ports do not deal with the same type of cargo at present as that which may be captured by the Channel Tunnel. Any impact the opening of the Channel Tunnel will have on the Scottish ports will be not so much on existing services as on the potential for future east coast ro-ro services. It was concluded here that the opening of the Channel Tunnel would have little impact on the commercial viability of such ferry services.

As for freight, the provision of through-train services for rail passenger traffic from Scotland to the Tunnel depends upon expected demand. Current plans are to run a daily through-service from Edinburgh to Brussels and Paris and overnight sleeper services from Edinburgh and Glasgow. It is assumed that for non-business trips these trains would be able to compete with air travel. Car-based tourism to the UK in general would, perhaps, be helped considerably by the Tunnel. There is general agreement that business travellers from Scotland will always favour air for their journeys — particularly if a direct flight is available. Air freight is subject to the same considerations as air passenger traffic. Firms who send their products by air do so because they want them to reach their destination quickly. Any possibility of transfer to rail from air will depend upon the time and cost differential between the two modes. For the electronics industries of Scotland, air freight is a particularly necessary and highly utilized mode for product distribution and will remain so in the future.

Ireland. Of the ro-ro freight transport between Ireland and continental Europe, 16% go on direct ferry services. The direct routes have the advantage of being a rest period for drivers. The land bridge route requires an overnight stop according to European social regulations. It is felt that there will not be a major switch of ro-ro vehicles using the land bridge routes to using the Channel Tunnel. Most people in the Irish transport industry feel that the Tunnel will be passenger-oriented and so passenger trains will be given priority over freight trains. The Tunnel has a time advantage of about three hours from Limerick via Rosslare to Paris compared with the direct ferry to Le Havre. However, it is generally believed that the saving will not be significant for Irish drivers as the time spent crossing the Channel is short relative to their total journey length. Goods destined for Germany are more likely to go on a ferry to a more eastern port such as Zeebrugge and then have a shorter road journey. For a destination such as Nantes, use of the Tunnel would add an extra 300 km to the overall journey compared to the use of the direct ferry service to Cherbourg.

The use of lo-lo freight transport to mainland Europe is likely to continue to be the predominant mode. In the short term it is unlikely that much lo-lo traffic will be diverted to the Tunnel. A comparison of times from Limerick to Paris using the direct sea route and the Tunnel showed a time difference of one hour in favour of the direct sea route. It would also be more expensive to use the Tunnel under the current rates structure.

The Channel Tunnel will probably capture some passenger traffic from the direct sea routes. There should be a time saving, especially during the winter months when the ferries are prone to long delays due to bad weather. Congestion on British roads is a disincentive to switch to the land route. However, passengers who at present drive to Europe via the land bridge route are likely to switch to the Tunnel. To capture any of the air passenger market, prices will need to be significantly lower than air fares as rail will never compete with air in terms of time. If overnight train services between Dublin and Paris or Brussels were offered at a reasonable price with good facilities, this service could gain a large share of the passenger market. British Rail's present plans are for one day and one night train to Brussels and Paris from Crewe, not linking up with Irish ferry times.

Pais Vasco. No major impact on transport flows to and from Pais Vasco is expected from the construction of the Channel Tunnel. The main effect foreseen is that a proportion of trucks currently crossing the Channel by ferry will start using the Eurotunnel. It is not expected that a substantial amount of freight now using ships from Basque ports will switch to land transport. Only if the Spanish railway system is integrated into the European rail network will the Tunnel affect Pais Vasco. In that case passengers and unaccompanied cars produced in Saragossa and Valencia may shift to rail, even though this is presently not foreseen by the Basque port authorities.

Norte. Transport operators view the improvement of the Iberian transport system, together with the introduction of high-speed rail in Europe and the Channel Tunnel, as having a significant effect on the reduction of trip time to destinations such as the Benelux countries and the UK with savings of about one day both for rail and road. Consequently, a large proportion of passengers and freight will be likely to use the land route instead of the sea passage. This will indirectly provoke the modernization of the ports in Norte and may even stimulate the introduction of a new ferry connection between Leixoes and the UK.

Interpretation

Table 4.10 and Figure 4.14 summarize the expected impacts of the Channel Tunnel on transport flows in the 13 case-study regions. It shows that the case-study regions indeed expect a wide range of impacts on transport flows. Partly these impacts are perceived as favourable, but in some cases they appear to the region as a threat for their transport industries, for the regional environment, or for regional development at large. How is it possible to generalize from these findings?

Variables

To approach this question, a number of variables will be proposed that may help to explain the differences in impacts on transport flows found in the regions. In part these variables are the same as in the previous section on transport infrastructure.

(i) Again distance to the Tunnel is a major factor as the effects on transport flows will become weaker with growing distance.

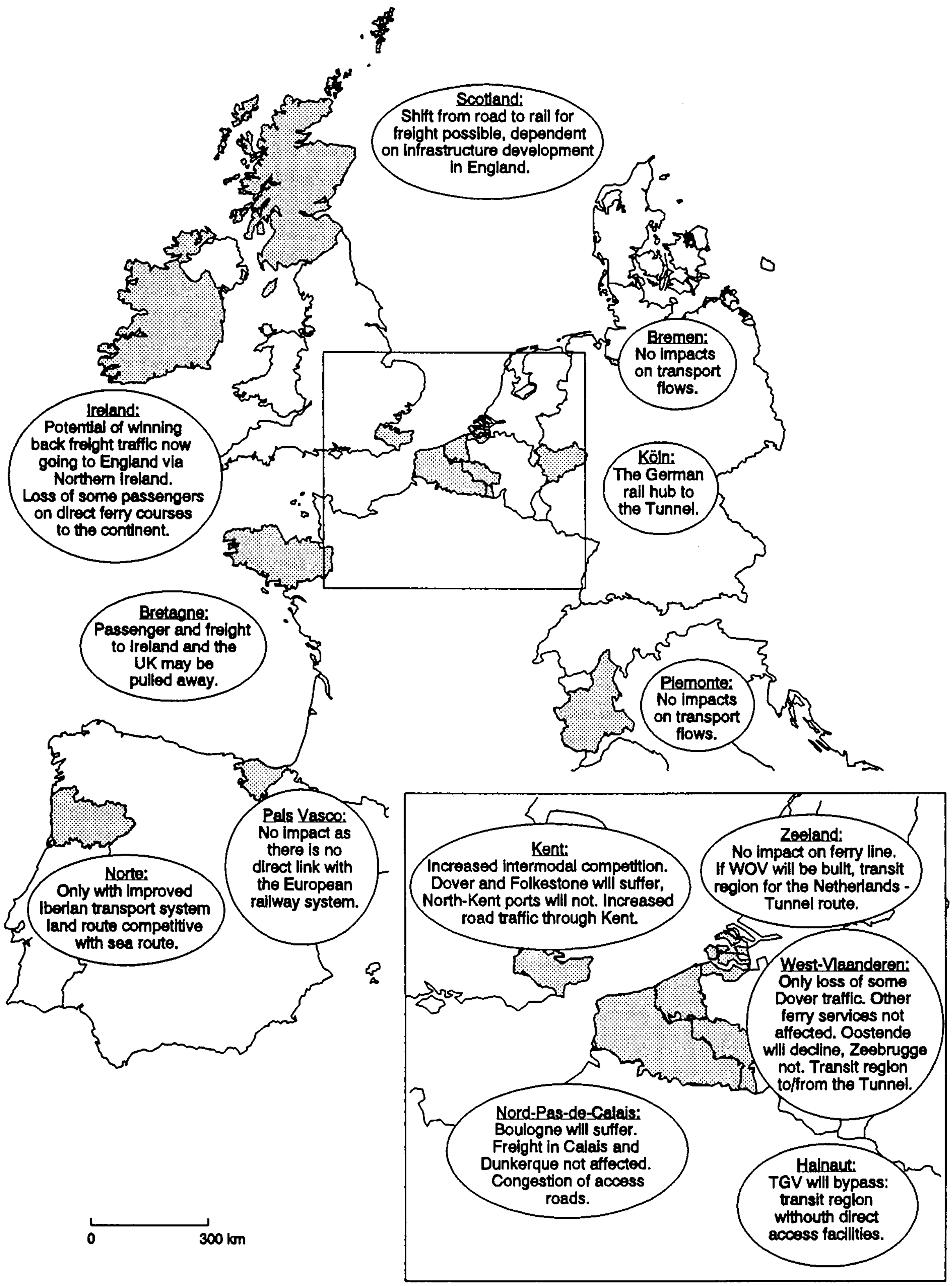
(ii) The integration of the region into the new European transport infrastructure (high-speed rail and motorways) and the schedule of implementation of the relevant links for the region will determine the magnitude and time of occurrence of the effect.

(iii) The volume and intensity of exchange of passengers and goods between the region and the UK and Ireland or, for Kent, Scotland and Ireland, with the European continent, are clearly the most important factors, as these are the flows that can be affected.

Table 4.10. Expected impacts on transport flows

Region	Expected impacts
Kent	Tunnel will provide faster and more reliable services. Competition will increase. Dover will lose traffic. Folkestone ferry traffic will move to Dover. Other ports in Kent will not suffer. Road traffic will increase by 20%. It is hoped that some traffic will be transferred to rail.
Nord-Pas-de-Calais	Eurotunnel expect to attract 18% of freight and 44% of passenger traffic between France and Britain. Port cities and French authorities expect much less loss of business. Access roads of the Tunnel could be congested. Calais will benefit more from the Tunnel than it will suffer.
West-Vlaanderen	Decline of some ferry business, but West-Vlaanderen will remain transit region for Channel traffic to the Netherlands. Loss of Dover traffic, but not of traffic to mid-England. Zeebrugge will be less affected. Ostend will decline. Freight transport little affected.
Hainaut	Current rail passenger traffic going through Hainaut will be replaced by TGV through-traffic. Freight traffic may go through Hainaut or via Kortrijk bypassing Hainaut. Potential for intermodal freight is small.
Zeeland	Main impact of Tunnel will be on road traffic. Vlissingen-Sheerness ferry traffic will not suffer. If Westerschelde crossing is built, most traffic from the Tunnel to the Netherlands will pass through Zeeland.
Cologne	If the high-speed rail connection Brussels-Cologne is built, Cologne will attract all traffic from the Tunnel to Germany and northern and Eastern Europe. Cologne/Bonn airport may be negatively affected.
Bremen	Major shift of UK freight traffic from Bremen to the Channel Tunnel is unlikely. Bremen's ports are overseas-orientated. No impacts on airport expected.
Brittany	The Tunnel may pull passenger and freight traffic to Ireland and Britain away from Breton ports. Roscoff is particularly likely to suffer.
Piemonte	No direct impacts of Tunnel on traffic flows in Piemonte expected. UK is not a primary trade partner of Italy. 90% of UK traffic goes by sea. Passenger traffic to UK is mostly by air; only TGV London-Turin could change that. Impacts of transalpine rail and road links are more important.
Scotland	The impact of Tunnel on traffic to and from Scotland will depend on many factors (access links, fares, etc.). There might be a shift from road to rail for freight if demand justifies through-freight trains to Scotland and if loading gauge problems can be solved. Road freight traffic goes mostly through east coast ports. For passenger traffic, through-trains or good interchange facilities in London will be essential.
Ireland	The Channel Tunnel may help to win back freight traffic now going to England via Northern Ireland, but for this to happen costs and congestion in Irish ports need to be reduced. Besides, the Tunnel will have no great impact on freight traffic from Ireland via England or direct. The Tunnel may, however, attract some passenger traffic from direct ferry routes.
Pais Vasco	As the Spanish and Portuguese railways have no direct link with the European railway system, no impacts of the Tunnel on transport in Spain are expected. Also no major impacts on the ports in Pais Vasco are foreseen. If in the future a link between the Spanish and French railway systems are established, a shift from road to rail traffic might occur.
Norte	Together with the improvement of the Iberian transport system, the Channel Tunnel could reduce travel time from Portugal to the UK by one day and make the land route competitive with the sea route.

Figure 4.14. Expected impacts on transport flows



(iv) Finally it makes a difference whether the region has a strong transport industry component involved in transport between the British Isles and continental Europe, be it ports, ferries or road transport companies, or not.

This last variable highlights that the changes in transport flows induced by the Tunnel can be looked at from two perspectives. The first is that of the transport users, and from this perspective any new transport infrastructure or service should be welcomed as, in general, it will increase the choice of transport options and in most cases will add faster or more convenient alternatives. Only if the new service leads to a deterioration or complete displacement of existing modes might transport users be negatively affected. The other perspective is that of the transport providers, and here the new infrastructure or service tends to be perceived primarily as competition, either as a challenge or a threat. So depending on whether the regions are more affected by the Tunnel as transport users or transport providers, two groups of regions can be distinguished.

Regions as Tunnel users

In the broadest sense all regions of Europe are potential Tunnel users but some clearly are more likely to use the Tunnel because of their closeness to the Channel and because they already have strong cross-Channel links. Of course Kent and Nord-Pas-de-Calais are important regions in this group as all traffic attracted by the Tunnel will pass through them. So these two regions will experience the most dramatic growth in traffic and enjoy benefits such as growth in transport-related business and increase in international accessibility, but will also have to deal with the potential negative impacts such as noise, pollution and land consumption. Cologne will enjoy the benefits of additional traffic through the Tunnel without hardly any negative impacts. Scotland and Ireland will benefit as potential Tunnel users, though their relative time savings will be small compared with their overall long travel times. Finally, Piemonte, Pais Vasco and Norte will have marginal benefits, but the volume of their links with the UK and Ireland tends to be small.

Regions as Tunnel competitors

It is true that the Tunnel traffic will be partly pulled away from Kent and Nord-Pas-de-Calais ports; however, the net balance for these regions will be overwhelmingly positive. This will be different for West-Vlaanderen where the loss of ferry traffic can only be compensated by either additional general growth or active diversification of port services as in Zeebrugge. Hainaut will be the victim of a displacement of traditional train services by the TGV, so it will lose traffic. Zeeland will attract additional traffic if the Westerschelde crossing is built, but not everybody in Zeeland is enthusiastic about that. Brittany, and to a marginal degree also Bremen, Pais Vasco and Norte, may lose some sea traffic to the Tunnel, but these losses are expected to be very small.

One further dimension of the Tunnel concerns its impacts on intermodal competition. As the Tunnel is primarily a rail tunnel, it is hoped that it will, in conjunction with further improvements of the European rail system, contribute to reinforcing the position of rail transport as the environmentally least-harmful mode of transport, especially to bringing some goods transport back from road to rail. However, the Tunnel also competes with maritime and air transport. In addition, the Tunnel not only induces modal shifts but also creates new traffic that otherwise would not occur.

The Tunnel and intermodal competition

Most of the future traffic going through the Tunnel will be pulled away from the ferries. Through-trains will carry the former boat-train passengers, while the Eurotunnel shuttles will carry cars and lorries which formerly used the ro-ro ferries. Only if attractive high-speed rail connections are implemented on either end of the Tunnel can a significant shift of passengers from road to rail be expected. Similarly, a shift of freight transport from road to rail depends on through-freight trains. So for Kent and Nord-Pas-de-Calais a substantial modal shift from road to rail through the Tunnel cannot be expected in the short run. In West-Vlaanderen and Zeeland Tunnel-bound traffic will be road traffic. For longer trips, the Tunnel might draw passengers and freight from sea or air transport. From Bremen, Brittany, Scotland, Ireland, Pais Vasco and Norte, the land route to the Tunnel may in some cases become preferable to the direct sea route, but in each case there are many pros and cons, so the outcome will not be uniform. Only very efficient high-speed trains through the Tunnel could draw passengers away from current flights between Scotland or Ireland and the Continent and between Cologne, Bremen or Piemonte and London, and even that is only expected for non-business trips.

Tunnel-generated traffic

Where a trip through the Tunnel is significantly faster and/or less expensive than existing transport alternatives, new traffic is likely to occur. International commuting between Kent and Nord-Pas-de-Calais will become feasible if not commonplace. Weekend trips from Cologne to London, now only possible by plane, will be much more convenient and possibly cheaper by high-speed train. The number of business trips between London and Brussels and Paris is likely to grow substantially. However, all these effects are dependent on the implementation of the high-speed rail connections, including those on the British end. Freight transport through the Tunnel is expected to grow significantly. However, it is difficult to assess how much of this growth will be attributed to the Tunnel, which will only be one element in the future European transport system under the auspices of the single European market.

4.3.3. Impacts on regional development

Evaluating the Tunnel's impact on economic activity needs to distinguish short-term effects, which are linked to infrastructure and equipment construction, and medium/long-term effects which will be felt through closer and more rapid communication in Europe. The former benefit mainly Kent and Nord-Pas-de-Calais. The latter concern most of the Community regions according to their access to new networks and, through them, to the Tunnel.

Therefore, after the Tunnel opening, the further the regions are from it, the greater their reliance on the TGV and enhanced land links, rather than on the Tunnel itself. This means, for instance, that Scotland and Ireland could become increasingly marginalized if Scotland-Ireland's road and rail links with south-eastern England are not improved. Even Piemonte might lose part of its somewhat privileged position at the intersection of the Blue Banana and the sunbelt if links across the Alps are not improved. On the contrary, the economy could be revitalized (expanding markets and installation of new firms) if new infrastructures provide better access to these regions.

(a) New markets, new firms and the labour market

One initial impact has already been felt through the construction of the Tunnel and its two terminals in Kent and in Nord-Pas-de-Calais. It is expected that new international firms would find it convenient to locate themselves not too far from the Tunnel and several regions are marketing their available office and industrial land in anticipation of that prospect. Further effects are expected in terms of access of regional economies to new markets. But employment provisions remain uncertain.

Short-term impacts

Construction of the Tunnel and related infrastructures has provided work on both sides of the Channel. On the Kent side, although the largest contingent among the 8 000 construction workers comes from Ireland (about 3 000), larger numbers are local than were originally believed likely.

Nord-Pas-de-Calais has derived a more direct benefit from works which created 5 114 jobs, including around 4 000 within TML and over 1 000 subcontractors on the Tunnel and terminal sites. Over 90% of these jobs were filled by workers from the Nord-Pas-de-Calais (87% managers and foremen). The estimation of the economic impact of the Tunnel construction is expressed by two figures: 1 000 NPC firms have been associated to it, with a financial flow of around FF 5 billion.

In Hainaut, some 30 sets of shuttle coaches will initially be built with BN participation. Next, the TGV will be built on its own site. Taking into account the location, it should mobilize the majority of Hainaut businesses (cement, civil engineering, quarries, steel, electricity, etc.). The Belgians will also participate considerably in the building of TGV coaches.

In regions with shipbuilding activities, like Bremen, a short-term positive impact can be expected due to the current demand for refurbishing ferries, as an anticipated response to the Tunnel challenge.

Other regions benefit from the Tunnel construction through contracts or subcontracts (like Hainaut) or through the provision of manpower (as Ireland). Such indirect impacts might even be felt in Piemonte, in terms of new markets for the mechanical industry. Since the TGV is not expected to be operational either in the UK or in Italy, FIAT is pushing the Italian technology of the 'pendolino'; this high-speed system, already running between Milan and Rome, could provide for speeds of 200 to 250 km/h between London and the Tunnel (although the issue is not only speed but also capacity), and on Italian cross-border sections. The prospect of cooperation between FIAT and CGE Alsthom (the constructor of the French TGV) in rail projects must obviously be justified in studies which will soon be carried out on the Italian side, and in inter-State and partnership agreements. If positive, the results of such studies are expected to introduce new developments for transport material manufacturing in Piemonte.

New markets

The regions closest to the Tunnel obviously hope to benefit from the location of new firms or potentially mobile ones because of their better access to other markets. In competing with each other, Kent mainly relies on the proximity of London and low labour costs, and Nord-Pas-de-Calais on land availability and major development programmes.

West-Vlaanderen economic actors, especially in the south, hope to benefit from the assumed positive impact of the Tunnel on the Lille agglomeration, through their close economic ties.

The same kind of impact on the Zeeland economy may follow from the growth the Tunnel may stimulate in northern France and Belgium whose markets are much more important for Zeeland than the British market. If there are investments in those regions, they will also have positive repercussions in Zeeland. In other words, if northern France and Belgium benefit from the Channel Tunnel, so will Zeeland. Nevertheless, the Channel Tunnel also provides Zeeland with opportunities to explore new markets in Britain. This is particularly the case for cross-border-oriented firms in Zeeuwsch-Vlaanderen. It also concerns agricultural products that may be more largely exported to the London metropolitan region, if the Tunnel system guarantees reliable timetables.

The enhanced strategic location of Cologne within Europe in the future opens up new economic opportunities. With downtown-to-downtown trains between Cologne, London and Paris, one-day business trips will become much easier and this will help to intensify international business contacts, mainly in the major activities that already have an international context, like fairs and the media, and also in insurance and the universities. In general, high-level service industries and firms producing and exporting high-value goods should be able to explore new markets.

In Bremen, exploring of new markets is not expected. If at all, there may be a slight negative impact on the shipbuilding industry if Channel ferries orders go down in the wake of the Channel Tunnel, which seems far from certain.

Ireland will be the only Member State within the EC without a land link. This is a serious disadvantage for Irish exporters who need to be able to compete with their European counterparts. Britain is Ireland's top export market, with 29.2% of total export value in 1988. With the opening of the Tunnel, Irish exporters will face increased competition from French firms who will be able to transport their goods through the Tunnel at much lower costs. Similarly, British exporters will have an advantage in the markets of northern Europe.

Employment and firms

The negative repercussions on employment in each region will only be felt where maritime traffic is directly challenged by the Tunnel, and to a lesser extent in terms of distance from the Tunnel, i.e. more in Kent, Nord-Pas-de-Calais, West-Vlaanderen and Zeeland than in Brittany. For the rest, the Tunnel may reinforce new job trends and attract new business, particularly among regions relatively close to the Tunnel. Firms' ability to relocate is likely to increase.

In Kent, there is enthusiasm for a linear development along the southern side of the Thames estuary, where most of Kent's unemployment is situated, especially after the government has chosen a northern rail route from Folkestone to London. In all, 37% of the expected 30 000 new jobs for the next decade should be in manufacturing, services and distribution, as indirect consequences of the Tunnel and related infrastructures. Kent does not anticipate much increase in trade either with the rest of the UK or with Europe. Easy access to the Continent has always been a feature of Kent: those firms that have located there to take advantage of easy access will have already done so, and the relatively minor improvement resulting from the shuttle is not expected to make much difference.

Nord-Pas-de-Calais will have new jobs in Calais which could compensate for job losses in the ferry industry: customs officers and maintenance workers in the Tunnel and terminal and service jobs in a variety of tourist and trade developments. New jobs are also expected in the tourist industry along the coast, as well as the high-level service projects of Euralille and Euroteleport in metropolitan Lille. The main question is how much of the current unemployment will be compensated by this job creation. However, no one is able to give a clear answer because the various support projects have not yet been definitively sized. In this sense, local strategies still depend on investment and installation decisions outside of the region. Regional officials involved in the economic thrust are basing their efforts on the Tunnel to raise Nord-Pas-de-Calais' value in the London orbit, which is the target of the Japanese and Americans.

No major effect of the Channel Tunnel on the labour market is expected in West-Vlaanderen, with the exception of the Ostend port, and particularly the State-run ferry operator RMT. There are today about 1 800 people working for RMT: 1 300 in sea-transport-related fields and 500 in the catering sector. As a reaction to the Channel Tunnel, RMT has to rationalize to reduce costs. This may have a strong impact on the number of jobs. The region will be included in the triangle of the active economic centres made up of Lille, Calais and Zeebrugge. This may attract investment by foreign firms. In particular, distribution or transport-related firms, as well as subcontracting firms or subsidiaries, may settle in. This may be a conjugated process in connection with the future development of Nord-Pas-de-Calais.

In Hainaut, cooperation between British, Belgian and French businesses on Tunnel construction has formed 'lasting synergistic relationships'. This led to the formation of the 'Eurosynergy network', which includes European businesses participating in European and worldwide markets.

In Zeeland, the Channel Tunnel is not likely to bring new activities by itself. But with the WOV and an upgraded through-route, the region would have excellent road connections with the major north-west European cities, to be added to other locational advantages: two deep-sea ports, industrial land, environmental and recreational qualities. Transport industries and technology-based firms may be the most interested. There might also be spillover effect, with firms leaving Rotterdam and Antwerp to settle in Zeeland.

Cologne hopes to benefit from its enhanced strategic position in Europe: the Channel Tunnel, together with the high-speed rail link, offers the opportunity to establish a business in Cologne, that may have been located in southern England. But the other way round is also possible. So, the location elasticity will increase on a European scale for a certain group of firms with international operations, because the access to markets and business partners will be much easier from locations further away.

Outside the central area, some regions fear to be left out of this increasing elasticity.

Bremen, not being integrated in the new European transport network, fears being left out in the competition to attract new firms and investment capital.

In Scotland, regional authorities consider that one of the region's main competitors in attempting to attract inward investment is Ireland where there is also an abundant and available labour supply.

There is a fear that Ireland will become less attractive for international firms to locate once the Tunnel opens. Ireland has always competed with Scotland and Wales in attracting these firms and until now could offer as good or better incentives. When the Tunnel opens Scotland and Wales could be seen as connected to Europe and a lot more accessible, putting Ireland at a disadvantage.

(b) Transport industries

The study enabled us to review certain initial hypotheses, particularly concerning Tunnel impact on port operations (see also Chapter 5, Subsection 5.3.2).

It may be expected that the Tunnel competition will have two kinds of impacts on port activities: a direct impact on turnover by diverting part of the passenger and freight traffic; and an indirect impact on employment by compelling ferry and port companies to focus their activities on the most competitive ones and obtain new efficiency gains, that will result in reducing the manpower.

The hypothesis of a marginal effect on north Kent ports can be confirmed up to a point. Most observers do not expect any significant loss of trade in north Kent ports. In addition to freight services, it is expected that the Olau Line service from Sheerness to Vlissingen in Zeeland will not suffer. The Sally Line from Ramsgate to Dunkirk in Nord-Pas-de-Calais is a bit more problematical, and Folkestone on the south coast is unlikely to survive. Dover is, of course, the critical element. P&O and Stena Sealink are the major passenger and combined carriers; both are investing in larger vessels and clearly plan to compete. The Dover Harbour Board is also investing in the future. Despite all this commercial activity, Dover is still expected to lose jobs.

Of the three Nord-Pas-de-Calais ports, Calais should derive the greatest benefit from the Tunnel, not only directly, but also because maritime passenger traffic should continue at least at its present level. Dunkirk could accommodate some of the increase in Channel freight traffic. Boulogne is likely to lose most of its passenger traffic, although it could be the landing point for British tourists attracted by projected development on the Côte d'Opale. Over the longer term, it could take advantage of the A16 coastal motorway.

In West-Vlaanderen, it was originally assumed that the most obvious and probably most serious impacts for West-Vlaanderen would affect Ostend and Zeebrugge. According to regional experts, this initial assessment is only true for Ostend, not for Zeebrugge. Whereas Ostend depends heavily on its function as a transit port to Dover, the port of Zeebrugge has more diversified destinations in the UK, particularly to mid and north England. In addition, Zeebrugge will increasingly become 'a normal' deep seaport rather than only a ro-ro port to the UK.

Port activities in Zeeland will not be affected by the Channel Tunnel, as there will be no serious impacts on the ferry line Vlissingen-Sheerness and besides this, the ports are primarily handling bulk goods.

In Bremen, the initial assumption is that regional specialization combined with advanced logistics, plus the increased demand created by a growing German economy, will more than offset any losses of the transport and port industry in Bremen. The advanced logistics and other port services such as 'value-added service' are the main assets of the Bremen ports. For example, firms are increasingly relocating their product assembly and finishing, as well as stock, in the port area. With these assembly and handling functions, partly on an international scale, the Bremen port becomes a part of the production process.

In Brittany, Roscoff and St Malo might suffer from a possible rerouteing of Channel traffic towards the more easterly (but neighbouring) ports such as Cherbourg and Caen, and eventually towards central Channel ports such as Le Havre.

In Ireland, ports with direct lines to the Continent will be challenged by the Tunnel. As industry is demanding an efficient transport system to and from its European markets, it is putting pressure on the transport industries to improve service, and that could be the main impact of the Tunnel.

Pais Vasco is not expecting short-term effects. In the year 2 000, however, negative impacts might begin to affect port activities, with reduced traffic to and from the UK because of train competition. But this will only affect some segments of traffic (e.g. cars and items from the Mediterranean regions). Besides, given the long time span envisioned for this effect to take place, trade patterns may have changed dramatically by then.

Norte considers itself too far from the Channel for its port of Leixoes, although inefficient, to be affected by competition from the Tunnel.

In some regions, the impact of the Tunnel and related transport infrastructures is likely to be felt on other sectors of the transport industries.

In Nord-Pas-de-Calais, road and combined rail/road transport will probably increase and other multimodal platforms are being considered or have been decided on. In addition, the region will be serviced by the TGV network with main stops at Calais, Arras and Lille where there will also be road/rail platforms.

In Hainaut, the LAR platform will handle most road freight traffic coming from the Tunnel by the A1 and going to Antwerp, Gent or Rotterdam.

In general, road transport deregulation is considered likely to harm small carriers and to concentrate power in the hands of large international firms. But in the UK regions, deregulation should not bring any major benefits, since road transport is already deregulated, relative to the rest of Europe.

(c) Tourist industry

As for the extension of economic markets, the regions with the greatest expectations of an impact on tourism are in the Blue Banana, as well as Ireland and Scotland.

Kent and Nord-Pas-de-Calais have already experienced growing flows of visitors to terminal sites (500 000/year on the French side and even more on the British side). They are preparing for a 1993 tourist boom, Kent counting on a 70-million person market (within a day's drive of Kent), and Nord-Pas-de-Calais on 90 million. Kent attracts large numbers of tourists from continental Europe and expects that the shuttle will encourage more, rejecting the assumption that it will be a mere transit zone on the way to London. At the same time, there is a fear that the very efficiency and structure of the new infrastructure will take inbound visitors through Kent and towards Ashford, west Kent, London and beyond. In the other direction, the shuttle services will probably reduce the amount of time spent in Kent by Continent-bound passengers, striking a blow to the tourist industry in east Kent. Even worse, existing tourism might be seduced away to the new leisure developments in Europe. Apart from places like Eurodisney, the terminal facilities on the French side are likely to be far more extensive than those in Kent. Passengers travelling from the UK are far more likely to interrupt their trips in France than in Kent.

West-Vlaanderen sees itself as a possible destination for a new flow of short holidays from the UK. So far, British tourists have been underrepresented in Flanders' sea resorts, because of a lack of marketing for Belgian tourism in the UK. The Tunnel will provide an opportunity for more spontaneous trips and will attract more of the British market, although the increase is anticipated to be modest. This may be a welcome boost for the seaside resorts, which have been dominated by Belgian visitors, but it would be a mixed blessing for Brugge which is already suffering from overexposure to tourists.

Hainaut also hopes that the Tunnel and TGV will encourage British tourism.

British tourists in the Netherlands prefer to go to Amsterdam and not to regions like Zeeland. But they may be attracted to travel to Zeeland by an easier access due to the WOV. However, the number of British tourists in Zeeland should remain low. They seem to have had a rather unpopular image in recent years: 'little money', 'beer' and 'troublemakers' are the keywords. In addition, if one considers the already congested summer recreation facilities and also the environmental capacity, the question is whether there is a need for even more tourists in Zeeland.

Cologne will also expand its tourist business attracting even more visitors from the Netherlands, Belgium and the British Isles who will be brought much closer. Just as the weekend trip from Cologne to London will become convenient and affordable, so will the weekend trip to the museums in Cologne for the British tourists. As the accessibility of Cologne for short vacations will increase through the new high-speed rail connections, the city will be more integrated into city tourism than it is today.

The English are showing an increasing interest in the Continent, and Brittany is a target: mainly buying holiday homes, but also an increase in English tourists.

Scotland is counting on possible generation of new Channel tourist traffic due to the Tunnel. How realistic these expectations are is questionable. Indeed surely distance and transport facilities are not the unique determining factors and Scotland will remain an attractive destination both for continental and UK tourists. However, while the Tunnel might encourage increased numbers of continental Europeans to visit the UK, Scotland may be disadvantaged by its relatively poor access, since a through-TGV access seems quite unlikely for the predictable future. At the same time, it is possible that the Scottish tourist industry could suffer, over the short term at least, subsequently to the opening of the Channel Tunnel, as English holiday-makers (90% of tourists in Scotland) could make use of the improved links with the European mainland rather than visiting Scotland. The opening of Eurodisney, among other factors, could increase the tendency, particularly for tourists from south-east England, to holiday abroad rather than venturing north to Scotland, in the short term.

In Ireland, tourism is a major economic asset responsible for about 69 000 jobs. But there is a fear that Ireland will be the only country relying on air and sea transport. The elimination of airport and on-board duty-free sales should increase air and ferry ticket prices; that might prevent continental visitors from going to Ireland. The Tunnel will also provide easier access for continental tourists to Scotland and Wales which offer similar holidays to those in Ireland. In order for Ireland not to lose part of its market share to these regions, it must put extra effort into marketing the attractions of Ireland. The services and capacities of direct routes from mainland Europe must be improved to provide direct access to Ireland.

Pais Vasco is not expecting any increased tourism from the UK, even though travel time is substantially reduced by the Tunnel (even before changes in the Basque rail system are introduced), British tourist demand is centred on Mediterranean beaches and thus no increase in the number of visitors is expected (at least, not from just the Tunnel). Business travellers will continue to use planes to Bilbao, which are not expected to suffer from increased train competition.

In Norte, the Tunnel is not regarded as being able to influence the tourism between the region and the UK; it simply might divert visitors from air to rail or road travel.

(d) Land and housing demand and prices

In Kent, if Ashford is the only town to have fast direct services to London, land and housing prices may increase by 6 to 10%, depending on the amount of land released for development.

Land and houses are cheaper on the continental bank of the Channel. Thus, it is not surprising to see the first stages of inflation based on a growing demand and a tendency toward higher prices.

So far British demand is primarily oriented towards holiday homes on the French coast in Nord-Pas-de-Calais and further south in Brittany. But land planners and economic development officers in Nord-Pas-de-Calais are waiting for an increase in British demand for office and plant space. They assume that demand could be particularly focused on Lille. In this case, we would see developments in the Belgian market, which is at the present time better on the Walloon side of northern metropolitan Lille, in Hainaut (at Tournai) or on the West-Vlaanderen coast. This phenomenon should not affect Zeeland, where real estate and land are already more expensive than in Belgium and France.

(e) Environment

Local environmental protests have been serious in Kent where the main damage has been the loss of land to the Tunnel, the dumping of sub-sea spoil at the foot of Shakespeare cliff, and the reduction of seaweeds. However, the Tunnel is now a fact and that has diminished the level of protest. Benefits are expected from an anticipated transfer of traffic from road to rail. There remains a conflict between British Rail and Kent County Council on the maximum level of noise that can be permitted. Building the new high-speed railway line mostly in tunnel would lead to enormous costs. Solutions could be sought through vertical alignment. Kent County Council have been attempting to convince BR that they need to adjust the vertical alignment to minimize environmental damage.

In Nord-Pas-de-Calais, construction of the Tunnel is raising ecological problems which, apart from noise and dust affecting those living nearby, are mainly related to excavation and backfill. Nature protection groups, less organized than in Kent, have not imposed the same constraints on Eurotunnel as in England. However, they worry about the situation and question the Eurotunnel impact studies, being sceptical about restoration of the area.

West-Vlaanderen, being close to the Tunnel, is likely to suffer some indirect negative impacts on the environment, such as the effects on nature and open space by the coastal motorway going to Calais. Another indirect impact consists of the increase in traffic volume expected, with all the negative effects of noise, pollution and ecological damage.

The main consequence that the Tunnel will have on the environment is that the related TGV lines are foreseen as likely to cut the country in half.

In Zeeland, environmental questions are raised by the WOV project and by the possible upgrading of the north-south route from Randstad to Belgium. More pollution, more noise and ecological damage would be the consequences; negative impacts on the foreshores, which are important feeding places for all sorts of waterfowl, are feared by environmental groups strongly opposed to the WOV.

Interpretation

Two zones may be distinguished: one including the central area as well as Ireland and Scotland, where strong effects are expected, and the other, peripheral, including Bremen, Brittany, Piemonte, Pais Vasco and Norte, less subject to possible impacts of the Tunnel (see Figure 4.15).

Explaining variables are classified into general and specific variables and they will be examined following the main distinction in two zones, but also within each of them.

General variables

The improvement of transport infrastructures may end up accelerating goods and passenger flows in the whole central area. Then, the Tunnel impact will vary according to the various regions' capacity to capture part of these flows. This capacity has to do with:

(i) transport logistics and services to firms;

(ii) tourism, accommodation, land and housing markets, natural and cultural environment.

Figure 4.15. Impacts on regional development expected by regional actors

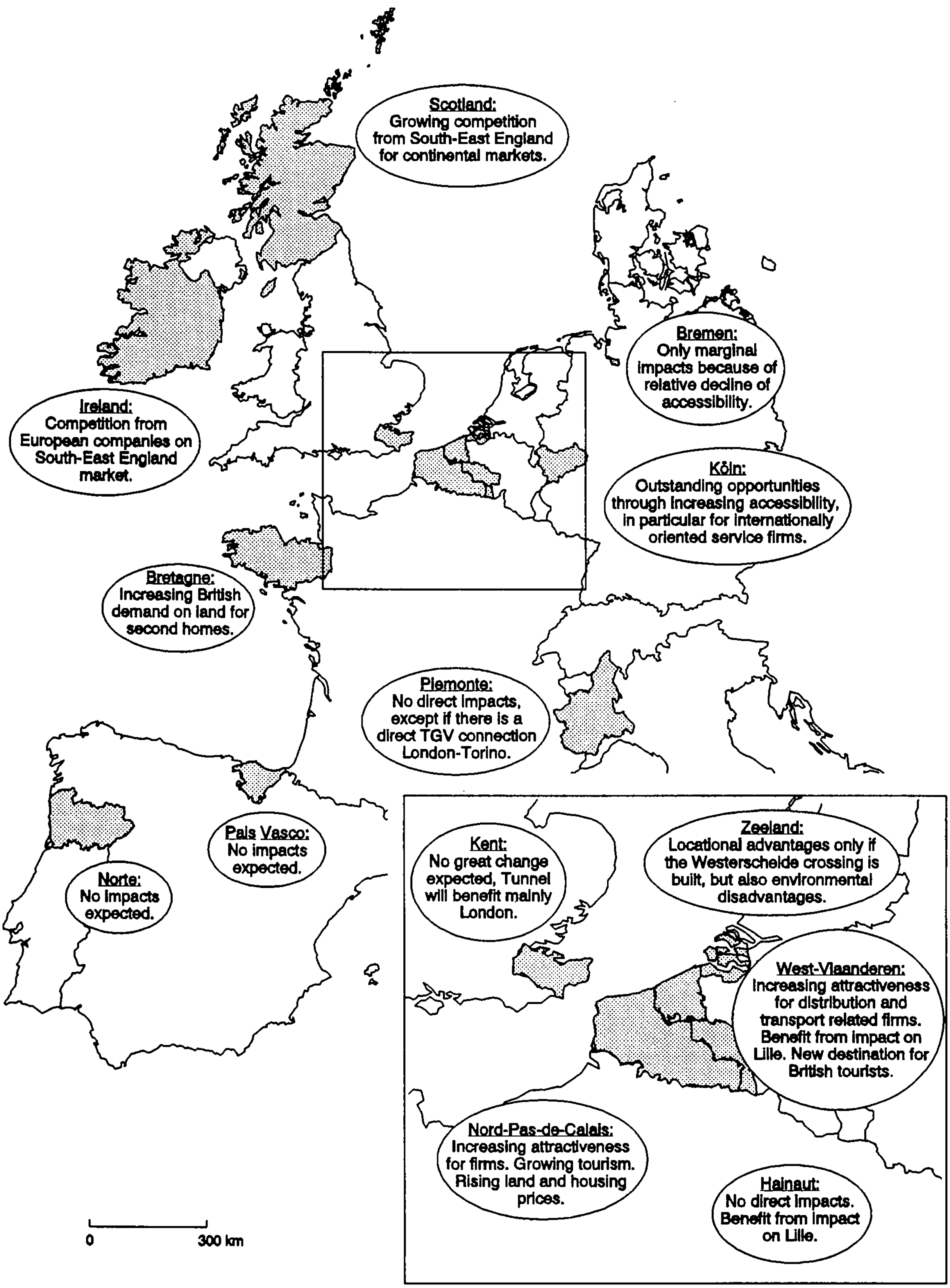


Table 4.11. Impacts on regional development

Regions	Expected impacts
Kent	No great change expected since the Tunnel is viewed as not making a big difference in access to the Continent, which was already easy, but being between London and the Tunnel might result in failure to attract new firms and tourism. Environmental benefit from an expected shift from road to rail.
Nord-Pas-de-Calais	The region may become more attractive for European firms. For Asian or American companies, it may be a second choice since it is now closer to London. Tourism is expected to be more important. Land and housing prices up.
West-Vlaanderen	Increasing attractiveness of the Lille-Calais-Zeebrugge triangle for distribution and transport-related or subcontracting firms and subsidiaries. Kortrijk would like to benefit from the impact on Lille. Ostend should be more affected than Zeebrugge. The region becomes a new destination for British short holidays.
Hainaut	No feeling of a direct relationship between the Tunnel and installation of new firms. Looking for new markets and tourists through Lille.
Zeeland	Locational advantages (two deep-sea ports, road connections, enough industrial land, quality of the environment) for transport industries and technology-based firms. With the WOV project and an upgraded north-south route, the region might attract more business and tourists, but there is not a general will to build this infrastructure which would be harmful for the environment.
Cologne	If location decisions are partly based on Cologne's position within the new transport networks, Cologne will certainly benefit, particularly high-level service industry and high-value goods producing firms. Cologne will also expand its tourist business, especially in the field of short holidays.
Bremen	Only marginal impacts are expected. Maybe a slight negative effect on the shipbuilding industry if Channel ferries suffer from Tunnel competition.
Brittany	Channel crossing from Roscoff and St Malo should not be much affected. Increasing British demand on land and secondary housing.
Piemonte	No direct impact expected, but possible impacts on industry through high-speed rail connections: hope to sell the Italian technology.
Scotland	Competition from south-east England for continental markets (trade, industry and tourism). Competition from Ireland — attracting new firms (similar assets).
Ireland	Competition from European traders on south-east England markets. Competition from Scotland and Wales/international firms. Fear that VAT on air and sea tickets and the abolition of duty-free sales might deter continental tourists from coming to Ireland.
Pais Vasco	No impact expected.
Norte	No impact expected but the opening of the Tunnel will coincide with industrial modernization and the need for better links with the rest of Europe.

The variables responsible for variations of the impacts through the core regions are:

(i) the main features of their economic activities: Kent being a residential and recreational area, neither major industrial firms nor international banks are likely to settle there as they would rather be in London;

(ii) the internal capacities to transform the region's economy: they may be weak as in Hainaut or high as in Nord-Pas-de-Calais;

(iii) the type of gaps to be filled: they may be political, like the debate on whether Zeeland should be crossed by a high-speed road over the Westerschelde, or economic: lack of jobs in Nord-Pas-de-Calais or lack of housing in Cologne;

(iv) how the tunnel fits into their economy: Nord-Pas-de-Calais has long been a transit and trade region and in the future, the Tunnel terminal as well as the TGV stations in Calais, Arras and Lille may strengthen this function;

(v) how important the access either to the Continent or to the UK and Ireland is: it is vital for Scotland and Ireland for example.

Specific variables
Following sectors, two main variables have to be taken into account:

(i) economic specificity: the main impacts on the economic development will be felt in the maritime regions where ports and ferry companies will have to face new competition in cross-Channel traffic;

(ii) links with the Tunnel: some regions have been qualified 'at a hub' and others 'along a pipe'; the former are expecting greater effects on firms' attraction, even though they lie further away from the Tunnel than others (Cologne as compared to Hainaut).

Sectorial effects
(i) Increased elasticity in access to markets and firms' location: shorter transport times allow a more open economic structure of the whole area; thus new rivalries may occur and the various regions will probably try to improve their opportunities on the grounds of their own assets; the meaningful variable is the above-mentioned internal capacity of transforming the economic system.

(ii) Tourism will be enhanced but the Tunnel might have contradictory effects, bringing in new visitors but pulling away others. Success in developing tourism will rely upon new regional policies but also on EC decisions that may have an impact on air and ferry ticket fares.

(iii) There will be a general readjustment of land and housing prices within the core area.

(iv) Environmental considerations will be mediated by the economic and financial benefits expected from the Tunnel; the lower the benefits, the lesser the acceptance of ecological damage.

To conclude, there will be a major discrimination between regions simply waiting for good or bad effects and regions trying to enhance the positive effects the Tunnel may have on their development. The distinction between these two categories is to be found in a compound variable made up of geographical situation and strategic capacity.

4.3.4. Impacts on the intra- and interregional balance

These effects, as identified and analysed in the preceding chapters, might be described as absolute effects in that they directly affect the region by directly or indirectly modifying certain aspects of its infrastructure or its economy. But we must also take into account relative or differential effects which can only be assessed by comparing the degree of change and the development of several regions. Thus an area unaffected by the Tunnel in absolute terms might be disadvantaged because other areas will benefit.

These differential effects are partly independent from the distance to the Tunnel, the main factors being access to the Tunnel and, more generally, connection with the new European high-speed network. The Tunnel is not only operating as a part of this network giving it more effectiveness, but it also considerably extends the network's economic dimension by uniting the UK and continental parts. Thus it strongly contributes to reinforcing the integration and efficiency of the best-connected areas compared with the peripheral ones. As a relative concept, peripherality can be perceived at all geographical levels. Within a region, a non-connected area will become peripheral and the remotest Community regions are fearing an increased peripherality. Therefore, relative impacts may affect the intraregional balance between different areas within a region as well as the interregional balance, that is the comparative competitiveness of the whole Community regions.

Regional actors are not everywhere fully aware of the challenges due to intra- and interregional balance changes. Particularly, the Tunnel's remoteness may, in some cases, affect their perception, leading them to think that there is nothing, either good or bad, to expect from it.

In modifying the advantages enjoyed by the regions in economic competition, whether positively or negatively, the reinforcement and redirection of the central system of transport and exchange will definitely have an influence on intra- and interregional disparities, and therefore on inter- and intraregional competitiveness.

(a) Impact on intraregional balances

We might anticipate that the Tunnel will have different effects on specific areas within a given region.

In Kent for example, aside from the fact that the Channel ports will certainly be more affected than the Thames estuary ones, there is a risk for the central part of the region of becoming a pipe between London and the Channel.

In eastern Nord-Pas-de-Calais, the depressed Hainaut and Cambrésis should not benefit from the Tunnel at all, thus their peripherality should be increased.

On the contrary, in West-Vlaanderen, an area still lagging behind like the Westhoek, could improve through its cross-border location and intraregional disparities could thus partly decline.

Hainaut could well go across an inversion of a long-established balance where the more developed part was the Mons-Charleroi area and this relies more on the TGV line than on the Tunnel itself.

In Zeeland, the effect of the Tunnel on the intra-regional balance is likely to be somewhat distorted by the WOV: it is locally assumed that without the WOV, the Channel Tunnel will reinforce the division of Zeeland, and that with it, the Tunnel may contribute to stimulating a southward orientation of northern Zeeland, linking more closely the two parts of the region.

It is more surprising to observe such differences in the more remote regions, where they appear in only a few.

The fear that Scotland will become more peripheral in Europe is especially felt in its most remote parts, the Borders and Grampian Regions; the former lacks rail and road linkage to the Tunnel; the latter sees as more important than the opening of the Tunnel itself the need for efficient and reasonably costed links to mainland Europe and a good transport infrastructure connecting it to the rest of Scotland and the south of England.

Without expecting any direct impact from the Tunnel, Norte is looking for an improvement of road and rail links with Europe, and anticipates new development in the least-developed inland areas through better accesses allowing for tourist flows and for decongestion of the main industrial zones.

Findings

Table 4.12. presents a general view of our observations.

The issues mentioned for each region reflect major regional concerns as identified in the monographs. These monographs are of course much more detailed. The tables show only the major points and in this form present a highly contrasted picture of the effects anticipated, hoped for or feared by each region.

These regions differ greatly in size, with surface area on a scale of 1 to 195 and population on a scale of 1 to 6.68. Their distance from the Tunnel varies from immediate proximity to almost 2 000 km. Prudent interpretation of the data presented in the table is therefore essential.

Interpretation

We might begin with a more detailed description of the variables which in our opinion explain these differences of impact on the regional areas.

Variables

The impact of the profound changes in the European transport system on different areas within the regions will differ depending on the economic and geographical position of the regions. We might identify a few variables that help explain why the Tunnel will not have the same impact on different parts of a given region.

(i) The regions lack uniformity in terms of their economic situation. Some areas or towns have a level of activity that is manifestly super-

Table 4.12. Impacts on the intraregional balance

Region	Issues
Kent	The Channel ports will be more heavily affected than Thames estuary ports. Folkestone will be more strongly affected than Dover and Ramsgate. Concerning BR traffic, if the Ashford international passenger station is built, it will have an impact on the core of Kent. If not, the impact will be derived from London and will be based on a system of service to Kent from London.
Nord-Pas-de-Calais	Metropolitan Lille will have a chance to develop financial, logistic, R&D and art functions. Being opened up by road infrastructures, the coastal area may have the opportunity to modernize. Artois and the former mining area may decide their own development based on metropolitan Lille. Hainaut and Cambrésis remain outside of the range of the Tunnel and TGV effect.
West-Vlaanderen	The two port cities of Zeebrugge and Ostend may experience increasingly divergent development: positive for the former, negative for the latter. Kortrijk's future seems quite secure, connected to metropolitan Lille.
Hainaut	The economic environment and infrastructure combine to favour a shift of the region's economic focus towards the west. Western Hainaut (Mouscron and Tournai) may benefit from the development of Lille and Kortrijk. In the eastern part, Charleroi needs to be more closely linked to Brussels. Mons' future is more problematic.
Zeeland	If there is a fixed link across the Westerschelde (WOV), the impact should be similar throughout the whole region. If there is no WOV, the Tunnel will reinforce the regional separation and strengthen the spatial differentiation: new opportunities for the already southward-oriented Zeeuwsch-Vlaanderen, but not for mid and north Zeeland.
Cologne	No foreseeable effect on intraregional balances, as the whole region will benefit along with the city of Cologne.
Bremen	No foreseeable effect on intraregional balances.
Brittany	Nobody is expecting or fearing any strong impact. Maybe the Channel ports could suffer slightly, while TGV-served areas may benefit.
Piemonte	No foreseeable effect on intraregional balances.
Scotland	Glasgow and Strathclyde may derive new opportunities from improved road and freight connections. The position of Edinburgh and Lothian seems relatively better for tourism and financial services. The situation of Grampian and the Borders should be more difficult.
Ireland	Dublin port may gain a larger share of the freight and passenger market than it has at present, and the southern ports may lose out. The western regions Chamber of Commerce, fearing that the west of Ireland may become more peripheral, have proposed that a study be undertaken to assess the benefits of a road linking all the western regions to southern ports, Euroroutes and the Channel Tunnel.
Pais Vasco	The development of the high-speed transport system would be more beneficial to the San Sebastian area. Nevertheless, once the Basque Y is built, accessibility to all the region is guaranteed.
Norte	It is anticipated that any direct or indirect improvement of transport infrastructure may be more beneficial to inland areas of Norte by making them more accessible to tourism and more closely linked to Spain and Europe.

Source: Eurostat (1989).

ior or inferior to the regional average, which gives them a greater chance of grasping opportunities or alternatively a greater vulnerability to sweeping changes.

(ii) Coastal areas have a greater or lesser vulnerability to the opening of the Tunnel. Their ports are facing the emergence of a new rival and the extent of their fear depends on their geographical position and the type of activity in which they are involved.

(iii) The important factor for inland areas is their place in the new transport system and their proximity to or remoteness from the major nodes of communication.

Typologies

Maritime regions

In these regions, the probable impacts of the Tunnel are affected both by the maritime exposure of ports and the main direction of trade. Negative impacts may also be corrected by appropriate policies.

Kent, Dover, Ramsgate and especially Folkestone, which is located on the Channel, are deemed to be more vulnerable than the more northern ports: Sheerness, Grain, Dartford and Chatham. In Brittany, only ports located on the northern coastline (especially St Malo and Roscoff) seem to be concerned. Despite their remoteness, Scottish ports look at the question differently depending on their eastern or western location. The Tunnel is not expected to have any effect at all on the western ports, whereas the eastern ports envisage playing a part in the freight and passenger transport market between the United Kingdom and the Continent. In Ireland, the eastern ports, especially Dublin, are expected to benefit more from the new situation than the southern ports.

Even if located on the same coast, the ports in a given region may differ in terms of direction of trade, being diversely concerned by the traffic between the Continent and the UK and Ireland. This is true for the ports of Nord-Pas-de-Calais. Dunkirk does not feel particularly implicated and Calais is more concerned than Boulogne: on the one hand, one it is going to lose some of its ferry traffic but, on the other, it will gain through the Tunnel terminal and related activities. In Pais Vasco, although Pasajes ships cars to the United Kingdom, a greater impact is assessed on that port because its relative specialization in high-value-added goods (e.g. cars) that already come by train to the harbour is greater than in Bilbao (where there are no car exports or imports).

Policy choices, too, may affect the Tunnel impact on port activities. This is particularly clear in West-Vlaanderen where the dynamism of Zeebrugge seems to protect it from the most harmful consequences; this does not appear to be the case for Ostend, despite its seeming optimism.

Blue Banana regions

Among the regions nourished by the central part of the new system of transport, we should identify those that are close to a large city and, subsequently to a major node of communication.

Thus southern and eastern Kent, which are already depressed, will not benefit in the same way as northern Kent from the new opportunities opened up to the regions south of London. In Nord-Pas-de-Calais, Lille plays a role similar to that of London although on a lesser scale. The closer areas (the coast and Artois) hope to gain certain advantages, while the more neglected (Valenciennes and Cambrésis) want better connections to the network. In West-Vlaanderen, Kortrijk is partly dependent on the Lille agglomeration, whereas the port cities face more serious competition from the Tunnel. Hainaut is divided: western areas (Mouscron, Tournai) see themselves as included in the orbit of Lille; to the east, Charleroi wants better connections with Brussels. Zeeland is in a slightly different situation: Zeeuwsch-Vlaanderen is drawn towards the towns and major axes of the south, while inland Zeeland is to some extent unwilling to abandon its isolation.

Large and small regions

In reality, the size of the region has a significant effect on the nature of the problem. The disparities are particularly significant in large regions. Thus, allowing for the necessary changes, we find the same problems that arise in Kent in the coastal area of Nord-Pas-de-Calais, whereas Lille faces similar problems to Cologne on a lesser scale. Likewise, although there are some similarities in the situations of Glasgow and Bremen, the other Scottish regions, the Borders and Edinburgh for example, are quite different.

(b) Impact on interregional balances

Will the opening of the Tunnel modify the position of the regions within Europe by significantly modifying the factors of competitiveness? The observations that emerge from the regional monographs are extremely varied and not immediately comprehensible. They need to be interpreted.

Findings

Table 4.13. below shows the probable impact of the Tunnel and the system of transport associated with it on the relative position of the regions in European interregional competition.

Interpretation

Variables

It appears necessary to take three groups of variables into account to understand the differences in appreciation of the impact on the interregional balance: geographical, economic and political variables.

(i) We have taken two geographical variables into account. The first is distance from the Tunnel: the greater the distance, the smaller the impact the Tunnel is expected to have on the region's relative competitiveness. However, distance is not just a question of kilometres — the quality of infrastructures and the continuity or discontinuity of the network are also important factors.

Position with respect to the Blue Banana, i.e. with respect both to the economic heart of Europe and the new European transport system, is the other geographical variable. Hopes and fears vary radically depending on whether the region in question is inside or outside the Blue Banana.

The regions closest to the Tunnel and best served by it hardly mention the additional advantages they will be able to derive from it. And it is significant that reinforcing interregional disparities should be felt chiefly in the regions located both at an average distance from the Tunnel and unsatisfactorily connected to it.

(ii) Two economic variables have an influence on the foreseeable impact on the relative competitiveness of the regions. One is the share of the region's external trade likely to be affected by the opening of the Tunnel: trade with continental Europe for Kent, Scotland and Ireland, trade with the British Isles for the continental regions. We might expect the impact to be greater for the first group than for the second.

The other economic variable is, naturally, the region's present competitiveness as measured by its economic and demographic importance and the productivity of its factors of production. The higher it is the less we can expect it to harbour fears for the relative position of the region.

(iii) There are three political variables to be taken into account. The first is the choice of development priorities, especially the choice between quantitative growth, improvement of living conditions and ecological concerns, which modify expectations with respect to the Tunnel and therefore the way its impacts are perceived.

The second is the way in which each region perceives its environment (hostile or friendly) and the nature of the relationship it seeks to establish with it (rivalry or cooperation).

The third is the region's capacity to formulate and implement a strategy to promote the favourable effects of the Tunnel or compensate for its adverse effects.

We might note that these variables are not independent of each other. Thus the relative competitiveness of each region is not unrelated to its position with respect to the Blue Banana; its attitude to the others is very probably related to the region's relative competitiveness and its strategic capacity.

However, there is no simple explanation for the foreseeable development of the interregional balance. For this reason we present a brief typology below, based on observations found in the monographs. (Figure 4.16. presents the summarized expected impact on case-study regions.)

Typologies

Dependent regions

According to the monographs, Scotland and Ireland would appear to be the most vulnerable to the new factor of competitiveness generated by the Tunnel. Is this due to the subjective approach of the authors? We do not believe so. Rather we believe the reason must be sought in the special state of dependence that characterizes both regions.

The relative importance of trade with continental Europe makes them more dependent on the Tunnel in the sense that it modifies the relative cost of imports and exports. At the same time, their remoteness from the Tunnel places them in a position of inferiority with respect to closer or more easily accessible regions.

Table 4.13. Impacts on interregional balances

Regions	Issues
Kent	Situated in south-eastern England, between London and the Tunnel, Kent is in the best situation in terms of interregional competitiveness. There is no certainty that Kent would like to reap the full economic benefits, because that would imply environmental effects and changes in well-being that not all residents are willing to accept. Besides, Kent is dependent on additional investment (in infrastructure and industry) it cannot control.
Nord-Pas-de-Calais	The region's position in interregional competition has not been fully gained. While its advantages are on the increase, they are not really clear. Its lack of spacial uniformity clouds its image. It has difficulty placing its confidence in Lille's leadership, without which it will be difficult to carve out its place between London, Paris, Brussels and Cologne. A strong metropolitan Lille could, in fact, be a force of attraction to neighbouring areas, particularly Hainaut and West-Vlaanderen. In keeping the best of the new opportunities, the region faces its lack of independent financial capability, that regional public actors try to compensate for by an appropriate policy. However, they have to deal with intraregional rivalries.
West-Vlaanderen	Because of its autonomous growth potential, West-Vlaanderen does not seem to fear the other regions, particularly Hainaut. Southern West-Vlaanderen (Kortrijk and Westhoek) could always turn towards metropolitan Lille, if it succeeds in its ambition to become a strategic node.
Hainaut	Hainaut has not yet found its place in the overly recent Walloon Region. Because of higher dependence from external decisions, it knows that it is in a weaker position than its Flemish neighbours, but there appears to be no possibility of building alliances. At the present time, it seems to believe that its only salvation is in gathering the support of other French-speaking regions: Brussels and Nord-Pas-de-Calais.
Zeeland	This region is facing a choice: either it ignores interregional competition and lets its lack of uniformity increase; or it decides to improve its position and necessarily accept the fixed link (WOV).
Cologne	Cologne justifiably considers itself well placed among the regions. It is wishing for a quick implementation of the high-speed rail links via Brussels to Paris, the Channel Tunnel and London, since its main concern is to be connected before Frankfurt, its rival city.
Bremen	Bremen may see its position deteriorate in relation to regions in the Blue Banana. The competition among North Sea ports is seen as more important than the Tunnel. Nevertheless, Bremen fears becoming more peripheral if it is kept away from the new European high-speed network.
Brittany	Brittany does not seem to envisage other risks in the additional competition, than the (undoubtedly weak) risk that could affect Channel ports. It may suffer, though, from the new opportunities given to large metropolitan areas (London, Paris, etc.) which will become even more attractive for service industries.
Piemonte	Regional actors do not foresee any impact on interregional balances. However, they are strongly concerned by new transalpine links with the economic core of Europe and may fear not being connected to the high-speed network.
Scotland	Disparities between north and south may increase within the UK, depending on investments in north-south rail links. Its extreme will cause Scotland to suffer more than the other regions. It is particularly fearful that all the advantages of a fixed link with the Continent will be cornered by south-eastern England. Without a high-speed link to London and the Tunnel, Scotland's peripherality will increase.
Ireland	The only real island left after the Tunnel opens, Ireland believes that it will become increasingly peripheral in respect to the economic heart of Europe. This is felt to an even greater extent because its traditional rivals, Wales and Scotland, are thought to be likely to get better connections.

Table 4.13. Impacts on interregional balances (continued)

Regions	Issues
Pais Vasco	In absolute terms, the region is not afraid of reaping disadvantages. Other regions, nevertheless, particularly those of the Blue Banana, have chances of progressing more rapidly. Despite its rather good current autonomy, the Basque economy will be affected comparatively by higher rates of investment and growth in other regions due to their better integration in the new network.
Norte	All regions in southern Europe will have their external links improved more rapidly than Norte. This could worsen Norte's position and reactivate emigration.

Source: Eurostat (1989).

Thus, Scotland is disadvantaged compared to the southern regions of the United Kingdom and especially compared to south-eastern England. It fears that tourists will stop there rather than travelling on to the north, that foreign firms seeking a local base will prefer the proximity of the continental market to the traditional advantages of Scotland and that, likewise, firms currently located in Scotland will begin to ponder the advantages of staying in the region.

The geographical remoteness of Ireland is aggravated by its insularity, and its competitiveness with its traditional rivals, Wales and Scotland, could be adversely affected. Its insular position further places it in a position of inferiority compared to all the European countries. This would in any case seem to be a commonly held opinion.

Cross-Channel space

The cross-Channel space constitutes a zone of interregional rivalry in which the rules of the game are modified by the appearance of the Tunnel. Five of our regions belong to this space: three of them, Kent, Nord-Pas-de-Calais and West-Vlaanderen, are more or less preparing themselves for this space reshaping; two other regions are waiting more passively: Hainaut and Zeeland.

These are the regions expected to be most affected by the opening of the Tunnel. At stake is the market for freight and passenger transport between the UK and continental Europe, the implantation of new activities in response to new opportunities, tourism and finally, the restructuring of this space (road networks, infrastructures, towns).

The opportunities open to each of these three (or five) regions are extremely varied and they cannot expect to play the same cards.

Kent is in a relatively favourable position, which would appear to be due to its proximity to London rather than to any specific advantages of its own. Nord-Pas-de-Calais is concerned about its capacity to obtain the maximum benefit from its nodal position between Paris, London, Brussels and Cologne without fully understanding that its greatest opportunity lies in the development of Lille. West-Vlaanderen is less inclined to ponder the matter; it relies on its own dynamism and hopes to benefit from the impetus given to its environment. The competition is centred on these three regions. Should they enter into competition against each other or should they opt for a greater or lesser degree of cooperation? The question has not yet been answered and we might ask whether it ever will be completely.

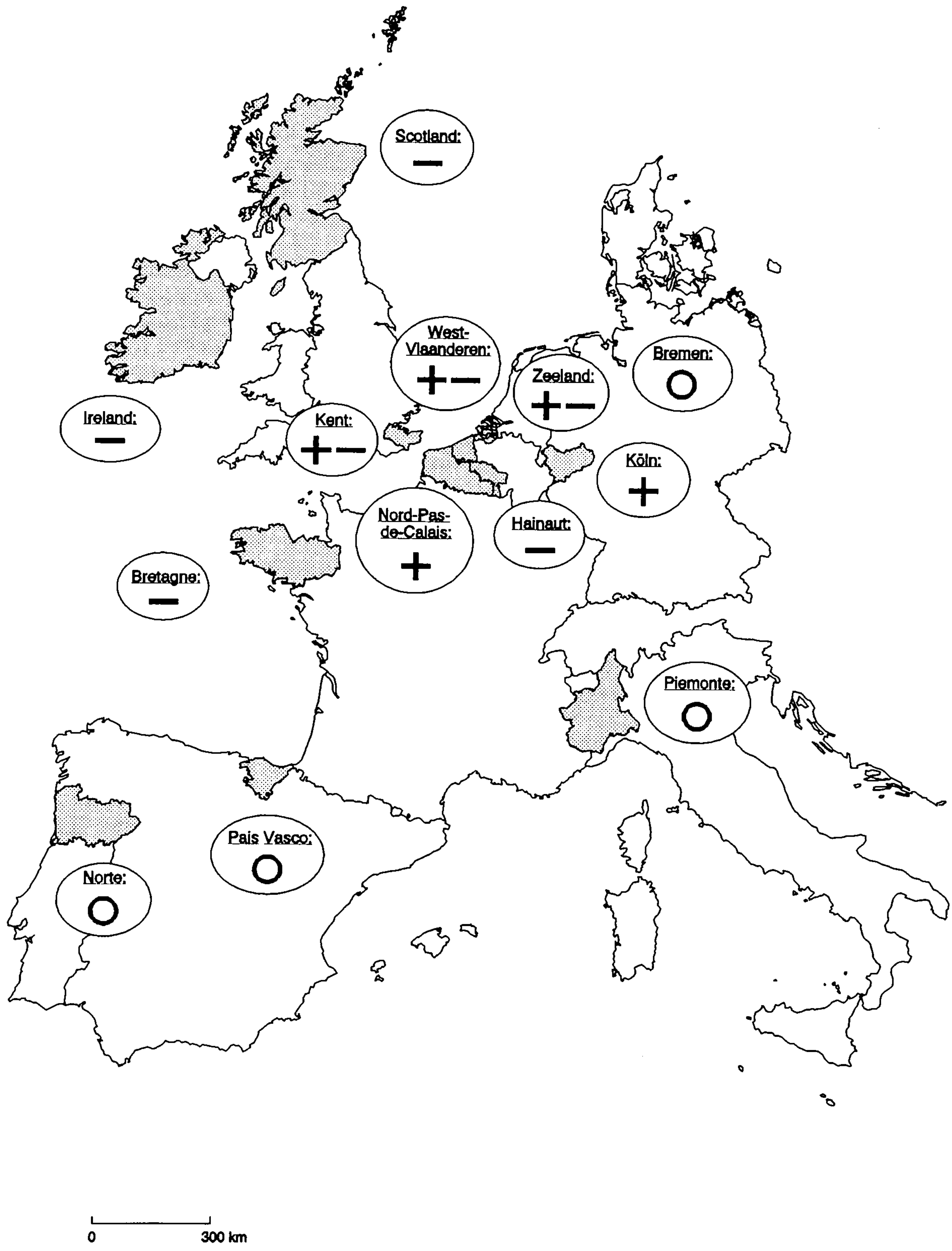
The opportunities open to the two other regions are minor in comparison, although this is due not only to their more peripheral position. With the exception of a few areas, Hainaut suffers from a currently depressed environment and difficulties in its relationship with the Flemish provinces; it tends to look for support to the closest French-speaking regions (Nord-Pas-de-Calais and Brussels). Zeeland has not yet definitively decided whether it will enter into the competition by taking advantage of its position in this cross-Channel space or alternatively seek to remain somewhat on the outside.

Central regions and peripheral regions

The Tunnel redirects and reinforces the European transport system. It brings London and south-eastern England into closer contact with the rest of the Blue Banana, reinforces the latter's cohesiveness, and encourages development of exchanges between its constituent regions, giving them a greater force of attraction and a better chance of economic development.

This distinction between central and peripheral regions was not, of course, created by digging a Tunnel under the Channel. However, the spectacular aspect of the Tunnel means that it has

Figure 4.16. Global impact on regional development following the regional analyses



become a symbol of this distinction — it strikes people as highly significant and when seen from a distance encourages them to ask questions, particularly questions concerning the increasing disparity between centre and periphery.

However, these questions are not simply being raised in regions that are manifestly remote or cut off from the economic centre of Europe. They are also being raised in the Blue Banana itself, and emerging gradually in regions and areas only slightly touched by the new systems of transport, which are beginning to ask whether they should resign themselves to being corridors of transit between large urban centres where all creative and decision-making activities are concentrated.

Indeed, in the Blue Banana itself, metropolitan areas like Cologne are better placed than intermediary regions such as Hainaut. Cologne appears to have only one preoccupation, which is the delivery in the best possible conditions and as soon as possible of the new fast railway lines linking it to London, Brussels and Paris and the reinforcement of its role as the gateway to Germany. Hainaut is keen to be more than just a corridor and continues to believe that the TGV will stop at Antoing. The same applies to Kent, which is not certain to have its international passenger station. In this respect, Nord-Pas-de-Calais has a relatively privileged position. It remains to be seen whether it will take full advantage of this position.

Zeeland, a sort of peripheral enclave within the Blue Banana, is not sure what position to adopt. Conversely, West-Vlaanderen knows that its future depends partly on reinforcing its connections with the new system of transport, especially via Lille.

As we move further away, the vision of objectives becomes clearer; the remoter regions want to avoid becoming even more peripheral, to halt the process of peripheralization. This is evident in Bremen and Scotland, as in Ireland, Pais Vasco and Norte. Only Piemonte and Brittany seem relatively indifferent to the risks.

4.4. Response of regional actors

4.4.1. Transport

(a) Access to the Tunnel and related infrastructures

Kent roads are already among the most heavily used in the country and any increase in traffic due to the Tunnel will add to growing commuter traffic in the area. The current level of road investment is the highest for any county (10% of the total roads budget) and the Freight Transport Association is constantly lobbying the government to continue its road-building programme. As for Kent County Council, it hopes that a significant amount of freight will transfer from road to rail. British Rail is investing in order to capture this market: UKL 1.1 billion to upgrade railways to the Tunnel, UKL 700 million to improve Kent trains and UKL 150 million to have new high-speed electric freight locomotives and to strengthen capacity around London. But passenger high-speed trains are not expected before the end of the century which will correspondingly reduce the performance of the system linked to the Tunnel.

Nord-Pas-de-Calais roads and motorways are also characterized by heavy congestion, especially the north-south A1. But, as mentioned above, the road network is being modernized and expanded. Thus Tunnel access should not be a problem in 1993, either by road or rail. The regional council has been backing State funds in order to get things ready in time. An additional clause to the State/Region Plan was added to launch a cross-Channel road plan financed two thirds by the State and one third by the region.

TGV Tunnel access from Lille and a certain number of intermediate locations has led the regional council to carry out a joint analysis with the SNCF and the Ministry of Transport that would involve handling the expenses of a certain number of secondary links and acquisition of a regional TGV.

(b) Maritime transport and the Tunnel

The Tunnel opening may affect maritime transport in regions where there are direct maritime links between the United Kingdom and the Continent. Each port authority has analysed the Tunnel's probable impact from its own perspective and is reacting or planning to react in consequence.

Ports

In Kent it is clear that Dover, the port most affected, expects to survive and grow, while Folkestone is not likely to do so and may revert to a recreational or fishing port. The Thames estuary ports are expecting to be relatively unaffected, while Ramsgate's future is uncertain. Strong arguments were put forward by those interviewed, but it should be noted that there may be some wishful thinking going on in these ports. If there is, it has been encouraged by the remarkable growth of Channel traffic during the 1980s which has given rise to the 'enough room in the market for all of us' syndrome.

The future holds various prospects for Nord-Pas-de-Calais ports, Calais being in a situation similar to Dover, and Boulogne to Folkestone. While each of the ports is modernizing independently, the Ministry of Transport and the Sea (the Minister is also Mayor of Béthune in Pas-de-Calais) has the support of the regional council in wanting to establish common management of the three ports, Dunkirk, Calais and Boulogne, in the form of a joint venture (GIE). Dunkirk is favourable, Calais less so. The Chamber of Commerce, managing the port of Calais, has long had reservations regarding the Tunnel, and expects competition will be difficult. However, in 1987, it shifted positions and now views the Tunnel and the port as complementary services, provided public authorities aid the port to equip itself and obtain motorway access.

Dunkirk has the third largest port in France, but has strong competition from Zeebrugge, Antwerp and Rotterdam. It has been penalized by a lengthy dockers' strike. While the UK is its leading customer, Channel traffic continued to decline in 1990 (– 5% in relation to 1989). At present, its management is formulating a new strategy based on two assets: proximity of the Tunnel and renovated transhipment facilities.

In West-Vlaanderen port authorities have invested in larger and more efficient container and ro-ro facilities, especially in Zeebrugge, to be prepared for the growth in goods transport expected from the opening of the single European market. The overall increase in port activities should, at least in Zeebrugge, largely compensate for eventual losses due to the competition from the Tunnel. The port authorities' confidence relies upon an ongoing diversification and on extension projects. Together with Dunkirk, Zeebrugge is the continental deep-sea port closest to the UK. With the Channel Tunnel, it gains a new land connection as well as a new hinterland.

On the other hand, the port of Ostend is facing a great challenge not only from the Channel Tunnel but also from new developments in cross-Channel traffic. If Ostend is to have a future, it has to invest in port facilities. Modernization and extension have been planned, but it is doubtful whether the port redevelopment will come in time for the new competition.

In Brittany, the road access and port services of St Malo are unsatisfactory. The port is studying a modernization plan.

In Scotland, although the Tunnel should have little effect on existing trade through Scotland's eastern ports, fears have been expressed that the opening of the fixed cross-Channel link might reduce the potential for the Scottish ports to establish ro-ro services with the European mainland (none of which exists at present between these regions). It has been suggested that such a link might compensate in part for a failure to improve inland links between Scotland and the south coast and hence to Europe.

In Pais Vasco, port authorities show serious concern about any hypothetical negative impact of the Channel Tunnel and, in general, pricing policy of railways that could affect the competitive position of maritime transport. However, this is understood to be a long-term problem as changes in the Spanish railways infrastructure will not come about before 1998 at the earliest.

Maritime companies

The maritime companies are counterattacking, and this is characterized by efforts to achieve the anticipated better productivity of larger boats and to decrease personnel in certain cases, as well as making efforts in the field of quality. This is all guided by a concern to maintain competitive prices. Trends towards concentration in this sector can be observed, which just may be the long-term response to a redistribution of market shares in cross-Channel traffic.

In Kent, the response of the ferry industry has been to invest in new ships and refurbishment. In 1990, P&O purchased four superferry freight ships and refurbished their passenger ferry *Pride of Kent.* The increase in freight ships by P&O on the short sea routes is seen to be due to the introduction of fast-lane customs operations at Dover, making same-day continental deliveries much more achievable and reducing warehousing costs. Further strategies on the part of the ferry companies have been to emphasize to their passengers the comfort of ferry crossing. To do this they have targeted certain groups, particularly at the top end of the market, which are seen to be at risk because of the Tunnel, and service is now being tailored to this market. For example, in 1990 P&O introduced Club Class which is aimed at the travelling executive and provides, for a small supplement, writing desks, newspapers, fax machines, telephones and photocopiers.

In Nord-Pas-de-Calais the maritime companies have renovated their fleet and are currently playing the card of quality and comfort. P&O built the first jumbo ferries (capacity: 650 vehicles) and next, Sally Line, Sealink and the French subsidiary SNAT invested in modernization. In 1993, jumbo ferry and catamaran services will be in operation, and the hovercraft will have disappeared.

In West-Vlaanderen, companies operating to mid-England will probably not be as greatly affected by the Channel Tunnel as ferry lines operating to southern England. North Sea Ferries has made a major investment in two jumbo ferries, thus increasing the freight and passenger capacity for its nightly Zeebrugge-Hull run. In addition, North Sea Ferries even started a new, freight-only service between Zeebrugge and Middlesbrough in 1988. The emphasis is on regular, reliable top-level service with more comfort and more leisure facilities on board the ferries.

P&O emphasizes that the consequences of the single European market for the ferry companies, namely the abolition of duty-free sales and the addition of value-added tax on tickets, fuel and ship construction, are considered more important than the opening of the Channel Tunnel. The strategy of P&O in the passenger market is to increase comfort and simultaneously reduce costs through the introduction of jumbo ferries. Big investments in upgrading the fleet is the salient feature of this strategy at the moment. The enhancement of inclusive travel tours (ferry service plus accommodation) is a possibility. Today's favourable image on the travel market is seen as one main advantage compared to Eurotunnel. P&O is also heavily investing in the extension of the freight fleet. New ferries will operate between Zeebrugge and Dover, the most important ro-ro freight route between the Continent and the UK. Another market strategy of P&O to survive the competition of the Channel Tunnel is to cooperate with other ferry companies, namely Sealink, although two former attempts have been rejected by the British Anti-trust Commission and the EC.

One important attempt of the State-run RMT to survive in the cross-Channel market is to be integrated into the P&O-Sealink expected joint venture. It is yet uncertain whether the link between RMT and P&O will be maintained at all. Otherwise new problems might emerge: marketing in the UK will be difficult as RMT does not have its own travel agency and agents in the UK. Depending on the reactions of other ferry companies to the Channel Tunnel, RMT may be squeezed out of the market. The second strategy is to cut costs. This will be done by reducing the ro-ro fleet, but keeping the jetfoils. There will be four very big ferry ships in the future, instead of the five at present. The total capacity will be the same as today, but fewer ships mean fewer crew members and fewer runs, thereby cutting costs. The strategy is also to reduce the number of crews per ship (two instead of four). The total reduction of the number of workers will be about 30%. The third strategy is to increase the comfort on the ferry boats, which today is often not very attractive to passengers. And finally, all political parties agree on the idea of a privatization process.

In Zeeland, the major ferry company, Olau Line operating on the Vlissingen-Sheerness route, is running two new ferries, the largest ro-ro passenger ships in the EC. Their strategy is to increase the capacity for passenger and freight transport, to reduce the relative operation costs, and to provide hitherto unknown comfort and facilities on the ferries in order to open up new markets.

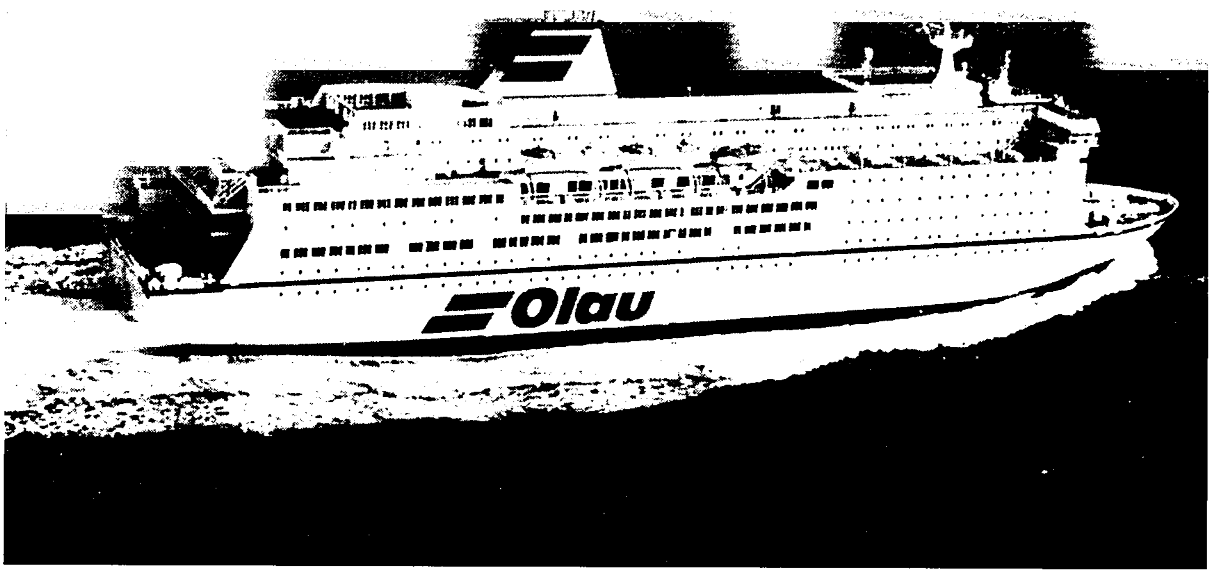
In Brittany, BAI, Emeraude Lines and Condor Lines (Commodore group) are trying to adapt their fleet to an evolving market.

In Ireland, Bell Lines who operate a very efficient lo-lo service from Waterford believe that the lo-lo system, if operated in an efficient manner, can compete for UK exporters to Europe. By investing in people and technology, they believe that Ireland can overcome its peripherality and become a competitive trading nation within Europe.

The ports and maritime companies have already been preparing for the Tunnel opening for two or three years. They have been making investments aimed at greater productivity and attractiveness of maritime service, both for passengers and freight. However, they do not have control over price developments nor access to ports, which are two factors that weigh heavily in their competitiveness *vis-à-vis* the Tunnel.

All ferry companies hope that the Tunnel will be operated fairly; that means fares based on costs. In such a case, ferry tickets could be competitive, and even more so if the Tunnel construction costs were increased. But the end of on-board duty-free sales and the inclusion of VAT on tickets are serious threats coming up to 1993.

Figure 4.17. Response of maritime companies: Jumbo ferries



The land access problem remains and is subject to hesitant national policies or financing pledged to other priorities. This obviously includes peripheral regions, Scotland, Ireland, Pais Vasco, Norte, which seem to be suffering the most from this handicap, although they are less concerned by the Tunnel competition.

(c) Other transport issues

The Channel Tunnel and related infrastructure will have a redistribution effect on the European land and air transport networks, and that is faced with various attitudes and strategies among regional transport industries.

Competition between air transport and the Tunnel and TGV system has been mentioned in Cologne where it is said that the latter would probably not compete with the former on long-distance journeys, like Cologne-London, but rather on short-distance flights. Therefore, the Cologne/Bonn airport is working in partnership with the Düsseldorf airport and the German railways, on better interregional connections.

Rail and road freight transport is likely to evolve through restructuring processes started or thought of in view of 1993.

Kent and Piemonte hope the Tunnel system will be responsible for a transfer from road to rail, as an alternative to the main roads congestion.

Competition among road carriers is becoming severe in north-western Europe, French hauliers fearing the competition from Belgian hauliers who in turn are concerned by Dutch competition. Nord-Pas-de-Calais is already undergoing a concentration process where small carriers disappear to the benefit of national or foreign groups. Hainaut appears to be more confident, relying in particular on the development of intermodal service areas. Freight distribution centres are to be established in Nord-Pas-de-Calais, Hainaut, Zeeland and Piemonte.

Table 4.14. Responses of the transport industries

Regions	Transport industries
Kent	**Rail:** BR announced investments on the Kent network excluding the international rail links. **Road:** The Freight Transport Association is lobbying the government to continue its road-building programme and pushing to increase the maximum loading weight of lorries. **Ferry:** Investments in new ships and refurbishment. Increased numbers of P&O freight ships on the short sea routes linked to the introduction of fast-lane customs operations in Dover. Club Class on P&O ferries meant to target the top end of the market.
Nord-Pas-de-Calais	**Rail:** The regional council works together with SNCF on connections between the international TGV network and the regional network. Rail freight transport is expected to do better, through combined transport and full trains. **Road:** Small carriers dread the worst, fearing Belgian and Dutch competition; major groups are preparing an expansion of their markets. **Ferry:** Fleet renovation and new jumbo ferries and catamarans planned for 1993.
Hainaut	**Rail:** Risk of seeing most freight from the Tunnel taking the Lille-Kortrijk-Ghent-Brussels route with the SNCF's support. **Road:** Carriers fear Dutch competition. Intermunicipal authorities develop specific service areas.
West-Vlaanderen	**Ferry:** North Sea Ferries put emphasis on regular, reliable, top service. P&O see the single European market as more threatening than the Channel Tunnel. Their strategy consists of better comfort, cost reductions and attempts to cooperate with other companies. RMT try to be integrated in the P&O-Sealink expected joint venture; in the meantime, they make efforts to cut costs and to increase on-board comfort.
Zeeland	**Road:** A new freight distribution centre in Terneuzen is meant to handle the expected growing flow of goods.
Cologne	**Rail:** The main concern is to be rapidly connected to the high-speed rail networks; but air transporters are confident that only short-distance flights may be challenged.
Brittany	**Rail:** The link with the international transport networks through the TGV is felt to be important. **Road:** Carriers wait and will see whether to use the Tunnel or not, according to their destination in the UK and to European driving time regulations. **Ferry:** All companies involved in adapting themselves to an evolving market.
Piemonte	**Rail:** Rail freight heavily challenged by road transport; intermodal transport could have a better future if certain infrastructures are completed. **Road:** Restructuring of road haulage is needed; professionals are threatened by European competition.
Scotland	**Rail:** BR's demand forecasts for freight and passenger flows are criticized as too conservative; fear that Channel Tunnel train services may not go beyond London. **Road:** Stress on the need for firms to prepare for the new transport and distribution system likely to evolve in the 1990s.
Ireland	**Road:** Hauliers doubt the success of the Tunnel for ro-ro traffic, main mode to Britain. **Ferry:** By investing in people and technology, Bell Lines mean to compete for UK exporters to mainland Europe.
Pais Vasco	**Rail:** Europa '93 Plan (see Table 4.16). **Road:** Business might increase with the Tunnel since flows to the UK are scarce.

Interpretation

The more direct the impacts, the more radical the counterattack. Thus, one should not be surprised to find out that the most advanced policies are on the side of maritime transport.

Sea
All ferry companies have invested in modernization and refurbishment, increasing the ships' size and stressing the quality. Some intend to cooperate with others, but so far they have been prevented from doing so by anti-trust legislation.

Ports try to adjust to maritime companies' strategies by enhancing their capacities and modernizing their logistics.

A possible future effect on both sides of the Channel is a concentration of the cross-Channel traffic on Dover, Calais and Zeebrugge, while the least-active ports will become leisure harbours and the main ones will develop specific assets.

The main variables responsible for the evolution of maritime transport under the influence of the Channel Tunnel are national transport policies, the marketing power of port authorities, the quality of the services they offer, and European regulations.

Rail
National economic policies have a direct impact on how the regions will see their transport industries benefit from the Tunnel and the high-speed rail system. Most of the case-study regions will still be out of it in 1993; a few will be fully connected; some will be connected, but only along a pipe.

The location variable is meaningful, combined with the economic and political strategies in the regions. Thus, most peripheral regions see the Tunnel issue as an opportunity for asking for better links, especially rail links with other European regions and countries. Altogether, the regional situations and expectations highlight the need for greater international coordination in the field of railway investment within the European Community.

Road
The dependence on national road policies is very strong but professional development is another important variable: in several regions, professionals mostly fear their neighbours' competition, by lack of technology and of cooperation; in the meantime, major international companies tend to absorb small carriers and prepare for an expansion of their markets.

On the whole, in addition to strategies expressed in the various transport sectors, policies will have to deal, in Tunnel time, with two main issues: technical and financial concentration, and European regulations and compensation.

4.4.2. Other industries

The Tunnel should normally expand markets in a number of regional economies. In Subsection 4.3.3, we saw the various aspects of its impact on development. At the same time, this assertion rarely leads to industrial policies and commercial offensives by the regions involved. This is shown in Table 4.15.

Interpretation

Within the Blue Banana, the most enthusiastic attitudes are linked not only to Tunnel proximity, but more to the existence of regional strategies: for example, the value of the Tunnel and the TGV for the development of economic activities is more clearly affirmed in Cologne than in Kent.

On the other hand, regions in the Blue Banana are characterized by their 'along a pipe' position as opposed to an 'at a hub' position, indicating the relays necessary for the Tunnel to be profitable for them: West-Vlaanderen and Hainaut are counting on reaping the benefits of repercussions on metropolitan Lille, whereas industrialists in Zeeland, who find themselves in an interstitial space between the major ports of Antwerp and Rotterdam, also stress the need for the Westerschelde crossing as a foundation for their expansion into British markets.

Besides this central zone, whatever the rhetoric concerning the Tunnel (analysed in terms of attitudes), the concept of future European transport infrastructure primes a fairly broadly shared vision of the possibility for attachments to Europe that goes beyond national boundaries and that is based on rapid transport networks. This is particularly strongly felt in Piemonte, Scotland and Ireland, and also perceptible in Brittany and even Pais Vasco and Norte, where regional authorities are trying to obtain rapid road and rail links with the rest of Europe in order to create favourable conditions for their economic development (see below).

Table 4.15. Response of other industries

Regions	Attitudes	Strategies and policies
Kent	Lack of good transport links considered as the major factor inhibiting the development of European markets. Criticisms to the government for not financing a high-speed link.	
Nord-Pas-de-Calais	High value-added services, like logistics and finance, should be promoted to: provide jobs to the youth, modernize the region's economy, provide NPC with the role of a trade zone.	Tunnel as the basis for marketing the region by the industrial restructuring commission. National and EC funds for restructuring. An exchange-contacts business structure set up by regional and general councils and TML to get subcontracting from the Tunnel. Efforts on training, language and research. Development of the banking system.
West-Vlaanderen	Tunnel as primarily enhancing the position of Lille.	Development of complementary functions to Lille's sought in Kortrijk, by improving training, quality control, product development and rationalization, energy-saving and automation.
Hainaut	The Tunnel would eventually encourage new industrial installations.	Small and medium-sized firms. Textile and mail-order sales in Mouscron; transport and associated services in Tournai.
Zeeland	Tunnel as another faster and more reliable way of reaching the UK markets. Industry leaders favour the WOV.	Chamber of Commerce is lobbying the authorities both for the WOV and an international transport route through Zeeland.
Cologne	Expected benefits from the Tunnel and high-speed rail link, especially through its possible extension to Hanover-Berlin-Warsaw-Moscow.	Lobbying of political powers by Chambers of Commerce of Paris, Lille, Amiens, Brussels, London, Rotterdam, Amsterdam, Liège, Aachen, Cologne, Bonn, to push the implementation of high-speed train plans.
Bremen	Tunnel removes a local bottleneck, without much effect on Bremen industry and trade.	
Brittany	Tunnel does not play any part in expectations of increased markets in continental Europe and the UK through new transport infrastructure.	
Piemonte	Only indirect impacts expected on the mechanical rail industry.	Collaboration between FIAT and CGE-Alsthom in high-speed train production.
Scotland	The Chamber of Commerce's claim is that businesses should take up the challenge rather than lobbying for rail and road investments; but CBI's emphasis is on proposals for roads.	CBI's proposal for road schemes: east coast highway from the M11 to the A1; upgrading the A1 from London to Edinburgh; a new highway from the Midlands to the north-west; upgrading the A75 from Carlisle to Glasgow.

Table 4.15. Response of other industries (continued)

Regions	Attitudes	Strategies and policies
Ireland	In order to take up the challenge, Irish industry wants an efficient, competitively priced transport service, with more competitive ports, larger ships and better infrastructure throughout England.	
Pais Vasco	Industries are not really concerned. They are interested in a high-speed rail system, but this will occur in the long run and there will be a problem of harmonizing different networks.	
Norte	No impact of the Tunnel on industrial modernization which is now a priority.	

Strategies and actions do not flow systematically from the positions expressed. This means that the economic actors in Kent have no particular strategy, since they are outside the cross-Channel transport activities mentioned above, and are totally integrated into the sphere of London's activity. West-Vlaanderen and Hainaut, which are regions with weak decision-making capabilities, have no well-thought-out economic policy regarding the Tunnel. No peripheral region has a programme other than Piemonte's desire to situate itself on the European market for high-speed trains within the framework of the FIAT-CGE Alsthom agreement.

Finally, the regions fall into three categories:

(i) those that develop strategies so that the Tunnel-TGV effect has an impact on their economic advances, i.e. Nord-Pas-de-Calais and Cologne;

(ii) those that count on direct benefits and design their actions at an intermediate level, i.e. West-Vlaanderen and Hainaut intend to cooperate with Nord-Pas-de-Calais, particularly with Lille, whereas Scotland and Ireland are depending on improved links with south-eastern England to gain new continental markets;

(iii) those that are not implementing any development strategy related to major transport infrastructure, either because they do not have the resources (Kent, Piemonte and Pais Vasco depend on national transport policies that have not made the choices hoped for), or those that have other concerns (Kent in London's sphere, as well as Bremen, Brittany, Pais Vasco and Norte).

The factors involved in belonging to one category or the other involve the geographic orientation of the trade network and the existence of regional development strategies: as the UK is Portugal's fourth-ranking economic partner, it is no surprise that Norte is more interested in land links to Spain, Germany and France than in the Channel Tunnel; while Kent is on one end of the Tunnel opening, it is essentially an agricultural, recreational and residential region that depends on London, and does not have the economic power necessary for independent development.

4.4.3. Local and regional authorities

A preliminary comment should be made regarding regional development strategies. The assumption was that these strategies would integrate the existence of the future Tunnel on the basis of various geographic and political criteria. In fact, all actors in development, whether economic, administrative or political, may have attitudes and reactions to the European transport infrastructure, but their strategies, particularly strategies that reflect policies and action programmes, can only be considered among actors who have the resources to back up such strategies. The truth is that the regions considered differ in status. Some have no elected authorities; others have little liberty in their development choices. The result is that in some cases the analysis is limited to elements of strategies or even vague desires.

Nevertheless, local and regional authorities increasingly tend to build up strategies, or at least to express views, within the framework of the European Community. The perspective of the Tunnel has obviously played a role in tightening up international cooperation between regions close to it. Facing a possible increase in transport flows, tourism and foreign markets, they are in symbiotic competition, i.e. they cannot simply compete, they have also to cooperate. Cross-border regions see their development very much dependent on relations with neighbouring regions of other countries. In such a context, some regions are likely to appear stronger than others; thus they might be in a position to lead interregional poles of development, as is already observable with the grouping of Hainaut and Zeeland around West-Vlaanderen and Nord-Pas-de-Calais.

The strategies expressed by local and regional authorities may be examined primarily in terms of their relationships to the attitudes and strategies of economic actors, and it becomes evident that they may provide support, make up for insufficiencies, or more uncommonly, be less prominent.

However, regional policies also have to be considered in their national context, i.e. from the angle of the status of regional powers in each country and in the relationships that they maintain with the central powers and the rest of the country.

Table 4.16. summarizes the various responses of local and regional authorities, which are analysed in the following paragraph.

Interpretation

Taking into account the internal and external analytical approaches mentioned, distinctions can be made between two groups of regions: those whose development strategies consider the Tunnel important and those that consider the Tunnel less important than European land links.

Regions where the Tunnel is important
The Tunnel is directly taken into account in the strategies of the three coastal regions closest to the Tunnel, namely Kent, Nord-Pas-de-Calais and West-Vlaanderen, and in Scotland, a peripheral region of the United Kingdom, and Ireland. The strategies for Hainaut and Cologne integrate the Tunnel in terms of the anticipated impact of the TGV, while Zeeland's regional authorities are trying to place themselves above local and sectoral conflicts raging around the WOV, and the Tunnel is adding fuel to the fire.

There are two types of regional strategies in this first series of regions: there is the global approach, as in Nord-Pas-de-Calais, West-Vlaanderen, Cologne and, to a lesser extent, Ireland, and the much more limited approach in Kent, Hainaut and Scotland. Geopolitical factors enter into the explanation of these differences: the geographic situation of each region combines with the relationships that it maintains with the central power and its financial and constitutional capabilities of transforming its strategies into policies.

Regions less concerned by the Tunnel
Besides Scotland and Ireland, who are part of the first group, the peripheral regions do not integrate the Tunnel directly into their development strategies.

Nevertheless, the transport infrastructure and single market are pivotal points in the perspective of 1993.

Bremen is very conscious of new opportunities lying in Eastern Europe and more concerned with the infrastructure in between than with the Channel Tunnel or the high-speed rail links.

Piemonte is oriented towards improving transalpine transport and would like to free itself of the constraints weighing on the Italian context.

Brittany intends to participate on the basis of the proximity of the TGV network connection to Paris (two hours from Rennes) and on trying to find a community of interests with other regions in the Atlantic arc.

Pais Vasco is targeting direct integration into Europe; there is an explicit concern for communications with Europe, by road (already very good), by rail (almost non-existent), by sea (near to full capacity) and by air (very underdeveloped). This issue is a leading priority of the Basque Government whose strategy is centred on helping Basque firms to become more competitive on the international scene by inducing international contacts and eliminating infrastructure disadvantages (cost, distance).

Norte does not really have a regional authority, but it still represents the industrial hub of the country. In this respect, the region is interested in better links with its preferred economic partners, namely Spain, Germany and France.

Weight of geographical and political factors
The current development of a major transport infrastructure provides the opportunity for Blue Banana regions located at a hub not only to utilize new advantages in their development strategies,

Table 4.16. Response of local and regional authorities

Regions	Attitudes, strategies and policies
Kent	Economic strategy based on new vitality, diversification, capitalization of opportunities, training. Kent Economic Development Board (now in the Training and Enterprise Council) set up to enable companies to move or to expand within Kent. Strategic tourism framework, to increase tourism spending and total visits.
Nord-Pas-de-Calais	Emerging partnership in planning and development policy mainly oriented towards transport infrastructures. 'Plan routier transmanche'. Tourism in two target areas: the coast and the depressed Avesnois. Multiplication of universities. Modernization of education and training to take up the challenge of the internationalization of the region. 'Mission transmanche' created within the regional council to derive maximum benefits from the Tunnel. Some local authorities still playing their own cards.
West-Vlaanderen	The Tunnel as a challenge to the ports and as an interesting, although not significant, new opportunity for further economic and tourist development. A six-point strategy aiming at improving accessibility from the south in order to derive some of the benefits expected from the Tunnel on Nord-Pas-de-Calais. Modernization and enlargement of the ports' ro-ro facilities, to attract more containers and to serve inland areas. Marketing of the region in the UK, targeting a quality conscious clientele.
Hainaut	Looking for partners beyond the national borders. Cross-border agreements as key strategy. PACTE (1989) with Nord-Pas-de-Calais: studies and information systems that should create favourable conditions for cooperation. A more recent agreement with Kent.
Zeeland	'Develop Zeeland and keep the good things', as a unifying concept above conflicting interests. No common view on the future function of Zeeland within Europe. Devotion of specific functions to three locations: economic activity in the Westerschelde basin, recreation along the coast, and green core in the delta area. Cross-border economic and cultural cooperation within the Euregio Scheldemond project. Tunnel mentioned as an additional but not essential factor in enhancement of the development strategy.
Cologne	Emerging regional interest for a common transport network. High-speed rail connection considered as a link not only with Western metropolises but also for the Ruhr-Rhine agglomeration. Intended regional efforts to take part in the European competition among regions in economic development, training, transport, land supply and promotion of regional concepts. The city of Cologne playing the high-level-services card.
Bremen	Feeling that the region has to play its own cards without being overly concerned by the Tunnel or by the high-speed rail network. Strengthening seaport and distribution functions. Financing industrial and transport-related projects within the economic structure action programme supported by the federal government and the EC. Development of services and research.
Brittany	A will to develop all possibilities by all lobbying means. Harmonization of transport networks within the region, also with neighbouring regions and along the Atlantic Arc. Thoughts about a European super-region with Pays de Loire (the Loire Region), Cornwall and Devon.
Piemonte	Urging better and new connections between the region and all of 'active Italy' (versus bureaucratic Italy) on one side and the modern European transport and communication networks on the other. No action programmes either from Piemonte alone or in cooperation with Lombardia, aimed at accomplishing their European objectives.
Scotland	Modernizing of the British railroads is the key to get the best from the Tunnel. Maximum support to BR's plans for modernization of through-traffic to and within Scotland, and to road upgrading. Call for a better transport infrastructure between south-east England and Scotland to promote Scotland as a tourist destination beyond London. The Scottish Office shares the British Government's view that freight demand from Scotland does not justify a direct through Tunnel service. Scottish Development Agency believes more in air service and telecommunications than in Tunnel and rail. Several local and regional authorities, part of nationwide inter-association initiative lobbying decision-makers.

Table 4.16. Response of local and regional authorities (continued)

Regions	Attitudes, strategies and policies
Ireland	Dublin Chamber of Commerce pushing the 'central corridor' through Dublin and Holyhead as more rapid and less costly. Irish Tourist Board aiming at attracting more tourism, despite the fact that the Tunnel leaves Ireland as the only island country; marketing Ireland as a verdant country with wonderful fishing and golfing opportunities.
Pais Vasco	No concern for the Tunnel except for being connected with the European high-speed rail and road transit systems. Region helping Basque firms to become more competitive and designing new connections with south-western Europe. The Europa '93 Plan for the construction of new rail and road connections, upgrading of through-roads and modernization of Bilbao's port and airport. But all investments other than in roads depend on Spanish Government.
Norte	Single European market more important than the Channel Tunnel. National government giving priority to the completion of infrastructure projects under way, and local authorities to plans aiming at modernizing traditional export-oriented industries.

but also to progress in building intraregional coherency. These regions benefit to different extents depending, on the basis of the acuteness of internal political divergences and the level of independence in their economic and cultural potential.

The transit regions in the Blue Banana have an intermediate status, not only because traffic will transit rather than stop, but also because their political and economic future depends on neighbouring metropolises.

For neighbouring regions, the Tunnel's distance results in its simply being considered in the context of the European rapid link infrastructure, and it appears to be a chance to become attached to Europe. In this respect, cross-border areas appear to be particularly sensitive: Nord-Pas-de-Calais exercises a certain attraction in Hainaut and West-Vlaanderen strategies, which are looking towards the south, whereas Piemonte, Pais Vasco and Norte, which are also border regions, tend to turn their backs on their respective national allegiances and to look towards northern Europe. However, as in Scotland, these regions do not have the resources to play the European card, which is why they are asking for compensation from the EC. This aspect will be covered in the following chapter.

4.5. Expectations for external action

The growth in the European exchange and transport system that will result from opening the fixed cross-Channel link and the advent of the single European market is giving rise to hopes, fears and therefore new requirements.

The issues facing the regions and regional economic actors are increasing dramatically with the creation of unified physical, logistic, fiscal and legal structures in Europe. The new dimensions assumed by the problems give the Tunnel a far greater importance in the perceptions and strategies of the different actors than would have seemed justified only a few decades ago. In some cases, it is seen as a challenge that they are unable to tackle on their own.

This means that many requirements will not be satisfied in the regions where they actually occur. As a result, expectations and demands are already being directed to national authorities and to the European Community.

It could be assumed that expectations of regional and/or national authorities would be the following (in order of importance):

financing new infrastructure,

transport policy,

economic policy.

But expectations are not formulated in the same way when addressed to national authorities or the European Community.

4.5.1. Expectations from the regional/national governments

The institutional status of the 13 regions varies considerably; they include sovereign nations such as Ireland, provinces with no real power or

Table 4.17. Main regional expectations from regional/national governments

Region	Issues
Kent	Kent County Council have been attempting to convince British Rail that they need to adjust the vertical alignment to minimize environmental damage in building up the new high-speed rail line. On the other hand, due to the regional policy of the central government, Kent may not expect substantial assistance.
Nord-Pas-de-Calais	All regional actors do not fully back up the regional council strategy *vis-à-vis* the Channel Tunnel and demands to the regional council and the French Government are very numerous and diverse. The main ones are for better rail and road connections to Lille and the neighbouring regions of Wallonie and Vlaanderen. They include the need for a stronger structuring of metropolitan Lille within the region.
West-Vlaanderen	The major expectations concentrate on accessibility infrastructure: improvement of port access roads and inside roads, implementation of the projected Zeebrugge-Ghent canal, completion of the highway between Veurne and the French border, a faster rail link from Kortrijk to Lille, and a new rail link from Veurne to France.
Hainaut	Requests are mainly concerned with road and rail infrastructure. They include the reinforcement of the north-south rail/roadways (the backbone of Wallonie), a rail junction between Charleroi and Maubeuge, better road connections between Tournai and Kortrijk, and eventually a junction between the Wallonie backbone and the line (presumably at Antoing).
Zeeland	The general expectation is for a better consideration of regional potentialities. The specific demand for investment in road infrastructure (highway and WOV) is supported by those who want a regional development strategy.
Cologne	The demands focused on one single point: the implementation of the decisions already taken in the field of transport infrastructure. They include better accessibility to the main railway station and the Cologne/Bonn airport, the connection between the TGV and the airport and a fast through-link between the Cologne/Bonn and Düsseldorf airports.
Bremen	Accessibility by all modes of transport is a major concern of the region. So, there is a demand for better access to the Bremen port area, improved links with inland areas of the port, in particular with Eastern Europe, and a faster connection to the high-speed rail system and the Cologne hub.
Brittany	To restrict the 'funnel effect', an improvement of north-south links is strongly requested. It concerns an improvement of the Rennes-Caen, Roscoff-Morlaix-Lorient and St Malo-Rennes-Nantes roads, and of the electrification of the St Malo-Rennes railway, with direct access to the network, and completion to Spain.
Piemonte	Piemonte would like to convince the national government to convert its rail policy, from north-south priority to closer ties with the new European high-speed system. This is generally considered as a desperate undertaking.
Scotland	The projects most frequently emphasized are transport infrastructure projects. Among them are the electrification of the Glasgow-Edinburgh and Edinburgh-Aberdeen lines, upgrading some parts of the A1, A68 and A74 motorways, the improvement of road and rail access to freight terminals and airports, support for passenger/freight ro-ro ferry services from eastern Scotland to the Continent, and improvement of all road and rail links from Scotland to the Channel Tunnel through England, especially London.
Ireland	Access to the ports, especially Dublin, needs to be improved. Freight and passenger port facilities need to be upgraded. Carriers are looking to the Irish Government to keep in-country transport costs down.
Pais Vasco	The main expectations are centred on the implementation of the investment plans contemplated in the Europe '93 Plan. The plan has been designed by the Basque Government, but most issues are to be approved by the central government.
Norte	Modernization of export-oriented industries and construction of some basic transport infrastructure cannot be postponed.

executive authority such as Hainaut and West-Vlaanderen, and regions with special status such as Bremen, Scotland and Pais Vasco.

The decision-making centre is therefore located at variable distances from the actors, depending on the region. In addition, in some cases there may be one, two or even more levels of authority between petitioner and decision-making centre; a factor that strongly influences the manner in which expectations and demands are formulated. However, this is certainly not the only reason for the diversity of these expectations and demands for action from the national authorities.

Before analysing the content and identifying its significance, we will present an overall summary.

(a) Findings

Table 4.17. above gives a brief description of the demands that impressed us as the most significant in each region.

We have also tried to evaluate the theoretical chances that these expectations will be taken into consideration. We have assumed that these chances depend quite heavily on the demographic and economic importance of the region in the country as a whole and have therefore in each case given two indicators of these factors: regional population as a percentage of national population and regional gross domestic product as a percentage of national gross domestic product.

There is not a single region in which the prospect of, or reference to, the opening of the Channel Tunnel does not create a demand for new transport infrastructure.

But demands are not always formulated in the same way. They differ in terms of:

the relative importance of the infrastructure directly linked to the Tunnel;

the breakdown between the different types of transport (road, rail, sea and air);

any reference to a wider transport policy;

the presence or absence of broader considerations associated with national planning;

the degree of optimism as to whether the authorities will take these expectations and demands into consideration.

Even if apparently of minor importance, these differences merit some interpretation, if only to ascertain whether they are actually addressed to national governments and whether the latter are capable of satisfying them.

(b) Interpretation

We should therefore try to understand the characteristic features explaining differences in expectations from the major actors in each of the 13 regions as a first step towards any generalization.

Variables

Numerous factors can be advanced to explain differences in both the importance and the specific nature of expectation and demand. They can be classified under geographic variables, economic variables and political variables.

Geographic variables

The geographic location of the region naturally influences the perception of needs and therefore the formulation of demands. The major factors here are:

proximity to or remoteness from the Tunnel;

maritime exposure, where applicable;

position with respect to the Blue Banana.

Economic variables

Economic factors of demand relate to perceptions of the importance of the Tunnel to the economy, both directly and indirectly.

Directly, the Tunnel affects the transportation of freight and passengers between the United Kingdom/Ireland and continental Europe. The relative importance of this trade to the economy and the relative importance of the Tunnel in this trade generates specific needs for complementary actions to enhance its economic effectiveness.

Indirectly, it is because of the opportunities and risks associated with the new system of transport that the Tunnel has generated and reinforced, that the prospect of its opening creates special expectations of logistic organization, regulation of transport, protection of the environment and, more generally, national planning.

Political variables

It is hardly astonishing that, when looking at expectations and demands directed by the regions to the central authorities, we place special emphasis on political factors. Three variables may be distinguished in this context.

The first is the region's political status and therefore its ability to formulate and implement an appropriate response to the challenges that the Tunnel may bring. This depends on:

the presence of a regional executive authority and its degree of autonomy;

the type of policy — whether interventionist or *laissez-faire* — implemented;

the means — particularly financial — at its disposal.

The strategic choices of the regions or the regional actors, whether overt or latent, make up the second variable. These choices are expressed in terms of:

end purpose: growth of GDP, improved living conditions, technological progress, respect of the environment;

means: reliance on own resources or seeking support from neighbouring regions;

priorities: employment, training, research, infrastructures, etc.

The third variable is the regional policy of the central authorities.This affects the regions in two ways:

whether the government's action is inspired by an attitude of interventionism or *laissez-faire*;

the place occupied by the region in the government's vision of development.

Typologies

Given the multiplicity and diversity of the variables, the regions can be classified according to a number of typologies.

Insular regions, continental regions

The strongest fears and the greatest number of demands for action in the field of transport are expressed in the two peripheral regions of Scotland and Ireland. They consist essentially of a demand for infrastructure to access the Tunnel, considered as an essential complement to the fixed link. Scotland's demand is more insistent than Ireland's since it is addressed to its own central government. For obvious reasons, Ireland's demands will be re-examined later in the subsection dealing with expectations directed at the European Community. The expectations of Kent in this matter are more hesitant.

Elsewhere on the Continent, access to the Tunnel is a matter of opportunity rather than genuine necessity. It is related to a desire to gain maximum advantage from the new transport system associated with the Tunnel for nodal regions (Nord-Pas-de-Calais, Cologne) or regions close to the nodes (Hainaut, West-Vlaanderen), or to obtain the best possible conditions for connection to this system in the case of more peripheral regions. Here the demands addressed to central government are clearer and often less crucial if the problem of connection can be entirely satisfied within the country (Bremen and Brittany) or if it depends on public investment in other countries (Piemonte, Pais Vasco and Norte).

The cross-Channel space within the EC space

Another type of problem leads to another type of demand, linked directly to traffic across the Channel. The importance of these demands is very different in the regions in what we might call the cross-Channel space and other regions in the Community.

In the first category, specific demands are directed to the State to upgrade the competitiveness of ports faced with forthcoming competition from the Tunnel. In most cases, private operators, the ferry companies, have invested heavily in modernizing their fleets. Current demands, therefore, principally concern infrastructures for serving the ports, whether close or remote. They are particularly evident in Nord-Pas-de-Calais (road access to the ports), West-Vlaanderen (port roads, roads and access canal to Zeebrugge and Ostend, better rail and road links to Nord-Pas-de-Calais) and even Kent (priority to the M25). Similar preoccupations can be seen in Zeeland (links with southern regions) and Brittany (linking St Malo to the TGV network and even further afield, in Bremen (port roads and more distant access roads).

The more remote regions approve of anything that will develop competition between different modes of transport and that might improve the conditions of cross-Channel traffic.

Independent regions, dependent regions

Among the regions, some evidently expect more of the central authorities than others. These regions have a political and administrative weight that allows them to formulate strategy along with considerable resources of their own. Among the 13 regions and apart from Ireland, which is a sovereign nation, Nord-Pas-de-Calais, Bremen, Brittany, Piemonte and Pais Vasco are in this position. Whatever their importance, expectations are generally very clearly expressed since they are integrated in a global approach to relatively long-term programming.

The demands of the other regions seem more localized. This is the case in West-Vlaanderen and Hainaut, where they are specific to each town or port. They may even be quite controversial, as in Zeeland, where the WOV is simultaneously desired and rejected, or in Kent, where some people want the international passenger station in Ashford, whereas others are strongly reluctant to approve construction of a new rail line, while most will want both the station and the new rail line.

Favoured regions, neglected regions

The quality of the relationship between region and central government, and the place of the region in the central government's overall national vision, creates a further division of the regions into two major groups: those that believe they have the right to expect a great deal from central government and those which, whether reluctantly or otherwise, do not expect very much.

Nord-Pas-de-Calais obviously belongs to the first group, as do Brittany and Norte.

The situation is less clear for the Belgian (West-Vlaanderen, Hainaut) and the German (Cologne, Bremen) regions.

Pais Vasco believes that the priorities of the central government (including the Mediterranean connection) may postpone Pais Vasco's own priorities concerning external links. Similarly, Piemonte assumes that the priorities of central government do not include external links. Zeeland sees itself as not taken enough into consideration and Scotland is not sure that London is really concerned about its problems.

The result is that in the last-mentioned regions, demands explicitly directed to the government are addressed at least as much to the European Community as to the national central authorities.

4.5.2. Expectations from the European Community

The expectations from the European Community were partially spontaneous and partially solicited. Most of the regions got into the habit of asking from the Community and receiving: consequently, it is normal for them to think of an EC contribution to resolve eventual problems resulting from the opening of the Tunnel. However, the survey of regional actors was not entirely innocent. In fact, our contacts knew that we were operating for the Community — that undoubtedly gave them ideas.

At the same time, all regions are anticipating help from Brussels concerning the Tunnel. These expectations are more or less directly connected with the Tunnel opening, but mention of the Tunnel tends to justify all demands in the view of our contacts. Let us see why.

(a) Findings

The major regional expectations are indicated in Table 4.18 (see below). They are considered here from the expressed point of view of the regions only, regardless of the reality of the EC objectives and programmes.

The situation of each region is illustrated on the basis of three indicators: population, distance from the Tunnel and the region's share of the Community in terms of GDP.

We see that there are two major categories of demands. One category refers to Community intervention within the framework of the reform of the Structural Funds (particularly those budgeted in Objective 2) or related to Community programmes (particularly Interreg). Others start on the basis of the region's anticipated needs in order to maximize the advantages and minimize disadvantages of the Tunnel opening.

Among the latter, demands naturally focus on (from most-often to least-often cited):

financing road and rail infrastructures;

regulation of transport and maintaining fair competition;

pressure on the central governments so that they do their duties;

financing various development projects more or less connected with the opening of the Tunnel.

Table 4.18. Main regional expectations from the European Community

Region	Issues
Kent	Aid from the EC is expected for restructuring the economy of the eastern and southern parts of the county. UKL100 million of Community money is expected through the cross-border development project involving a cooperation approach with Nord-Pas-de-Calais. Some of this might go towards funding the high-speed rail links.
Nord-Pas-de Calais	Various expectations and demands are directed to the European Community. Among them are several tourism projects (including the V1/V2 museum in Calais), a tax-free business in Valenciennes, and several cross-border cooperation projects with Hainaut, West-Vlaanderen and Kent.
West-Vlaanderen	The ferry companies hope that clear regulations will guarantee fair competition in the cross-Channel transport market. Through Interreg, it is expected the Community will contribute to the improvement of economic and cultural relations with Nord-Pas-de-Calais.
Hainaut	Hainaut feels that it has been unjustly treated by the Community in terms of credit eligibility and allocations, as compared with Nord-Pas-de-Calais, and also for the Objective 2 and Interreg programmes.
Zeeland	The province counts on developing a certain number of its projects, such as infrastructure, within the framework of Euregio Scheldemond.
Cologne	Taking into account the international character of the new high-speed rail network, Cologne believes that a speedy connection with the networks depends mainly on the Community, which is the only authority capable of coordinating the route and its planning.
Bremen	One of the requirements is a settlement on fair competition conditions for all ports on the North Sea and the Channel. More generally, Bremen wants a balanced European regional policy, taking into account the issues and interests of outlying regions, with special attention to the Banana Skin.
Brittany	Ferry companies are asking for equal labour and social regulations and costs. Otherwise, the investment assistance could not be abolished. The major concern is the elimination of maritime extraterritoriality and consequently application of VAT and the disappearance of duty-free shops. In addition, there are hopes for a European contribution to the estuary route, to reinforce solidarity of the Atlantic regions.
Piemonte	The European Community should recognize the projects for transalpine connections as an EC priority, thus pushing their implementation by the Italian and French Governments and contributing to their financing. Appropriate EC regulations could compel the central authorities to pay more attention to the intermodal combined transport system.
Scotland	The main concern of Scotland seems to be to avoid becoming an increasingly peripheral region within the Community. Such a risk might justify some public (UK and EC) subsidies for an accessibility project. A specific demand is made for reorientation of ERDF Objective 2 priorities toward technological and transport infrastructure, in order to improve economic performance, technological and physical environment, and therefore economic competitiveness. The EC should eventually compel the UK Government to accept and implement the additionality principle.
Ireland	Ireland wishes to be compensated for its increased isolation so that it will not lose out by not being physically linked to the new European transport network. Concrete demands include port and other transport infrastructure investments in Ireland and in western UK, and investment in sea transport, as on road/rail in other EC countries.
Pais Vasco	It is expected that the EC will support the development of the Atlantic arc regions by including among the European priorities the big transportation routes that go through the Irun/Hendaye frontier. This connection has already been included among the 15 key accessibility projects to be studied in northern Spain and Portugal. The next step should be funding.

Table 4.18. Main regional expectations from the European Community (continued)

Region	Issues
Norte	The demands addressed to the EC are the same as those of the Portuguese Government: financial assistance for export-oriented firm modernization as well as upgrading international transport infrastructures.

Source: Eurostat (1989).

It remains to obtain a clearer view and to analyse the reasons for the differences in expectations.

(b) Interpretation

The identification and description of the factors involved in the various expectations from the Community will enable us to draw up regional classifications, which is a first step in evaluating the region's overall demand from Brussels.

Variables

The variables in the demands addressed to the Community appear to be essentially the same as those addressed to national authorities. We will simply recapitulate these variables.

The geographic variables (distance to Tunnel, maritime exposure and place in the new transport system) help form a picture, and consequently an awareness of risk and of chances, thereby making the basis of a possible strategy.

The economic variables (weight of cross-Channel trade and changes in relative competitiveness) justify the size of the requests, as well as their insistence on the transport infrastructure.

The political variables (political capacity, strategic choices and relations with the central power) can explain the more or less coherent nature of the requests.

Typologies

We do not believe that these variables interact in exactly the same way where requests are addressed to the central government of a State. Here, their combination produces a significantly different typological system.

Maritime network, land network
The involvement of the region in traffic between the United Kingdom/Ireland and the Continent brings up a very special sort of request.

Tunnel competition does not frighten the coastal regions of the Channel and the North Sea, provided the rules of fair competition are respected between the various means of transportation. This concern is explicitly stated in West-Vlaanderen, Zeeland and Bremen.

There appears to be greater fear concerning the extension of common law to land and sea transport (particularly the elimination of duty-free shops) and a general application of VAT. According to the ferry companies, this would result in cost increases with harmful consequences. We picked up echoes of this fear in West-Vlaanderen, in Brittany and in Ireland. Air transport in Scotland and Ireland is also affected by the same fears. There is no real request formulated here, but rather recriminations. In addition, the Continent seems to be ignoring much of this problem.

Similar problems regarding road transport are only rarely brought up. Concern is focused on the new land transport system, particularly the high-speed rail network.

Kent would like to see the Community take charge of the extra costs of an environmentally suitable handling of the new rail line. Cologne is impatient for the TGV, and hopes that the Community can speed up construction. Piemonte, at wit's end with its national government's transport infrastructure choices, is turning to the Community to assure its access to the outside world. Ireland is counting on the Community to convince the UK to improve access to Irish ports. Pais Vasco hopes that the Community will participate in improving links to northern Spain and Portugal, and connections to the French network. Norte is of course supporting the same request.

Regions with programmes, regions with projects
Some of our regions do not seem to have an overall strategy. They can provide no coherent response to the Tunnel challenge, nor address appropriate requests to the Community. This is the case of smaller regions: West-Vlaanderen,

Hainaut, and Zeeland. Their requests are formulated in terms of Community intervention programmes (Interreg, Objective 2), which they would like to see continued or applied to their area. Kent has a somewhat similar attitude, since Kent County Council has tried to demonstrate a strategy, but still lacks power.

Within the same context, Scotland would like ERDF Objective 2 policy reoriented to place priority on technological development infrastructure as well as on transport.

No specific mention is made of any particular European programme in other regions, giving the impression that requests are formulated uniquely on the basis of local needs and not on financing opportunities. This is the approach behind the desire to see the Community place priority on connecting eastern transport to the central system, which is a general and not astonishing position on the part of the most distant regions. This position is expressed in Piemonte for transalpine links between Italy and France, in Pais Vasco and Norte for the northern Iberian network connection to the French and European network, in Ireland for access and transit through the UK. In Pais Vasco and Brittany there is an additional and explicitly expressed desire to have the Community become more deeply involved in the development of the Atlantic arc. This is the initiation of an alternative and independent strategy in relation to the Blue Banana. In Piemonte, this strategy is not Atlantic, but rather Mediterranean. In Bremen, the concern is for a balanced European regional policy, particularly taking into account the more remote regions with special attention to the Banana Skin.

It is not surprising that Nord-Pas-de-Calais has a more complex response to the Tunnel challenge, and, at the same time, that its expectations from the Community are not totally clear. The reason is that this region has, so to speak, its nose in the Tunnel. In spite of its planning experience, it is difficult for Nord-Pas-de-Calais to distinguish between what is essential and what is an accessory; which means that a multiplicity of projects and expectations, without an evident strategic objective, will not reinforce Lille's position in terms of the obvious priority that it should have.

National regions, Community regions

The Tunnel is not generally viewed as a simple local development of facilities. Even if it does not directly affect some regions, none of the regions is totally indifferent. For most of them, it is an occasion to situate themselves within the Community space, and not only in the national space.

The first manifestation of this orientation is to develop cross-border cooperation agreements between British, Belgian, French and even Dutch regions, and the references that these regions have made to appropriate Community programmes. In one way or another, this is what is happening in Kent, Nord-Pas-de-Calais, West-Vlaanderen, Hainaut and even Zeeland.

Attitudes are different in other places: the Community is looked to more than central government in terms of having regional projects and needs taken into account. This is clearly expressed in Piemonte, somewhat less explicitly in Pais Vasco and it appears to be an implicit part of Scotland's approach.

This is probably an indication that these regions are beginning to consider themselves more as subunits of the European Community than as subunits of their nation. The Tunnel, just like any other major infrastructure with a continental impact, reinforces such an orientation. This evolution results in greater expectations of the EC. They are presented at the end of Chapter 6 (Section 6.4, 'Conclusions').

5. The model analysis

5.1. Introduction

In order to quantify more precisely the impacts of the Channel Tunnel on the regions, it is necessary to have a methodology which will allow these impacts to be estimated in a consistent fashion. This is achieved through use of Meplan, a model that was designed to reproduce, forecast and evaluate interaction between transport and the location of economic activity.

The Meplan package is composed of four main modules.

LUS — regional economic module.
This estimates the pattern of trade and of passenger flows between the regions and to and from external zones.

TAS — freight and passenger transport module.
This estimates the flows of vehicles on the road, rail, air and sea networks.

FRED — interface between trade and transport module.
This converts the trade in commodities from annual value to daily flows in tonnes, and the annual demand for passenger movements into number of trips per day. It also feeds the transport costs and times back as inputs to the regional economic model.

EVAL — evaluation of policies module.
This module estimates the costs and benefits associated with a policy compared with an alternative policy.

The way in which these modules are linked together for one time period can be seen by looking at the horizontal links of Figure 5.1. The transport costs and characteristics generate patterns of accessibilities between zones which help determine the patterns of trade. Starting with 1986 as the base year in which the calibration of the parameters of the model is carried out, the model is then run at five-yearly intervals over a 15-year time period.

The first three of these modules are described in more detail in subsequent subsections. Firstly, their theoretical structure is outlined. Then there is an outline of the ways in which they have been implemented for this study.

5.2. Structure and theory of the model

5.2.1. The regional economic model

5.2.1.1. Overview

The regional economic model estimates the pattern of trade in commodities and services and the pattern of passenger movement both between regions within the EC and also to and from world market regions. The main inputs to the regional economic model are the population-based demand for commodities and services, the capacity of production in each region and the transport cost between regions.

The European Community is divided into 33 zones for modelling purposes as shown in Figure 5.2 and listed in Table 5.1. In the vicinity of the Channel

Figure 5.1. Evolution of the economic structure and transport through time

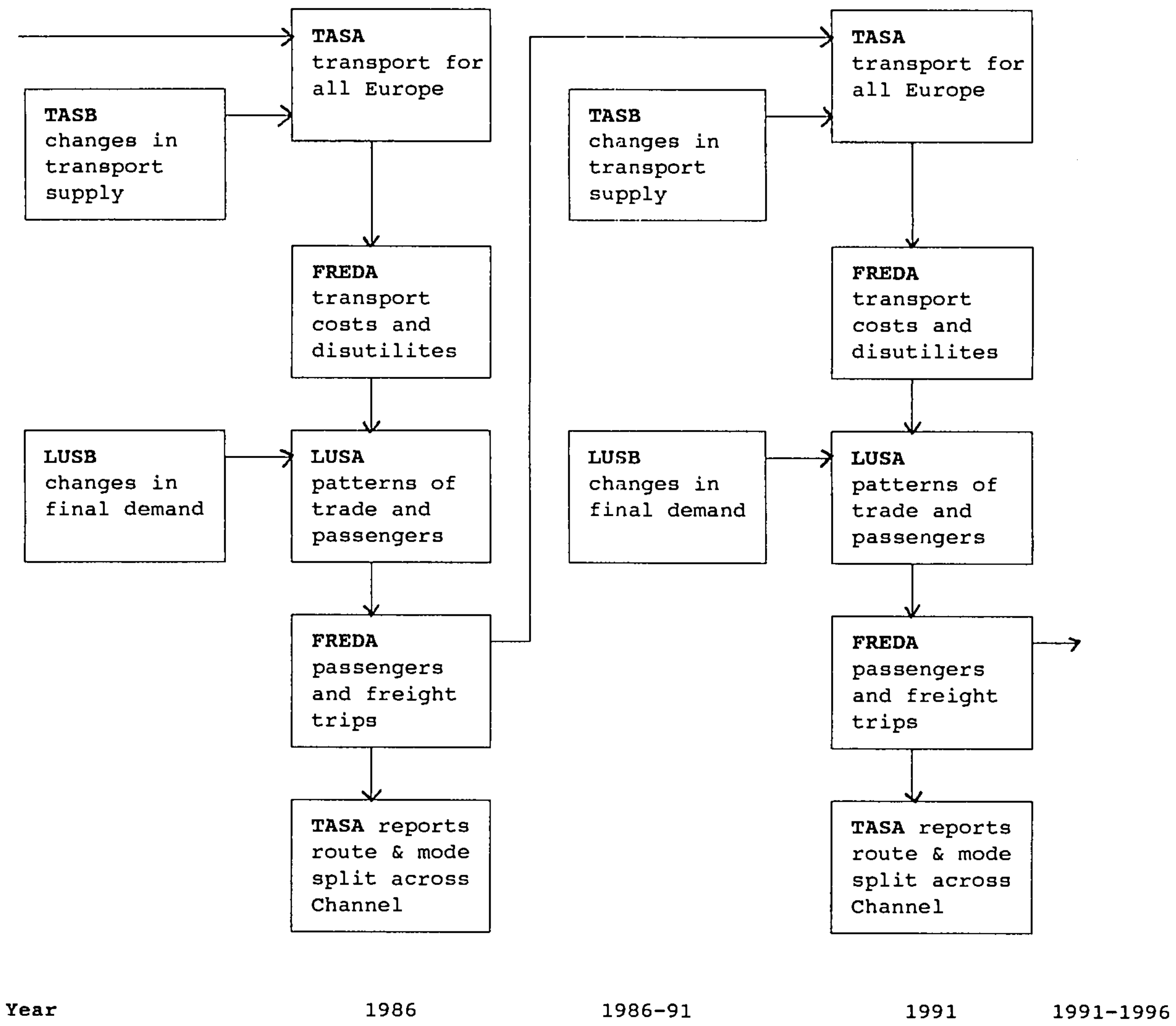


Figure 5.2. Channel Tunnel zone plan

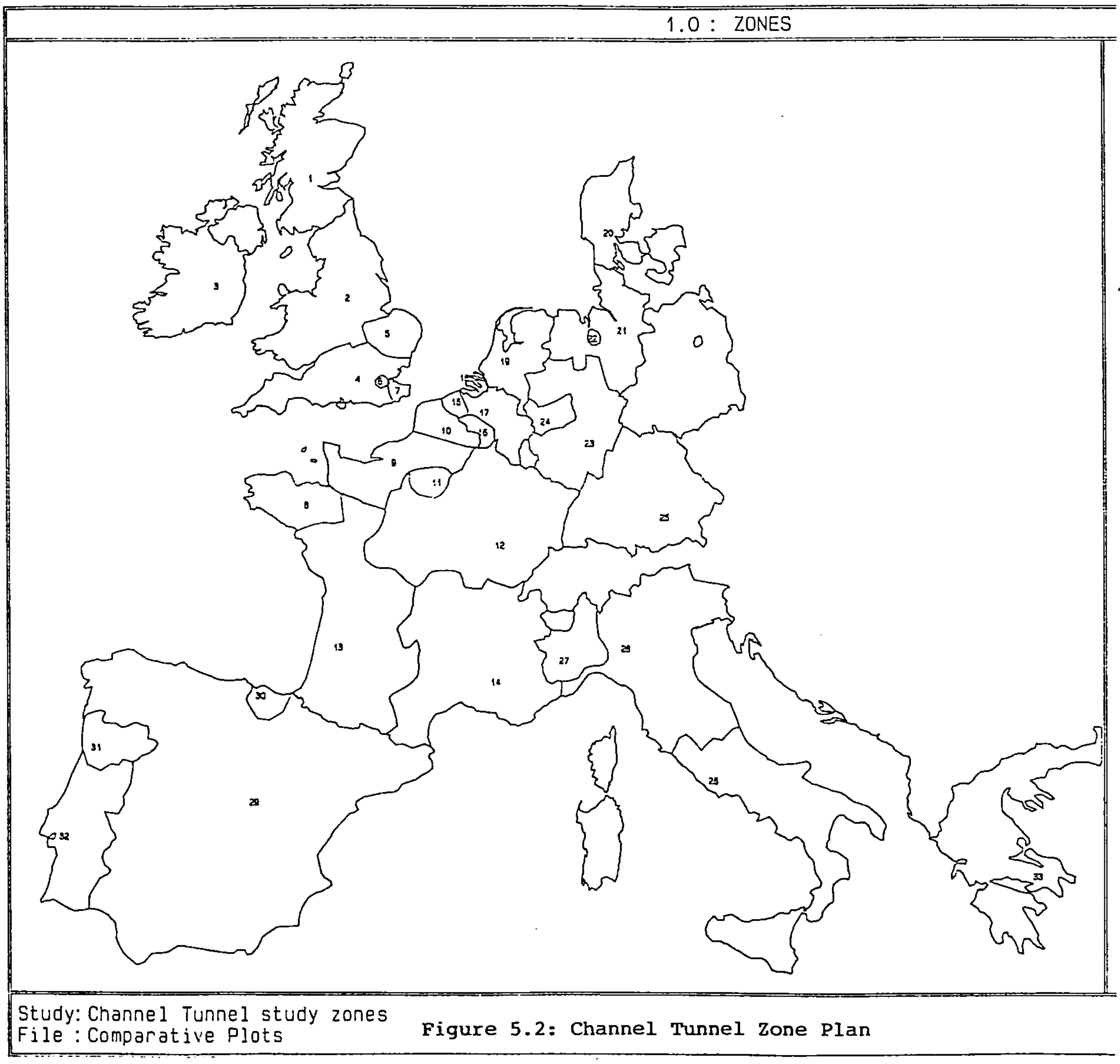


Figure 5.2: Channel Tunnel Zone Plan

Tunnel, these zones are relatively small (NUTS level 2 or level 3), becoming progressively larger with distance from the Channel. The regions that were selected for the in-depth studies are all kept as separate zones within this zoning system, in order that the model can estimate measures and indicators of their rate of development into the future. Because the regional economic model works with a detailed set of economic sectors within a zone, it is less important that zones be defined which are small and of equal size and economically homogeneous. Instead what is necessary is that they be homogeneous with respect to the transport influences from the Channel.

As well as the 33 zones within the EC which are considered as internal zones, there are also a small number of external zones to represent international trade with the rest of the world.

The starting point for the economic system in the model is the final demand (internal and external) for various categories of products and services. The internal final demand is spatially determined based on the population in each internal zone, its income and consumption patterns. The international demand (exports to non-EC countries) is exogenously determined for the external world market zones.

The economic structure of the regions is represented within the model by 27 aggregate industrial factors. These generate the demands for movements of commodities (i.e. trade) between the regions. The precise definitions of these factors is determined by the need to represent the main potential commodities which could be moved through the Tunnel and the economic sectors that are of special importance in the regions adjacent

Table 5.1. The zoning system for the Channel Tunnel study

Zone number	Zone name	NUTS code
	UK and Ireland	
1	Scotland*	7A
2	Northern Ireland	7B
	North	71
	Yorkshire and Humberside	72
	East Midlands	73
	West Midlands	77
	North-West	78
	Wales	79
3	Ireland*	8
4	South-East	75 (not 755 and 757)
	South-West	76
5	East Anglia	74
6	London	755
7	Kent*	757
	France	
8	Brittany*	252
9	Picardie	222
	Haute-Normandie	223
	Basse-Normandie	225
10	Nord-Pas-de-Calais*	23
11	Île-de-France	21
12	Champagne-Ardenne	221
	Centre	224
	Bourgogne	226
	Est	24
13	Pays de la Loire	251
	Poitou-Charentes	253
	Sud-Ouest	26
14	Centre-Est	27
	Méditerranée	28
	Belgium	
15	West-Vlaanderen*	519
16	Hainaut*	523
17	Belgium	5 (not 519 and 523)

Table 5.1. The zoning system for the Channel Tunnel study (continued)

Zone number	Zone name	NUTS code
	Netherlands	
18	Zeeland*	474
19	Netherlands	4 (not 474)
	Denmark	
20	Denmark	9
	Germany	
21	Schleswig-Holstein	11
	Hamburg	12
	Niedersachsen	13
	West Berlin	1B
22	Bremen*	14
23	Nordrhein-Westfalen	15 (not 152)
	Hessen	16
	Rheinland-Pfalz	17
24	Cologne*	152
25	Baden-Württemberg	18
	Bayern	19
	Saarland	1A
	Italy	
26	Valle D'Aosta	312
	Liguria	313
	Lombardia	32
	Nord Est	33
	Emilia-Romagna	34
	Centro	35
27	Piemonte*	311
28	Lazio	36
	Campania	37
	Abruzzi-Molise	38
	Sud	39
	Sicily	3A
	Sardinia	3B
	Spain	
29	Noroeste	B1
	Noreste	B2 (not B21)
	Madrid	B3
	Centro	B4
	Este	B5
	Sur	B6
	Canaries	B7
30	Pais Vasco*	B21
	Portugal	
31	Norte*	C11
32	Continente	C1 (not C11)
	Greece	
33	Greece	A
	External zones	
34	Austria/Switzerland	
35	Eastern Europe	
36	Scandinavia	
37	USA and rest of world	

* Denotes special study zone.

to the Channel Tunnel. The services sectors of the economy are also included as six factors.

The production in any zone gives rise to a demand for intermediate products. In the model the production in each sector gives rise to a demand for a variety of industrial products or services as well as labour, according to each sector's specific technology. The production cost of a product in a zone is estimated as the sum of the costs of the intermediate products that it consumes together with the costs of transporting these inputs from their respective production zones.

The total demand for consumption in a zone consists of the final plus the intermediate demand for that product. To supply this demand each country has, during the past, developed an economic structure influenced by each region's natural resources, population and accessibility to markets. The production in each region depends on the regional productive capacity as well as the cost of transporting the region's products to the area where the products are demanded. The regional capacity is approximated by the existing levels of production disaggregated by economic sector.

The pattern of regional trade is influenced by the transport cost which is calculated for all pairs of regions as an average of the transport costs depending on the actual modal split for each flow. The spatial pattern of the trade, as well as the passenger transport, is determined by using a random utility framework so that final and intermediate consumers decide according to zonal production levels and transport costs from where they will obtain goods and services. The random utility framework is used in order to take account of heterogeneity in the range of goods and services consumed.

The regional economic model produces multi-regional trade flows of commodities and services as well as flows of passengers. These form the basis for generating the demand for transport.

A change in the transport cost as an effect of infrastructure investments, or from changes in fuel prices or taxes will affect the regional trade pattern. Based on these changes, together with other exogenous economic changes that are forecast, expected changes in the regional economic structure can be analysed.

Emphasis within the study is being focused particularly on the development potential of the regions in the vicinity of the Tunnel, and on the trade that takes place between mainland Europe and the United Kingdom plus Ireland. This emphasis determines the orientation of the implementation of the regional economic model. While the model is set up to represent the flows of all commodities between all pairs of zones, the main effort has been placed on ensuring that flows which cross the Channel are represented accurately. This means that in the context of this particular study many of the more distant flows (e.g. from Spain to Italy) are being included for the sake of completeness rather than with a view to their being analysed independently in detail.

In this way the relative impact of the Tunnel on the transport costs of inputs to production and on the costs to consumers of finished products can be identified consistently for the different regions. It also highlights the extent to which the accessibility (i.e. average costs of inputs to production) of the peripheral regions compares with the more central regions.

5.2.1.2. Input-output framework — simplified example

The clearest way to represent the economic linkages between different factors is by use of a Leontief input-output model framework (Leontief, 1986). The basic concept is that the production of some economic activity, an output, consumes a range of other types of economic activities as inputs. These inputs, in the process of being produced, in turn consume further inputs, and so on. The original development of input-output models was mainly concentrated on macroeconomic applications with little treatment of the spatial implications. However, for regional modelling purposes the spatial aspects are crucial.

A simplified view of how a spatial input-output model is structured is presented in Figure 5.3 which describes a two-sector multi-zone situation. This example can be explained as follows. Exogenously specified amounts of population are located in each zone of the study area. The purpose of this model is to estimate the spatial pattern of location of industries and of services.

In an input-output system, population or households are usually treated as a final or exogenous sector. In this example, the exogenously specified population in a specific zone i consumes goods and services. This creates a demand, called the final demand, for these goods and services. This demand is satisfied from zones adjacent to zone i.

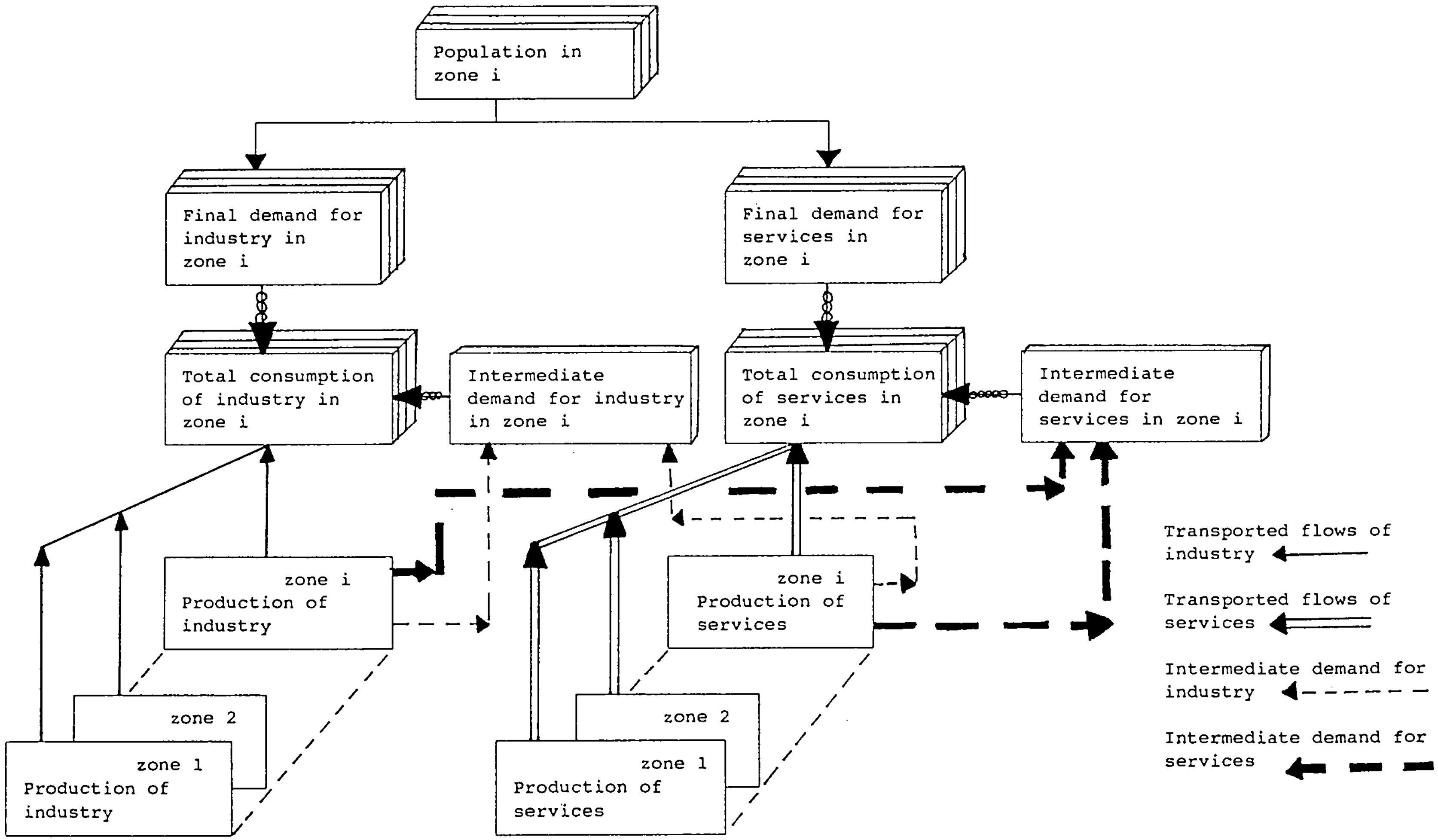


Figure 5.3. Spatial input-output model for a two-commodity multi-zone example

The transport of goods from their production zone to their zone of consumption creates a set of freight movements. Consumers moving between home and where the services are available create a set of passenger trips.

For a factory to function it needs various inputs such as energy, raw materials, financial services, etc. Thus each factory will consume an array of industrial and service inputs. This consumption requires a set of freight shipments and of business trips from the zones in which the goods and services are produced. The demand for inputs that is created by endogenously generated factors (i.e. industries and services) is termed the intermediate demand, whereas the final demand represents those inputs whose demand is created by exogenous factors (i.e. population).

The total demand for services is the sum of the final demand plus the intermediate demand. The system does not end here, however, since the industries and services consumed by the factory consume inputs as well. Shops and offices require financial services and energy for heat and light. Thus the total demand for services in a zone gives rise to a further increment of intermediate demand for labour and for services in that zone. These intermediate demands will then be satisfied by the transport of each of these factors from the zones in which they are produced.

Generally, goods movements are from the zone where they are produced to the zone where they are consumed. However for services, whether the direction of movement is from the zone of production as in the case where the service employee visits the customer, or to the zone of production as is the case where the customer visits the supplier of a service, it is not problematic since there will normally be a balancing return trip in each case.

The connections between all the factors are represented in Figure 5.3 where it is shown that the process is circular, in that population creates a demand for goods and services, which in turn consume further goods and services creating further increments in demand, and so on.

The increments become smaller in each iteration and the procedure will always converge in practice to a stable eventual level of total consumption for each factor in each zone.

5.2.1.3. Input-output framework for the Channel Tunnel study

Having outlined a simple example of the operation of the input-output framework, the Meplan model for the Channel Tunnel study can be seen to operate in an analogous fashion. The starting point for the spatial input-output model is the level of final demand for each factor in each zone. This final demand comprises that part of consumption which is by households or government or which is used as investment by industry. Exports are treated within the model as if they were final demands in external zones (i.e. outside the EC).

Within the Meplan framework the production of each factor is allocated to zones using a static spatial input-output structure as outlined above. On the other hand, the final demand and exports by zone are modified exogenously from one time period to the next.

Taking the final demand of each factor as given for a particular year, the regional model generates the production of each industrial factor and in turn the production of each service factor. To achieve this, the following fundamental input-output equation is used: total demand is the sum of the final demand plus the intermediate demand. In mathematical form this is:

$$Y_i^m = Y_i^{mo} + \sum_n \alpha_i^{mn} X_i^n \qquad (5.1)$$

where

Y_i^m = total demand for (i.e. total consumption of) factor m in zone i
Y_i^{mo} = the final demand for factor m in zone i
α_i^{mn} = the technical coefficient, which is defined as the number of units of m consumed to produce one unit of n in zone i
X_i^n = total endogenous production of factor n in zone i.

The technical coefficients that are used were extracted from the 1980 input-output table for a group of nine EC countries as this represented the most complete source of consistent data available at present. Ideally these coefficients could be further broken down to allow technologies to vary by country, using country-specific (i.e. varying by zone) coefficients for the major countries near the Channel Tunnel. However, this would substantially increase the computer running time and data-processing needs of the project and has not been implemented to date. When looking to the future the trend to convergence of economic and taxation structures of the different EC countries means that the use of coefficients averaged across all countries has certain advantages for forecasting purposes. Accordingly, the use of a common table is not as problematic as might first appear.

5.2.1.4. The spatial allocation process

In the previous subsection the economic linkages between the factors were described. In this subsection the emphasis is on describing the spatial linkages. These relate the zone in which a factor is produced to the zone where it is consumed.

For some factors there is no concept of a spatial linkage; these are deemed to be non-transportable factors. For example, in the current study factor 37, construction, is a non-transportable factor. Buildings may be constructed or demolished but they do not move.

The other industrial and service factors are transportable. The model estimates for each of these factors the trade from the zone of production to the zone of consumption.

There is a common spatial allocation model for all transportable factors. This is analogous to a destination-constrained distribution model; it takes as fixed the demand for the factor in consumption zones, and distributes the satisfaction of this demand among the sources of supply available in the zones of production. The functional form is a single level, multinomial logit model of discrete choice. The choice set is the set of production zones I available to a consumer in zone j.

The form of the model to determine the trade between a production zone i and a consumption zone j is as follows:

$$T_{ij} = Y_j \frac{S_i \exp[-\lambda(c_i + d_{ij} - w_i)]}{\sum_{i'} S_{i'} \exp[-\lambda(c_{i'} + d_{i'j} - w_{i'})]} \qquad (5.2)$$

where the superscript m denoting the factor has been omitted from all the terms and where

- T_{ij} = trade between consumption zone j and production zone i
- Y_j = the total demand for consumption in zone j
- S_i = measure of size of zone i
- c_i = cost of production at i
- d_{ij} = disutility of transport between i and j
- w_i = zonal attractor at i
- λ = concentration parameter (positive valued).

The logic underlying this model structure is as follows. The total consumption in zone j is multiplied by an expression representing the probability of it being produced in zone i. This probability depends on a number of terms. These are now explained individually.

The size term is generally measured by the capacity of production of the specified factor that is available within a zone. It reflects the property that, all other aspects being equal, a car factory is more likely to purchase steel from a region which is a major producer than a minor producer of steel. Since some zones contain far more capacity than others, and since on occasion zones may need to be combined or to be split, the use of a relevant measure of the size of a zone helps to represent these aspects and also increases the speed of convergence of the model.

The cost of production in a zone for a factor comprises the costs of all inputs to production. The calculation of this cost will be discussed in more detail in Subsection 5.2.1.5. It can be seen from equation 5.2 that all other aspects being equal, the higher the cost of production in zone i, the less likely it is that consumers in zone j will demand their production from zone i.

The disutility of transport between zones i and j is estimated from the transport model. It includes all aspects relevant to the characteristics of the trip, such as the cost, the travel time, the reliability of the mode, etc., so that it represents a generalized cost of transport. It is a composite disutility across modes. If the factor being allocated is industrial, then the disutility refers to freight transport, and if it is a service factor, then it relates to passenger journeys. The greater the disutility of travel, the less likely it is that consumers from zone j will purchase from zone i.

The regional model, as it is currently implemented for the Channel Tunnel study, concentrates mainly on the influence of transport costs and accessibilities on patterns of trade, and at present excludes many other features from explicit representation in the model. These other influences include such items as the existence of multinational enterprises, historic trading patterns, etc. which are awkward to include explicitly in the model without requiring substantially more detail and data. A simpler approach, which tries to take some implicit account of a wide range of elements influencing location patterns not yet explicitly accounted for in the model, is implemented through use of the zonal attractor term in equation 5.2. In the calibration phase of the study, various parameters are adjusted such that the modelled patterns of trade and of production are close to the observed patterns. Having completed the exercise of calibrating the parameters of the model, the model estimates of the zonal factor production totals are then compared with the observed zonal factor totals for each of the transportable factors. This enables zonal attractor values to be calculated which force the modelled and observed values to match exactly in the base year 1986. These resulting zonal attractors for each factor represent the influence of all the elements that fall outside the regional model framework that affect the patterns of location in the base year. When running the model in future years, these attractors are retained on the basis that many of the elements which are contained within them are elements whose importance is likely to continue for some time into the future. As such, the zonal attractors can be considered to operate through time as inertia terms that damp the influence of the other elements that are explicitly represented in the regional model.

If resources become available to develop this model further, it would be worthwhile to carry out more detailed research and analysis on the structural components of the attractor factors that were generated. Through econometric analysis these could be linked back to those characteristics of the zones which give them special advantages or disadvantages for the development of economic sectors. These characteristics could be aspects such as the existence of a skilled workforce or tradition in an industry, special subsidies or tax incentives, climatic or fertility advantages for agricultural products, etc. When these characteristics have had their relative importance quantified, they can be extracted from the general attractor term and then be separately forecast into the future. In this way, further aspects relevant to regional development in an economic sector could be introduced in a systematic and consistent fashion within the regional economic model framework described above.

The final term to be explained in equation 5.2 is the concentration parameter. This parameter is always positive. Larger parameter values will have the result that choices of location by consumers in zone j will concentrate almost completely on whichever zone i has the least value of the exponential term of equation 5.2. When the parameter is smaller, the spread of choices will be distributed more widely over a greater range of production zones i. The value of λ used for each factor is the value which makes the modelled pattern of distribution of trade most accurately duplicate the observed pattern of trade for that factor.

5.2.1.5. Production and consumption costs of factors

In spatial input-output models the treatment of transport and its costs is rather different to that adopted in conventional aspatial input-output models. Below is an explanation of the way in which the costs of transport are measured in the Meplan regional model, together with an outline of how this corresponds to the conventional approach. This subsection will also describe how costs and prices in general are represented within the models and how they are used for policy evaluation.

In aspatial input-output models there are normally one or more branches referring to the transport industry. For freight these represent the consumption of transport services by firms. Typically they will represent payments to rail companies and public hauliers but will not include own-account transport. The relative balance between the use of public hauliers and own-account transport differs between different countries, between different branches of industry within a country, and, moreover, differs over time within an industry. Accordingly, any analysis whose focus is on the impact of transport costs on patterns of trade for an industry should be based on all transport costs, both explicit (public hauliers) and implicit (own-account transport). Analogous issues arise with respect to business trips where rail and air travel would be explicitly accounted within transport services but car travel may not be fully accounted.

Within the Meplan regional model all transport costs are explicitly and fully represented. Because they are based on the patterns of flow by mode between zones, they allow for spatial differentiation in the magnitude of transport costs for each economic sector.

The cost of production of one unit of factor n is calculated by summing the cost of the inputs to production as:

$$c_i^n = \sum_m \alpha_i^{mn} \hat{c}_i^m \qquad (5.3)$$

where

c_i^n is the production cost within zone i of one unit of factor n

$\hat{c}_i^m$ is the consumption cost of input m in zone i.

This production cost includes both the costs of intermediate inputs and also those costs due to what are termed primary resources. The primary resource costs comprise three main components: the salaries of employees, profits and investment, taxes and subsidies. Note that unlike some input-output tables, imports are not considered directly as a primary resource cost, but rather are considered to be the consumption of factors that are produced in external rather than internal zones. Although it would be preferable to disaggregate the primary resource cost into its three components, data are not currently available to allow this disaggregation so that they are grouped together in a single factor, numbered 44, which is deemed non-transportable.

Input-output tables can be created in units of physical volume (e.g. the number of tonnes of iron ore needed to produce one tonne of steel) in units of value (e.g. the number of ecu of iron ore per ecu of steel) or in a combination of both as used in sophisticated social accounting matrix (SAM) formulations. All of these can be implemented in the Meplan regional model. However, because the primary data source, the 1980 input-output table, is in value terms, it was decided to implement the model in value terms. This implies that the level of production and consumption in a zone is measured in units of million ecu.

There is, none the less, a price-determining mechanism embedded within the model in the form of equation 5.3 above. The prices are built up as follows. Primary resources and imports are exogenously assigned a price of 1, which simply states that ECU 1 million of imports costs one times ECU 1 million at the point of import. The factors which are produced within the EC have their prices determined endogenously within the regional model.

Consider, firstly, the case of the aspatial input-output model. In this transport costs are included in the traditional aspatial fashion. The consistency requirements of the table ensure that once the input-output model has been iterated sufficiently to generate all the intermediate consumption, then the production costs and consumption costs for each factor build up to the value 1. This requirement has been used as a check on the accuracy of the data assembly and aggregation in the creation of the technical coefficients for the Meplan implementation and has been confirmed to hold when the spatial costs of transport are suppressed.

Consider, secondly, the case where spatial transport costs are explicitly included in the model. In this case the cost of consumption of one unit of factor m is measured as:

$$\hat{c}_j^m = \sum_i \left[(c_i^m + \bar{c}_{ij}^m)\, T_{ij}^m \right] / \sum_i T_{ij}^m \qquad (5.4)$$

where

- $\hat{c}_j^m$ is the cost of consuming one unit of factor m in zone j
- c_i^m is the purchase price of one unit of factor m in zone i
- $\bar{c}_{ij}^m$ is the monetary cost of transporting one unit of factor m from its zone of production i to its zone of consumption j
- T_{ij}^m is the volume of trade from zone i to zone j as estimated by equation 5.2.

Here it can be seen that the consumption cost is a simple weighted average of the production costs plus the costs of transporting the factor from the producer to the consumer. The weighting is based on the estimated distribution pattern of trade for the factor to that zone.

In this second approach both the production costs and the consumption costs will be greater than the value 1, since double counting of the transport costs has occurred. While normally such double counting would be something to be avoided, in this context it will be seen that it is actually beneficial. The reasoning behind this viewpoint is as follows.

In the aspatial input-output model, by definition, transport costs will be the same for all consumers in a sector regardless of where they are located. This gives a base level of transport costs averaged over the EC as a whole. On the other hand, the regional model, because it has spatial transport costs explicitly included, will generate costs of consumption which are greater in the regions remote from the zones of production, as can be seen from the structure of equation 5.4. The extent to which the consumption cost for a specific factor in a zone exceeds 1 will represent the degree of transport disadvantage to consumers of that factor in that zone. The system is in fact more sophisticated than this, in that even if consumers in a peripheral region have a local source of production of the factor in question, they may still need to pay above-average prices in order to cover the high costs of transporting the inputs to production to this peripheral region. These production prices are built up in the model through equations 5.3 and 5.4. Thus the extent to which the production prices in a zone exceed 1 are analogous measures of the degree of transport disadvantage to producers in the zone.

Because this structure is built on a full input-output structure, it will correctly balance the relative importance of transport costs to other production costs. This means that for sectors which have low-value high-volume (i.e. high relative transport cost) inputs the resulting estimated prices will exceed 1 by a greater amount than those sectors which have high-value low-volume (i.e. low relative transport cost) inputs.

This structure also allows the transport cost impact of a specific policy to be measured individually for both producers and consumers of every factor in every zone. Here it should be noted that since factors other than pure cost enter into the mode choice and zone choice models, the evaluation of benefits is more consistently carried out through use of composite disutilities rather than just monetary cost savings. These composite disutilities are also produced within the regional model at a disaggregate level.

This discussion has illustrated the way in which the Meplan regional model ensures a full and explicit representation of all the effects of changes in transport costs and characteristics on both producer prices and consumer costs. In later sections the ways in which these transport costs and characteristics are measured will be outlined.

5.2.1.6. Iterative structure of the spatial allocation model

In Subsections 5.2.1.3 to 5.2.1.5 the various components of the spatial allocation model have been identified separately. This separation between the concepts does not exist in practice within the model, but rather was created artificially to structure the explanation of the model.

The model itself allows every factor in every zone to consume any other factor from any other zone, and a change in any one price in the system can affect the location directly or indirectly of all transportable factors within the model.

There is a powerful iterative structure built into the model which allows:

iterations around the input-output system;

iterations around the spatial allocation system;

iterations around the zonal productive capacity/demand balancing;

all to be under way in parallel. The details of many parts of the algorithm are described in Williams (1979).

The number of iterations required before the model arrives at a completely converged stable solution depends very much on how good the starting point is from which the iterations commence. Provided that the data used in the model are logically consistent and that parameter values are sensible, the model has always been found to converge to a stable solution.

5.2.1.7. Incremental models

The core of the regional model is the way in which the patterns of location of production and consumption of the factors evolve both through time and through space and the way in which they interlink and interact with one another. The estimation of the location of factors is carried out by one of two types of model.

The first type of model is used for the allocation of the industrial and service factors. It is a spatial allocation model that is static in the sense that any run of the model represents the pattern of location at one point in time. This model is described in Subsections 5.2.1.2 to 5.2.1.6 and is contained in the Meplan module LUSA.

The second type of model is much simpler and is used for the allocation of changes through time in the levels for each factor of the final demand. It estimates the increment of growth or decline for each factor in each zone between one time period and the next. It operates singly for each factor in turn. This model is contained in the Meplan module LUSB.

On the basis of past trends in GDP per capita of each country, projections are made of future economic growth rates for each country. Using the growth rate in GDP the final demand per capita in the country is increased pro rata for each economic factor. The population in each zone within a country is increased by a growth rate based on past population trends in the country. The updated final demand rate for the country is applied to the updated population in each zone of the country to produce the updated total final demand for the year in question.

5.2.2. The interface between regional economics and transport

For the Meplan regional model to estimate the spatial pattern of location of production and consumption, it requires as inputs the disutility and the monetary costs of travel for each trade between all zone pairs. For the transport model to function, it requires estimates of the future flows of freight and of passengers by type between each pair of zones.

5.2.2.1. Outputs sent from the regional model to the transport model

The demand for freight transport that has been estimated by the regional economic model is converted from its annual value in ecus to the tonnes moved per day. The conversion is carried out by multiplying the trade by a volume to value ratio estimated for each commodity type. These flows include both interindustry flows of input intermediate goods and also finished products to final demand. These flows in tonnes are aggregated together into a number of flow types. These flow types range from bulk low-value goods at one extreme, which will be little affected by the Tunnel, through to low-volume high-value manufactured goods at the other extreme, where the quality of service (in terms of higher frequency, capacity and reliability) afforded by the Tunnel will be important.

In a similar fashion the annual demand for passenger trips is converted into the number of passenger trips per day. Within the regional economic model six passenger types are distinguished. This separation into market segments is to take account of the different expected growth rates in the future, their different modal split behaviour and consequently the different influence that the Channel Tunnel is likely to have on their patterns of behaviour.

5.2.3. The transport model structure

5.2.3.1. An overview of TAS

The transport module of the Meplan package is known as TAS. TAS takes flows between origins and destinations and predicts the modes and routes that they will use. To do this usefully, some inherently complex and often untidy features have to be considered:

(i) transport systems are made up of networks;

(ii) different modes of transport have different characteristics;

(iii) users not only respond to the availability of transport but also affect it, usually by getting in each other's way;

(iv) the predicted outcome not only from the users' points of view but also from those of public transport operators, highway management authorities and government bodies that give subsidies or receive taxes generally needs to be examined.

The transport model comprises three TAS programs.

TASB is used to check the network for consistency and to sort the network data into the order required for path calculations.

TASA makes the actual predictions of modal split and route choice. In general, its first results will imply congestion in parts of the network. The delays that result are estimated, and the modal split and process of adjustment, called capacity restraint, is repeated until no more changes in route or mode are taking place.

TASE is used to organize data from TASA into formats required for evaluation tables. A typical application of TASE is to establish the costs and revenues of public transport operators from the outputs of TASA.

Many transport models have been developed over the last 30 years, giving rise to a 'conventional' form of transport model with which Meplan can appropriately be compared. The critical difference between Meplan's TAS and the conventional four-stage transport model is that of the four stages, trip generation, trip distribution, modal split and assignment, only the last two are present, because in Meplan the number and pattern of economic trades are calculated in LUS and converted to trips by the interface program FREDA. Each run of TASA therefore uses a fixed trip matrix.

In technical terms, Meplan offers a hierarchical, multinomial logit modal split model and a multipath assignment. Capacity restraint is carried out by adjusting link speeds, and the model is solved by iterative running using the full matrix throughout.

5.2.3.2. The study area and zoning system

When modelling a transport system it is usual to define a boundary to the study area and to subdivide this area into zones. The main criterion governing the study area definition is that it should include all areas and transport links which would be significantly affected by the proposals being evaluated by the model. It is also useful if the boundary follows major administrative boundaries to facilitate the provision of input data and the interpretation of output results.

Zones are modelled by connecting a zone centroid to the network which represents the place where an average journey from the zone is considered to start. They are the basis of modelling transport demand since the trip matrix created by the regional economic model represents movement between each origin zone and each destination zone.

5.2.3.3. The supply of transport — Networks

The transport infrastructure is represented in the module TAS by a network of links and nodes. It is usual to represent the transport network in great detail in the area where the greatest changes are expected to allow detailed modelling, but to simplify the network as distance increases.

In Meplan a single network is defined in which all the different link types are represented. This use of a single network allows great flexibility in the treatment of intermodal trips such as when cars transfer to a ferry for a sea crossing.

Information included for each link depends on the link type but generally includes:

Origin and destination node: the nodes in question at either end of the link.

Distance: the length of links are summed to give the journey distance between zones which can be used in calibration/validation.

Charge: a charge on an individual link is normally used only for exceptional costs to users such as tolls on roads or air fares. General costs are defined elsewhere in the model when considering different modes.

Time/speed: either of these can be used when defining a link type. Within the model, the speed is converted everywhere to the time on the link. Speed is often easier to code for road links but for timetabled air or rail services, for example, time is easier to include.

Capacity: normally the maximum throughput of the link at high levels of congestion is included.

Exogenous load: can be used to represent traffic that uses link capacity but is not otherwise modelled.

Although the majority of links defined in the network usually corresponds directly to the transport infrastructure such as roads and railways, Meplan can also use links to represent other physical characteristics such as transfer between air services, waiting, or access (for example, between a zone centroid and the network proper).

5.2.3.4. The demand for transport — Trip matrices

One of the main outputs from the Meplan regional economic model is the set of matrices of trades between zone pairs. Many of these trades are not usable directly as trip matrices in the transport model since they are generally in value rather than physical units, nor are they usually appropriate for the modelled time period. The regional economic/transport interface model, FREDA, modifies these to produce matrices by flow type in appropriate units and for the time period being modelled. It is these flow matrices which represent the demand for movement of passengers and freight.

Modal split and assignment, which are discussed below, are the processes whereby this demand for movement is allocated to the different transport modes available and to the different links in the network.

5.2.3.5. Users and operators

To understand the transport model fully it is helpful to distinguish between transport users, who pay a tariff to use a service, and transport operators, who provide transport services for users. Vehicle operating costs are generally used in the transport model to determine the least-cost paths through the network. The assumption made is that vehicle operators will tend to use those paths which imply the lowest vehicle operating costs. In some cases, such as for passenger movements and high-value freight, it is also normal to include a further element in the cost function to take account of the user's value of time.

The transport model also requires user tariff information for all facilities for which users are charged. User tariff information, along with other characteristics of a mode, is utilized in the model to determine which modes or combination of modes will be chosen by a user when making a journey or sending a consignment of freight. Segmentation of the market for transport has been represented in the model through the inclusion of different tariffs for different passenger types. For example, the air fares for business trips have been coded at the level of fully flexible fares, while leisure travel was coded at the economy fare for booking in advance. Package holiday travellers were coded at a further discount of 20% below this fare. Analogous fare adjustments were made on other modes.

5.2.3.6. Modes and modal split

The transport model represents the different modes of transport available to travellers using a two-level description. When considering movement at the individual link level, a passenger or unit of freight is represented as having a travel state (network mode) appropriate to that of the link. For example, on a motorway the travel states car ride, coach ride and goods vehicle drive could be included.

When considering movement at the level of a whole trip, each passenger or unit of freight is represented as having a user mode appropriate to the trip. Each user mode is built up as a collection of travel states, or network modes, which occur on links in the network. For example, flows that go part way by rail or truck but then continue on board ships could be coded as trips by user mode 'shipping' that use network modes 'rail' or 'truck' for part of the trip.

Different categories of links are used to specify different values of time and money cost functions for different travel states, and to restrict certain travel states to certain links.

Each trip has its own specification for both the mode and the route distribution processes. That is, the available modes, the parameters for the mode and route choice model, and the hierarchical structure for the mode choice model are all specified separately for each type. This allows various types of trip to be treated separately, each with its own set of characteristics.

The modal split process for trips is represented using a multilevel logit model of discrete choice. This is the theoretically most sophisticated model in general practical use and acceptance for modal split prediction. Its mathematical derivation is widely available (e.g. Wilson et al., 1981) and need not be repeated here. The reason for the model's popularity is that it is based on an explicit and justifiable theory of utility-based choice, while at the same time being practical to calibrate and operate.

It is possible to define a hierarchical choice model in which it is assumed that actors will make choices at different levels. For example, at the upper level of choice the options of car and coach transport could be given. At the second more detailed level, individual options within each group such as Channel crossing by ferry or by shuttle could be given.

The choice of modes for a trip is therefore dependent on the relative travel disutility of each mode. This travel disutility (or generalized cost) comprises:

(i) the money cost (or operating cost or fares),

(ii) the travel time (with potentially different values of time applied to the different travel states),

(iii) a mode specific constant (to represent the convenience, flexibility or availability of the mode).

The modal split model takes as input the characteristics of the transport supply and matrices of trips by type. It then produces as output the number of passengers and freight units by type travelling between each pair of zones on each mode of transport. It also measures the average money costs, travel times, and disutilities which are input to the regional economic model for the next time period. They are the measures of accessibility among zones that influence future spatial choices.

The disutility of travelling along a link is defined from the distance, time and money cost incurred on the link. Different definitions are established for each link category and travel state for each trip type. This allows different mode specific values of time to be specified, for example, for waiting and riding. The money cost incurred on a link is also built up from the properties of the link, travel state and trip type. This is because both the generalized cost for travel and the money cost for travel, separate from the generalized cost, are required in Meplan. Generalized costs are intended to represent the general difficulty associated with travel. They are used in modelling the travel decisions within the transport model. Money costs play a particular role on their own in the regional economic model and are passed on separately for use there.

5.2.3.7. Trip assignment

Trip assignment is the process whereby flows between zones are actually allocated to the links defined in the network to produce link loads. The assignment model in Meplan is a multipath assignment and, like the modal split calculations, is based upon random utility theory.

This assumes that each individual traveller will make each choice of route through the network on the basis of a personal perception of the possibilities available. This is achieved in the transport model by assuming that individuals' perceptions of route characteristics form a distribution around the average route characteristics calculated in the model. By assuming a particular shape to this distribution, a logit model is used to predict the choice of route at each point in the network for each journey and group of travellers identified.

This assignment model is similar to that developed by Dial (1971) in that it allocates flows to a set of 'reasonable' paths, based upon the 'generalized cost' of alternative routes. A 'reasonable' path is one in which every successive node through which the traveller passes is nearer, in terms of generalized cost, to the destination. In Meplan, flows will be allocated to all the reasonable paths available to a particular journey. The extent to which travellers concentrate on the minimum paths or, conversely, spread out over all the paths, is represented by the distribution in individual perceptions of the choices and has to be estimated in the implementation of the model.

Assignments are carried out for each user mode and for each flow. The assignment considers which network modes are available for each user mode so as to assign the flow onto appropriate link types and to use the appropriate functions and parameters to calculate disutilities. The identity of the network mode available on a link does not in itself affect the assignment.

The operation of the assignment process occurs in two phases. The first builds up information about paths by each mode and for each flow, from every origin to one destination at a time. This information is needed for the modal split to be predicted. The second part of the assignment process comes after the modal split and predicts flows by mode for all the flows in the flow group, again from every origin to each destination in turn, and predicts which paths they will take through the network.

Both these distributions are done using the following functional form:

$$R_{ijk} = F_{ij} \exp[-\mu(g_{ijk} + \beta_k)] \,/ \sum_{k' \in K_{ij}} \exp[-\mu(g_{ijk'} + \beta_{k'})] \quad (5.5)$$

where

- i = index representing origin zone
- j = index representing destination zone
- k = index representing modes for split among modes and representing paths for split among paths
- K_{ij} = the set of all modes for split among modes and all paths for split among paths from i to j
- F_{ij} = the volume of trips going from i to j, in total for split among modes and for a given mode for split among paths
- R_{ijk} = the volume of trips going from i to j by mode k for split among modes and along path k for a given mode for split among paths
- μ = a concentration parameter that allows calibration of the sensitivity of the distribution process to the influences represented explicitly
- g_{ijk} = the generalized cost for mode k for split among modes and path k for split among paths
- β_k = mode specific constant for mode k for split among modes and zero (i.e. not used) for split among paths.

A balanced assignment with capacity restraint is sought iteratively. In each iteration the origin destination matrix for each trip type is loaded separately and the total loads on links resulting from both the freight and passenger movements added together and then used for capacity restraint considerations. The congestion caused by all 'vehicles' on a link is estimated and the travel times are adjusted causing changes in mode and route choice. The process is iterated until the patterns of transport have converged to a stable solution. Note that in the current phase of the Channel Tunnel model, capacity constraint is not implemented.

5.2.3.8. Transport model outputs

Among the outputs from the transport model are the average costs, times and disutilities of movement between each pair of zones for each type of flow. This information is fed back to the interface program which converts it into costs and disutilities per unit of economic trade. These costs and disutilities are in turn input to the regional economic model when it is run for the next time period, and there provide the time-lagged measures of accessibility between zones which influence the future spatial pattern of regional development.

5.3. Model implementation and calibration

5.3.1. The regional economic model

5.3.1.1. Factor definitions

This subsection outlines the background to the definition of the factors to be used in the regional economic model LUS. The set of factors comprises the complete set of entities to be included within the regional economic model. Factors include industrial sectors, travel purposes, basic socioeconomic information, etc. Some factors correspond to entities which are transportable either as freight or as passenger trips. Others, such as construction (buildings once constructed do not move have outputs which are not transportable.

Table 5.2 provides a list of the factors and the units in which they are measured.

Passenger travel factors (factors 5 to 10)
The passenger travel factors have been defined so as to be consistent with the main source of data available to the project, namely the UK Department of Transport survey of passengers to and from the UK. They have been distinguished in order to represent realistically the main passenger travel markets across the Channel.

It is advantageous to keep these factors separate for the following reasons. Firstly, the choice of modes is quite different between business and non-business travellers, given that business travellers typically have their travel costs covered by a firm and may be prepared to spend substantially more money for a fast and flexible service than are non-business travellers. Also, holiday-makers on inclusive tours will differ in their choice of modes of transport from those on independent holidays.

Secondly, the spatial distribution patterns of these six market segments may be quite different. Some segments (e.g. day-trippers) will have mainly local trips in the vicinity of the Channel, while others (e.g. inclusive tours) will have a much wider geographical spread.

Industrial factors (factors 11 to 43)
The main issue in determining the set of factors to use to represent industrial sectors was the requirement to be able to build up consistent data sets for which data is available for all zones. The only sets of input-output tables available for individual EC countries on a common year (1980), are at the 59 branch level for six countries:

Belgium
Denmark
France
Italy
Netherlands
United Kingdom

and at the 44 branch level for three countries:

Germany
Portugal
Spain.

No tables are available as yet for 1980 for the remaining three EC countries:

Greece
Luxembourg
Ireland.

Since it is easier to aggregate categories than to disaggregate categories, the categorization of economic sectors used in the regional model is at the R44 branch level. Of these 44 branches, 27 of them correspond to primary and industrial production (factors 11 to 37). These branches produce outputs that are transported as freight movements rather than person trips.

The remaining 17 economic sectors correspond to service branches. The service branches produce as outputs movements of people or money but not of freight. It is convenient to aggregate some of the service branches in the model for two reasons. Firstly, for a number of the countries the input-output tables are not available at the full R44 level. Secondly, the relationship of these branches to the travel factors allows some of them to be aggregated together without substantial loss in precision of the results.

Table 5.2. Meplan factors

Factors	Units	Transportable
Miscellaneous factors		
1 Population	Persons	N
2 Employment	Employees	N
3 Income/capita	Million ECU	N
Travel factors	(Trips)	
5 Business or study		Y
6 Inclusive tours		Y
7 Independent holiday		Y
8 Visit friends		Y
9 Day-trippers		Y
10 Miscellaneous		Y
Industrial factors	(Million ECU)	
11 Agricultural		Y
12 Coal		Y
13 Coking		Y
14 Petroleum		Y
15 Energy		Y
16 Radioactive		Y
17 Metal ores		Y
18 Minerals		Y
19 Chemicals		Y
20 Metal products		Y
21 Machinery		Y
22 Instruments		Y
23 Electrical		Y
24 Vehicles		Y
25 Transport equipment		Y
26 Meat		Y
27 Dairy		Y
28 Other food		Y
29 Beverages		Y
30 Tobacco		Y
31 Textiles		Y
32 Leather		Y
33 Timber		Y
34 Paper		Y
35 Rubber		Y
36 Other manufacturing		Y
37 Construction		N
Service factors	(Million ECU)	
38 Repair, retail, communication		Y
39 Lodging, catering		Y
40 Transport services		Y
41 Business, finance		Y
42 Market services		Y
43 Non-market services		Y
Miscellaneous factors	(Million ECU)	
44 Primary resource costs		N
48 Cross-Channel tourism		N

Miscellaneous factors (factors 1, 2, 3 and 44)
These factors include population, employment, income per capita plus primary resource costs. Some further factors were also used in the model for technical reasons to interface the travel factors with the service factors.

5.3.1.2. Data inputs

Population
Population is included both in the model directly as an exogenously specified factor and also used to divide up the final demand values for countries which are disaggregated into more than one zone.

The 1986 population values have been determined from Eurostat: *Regions* — 1989 edition. The Eurostat *Regions* figures are defined at NUTS level 2 divisions and therefore can be used to determine population figures for most of the study zones explicitly (London and Kent being the only exceptions). The London and Kent populations have been approximated from 1986 population data from another source (Central Statistical Office: *Regional trends 24* — 1989 edition). Note that the Luxembourg population has been included with that in zone 17 — Belgium.

Table 5.3 contains 1980, 1985 and 1986 population figures.

Final demand
The source of much of the economic information for this study is the set of Eurostat reports and tables relating to consistent input-output tables for 1980. This information, however, is only available for nine of the EUR 12 countries, being currently unavailable for Ireland, Greece and Luxembourg.

For each EUR 9 country, then, final consumption of households, consumption of general government and private non-profit-making institutions and the gross fixed capital formation (GFCF — or gross fixed investment) were obtained from the Eurostat tables (R44 division) and combined to form the final demand values for each country. These figures were converted from the country national currency into 1980 ecus and then proportioned into the study zones according to the population in each zone. They were then aggregated into the Meplan factors.

Table 1 in Appendix A5.1 contains the EUR 9 final demand values as input into the Meplan model.

For Greece, Ireland and Luxembourg, domestic consumption and investment values were estimated from information in Eurostat: *National accounts ESA.*

Imports and exports
In this study, export and import refer to the export/import of goods to countries outside of the study area (i.e. to the external zones) and not to the export/import of goods between different countries in EUR 12.

Exports in 1980, by branch, were provided in the Eurostat input-output tables. These figures were scaled up to 1986 values and adjusted to take account of exports from Greece, Ireland and Luxembourg by information provided in Eurostat: *External trade — Statistical yearbook 1990.* Each branch total was then apportioned to the external zones according to proportions derived from Eurostat: *External trade — Statistical yearbook 1990.* It should be noted that all branches that are exported are exported to each of the four external zones in the same proportion. This will be adjusted if and when improved information becomes available.

Table 2 in Appendix A5.1 contains the 1986 exports by Meplan factor division from EUR 12.

Imports in 1980 were scaled up to 1986 values by branch in an analogous fashion to the exports.

Production capacities
Sector production capacities for each economic factor are required to run the Meplan model. For the nine countries for which Eurostat input-output table information is available, 1980 figures for domestic output by the R44 branch were obtained. These values were scaled up to 1986 values by a ratio of the 1986 to 1980 gross value-added at market price figures provided in the Eurostat publication *National accounts ESA — Detailed tables by branch 1989.* Scaling the figures up in this manner assumes an unchanging structure of production through time (in the absence of available data on how production structures have changed). In line with this the proportion of inputs from all branches to any particular branch would not be expected to change over time.

Having calculated the production capacities for each R44 branch for each country, the distribution of capacities for countries which are disaggregated into more than one zone had to be

Table 5.3. 1980, 1985 and 1986 zonal population figures *(1 000)*

Country	1980	1985	1986
Germany	61 567	61 022	61 067
Zone 21 North Germany	13 400	13 258	13 255
Zone 22 Bremen	695	663	657
Zone 23 Mid-Germany	22 357	21 959	21 937
Zone 24 Cologne	3 915	3 879	3 881
Zone 25 South Germany	21 200	21 263	21 337
France	53 858	55 172	55 394
Zone 8 Brittany	2 680	2 757	2 758
Zone 9 Normandy	4 702	4 828	4 849
Zone 10 Nord-Pas-de-Calais	3 921	3 931	3 929
Zone 11 Île-de-France	10 008	10 228	10 231
Zone 12 Mid-France	10 116	10 274	10 315
Zone 13 South-west France	10 126	10 389	10 441
Zone 14 South-east France	12 305	12 765	12 871
Italy	56 416	57 141	57 246
Zone 26 North Italy	27 005	27 003	26 979
Zone 27 Piemonte	4 501	4 403	4 392
Zone 28 South Italy	24 910	25 735	25 875
Netherlands	14 149	14 490	14 570
Zone 18 Zeeland	350	356	356
Zone 19 Rest of Netherlands	13 799	14 134	14 214
Belgium + Luxembourg	10 224	10 227	10 232
Zone 15 West-Vlaanderen	1 079	1 090	1 092
Zone 16 Hainaut	1 307	1 280	1 276
Zone 17 Rest of Belgium	7 838	7 857	7 864
United Kingdom	56 314	56 620	56 763
Zone 1 Scotland	5 153	5 137	5 121
Zone 2 Midlands, North England	27 925	27 825	27 842
Zone 4 South England	13 228	13 472	13 552
Zone 5 East Anglia	1 882	1 965	1 992
Zone 6 London	6 644	6 721	6 750
Zone 7 Kent	1 482	1 500	1 506
Ireland	3 401	3 541	3 541
Zone 3 Ireland	3 401	3 541	3 541
Denmark	5 123	5 114	5 121
Zone 20 Denmark	5 123	5 114	5 121
Greece	9 643	9 935	9 966
Zone 33 Greece	9 643	9 935	9 966
Spain	37 443	38 505	38 669
Zone 29 Rest of Spain	35 266	36 325	36 483
Zone 30 Pais Vasco	2 177	2 180	2 186
Portugal	9 766	10 158	10 208
Zone 31 Norte	3 416	3 553	3 577
Zone 32 Rest of Portugal	6 350	6 605	6 631
Total	317 904	321 925	322 777

1980 and 1985 figures from Eurostat: *Regions* — 1988 edition.
1986 figures from Eurostat: *Regions* — 1989 edition.
Approximate 1980, 1985 and 1986 London and Kent values.
1980 Norte value estimated according to 1985 proportions.

estimated. Employment data was used for this purpose.

Employment figures for 1986 for both the R06 and R17 sector divisions at NUTS levels 2 and 3 were available from a detailed Eurostat file. Generally, the R06 sector employment information was complete; however, there were significant gaps in the information at the R17 level. Specifically, there were gaps in the industry and energy sectors, and in the German and the UK data in general. These gaps were supplemented by information obtained from other data sources (Eurostat: *Regions — Statistical yearbook 1988;* Central Statistical Office: *Regional trends 24* — 1989 edition; *Employment Gazette* (November 1987) and two of the special region study reports: '(Cologne: Preliminary situation analysis and possible impacts of the Channel Tunnel' and 'Situation analysis and possible impacts: Kent'). Note that the Eurostat R06 sector totals were retained throughout.

The R17 employment data were then used to estimate the distribution of sector production capacities. Because the sector production capacities were at the R44 level and the employment information at the R17 level, sectors at the R44 level were divided according to their appropriate R17 employment category.

Values for Greece, Ireland and Luxembourg were estimated from Eurostat: *National accounts ESA, 1989.*

5.3.1.3. Technical coefficients

It has been assumed that the input-output structure contained in the Eurostat input-output tables applies to all countries in the study. Essentially, this assumption implies that to produce one unit of a factor in one country requires the same amount of inputs as it does in another country. Note that, however, the final demand values and production capacities have been country or zone specific.

The technical coefficients were derived from the 1980 Eurostat input-output tables. It was assumed that these same rates apply to the 1986 situation. For computer efficiency, all coefficients of less than 0.0001 were set to zero.

5.3.1.4. Regional economic model calibration

Because this study is primarily concerned with transport flows across the Channel, the LUS model calibration process concentrated on best representing money flows of the various factors to and from the UK. Observed 1986 trade volumes between the UK and EUR 12, by Nimexe category divisions, were used to measure the accuracy of the calibration results. Note that the Meplan factor definitions do not directly coincide with the Nimexe definitions and therefore for comparison purposes both were aggregated into categories which are approximately equivalent.

Calibration of the land-use model essentially involves determining the distribution parameter, lambda (λ), for each factor which best represents the observed distribution of trade for that commodity. For each commodity different values of lambda were tested to seek to reproduce the trade across the Channel. During this process it was discovered that, because of the large intracountry flows, lambda values of such a large magnitude were required so that the model convergence was impeded. Secondly, it was found that such lambda values resulted in intercountry trade patterns which were much too concentrated.

In order to represent both the large intracountry flows and the more dispersed intercountry trade, a special programme was written which added a constant extra disutility to the transport disutility if the origin and destination zones were not in the same country. This extra disutility represents the additional difficulty in trading between countries which is not accounted for in transport costs and disutilities as determined in the TAS model. With this additional adjustment, the large intracountry flows were able to be replicated, and, since the disutility term being added to all trade pairs outside the country was a constant, relative trade patterns between countries were not affected.

A comparison of the observed and modelled trade flows between the UK and mainland Europe, in money terms, is presented in Table 5.4.

It should be noted that in this study the majority of effort was spent on best representing the trading patterns of those commodities which would be in competition in using the Channel Tunnel and, therefore, representation of the fuel and other bulk flow trade patterns is less accurate.

In addition to representing accurately the trade flows across the Channel, trading patterns for the various factor categories were examined and compared with observed values. Eurostat, *External trade — Analytical tables – 1986* (Volume Z),

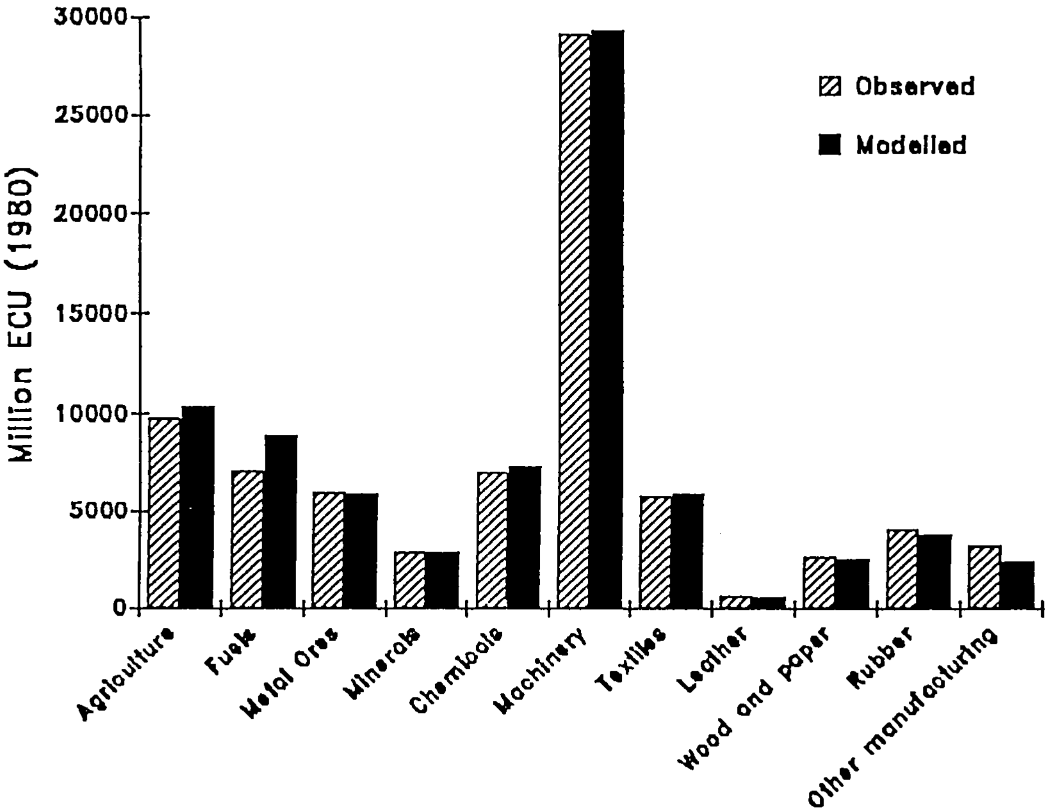
Table 5.4. Comparison of observed and modelled 1986 trade flows between the UK and mainland Europe

(million ecu)

Category	Total flow: Observed	Total flow: Modelled
Agriculture	9 868	10 423
Fuels	7 121	8 989
Metal ores	6 017	5 943
Minerals	2 961	2 977
Chemicals	7 038	7 372
Machinery	29 194	29 354
Textiles	5 816	5 929
Leather	684	620
Wood and paper	2 673	2 607
Rubber	4 118	3 860
Other manufacturing	3 280	2 461
Total	78 770	80 535

Source: Eurostat, *External trade — Analytical tables — 1986* (Volume Z).

Figure 5.4. Comparison of observed and modelled 1986 trade flows between the UK and mainland Europe



provided observed commodity trading patterns between the UK and EUR 12. From this information 'observed' average distances, for trades of commodities, were calculated assuming a central location in each country from which the trade was assumed to originate or end. Modelled results were compared with these observed values and are shown in Table 5.5 below. Note that these values represent intercountry trading patterns only.

5.3.2. The interface between the regional economic and transport models

5.3.2.1. Volume to value ratios

In order to convert the trades in the land-use model into transport flows for the transport model and to convert disutilities per unit of flow output from the transport model into disutilities per unit of trade it is necessary to input volume/value ratios for all the transportable commodities.

UK trade figures for 1989 in both volume and value terms were obtained from Port Statistics (1989). These values were used to calculate the volume of goods in tonnes per ECU 1 million (1980) of money, by NST chapter, as shown in Table 5.6. The conversion factor to convert 1989 pounds sterling to 1980 million ecus was derived from COBA; Eurostat: *Facts through figures — A statistical portrait of the British in the Community;* and *UK in figures* — 1990 edition.

Note that because the Meplan factors are defined at a more disaggregate level than the NST chapters, the same volume to value ratio was used initially for all categories contained in the same NST chapter and subsequent adjustments were made to individual factors on the basis of judgment.

For container-type movements (flow groups 9 and 10), the volume to value figures required further adjustment to convert the transport volume measurement from units of tonnes to units of feu (40-foot equivalent units). Statistics on the average number of tonnes carried by a loaded truck (35.1 to 38 tonne size), by NST/R commodity classification, were provided from the international road haulage survey (1989). It was assumed that a 35.1 to 38 tonne truck carried 1 feu. This conversion from tonnes to feu, for each commodity, was assumed to be equally relevant for all container traffic.

Note that this method of conversion was not applied to the energy factor (factor 15). In this case, the conversion factor was set to zero as it was assumed that energy products travelled by

Table 5.5. Comparison of observed and modelled average distances for trades of commodities

(km)

Trade	Observed	Modelled results
18 Minerals	1 069.6	938.7
19 Chemicals	1 085.8	984.1
20 Metal products	1 158.3	1 123.0
21 Machinery	1 181.6	1 031.8
22 Instruments	1 181.6	1 027.2
23 Electrical	1 181.6	1 041.4
24 Vehicles	1 129.6	1 060.7
25 Transport equipment	1 129.6	1 038.7
26 Meat	1 078.5	1 043.4
27 Dairy	1 042.4	1 138.7
28 Other foods	1 068.7	1 019.1
29 Beverages	1 078.5	1 096.9
30 Tobacco	1 114.5	1 226.7
31 Textiles	1 238.1	1 208.8
32 Leather	1 272.1	1 168.6
33 Timber	1 097.8	1 064.3
34 Paper	1 124.2	1 009.9
35 Rubber	1 023.1	993.4
36 Other manufacturing	1 065.3	1 116.1

Table 5.6. Volume to value ratios

NST chapter	Volume (1 000 t)	Value (1980 million ECU)	Volume to value
0 Agricultural products	21 121	6 596	3.202
1 Foodstuffs	18 855	14 340	1.315
2 Solid mineral fuels	15 523	627	24.758
3 Petroleum and products	115 722	9 694	11.937
4 Ores and metal waste	25 602	2 070	12.368
5 Metal products	15 014	9 618	1.561
6 Crude and manufactured minerals	17 267	1 397	12.360
7 Fertilizers	4 141	348	11.899
8 Chemicals	22 282	20 596	1.082
9 Machinery, transport equipment, manufactured articles and miscellaneous manufactured goods	27 378	94 755	0.289

methods not represented in the network (i.e. pipeline etc.).

Because all transport network information was input as costs in 1990 pounds sterling, an additional conversion was required to convert the transport disutilities from TAS into LUS disutilities per unit of trade in 1980 million ecus.

In order to convert the LUS trade flows which are measured in 1980 million ecus of goods per year, to transport flows per day, a 365 working days per year conversion was assumed.

The other information required in the conversion is the proportion of trade flow contained in each transport flow type (i.e. the proportion of agriculture, in value terms, which is bulk, semi-bulk, general-value container and high-value container). Very little relevant information was available and therefore values have largely been assumed with some guidance from 'International road haulage by United Kingdom registered vehicle — Report on 1989' and 'Origins, destinations and transport of UK international trade' (1986).

Once commodity types were apportioned to flow groups, the volume to value ratios were further adjusted to account for the differences in the value of goods per unit of volume for the four flow groups. For instance, goods moved in powered goods vehicles, or as air freight tend to be of higher value per unit of volume than those transported in containers or unaccompanied trailers. Non-unitized goods, bulk and semi-bulks, tend to be of an even lower value per unit volume. This final adjustment to the volume to value ratios was made bearing in mind the average volume to value ratio value as calculated above for each commodity.

5.3.3. Implementation and calibration of the transport model

In this subsection the way in which the transport model has been implemented for the Channel Tunnel study is described.

5.3.3.1. Transport zoning system

Thirty-seven transport zones in total are defined in the transport model and are illustrated in Figure 5.2 and listed in Table 5.1 (in Section 5.2). The European Community was divided into 33 internal zones based on NUTS region definitions. In the vicinity of the Channel Tunnel, zones were kept relatively small to allow detailed modelling but as distance from the Channel increases their size becomes progressively larger. The following four external zones were also defined.

34 Austria/Switzerland
35 Eastern Europe
36 Scandinavia
37 USA and rest of the world

5.3.3.2. The transport network — General

As in other transport models, the supply of transport in the Meplan Channel Tunnel model is

Table 5.7. Link type definitions

Number	Link type name	Capacity unit
1	Toll motorway	Pcu
2	Other motorway	Pcu
3	Non-motorway dual carriageway	Pcu
4	Non-motorway single carriageway	Pcu
5	Road access	Pcu
6	Car ferry (non-cross-Channel)	Pcu
7	Road border crossing	Pcu
8	Rail line	Passenger
9	Rail access	Passenger
10	Rail transfer	Passenger
11	Rail border crossing	Passenger
12	Air route (standard)	Passenger
13	Air access	Passenger
14	Air transfer	Passenger
15	Car ferry (cross-Channel)	Passenger
16	Coach ferry (cross-Channel)	Passenger
17	Passenger ferry	Passenger
18	Coach ferry (non-cross-Channel)	Passenger
19	Ship	Tonne
20	Ship transfer	Tonne
21	Air route (business)	Passenger
22	Special air access	Passenger
23	Train on ferry	Tonne
24	Intrazonal	Feu
25	Car shuttle (Tunnel)	Passenger
26	Tunnel access	Wagon
27	Ship link (sea)	Tonne
28	Coach shuttle (Tunnel)	Passenger
29	Goods vehicle shuttle (Tunnel)	Lorry
30	Goods vehicle ferry (cross-Channel)	Lorry
31	Through passenger train (Tunnel)	Passenger
32	Through freight train (Tunnel)	Feu
33	Goods vehicle non-cross-Channel ferry	Lorry

represented by a network of links and nodes. In the model there is a single network in which all the different types of link are represented. This use of a single network allows great flexibility in the treatment of intermodal trips such as when road vehicles transfer to ferries for sea crossings.

In all, 33 link types have been defined. These are listed in Table 5.7. The majority of these represent actual links such as roads, railway lines, air routes and sea crossings and these will be discussed in subsequent subsections. However, several links, known as transfer links, have also been defined. These are not 'actual' transport links as such, but have been incorporated to enable flows to transfer between network modes. Transfer links will be discussed in greater detail in the network-specific subsections which follow. Similarly, for each network type, access links (or centroid connectors) have been defined to allow the connection of zone centroids to the network proper. These will also be discussed in greater detail in the network-specific subsections. Intrazonal links are also examined.

5.3.3.3. Road network

Figures 5.5 and 5.6 show the road network assumed for the Channel Tunnel study. As the maps show, a high density of road network has been included in the vicinity of the Channel Tunnel to allow detailed accurate modelling. However, as distance increases from the main area of interest, the network representation is less detailed. For example, only one motorway between London and Birmingham has been assumed because in the regions links have been aggregated to give a more general representation of the network.

Figure 5.5. Modelled road network in the Channel area

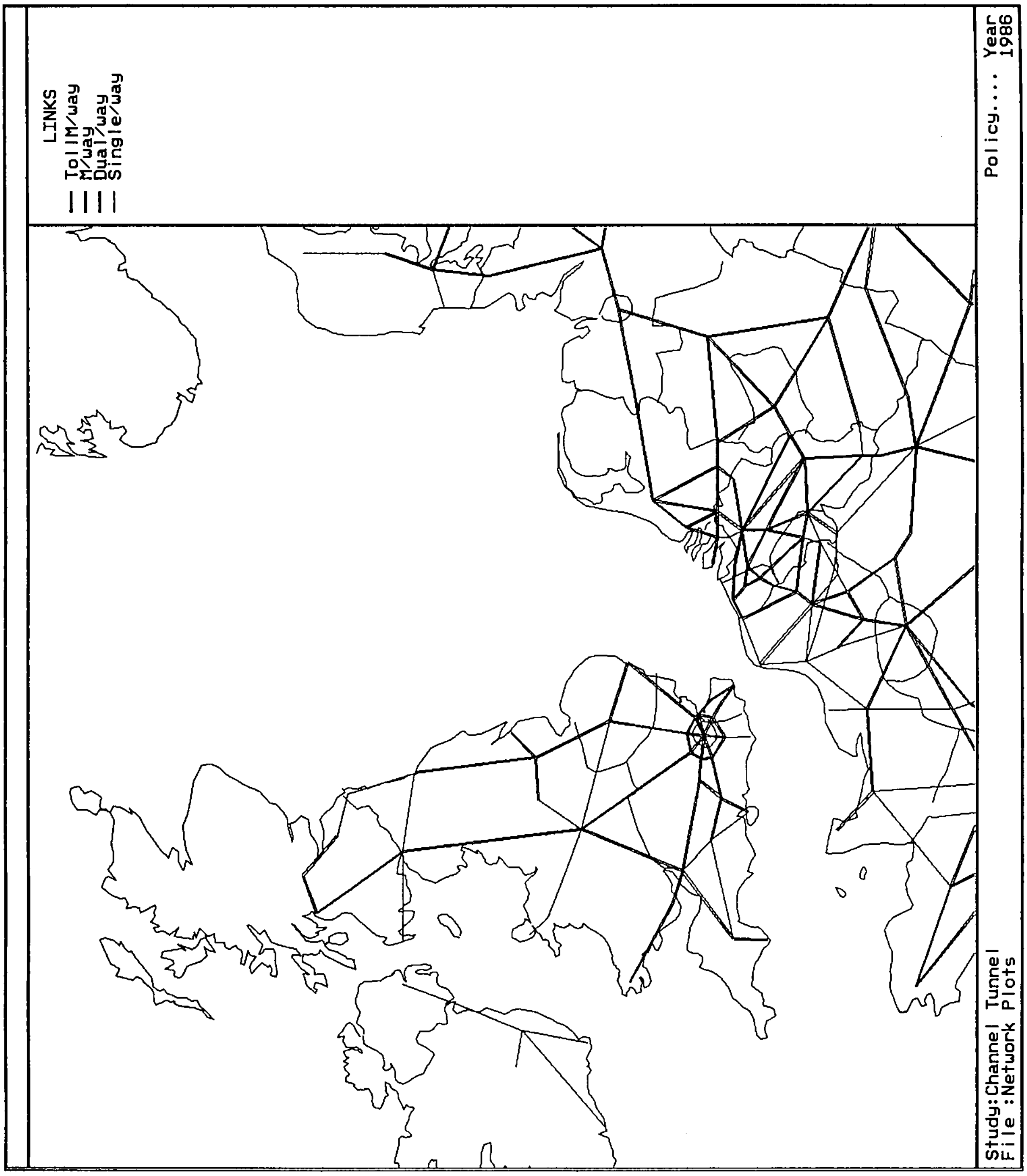
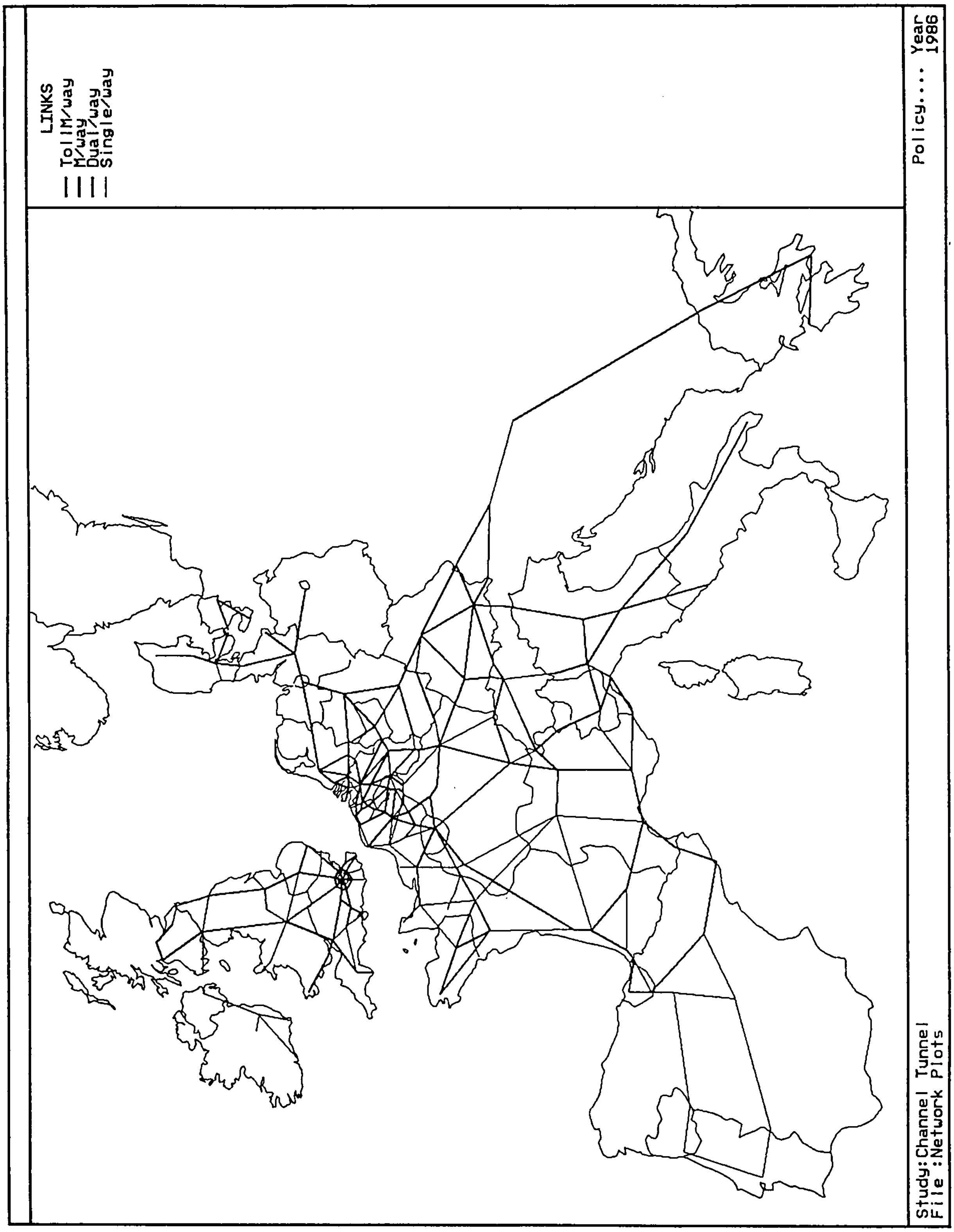


Figure 5.6. Modelled road network



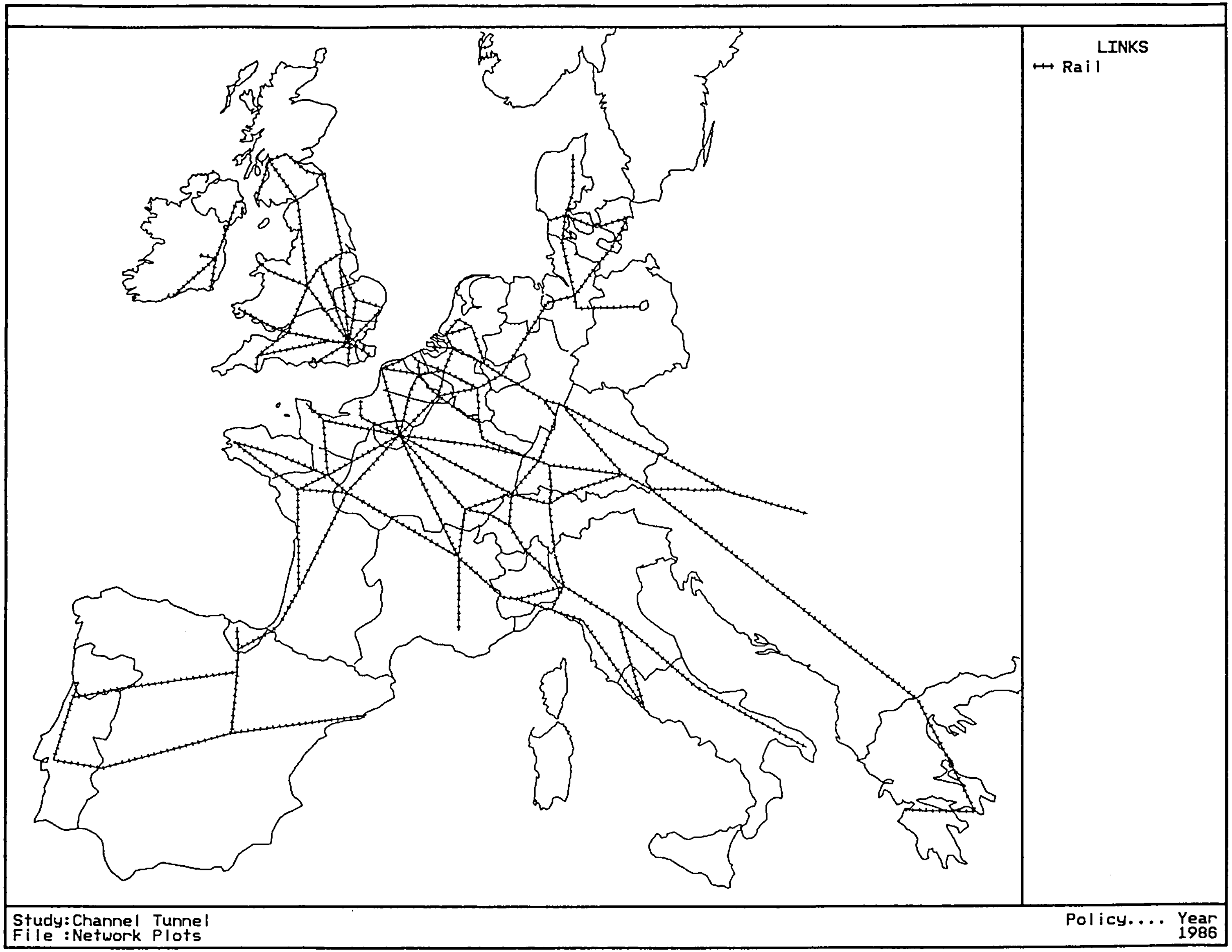


Figure 5.7. Modelled rail network

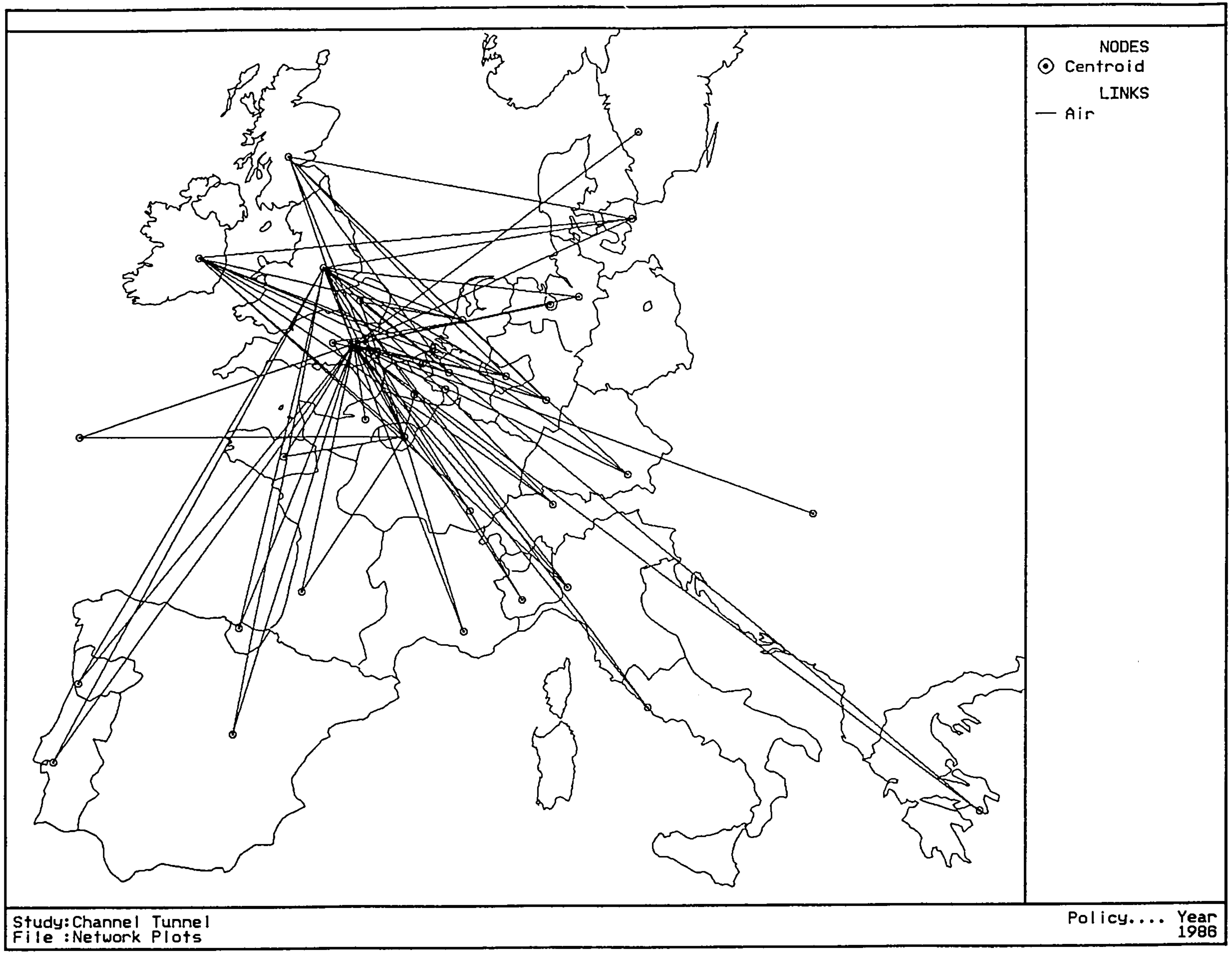
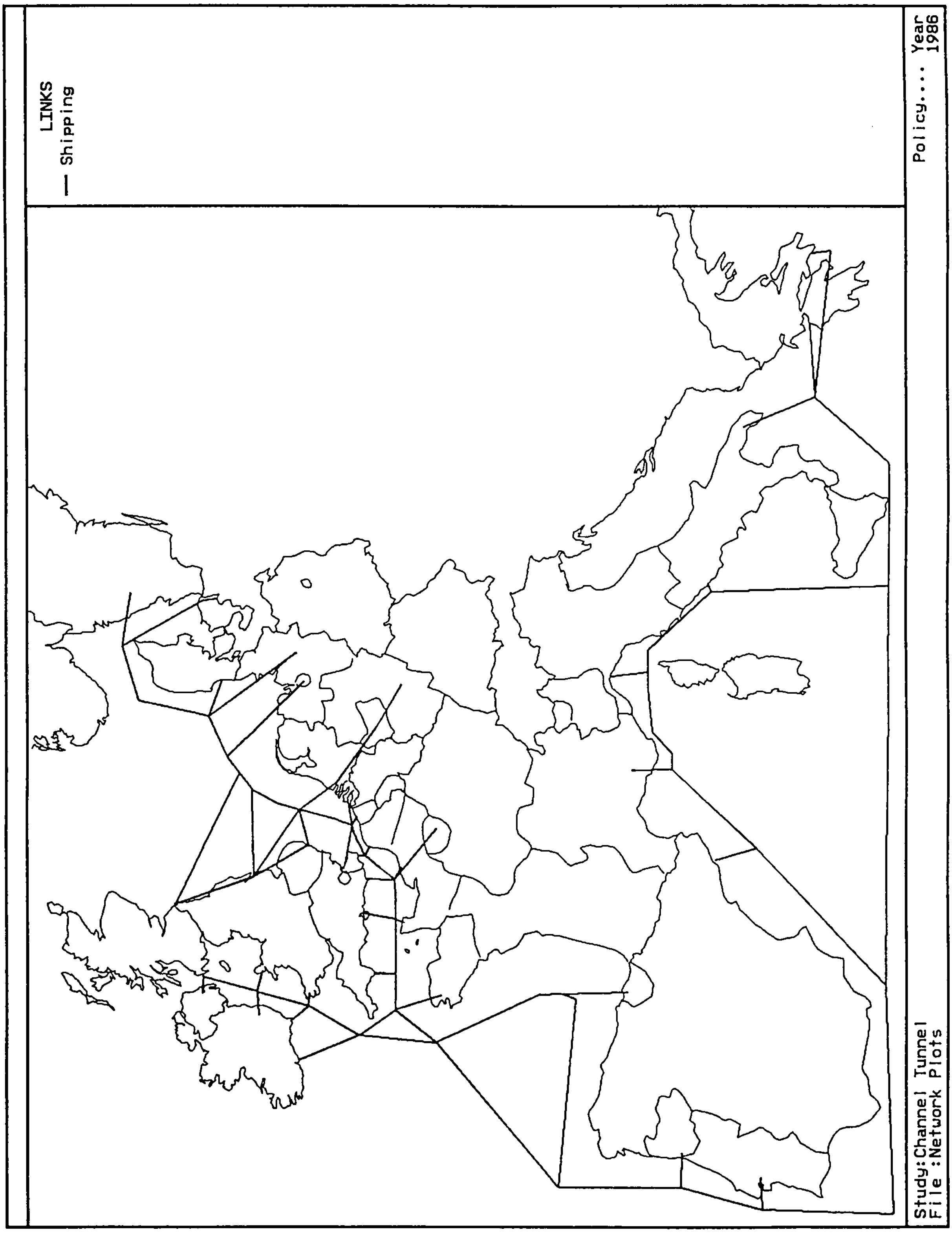


Figure 5.8. Modelled air network

Figure 5.9. Modelled shipping network



The road links included in the model were determined by examining the *AA Big Road Atlas Europe* (January 1987 edition). These were classified into link types 1 to 7 as listed in Table 5.7. For each of 'real' link types 1 to 4 and 7, the link lengths were scaled from the AA road atlas. Both road speeds and tolls were extracted from the 1990 *RAC Continental Motoring Guide.*

'Pseudo' road link types 5 and 7 were coded using a different approach. For road access from centroids a simple assumption of 1 km link length and 0.5-hour travel time was made to represent the average time taken to access the main road network within a zone.

At those locations where a road crosses a country boundary (link type 7), two road nodes were created on either side of the border and a connecting link inserted of length 0.1 km with a travel time of 0.2 hours (12 minutes) to account for border delays. Delays to goods vehicles were assumed to be one hour.

5.3.3.4. Rail network

The modelled rail network is illustrated in Figure 5.7. As with the other network types, modelled density decreases with distance from the Channel.

The links to be included were determined using the Thomas Cook European timetable (27 May to 30 June 1990) and these were classified as link type 8 as listed in Table 5.7. Link lengths and times were also determined from the Thomas Cook timetable.

As for the road network, for rail access links (type 9), a simple assumption of 1.0 km link length and 0.5-hour travel time was made, and for transfer links (type 10) a zero link length and 0.5-hour travel time was assumed except for Dover and Calais, where 0.25 hours was used to reflect the more frequent service. However, for rail border crossing (type 11), zero time and minimal link lengths were assumed to reflect the fact that trains are not delayed at frontiers.

On all rail link types no capacity restriction has been assumed.

5.3.3.5. Air network

The air network is shown in Figure 5.8 and has been represented using link types 12, 13, 14, 21 and 22 as listed in Table 5.7.

Information on average weekday travel times was extracted from the *ABC World Airways Guide* (December, 1989). It has been assumed that air travel links have two-way characteristics, that is that the average time to fly from London to Paris is equal to the average time from Paris to London.

Link distances were calculated from the node coordinates and therefore represent straight line, 'as the crow flies' distances. Two types of air travel link have been identified to provide a distinction between general air travel (link type 12) and business air travel (link type 21). Fares for each link were provided by a local travel agent. The cheaper tourist fare is based on a booking made 14 days in advance and including a stay over a Saturday night whereas a fully flexible fare for business travel was assumed.

Air access is generally provided via an air access link (type 13) from the zone centroid. These links generally have a one-hour travel time. However, for zones which do not have direct access to an international airport such as Kent, a special air access link (type 22) is provided. This special access link represents the average time and distance characteristics to the nearest zone with international airport facilities.

Air transfer links (type 14) represent the time required to check-in and exit from an airport. The time on these two-way links has been coded as three quarters of an hour, to represent, on average, a one-hour check-in time and 30-minute exit time.

All air links have no capacity restrictions.

5.3.3.6. Ferry network

The cross-Channel ferry network was represented by link types 15 to 18, 23 and 30 as listed in Table 5.7, and link type 33 represented the non-cross-Channel ferries.

Ferry travel information was determined from 1990 ferry guides. For routes where no ferry guide information was available, information was extracted or approximated from newspaper articles in *The Observer* (1 April 1990) and *The Independent* (6 January 1990). Travel times between nodes were average times, as determined from the various ferry guide information sources. Two types of costs and hence two link types were differentiated for ferry travel: foot passenger (type 17) and car passenger (type 15) costs. Foot passenger costs were one-way costs based on five-day excursion fares. Car travel costs were one-way, per person costs, based on five-day return excursion fares for a medium car (6.00 m) and two adults.

Straight line distances between ferry nodes were measured from RAC European road maps and the *Bartholomew Europe atlas and drivers' guide* (1989).

No capacity restriction was assumed for ferry links. The delays encountered when boarding were incorporated into the ferry ride to make an overall ferry service.

5.3.3.7. Shipping network

The shipping network was represented by link types 19, 20 and 27 as listed in Table 5.7. Link types 19 and 27 were used to represent shipping links proper and were coded with distances scaled from appropriate maps and average speeds of 20 km/h.

Link type 20 was used to represent the transfer between land-based modes and the shipping network and included a one-hour transfer time per tonne.

5.3.3.8. Intrazonal links

Intrazonal links (type 24) have been coded for all internal zones to allow the modelling of freight movement within zones. The link distance was based on the assumption that the average intrazonal trip length in a zone would approximate to one third of the average zone diameter. The diameter of each internal zone was therefore measured and an appropriate value coded into the network. The corresponding time was calculated using the assumed speed for lorries of 80 km/h. The speed for the other mode for which intrazonal travel was modelled (train freight) was included when considering individual modes.

5.3.3.9. The Channel Tunnel

The Channel Tunnel itself has been represented by separate link types for each mode that will be able to use it. Link types 25, 26, 28, 29, 31 and 32 have thus been specified as listed in Table 5.7. A distinction has been made between through-trains, for which there are no 'terminal' delays/costs and shuttle trains which transport road vehicles, thereby incurring delays due to loading, frontier controls and security checks.

5.3.3.10. Flow types, user modes and network modes

In the Channel Tunnel study, matrices of transport demand by flow type (which distinguish between purpose of personal travel and types of cargo for goods) are created by the regional economic/transport model interface module FREDA.

The modal split and assignment processes (as discussed in Subsection 5.2.3) are performed on these flows by allocating flows to user modes, which are made up of a combination of network modes (or travel states), which can use certain link types.

It is therefore useful to consider the flow types, user modes and network modes that have been defined in the model and to explain the interrelationships between them and the link types they are permitted to use.

Ten flow types have been defined, of which six relate to passenger trips and four to flows of freight. These are listed below in Table 5.8.

Table 5.8. Channel Tunnel study flow types

Passenger trip purposes		
Flow type	Flow name	Flow unit
1	Business/study	Person
2	Inclusive tour	Person
3	Independent holiday	Person
4	Visit friends/relatives	Person
5	Day-tripper	Person
6	Miscellaneous	Person
Freight flow types		
Flow type	Flow name	Flow unit
7	Bulk solid and liquid	Tonnes
8	Semi-bulk	Tonnes
9	Unitized — general	Feu*
10	Unitized — high value	Feu*

* Feu: 40-foot equivalent unit container.

In the Channel Tunnel study, 12 user modes have been defined of which six relate to passenger travel and six to the transportation of freight. To allow effective modelling of the competition for cross-Channel traffic, separate user modes for cars, coaches and trucks on both ferries and the Tunnel have been included. All 12 user modes are listed below in Table 5.9.

Table 5.9. User mode definitions

User mode	Name	Passengers or freight
1	Car with ferry	Passenger
2	Coach with ferry	Passenger
3	Train/ferry	Passenger
4	Plane	Passenger
5	Truck with ferry	Freight
6	Through-rail	Freight
7	Bulk ship	Freight
8	Other ship	Freight
9	Air freight	Freight
10	Car with Tunnel	Passenger
11	Coach with Tunnel	Passenger
12	Truck with Tunnel	Freight

In the case of passenger travel, passenger flow types (2 to 6) are permitted to use all six passenger user modes. However, it has been assumed that business travellers (flow type 1) would not use coaches. In the case of freight flows, a more complex relationship exists whereby only certain flow types are permitted to use certain user modes. These relationships are shown in Table 5.10 below.

Table 5.10. Relationship between freight flow types and user modes

Freight flow types	Permitted to use user modes
7 Bulk solid and liquid	7 Bulk ship
8 Semi-bulk 9 Unitized — general	5 Truck with ferry 6 Through-rail 7 Bulk ship 8 Ship 12 Truck with Tunnel
10 Unitized — high value	5 Truck with ferry 6 Through-rail 9 Air freight 12 Truck with Tunnel

As discussed earlier, user modes are used to represent movement at the level of the whole trip and are built up as a collection of network modes which occur on links in the network.

In the Channel Tunnel study, 22 network modes have been defined of which 12 relate to passenger travel and 10 relate to the movement of freight. These are listed below in Table 5.11.

Table 5.11. Network mode definitions

Network mode	Mode name	Modal unit
1	Car ride	Pcu
2	Coach ride	Passenger
3	Train ride	Passenger
4	Air ride	Passenger
5	Air business	Passenger
6	Air access	Passenger
7	Car ferry	Passenger
8	Passenger ferry	Passenger
9	Goods vehicle drive	Lorry
10	Train freight	Feu
11	Air freight	Feu
12	Goods vehicles on ferry	Lorry
13	Train ferry	Feu
14	Ship freight	Tonne
15	Ship access	Tonne
16	Car Tunnel	Passenger
17	Coach Tunnel	Passenger
18	Goods vehicle Tunnel	Lorry
19	Through passenger Tunnel	Passenger
20	Through freight Tunnel	Feu
21	Car ferry, non-cross-Channel	Passenger
22	Goods vehicles on ferry, non-cross-Channel	Feu

The relationships between user mode and network mode showing which travel states combine to make up a user mode is shown in Table 5.12 below.

In the transport model, only certain network modes are permitted to use certain link types. The relationship between link type and network mode is shown in Table 5.13.

5.3.3.11. Path building

To understand the transport model it is helpful to distinguish between transport users, who pay a user tariff for a service, and transport operators, who provide a transport service for users. In the Channel Tunnel model, it is assumed that path building and assignment are dependent upon vehicle operating costs and that vehicle operators will tend to use those paths which imply the lowest vehicle operating costs. The modal split process, however, is based upon the tariff charged to the user under the assumption that users will tend

Table 5.12. Relationship between user mode and network mode

User mode	Network mode
1 Car with ferry	1 Car ride 7 Car ferry
2 Coach with ferry	2 Coach ride 8 Passenger ferry
3 Train/ferry	3 Train ride 8 Passenger ferry 19 Through passenger Tunnel
4 Plane	4 Air ride 5 Air business 6 Air access
5 Truck with ferry	9 Goods vehicle drive 12 Goods vehicle on ferry
6 Through-rail	10 Train freight 13 Train ferry 20 Through freight Tunnel
7 Bulk ship	10 Train freight 14 Ship freight 15 Ship access
8 Other ship	9 Goods vehicle drive 10 Train freight 14 Ship freight 15 Ship access
9 Air freight	6 Air access 11 Air freight
10 Car with Tunnel	1 Car ride 16 Car Tunnel 21 Car ferry, non-cross-Channel
11 Coach with Tunnel	2 Coach ride 17 Coach Tunnel
12 Truck with Tunnel	9 Goods vehicle drive 18 Goods vehicle Tunnel 22 Goods vehicle on ferry, non-cross-Channel

to select a mode that minimizes their costs and hence offers a low tariff.

Vehicle operating costs are used in the Channel Tunnel transport model to determine the least cost paths through the network by the vehicles in a specific mode. These are calculated by first specifying a function relating the monetary costs (to the user) of one modal unit traversing a link to the characteristics of that link.

Having calculated the above network costs for each mode on a link-by-link basis, the generalized cost of travel by a flow on a mode on a link can be calculated as a function of this network cost and the time taken to traverse it. Thus, a set of reasonable paths can be obtained for each combination of mode and flow from which a 'composite' disutility can be calculated.

While the tariff information relating to passengers is based on accurate published information, that relating to freight is of necessity more tentative. For reasons of commercial competitiveness, operators are unwilling to provide information on the charges actually levied on major users so the figures used in the model are approximations drawing on a number of sources.

5.3.3.12. Modal split

Having determined the paths available between zones to the different flow/mode combinations, the proportion of those flows using each mode is estimated based upon their relative disutilities.

For the three pairs of user modes which involve a direct choice between ferry and Tunnel, i.e. for car/ferry and car/Tunnel (1 and 10), coach/ferry and coach/Tunnel (2 and 11), and truck/ferry and truck/Tunnel (5 and 12), the ferry/Tunnel split is calculated first as a submodal ratio and the main modal allocation is then made between car (1 + 10), coach (2 + 11), truck (5 + 12) and all other available modes. The submodal parameters were chosen in such a way that the result in any non-Tunnel case represents a single hierarchy choice.

5.3.3.13. Traffic assignment

The purpose of traffic assignment is to transform the flows in a mode into vehicles/wagons/vessels and to assign these to the links on their modal path. In the Channel Tunnel model a probabilistic multipath Dial-type algorithm based on a logit structure is used which assumes that 'vehicles' are more likely to use the least disutility path than other paths but will spread to paths with larger disutilities. As discussed earlier, assignment uses the same cost functions as the path-building process because it is assumed that vehicle routeing is based on operators aiming to minimize their operating costs.

Table 5.13. Relationship between link type and network mode

Link type definitions		Network mode number																					
No	Link name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Toll motorway	x	x							x													
2	Other motorway	x	x							x													
3	Non-motorway/dual-carriageway road	x	x							x													
4	Non-motorway/single-carriageway road	x	x							x													
5	Road access	x	x							x													
7	Road border crossing	x	x							x													
8	Rail line			x							x												
9	Rail access			x							x												
10	Rail transfer										x												
11	Rail border crossing			x							x												
12	Air route (standard)				x							x											
13	Air access						x																
14	Air transfer						x																
21	Air route (business)					x																	
22	Special air access						x																
15	Car ferry							x															
6	Car, non-cross-Channel ferry							x														x	
16	Coach ferry								x														
17	Passenger ferry (rail)								x														
18	Coach non-cross-Channel ferry								x									x					
23	Train ferry													x									
30	Goods vehicle ferry												x										
33	Goods vehicle non-cross-Channel ferry												x										x
19	Shipping line														x								
20	Ship transfer															x							
27	Sea shipping link														x								
24	Intrazonal									x	x												
25	Car shuttle (Tunnel)																x						
26	Tunnel access																x	x	x	x	x		
28	Coach shuttle (Tunnel)																	x					
29	Goods vehicle shuttle (Tunnel)																		x				

5.3.4. Outputs provided by the Meplan Channel Tunnel model

Having incorporated all the information and data discussed in the preceding sections into a working model, it is useful to outline the resultant model outputs.

The major outputs from the Meplan model are listed below. Although interzonal movements of freight are projected between all zone pairs, only those crossing the Channel have been fully checked and are represented in detail. The passenger flows are only included for pairs of zones on opposite sides of the Channel (i.e. between UK/Ireland and mainland Europe).

A. Outputs from the regional economic development module

(a) For each zone, production and consumption of commodities is estimated for aggregate economic sectors.

(b) The value of trade for each commodity between each pair of zones.

(c) Changes in the costs of production of a commodity in a zone due to changes in the costs of transport of the inputs to production in that zone.

B. Outputs from the transport and trade interface module

(a) The volume of trade and transport by type flow between each pair of zones. Volumes are measured in tonnes for freight or passengers for personal movement.

(b) Transport cost for each commodity between pairs of zones.

C. Outputs from the transport module

(a) Flows on each main mode of transport.

(b) Assignment of these flows to a defined network of links.

(c) Trip distances, speeds, times and costs.

The use of Meplan in this study therefore provides:

(a) detailed numerical forecasts of the likely effects of the Channel Tunnel on economic activity in each defined zone;

(b) effects on travel costs, distances and times;

(c) how these effects will vary over time;

(d) how they will be affected by possible EC or national policies on transport infrastructure development;

(e) the advantages and disadvantages of possible policy options related to the Channel Tunnel.

5.4. Model validation: How good is the model?

After the model has been set up and calibrated, it is essentially ready for use as a predictive tool or, more precisely, for the simulation of different scenarios of transport infrastructure development in Europe related to the Channel Tunnel.

However, before this is done, it is useful to conduct one further test to find out whether the calibration of the model was successful, i.e. whether the calibrated model is able to replicate the essential features of the modelled reality with sufficient precision and reliability. This test is called validation. Only if the model passes this test can it be used for prediction and simulation with confidence.

In methodological terms, validation of a model means to compare its predictions with observed information about the aspect of reality modelled. This is possible in this case because the base year of the model is 1986 and its time horizon is 2001, i.e. the model covers a period of time for which, at least in part, observed data are available. It should therefore be possible to run the model from 1986 to 1991 and compare the results produced for 1991 with the most recent data available from Eurostat or national statistics. The results of this comparison will be presented in this section.

5.4.1. Validation data

The selection of data for the validation should take into consideration the purpose for which the model will later be used. Being an abstraction of the real world, no model can be expected to reproduce every detail or every aspect of reality. It is also useful to stress that, due to the probabilistic nature of the model, equations and the ubiquity of data error, it would be unrealistic to expect perfect correspondence between all observed and model-predicted values. However, it is necessary to demand that the model is able to reproduce those aspects of reality that are of special importance for the project in question, because without this ability it cannot be expected to give credible answers to the questions it will be asked later.

What are the essential aspects of the Channel Tunnel project? It is the task of the model to estimate the pattern of trade in commodities and services and of passenger movements between the regions in the EC under assumptions about the improvement of the transport infrastructure, including the Channel Tunnel, and to assess their likely impacts on the development of economic activities in the regions. It follows from this that the model must be capable of predicting with reasonable reliability the development of:

(i) flows of passengers and commodities between regions in particular between regions on either side of the Channel, by trip purpose, commodity type and transport mode;

(ii) economic activities in terms of commodity production or service provision in the regions by industry or commodity/service type.

While it is easy to extract almost any variable from the model in every desired combination, aggregation or disaggregation, it is difficult to find suitable indicators for this comparison from Eurostat or national statistics because the data may not be available in the right spatial disaggregation or for the right year, or may not be collected at all. Moreover, no data can be used for the validation that have already been applied in setting up the model because this would not provide an independent test.

5.4.2. Assumptions

The validation tests presented here assess the ability of the model to reproduce the pattern of observed flows and economic activities after the simulation of the first five-year period, i.e. in the year 1991. For these tests, the model was run using the transport network as in the base year, which seems justified as no major new infrastructure projects have been completed in the 1986-91 period. With respect to population and final demand, the assumption was made that the rates of change observed in the early 1980s have also stayed in effect in the 1986-91 period. Everything else, production technology and all cost parameters, are taken as remaining constant. These assumptions are spelt out in more detail in Subsection 5.5.1.

5.4.3. Passenger flows

The first set of validation tests addresses the ability of the model to reproduce the pattern of cross-Channel passenger flows after moving forward the first time-step of five years to 1991. The most recent available data on passenger flows between the UK and the European continent are ferry and air travel data for the year 1989. These are shown in Table 5.14 together with the observed values for 1987 and the modelled values for 1986 and 1991.

The total number of observed passengers increased over the two-year period at a rate of 4.4% per annum, which differs from the rate of change in the previous 14-year observations (5.6%) used within the model. This latter rate is equivalent to 11.5% over a two-year interval and the number of total modelled passengers for 1991 is consistent, given this rate of growth, with the most recent (1989) total.

Table 5.14. Passenger for given observed and modelled years to/from the UK and from/to the Continent by mode and port region

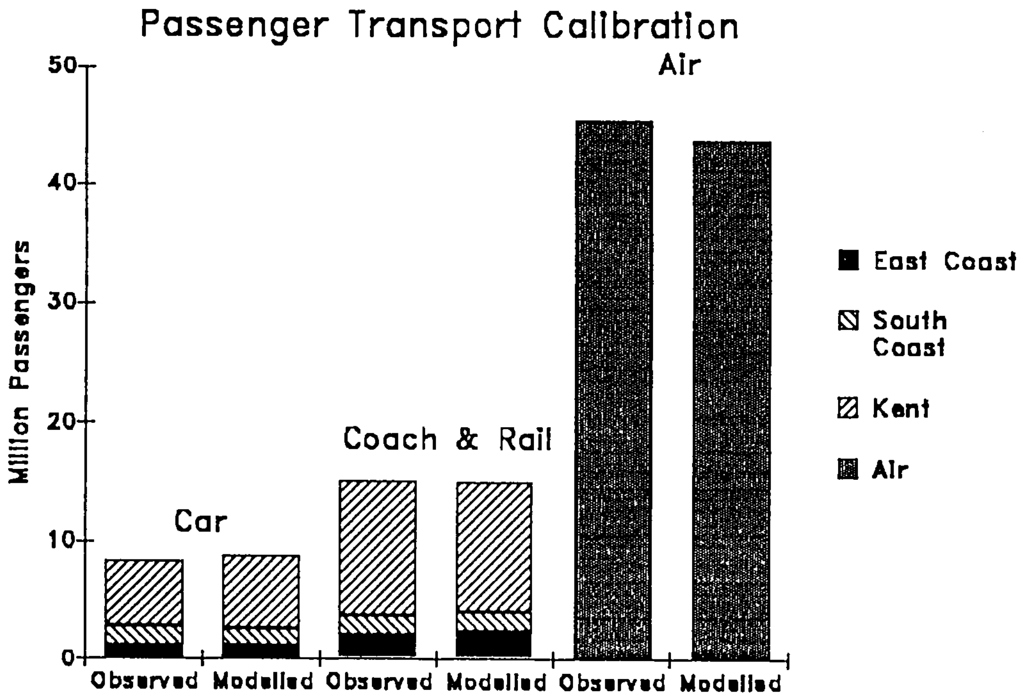
Passenger traffic between the UK and the Continent

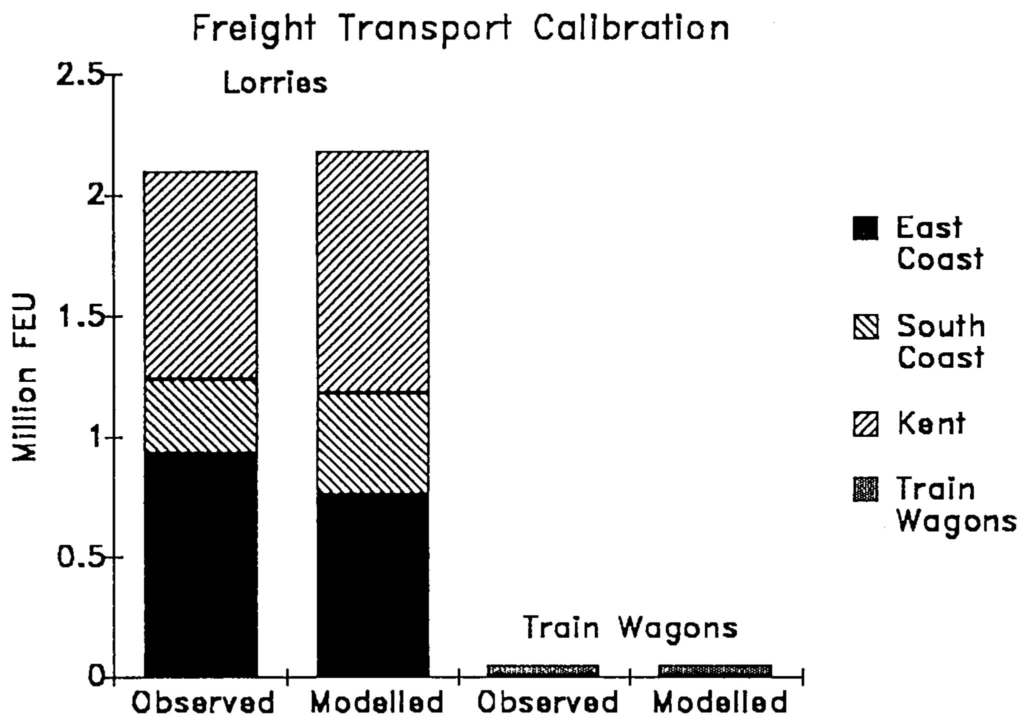
(1 000 per year)

UK coastal region Mode: Ferry	1987 Observed	1986 Modelled	1989 Observed	1991 Modelled	Ratio of 1991 modelled to 1989 observed
East					
Car passengers	1 229	1 276	1 433	1 491	1.04
Coach and rail passengers	1 859	2 251	1 903	2 301	1.21
South					
Car passengers	1 671	1 394	2 176	1 815	0.83
Coach and rail passengers	1 732	1 682	2 285	2 025	0.89
Kent					
Car passengers	5 610	6 301	5 864	7 487	1.28
Coach and rail passengers	11 296	10 846	12 399	14 730	1.19
Total ground passengers	23 397	23 750	26 060	29 849	1.15
Total air passengers	45 472	43 748	48 997	53 774	1.10
(% of total)	(0.66)	(0.65)	(0.65)	(0.64)	
Total passengers	68 869	67 498	75 057	83 623	1.11

Sources of observed data: International Passenger Transport, UK Department of Transport (1990), HMSO, London; Port Statistics 1989, UK Department of Transport and British Ports Federation (1990), London.

Figure 5.10. Comparison of observed and modelled passenger flows between the UK and mainland Europe (for calibration)





The division into air and ferry travel differs little between the four sets of data, with the percentage of air travellers between 65 and 66% for each run. The observed 1989 and estimated 1991 proportions of car and foot passengers on the ferries are identical (36% by car); as are the proportions of total ferry passengers using the combined port groups of Kent and the South (87%). The split between the Kent group and the southern group of ports is modelled as 80% to Kent, the observed proportion being 85%. The distribution of car passengers between the eastern, southern and Kent port groups is modelled in the ratio 14:17:69, which compares satisfactorily with the observed ratio of 15:23:62.

5.4.4. Freight flows

The second level of validation tests looks into flows of commodities predicted by the model. Do they correspond with what is known about actual freight transport patterns across the Channel? Data on cross-Channel freight transport are available for 1986 and 1989. Table 5.15 shows the observed cross-Channel freight traffic by lorry through each of the three port groups and by rail. Also shown are equivalent modelled estimates of their quantity. The 1991 modelled values are of particular interest because this is the first model year for which the constraints applied in the base year (see Subsection 5.3.1) have been removed. It can be seen that the 1986 modelled and observed totals agree but that the model shows most freight lorry traffic through Kent (46% against an observed 41%) while the observed maximum flow was through the eastern group (44% against a modelled 35%). Note that part of this difference may be due to the impact of road congestion around London reducing lorry traffic to Kent. In the current phase of the model road capacity, restraint was not implemented. The observed growth in lorry freight is at the rate of 8% per annum. Neither observed nor modelled figures show a change in the regional distribution.

5.4.5. Economic activities

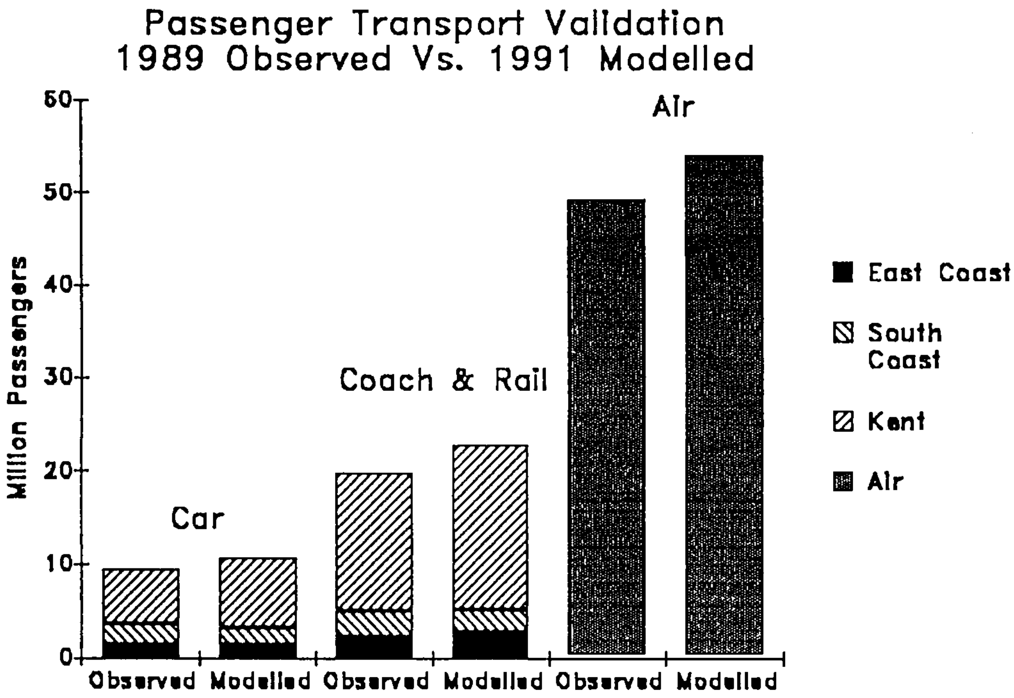
The third set of validation tests examines the performance of the model with respect to forecasting the level of economic activities in the 33 model regions. It may be recalled that economic activity, i.e. the production of commodities and the provision of services, is determined in the model as a function of final demand, of the production technology as expressed by the input-output table, and of accessibility, i.e. transport costs. If the model is to make reliable forecasts about the changes in economic activities as a result of the Channel Tunnel, it should be able to reproduce the existing pattern of economic activities in the regions of the Community prior to the construction of the Tunnel and its related infrastructure.

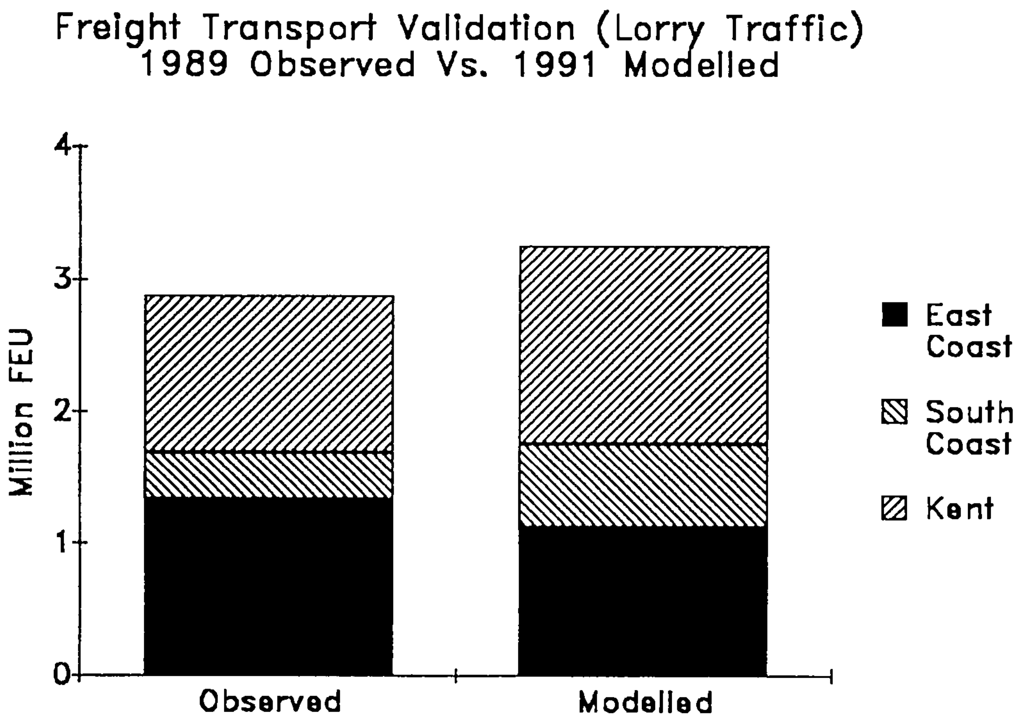
Table 5.15. Observed totals for goods vehicles from/to the UK and to/from the Continent

Freight flows between the UK and the Continent					*(1 000 per year)*
By ferry	UK coastal region	1986 Observed	1986 Modelled	1989 Observed	1991 Modelled
Lorries	East	930	760	1 340	1 126
(% all regions)		(0.44)	(0.35)	(0.46)	(0.34)
Lorries	South	311	424	359	638
(% all regions)		(0.15)	(0.19)	(0.13)	(0.20)
Lorries	Kent	864	1 006	1 190	1 501
(% all regions)		(0.41)	(0.46)	(0.41)	(0.46)
Lorries	Total	2 105	2 190	2 889	3 265
Train wagons	Total	29	29	–	57
Air freight (1 000 tonnes)	Total	–	120	–	193

Source of observed data: Port Statistics 1989, UK Department of Transport and British Ports Federation (1990), London.

Figure 5.11. Comparison of 1989 observed and 1991 modelled passenger and freight flows between the UK and mainland Europe (for calibration)





Value-added (factor 44) represents the sum of payments on taxation, labour and profits of all goods and services produced in a zone. As this factor is an output of the model, even in the base year, predicted base-year values are used as a means of measuring the validity of the land-use model. Base-year values are compared with values obtained from Eurostat tables in Table 5.16. Note that the latest Eurostat values available are for 1985 and have been converted to 1980 ecus. A comparison of these results indicates that the model accurately predicts economic activity, measured in value-added, at the zonal level. Because the same input-output table has been used for all zones in the study area, the model tends to overestimate value added in the less industrialized zones and underestimate values in the more industrialized zones. These effects, however, do not seem to be significant.

5.4.6. Summary

The validation exercise presented has demonstrated that the model produces a set of passenger and trade flows and a distribution of economic activities that reasonably correspond with the real world. It is therefore concluded that the model is able to reproduce the aspects relevant for this project with sufficient detail and reliability and can be applied for the intended examination of the impacts of the Channel Tunnel.

5.5. Model results

The main part of this section discusses the results of the model analysis: model forecasts of changes in passenger travel, trade flows and economic activities in the region. Before the results are presented, descriptions of the general assumptions common to all model simulations and the three policy scenarios are provided.

5.5.1. General assumptions

To facilitate comparison between different model runs, each run should be based on identical assumptions about the development of socio-economic background trends representing the environment under which the model operates. In the case of the Channel Tunnel study, this primarily means the exogenous projections of population and final demand by region over the whole forecasting period.

The following subsection describes the population and final demand forecasting process as well as other assumptions with regard to growth in passenger and freight flows.

5.5.1.1. Population forecasts

Forecasting population change through natural change and migration is not the task of Meplan in this project. Therefore the application of Meplan requires the exogenous specification of population in the model regions for the beginning of each time period of the simulation, i.e. for 1991, 1996 and 2001.

Assembling population forecasts for each region in Europe would be a major undertaking. One possible approach would be to collect forecasts made by national governments or by the European Community and aggregate them for the model regions. However, such an approach would have far-reaching implications for the forecasting of final demand as household consumption would change with population.

Therefore a combined and consistent approach to forecasting both population and final demand was taken. In both cases the basic assumption was adopted that the pattern of change observed in the 1980s in each country will prevail during the forecasting period.

This assumption seems plausible because the rates of change during the 1980s have not fluctuated dramatically and represent the differences in population growth/decline and economic prosperity in the countries of Europe. Its methodological advantage is that it is consistent with the approach used for forecasting final demand (see below). Its disadvantage is that it does not take full account of the convergence of fertility levels in Europe, in particular the decline in fertility observed in countries such as Ireland and Portugal. In addition, it fails to consider the probability that the next decade could be one of massive immigration into the countries of the Community from East European and Mediterranean countries. However, to anticipate these possibly fundamental changes would require a substantial research effort going beyond the possibilities of this project.

The method used, therefore, was to calculate mean annual rates of population change in the countries of the Community between 1980 and 1986 and to apply these national rates of popula-

Table 5.16. Comparison of observed and modelled value-added *(1980 ECU)*

Zone	1985 observed	1986 modelled
Germany	630.3	585.9
Zone 21 North Germany	136.0	122.7
Zone 22 Bremen	8.7	7.8
Zone 23 Mid-Germany	263.6	245.8
Zone 24 Cologne	a	a
Zone 25 South Germany	222.0	209.6
France	397.9	441.0
Zone 8 Brittany	16.1	20.1
Zone 9 Normandy	32.5	37.2
Zone 10 Nord-Pas-de-Calais	23.2	27.9
Zone 11 Île-de-France	110.0	101.8
Zone 12 Mid-France	67.7	79.2
Zone 13 South-west France	64.7	77.8
Zone 14 South-east France	83.7	97.0
Italy	278.4	311.3
Zone 26 North Italy	157.0	167.8
Zone 27 Piemonte	24.9	31.6
Zone 28 South Italy	96.5	111.9
Netherlands	123.7	120.3
Zone 18 Zeeland	3.0	3.0
Zone 19 Rest of Netherlands	120.7	117.3
Belgium + Luxembourg	71.6	80.4
Zone 15 West-Vlaanderen	b	b
Zone 16 Hainaut	b	b
Zone 17 Rest of Belgium	b	b
United Kingdom	371.5	411.1
Zone 1 Scotland	32.0	34.9
Zone 2 Midlands, North-England	167.3	194.3
Zone 4 South England	27.9	88.9
Zone 5 East Anglia	12.4	14.6
Zone 6 London	131.9	78.4
Zone 7 Kent	c	c
Ireland	12.2	15.3
Zone 3 Ireland	12.2	15.3
Denmark	44.7	51.2
Zone 20 Denmark	44.7	51.2
Greece	15.3	35.0
Zone 33 Greece	15.3	35.0
Spain	118.9	155.7
Zone 29 Rest of Spain	110.5	145.2
Zone 30 Pais Vasco	8.4	10.5
Portugal	9.4	20.7
Zone 31 Norte	2.7	7.0
Zone 32 Rest of Portugal	6.7	13.7

[a] Cologne value-added with mid-Germany (zone 23).
[b] Only total Belgium + Luxembourg observed value available.
[c] Kent value-added with London (zone 6).

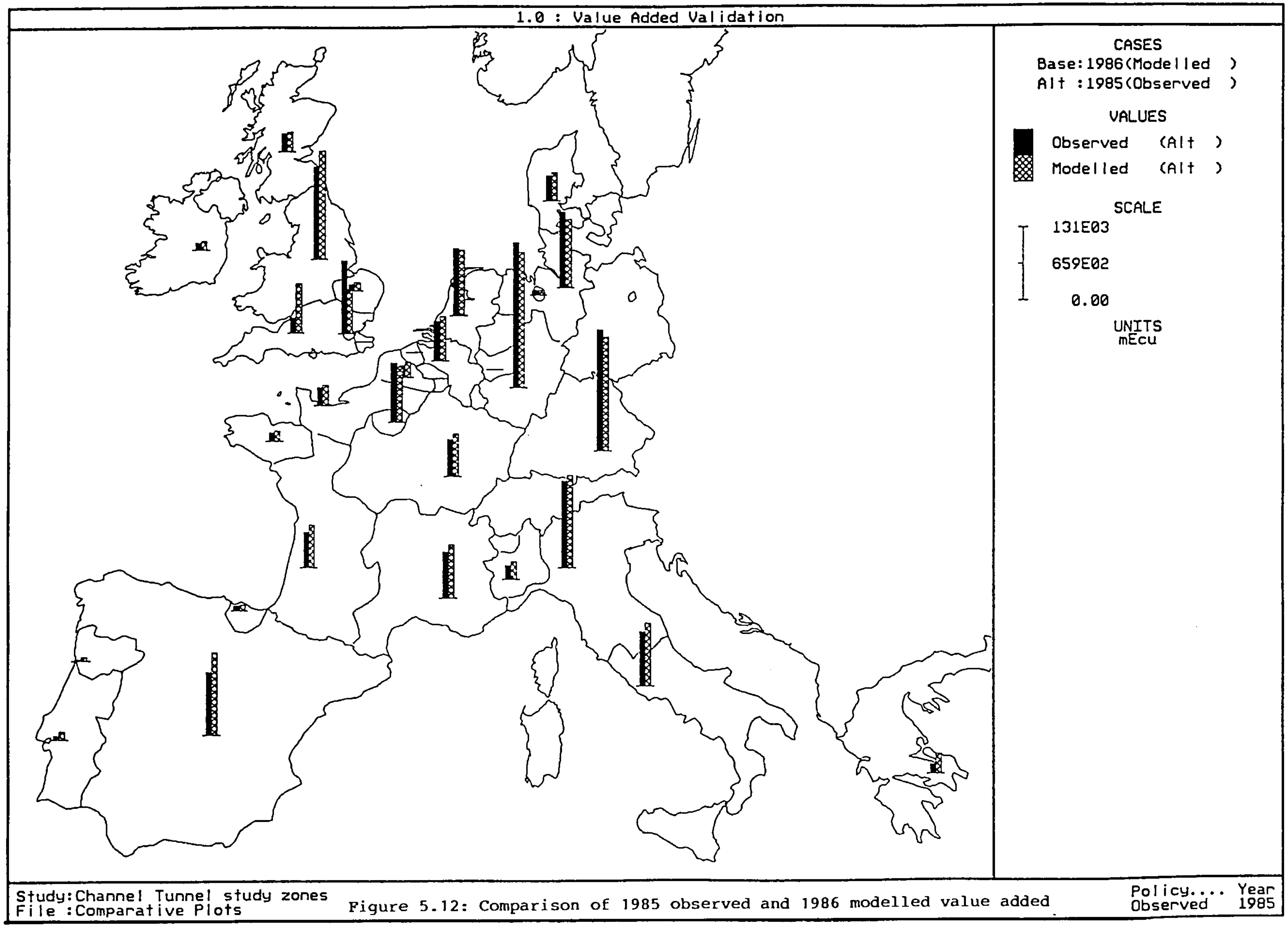


Figure 5.12. Comparison of 1985 (million ECU) observed and 1986 modelled value-added

tion change to the regions of each country to forecast regional population for the years 1991, 1996 and 2001. Table 5.17 contains the results of this procedure.

It can be seen that Portugal, Ireland, Greece and Spain (in that order) have the highest growth rates. There are two more countries with population growth above the EC average: the Netherlands and France. Italy's population growth is about the same as that of the Community as a whole. The UK population grows only very little, while Belgium's and Denmark's populations are practically constant. Western Germany has a declining population.

These results seem reasonable inasmuch as it is not unlikely that the trends they represent will also remain in force in the future. If anything, the population growth in Portugal, Greece and Spain could come down a little and be closer to the Community average. It is also likely that the population decline in western Germany will be offset by growing immigration from eastern Germany and Eastern Europe. However, these possible modifications of the trends do not seem substantial enough to warrant a more elaborate analysis.

5.5.1.2. Forecast of final demand

For simulation runs with Meplan, forecasts of final demand for output of each industry in each model region for the years 1991, 1996 and 2001 are required.

Forecasting final demand needs to be done in a manner which is consistent with the forecasts of regional population. Therefore the same assumption is made here that the pattern of change observed in the 1980s in each country will prevail during the simulation period.

This assumption seems plausible because the rates of change during the 1980s did not fluctuate dramatically as they did, for instance, during the recessions of the 1970s. It has the advantage of being consistent with the assumptions made for forecasting population (see above). It has the disadvantage that it does not consider any changes in consumption and investment that may arise out of the single European market. However, to anticipate these possible changes would require a much greater research effort.

A further necessary simplification concerns the distribution of final demand across industrial sectors. It is assumed that the shares of the outputs of all industrial sectors of total final demand remain the same over the simulation period, i.e. that no major changes of tastes or consumption patterns occur.

Final demand in Meplan consists of two components: 'gross fixed capital formation' and 'final consumption of households'. To forecast final demand by industry and region for the years 1991, 1996 and 2001, the mean annual rate of change of final demand between 1980 and 1987 was calculated for each country using information on gross fixed capital formation and final consumption in 1980 and 1987 from Eurostat (1989) and applied to final demand by region in 1986.

The results are shown as index values for each country for the years 1991, 1996 and 2001 in Table 5.18. These index values were used to scale the elements of all rows of the base-year final demand matrix to yield the final demand matrices for 1991, 1996 and 2001 (not shown here).

Table 5.18 shows that there is much more variation between the countries in fixed capital formation than in final consumption. Three countries, Denmark, the United Kingdom and Spain showed a growth of fixed capital formation of one fifth between 1980 and 1987. Three other countries, however, experienced a substantial decline in fixed capital formation in real terms: Belgium by 9%, Ireland by 12% and Greece by 19%. In the other countries fixed capital formation remained more or less constant.

Final consumption of households grew in all countries in real terms in the same period. The highest growth rates were found in the United Kingdom (22%), Italy (17%) and France (17%). The lowest growth of final consumption occurred in Ireland (3%) and the Netherlands (4%).

In combination, the two measures yield the highest growth in total final demand in the United Kingdom, Spain and Italy. In the United Kingdom, final demand grows by one half until 2001. In Ireland, the decline in fixed capital formation offsets the growth in final consumption with the effect that total final demand declines.

With the probable exception of the United Kingdom and Ireland, these results seem plausible. The strong growth in the UK may not be very

Table 5.17. Population forecasts by region 1986-2001 *(1 000)*

Country/region	Annual change 1980-86	Population 1986	Population forecast 1991	1996	2001
United Kingdom	0.13245	56 763	57 140	57 519	57 901
1 Scotland	0.13245	5 121	5 155	5 189	5 224
2 Midlands, North England	0.13245	27 842	28 027	28 213	28 400
4 South England	0.13245	13 552	13 642	13 733	13 824
5 East Anglia	0.13245	1 992	2 005	2 019	2 032
6 London	0.13245	6 750	6 795	6 840	6 885
7 Kent	0.13245	1 506	1 516	1 526	1 536
Ireland	0.67459	3 541	3 662	3 787	3 917
3 Ireland	0.67459	3 541	3 662	3 787	3 917
France	0.46977	55 394	56 707	58 052	59 428
8 Brittany	0.46977	2 758	2 823	2 890	2 959
9 Normandy	0.46977	4 849	4 974	5 092	5 213
10 Nord-Pas-de-Calais	0.46977	3 929	4 022	4 118	4 215
11 Île-de-France	0.46977	10 231	10 474	10 722	10 976
12 Centre	0.46977	10 315	10 560	10 810	11 066
13 South-west France	0.46977	10 441	10 689	10 942	11 201
14 South-east France	0.46977	12 871	13 176	13 489	13 808
Belgium/Luxembourg	0.01304	10 232	10 239	10 245	10 252
15 West-Vlaanderen	0.01304	1 092	1 093	1 093	1 094
16 Hainaut	0.01304	1 276	1 277	1 278	1 278
17 Belgium	0.01304	7 864	7 869	7 874	7 879
Netherlands	0.48987	14 570	14 930	15 300	15 678
18 Zeeland	0.48987	56	365	374	383
19 Rest of Netherlands	0.48987	14 214	14 566	14 926	15 295
Denmark	– 0.00651	5 121	5 119	5 118	5 116
20 Denmark	– 0.00651	5 121	5 119	5 118	5 116
Germany	– 0.13581	61 067	60 653	60 243	59 835
21 North Germany	– 0.13581	13 255	13 165	13 076	12 988
22 Bremen	– 0.13581	657	659	654	650
23 Mid-Germany	– 0.13581	21 937	21 788	21 641	21 494
24 Cologne	– 0.13581	3 881	3 855	3 829	3 803
25 South Germany	– 0.13581	21 337	21 192	21 049	20 906
Italy	0.24371	57 141	57 947	58 657	59 375
26 North Italy	0.24371	26 979	27 309	27 644	27 982
27 Piemonte	0.24371	4 392	4 446	4 500	4 555
28 South Italy	0.24371	25 875	26 192	26 513	26 837
Spain	0.53842	38 669	39 721	40 802	41 913
29 Rest of Spain	0.53842	36 325	37 476	38 496	39 543
30 Pais Vasco	0.53842	2 186	2 245	2 307	2 369
Portugal	0.74047	10 158	10 592	10 990	11 403
31 Norte	0.74047	3 577	3 711	3 851	3 996
32 Rest of Portugal	0.74047	6 631	6 880	7 139	7 407
Greece	0.55063	9 966	10 243	10 529	10 822
33 Greece	0.55063	9 966	10 243	10 529	10 822
Total	0.25386	322 777	326 895	331 065	335 289

Table 5.18. Forecast of final demand by country

Country	Observed 1987 Index 1980 = 100		Forecast of final demand Index 1986 = 100		
	GFCF	FCOH	1991	1996	2001
United Kingdom	120.2	121.8	114.87	131.96	151.58
Ireland	87.6	102.6	98.60[a]	97.23[a]	95.87[a]
France	99.7	116.9	108.47	117.65	127.61
Belgium	90.7	109.4	103.30	106.71	110.23
Luxembourg	96.6	113.0	105.60	111.50	117.74
Netherlands	108.6	104.2	103.78	107.69	111.76
Denmark	120.5	113.0	110.43	121.95	134.67
Germany	98.7	111.0	105.41	111.12	117.14
Italy	105.9	117.6	110.04	121.08	133.23
Spain	117.2	113.5	110.09	121.19	133.41
Portugal	105.7	111.9	107.11	114.72	122.87
Greece	81.0	112.6	103.07	106.23	109.49
EUR 7[b]	104.3	115.0	108.53	117.79	127.84

[a] Set to 100 for model simulations.
[b] B, DK, D, F, I, NL, UK.
Abbreviations: GFCF: Gross fixed capital formation; FCOH: Final consumption of households.
Source: Eurostat (1989), *National accounts ESA,* Tables 5 and 6.

realistic in the face of the current recession climate. The decline of final demand in Ireland was due to the decline in fixed capital formation. It was thought to be appropriate to assume that this deficit in capital formation will be compensated by Community support measures during the forecasting period. Therefore the index values for Ireland used in the simulations were set to 100.

5.5.1.3. Trends of growth in freight flows

From an analysis of UK Department of Transport (DTp) statistical sources, trends in the growth pattern of both domestic UK freight movements and international movements have been examined. These suggest that domestic freight movements within the UK have grown slightly (16%) with respect to tonnes lifted from 1978 to 1988, although there have been fluctuations within this general trend. Tonne-kilometres moved have increased more quickly over the same period (DTp, transport statistics, the United Kingdom, 1978-88). Note that this pattern of moderate domestic growth has also been found in Sweden (Swedish trunk road study — ME&P, 1989).

However, examining import/export trends suggests a dramatic increase in non-bulk tonnes lifted, with an average increase in unitized goods of approximately 50% every five years over the period 1970-89 (DTp, Port Statistics 1989). In the UK, it is clear that other factors must be considered to explain the very rapid growth in international trade since neither changes in GDP through time, nor improvements in transport facilities, are sufficient to explain the consistently rapid growth in import/export movements.

This rapid growth in trade between nations, especially in finished goods, is mainly led by non-transport forces. These are associated both with a general internationalization in trade, and, in particular within the EC, growing integration in trade between the member countries. It is hypothesized here that this trend towards integration in trade will continue into the future taking account of the changes expected in 1992 and the continuation of past trends.

All the three controls on growth in trade flows between countries are included in the Meplan model. These are

(i) improvements in transport facilities and characteristics;
(ii) growth in GDP and associated production levels;
(iii) internationalization of trade.

While the first two of these are fully treated in the current implementation of the model, the resources required to allow a robust treatment and full calibration of changing internationalization patterns of trade through time were beyond the resources available to this study. In order to generate the high levels of growth observed in practice, international trade experiments were carried out which suggested that the level of changes required in the intercountry disutility terms that control the volume of trade between countries were so large that the calibration of the model was seriously affected.

Accordingly, rather than make major adjustments to these intercountry disutilities, it was decided to scale up the freight transport flows output from the model in an explicit fashion to represent that growth in non-bulk freight due to greater internationalization of trade, over and above the elements of growth due to GDP changes and transport supply changes.

The hypothesized total growth rates are shown in Table 5.19. As the international trade increases as a proportion of all the trade of a country, it is assumed that the scope for further increases in this proportion decline relatively.

Table 5.19. Hypothesized growth rates in non-bulk freight movements between the United Kingdom and mainland Europe

	Growth due to GDP (%)	Further growth due to trade internationalization (%)	Total assumed growth rate (%)
1986-91	9	38	50
1991-96	9	28	40
1996-2001	9	10	20

The growth rates due to trade internationalization were applied to all non-bulk transport flows irrespective of mode or policy in the appropriate year. The passenger flows were treated in a separate fashion and are subject to different growth factors.

5.5.1.4. Passenger growth factors

The passenger trips represented in the model are those trips in which one end of the trip is in the UK or Ireland and the other end is on the Continent (defined hereafter as cross-Channel traffic). The amount and distribution of passenger travel of this cross-Channel type is determined for the base-year model for each of the six purposes by observed travel behaviour. Future growth in the five non-business types of passenger travel is ensured by applying a basic factoring of 5.6% per annum per head of population. This value matches the observed growth in passenger trips over the 14 years from 1975 to 1989 from 142 000 per annum to 306 000 per annum. The volume of business trips from each zone is directly proportional to the amount of 'business and finance' located in that zone and some growth is therefore transmitted to these trips as a result of growth in the consuming factor. For business travel, therefore, a lower exogenous growth trend was chosen. The rate selected was 2.4% per annum, a value which when combined with the intrinsic growth again matches the observed trend in overall travel.

In addition to these basic rates of growth, passenger trips are allowed to increase in the model as the consumption disutilities of travel from a zone decrease. This is to allow both for the growth in total travel which results from decreases in the average consumption disutility of travel and also for the increase in cross-Channel trips resulting from the diversion of other trips to the now more attractive cross-Channel destinations. The parameters describing this elasticity of travel were deduced for each of the trip purposes and for each side of the Channel by examination of base-year trips and the matching base-year disutilities. The demand coefficients were adjusted so as to reproduce the observed base-year trips exactly and to incorporate the predetermined annual growth rates.

5.5.1.5. Assumptions on the perceived quality of service of the Tunnel

In order to make meaningful progress on the representation within the transport model of the Channel Tunnel, it is necessary to make assumptions on the general quality of service as it will be perceived by users and on how this will compare with the future quality of service provided by its competitors, the ferries.

The travel times used to represent the various services through the Tunnel were at the higher end of the range of those published by Eurotunnel (*The Channel Tunnel, a 21st century transport system,* 1990). The tariffs to be charged are as yet unknown so for simplicity they are set at the same level as for the short sea ferry crossings. If it were as simple as that, then due to the considerable time savings all current users of the Dover to Calais ferries would switch to the Tunnel when it opens.

In practice it is not believed that such a total switch would take place even if there was no price differentiation. This is because different individuals have different tastes. For example, ferry crossing may be perceived as more advantageous by lorry drivers as the longer duration crossing time may qualify for rest periods. For many car passengers the ferries will offer the opportunity to take a break from driving, and to have time to have a meal, shop or rest before continuing the next leg of a long journey. How passengers in general will view this versus a more frequent service with a shorter time, but spent in a wagon full of cars in a Tunnel, is not easy to predict once the novelty value of the Tunnel has abated. Similarly, the importance to be attached to avoiding the possibility of rough weather at sea is a matter for conjecture.

For these reasons the split in traffic on the Dover-Calais crossing between the shuttle and the traditional ferry services could plausibly move in either direction from those presented in the tables in the next section.

This is less of an issue for the through passenger rail service, where there is an unambiguous improvement in service from that currently offered, through cutting out the need to leave and rejoin trains with significant walking (often with luggage) in between. This combined with substantial time savings and system reliability will make rail competitive in the cross-Channel air market.

Assumptions of no change are made about the quality of the air services that are provided in competition with the Tunnel. The increase in frequency of air services that has been achieved in recent years has been balanced with a decrease in their reliability due to congestion in the air. The extent to which current initiatives to improve the effectiveness of air traffic control will lead to overall improvements in the quality of service for cross-Channel travellers is hard to assess, since the growth in longer distance air traffic seems likely to lead to fairly high levels of air congestion in the region around the Channel, even if there is a reduction in the demand for shorter distance flights due to the opening of the Tunnel and to the TGV services on mainland Europe. Air tariffs are assumed to stay at their existing levels in real terms once inflation is discounted.

5.5.1.6. Other assumptions

All other factors affecting the forecasting environment of Meplan were assumed to remain constant. Such factors include, among others, the production technology as embedded in the technical coefficients of the input-output table, imports from and exports to non-EC countries and the assumptions about resource costs and unit costs of transport.

It may be argued that some of these assumptions such as, for instance, the assumption that energy prices will remain constant in real terms over the forecasting period may not be realistic. On the other hand, a full-scale investigation of likely developments for each of the numerous cost parameters in the model would involve a disproportionate amount of research which clearly would not be possible in this project. So the assumptions are designed broadly to represent the continuation of current trends without attempting to replicate every detail of all possible factors. In addition, it has to be kept in mind that the absolute values of the model forecasts are not of primary interest in this study but rather the differences that may appear between the different policy alternatives or scenarios investigated.

5.5.2. Network assumptions

While the above assumptions are the same for all simulation runs conducted with Meplan, the simulations differ with respect to the transport infrastructure that is assumed to be implemented in each simulation. In other words, the policy alternatives investigated in this study are represented by different future networks.

5.5.2.1. Future networks: Principles

There is no such thing as the definite future European transport network. A review of various documents, newspaper reports, etc., reveals a large variety of possible configurations of new high-speed rail links and new motorways. The picture gets more confusing if upgraded existing rail lines and motorways are taken into account. The sources differ even more if the time schedule for the completion of individual links is considered.

The following future network alternatives combine information from various sources. The future high-

Table 5.20. The incremental network changes

Year	Case		Network implemention
1986	Base		Initial network
1991	Present	Rail	• London-Cardiff • Paris-Rennes
		Road	• Tours-Le Mans • Bayonne-Toulouse
1996	B	Rail	• Lens-Tourcoing-Calais-Paris • Tourcoing-Brussels • Aachen-Cologne-Mönchengladbach • Mannheim-Baden-Baden-Basle • Edinburgh-Newcastle-Doncaster-London
		Road	• Chamonix mountain pass • Cherbourg-Caen-Rennes-Brest-Nantes-Saintes • Chartres-Rouen-Abbeville-Amiens-Paris • Ostend-De Panne-Calais-Abbeville • Narbonne-Clermont Ferrand-Bordeaux-Bayonne • Orange-Oulx-Turin • Glasgow-Carlisle
1996	C	As B above, together with	
		Rail	• Paris-Nancy • De Panne-Brugge
		Road	• Ostend-Bergen Op Zoom-Antwerp • Vlissingen-Rotterdam
2001	B	Rail	• Stirling-Edinburgh • Glasgow-Carlisle-Birmingham-London-Dover • Belfast-Dundalk-Dublin-Cork • Paris-Tours-Bordeaux-Bayonne-Hendaye • Dijon-Lyons-Orange • Amsterdam-Utrecht-Mönchengladbach • Copenhagen-Nyborg-Kolding-Århus • Cologne-Bremen-Hamburg-Hanover • Frankfurt-Wurzburg-Munich • Bologna-Milan-Turin • Madrid-Miranda • Oporto-Pamphilosa-Lisbon • Vienna-Salzburg
2001	C	As B above, together with	
		Rail	• Paris-Calais • Nancy-Strasbourg • Lyons-Oulx-Turin • Brugge-De Panne • Breda-Brussels-Liège-Aachen • Amsterdam-Rotterdam • Bologna-Rome-La Spezia • Frankfurt-Cologne • Berlin-Hanover • Brindisi-Pescara • Madrid-Burgos-Vilar Formosa-Pamphilosa • Burgos-Miranda-Bilbao

Figure 5.13. Road network improvements

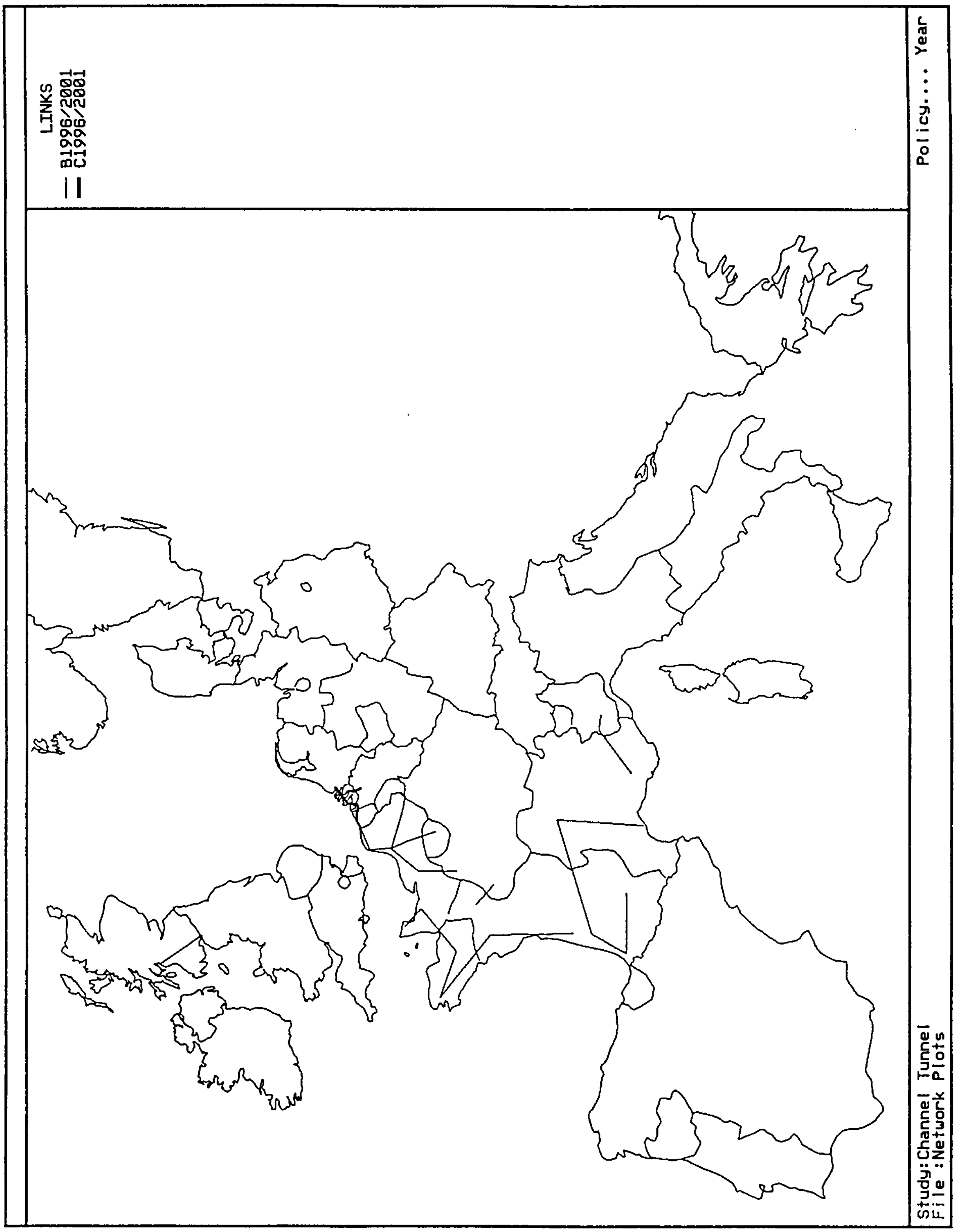
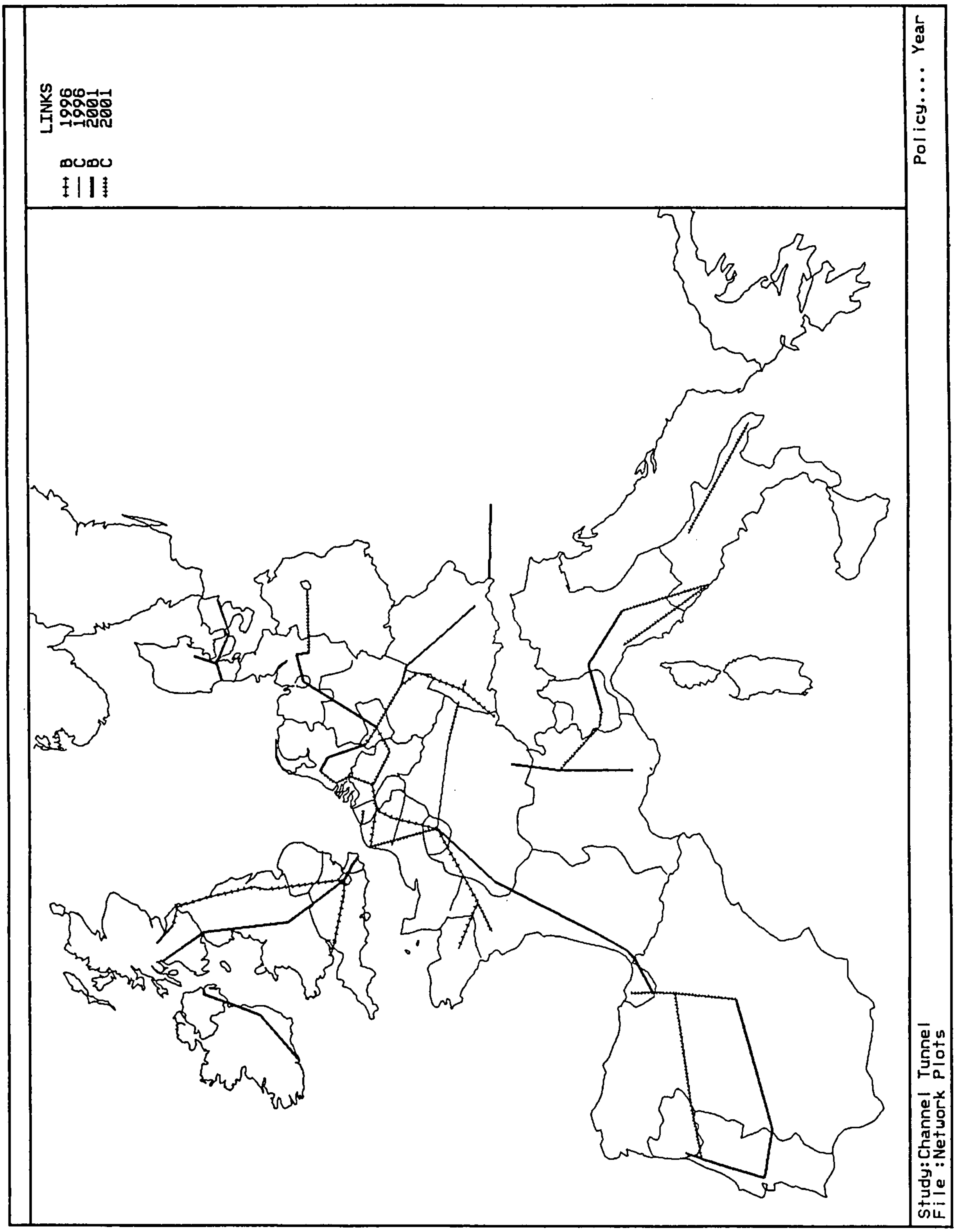


Figure 5.14. Rail network improvements



speed rail system is largely based on information from the Union of European Railways (UER). The information on new French motorways is based on the *programme routier* of the 10th national plan. In addition, information collected in the regional case-studies was used.

A further problem is related to the speed of the new high-speed railway lines. The maximum speeds normally quoted (300 km/h on new high-speed lines and 200 km/h for upgraded existing lines) give no clear indication of the station-to-station times to be expected. In general the maximum speeds apply only to a part of the distance; on other sections such as in mountainous areas, in tunnels or in urban areas the actual speeds are considerably lower. Therefore, the following network alternatives use station-to-station times based on information from the European Conference of Ministers for Transport (ECMT) or reasonable estimations if data were not available.

5.5.2.2. Network alternatives

The following five network configurations are defined:

A	Present network without Tunnel;
B/B1	Limited network without/with Tunnel;
C/C1	Extended network without/with Tunnel.

The three network alternatives are the present network, the limited network and the extended network.

The present network is the network as coded for the year 1991 and consists of the base network for 1986 plus improvements for 1986-91. The limited network consists of the present network together with changes in case B, and the extended network is made up of the case B network with addition from case C. Table 5.20 summarizes the major network changes for all simulation periods.

5.5.2.3. Extended network

The extended network consists of all new links and upgradings contained in Figures 5.8 and 5.9 which give the expected year of implementation for both the rail and road changes. The Spanish railways change to standard gauge. The loading gauge on the British west coast main railway line is upgraded as far as Crewe to accommodate continental freight trains.

When the Channel Tunnel opens it will allow the transportation of freight by non-stop through-rail between the United Kingdom and mainland Europe. It is anticipated that certain of the major centres of commercial and industrial activity in mainland Europe will be connected with the UK through scheduled direct rail freight services.

This premium service has been incorporated into the extended network alternative in the transport model by including low through running times for those areas for which a high level of service is expected. These zones are listed in Table 5.21.

Table 5.21. Zones for which direct rail freight service has been assumed

Zone number	Description
2	Midlands, North England
4	South England
6	London
7	Kent
11	Île-de-France
14	South-east France
17	Belgium
23	Mid-Germany
24	Cologne
26	North Italy
27	Piemonte

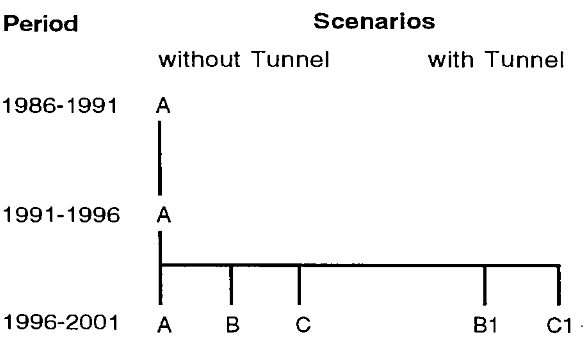
Because of the general difference in loading gauges between the UK and mainland Europe and because there are no agreed plans in the UK to upgrade other than possibly to London and then to Crewe, the implication is that specialized wagons would be needed for many services to the UK that require to use other lines in the UK. These wagons are likely to be available only on a limited number of regular services between the UK and mainland Europe. (British Rail, 1989, international rail services for the United Kingdom). The alternative is rail consolidation centres where wagons are switched and where delays and problems of security may occur.

For much of the traffic to smaller freight centres in Europe, significant delays will be expected at marshalling yards and difficulties will be encountered in finding suitable wagons, so for this traffic the model does not include a major improvement in service when the Channel Tunnel opens. Instead more limited gains are associated with the upgrading of various rail lines as shown in Figure 5.14.

5.5.2.4. Policy scenarios

It is hard to say which of the above five network configurations provides the base forecast. Probably the concept of the base forecast as the most likely future development does not make much sense in this project. In the current project there is only one policy measure of interest, the Channel Tunnel. Therefore the network alternatives specified above are themselves not the object of investigation but provide different background scenarios for the Tunnel. So there will be no single base forecast with which all simulation runs are compared.

Taking account of the fact that until 1996 all five network alternatives are identical except with respect to the Channel Tunnel, the following scenarios emerge for the simulation:



It is obvious that the five scenarios differ vastly in terms of their likelihood to be implemented. It is clear that scenarios A, B and C, the scenarios without the Tunnel, will not be implemented as the Tunnel is already nearing completion. However, these scenarios are necessary as benchmarks for the comparison in order to assess the magnitude of the Tunnel's impacts. The real contenders in terms of likelihood of implementation are scenarios B1 and C1. Both contain the Tunnel but differ in the speed by which the high-speed rail and road infrastructure is implemented. So it is interesting to compare their results with their respective counterparts without the Tunnel and against the 'do-nothing' scenario A.

Each of these comparisons will provide a different kind of information:

B1-B C1-C These two comparisons show the pure impact of the Channel Tunnel at different levels of implementation of the high-speed rail and road infrastructure.

B-A C-A These two comparisons show the impact without the Channel Tunnel at different levels of implementation of the high-speed rail androad infrastructure and can be used to differentiate benefits due to non-Tunnel transport infrastructure investment from those due to the Tunnel itself.

The following discussion will therefore focus on the four types of comparisons identified above. To make these comparisons possible, the five scenarios A, B, C, B1 and C1 were simulated with Meplan subject to the general assumptions stated at the beginning of this section. In Subsection 5.5.3, the results of these simulations are presented.

5.5.2.5. Travel times

The Channel Tunnel has two functions in the European transport network. The shuttle trains improve the cross-Channel link between the British and the continental motorway networks. Fast through-rail services via the Tunnel close a missing link in the emerging European high-speed rail network. Therefore the Tunnel will have strong impacts on travel times between the European mainland and the United Kingdom and Ireland.

Travel times are one element of the transport cost function of the Meplan model. Therefore the transport module of Meplan provides travel times for each flow type and user mode for each modelled scenario and year. Based on these model travel times, the influence of the Channel Tunnel on travel times is illustrated in Figures 5.15 to 5.22. Each map shows travel times represented by isochrones for business travellers from the UK and Ireland to Paris and from mainland Europe to London. Due to the design of the networks implemented in the model, the isochrones are rather exact in regions close to the Tunnel, but more approximate in more distant regions.

As a basic reference for future transport improvements, today's travel times are presented in Figure 5.15 for road and in Figure 5.16 for rail. Journeys from the UK (Kent) to Paris last at least six hours by car or seven hours by train. The shortest travel times from mainland Europe (Nord-Pas-de-Calais) to London are five and six hours, respectively. Further away from the Channel, travel times increase with minor steps along faster links, and faster steps if there are barriers like the Alps. The effect of the TGV Sud-Est is particularly obvious. With this exception, travelling across the Channel is generally faster by car than by rail.

Figures 5.17 and 5.18 present travel times in 2001 calculated for scenario C, i.e. with high investments on the European motorway and high-speed rail networks, but, hypothetically, without the Channel Tunnel.

Travel times by car (Figure 5.17) are only slightly less in 2001 compared with 1991. The overall pattern is the same with the exception of shorter travel times in regions such as Brittany that will be accessed by a motorway for the first time. But for rail (Figure 5.18) a pattern different from that of 1991 emerges. Due to the widespread implementation of high-speed rail lines, travel times on both sides of the Channel are sharply reduced. Without the Tunnel, regions further away from the Channel benefit more.

Figures 5.19 and 5.20 display travel times for scenario C1 (extended network as in scenario C plus the Channel Tunnel in operation), making the picture of changing accessibility in Europe complete.

With respect to road travel times across the Channel (Figure 5.19), all European regions benefit. As expected, the greatest improvements over scenario C are found close to the Tunnel, whereas the relative time savings are much less in more peripheral regions. With respect to rail, all European regions benefit (Figure 5.20). The supplementary effect of the Channel Tunnel as a centrepiece of the European high-speed rail network is clearly visible. The isochrones highlight the most important links, such as the French TGVs Sud-Est and Grand Sud, Atlantique, the Loire Region and Brittany and the high-speed rail line to Cologne via Brussels. For many cross-Channel crossings, travel times by train will be nearly halved compared with today.

The main result of this analysis of travel times is that the Channel Tunnel benefits primarily rail, whereas the time savings for cars are only modest. This means that, if the high-speed rail network including the Channel Tunnel were implemented, the train will become the fastest surface mode of transport in Europe.

5.5.3. Simulation results

There are innumerable ways of presenting the output of a complex simulation model like Meplan. In order to keep the presentation of results within reasonable limits in this report, only a few essential dimensions of analysis relevant for this purpose of the study have been selected for presentation.

The impacts of the Tunnel on passenger and freight traffic are examined in turn below. The model results are presented in tables showing the results for the five scenarios A, B, C, B1 and C1 (see above) in the years 1996 or 2001, the forecasting horizon.

The regional economic effects are examined in Subsection 5.5.4.

5.5.3.1. Analysis of passenger traffic

The main trends of passenger cross-Channel passenger flows by UK coastal region and mode are outlined below and shown in Table 5.22. When interpreting these results certain facts should to be kept in mind.

Firstly, the scenarios B and C that have been assumed include major motorway improvements before 1996 in France, while the only significant rail improvements in this period are the TGV from the Tunnel to Paris and Brussels. The rail service from London to the Tunnel is improved to allow cross-Channel trains to reach 160 km/h. From 1996 to 2001 major improvements to the rail service are made but few improvements are made to roads.

Secondly, no assumptions of changes in transport tariffs have been made for the future, so the tariffs for each mode relate to each other as in 1990.

Thirdly, all results relate only to passenger traffic which crosses between UK/Ireland and mainland Europe.

The main results from Table 5.22 are that air loses market share significantly and rail gains due to the infrastructure improvements (scenarios B and C). Both car and coach gain modestly. It can be seen that the differences in cross-Channel traffic between the with and without Tunnel scenarios are greater than those created by the road and rail improvements in Europe, which have a limited impact in 1996 but rather more in 2001 due to the increase assumed in the number of high-speed rail links.

The gain in rail mode share is more pronounced in 2001 than in 1996 in the case where the Tunnel is

Figure 5.15. Journey times by car, 1991

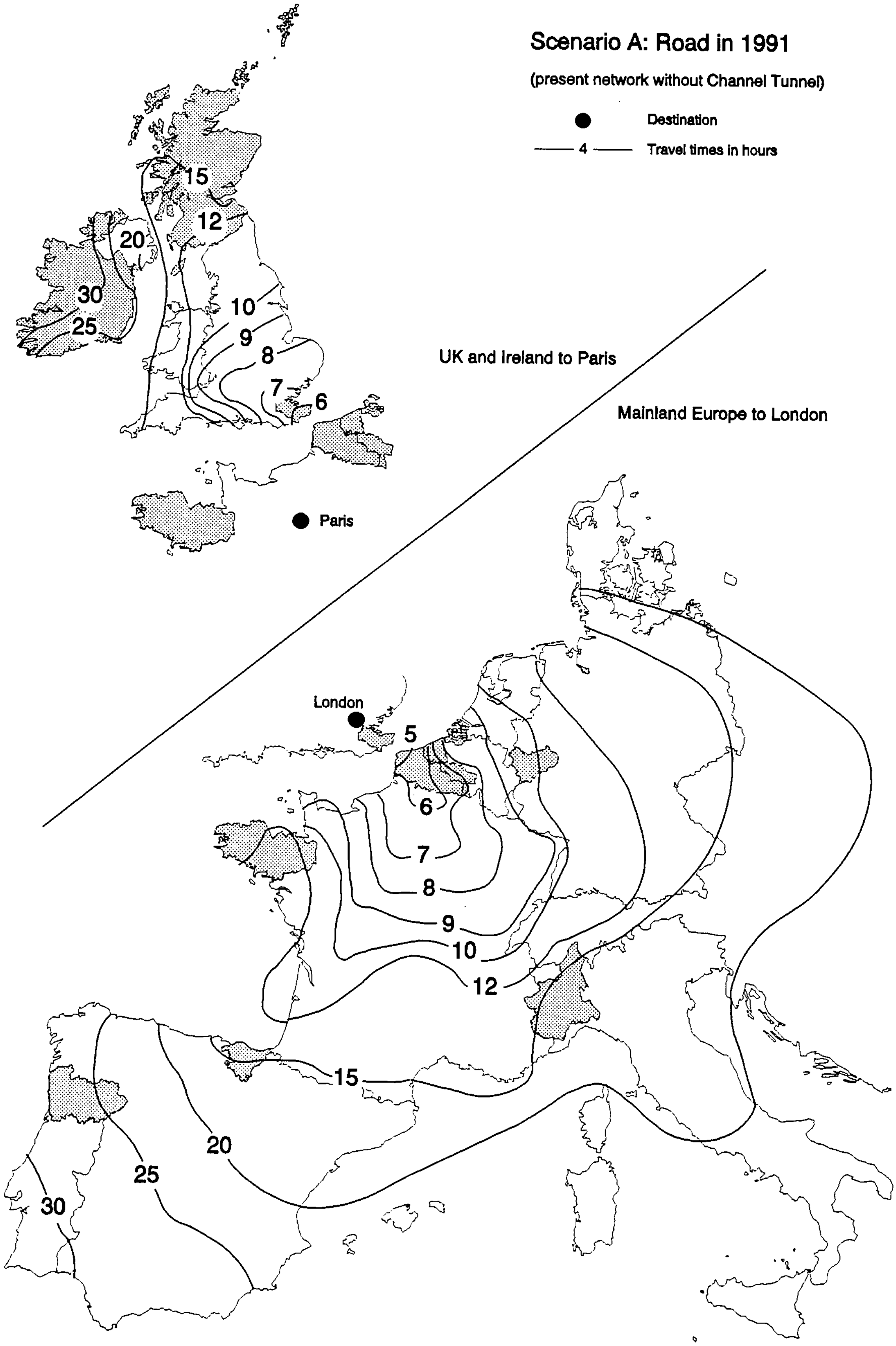


Figure 5.16. Journey times by rail, 1991

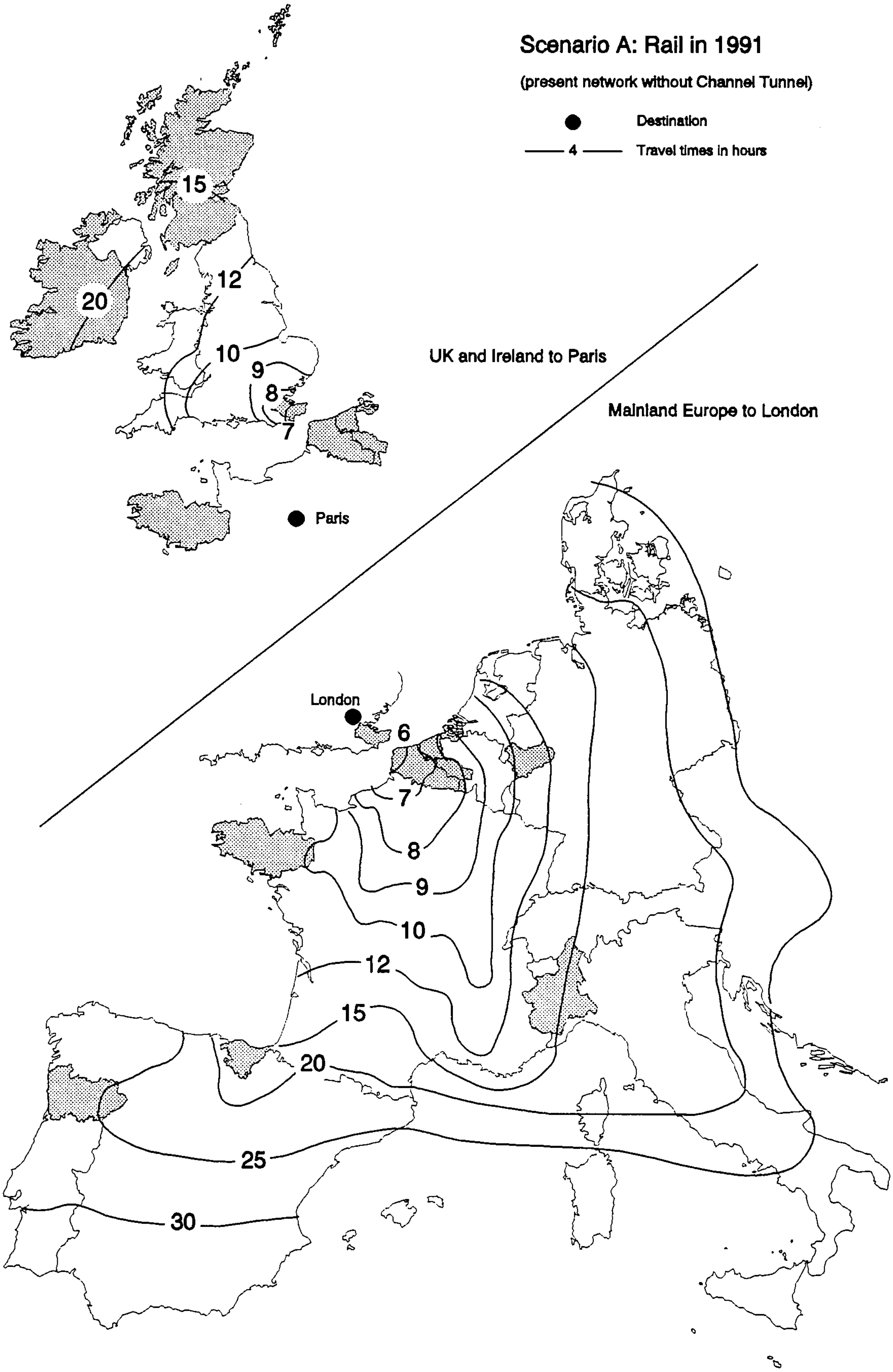


Figure 5.17. Journey times by car without Tunnel, 2001

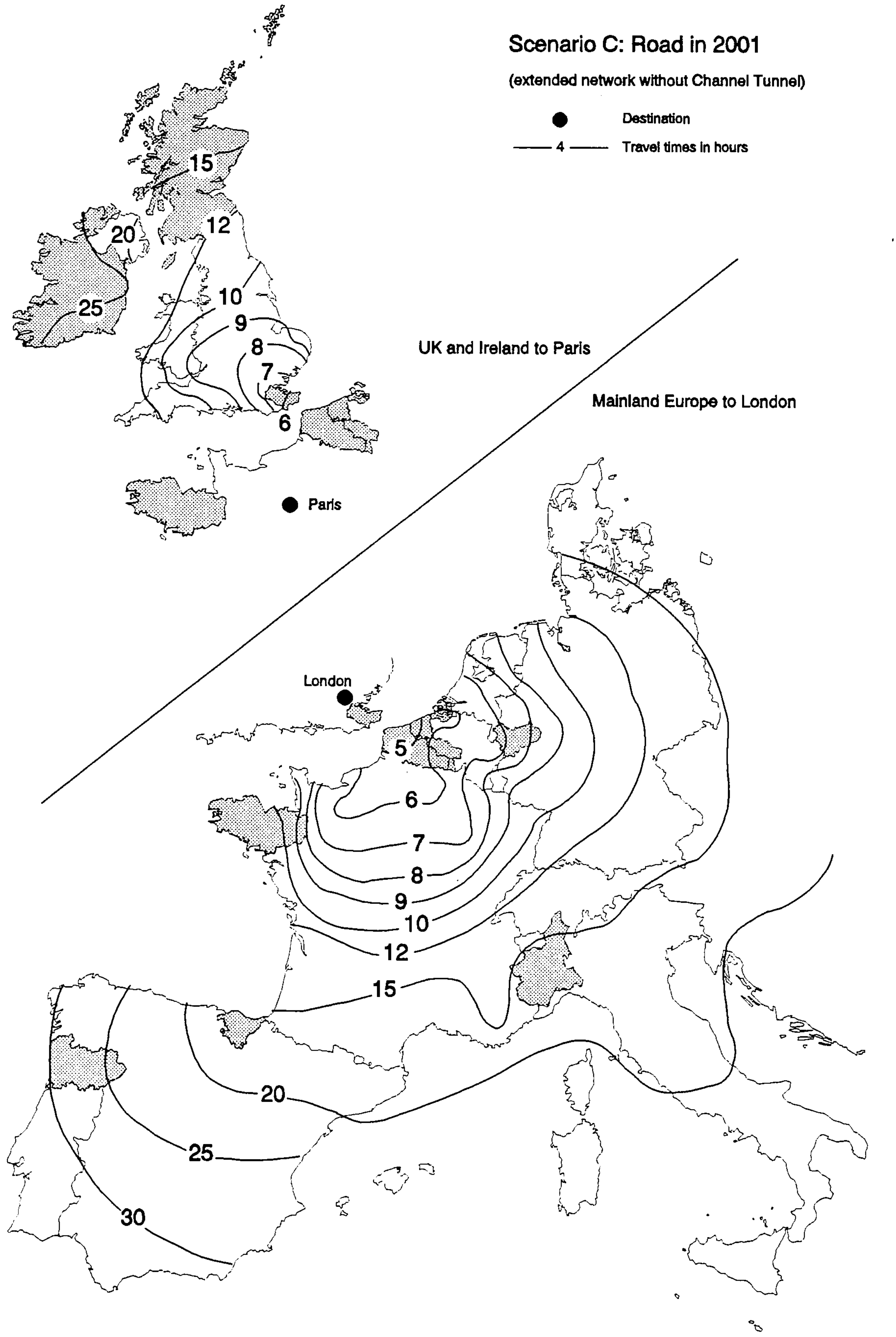


Figure 5.18. Journey times by rail without Tunnel, 2001

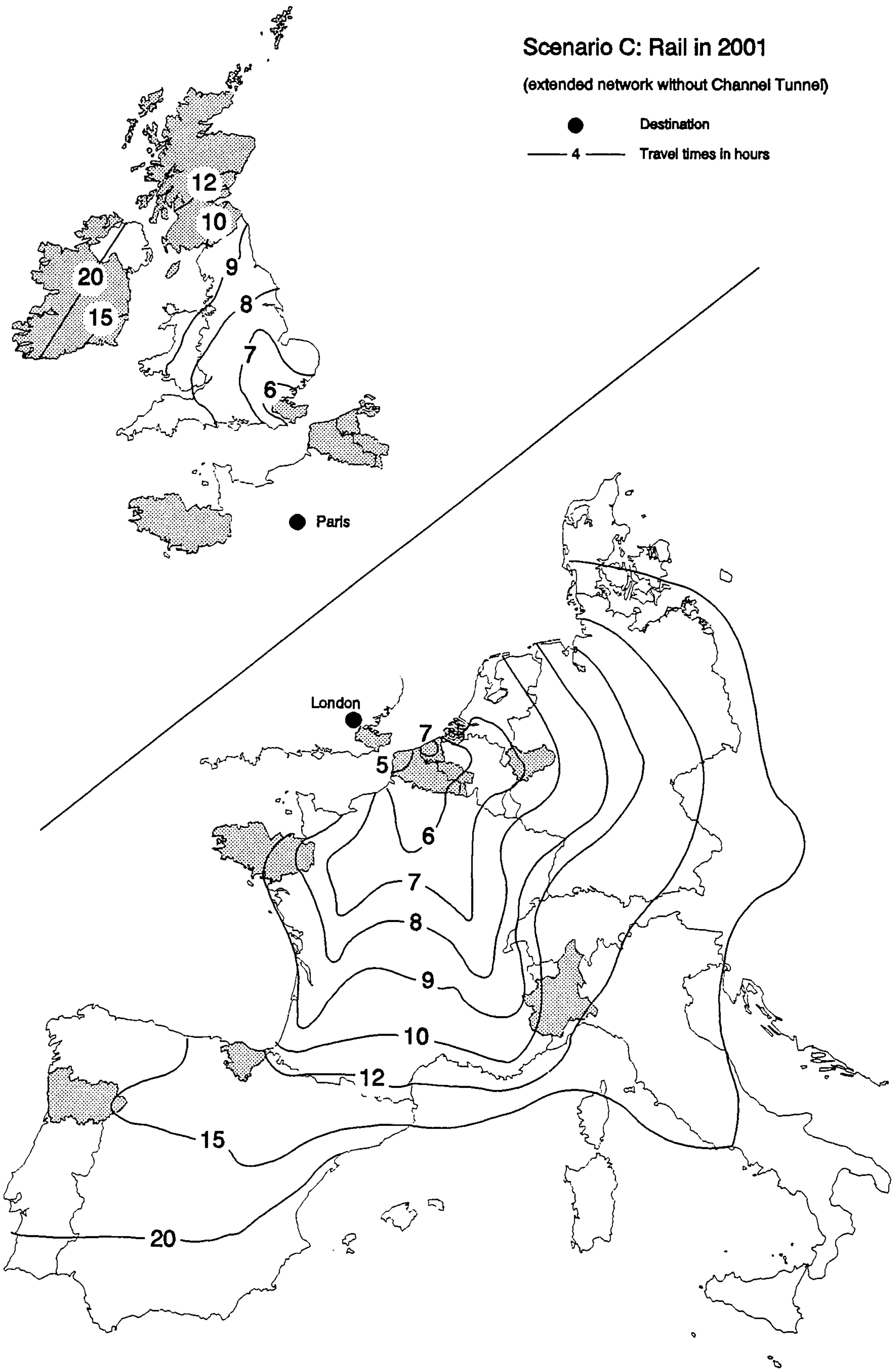


Figure 5.19. Journey times by car with Tunnel, 2001

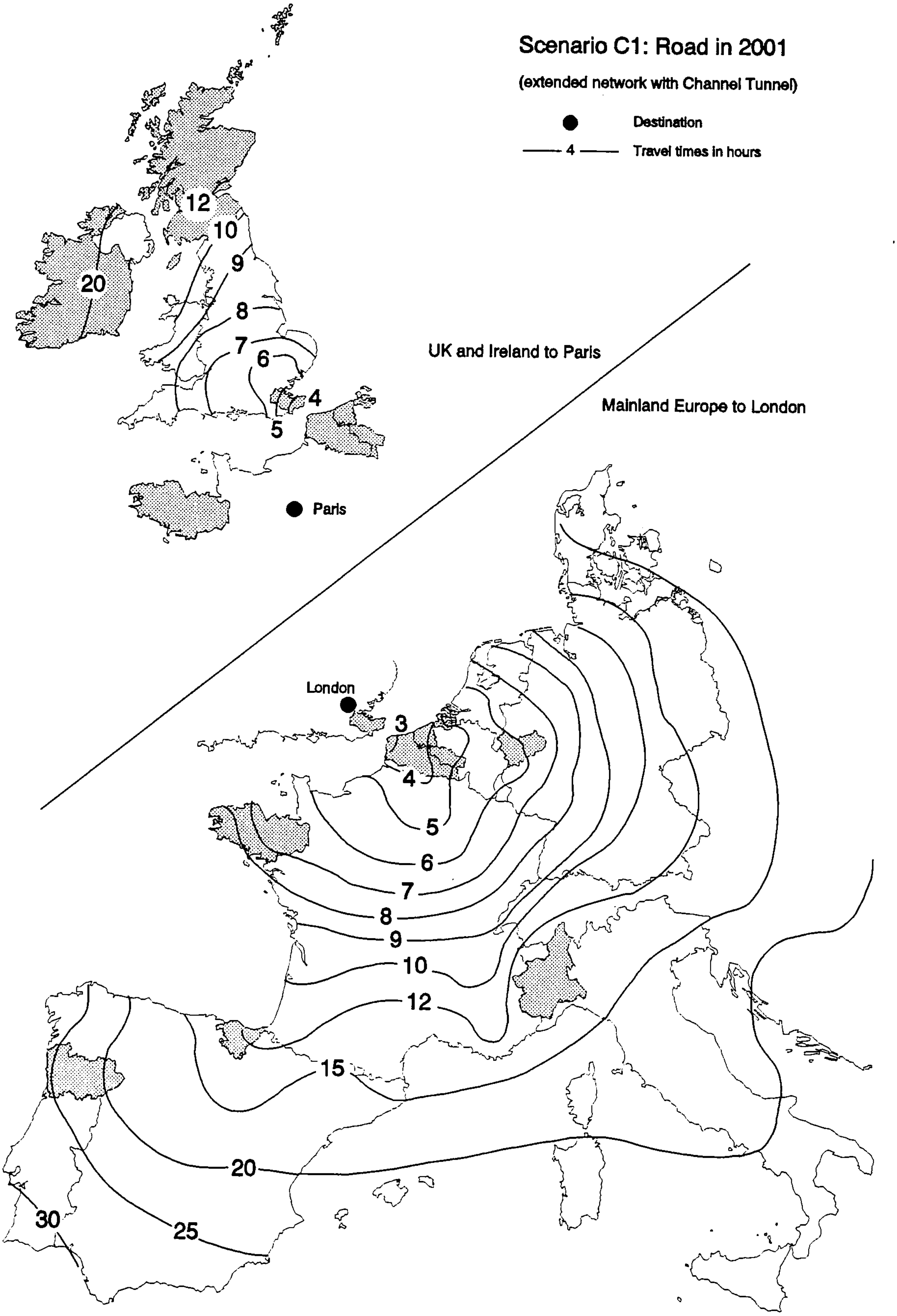


Figure 5.20. Journey times by rail with Tunnel, 2001

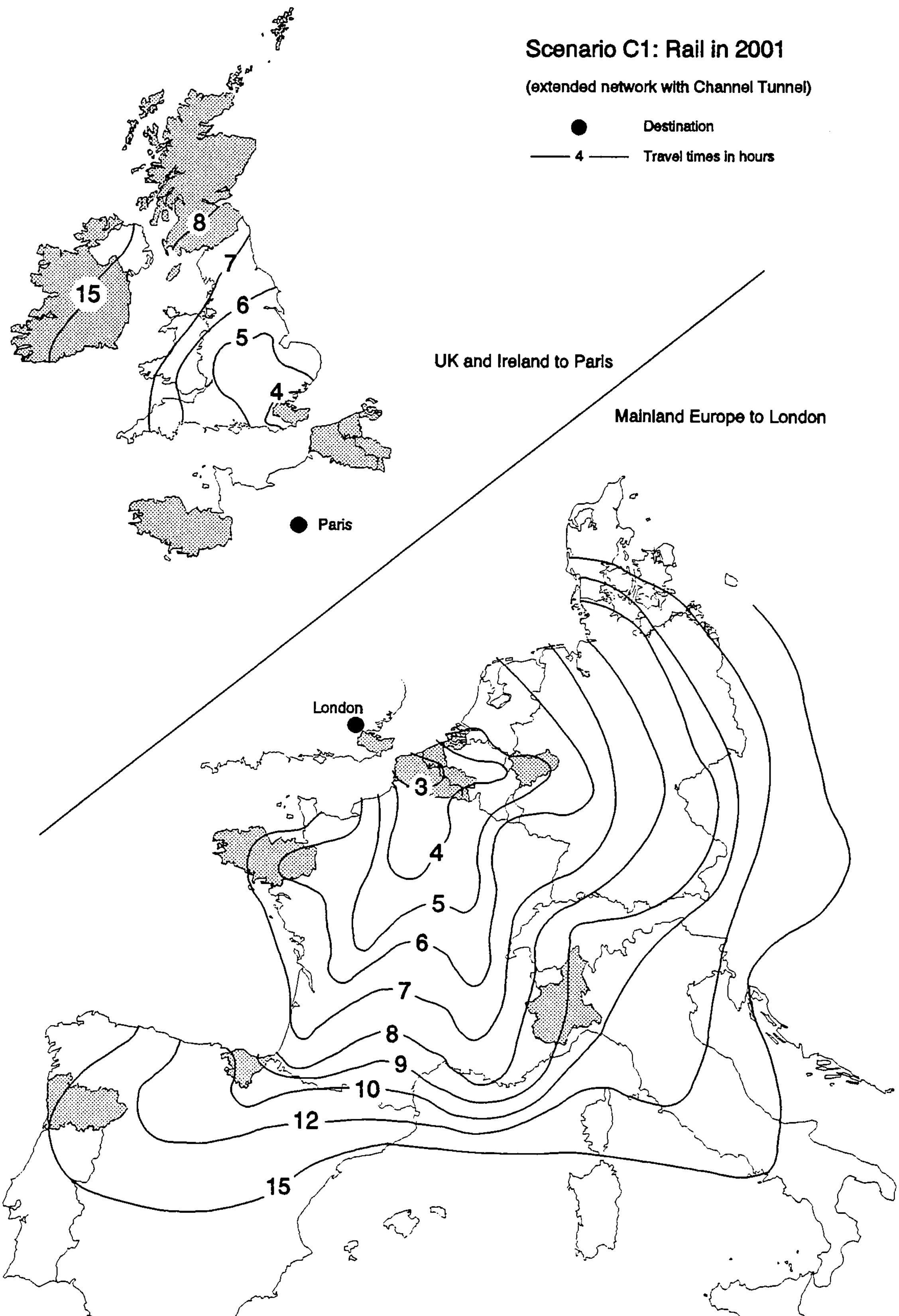


Figure 5.21. Journey times by car, 1991 and 2001

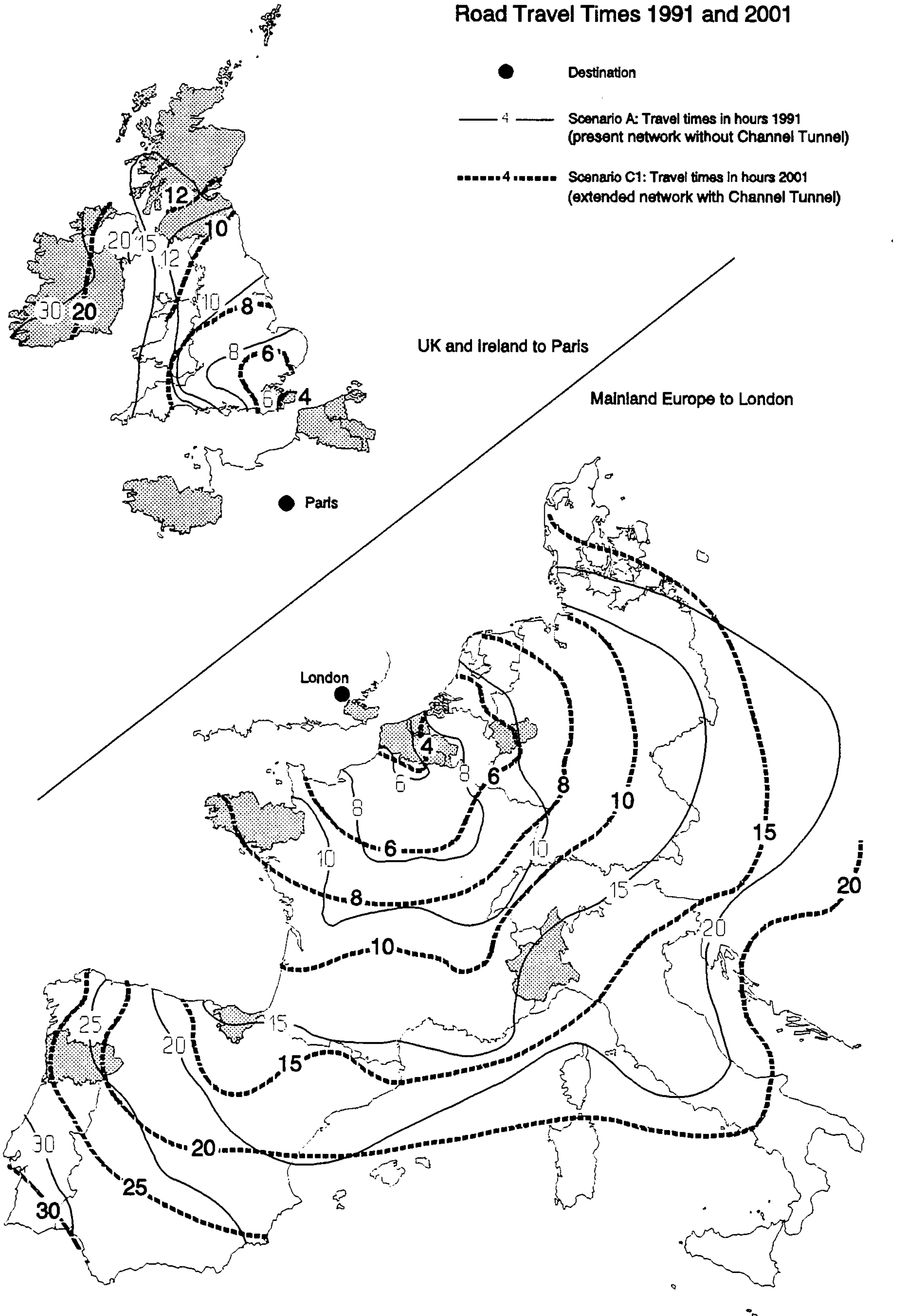


Figure 5.22. Journey times by train, 1991 and 2001

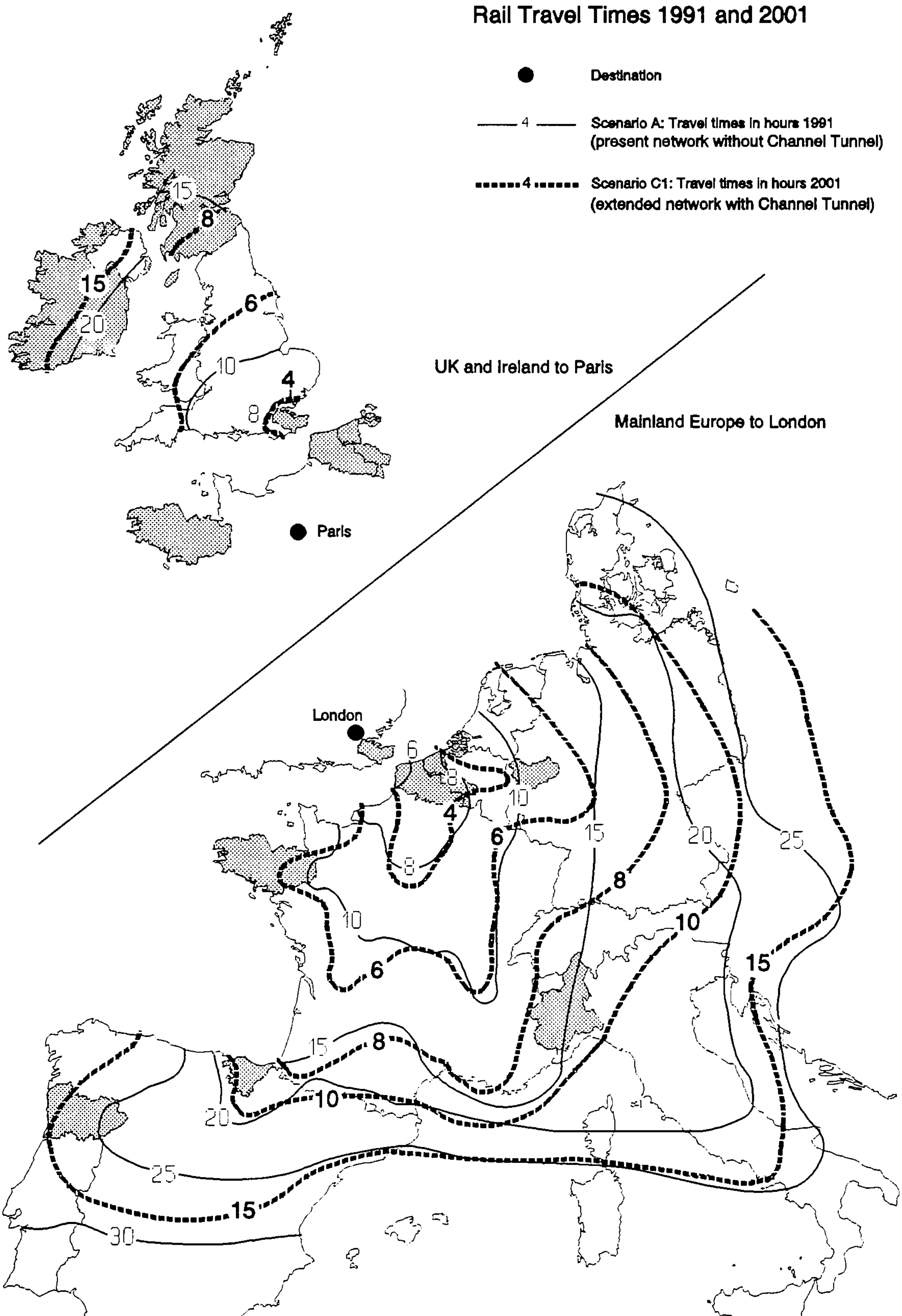
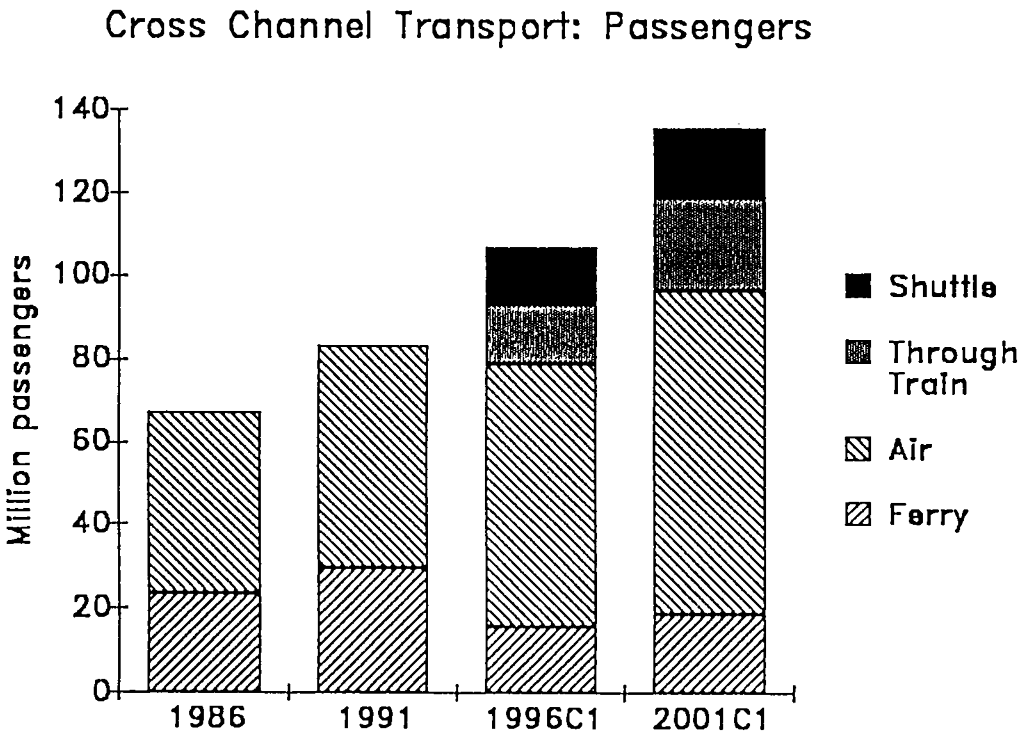


Figure 5.23. Forecast passenger and freight flows (C1) between the UK and mainland Europe



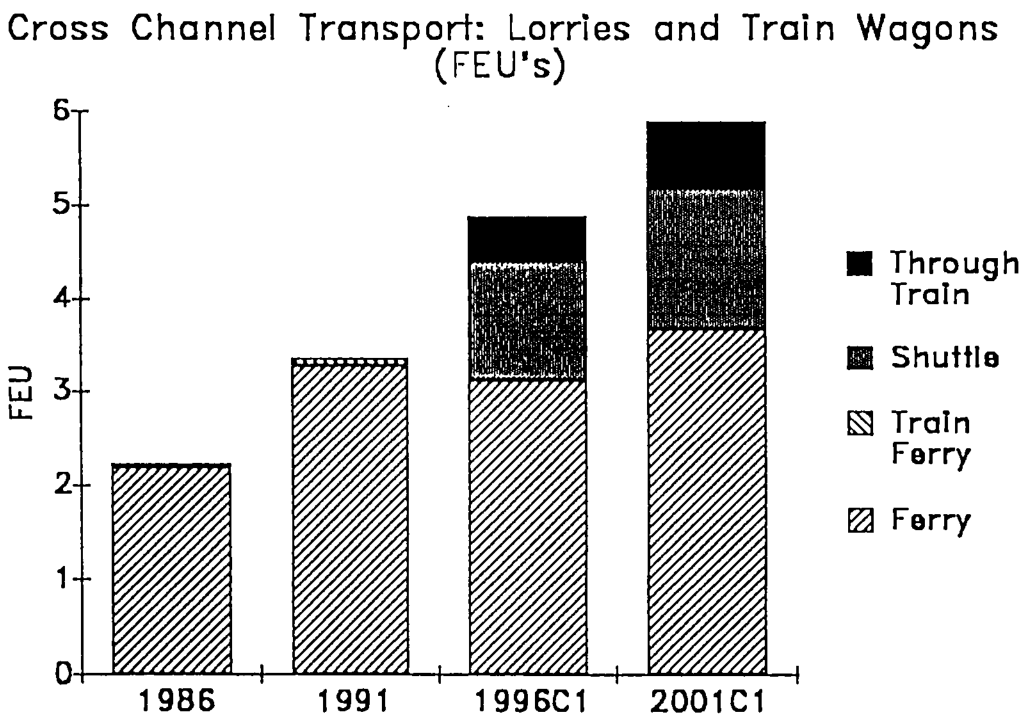


Table 5.22. Predicted cross-Channel passengers by mode for 1996 and 2001

Cross-Channel passenger traffic modelled for 1996 between the UK and mainland Europe

(1 000 per year)

UK coastal region	A	B	C	B1	C1
East					
Car passengers by ferry	1 736	1 876	1 874	1 347	1 331
Coach and rail passengers by ferry	2 970	2 493	2 498	1 033	1 035
South					
Car passengers by ferry	2 243	2 607	2 599	2 185	2 176
Coach and rail passengers by ferry	2 631	2 301	2 296	605	604
Kent					
Car passengers by ferry	8 790	8 384	8 479	5 336	5 315
Coach and rail passengers by ferry	17 678	19 767	19 792	6 089	5 315
Channel Tunnel					
Car passengers by shuttle	–	–	–	4 526	4 673
Coach passengers by shuttle	–	–	–	9 289	9 318
Through-rail passengers	–	–	–	13 420	14 190
Total ground passengers	36 048	37 428	37 538	43 830	43 957
Total air passengers	66 717	66 043	65 974	63 428	63 354
Total passengers	102 765	103 471	103 512	107 258	107 311

Cross-Channel passenger traffic modelled for 2001 between the UK and mainland Europe

(1 000 per year)

UK coastal region	A	B	C	B1	C1
East					
Car passengers by ferry	2 029	2 185	2 156	1 545	1 502
Coach and rail passengers by ferry	3 547	2 909	2 712	1 056	902
South					
Car passengers by ferry	2 810	3 246	3 174	2 719	2 644
Coach and rail passengers by ferry	3 285	2 298	1 059	468	398
Kent					
Car passengers by ferry	10 618	10 000	9 998	6 380	6 249
Coach and rail passengers by ferry	21 605	26 123	30 154	7 850	7 345
Channel Tunnel					
Car passengers by shuttle	–	–	–	5 287	5 391
Coach passengers by shuttle	–	–	–	11 292	11 115
Through-rail passengers	–	–	–	18 062	22 681
Total ground passengers	43 894	46 761	49 253	54 659	58 227
Total air passengers	85 052	83 392	81 841	79 621	77 506
Total passengers	128 946	130 153	131 094	134 280	135 733

Table 5.22. Predicted cross-Channel passengers by mode for 1996 and 2001 (continued)

Cross-Channel passenger traffic modelled between the UK and mainland Europe *(1 000 per year)*

Mode	Ferry		Tunnel Shuttle		Through-rail			
	Car	Pass	Car	Coach	Pass	Ferry	Tunnel	Air
Mode Unit	Pass	Pass	Pass	Pass	Pass	Total Pass	Total Pass	Total Pass
1986	8 971	14 779				23 750		43 748
1991	10 793	19 056				29 849		53 774
1996A	12 769	23 279				36 048		66 717
2001A	15 457	28 437				43 894		85 052
1996B	12 867	24 586				37 428		66 043
2001B	15 431	31 330				46 761		83 392
1996C	12 952	24 586				37 538		65 974
2001C	15 328	33 925				49 253		81 841
1996B1	8 868	7 727	4 526	9 289	13 420	16 595	27 235	63 428
2001B1	10 644	9 374	5 287	11 292	18 062	20 018	34 641	79 621
1996C1	8 822	6 954	4 673	9 318	14 190	15 776	28 181	63 354
2001C1	10 395	8 645	5 391	11 115	22 681	19 040	39 187	77 506

included. In particular, in Table 5.22 comparisons of the policy C1 (extended network) versus B1 in 2001 illustrate the effects of having a well-connected high-speed rail system. In this scenario, most of the rail gain is at the expense of air travel rather than of car or coach. It should be noted, however, that the levels of rail improvements assumed in C1 are unlikely to be achieved in practice until some years later than 2001.

5.5.3.2. Analysis of freight traffic

Forecast future freight movements by coastal region for the different policies are shown in Table 5.23 with overall movements and mode split summarized in Table 5.24.

As with the analysis of passenger flow trends, it is important when considering future freight traffic patterns to keep in mind the main assumptions regarding the development of the transport networks. These are that the B and C scenarios assume major motorway improvements in France between 1991 and 1996, and then major improvements to the international rail network with limited further road improvements between 1996 and 2001. The B1 scenario represents a shuttle-oriented service through the Tunnel whereas the C1 scenario assumes a proper through-rail freight service has been built up.

Comparing the medium infrastructure investment policy (B) with the no investment scenario (A), Table 5.24 shows that in 1996 there is likely to be limited impact on cross-Channel freight modal split. However, by 2001 when the improved rail service is assumed to be operational and the road programme is completed, then both the truck and train (on ferry) modes increase their market shares at the expense of air freight.

Under the high-investment policy scenario (C) in 1996, some growth in truck (on ferry) market share is anticipated at the expense of air with the volume of freight transported by rail being unchanged, relative to the no investment scenario (A). In 2001 similar gains in truck market share as predicted in scenario B occur, but the rail freight share increases with the improved rail service. These increases are at the expense of air.

With the introduction of the Channel Tunnel, under both high and low infrastructure investment scenarios, a reduction in both the air freight and the ferry market shares is anticipated. This effect is more pronounced in 2001 under the C1 policy assumptions in which the Tunnel and its complementary road and rail networks are fully operational. Under these conditions, the through-rail market share greatly increases at the expense of airfreight.

5.5.3.3. Comparison of Meplan forecasts with other predictions

Forecasts of Tunnel traffic have been produced by various organizations. The main forecasts that have been made are those which have been produced by British Rail, Eurotunnel for 1988 and 1990 and SNCF. These estimates are summarized in Table 5.25 below.

Table 5.23. Predicted cross-Channel freight flows by mode for 1996 and 2001

Cross-Channel freight traffic modelled for 1996						*(1 000 per year)*
Mode Ferry	UK coastal region	1996				
		A	B	C	B1	C1
Lorries	East	1 566	1 558	1 535	1 504	1 450
Lorries	South	897	935	935	828	777
Lorries	Kent	2 099	2 092	2 133	915	897
Lorries	Tunnel	–	–	–	1 381	1 290
Lorries	Total	4 562	4 585	4 603	4 628	4 414
Wagons		80	80	80	–	–
Through-freight	Tunnel	–	–	–	83	319
Air freight (1 000 tonnes)		266	266	248	230	212

Cross-Channel freight traffic modelled for 2001						*(1 000 per year)*
Mode Ferry	UK coastal region	2001				
		A	B	C	B1	C1
Lorries	East	1 868	1 853	1 816	1 791	1 709
Lorries	South	1 081	1 125	1 119	997	916
Lorries	Kent	2 514	2 505	2 549	1 096	1 057
Lorries	Tunnel	–	–	–	1 651	1 511
Lorries	Total	5 453	5 483	5 484	5 535	5 193
Wagons		95	99	114	–	–
Through-freight	Tunnel	–	–	–	101	465
Air freight (1 000 tonnes)		310	291	291	272	233

Table 5.24. Cross-Channel freight flows and mode split by policy

Cross-Channel freight flow totals (1 000 per year)

Mode	Ferry		Tunnel			Total		
	Goods vehicles	Train freight	Goods vehicles	Train freight		Goods vehicles	Train freight	Air freight
Mode Unit	Lorries	Wagons	Lorries	Wagons		Lorries	Wagons	Tonnes
1986 1991	2 190 3 265	29 57				2 190 3 265	29 57	120 193
1996A 2001A	4 562 5 463	80 95				4 562 5 463	80 95	266 310
1996B 2001B	4 585 5 483	80 99				4 585 5 483	80 99	266 291
1996C 2001C	4 603 5 484	80 114				4 603 5 484	80 114	248 291
1996B1 2001B1	3 247 3 884	– –	1 381 1 651	83 101		4 628 5 535	83 101	230 272
1996C1 2001C1	3 124 3 682	– –	1 290 1 511	319 465		4 414 5 193	319 465	212 233

Table 5.25. Summary of annual international traffic forecasts for the Channel Tunnel

Year	Forecast	Passengers Through (million)	Passengers Shuttle (million)	Freight Through (million tonnes)	Freight Shuttle (million tonnes)
1993	BR	13.4		6.1	
	Eurotunnel (1988)	15.4	15.3	7.4	8.1
	Eurotunnel (1990)	14.0	14.6	7.2	9.0
	SNCF	16.5		7.2	
2003	BR	17.4		7.0	
	Eurotunnel (1988)	19.8	21.5	11.4	12.2
	Eurotunnel (1990)	24.7	19.9	12.2	14.6
	SNCF	21.4		10.6	
2013	BR	21.2		7.7	
	Eurotunnel (1988)	22.4		16.4	
	Eurotunnel (1990)	28.9	25.0	18.1	19.9
	SNCF	26.2		13.4	
2023	BR	25.9		8.5	
	SNCF	31.9		16.4	

Note: In all cases the figures do not allow for the likely generative effect of a high-speed link in Britain, but do include TGV operation in France, Belgium extensions and beyond at appropriate dates.
Sources: For BR, SNCF and Eurotunnel (1988): Steer Davies and Gleave (1989); Eurotunnel (1990): Eurotunnel Project Information (June 1990).

In general, the results of the studies are markedly different in both the overall level of traffic and its composition. This arises from the use of different data and assumptions to derive estimates of cross-Channel traffic and from dissimilar approaches to modelling travel behaviour.

On the passenger side, much of this variation appears due to the assumptions made regarding the generative effects of new high-speed links on the Continent. For example, the SNCF estimates, which are consistently larger than those of other organizations, are based on experience with TGV Sud-Est in which a large diversion from both air and car modes has been observed, as well as the generation of new business trips. The application of these observations to an international situation has been questioned by some critics (Steer Davies and Gleave, 1989). The BR forecasts are developed from base values with little newly generated traffic assumed. Both Eurotunnel estimates take into account traffic generation effects; the revised estimates for 1993 are lower as a result of decreases in coach traffic.

The variation in freight forecasts can partly be explained by the need to estimate traffic for a new mode of transport from a non-existent base (Vickerman and Flowerdew, 1990). In theory, because the Channel Tunnel removes the need for two intermodal transfers and will offer a higher level of service at greater speed than is currently offered by the train ferry, it should greatly enhance the competitive position of rail. However, the extent to which this will occur in practice is dependent on the adequacy of access to the Tunnel and the ability of rail to operate long hauls without changes of vehicle (Steer Davies and Gleave, 1989). The variation in forecasts reflects this uncertainty, as well as the use of different modelling techniques by the various organizations. According to Steer Davies and Gleave, the Eurotunnel forecast of 7.4 million tonnes (1988 forecast) appears to be a reasonable one. Again, BR's forecasts appear to be conservative relative to the Eurotunnel and SNCF values.

The Meplan forecasts are summarized in Table 5.26 below

Looking in more detail at the Eurotunnel forecasts, the assumptions underlying them are similar in many respects to those used in the Meplan model. In both cases the tariffs for the Tunnel were assumed to be similar in real terms to those on the competing Dover-Calais ferry service. The

Table 5.26. Summary of Meplan annual international traffic forecasts for the Channel Tunnel

Year	Policy	Passenger (million tonnes)		Freight (million tonnes)	
		Through	Shuttle	Through	Shuttle
1996	B1	10.54	13.82	1.75	13.94
	C1	10.53	14.00	6.03	13.04
2001	B1	14.33	16.58	2.12	16.68
	C1	17.10	16.51	8.80	15.26

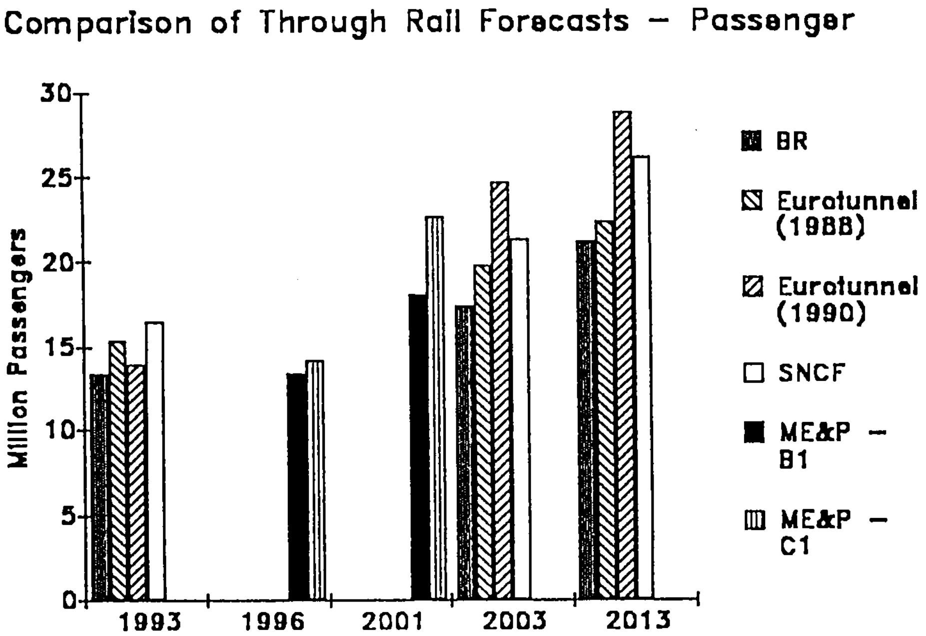
total transit times through the system for shuttle users that are assumed in the Meplan model are 66 minutes for car and 84 minutes for lorries, which are marginally higher than those used by Eurotunnel of 64 and 81 minutes respectively.

However, the modelling approaches used in the two cases differ substantially in emphasis. The Meplan model focuses particularly on the spatial aspects of the origin of the demand for cross-Channel traffic from all of the EC and on the wider implications of the Tunnel for economic development. The Eurotunnel forecasts are narrower in aims, concentrating on the numbers of users and on revenues they generate, but are based on more detailed market research on how specific segments of the freight and passenger market are likely to respond to the types of services on offer. Despite these differences in approach, the forecasts from the two models are not very different, with the annual revisions that Eurotunnel have made in their forecasts leaving their 1991-based forecasts progressively closer to those from the Meplan C1 series.

A comparison of the Meplan C1 results with the Eurotunnel (1990) estimates (and noting that the Meplan forecast years are intermediate between the Eurotunnel forecast years) indicates that the Meplan estimates of total passenger patronage are a little lower, mainly in the early years. The modal splits, however, are of a similar magnitude for all years.

The Meplan freight traffic forecasts also show some differences when compared with the other estimates. The total tonnes of freight forecast to use the Tunnel (Meplan C1 series) is comparable with the Eurotunnel (1990) estimates; however, significantly different percentages by shuttle and rail are predicted. With regard to shuttle estimates, Meplan predicts much higher values than

Figure 5.24. Comparison of Channel Tunnel through-rail forecasts for passenger and freight flows



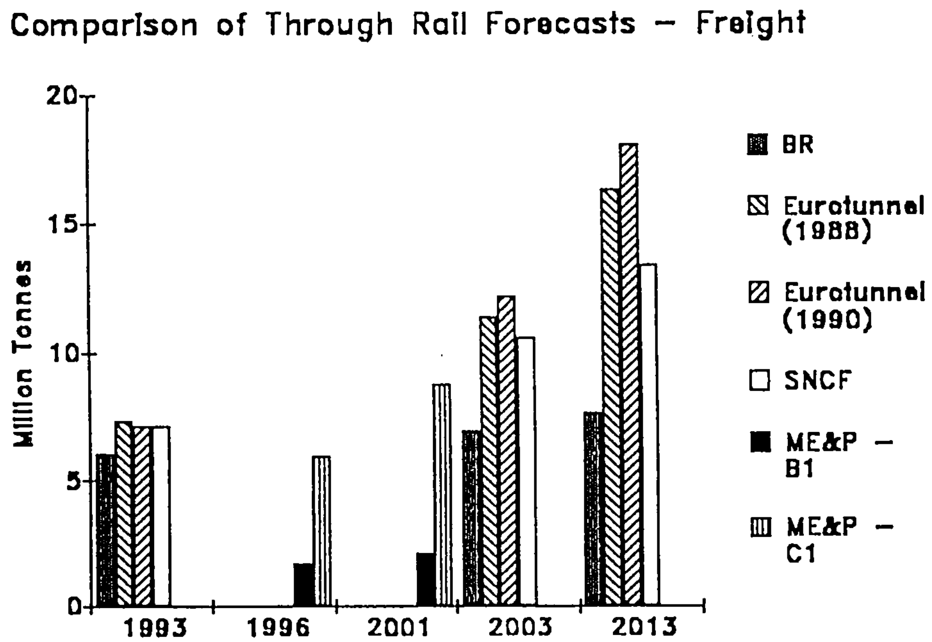
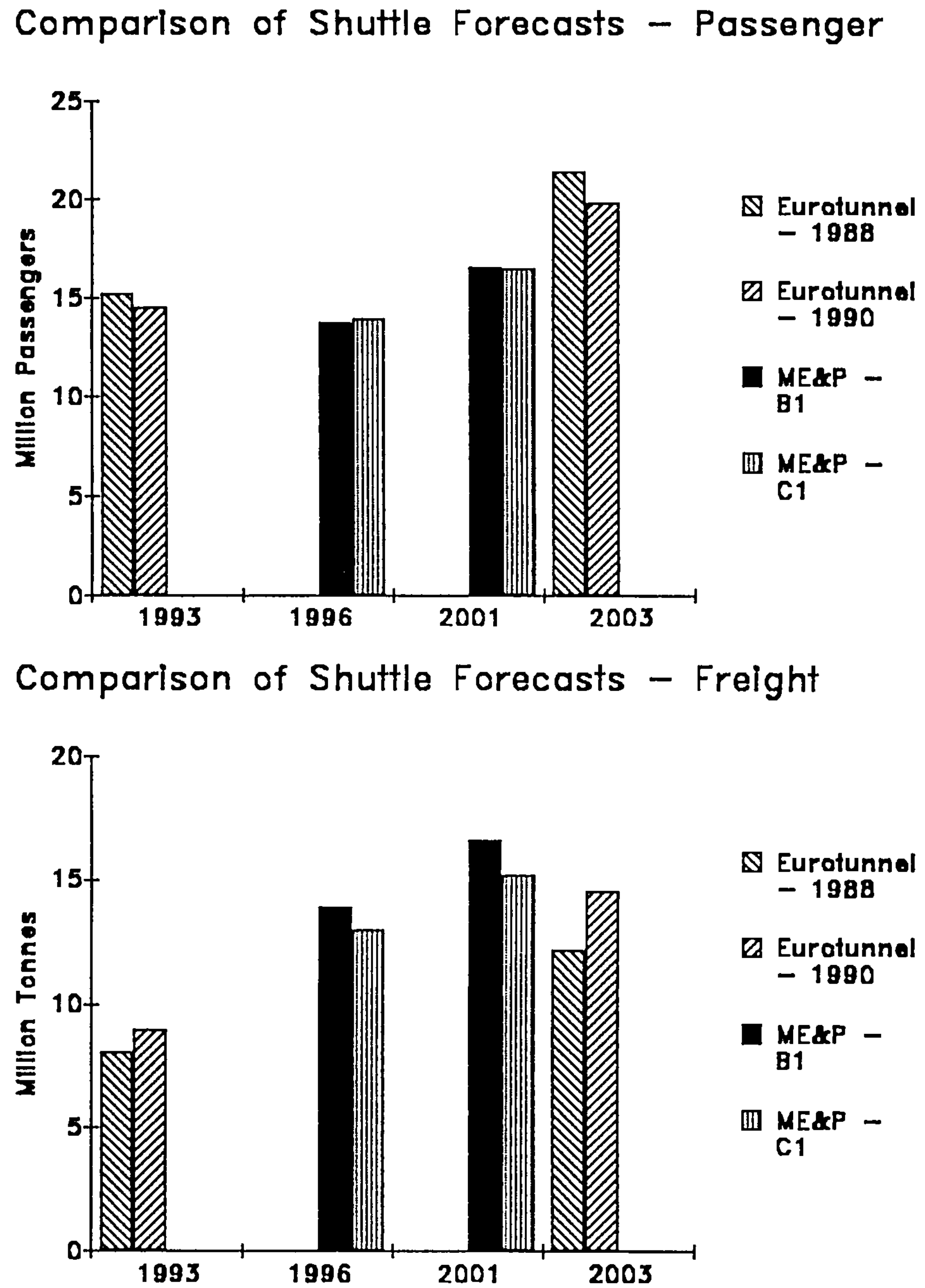


Figure 5.25. Comparison of Channel Tunnel shuttle-rail forecasts for passenger and freight flows



Eurotunnel, although the difference narrows with time. Both Meplan and Eurotunnel assume tariffs in the range of those currently charged on the short sea crossing between Dover and Calais. Similar crossing times are also assumed. The difference then, is likely a result of different assumptions with regard to 'quality of service' as perceived by the users, i.e. lorry drivers.

For example, the Meplan model does not take into account that longer duration ferry crossings may be perceived as more advantageous by lorry drivers as the ferry crossing time qualifies as time towards the required rest period. Therefore, the Meplan shuttle estimates may be somewhat inflated. The difference in the rail figures may also be contributed to quality of service assumptions. Certainly, for the low-investment assumptions, with an incomplete through-freight service, much reduced levels of traffic are predicted by Meplan. Under the 2001 high-investment assumptions of a fully operative through-freight service, the estimates exceed those produced by BR but are less than the estimates made by SNCF.

5.5.4. Analysis of regional economic effects

This subsection describes the changes in economic activity predicted by the model as a result of the transport policies investigated in this study. Regional economic effects are measured through changes in 'value-added' (factor 44) which comprises the sum of payments on taxation, labour and profits, that is all payments apart from intermediate consumption of goods and services that are input to the sector.

Subsection 5.5.4.1. discusses changes in value-added throughout the EC as different transport policies are introduced. The following subsection contains a detailed analysis of the economic effects of the Channel Tunnel for different economic sectors and different regions in the EC. The last subsection describes the economic effects on each of the special study areas.

5.5.4.1. Changes in value-added — General overview

Figures 5.26 to 5.29 illustrate the changes in value-added for 1996 for the following transport policy options: B, C, B1 and C1. The gains and losses in value-added from these transport policies are small, ranging from – 1.0% to – 0.3%, but do reflect changes in accessibility.

As expected, comparing the 1996 B policy with the base case shows that Brittany, Normandy and south-west France experience the largest value-added gains as a result of the substantial roadway infrastructure investment in these zones. Piemonte also shows significant gains, again as a result of roadway infrastructure investment (Turin-Aostavalley-Montpellier motorway). With the addition of the Ostend-Rotterdam motorway in the 1996 C policy, there is a significant value-added gain in Zeeland and West-Vlaanderen also gains in this policy option.

The regional effects of the B1 Channel Tunnel option are shown in Figure 5.28. In general, the economic effects due to the Tunnel are not as pronounced as those obtained from the mostly road and rail infrastructure changes in the 1996 B and C policies. Given that the value-added changes are small, the predicted pattern of regional economic development is certainly a reasonable one with those regions nearest the Tunnel (London, Kent, Nord-Pas-de-Calais, West-Vlaanderen and Île de France) gaining the most, and gains decreasing as distance from the Tunnel increases. From Figure 5.29 it is observed that those zones along the Dover-Calais crossing axis (the Blue Banana region) benefit the most in value-added terms. This is a sensible result as the Channel Tunnel will benefit a larger proportion of trade, both passengers and freight, from these zones simply because a larger proportion of trade from these zones crosses the Channel in the Dover/Calais region.

The zones on the periphery of the study area suffer the greatest loss in value-added terms: specifically, Denmark, Pais Vasco and the rest of Spain, Norte and the rest of Portugal and Greece. Losses in Normandy and north Italy can be explained as balancing the large gains in neighbouring zones.

With the improved Channel Tunnel rail service in the C1 policy, continental countries in the Blue Banana region tend to gain at the expense of the UK.

The 2001 Channel Tunnel policy results show much the same effect as for 1996 except that in 2001 the effects are more pronounced. These differences are particularly magnified for the policies of high investment C and C1, where strong producing zones such as south-east France, Piemonte and mid-Germany tend to increase their gains through the benefits of improved rail

Figure 5.26. 1996 percentage change in value-added (B-A)

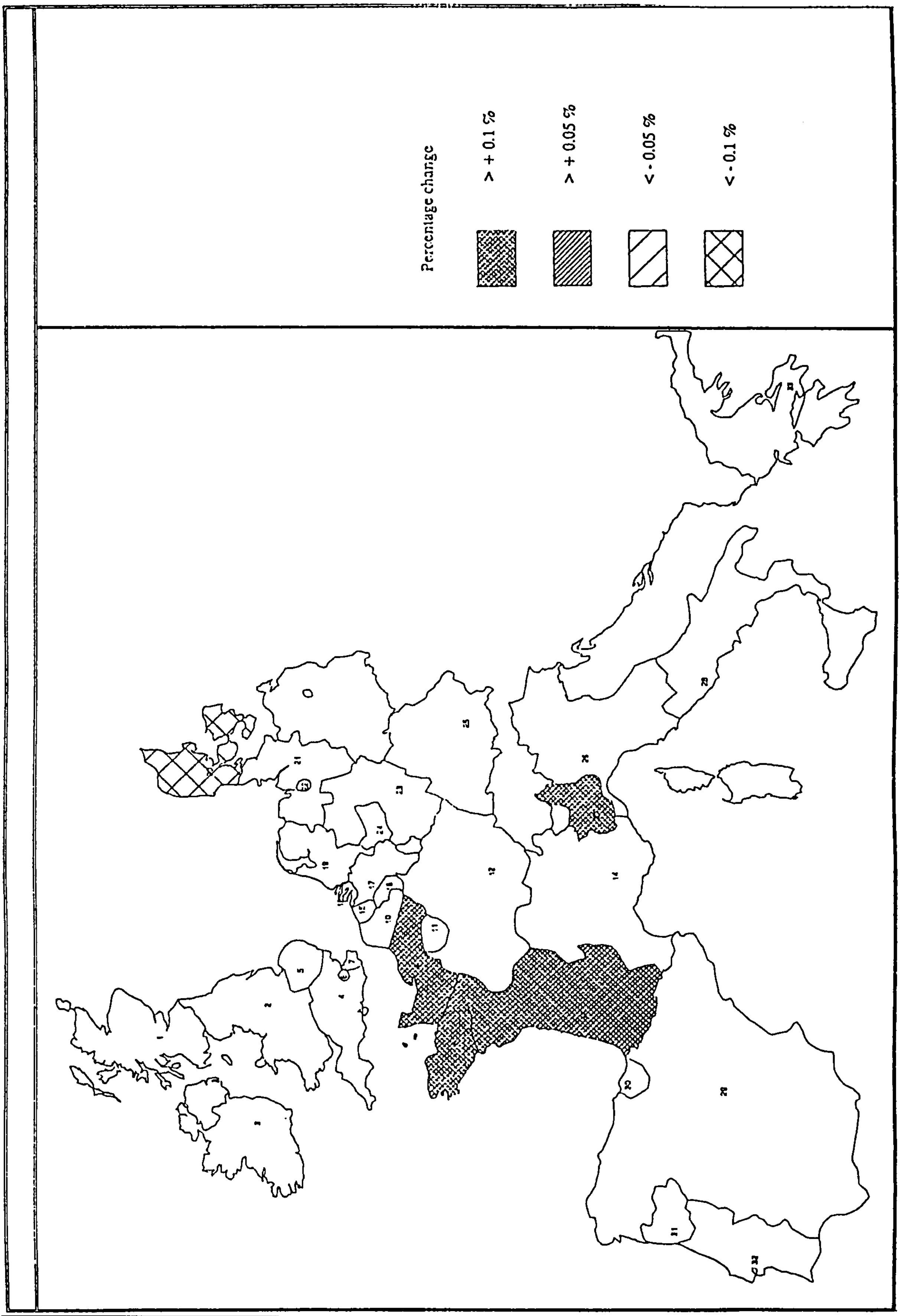


Figure 5.27. 1996 percentage change in value-added (C-A)

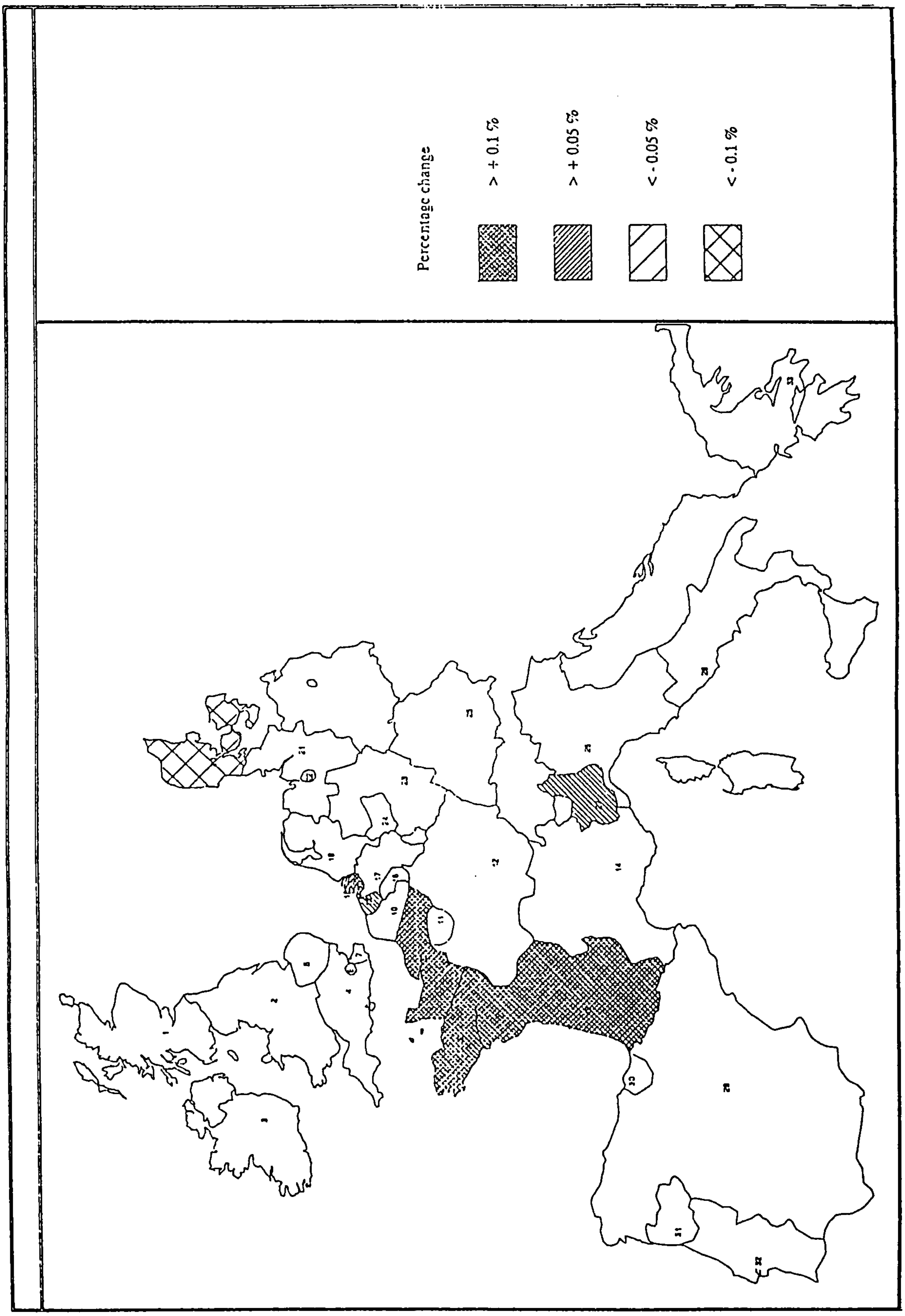


Figure 5.28. 1996 percentage change in value-added (B1-B)

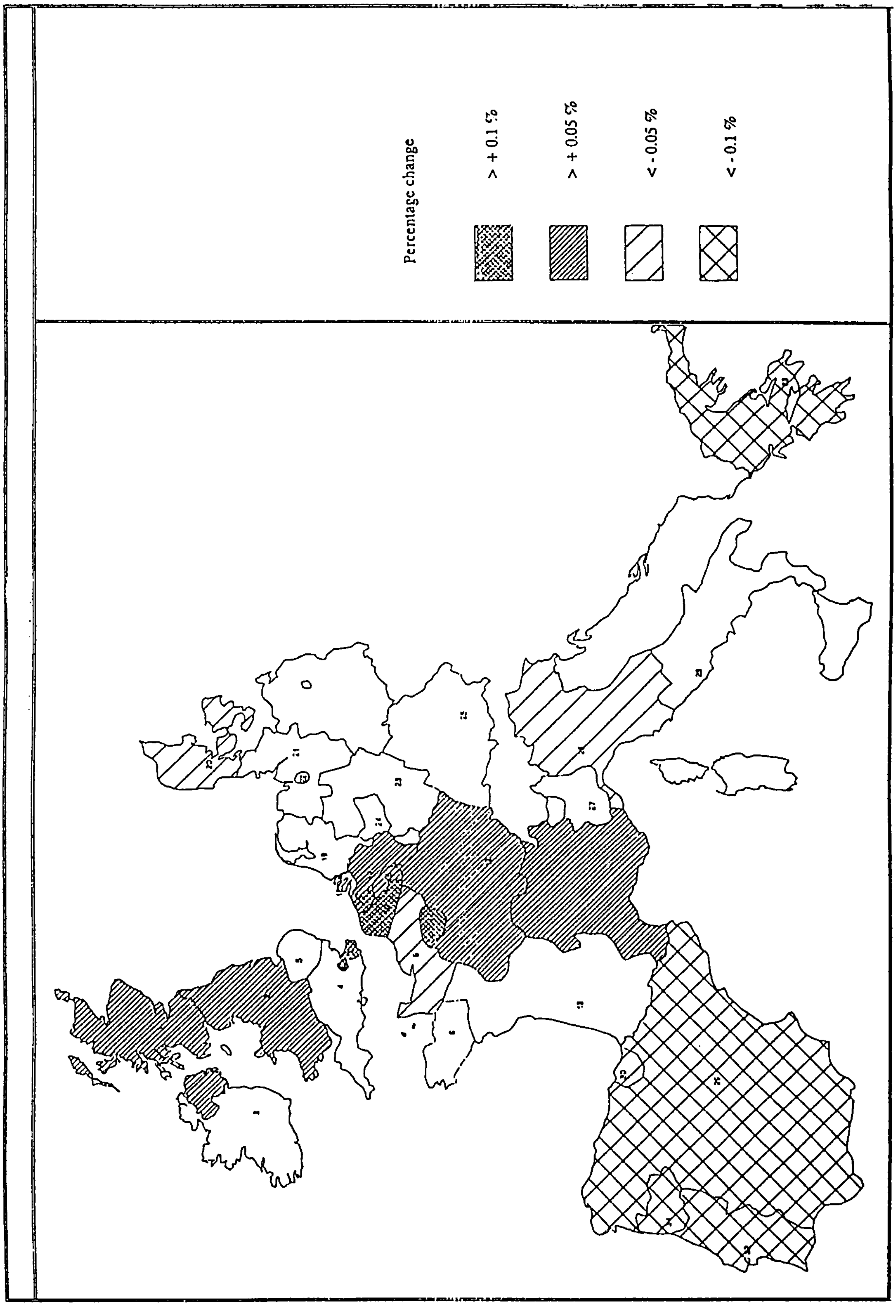


Figure 5.29. 1996 percentage change in value-added (C1-C)

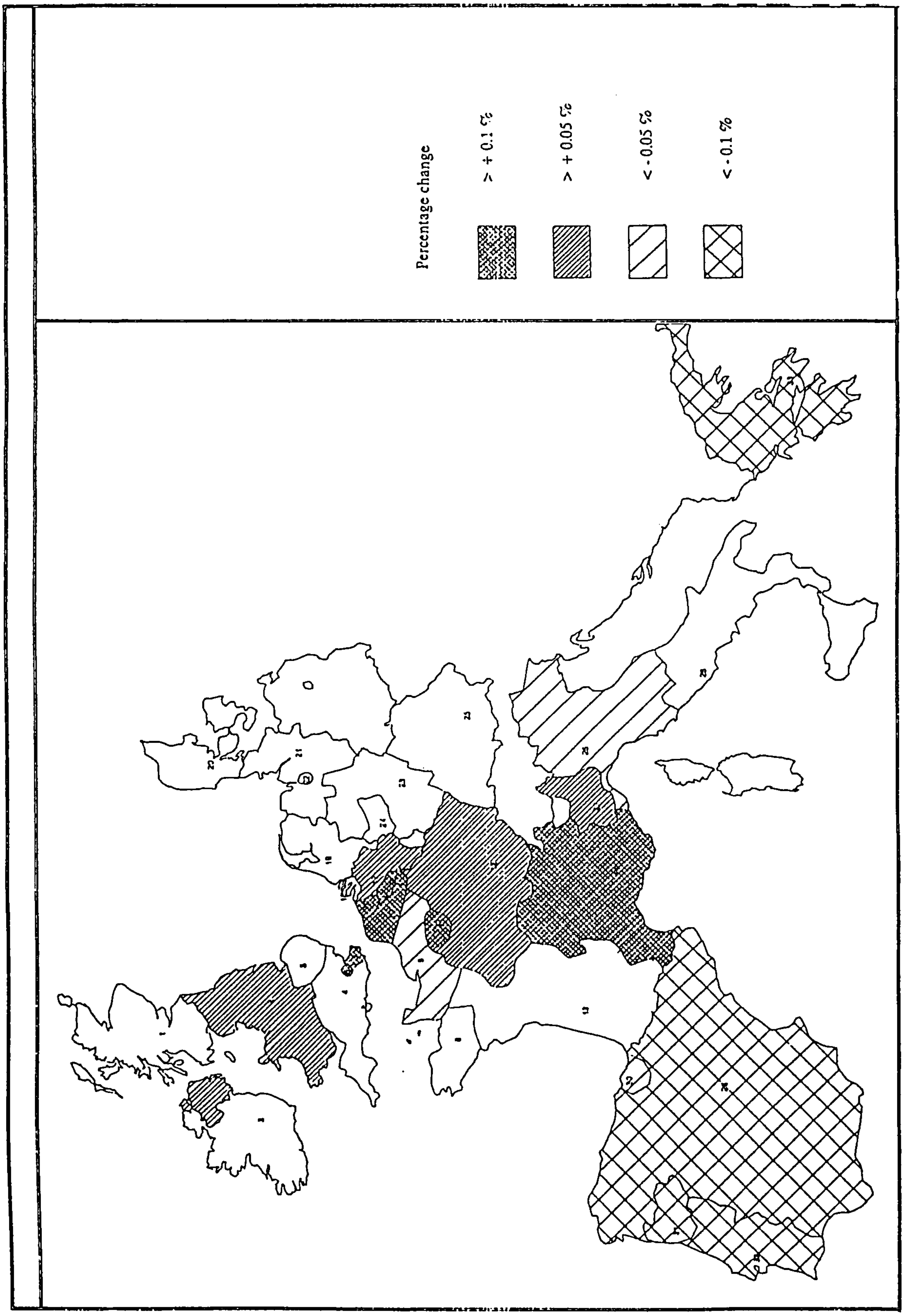
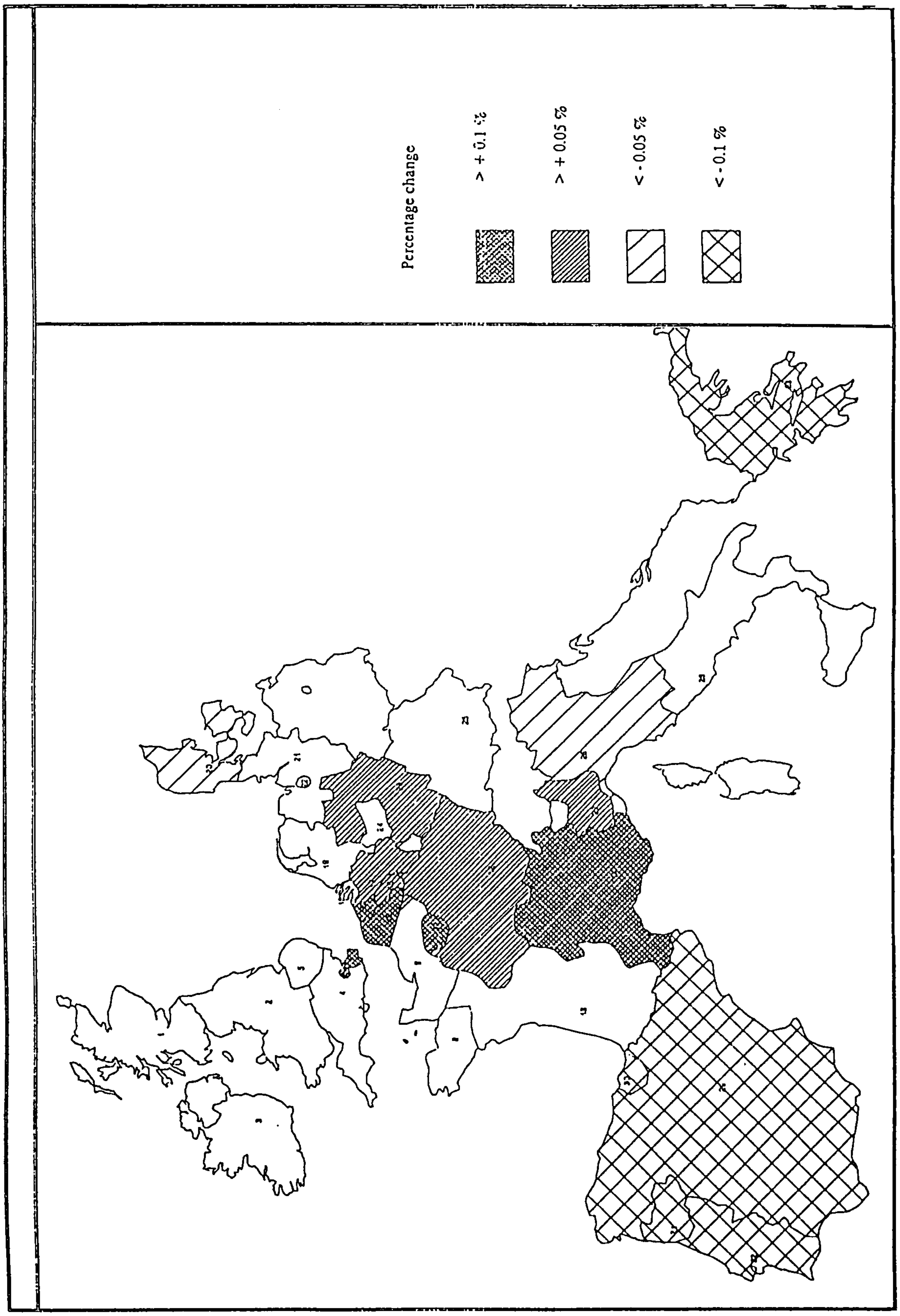


Figure 5.30. 2001 percentage change in value-added (C1-C)



connection while the British Midlands and Scotland lose (see Figure 5.30).

5.5.4.2. Economic effects of the Channel Tunnel on the EC regions

The results in the previous subsection represent the combined effects of all the different forces for change that will arise from the introduction of the Channel Tunnel. In this subsection these effects are separated into their components in order to show their nature and magnitude for the different regions of the EC.

For this analysis the value-added changes have been grouped into three broad categories:

(1) Influences on production industries — caused mainly by changes in the costs and characteristics of the transport of freight.

(2) Influences on business and financial services — caused mainly by changes in the costs and characteristics of business travel.

(3) Influences on tourist industries — caused mainly by changes in the costs and characteristics of cross-Channel leisure passenger travel.

Tables 5.27 to 5.34 show the change in value-added as a result of production in each of the above categories for a specified transport policy comparison. This is estimated for the aggregate of all the producers in an economic sector in a region. The unit of measurement in the column 'Base' gives the magnitude of the value-added under policy A (which implies no new investment in infrastructure). It is measured in units of 1980 millions of ecus. The remaining columns contain the absolute deviations, again measured in million ecus, associated with each specified policy comparison. The use of absolute deviations allows the results for different tables to be added together to see how gains and losses may cancel out for a region.

The commentary below refers to the results for both 1996 and 2001. Only where the pattern of results differs significantly between the two are they analysed separately.

Production industries

Three broad generalizations can be identified for changes in production industries with the implementation of the Channel Tunnel.

Most importantly, the impact is quite limited. This is not surprising given that for lorries the Tunnel offers a minor rather than a major improvement in service. It gives a variation on the existing ferry service, with a faster through-time and frequency, but with disadvantages for drivers needing an official rest break. For rail, if past experience on other routes is relevant, many shippers will find it inconvenient to use, for reasons of security and flexibility, terminal connections at each end etc., so that the benefits are likely to be limited when averaged over the whole community of producers in a region, both rail and non-rail users.

Secondly, although there are variations in the spatial pattern of gains and losses between different production sectors, the pattern is similar for groups of related economic sectors. Gains tend to be highest in zones closest to the Tunnel. The main losers tend to be in the southern EC regions but these are also influenced by changes in the patterns of tourism, as discussed below.

The model as currently implemented assumes that production technologies in each economic sector stay constant through time and through space. This assumption could be relaxed and made more realistic with better data inputs and further resources for the model calibration. As it currently stands, the model focuses mainly on how access changes the costs of inputs and the marketability of outputs from production. Independent changes through time in production technologies which might simplify or dampen the benefits derived from the Tunnel are not currently measured in the results.

Thirdly, production sectors which are strong within a country and export significantly to their EC partners gain from the Tunnel through improved access to their markets. On the other hand, sectors in which a country is a net importer tend to lose from the Tunnel, and from the associated improved rail service where it allows improved access for the main countries that export to it.

Having reviewed the effects on producers as a whole from the improvements that will be offered by transport infrastructure developments, it is worth narrowing the focus to some groups of sectors to differentiate the effects on them in specific regions.

For the group of sectors associated with engineering industries (instruments, electrical, machinery), the main beneficiaries are the UK, Ireland, France (except the west), the Benelux countries and north and mid-Germany. In the improved rail policy C1, especially by 2001, strong producing zones such as south-east France, Piemonte and mid-Germany increase their gains through the benefits of this improved rail connection while the British Midlands and Scotland lose.

In the case of vehicle and transport equipment production, the UK is a small net loser. These are industries which have been declining in competitiveness for years and the UK is now a substantial net importer. The small gains are concentrated in mainland Europe, particularly France.

For the primary agricultural sectors, meat and dairy products, the main gainers are the traditionally strong countries in these sectors, namely Ireland, France, the Benelux countries and Denmark. Germany has marginal gains and the UK and southern Europe lose.

In the case of food processing, beverages and tobacco, the UK (including the Midlands and Scotland) are gainers along with, to a lesser extent, Ireland, France and the Netherlands. Germany has small losses, with larger losses being recorded in Denmark and in southern Europe.

The remaining mixture of industries in aggregate show gains for France, the Benelux countries, Ireland and Germany with losses in the British Midlands and Scotland and in southern Europe. These general losses hide some gains in specific industries such as leather in northern Italy which is a major exporter to the UK market.

Bringing these results together for the different industries suggests that southern England, Ireland, France and the Benelux countries are either gainers or about neutral for most sectors. Germany on balance gains, and Denmark, northern Italy and Piemonte have mixed gains and losses. The Iberian peninsula, southern Italy and Greece all lose consistently in the production industries.

This suggests that the Tunnel acts to reinforce the existing strength of industry in the Blue Banana area. In this area freight transport is made more efficient between its regions, and the stronger regions in any specific sector tend to be the gainers from this. On the other hand, for the southern European zones their trade to the UK is proportionately less and it is more likely to be by container ship, so that the benefits of the Channel Tunnel to them are small relative to the benefits to the more adjacent countries.

Business and financial services

These are defined so as not to include services related to lodgings and catering, since these are included in the tourism effects. The services effects comprise the effects of office-related services, mainly in the financial and business services sectors.

Gains in value-added here represent an increase in the size of the sector in the region. These gains come about partly through savings in the costs of physical inputs to these industries, but these will be quite small in practice. The main gains are derived from reductions in the average costs of overseas business trips. These cost reductions include both the direct tariff reductions (which may often be small) and the savings in travel time and improvement in travel conditions that will arise, especially with the implementation of high-speed rail.

The general effect of the Tunnel in absolute terms is to concentrate business and financial services development in the existing strong triangle of London, Paris and Brussels, with gains also to the British Midlands, the centre and east of France, and to mid-Germany. In relative terms, the small zones near the Tunnel such as Kent, Nord-Pas-de-Calais, West-Vlaanderen and Hainaut also gain significantly. In the model it has been assumed that two of these small zones will have direct access to the high-speed rail networks. This will be true from the start for Nord-Pas-de-Calais. For Kent the Ashford station is unlikely in practice to open until some time after the Tunnel and is still subject to some political uncertainty. For Hainaut current plans do not envisage direct access to the high-speed rail network so that in the model passengers from Hainaut or West-Vlaanderen need to travel outside their regions to get to Brussels, Lille or Calais to access the high-speed rail system. The losers are the regions in northern, southern and south-western Europe including Ireland. The developments to the high-speed rail system by the year 2001 improve the situation for zones such as southern Germany and Piemonte.

Again it is a picture of the major players gaining and the more peripheral regions losing as the areas which gain in efficiency increase market share.

Tourism

Tourism affects the production of lodgings and catering and in this study only the cross-Channel component is considered. Some of the changes in passenger trips are the direct result of the redistribution of existing cross-Channel trips. Other modelled trip changes come about partly from the diversion of non-Channel passenger trips (which are not initially modelled in this study) and partly from increases in trip generation rates as travel becomes easier.

The most significant increases in value-added as a result of increased tourism are seen in the UK, France, Belgium, the Netherlands and Germany. Tourism losses are predicted for Spain, Portugal and Greece. This is a sensible result as the Channel Tunnel and the associated road and rail investments tend to improve accessibility for touring holidays but do nothing for the air routes between the UK and southern Europe.

Table 5.27. 1996 industrial and food production: Change in value-added

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	10 900.	+ 4.40	+ 3.70	+ 6.20	+ 2.50
2 Midlands, North England	69 600.	+ 10.30	+ 7.00	+ 26.60	+ 15.70
3 Ireland	4 370.	+ 0.20	+ 0.60	+ 6.50	+ 7.40
4 South England	26 300.	+ 1.00	+ 1.00	+ 18.80	+ 14.70
5 East Anglia	5 590.	+ 2.40	+ 2.50	+ 4.70	+ 3.50
6 London	14 400.	− 2.10	− 1.40	+ 13.00	+ 14.80
7 Kent	2 910.	+ 0.20	+ 0.50	+ 3.20	+ 5.90
8 Brittany	6 760.	+ 84.20	+ 84.30	+ 2.10	+ 0.90
9 Normandy	13 500.	+ 53.90	+ 56.50	+ 3.60	+ 0.30
10 Nord-Pas-de-Calais	7 780.	− 3.80	− 4.70	+ 6.10	+ 9.10
11 Île-de-France	22 000.	− 44.60	− 46.90	+ 8.60	+ 10.10
12 Mid-France	26 400.	+ 12.10	+ 9.50	+ 7.90	+ 9.10
13 South-west France	25 200.	+ 140.00	+ 138.00	+ 4.40	+ 3.70
14 South-east France	25 500.	− 29.60	− 31.90	+ 5.60	+ 20.70
15 West-Vlaanderen	3 020.	+ 2.30	+ 4.30	+ 2.90	+ 3.60
16 Hainaut	1 960.	+ 0.10	+ 0.40	+ 1.30	+ 2.20
17 Rest of Belgium	19 900.	− 4.70	+ 1.70	+ 11.70	+ 21.70
18 Zeeland	1 000.	− 1.20	+ 28.50	+ 0.20	+ 0.70
19 Rest of Netherlands	35 500.	− 42.90	− 39.60	+ 15.60	+ 19.80
20 Denmark	14 200.	− 20.30	− 19.80	+ 3.50	+ 6.70
21 North Germany	34 900.	− 3.90	− 4.40	+ 2.60	+ 0.80
22 Bremen	2 140.	− 1.40	− 1.50	+ 0.10	− 0.20
23 Mid-Germany	66 900.	− 69.20	− 69.20	+ 4.20	+ 5.60
24 Cologne	11 200.	− 12.60	− 11.90	+ 1.40	+ 3.10
25 South Germany	86 600.	− 16.60	− 20.40	− 5.09	− 5.50
26 North Italy	69 800.	+ 33.10	+ 28.50	− 6.50	− 3.90
27 Piemonte	12 200.	+ 15.20	+ 14.40	− 1.30	+ 8.90
28 South Italy	30 000.	− 24.90	− 26.40	− 3.90	− 5.40
29 Rest of Spain	48 200.	− 39.40	− 42.40	− 39.80	− 41.90
30 Pais Vasco	4 590.	+ 4.70	+ 4.30	− 3.20	− 3.60
31 Norte	3 410.	+ 1.70	+ 1.40	− 2.80	− 2.90
32 Rest of Portugal	4 450.	− 2.20	− 2.50	− 5.10	− 5.30
33 Greece	8 630.	+ 6.80	+ 6.50	− 6.40	− 7.70
Study area	716 000.	+ 53.81	+ 70.81	+ 86.50	115.00

Table 5.28. **1996 repair, retail, communication, lodging, catering, transport services, business, finance, market services, non-market services change in value-added**

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	22 800.	+ 0.40	+ 0.40	+ 14.80	+ 15.00
2 Midlands, North England	121 000.	+ 2.20	+ 2.50	+ 164.00	+ 160.00
3 Ireland	10 300.	− 0.10	− 0.10	− 1.90	− 1.70
4 South England	61 400.	− 0.90	− 0.80	+ 18.20	+ 18.10
5 East Anglia	8 470.	0.00	+ 0.10	+ 1.00	+ 0.80
6 London	63 300.	− 2.80	− 2.60	+ 143.00	+ 147.00
7 Kent	5 840.	0.00	0.00	+ 6.30	+ 6.20
8 Brittany	14 100.	+ 0.80	+ 0.80	− 12.30	− 12.00
9 Normandy	23 200.	+ 0.70	+ 0.80	− 38.60	− 38.30
10 Nord-Pas-de-Calais	17 700.	+ 0.40	+ 0.60	+ 34.70	+ 35.10
11 Île-de-France	83 700.	+ 2.20	+ 2.50	+ 182.00	+ 184.00
12 Mid-France	46 600.	+ 0.60	+ 0.60	+ 62.40	+ 63.10
13 South-west France	46 700.	+ 1.60	+ 1.60	+ 1.40	+ 2.20
14 South-east France	79 000.	+ 2.70	+ 2.91	+ 90.20	+ 93.40
15 West-Vlaanderen	4 350.	− 0.10	− 0.10	+ 5.70	+ 5.70
16 Hainaut	4 560.	0.00	0.00	+ 4.40	+ 4.50
17 Rest of Belgium	35 600.	− 0.40	− 0.30	+ 30.00	+ 30.60
18 Zeeland	1 810.	− 0.10	+ 0.20	+ 0.60	+ 0.60
19 Rest of Netherlands	72 500.	− 1.10	− 0.20	− 7.80	− 7.40
20 Denmark	34 900.	+ 0.40	+ 0.40	− 33.60	− 33.10
21 North Germany	92 400.	− 3.10	− 3.00	− 59.40	− 60.50
22 Bremen	5 210.	− 0.10	− 0.10	+ 0.50	+ 0.40
23 Mid-Germany	120 000.	− 3.50	− 3.30	+ 88.10	+ 94.10
24 Cologne	30 300.	− 1.40	− 1.30	+ 10.30	+ 10.70
25 South Germany	121 000.	− 3.09	− 2.90	− 83.91	− 98.50
26 North Italy	106 000.	+ 8.80	+ 9.10	− 140.00	−140.00
27 Piemonte	15 800.	+ 0.50	+ 0.50	+ 3.00	+ 3.40
28 South Italy	75 200.	+ 0.40	+ 0.60	−28.50	− 28.00
29 Rest of Spain	98 100.	+ 1.90	+ 2.10	− 330.00	− 330.00
30 Pais Vasco	4 840.	0.00	0.00	− 5.80	− 5.70
31 Norte	3 380.	+ 0.10	+ 0.10	− 6.90	− 6.80
32 Rest of Portugal	8 160.	0.00	0.00	− 7.10	− 6.90
33 Greece	26 300.	+ 1.80	+ 1.80	− 55.40	− 54.50
Study area	1 460 000.	0.00	0.00	100.00	100.00

Table 5.29. 1996 tourism: Change in value-added

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	1 202.	+ 1.00	+ 1.10	+ 0.49	+ 0.50
2 Midlands, North England	6 511.	+ 0.10	− 0.20	+ 3.30	+ 3.30
3 Ireland	344.	− 0.02	− 0.15	− 0.74	− 0.75
4 South England	3 424.	+ 1.30	+ 1.20	+ 5.00	+ 5.10
5 East Anglia	483.	− 0.02	− 0.03	+ 0.58	+ 0.59
6 London	2 034.	+ 5.10	+ 6.20	+ 23.50	+ 23.50
7 Kent	327.	+ 0.35	+ 0.39	+ 1.32	+ 1.32
8 Brittany	589.	+ 5.85	+ 5.72	+ 6.06	+ 6.02
9 Normandy	954.	+ 5.81	+ 5.68	+ 0.98	+ 0.94
10 Nord-Pas-de-Calais	752.	+ 2.01	+ 1.96	+ 12.00	+ 12.00
11 Île-de-France	2 753.	− 0.30	− 0.60	+ 17.50	+ 17.50
12 Mid-France	2 038.	− 0.04	− 0.08	+ 3.27	+ 3.25
13 South-west France	2 134.	+ 0.68	+ 0.43	+ 8.20	+ 8.15
14 South-east France	2 880.	− 0.50	− 0.80	+ 13.40	+ 13.30
15 West-Vlaanderen	220.	+ 1.41	+ 1.28	+ 9.90	+ 9.90
16 Hainaut	207.	+ 0.14	+ 0.13	+ 0.95	+ 0.95
17 Rest of Belgium	1 645.	+ 3.55	+ 3.67	+ 7.64	+ 7.65
18 Zeeland	46.	+ 0.31	+ 0.76	+ 0.11	+ 0.13
19 Rest of Netherlands	1 949.	+ 2.60	+ 3.07	+ 5.02	+ 5.15
20 Denmark	696.	− 0.61	− 0.61	+ 0.33	+ 0.36
21 North Germany	2 343.	+ 0.64	+ 0.75	+ 1.72	+ 1.72
22 Bremen	165.	+ 0.08	+ 0.09	+ 0.14	+ 0.14
23 Mid-Germany	3 768.	+ 4.52	+ 4.99	+ 7.81	+ 7.85
24 Cologne	517.	+ 1.35	+ 1.46	+ 2.48	+ 2.49
25 South Germany	3 444.	+ 0.32	+ 0.54	+ 1.89	+ 1.92
26 North Italy	4 388.	− 1.62	− 0.94	+ 2.87	+ 3.19
27 Piemonte	627.	− 0.16	− 0.18	+ 1.05	+ 1.04
28 South Italy	3 267.	− 1.45	− 1.11	− 1.28	− 1.02
29 Rest of Spain	8 449.	− 10.70	− 11.60	− 43.10	− 43.40
30 Pais Vasco	456.	− 0.47	− 0.55	− 1.45	− 1.45
31 Norte	224.	− 1.20	− 1.28	− 4.65	− 4.70
32 Rest of Portugal	543.	− 2.50	− 2.70	− 9.30	− 9.30
33 Greece	1 510.	− 5.00	− 5.20	− 19.00	− 18.90
Study area	60 889.	+ 12.50	+ 13.40	+ 58.10	+ 58.50

Table 5.30. 1996 value-added, primary resource cost: Production

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	41 300.	– 12.20	– 12.90	+ 22.00	+ 18.00
2 Midlands, North England	239 000.	– 42.20	– 45.80	199.00	174.00
3 Ireland	16.500.	+ 0.30	+ 0.60	+ 4.90	+ 5.60
4 South England	100 000.	– 4.10	– 3.80	+ 43.30	+ 38.20
5 East Anglia	16 500.	+ 0.40	+ 0.40	+ 6.40	+ 4.70
6 London	88 100.	– 6.80	– 4.60	182.00	187.00
7 Kent	10 900.	– 2.50	– 2.10	+ 10.90	+ 13.60
8 Brittany	23 700.	+ 96.00	+ 95.90	– 4.30	– 5.30
9 Normandy	43 200.	+ 66.60	+ 69.20	– 34.00	– 37.20
10 Nord-Pas-de-Calais	32 500.	– 0.70	– 1.60	+ 54.90	+ 59.00
11 Île-de-France	121 000.	– 40.50	– 42.80	212.00	216.00
12 Mid-France	88 800.	+ 12.91	+ 10.30	+ 75.80	+ 78.10
13 South-west France	85 200.	153.00	150E00	+ 14.59	+ 14.50
14 South-east France	122 000.	– 28.60	– 31.40	111.00	131.00
15 West-Vlaanderen	8 630.	+ 3.70	+ 5.90	+ 18.60	+ 19.50
16 Hainaut	8 450.	– 0.40	+ 0.10	+ 7.10	+ 8.50
17 Rest of Belgium	68 300.	– 4.40	+ 3.20	+ 51.80	+ 64.09
18 Zeeland	3 520.	– 1.20	+ 30.70	+ 1.10	+ 1.50
19 Rest of Netherlands	128 000.	– 43.30	– 37.30	+ 14.30	+ 18.80
20 Denmark	59 600.	– 73.00	– 72.30	– 30.30	– 26.80
21 North Germany	143 000.	– 9.50	– 9.59	– 55.00	– 58.00
22 Bremen	8 290.	– 1.70	– 1.70	+ 0.80	+ 0.40
23 Mid-Germany	228 000.	– 100.0	– 10E01	102.00	111.00
24 Cologne	47 400.	– 16.20	– 15.10	+ 14.60	+ 17.00
25 South Germany	234 000.	– 3.70	– 7.09	– 87.89	– 100.00
26 North Italy	203 000.	100.00	+ 96.00	– 150.00	– 140.00
27 Piemonte	37 500.	+ 38.50	+ 37.30	+3.50	+ 23.70
28 South Italy	126 000.	– 11.90	– 13.00	– 34.30	– 34.50
29 Rest of Spain	177 000.	– 34.91	– 38.81	– 430.00	– 430.00
30 Pais Vasco	11 800.	+ 4.70	+ 4.30	– 10.80	– 11.40
31 Norte	8 300.	+ 1.90	+ 1.50	– 14.90	– 14.90
32 Rest of Portugal	15 600.	– 2.10	– 2.70	– 22.30	– 22.30
33 Greece	40 100.	+ 10.70	+ 10.20	– 82.40	– 82.00
Study area	2 590 000.	0.00	100.00	200.00	200.00

Table 5.31. 2001 industrial and food production: Change in value-added

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	12 100.	+ 6.10	− 6.20	+ 5.80	+ 1.10
2 Midlands, North England	72 500.	+ 10.20	−13.40	+ 23.70	+ 8.90
3 Ireland	4 660.	+ 0.30	−11.70	+ 6.80	+ 7.80
4 South England	28 900.	+ 0.20	+ 31.40	+ 18.40	+ 13.30
5 East Anglia	6 180.	+ 2.70	+ 5.30	+ 4.80	+ 3.40
6 London	15 800.	− 3.20	+ 20.20	+ 12.90	+ 15.00
7 Kent	3 200.	+ 0.40	180.00	+ 3.20	+ 5.30
8 Brittany	7 290.	+ 91.90	+ 89.90	+ 2.90	+ 2.10
9 Normandy	14 500.	+ 58.30	+ 56.50	+ 4.50	+ 0.70
10 Nord-Pas-de-Calais	8 340.	− 3.90	+ 3.90	+ 7.20	+ 11.50
11 Île-de-France	23 500.	− 48.40	− 52.00	+ 10.30	+ 12.80
12 Mid-France	28 400.	+ 14.60	+ 9.20	+ 10.30	+ 12.70
13 South-west France	27 200.	152E00	148.00	+ 7.10	+ 7.40
14 South-east France	27 500.	− 30.10	− 33.90	+ 7.80	+ 29.00
15 West-Vlaanderen	3 190.	+ 2.90	+ 6.00	+ 3.30	+ 4.50
16 Hainaut	2 070.	+ 0.10	+ 0.30	+ 1.60	+ 3.00
17 Rest of Belgium	21 000.	− 3.90	+ 3.90	+ 14.40	+ 28.80
18 Zeeland	1 060.	− 1.40	+ 34.20	+ 0.30	+ 0.80
19 Rest of Netherlands	37 600.	− 48.00	− 53.20	+ 19.60	+ 27.30
20 Denmark	15 200.	− 15.50	− 19.90	+ 4.20	+ 9.50
21 North Germany	36 900.	− 4.40	− 15.70	+ 4.00	+ 2.50
22 Bremen	2 270.	− 1.40	− 2.10	+ 0.10	− 0.10
23 Mid-Germany	70 700.	− 70.90	− 89.10	+ 6.70	+ 12.00
24 Cologne	11 900.	− 12.50	− 14.60	+ 1.80	+ 4.60
25 South Germany	91 500.	− 15.70	− 45.10	− 1.90	+ 1.10
26 North Italy	75 200.	+ 31.50	+ 10.90	− 6.30	− 0.20
27 Piemonte	13 100.	+ 15.30	+ 12.90	− 1.10	+ 13.30
28 South Italy	32 500.	− 29.50	− 37.00	− 4.00	− 5.50
29 Rest of Spain	52 500.	− 54.10	− 81.70	− 48.50	− 57.10
30 Pais Vasco	4 960.	+ 4.20	+ 2.30	− 3.60	− 4.30
31 Norte	3 650.	+ 1.90	+ 0.30	− 3.80	− 4.70
32 Rest of Portugal	4 770.	− 3.40	− 6.60	− 7.20	− 8.30
33 Greece	9 010.	+ 4.20	− 0.90	− 8.90	− 10.90
Study area	770 000.	+50.50	132.00	+96.81	147.00

Table 5.32. 2001 repair, retail, communication, lodging, catering, transport services, business, finance, market services, non-market services: Change in value-added

(1980 million ecu)

Zone	Base	B-A	C-A	B1-B	C1-C	!
1 Scotland	24 700.	+ 0.80	+ 1.20	+ 20.10	+ 18.50	
2 Midlands, North England	131 000.	- 6.20	- 3.11	162E00	123.00	
3 Ireland	11 200.	- 0.10	+ 0.20	- 1.70	- 2.20	
4 South England	66 600.	- 0.70	+ 1.50	+ 17.50	+ 14.09	
5 East Anglia	9 170.	- 0.20	+ 0.10	+ 0.30	- 0.40	
6 London	68 500.	- 6.30	- 4.00	147E00	115.00	
7 Kent	6 330.	0.00	+ 1.90	+ 5.80	+ 5.10	
8 Brittany	15 300.	+ 0.90	+ 1.20	- 17.20	- 21.20	
9 Normandy	25 100.	+ 0.30	+ 0.70	- 39.30	- 6.10	
10 Nord-Pas-de-Calais	19 200.	- 0.10	+ 0.10	+ 36.70	+ 25.40	
11 Île-de-France	90 600.	+ 4.70	+ 6.30	172E00	143.00	
12 Mid-France	50 500.	+ 0.10	+ 0.70	+ 64.90	+ 64.30	
13 South-west France	50 600.	+ 2.00	+ 2.60	+ 12.10	+ 9.60	
14 South-east France	85 500.	- 0.70	+ 0.80	101E00	+ 77.20	
15 West-Vlaanderen	4 720.	- 0.10	0.00	+ 5.60	+ 4.10	
16 Hainaut	4 950.	0.00	+ 0.10	+ 4.50	+ 2.90	
17 Rest of Belgium	38 600.	- 0.90	- 0.40	+ 29.90	+ 19.50	
18 Zeeland	1 960.	0.00	+ 0.30	- 0.10	- 1.10	
19 Rest of Netherlands	78 500.	- 0.80	+ 0.30	- 12.70	- 17.20	
20 Denmark	37 900.	+ 0.30	+ 0.80	- 37.20	- 43.60	
21 North Germany	100 000.	- 1.60	- 0.10	- 41.80	- 71.60	
22 Bremen	5 650.	- 0.10	+0.10	+0.60	- 0.10	
23 Mid-Germany	130 000.	-1.40	+0.60	+ 64.10	135.00	
24 Cologne	32 800.	- 0.30	- 0.60	+ 6.30	+ 4.40	
25 South Germany	131 000.	- 1.09	+ 0.80	- 41.41	+ 9.91	
26 North Italy	115 000.	+ 12.80	+ 14.80	- 15E01	- 120.00	
27 Piemonte	17 100.	+ 0.90	+ 1.30	- 0.80	+ 9.20	
28 South Italy	81 500.	+ 0.90	+ 1.80	- 32.30	- 24.70	
29 Rest of Spain	106 000.	+ 3.70	+ 5.30	- 34E01	- 310.00	
30 Pais Vasco	5 250.	0.00	+ 0.10	- 5.20	- 5.50	
31 Norte	3 660.	+ 0.10	+ 0.10	- 7.30	- 6.50	
32 Rest of Portugal	8 840.	0.00	0.00	- 7.80	- 7.30	
33 Greece	28 500.	+ 2.40	+ 2.70	- 65.60	- 75.10	
Study area	1 580 000.	0.00	0.00	0.00	100.00	

Table 5.33. 2001 tourism: Change in value-added

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	1 316.	+ 1.58	+ 1.81	+ 0.58	+ 0.65
2 Midlands, North England	7 128.	+ 0.40	+ 0.50	+ 3.60	+ 4.50
3 Ireland	376.	− 0.09	− 0.70	− 1.01	− 0.90
4 South England	3 749.	+ 2.10	+ 3.50	+ 5.60	+ 7.00
5 East Anglia	529.	− 0.05	+ 0.22	+ 0.68	+ 0.58
6 London	2 227.	+ 8.90	+ 17.90	+ 26.70	+ 31.70
7 Kent	358.	+ 0.41	+ 0.60	+ 1.46	+ 1.42
8 Brittany	645.	+ 8.11	+ 8.54	+ 8.84	+ 13.57
9 Normandy	1 045.	+ 7.13	+ 4.95	+ 0.60	− 1.54
10 Nord-Pas-de-Calais	824.	− 3.71	+ 4.82	+ 13.19	+ 13.57
11 Île-de-France	3 014.	+ 2.10	+ 10.30	+ 23.20	+ 25.60
12 Mid-France	2 232.	+ 0.35	+ 1.86	+ 4.34	+ 4.75
13 South-west France	2 336.	+ 8.20	+ 13.50	+ 13.90	+ 14.90
14 South-east France	3 154.	+ 3.70	+ 11.60	+ 19.10	+ 20.90
15 West-Vlaanderen	241.	+ 4.01	+ 5.08	+ 13.87	+ 13.49
16 Hainaut	227.	+ 0.32	+ 0.34	+ 1.27	+ 1.22
17 Rest of Belgium	1 801.	+ 5.72	+ 5.93	+ 10.03	+ 9.69
18 Zeeland	51.	+ 0.60	+ 1.38	+ 0.09	− 0.90
19 Rest of Netherlands	2 134.	+ 2.20	+ 3.50	+ 8.10	+ 13.70
20 Denmark	762.	− 0.58	− 0.36	+ 0.63	+ 0.62
21 North Germany	2 565.	+ 1.70	+ 2.60	+ 2.60	+ 2.75
22 Bremen	180.	− 0.16	+ 0.23	+ 0.19	+ 0.21
23 Mid-Germany	4 126.	+ 6.17	+ 15.67	+ 9.80	+ 13.30
24 Cologne	566.	+ 1.82	+ 2.89	+ 3.05	+ 3.31
25 South Germany	3 771.	+ 2.13	+ 5.17	+ 3.12	+ 3.93
26 North Italy	4 804.	− 1.10	+ 5.00	+ 3.90	+ 5.80
27 Piemonte	687.	− 0.14	+ 1.51	+ 1.32	+ 1.91
28 South Italy	3 577.	− 3.00	− 1.10	− 2.20	− 2.10
29 Rest of Spain	9 251.	− 23.70	− 47.00	− 59.90	− 69.10
30 Pais Vasco	500.	− 0.38	− 1.84	− 2.01	− 2.52
31 Norte	246.	− 2.50	− 4.90	− 7.10	− 8.30
32 Rest of Portugal	595.	− 5.40	− 9.40	− 13.30	− 15.60
33 Greece	1 653.	− 12.50	− 25.50	− 29.10	− 34.00
Study area	66 667.	+ 22.20	+ 38.50	+ 65.10	+ 74.10

Table 5.34. 2001 value-added, primary resource cost: Production

(1980 million ECU)

Zone	Base	B-A	C-A	B1-B	C1-C
1 Scotland	45 200.	– 10.90	– 30.40	+ 27.20	+ 20.10
2 Midlands, North England	262 000.	– 55.88	– 12E01	194E00	126.00
3 Ireland	17 800.	+ 0.40	– 12.50	+ 5.00	+ 5.30
4 South England	109 000.	– 4.10	+ 38.40	+ 42.80	+ 34.40
5 East Anglia	18 100.	+ 0.50	+ 4.00	+ 5.80	+ 2.80
6 London	95 900.	– 8.20	+ 35.80	189E00	163.00
7 Kent	12 000.	– 2.60	262E00	+ 10.80	+ 12.30
8 Brittany	25 700.	106.00	105E00	– 5.50	– 5.60
9 Normandy	46 700.	+ 72.20	+ 67.70	– 34.00	– 6.70
10 Nord-Pas-de-Calais	35 200.	+ 0.60	+ 14.70	+ 59.50	+ 53.50
11 Île-de-France	131 000.	– 39.31	– 36.70	209E00	186.00
12 Mid-France	96 000.	+ 15.30	+ 9.10	+ 82.00	+ 85.09
13 South-west France	92 300.	174.00	174E00	+ 33.80	+ 32.90
14 South-east France	132 000.	– 28.50	– 24.50	131E00	132.00
15 West-Vlaanderen	9 240.	+ 6.80	+ 11.60	+ 23.30	+ 22.80
16 Hainaut	9 060.	– 0.10	+ 0.50	+ 7.80	+ 8.20
17 Rest of Belgium	73 200.	– 2.00	+ 7.60	+ 57.30	+ 63.40
18 Zeeland	3 800.	– 1.00	+ 37.90	+ 0.50	– 1.10
19 Rest of Netherlands	138 000.	– 48.59	– 52.30	+ 16.69	+ 25.59
20 Denmark	64 500.	– 73.70	– 78.60	– 32.70	– 34.00
21 North Germany	154 000.	– 7.91	– 18.70	– 34.59	– 66.20
22 Bremen	8 920.	– 1.70	– 2.40	+ 1.00	+ 0.20
23 Mid-Germany	244 000.	– 100.00	– 11E01	+ 83.89	166.00
24 Cologne	51 000.	– 14.80	– 16.90	+ 11.90	+ 13.30
25 South Germany	251 000.	+ 2.61	+ 24.50	– 39.70	+ 16.50
26 North Italy	220 000.	106.00	+ 91.80	– 15E01	– 110.00
27 Piemonte	40 500.	+ 41.00	+ 41.60	+ 0.30	+ 38.50
28 South Italy	137 000.	– 16.50	– 22.00	– 38.91	– 31.91
29 Rest of Spain	193 000.	–60.70	– 11E01	– 46E01	– 450.00
30 Pais Vasco	12 800.	+ 4.20	+ 0.80	– 11.20	– 12.90
31 Norte	8 970.	+ 0.90	– 3.40	– 18.80	– 20.00
32 Rest of Portugal	16 900.	– 6.20	– 13.80	– 29.30	– 32.10
33 Greece	43 100.	+ 1.40	– 17.20	– 10E01	– 120.00
Study area	2 800 000.	0.00	200.00	300.00	300.00

Figure 5.31. 1996 industrial and food production: Contribution to change in value-added

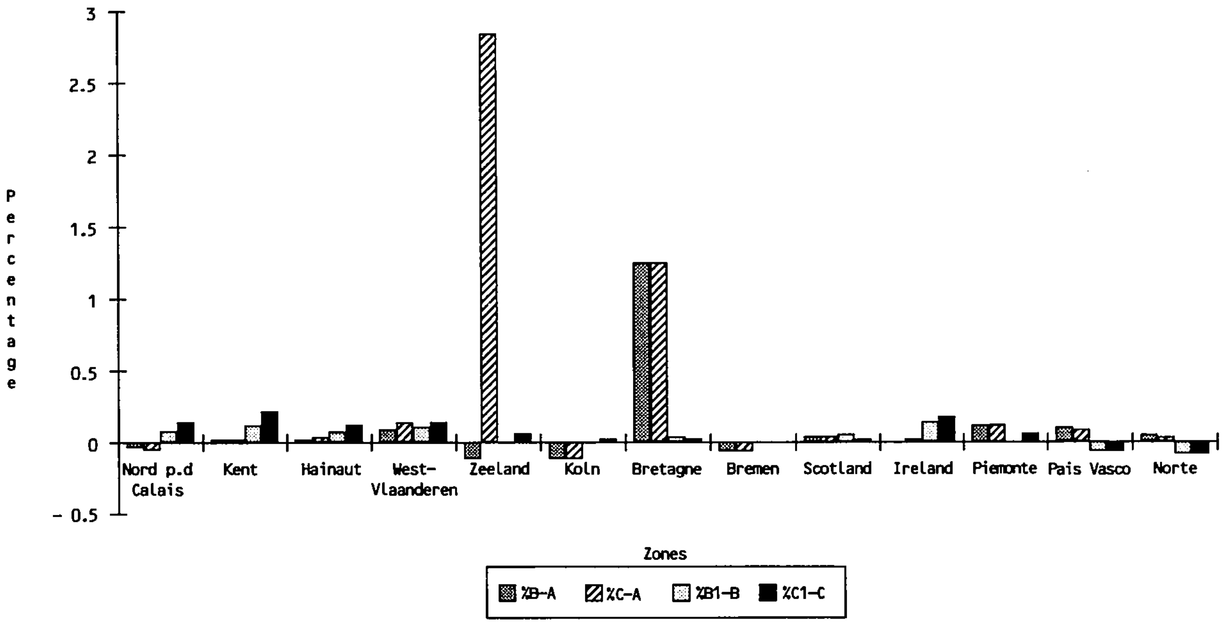


Figure 5.32. 1996 repair, retail, communication, lodging, catering, transport services, business, finance, market services, non-market services: Contribution to change in value-added

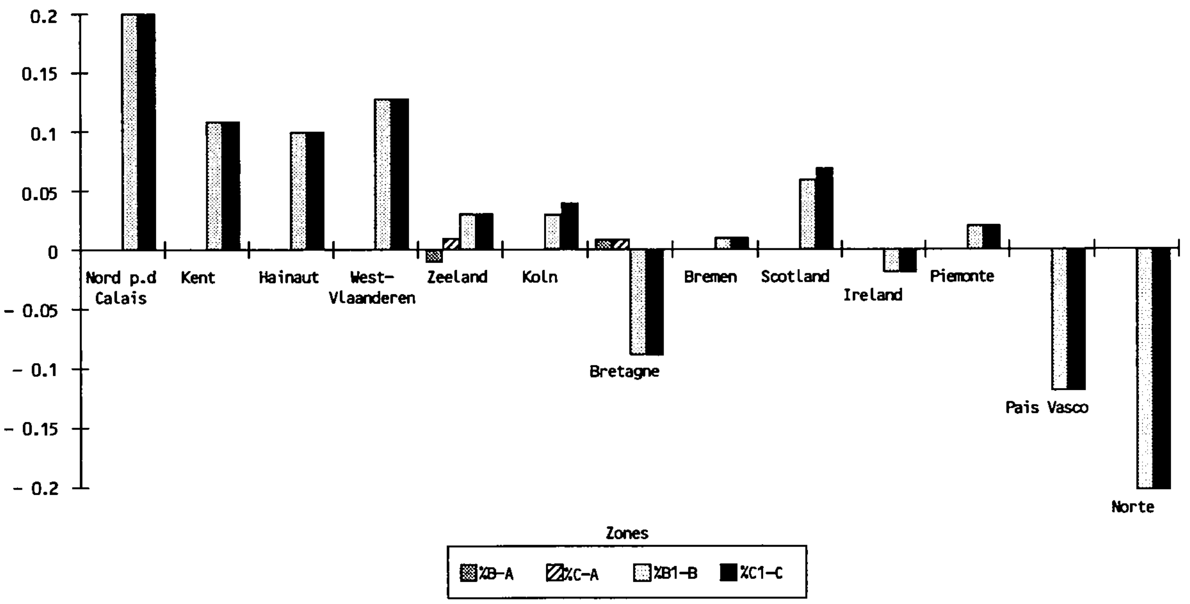


Figure 5.33: 1996 tourism: contribution to change in value-added

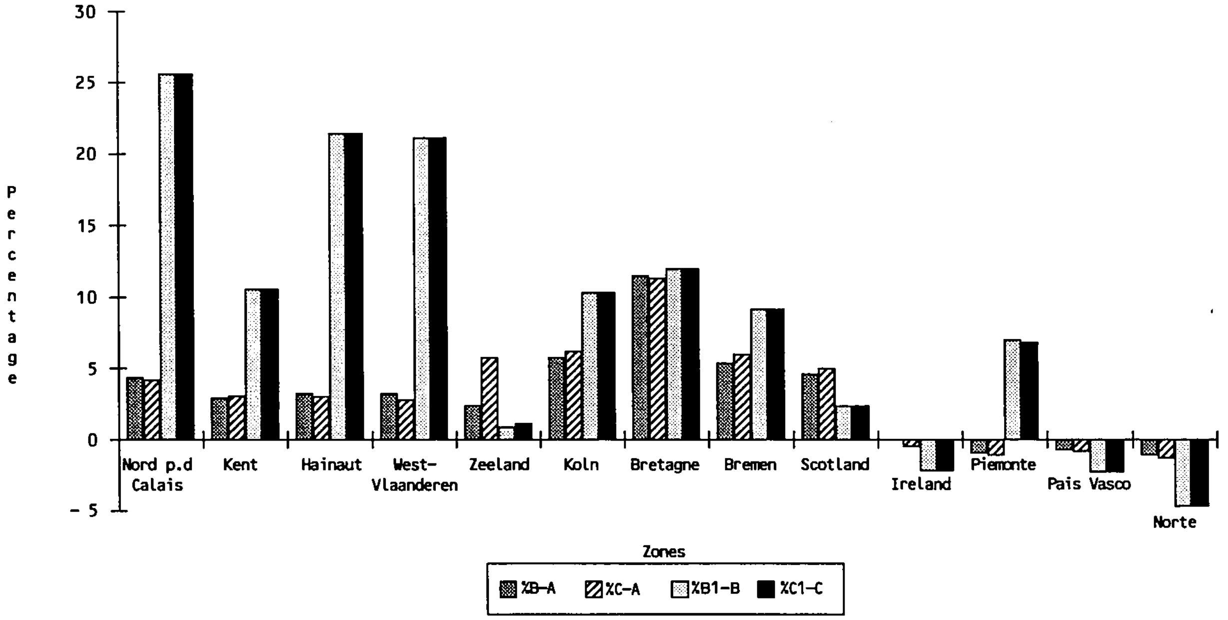


Figure 5.34. 1996 percentage change in value-added

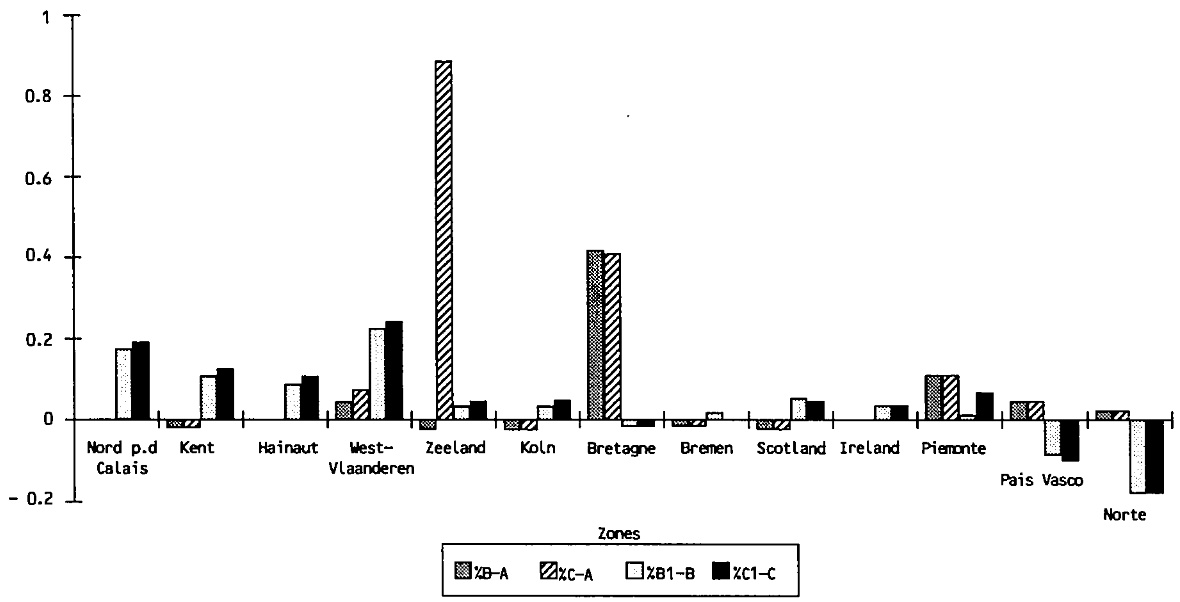


Figure 5.35. 2001 industrial and food production: contribution to change in value-added

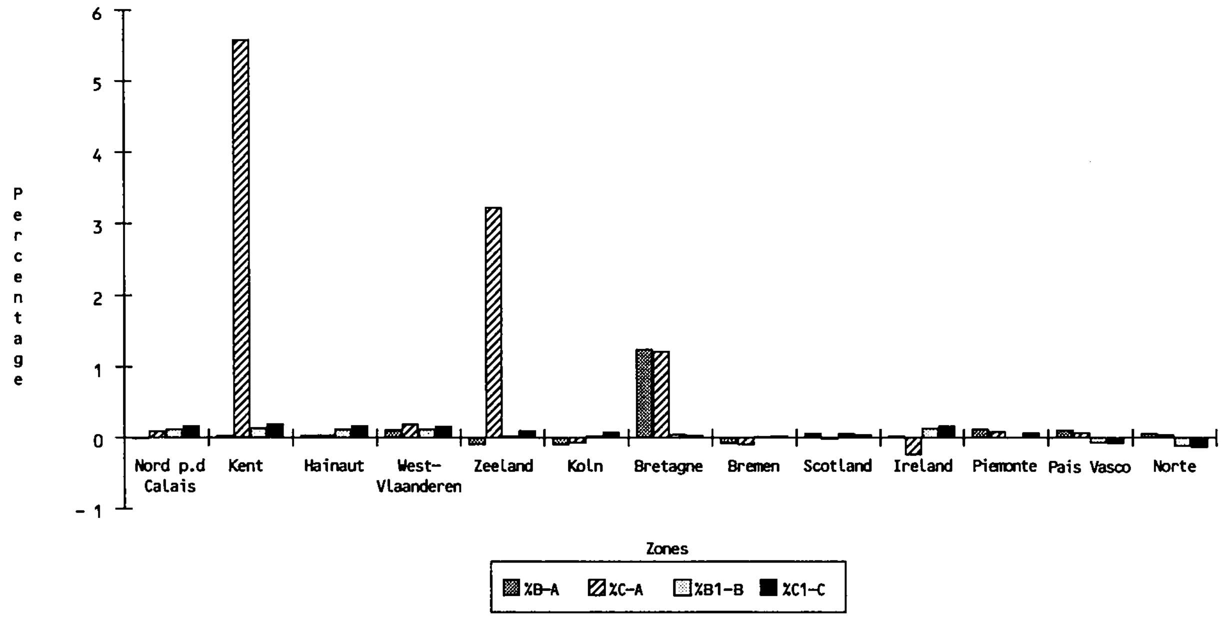


Figure 5.36. 2001 repair, retail, communication, lodging, catering, transport services, business, finance, market services, non-market services: contribution to change in value-added

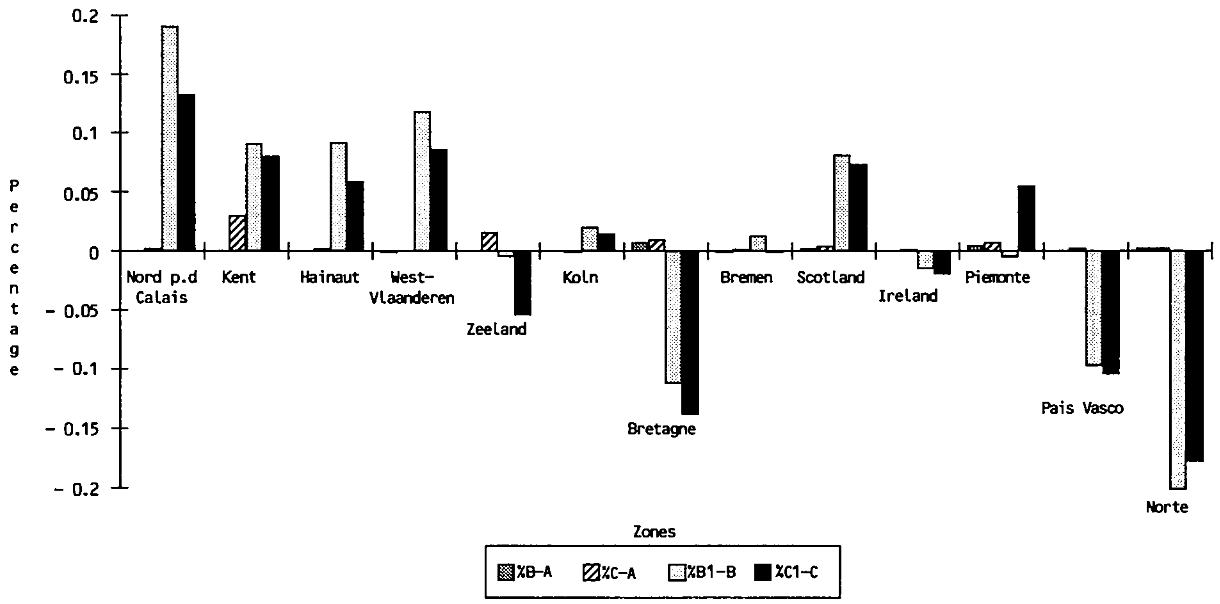


Figure 5.37. 2001 tourism: contribution to change in value-added

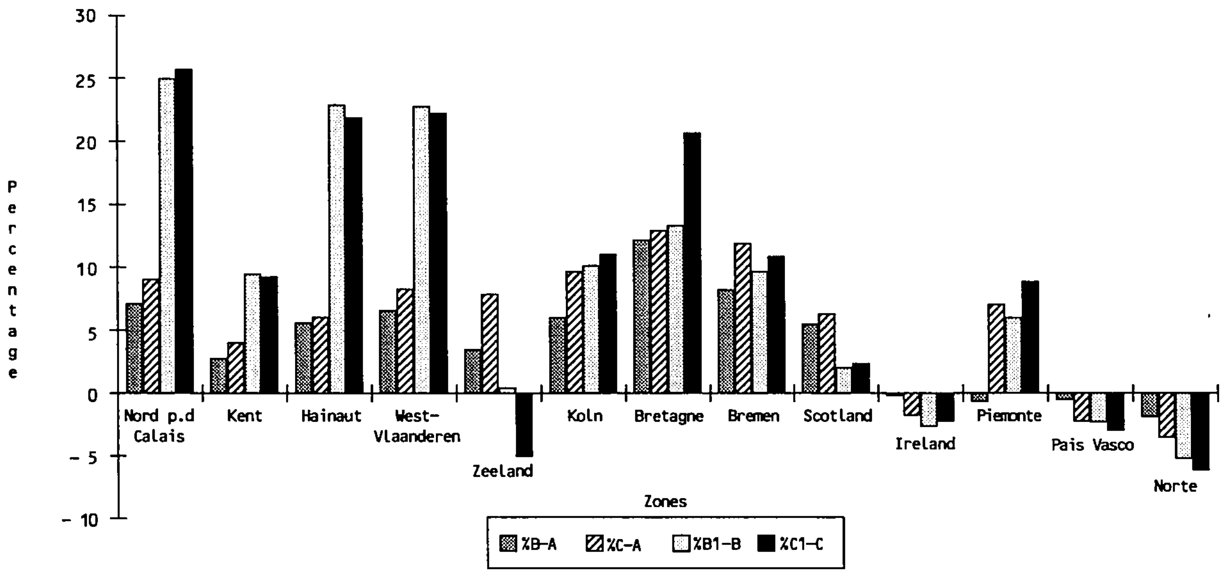
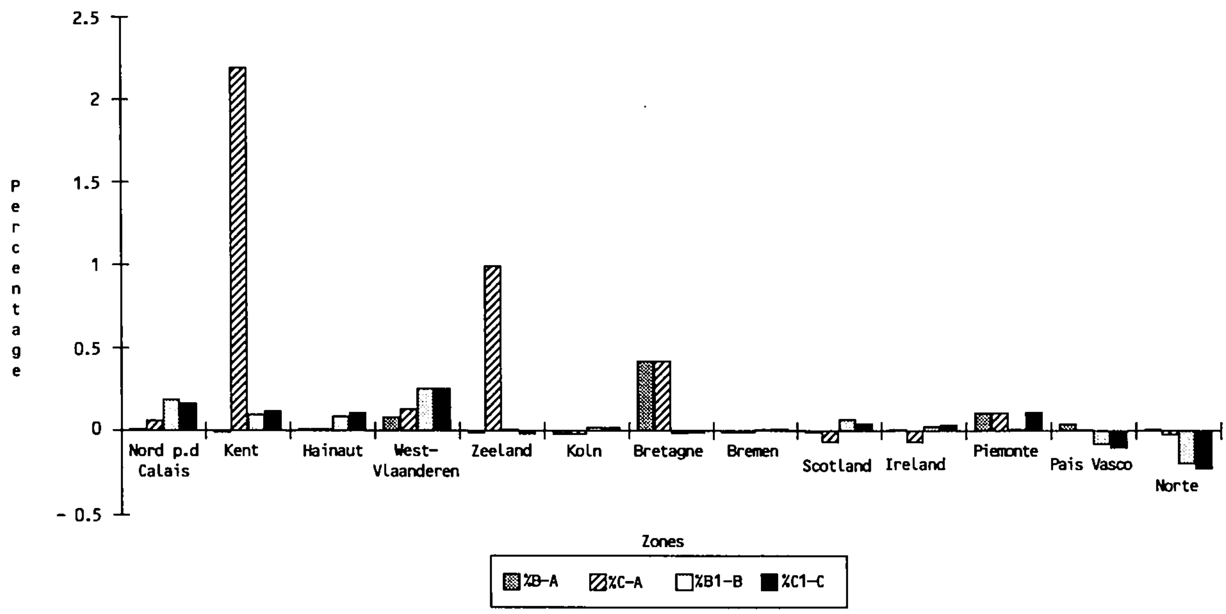


Figure 5.38. 2001 percentage change in value-added



6. Synthesis and conclusions

This study about the regional impacts of the Channel Tunnel in Europe is unique in the sense that it simultaneously applied two different methods of analysis: (1) a 'quantitative' computer model of transport interactions and economic activities (Meplan) and (2) mainly 'qualitative' regional case studies based on empirical research and interviews with regional experts and decision-makers.

Now, after the results of these two parts of the study have been presented separately in Chapters 4 and 5, in this chapter they will be brought to a synthesis. In a first step the results of the two methodologies will be confronted with each other. Are the forecasts of the model in accordance with the conclusions drawn from the regional analyses? Did the model identify the same regions as the 'winners' of the opportunities afforded by the Channel Tunnel as the experts and decision makers in the regions? How about the 'loser' regions which according to the model are likely to suffer from the shifts in transport flows and economic opportunities provided by the Tunnel: Are the responsible actors in these regions aware of the risks they are facing? About transport flows: Does the model predict flows of passengers and goods through the Tunnel and corresponding shifts away from other modes that are in line with the expectations of regional transport actors such as ferry or port operators? In general, are the forecasts of the model compatible with the perceptions, expectations, hopes and fears of the regions?

In the ideal case, of course, the results of both parts of the study are in complete agreement. But, as the careful reader of Chapters 4 and 5 will have already noticed, this is only partly the case. As will be shown in the following sections, the model in most cases agrees but in some important aspects disagrees with what the regional actors believe. From a methodological point of view, these differences could be of great interest because they might provide some insight into the limitations of the modelling approach or, for that matter, into the limitations of merely regional views that lack the comprehensive overview of the relative position of the regions towards each other.

However, as this study is not an exercise in methodology but a serious effort in policy analysis, these considerations, though interesting, can only be a by-product. To accomplish the aims of the study, it is necessary to reconcile any differences between its two parts before final conclusions can be drawn. Unfortunately, because of the limited duration of the study, the two parts had to be conducted in parallel. So, while there was considerable input from the regional analyses into the data collection, model specification and calibration phase of the model analysis, the model results only became available long after the interviews in the regions. Therefore it was not possible to confront the interview partners in the regions with the results of the model regarding their region — neither in the confirmative nor in the contradictory case. Therefore, in this synthesis chapter, any disagreements between the two parts of the study will have to be resolved by applying the research team's own judgment based on criteria such as plausibility, supporting empirical evidence and conformity with accepted theory.

In order to accomplish this. Chapter 6 is subdivided into four sections. In the first section the two methodologies applied in the two parts of the study and their comparative strengths and limitations are reviewed. The second section will summarizes the results for transport flows and regional development of the two parts and confront them where they are comparable and highlight where they corroborate each other and where they disagree. In the latter case the likely reasons for their disagreement will be discussed and it will be indicated which of the forecasts or expectations seems to be more plausible and under which conditions. The third section generalizes the findings to all European regions focusing on the impacts of the Channel Tunnel on transport flows in Europe and on the expected effects on regional development in Europe. Finally, the last section draws conclusions of the results of the study and identifies issues arising for the Community.

6.1. Problems of synthesis

In order to be able to compare the results of the two parts of the study, the results must be comparable. That is they must not only cover the same domain of reality but must describe it in a comparable language and metric, degree of precision and spatial and temporal scale. How far this has been achieved in the present project is assessed in the first subsection. The following subsection documents how far there has been an intermediate flow of information between the two parts of the study that might have predetermined the similarity or dissimilarity of the two sets of results. Finally, there is a discussion of what action take in the case of disagreement between the results of the regional analyses and the model. What are the *a priori* expectations about the most likely results and on which kind of theoretical considerations could they be based?

6.1.1. The two approaches

It is not the intention to repeat the description of the two methodological approaches applied in the two parts of the study here (see Chapter 3). However, it is necessary to state the basic differences between the two methods in order to highlight the specific strengths and shortcomings of each of them.

In some respects, the two methodological approaches are the exact opposite, or complement, of each other:

Input information

The regional analyses were completely open as to which information to collect. Although there was at the outset a catalogue of desirable data to be assembled for each region, the actual data collection could be flexibly adjusted to the data available in and about each region. Missing or imprecise data presented no serious problem as data could always be interpreted and qualified using words. Moreover, data in the sense of numerically coded information played only a relatively subordinate role in the research process. Much more important was 'informal' information consisting of opinions, value judgments, hopes or concerns of the regional actors interviewed. The shortcoming of this was that it was very difficult to make comparisons between the case-study regions. In fact, the comparative description of the current situation in the case-study regions (Section 4.2) had to be largely based on standardized information collected elsewhere, for instance by Eurostat.

In contrast to this, the model analysis relied exclusively on quantitative data. These data had to be available for all 33 internal model regions defined in the study (see Map 5.2). Missing data were not acceptable; if a particular data item was not available, it had to be surrogated by an appropriate approximation. In addition, a large number of model parameters such as technical coefficients or cost parameters had to be collected or, in the absence of data, estimated by a variety of estimation procedures. Finally, for calibrating and validating the model, a substantial amount of trade and transport flow data had to be compiled from different sources and brought into a form suitable for the task. The difficulty of obtaining data for the model imposed restrictions on the type of information used, and while the model is one of the most complex of its kind, it is still fundamentally 'reductionist' in the sense that by necessity it seeks to derive its results from only the most essential input variables and so is not able to take account of the same rich set of information as the regional analyses.

Relation to theory

In principle both the case-study method and the model analysis should not differ with respect to their relation to theory. After all, both methods rely on a strong base of empirical evidence and theoretical knowledge about the role of transport infrastructure in the organization of space. However, there are differences in the way theoretical knowledge is applied in the research process. In the model analysis, theory is already all-important in the model specification phase, in fact the model itself could not have come into existence without such foundation. It is even possible to say that the model is a theory (or a set of theories) about activities and interactions in space cast into the form of a computer algorithm. This does not mean that the theory or theories embedded in the model are completely fixed and cannot be changed during the work with the model: by adjusting the model parameters in the calibration phase the model can express a Nide range of manifestations of reality, and to find the ideal parameter settings involves a learning process about the relationship between theory and reality. However, there may also be certain fundamental assumptions built into the model that cannot be changed without breaking its whole structure. In the case of Meplan one such assumption is that the location of economic activities and the flows of trade and transport between them tend to equilibrium — a feature of the model that will become relevant in the later discussion.

Of course also the regional analyses were based on theoretical considerations. Already the selection of case-study regions expressed certain expectations about the likely impacts of a major piece of infrastructure like the Channel Tunnel. Without a theoretical background no relevant questions could have been asked in the interviews, and that this process was planned with a clear concept in mind, is witnessed by the 'Guideline for interviews' prepared early in the project. Yet despite this rational approach there was a slightly different attitude to theory in the case studies compared with the modelling exercise. The *a priori* conceptualizations were always kept open for change in case new unexpected information should make this necessary, and evidently this was easier without a predefined model. This difference in attitude may have been a subtle one, but it seems that the learning element was more pronounced in the regional analyses.

Theoretical content

Besides the difference in relation to theory, there are, at least potentially, differences in theoretical content between the two approaches that may become relevant for the subsequent discussion of the results.

As described in Section 5.2, Meplan is essentially a multiregional and multisectoral spatial interaction model where the spatial interactions are both trade flows and passenger trips. In its economic part, it is an equilibrium model in that it assumes that, under the restrictions given by the transport infrastructure, economic activity tends to move where the costs of production including transport costs are lowest. If, under these assumptions, a spatial barrier between two economic regions is removed or lowered, the model should predict additional growth in the less developed or more peripheral region of the two where production factors such as wages or land are cheaper. This is because without the barrier these regions become more competitive with the effect that they receive more orders from the more central regions. The central regions also become more accessible from the periphery; so the peripheral regions may buy more from the centre, but as the peripheral regions are smaller and poorer, these purchases will slightly affect the growth of the central regions.

The Channel can be perceived as a spatial barrier, and the Channel Tunnel contributes to removing or lowering that barrier. Consequently, the Meplan model can be expected to forecast, *ceteris paribus,* a slight shift of growth from the more central European continent to the more 'peripheral' British Isles, or at least to the more peripheral parts of them, Scotland and Ireland.

The equalizing effect of the removal of a barrier is a well-known result of foreign-trade theory, which is of current interest in the debate about the expected impacts of further economic integration in Europe, in particular about the likely impacts of the single European market. The barriers in that context are, of course, the barriers to trade due to customs and border regulations. Following neoclassical economic equilibrium theory, equalization occurs when capital moves to where production factors are cheapest and labour to where wages are highest. As the single European market removes barriers for capital transfer and migration between the countries in Europe, it should contribute to equalizing living conditions in Europe and hence benefit the peripheral regions.

However, this forecast has not remained undisputed. Critics of the neoclassical economic equilibrium paradigm argue that it neglects countervailing effects such as economies of scale, agglomeration, monopolies, the role of innovation and public economic strategies and policies, and that these more than outweigh the equalizing effects and thus lead to polarization. Following the polarization paradigm, the removal of barriers between national economies by the SEM should reinforce growth in the more central regions of Europe. In the context of the Channel Tunnel, the polarization paradigm seems to be more popular among regional experts and practitioners. The frequent references to the Blue Banana and the importance of being part of it or being linked to it (by high-speed rail) point in this direction. So it can be expected that the regional analyses, which draw upon the perceptions and opinions of regional decision-makers, will tend to predict more polarizing effects of the Tunnel, i.e. accelerated growth of the core at the expense of the periphery.

Which of the two hypotheses is true? The results of the ongoing debate about the implications of the single European market suggest that from a theoretical point of view neither the equalization nor the polarization paradigm can be called fundamentally superior. It is argued that the question of whether the removal of a trade barrier leads to equalization or polarization is presently impossible to decide on a theoretical basis and that the actual outcome in each case depends on the specific constellation of trade relations (Bröcker, 1990). However, if the above association of the Meplan model with the equilibration paradigm and the regional analyses with the polarization paradigm is correct, one should not be surprised if the regional experts and decision-makers tend to forecast gains in the central regions and losses in the peripheral ones due to the Channel Tunnel, whereas Meplan tends to predict gains in the peripheral regions where the Tunnel leads to a significant improvement in transport, but losses for other regions.

Model characteristics

Fortunately, the model as implemented for this project was generally able to respond in a robust and reliable way to the issues and policies examined. However, the model had some characteristics that influenced the results in a specific way. To interpret the results of the Meplan model as implemented for the study, the following features should be taken into account:

(i) The model is demand oriented and does not take account of changes in supply after the base year. In other words, the economic activity in a region always equals total purchases in that region and depends only on base year supply and future changes in production costs in the region and interregional transport costs, but not on the changes in the production capacity or supply in the region. Consequently, regional dynamics based on regional policy or on regional entrepreneurial investment decisions are not reflected in the model.

(ii) Second, a distinction has to be made between results for industrial and agricultural production on the one hand and for services and tourism on the other. For industrial and agricultural production the changes in value added are based on changes in all freight flows, i.e. on changes in the whole matrix of input-output relationships, whereas the changes of value added of service industries and tourism are based only on cross-Channel transport flows and not on other transport flows in Europe. Consequently, the impact of the European transport network improvement is only shown for industrial and agricultural production, whereas the impact of the network on service industries is based only on the parts of the network included in the cross-Channel transport flows. The impact of the Tunnel is not affected by this difference.

(iii) A third characteristic of the model is the missing link between changes in transport flows and the transport industry. This means, for example, that declining numbers of ferry passengers on a certain route are not reflected in a decline in the transport industry in that region (e.g. in Kent, Nord-Pas-de-Calais and West-Vlaanderen).

(iv) The forecasts from the model are in terms of value added and not in terms of employment. This means that the economic growth predicted for a certain region will not necessarily induce increasing employment in that region.

(v) The forecasts from the model are based on the assumption that the prices charged through the Tunnel would be in line with those charged by the ferries, even though Eurotunnel assumes that it will undercut the ferries in real terms by 10%. If the eventual pricing system is vastly different, then clearly the forecasts would change somewhat.

(vi) The model does not distinguish between different ports of an individual region. Therefore, the impacts on cross-Channel transport flows of individual ports cannot be obtained directly.

(vii) In the model, ferries operate as at the present time. Consequently, the ongoing modernization efforts of ferry companies and port authorities such as larger, faster and more luxurious ferries and more convenient terminal facilities and faster boarding procedures in order to improve their competitive situation are not tested in the model. Also, the model does not take into account the possibility of lorry drivers using ferry crossings as part of their required rest time and the attitude of some tourists to consider the ferry crossing as part of their holiday. Consequently, the model may tend to overestimate the number of passengers and lorries that will shift from the ferries to the Tunnel.

Output information
The asymmetry found in the input information used by the two approaches is also characteristic of the kind of information they produce.

Again for the regional analyses there are, in principle, no limits to the kind of information it can produce except for constraints of time. In a case study it is possible to uncover an enormous wealth of facts, relationships, opinions, expectations and responses in the particular region. However, there is the danger of a myopic perspective in telling the regional 'story'. After all, the case-study region is not the real object of interest, but was selected because it was supposed to be representative of a relevant set of other regions with similar problems. But is there any guarantee that the 'story' is also valid for them? In other words, the problem of the case-study method is the problem of generalizability. Also there is the danger that the information collected in one region may be in conflict with that collected in others. The most common example of this kind of fallacy is that all case-study regions claim to foresee a growth that, if added up across all similar regions, would lead to quite unrealistic assumptions of total growth. Fortunately, this did not happen here. Another problem is that only rarely do the case-study regions constitute a representative sample of all regions. In this study, for instance, for obvious reasons maritime regions are over-represented, and this of course reduces the generalizability of the results.

The model analysis, on the other hand, has other shortcomings and advantages. Clearly the kind of information it can provide is more limited as it is constrained by the predefined input information. That is, not all questions that may become relevant during the research process will necessarily be answered by the model. More serious is the risk that the reductionist model skeleton may turn out to be unsuitable to grasp the aspects of reality that emerge as being the most essential. However, if it is possible to avoid these pitfalls, the benefit gained from the model can be much greater than from any case study because the model at any point in time — within its self-defined limits — represents a complete and totally consistent inventory of all regions, not only those in the case study. In addition, the model makes forecasts subject to clearly specified scenarios of infrastructure improvement for both rail and road ranging from a do-nothing scenario to the most optimistic schedule of construction, each with and without the Channel Tunnel. While the information the model is able to provide about a particular region may not be as detailed and specific as that produced by a case study, it does much more by linking the information about the individual regions together in one coherent and consistent framework.

6.1.2. Information flows between the two approaches

As already mentioned, the two parts of the study were conducted in parallel, and the model results only became available after the regional analyses had been completed. This implied that intermediate results could only be communicated from the regional analyses to the model analysis and not vice versa.

In particular, three kinds of information were given to the modelling team by the authors of the regional analyses:

Networks. The authors of the regional analyses provided a phased list of rail and motorway improvements expected in the case-study regions, with special emphasis on the expected schedule of completion of high-speed rail lines. This list was used by the modelling team as a basis for defining the network scenarios to be simulated with the model (see Chapter 5).

Impacts on transport flows. In the regional analyses and during the interviews a number of hypotheses and expectations were put forth regarding the likely impacts of the Channel Tunnel (in conjunction with the improvements of the high-speed rail and motorway systems) on transport flows and likely shifts between modes, in particular, intermodal competition between rail and ferry, rail and road and rail and air. These hypotheses were used by the modelling team to assess the plausibility of the results in the process of model validation.

Impacts on regional development. Depending on the sectoral composition, different industries are likely to be affected by the Channel Tunnel in each region. The authors of the regional analyses therefore provided the modelling team with preliminary hypotheses about which economic impacts and with respect to which sectors appeared to be expected in the case-study regions. This information was used by the modelling team to check whether the model could address the questions brought up in the regional analyses concerning the future of particular industries.

In addition the two teams met in five project meetings and in two larger workshops with all the people involved in the project to discuss the progress of the work and new issues arising out of both the regional analyses and the ongoing process of model specification and calibration. Moreover, members of the regional analysis team at IRPUD (Dortmund) spent altogether four weeks at ME&P in Cambridge collaborating with the modelling team in setting up the model, evaluating first calibration results and defining the network scenarios.

6.1.3. In case of disagreement?

Although, through this intensive process of information exchange and consultation, everything possible was done to ensure a consistent set of results for the two parts of the study, there was no mechanism to guarantee that the results would be identical in all cases. In fact it will become clear in the following sections that in some aspects the model forecasts are not in agreement with what the regional actors considered to be the most likely development. This subsection discussed what can be done in the case of such disagreement to make a well-founded judgment about which of the competing opinions has more plausibility.

There are, in principle, three ways to proceed if model results and expert opinion are in disagreement:

(i) In the ideal case, one would enter a new cycle of the research process and confront the previous interview partners with the dissenting forecasts of the model and the assumptions that led to these forecasts. One possibility would be that the regional experts would revise their expectations after exposure to the reasoning behind the model results. Or, they would maintain their former view and perhaps give important suggestions why the model forecasts are likely to be wrong. In that case it might be worthwhile to review the model specification in the light of the new evidence and eventually come up with a new set of forecasts. Unfortunately, this most desirable iteration of the research process is ruled out here because of time constraints.

(ii) Another possible way out would be to decide which of the two conflicting forecasts is right, based on a preconceived assessment of the reliability of the two methodologies. Adherents of a 'hard-science' approach would tend to rely more on the model forecasts, whereas people with a social science background might tend to dismiss any model results and solely rely on the experience and practical wisdom of the regional experts. Either decision would be open to criticism because of their lack of a sound foundation.

(iii) A third attitude would not dismiss any of the two forecasts in disagreement on a priori grounds but would try to identify the causes of their differences. This would mean to relate them back to the theoretical concepts underlying the two approaches either explicitly, as in the model, or implicitly, as in the case of the regional actors. Only if it is possible to explain the differences in forecasts by differences in perspective and assumptions is it possible to arrive at a well-founded judgment about the validity of the results and the assumptions. In addition, such a final judgment could be based on a confrontation with other existing regional studies in order to resolve disagreements. This third approach will be followed here.

6.2. Confrontation of regional analyses and model analysis

In this section the results of the regional analyses and the model analysis will be compared and commented upon. It will be pointed out where they are in agreement and in which aspects they disagree. In the latter case the possible causes for disagreement will be determined and a final judgment on the results will be given. The order of discussion of the results follows that of Chapters 4 and 5. First the forecasts on cross-Channel transport flows without and with the Tunnel will be examined, and there will be a discussion on how far the model results coincide with the expectations of the case-study regions and the conclusions of the regional analyses. After that the impacts of the Tunnel on regional development predicted by the model will be compared with the hopes or fears found in the case-study regions and the final results of the regional analyses. The third part of this section picks up the initial grouping of the case-study regions of Subsection 4.2.6 and discusses whether the Channel Tunnel will lead to a regrouping of these regions in the European context. This part will provide the base for the generalization of the results of this study to all EC regions in Section 6.3.

6.2.1. Transport flows

The forecasts of the Meplan model on cross-Channel transport flows are both comprehensive and detailed. They include flows of passengers to and from the UK by trip purpose and region-to-region trade flows by industry and cargo type for all relevant transport modes or combinations of modes for the years 1986, 1991, 1996 and 2001 for five scenarios of infrastructure improvement:

A Present network without Tunnel

B Limited network improvements without Tunnel

C Extended network improvement without Tunnel

B1 Limited network improvement with Tunnel

C1 Extended network improvement with Tunnel.

Only a small subset of the transport flows generated in the model could be presented in Chapter 5 of this report. Even in reduced form the information provided by the model is much more complex and specific than the corresponding information contained in the regional analyses, which mainly consist of qualitative statements about expected growth or decline of transport markets for particular modes such as ferries. These statements, however, are normally region-specific, i.e. refer to one of the case-study regions only, whereas the model results refer not only to the transport flows of single regions but also to all cross-Channel flows arriving or departing in one of the UK coastal regions, East, South and Kent, and at all British aiports. However, mainly because of the qualitative statements of the regional analyses, the results are comparable only in a limited sense. The discussion will start with an inspection of transport flows forecast for the 13 case-study regions.

Transport flows by region
In this subsection summarizing conclusions on the impact of the Channel Tunnel on transport flows will be presented for each of the 13 case-study regions. The presentation for each region consists of a table summarizing the impacts of the Channel Tunnel on transport flows by mode (Tables 6.1 to 6.13) and a text box with a concluding interpretation. In the tables three types of impacts as reported in Chapters 4 and 5 are distinguished:

a the expectations of the regional actors interviewed,

b forecasts based on the regional analysis,

c forecasts of the Meplan model,

whereby the most significant impacts are highlighted. The text box contains a final concluding interpretation of the impacts on transport flows for the region with particular remarks in case the three kinds of forecasts differ.

Impacts on regional [illegible] [illegible] questions brought up in the regional [illegible] concerning the future of particular industries.

In addition the two teams met in five pro[illegible]etings and in two larger workshops with all the people involved in the [illegible] of the work and new issues arising out of both the regional analyses [illegible] of model specification and calibration. Moreover, members of the regional analysis [illegible] in Cambridge collaborating with the modelling team in setting up the model, [illegible] bration results and defining the network scenarios.

6.1.3. In case of disagreement?

Although, through this intensive process of information exchange and consultation, everything possible was done to ensure a consistent set of results for the two parts of the study, there was no mechanism to guarantee that the results would be identical in all cases. In fact it will become clear in the following sections that in some aspects the model forecasts are not in agreement with what the regional actors considered to be the most likely development. This subsection discussed what can be done in the case of such disagreement to make a well-founded judgment about which of the competing opinions has more plausibility.

There are, in principle, three ways to proceed if model results and expert opinion are in disagreement:

(i) In the ideal case, one would enter a new cycle of the research process and confront the previous interview partners with the dissenting forecasts of the model and the assumptions that led to these forecasts. One possibility would be that the regional experts would revise their expectations after exposure to the reasoning behind the model results. Or, they would maintain their former view and perhaps give important suggestions why the model [illegible]

(ii) [illegible] reliability of the two m[illegible] of a 'hard-science' approach would tend to rely more on the mode[illegible] people with a social science background might tend to dismiss any model results and solely rely on the experience and practical wisdom of the regional experts. Either decision would be open to criticism because of their lack of a sound foundation.

(iii) A third attitude would not dismiss any of the two forecasts in disagreement on a priori grounds but would try to identify the causes of their differences. This would mean to relate them back to the theoretical concepts underlying the two approaches either explicitly, as in the model, or implicitly, as in the case of the regional actors. Only if it is possible to explain the differences in forecasts by differences in perspective and assumptions is it possible to arrive at a well-founded judgment about the validity of the results and the assumptions. In addition, such a final judgment could be based on a confrontation with other existing regional studies in order to resolve disagreements. This third approach will be followed here.

6.2 Confrontation of regional analyses and model analysis

In this section the results of the regional analyses and the model analysis will be compared and [illegible] tions of the case-study regions and the [illegible]

6. Résumé

Cette étude des impacts régionaux du tunnel sous la Manche est unique en ce qu'elle applique simultanément deux méthodes d'analyse: 1) un modèle informatique «quantitatif» des interactions des transports et des activités économiques (Meplan); 2) des études de cas régionaux principalement «qualitatives» fondées sur des recherches empiriques et des interviews d'experts régionaux et de décideurs.

Les résultats de ces deux parties de l'étude ayant été présentés séparément dans les chapitres 4 et 5, le présent chapitre en fera la synthèse. Dans une première étape, les résultats des deux méthodes seront confrontés. Les prévisions du modèle concordent-elles avec les conclusions des analyses régionales? Ce modèle identifie-t-il comme bénéficiaires des opportunités offertes par le tunnel les mêmes régions que les décideurs régionaux? Qu'en est-il des régions «perdantes» qui, selon le modèle, risquent de souffrir des mutations entraînées par le tunnel dans les flux de transport et les opportunités économiques: les acteurs responsables de ces régions sont-ils conscients des risques? À propos des transports: les flux de passagers et de marchandises via le tunnel, prévus par le modèle, et la désaffection correspondante d'autres modes de transport sont-ils en phase avec ce à quoi s'attendent les agents de transport régionaux tels que les compagnies de *ferry-boats* et les opérateurs portuaires? De façon générale, les prévisions du modèle sont-elles compatibles avec les perceptions, attentes, espoirs et craintes des régions?

Certes, dans la meilleure hypothèse, les résultats des deux parties de l'étude concordent entièrement. Mais, comme le lecteur attentif des chapitres 4 et 5 l'aura déjà noté, ce n'est en fait que partiellement le cas. Comme on le verra dans les sections suivantes, le modèle concorde dans la plupart des cas, mais présente, sous certains aspects importants, des discordances avec l'avis des acteurs régionaux. D'un point de vue méthodologique, ces différences pourraient être d'un grand intérêt en fournissant un éclairage sur les limitations de l'approche modélisée ou sur celles de points de vue purement régionaux auxquels fait défaut la saisie complète de la position *relative* des régions entre elles.

Toutefois, comme cette étude n'est pas un exercice de méthodologie, mais un effort sérieux d'analyse politique, ces considérations, malgré leur intérêt, ne peuvent être qu'accessoires. Pour atteindre les objectifs de l'étude, il est nécessaire de concilier les différences entre ses deux parties avant de pouvoir en tirer les conclusions. Malheureusement, la durée limitée de l'étude a obligé à mener ses deux parties de façon parallèle. Ainsi, bien que les analyses régionales aient été d'un apport considérable pour la collecte de données, la spécification du modèle et la phase de calibrage de l'analyse de modèle, les résultats de cette analyse n'ont été disponibles que longtemps *après* les enquêtes dans les régions. C'est pourquoi il n'a pas été possible de confronter les partenaires régionaux interrogés avec les résultats de l'analyse de modèle relatifs à leur région, ni dans les cas de concordance ni dans ceux de discordance. Dès lors, pour résorber toute discordance entre les deux parties de l'étude dans ce chapitre de synthèse, l'équipe de recherche devra recourir à son propre jugement sur la base de critères comme la plausibilité, l'appoint des constatations empiriques et la conformité avec les théories admises.

À cette fin, le chapitre 6 est subdivisé en quatre sections. Dans la première, on passera en revue les deux méthodes appliquées dans les deux parties de l'étude et on comparera leurs points forts et leurs points faibles. La deuxième section résumera les résultats de ces deux parties quant aux flux de transport et au développement régional, confrontera ces résultats lorsqu'ils sont comparables et éclairera les points sur lesquels ils convergent ou divergent. Dans ce dernier cas, les causes des discordances seront examinées et on indiquera quelle prévision faite ou quelle attente formulée semble la plus plausible et à quelles conditions. La troisième section généralisera les résultats de cet examen à toutes les régions d'Europe, sous l'angle de l'impact européen du tunnel en matière de flux de transport et de ses effets attendus sur le développement régional en Europe. Enfin, une dernière section tirera les conclusions générales des résultats de l'étude et identifiera les enjeux qui en découlent pour la Communauté.

6.1. Problèmes de synthèse

Afin que les résultats des deux parties de l'étude puissent être comparés, ces résultats doivent être comparables. C'est-à-dire qu'ils doivent non seulement couvrir le même domaine de réalité, mais le décrire de façon comparable par le langage, le mesurage, le degré de précision, l'échelle spatiale et temporelle. Une première sous-section évaluera jusqu'à quel point ces conditions ont été remplies. Dans la deuxième, on cherchera à savoir dans quelle mesure il a existé entre les deux parties de l'étude un flux intermédiaire d'informations qui pourrait avoir prédéterminé la similarité ou la dissemblance des deux séries de résultats. Enfin, on examinera ce qui peut être fait dans les cas de discordance entre les résultats des analyses régionales et ceux de l'étude de modèle: quelles attentes a priori sont-elles suscitées par les résultats les plus probables, et sur quelles sortes de considérations théoriques sont-elles fondées?

6.1.1. Les deux approches

Il ne s'agit pas de refaire ici la description des deux approches méthodologiques appliquées dans les deux parties de l'étude (voir chapitre 3). Toutefois, il est nécessaire d'établir les différences de base entre les deux méthodes, afin d'être à même d'éclairer leurs atouts et leurs handicaps respectifs.

Sous certains rapports, les deux approches méthodologiques sont tantôt à l'exact opposé l'une de l'autre, tantôt elles se complètent.

Informations entrantes

Les analyses régionales sont entièrement ouvertes en ce qui concerne le type d'informations à collecter. Bien qu'une grille de données requises pour chaque région ait été établie au départ, les données concrètement rassemblées devaient pouvoir être ajustées de façon souple aux données par ailleurs disponibles sur et dans chaque région. Les données manquantes ou imprécises ne constituaient pas un problème majeur, dès lors que les informations pouvaient être interprétées et évaluées par le moyen des mots. Du reste, les données au sens d'informations codées numériquement n'ont joué qu'un rôle relativement secondaire dans le processus de recherche. Bien plus importante a été l'information «informelle», constituée des opinions, des jugements de valeur, des espoirs ou des préoccupations des acteurs régionaux interrogés. Handicap de cette approche: la grande difficulté d'établir des comparaisons entre les différentes régions étudiées. En fait, la description comparative de la situation récente de ces régions (chapitre 4.2) a dû se fonder largement sur les informations standardisées collectées ailleurs, par exemple par Eurostat.

En revanche, l'analyse de modèle était exclusivement liée à des données quantitatives. Il a fallu disposer de ces données pour chacun des trente-trois modèles régionaux internes définis dans l'étude (voir carte 5.2). Le manque de données n'était pas admissible; si une donnée faisait défaut sur un point particulier, une approximation ad hoc y a suppléé. À cela s'est ajoutée la détermination d'un grand nombre de paramètres tels que des coefficients techniques ou des paramètres financiers; en l'absence de données, ces paramètres ont été estimés grâce à des procédés variés. Enfin, pour calibrer et valider le modèle, des données de sources diverses relatives aux flux commerciaux et de transport ont été rassemblées en quantité substantielle et coulées dans une forme adaptée à la tâche. La difficulté d'obtenir des données pour le modèle a imposé des restrictions quant aux types d'informations utilisées, et, quoique ce modèle soit l'un des plus complexes du genre, il reste fondamentalement «réductionniste» en ce sens que, par nécessité, il cherche à tirer ses résultats des seules variables les plus essentielles et ne peut donc jouer sur une gamme d'informations aussi riche que les analyses régionales.

Relation à la théorie

En principe, dans une situation idéale, la méthode des études de cas et l'analyse de modèle ne devraient pas différer dans leur relation à la théorie. Après tout, les deux méthodes reposent sur une solide base de constatations empiriques et de connaissances théoriques relatives au rôle des infrastructures de transport dans l'organisation de l'espace.

Et pourtant, il existe des différences dans la manière dont le savoir théorique est appliqué aux processus de recherche. Dans l'analyse de modèle, la théorie joue déjà un rôle de tout premier plan dès la phase de spécification du modèle; en fait, le modèle lui-même n'aurait pu voir le jour sans ce fondement. Il est même permis de dire que le modèle est une théorie (ou une combinaison de théories) sur les activités dans l'espace et leurs interactions, coulée dans la forme d'un algorithme informatique. Cela ne signifie pas la fixation définitive de la (ou des) théorie(s) enchâssée(s) dans le modèle, sans possibilité de changement au cours du travail réalisé avec ce dernier: l'ajustement des paramètres pendant la phase de calibrage permet au modèle de refléter un large éventail de manifestations de la réalité, et la mise au point des paramètres idéaux implique un processus d'apprentissage sur la relation entre théorie et réalité. Toutefois, il peut exister certaines hypothèses fondamentales, élaborées au sein du modèle qui ne peuvent pas être modifiées sans rompre l'équilibre de sa structure entière. Dans le cas de Meplan, une hypothèse de cet ordre est que la localisation des activités économiques et les flux commerciaux et de transport tendent à un *équilibre;* c'est là une caractéristique du modèle qui deviendra déterminante dans la discussion ultérieure.

Bien sûr, les analyses régionales se sont fondées elles aussi sur des considérations théoriques. La sélection des cas étudiés reflétait déjà par elle-même certaines attentes quant aux impacts probables d'un ouvrage d'infrastructure tel que le tunnel sous la Manche. Sans arrière-plan théorique, aucune question déterminante n'aurait pu être posée lors des enquêtes; le fait que le processus de recherche a été planifié à la lumière d'une conception clairement établie est attesté par l'élaboration, dès le début du projet, d'un *Guide des interviews.* Mais malgré cette approche rationnelle, les études de cas présentent une légère différence de relation à la théorie en comparaison avec l'exercice de modélisation. Les conceptualisations a priori y sont en effet toujours restées ouvertes au changement, dans l'éventualité où une information nouvelle et inattendue le rendrait nécessaire, et cela était évidemment plus facile sans modèle prédéfini. Pour subtile que puisse avoir été cette différence d'attitude, il semble que l'élément d'apprentissage ait été plus marqué dans les analyses régionales.

Contenu théorique

Outre la différence de relation à la théorie, les deux approches révèlent, au moins potentiellement, des différences dans leur *contenu* théorique, qui peuvent devenir déterminantes dans la discussion ultérieure des résultats.

Comme décrit au chapitre 5, Meplan est essentiellement un modèle multirégional et multisectoriel d'interaction spatiale, où les interactions spatiales sont dues à la fois aux flux commerciaux et au trafic de passagers. Dans sa partie économique, c'est un modèle fondé sur l'*équilibre*, en ce qu'il part de l'hypothèse que, compte tenu des contraintes imposées par les infrastructures de transport, l'activité économique tend à se déplacer là où les coûts de production, transport compris, sont les plus bas. Selon cette hypothèse, si une barrière spatiale entre deux régions économiques est supprimée ou réduite, le modèle devrait prédire une croissance additionnelle dans la moins développée ou la plus périphérique des deux, où des facteurs de production comme les salaires ou les sols sont à meilleur marché. Cela parce que, sans cet obstacle, ces régions deviennent plus compétitives, avec pour effet qu'elles reçoivent plus d'ordres des régions les plus centrales. Il est vrai que ces dernières deviennent elles-mêmes plus accessibles pour la périphérie, si bien que les régions périphériques peuvent leur acheter davantage; mais comme les régions périphériques sont plus petites et plus pauvres, ces achats n'influenceront que peu la croissance des régions centrales.

La Manche peut être vue comme une barrière spatiale, que le tunnel sous la Manche contribue à supprimer ou à réduire. En conséquence, on peut s'attendre à ce que le modèle Meplan prévoie, *ceteris paribus,* un glissement de croissance, quoique léger, des régions les plus centrales du continent européen vers les îles britanniques plus «périphériques», ou du moins vers leurs parties les plus périphériques, l'Écosse et l'Irlande.

L'effet égalisateur de la suppression d'une barrière est bien connu dans la théorie du commerce international; il a récemment suscité l'intérêt dans le débat sur les impacts attendus de l'intégration économique européenne à venir, en particulier les impacts probables du marché unique européen. Dans ce contexte, les barrières aux échanges commerciaux sont, bien entendu, les douanes et les règlements frontaliers. Selon la théorie économique néoclassique de l'équilibre, une égalisation s'opère du fait que les capitaux se déplacent là où les facteurs de production sont les moins coûteux et le travail, là où les salaires sont les plus élevés. En supprimant les barrières aux transferts de capitaux et aux migrations entre régions d'Europe, le marché unique européen devrait contribuer à égaliser les conditions de vie en Europe et, partant, devrait bénéficier aux régions périphériques.

Ces prévisions ne vont cependant pas sans controverses. Les critiques du concept économique néoclassique de l'équilibre objectent qu'il néglige des effets contrariants comme les économies d'échelle, l'agglomération, les monopoles ainsi que le rôle de l'innovation et des politiques et stratégies économiques publiques; selon eux, ces facteurs font plus que contrebalancer les effets égalisateurs et conduisent donc à une *polarisation.* D'après ce concept de polarisation, la suppression des barrières entre économies nationales au sein du marché unique renforcerait la croissance dans les régions européennes les plus centrales. Dans le contexte du tunnel sous la Manche, le concept de polarisation semble plus populaire parmi les experts et praticiens régionaux. Les références fréquentes à la «banane bleue» et à l'importance d'en faire partie ou d'y être rattaché (par le biais du train à grande vitesse — TGV) s'inscrivent dans ce courant. On peut donc s'attendre à ce que les analyses régionales, qui font appel aux perceptions et aux opinions des décideurs régionaux, tendront davantage à prédire les effets polarisants du tunnel, c'est-à-dire une croissance accélérée du centre aux dépens de la périphérie.

Laquelle des deux hypothèses est-elle vraie? Les résultats du débat en cours sur les implications du marché unique suggèrent que, d'un point de vue théorique, ni le concept d'égalisation ni celui de polarisation ne peuvent être résolument considérés comme prévalents. On fait valoir qu'il est actuellement impossible de trancher sur une base théorique la question de savoir si la suppression des barrières commerciales conduit à l'égalisation ou à la polarisation et que l'aboutissement réel du processus dépend dans chaque cas de la constellation spécifique des relations commerciales (Bröcker, 1990). Toutefois, si l'association opérée ci-dessus entre le modèle Meplan et le concept d'égalisation, entre les analyses régionales et le concept de polarisation, est correcte, on ne devrait pas s'étonner que les experts et décideurs régionaux inclinent à prévoir des gains pour les régions centrales et des pertes pour la périphérie sous l'effet du tunnel, tandis que Meplan tend à prédire des gains pour les régions périphériques auxquelles le tunnel apporte une amélioration significative en matière de transport et des pertes pour les autres régions.

Caractéristiques du modèle

Heureusement, tel qu'élaboré pour ce projet, le modèle s'est révélé globalement apte à répondre de manière solide et fiable aux questions et problèmes politiques posés. Il présente toutefois un petit nombre de caractéristiques susceptibles d'avoir une influence spécifique sur les résultats. Pour interpréter les résultats de Meplan tel que mis en œuvre dans l'étude, il est donc nécessaire d'avoir à l'esprit les traits particuliers suivants du modèle:

— le modèle est orienté vers la demande et ne tient donc pas compte des changements survenus dans l'offre après l'année de référence. En d'autres termes, l'activité économique d'une région est toujours équivalente au total des achats effectués dans cette région et dépend seulement de l'offre de l'année de référence et des changements futurs dans les coûts de production de la région et les coûts des transports interrégionaux, mais ne dépend *pas* des modifications de la capacité de production ou de l'offre de cette région. En conséquence, les dynamiques régionales fondées sur la politique régionale ou sur les décisions d'investissement entrepreneurial au niveau régional ne sont pas reflétées par le modèle;

— en second lieu, une distinction doit être faite entre les résultats, d'une part, pour la production industrielle et agricole et, d'autre part, pour les services et le tourisme. Pour la production industrielle et agricole, les modifications de la valeur ajoutée sont fondées sur les changements dans l'ensemble des flux de marchandises, c'est-à-dire dans la matrice *entière* des relations d'entrée et de sortie, tandis que les changements de valeur ajoutée pour les services et le tourisme se fondent *uniquement* sur les flux de transport trans-Manche, et non pas sur les autres flux de transport en Europe. En conséquence, l'impact de l'amélioration du réseau européen de transport apparaît seulement pour la production industrielle et agricole, alors que l'impact de ce réseau sur les services est fondé sur les seules parties du réseau incluses dans les flux de transport trans-Manche. L'impact du tunnel n'est pas affecté par cette différence;

— une troisième caractéristique du modèle est l'absence de lien entre les changements dans les flux de transport et le secteur économique des transports. Cela signifie, par exemple, qu'un nombre décroissant de passagers des *ferry-boats* sur telle ou telle ligne n'est pas reflété par un déclin du secteur des transports dans la région concernée (par exemple le Kent, le Nord-Pas-de-Calais et West-Vlaanderen);

— les prévisions du modèle sont exprimées en termes de valeur ajoutée, et non en termes d'emploi. Cela signifie que la croissance économique annoncée pour telle région n'induira pas nécessairement une croissance de l'emploi dans cette région;

— les prévisions du modèle partent de l'hypothèse que les prix pratiqués pour le tunnel seraient alignés sur ceux des *ferry-boats,* bien qu'Eurotunnel vise à un prix inférieur de 10 %, en termes réels, à celui des *ferry-boats.* Si le système de fixation des prix s'avérait en fin de compte tout différent, il est alors clair que les prévisions seraient quelque peu modifiées;

— le modèle ne fait pas de distinction entre les différents ports au sein d'une même région. On ne peut dès lors obtenir une estimation directe de l'impact des flux de transport trans-Manche sur un port particulier;

— dans le modèle, les *ferry-boats* opèrent de la même façon qu'aujourd'hui. En conséquence, les efforts de modernisation actuellement consentis par les compagnies de *ferry-boats* et les autorités portuaires pour renforcer leur position compétitive — bateaux plus spacieux, plus rapides et plus luxueux, meilleurs équipements à quai, formalités d'embarquement accélérées... — n'entrent pas en jeu dans Meplan. De même, le modèle ne tient pas compte de la possibilité que des camionneurs intègrent dans leur temps de repos les traversées en *ferry-boat* ou que des touristes considèrent celles-ci comme faisant partie de leurs vacances. Il en découle que le modèle tend à surestimer le nombre de passagers et de camionneurs qui délaisseront les *ferry-boats* pour le tunnel.

Ces caractéristiques du modèle ont été prises en compte dans les conclusions.

Informations sortantes

L'asymétrie constatée entre les informations utilisées dans les deux approches caractérise aussi le type d'information qu'elles produisent.

Ici encore, il n'existe, en principe, pas de limite au type d'information que peuvent produire les analyses régionales, sinon les contraintes de temps. Une étude de cas offre l'occasion de mettre au jour une vaste profusion de faits, de relations, d'opinions, d'attentes et de réponses dans une région donnée. On voit toutefois poindre ici le danger d'une certaine myopie dans la mise en scène de l'«histoire» de la région. En somme, la région étudiée n'est pas le centre d'intérêt réel, mais a été sélectionnée parce que jugée *représentative* d'un éventail significatif d'autres régions confrontées à des problèmes similaires. Mais qu'est-ce qui garantit que ladite «histoire» vaut aussi pour elles? En d'autres termes, le problème des études de cas est celui du degré possible de généralisation. Il existe aussi le danger que l'information collectée dans une région entre en conflit avec celle d'autres régions. L'exemple le plus commun de ce type de fourvoiement est que chaque région étudiée prétende prévoir de tels résultats que, ajoutés à ceux des autres régions, cela aboutisse à des pronostics de croissance totale parfaitement irréalistes. Ce n'est heureusement pas le cas ici. Un autre problème est que les régions étudiées ne constituent que rarement un échantillonnage représentatif de toutes les régions. Dans le cas présent, par exemple, les régions maritimes sont surreprésentées pour des raisons évidentes, ce qui réduit, bien sûr, la «généralisabilité» des résultats.

L'analyse de modèle présente de son côté d'autres atouts et handicaps. À l'évidence, le type d'information qu'elle peut produire est plus limité, du fait de la prédéfinition des informations qu'elle utilise au départ. Il peut se faire que le modèle ne puisse répondre à toutes les questions qui peuvent s'avérer déterminantes au cours du processus de recherche. Un risque plus grave est qu'un modèle trop schématique et réducteur s'avère inapte à saisir les aspects de la réalité qui apparaissent comme les plus essentiels. Toutefois, si l'on a pu éviter ces pièges, les avantages du modèle peuvent être jugés de loin supérieurs à ceux de toute étude de cas, puisque à chaque étape — et dans des limites autodéfinies — le modèle dresse un inventaire complet et entièrement logique non seulement pour les régions étudiées, mais pour toutes les régions. De plus, les prévisions du modèle sont sujettes à des *scénarios* clairement établis d'amélioration des transports tant ferroviaires que routiers, allant du statu quo au plan de grands travaux le plus optimiste, chaque fois *avec* et *sans* le tunnel sous la Manche. Si le modèle ne peut fournir sur une région particulière une information aussi spécifique et détaillée que celle produite par les études de cas, il fait énormément plus en intégrant l'information sur les différentes régions dans un cadre cohérent et logique.

6.1.2. Flux d'information entre les deux approches

Comme déjà mentionné, les deux parties de l'étude ont été menées parallèlement, et les résultats du modèle n'ont été disponibles qu'après l'achèvement des analyses régionales. Cela implique que des résultats intermédiaires pouvaient seulement être transférés des analyses régionales au modèle, et non l'inverse.

Trois types d'information ont en particulier été communiqués à l'équipe de modélisation par les auteurs des analyses régionales:

— *réseaux:* les auteurs des analyses régionales ont fourni, par étapes, la liste des améliorations des liaisons ferroviaires et routières attendues dans les régions étudiées, en mettant spécialement l'accent sur le calendrier d'achèvement prévu des lignes de TGV. L'équipe de modélisation s'est fondée sur cette liste pour établir les scénarios d'évolution des réseaux à simuler grâce au modèle (voir chapitre 5);

— *impact sur les flux de transport:* dans les analyses régionales et au cours des interviews, nombre d'hypothèses et d'attentes ont été mises en avant quant aux effets probables du tunnel sous la Manche (en conjonction avec les progrès du TGV et du réseau autoroutier) sur les flux de transport et sur les glissements probables entre modes de transport, en particulier la compétition intermodale entre rail et *ferry-boats,* rail et route, rail et air. L'équipe de modélisation a utilisé ces hypothèses pour évaluer la plausibilité des résultats au cours du processus de validation du modèle;

— *impact sur le développement régional:* en fonction du paysage sectoriel de chaque région, différentes activités y seront probablement affectées par le tunnel sous la Manche. C'est pourquoi les auteurs des analyses régionales ont fourni à l'équipe de modélisation des hypothèses préliminaires sur les impacts économiques auxquels il semblait falloir s'attendre dans les régions étudiées ainsi que sur les secteurs concernés. Cette information a servi à l'équipe de modélisation à vérifier si le modèle pouvait traiter les questions posées dans les analyses régionales sur l'avenir de telle ou telle activité.

Par ailleurs, cinq réunions internes au projet et deux ateliers plus larges ont permis aux deux équipes de rencontrer l'ensemble des acteurs concernés pour discuter des progrès du travail et des nouvelles questions surgies tant des analyses régionales que du processus continu de spécification et de calibrage du modèle. De plus, des membres de l'équipe d'analyse régionale de l'IRPUD (Dortmund) ont passé en tout quatre semaine aux côtés du ME & PE, à Cambridge, pour seconder l'équipe de modélisation dans la mise au point du modèle, en évaluant les résultats du premier calibrage et en établissant les scénarios de réseaux.

6.1.3. Et en cas de désaccord?

Tout le possible a été fait, au cours de ce processus intensif d'échange d'informations et de consultation, pour assurer que les deux parties de l'étude aboutissent à un ensemble logique de résultats. Aucun mécanisme ne pouvait toutefois garantir que les résultats seraient identiques dans tous les cas. En fait, il apparaîtra clairement dans les sections suivantes que, sous certains aspects, les résultats du modèle ne concordent pas avec ce que les acteurs régionaux considèrent comme le développement le plus probable. Dans la présente sous-section, on examinera ce qui peut être fait dans le cas d'une telle divergence, en vue d'établir un jugement pertinent sur la plausibilité des opinions en présence.

Il existe, en principe, trois manières de procéder si les résultats du modèle et les opinions des experts ne concordent pas:

1) dans le cas idéal, un nouveau cycle de recherche serait ouvert, et on confronterait les partenaires de l'enquête avec les prévisions divergentes du modèle et les hypothèses qui ont conduit à ces prévisions. Une possibilité serait que les experts régionaux révisent leurs pronostics après s'être rangés au raisonnement qui sous-tend les résultats du modèle. Ou bien, ils maintiendraient leur point de vue et apporteraient peut-être d'importants éclaircissements montrant en quoi les prévisions du modèle sont probablement erronées. Dans ce cas, il pourrait valoir la peine de revoir la spécification du modèle à la lumière des éléments nouveaux pour aboutir à une nouvelle gamme de prévisions. En raison des contraintes de temps, il est malheureusement exclu, en l'occurrence, de faire ce choix idéal de réitération du processus de recherche;
2) une autre issue possible serait de décider laquelle des positions en présence s'appuie clairement sur une estimation préalable de la fiabilité des deux méthodes. Les tenants d'une approche «purement» scientifique tendraient à se fier davantage aux prévisions du modèle, tandis que les héritiers d'une formation en sciences sociales pourraient contester les résultats d'un modèle quel qu'il soit et ne faire foi qu'à l'expérience et à la sagesse pragmatique des experts régionaux. L'une comme l'autre de ces décisions prêteraient le flanc aux critiques par manque d'un fondement solide;
3) une troisième attitude consisterait à n'écarter aucune des prévisions controversées sur la base d'un a priori, mais tenterait d'identifier les causes de leur divergence. Cela impliquerait de les relier aux concepts théoriques sous-jacents aux deux approches, que ce lien soit explicite, comme dans le modèle, ou implicite, comme c'est le cas pour les acteurs régionaux. Ce n'est que s'il est possible d'expliquer les différences de prévisions par des différences d'hypothèses et de mise en perspective qu'il sera possible d'aboutir à un jugement pertinent sur la validité des résultats et des hypothèses. En outre, un tel jugement devrait s'appuyer sur une confrontation avec d'autres études régionales existantes, afin de faciliter l'issue de la controverse. C'est cette troisième approche que l'on suivra ici.

Table 6.1. Kent: Impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* Transfer of about half of ferry traffic to Tunnel from Channel ports. No shift of freight from road to rail. Some shift in short-distance cross-Channel air transport to Tunnel likely. *b* Reasonable, but as there are no effective network improvements, this depends critically on assumptions on prices of the competing modes. *c* Results not available from the model.
Extended network C1	Ferries	*a* Tunnel will be a significant competitor. Dover will lose traffic due to its location and nature of its trade. Folkestone ferry traffic will move to Dover; north Kent ports will not suffer. *b* Reasonable expectation, even in this Tunnel access region the impact on ferry routes depends on the intraregional location of the ports. *c* Although the total cross-Channel traffic will grow significantly, the forecasts of traffic for the Kentish ferries are negative. In 2001, there will be a passenger loss of 38% and even a loss of 67% of accompanied ro-ro traffic compared with 1991 values. Only unaccompanied ro-ro traffic is slightly increasing with 11%. The predicted losses of potential ferry traffic in 2001 are much more significant. The C1 scenario has 35% less car travel, 70% less coach excursions and 80% less rail passengers in 2001 than C, and 70% less accompanied and 11% unaccompanied ro-ro traffic.
Extended network C1	Road	*a* Shift to rail for some through-traffic, but road traffic will continue to grow. *b* Plausible, unless active restraint measures are used or public transport subsidized on UK side. *c* The Tunnel will cause no change in passenger car or coach mode split for travel between Kent and the Continent. 40% of car traffic and 70% of coach traffic are forecast to use the Tunnel, this will add 25% to all passenger kilometres travelled in Kent. The Tunnel will produce a significant modal shift in ro-ro traffic, both accompanied and unaccompanied, to container rail transport (10% and 5%, respectively). Of the remaining accompanied ro-ro traffic 70% will use the Tunnel. Even with this shift to rail, total lorry traffic in Kent grows.
Extended network C1	Rail	*a* Shift of freight from road to rail. For passengers, the use of through-rail from Kent depends on the implementation of Ashford international station. *b* Reasonable expectation. *c* Increase of 7% in passenger rail modal split, generally at the expense of air transport. Significant shares of ro-ro traffic will shift to rail container transport.
Extended network C1	Air	*a* Unlikely to have much effect on London airport traffic, apart from London-Paris, London-Brussels and a few other routes. Development of smaller aiports in Kent will be further discouraged. *b* Reasonable, only short-distance routes affected, main business and holiday routes will remain air markets. *c* Air modal split is forecast to decrease by 7%.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Kent: Conclusions on transport flows

Kent has to face increasing traffic volumes, mostly on roads, flowing through the region as a result of a general growth of cross-Channel traffic and of additional traffic attracted by the Tunnel. Only with a clearly improved rail link between the Tunnel and London and other UK regions is it possible to transfer some road traffic to rail. A high-speed rail line from London to the Tunnel is likely to cause a significant shift from air to rail; mainly short-distance flights to/from the Continent may be affected. A significant portion of ro-ro traffic can be expected to shift to container rail transport if an appropriate through-rail service is implemented.

Within a fast-growing cross-Channel transport market, the Tunnel will take over a significant portion of the traffic that would be transported by ferry. Ferries between Kent and mainland Europe will suffer after the Tunnel starts operating. Despite the increase in cross-Channel traffic, ferries from Kent will carry about 30% passengers and nearly 70% accompanied lorries less in 2001 than in 1991. However, the various Kent ports are differently affected: Folkestone ferry traffic will move completely to Dover; Ramsgate may also close. Dover will lose a substantial volume of traffic. Ports in north Kent are not seriously affected.

Table 6.2. Nord-Pas-de-Calais: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* All transport flows are expected to grow. *b* Reasonable expectation. Calais and Lille will become major intermodal centres for both passenger and freight traffic. *c* Results not available from the model.
Extended network C1	Ferries	*a* In contrast to Eurotunnel, other regional actors do not expect a great loss of ferry business, in particular not for freight. None of the ferry companies expect to go out of business. *b* Calais may lose some ferry passengers but the general increase in Channel traffic will offset this loss. Boulogne will seriously suffer and has to rely on fishing. Dunkirk with only marginal Channel traffic hardly affected. *c* No separation between different Nord-Pas-de-Calais ports. Compared to 1991, there will be 40% less passengers in 2001, 66% less accompanied and 26% less unaccompanied ro-ro traffic. Without the Tunnel, however, the number of ferry passengers in Nord-Pas-de-Clais would have almost doubled. Compared to the potential traffic without the Tunnel in 2001 this means 35% less cars, 70% less coaches and 80% less rail passengers, and 70% less accompanied and 25% less unaccompanied ro-ro traffic.
Extended network C1	Road	*a* The completion of motorway projects should enable the region to cope with the increasing number of cars and lorries using the Tunnel. *b* Access roads to the Tunnel might be congested, especially those to Belgium. *c* The Tunnel will increase passenger kilometres travelled in Nord-Pas-de-Calais by 25% (in 2001) despite a 3% model shift from car to rail. 15% of ro-ro traffic will to container rail transport on through-trains. Over 50% of car traffic will use the Tunnel, but approximately 90% of coach traffic.
Extended network C1	Rail	*a* Nord-Pas-de-Calais passengers will increasingly use rail as the TGV has many stops in the region and other cities will be well connected through an improved regional network. Shift from road to rail-freight transport. *b* Reasonable expectation. Lille will become a major international rail hub. *c* In 2001, the high-speed rail alone attracts already 55% of all passengers travelling from/to the Nord-Pas-de-Calais region across the Channel. The Tunnel adds only 2% more passengers, resulting in 57%.
Extended network C1	Air	*a* No expected impact reported. *b* No growth potential for London connections. *c* Slight decrease in cross-Channel passenger air modal split.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Nord-Pas-de-Calais: Conclusions on transport flows

Nord-Pas-de-Calais should expect comparable impacts of the Channel Tunnel on transport flows as Kent. There will be increasing amounts of traffic, mostly on roads, with resulting congestion on many access roads. Some shift to rail is forecast at the expense of air for passengers. A significant shift of ro-ro traffic to container rail transport is predicted if the corresponding rail services and infrastructures in other European regions will be implemented. Nord-Pas-de-Calais will become a major international transport hub, in particular with respect to rail.

As in Kent, the Tunnel will take a significant portion of the growth of traffic that would otherwise be transported by ferry. At the beginning of the next century, ferries from Nord-Pas-de-Calais to the UK will carry 40% less passengers than in 1991, despite a general increase in cross-Channel passengers. There will be also a major negative impact on ro-ro traffic; in 2001 ferries will carry only a third of the accompanied and three quarters of the unaccompanied ro-ro traffic of that carried in 1991. Again, the intraregional impact of these losses is unequal: the ports of Boulogne and Calais will suffer most, whereas Dunkirk is less affected.

Table 6.3. West-Vlaanderen: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited	All modes	*a* Loss of passengers and freight to Dover, but not to mid-England. Loss of rail passengers. Unaccompanied trailer traffic not affected. Consequently, Ostend ferries operated by the State-run RMT are seriously affected, Zeebrugge ferries only slightly affected. *b* Reasonable expectation. The result is the decline of Ostend and a more positive development in Zeebrugge. The response of the ports supports this view. *c* Results not available from the model.
Extended network C1	Ferries	*a* Same impacts as in Scenario B1. *b* Reasonable expectation, because the main infrastructure improvements affecting West-Vlaanderen are already made in B1. *c* Overall, there is a 11% decrease of ferry passengers forecast by the model compared with 1991, and a 69% decrease for accompanied ro-ro traffic. Only unaccompanied ro-ro traffic is forecast to increase with 14%. Without the Tunnel, however, the number of ferry passengers would have more than doubled. Compared with the hypothetical situation without the Tunnel, ferries carry 70% less rail, 75% less coach and 35% less car passengers and 70% accompanied, 5% unaccompanied and 10% other container traffic. Differentiation between the two West-Vlaanderen ports not included in the model.
Extended netword C1	Road	*a* Major transit region between central and north Europe and the UK for Tunnel and ferry-bound traffic. *b* Reasonable expectation. West-Vlaanderen has to carry a large part of the overall growth in traffic between central and north Europe and the UK. *c* Car mode split between West-Vlaanderen and the UK decreases slightly with the Channel Tunnel, the absolute number of cars, however, remains more or less the same as a result of the increase in tourism. Total passenger road traffic in West-Vlaanderen increases as a result of increasing tourism and gains in through traffic (+8% passenger kilometres). 70% of ro-ro traffic shift from West-Vlaanderen ports to the Tunnel.
Extended network C1	Rail	*a* Shift of rail passengers from Ostend to the Tunnel. *b* Reasonable, the international train services to Ostend will be discontinued. *c* Large losses of rail passengers at West-Vlaanderen ports. There is a small shift from ro-ro to container rail transport.
Introducing jumbo ferries	Ferries	*a* With increasing comfort and capacity the ferry companies are able to stay in the cross-Channel market. *b* Reasonable expectation, only by reducing costs and increasing service will the ferries successfully compete with the Channel Tunnel and also with other ferry lines and cross-Channel ports. *c* Not tested in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

West-Vlaanderen: Conclusions on transport flows

West Vlaanderen will become a major transit region between the UK and central and northern Europe for Tunnel and ferry traffic. Consequently the traffic on roads will grow significantly. The number of foot passengers on the ferries will decrease as international trains run directly through the Tunnel.

However, due to the general growth in traffic, there will be only a 10% decrease in ferry of passengers in 2001 compared with 1991 (taking all West-Vlaanderen ferry lines together). The impact of the Tunnel on accompanied ro-ro traffic, mostly on the short sea crossings, will be much more serious: the ferries will carry only about one third of today's lorries with drivers, the rest will mostly switch to the Tunnel or container rail transport. The impact on individual transport flows depends on the route: only the short sea crossings to Dover and other nearby ports are seriously affected, with the consequence that Ostend will critically suffer, whereas Zeebrugge with most ferry lines running to mid and northern England destinations is less affected. However, in absolute numbers accompanied ro-ro is not as important for West-Vlaanderen as unaccompanied ro-ro traffic. The latter is not affected and will continue to grow in future. West-Vlaanderen will therefore maintain its position as the most important continental freight hub for cross-Channel ferry transport.

Table 6.4. Hainaut: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* Hainaut's position at the crossroads of the Paris-Brussels and Lille-Liège-Cologne railroads and highways makes it a communication intersection centred on Mons and in the western parts of the region. Flows of passengers and freight between the Tunnel and Germany might go through Hainaut. *b* Reasonable, but finishing the motorways and choosing the TGV route are dependent on political choices between Flemish and Walloon areas. *c* Results not available from the model.
Extended network C1	Sea	*a* No impact expected. *b* The completion of the Tournai-Kortrijk motorway would link Hainaut better to the port of Zeebrugge and would reinforce its role as competitor of the Tunnel in the freight market. *c* No impact.
Extended netword C1	Road	*a* The completion of the A8 between Tournai and Brussels could attract most traffic between the UK and Germany. *b* The Tunnel opening should reinforce the use of the east-west motorway crossing Hainaut. Together with the improved north-south connections such as Toumai-Kortrijk, Charleroi-Maubeuge and Charleroi-Reims the consequence will be increasing through-traffic in the region. *c* With the implementation of the Tunnel, car and coach traffic between Hainaut and the UK decreases. The Channel Tunnel causes an 8% decrease in passenger kilometres travelled in Hainaut, as through-traffic shifts from car to rail. Nearly 50% of car and coach traffic between Hainaut and the UK will use the Tunnel and 70% of accompanied ro-ro traffic. There is a 10 to 15% shift in ro-ro traffic to rail container.
Extended network C1	Rail	*a* The region will probably be crossed by a new railroad line without a station. Compensations are asked for. *b* The TGV may lead to some shift from road to rail in passenger transport, but an improved rail access to the TGV stations outside the region is a necessary condition. Only marginal impact on freight transport, because Belgian carriers are not very interested in rail transport or intermodal transport (the road-rail platforms tend to remain underloaded). *c* A 5% shift to rail in cross-Channel passenger transport. Marginal gains in rail-freight transport at the expense of ro-ro traffic.
Extended network C1	Air	*a* The development of Charleroi airport is proposed as an alternative airport to Brussels. *b* Charleroi will increasingly compete with Lille which is more important. *c* There is a 3% shift from air to rail, but the decline is compensated by the increase in tourism and business travel.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Hainaut: Conclusions on transport flows

Hainaut remains a transit region with increasing through-traffic on roads and rail. Passengers and freight between the Tunnel and parts of Belgium and Germany might go through Hainaut if the TGV is implemented and the missing links in the motorway network are completed. Every second car and two of every three lorries between Hainaut and the UK will use the Tunnel. [only small shifts of passengers and freight to rail can be expected;] With the non-stop TGV line in the region and the attitudes of Belgian carriers. [ ].

Table 6.5. Zeeland: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* No impact. *b* Reasonable expectation because Zeeland remains an island between major transport corridors. *c* Results not available from the model.
Extended network C1	Ferry	*a* Small impact on Vlissingen-Sheerness ferry. Only marginal time savings for Tunnel passengers. Passenger loss of 10 to 15% on day services, none on night services in the first years of Tunnel operation. No losses on goods transport. *b* Reasonable expectation. Ferry line has certain advantages compared to the Channel Tunnel. *c* Compared to 1991 there is a loss of 17% car passengers in 2001. However, without the Tunnel this number would have grown by about 30%. Significant losses of growth potential are also predicted for accompanied ro-ro traffic. However, these impacts may be magnified as the model does not explicitly take into account the possibility of drivers using ferry crossing time toward their required rest periods or the high quality of service offered to passengers on this line.
Extended network C1	Road	*a* Strongest of all impacts if road bottlenecks toward Rotterdam and Belgium are removed. *b* Most traffic between the Netherlands and the Tunnel will pass through Zeeland. *c* The implementation of the Channel Tunnel (comparing Scenario C1 and C) will lead to an additional increase by 13% in road passenger kilometres for Zeeland. There are marginal increases in car/coach modal split for Zeeland/UK passenger travel. 40% of car and 70% of coach traffic of cross-Channel passenger traffic from Zeeland will use the Tunnel; so will 70% of ro-ro traffic, although the absolute changes are marginal.
Extended network C1	Rail	*a* No impact, as there is no direct access to the high-speed rail network and the rail link to the Tunnel is very inconvenient with a long detour. *b* Reasonable expectation. *c* There is a slight shift of rail passenger to car. No shift in freight mode is predicted.
Introducing jumbo ferries	Ferry	*a* Increasing capacity and comfort will enhance the competitive position of the Vlissingen-Sheerness ferry line. *b* Reasonable expectation. The jumbo ferries are already operating. *c* Not tested in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Zeeland: Conclusions on transport flows

Zeeland will only feel an impact of the Tunnel on transport flows in the region if the Westerschelde crossing is implemented. But in that case, the region will become the transit region for large parts of the Netherlands to the Tunnel. The impact on the volume of passengers and ro-ro traffic of the ferry line between Zeeland and Sheerness is negligible.

Table 6.6. Cologne: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* No change in modal split. *b* Reasonable expectation, because, there is no real improvement in rail in B1. *c* Results not available from the model.
Extended network C1	Road	*a* Some shift to rail. *b* Reasonable expectation, but general growth in road traffic will conceal this shift. *c* Very small shift from car to rail in Cologne/UK passenger travel. This decrease, however, is compensated by overall growth in tourism and business travel so that in absolute terms there is an increase in car travel. Nearly 50% of passenger cars and 70% of coaches between Cologne and the UK will use the Tunnel. The model estimates a 5% shift of cross-Channel ro-ro traffic to rail.
Extended network C1	Rail	*a* Increasing use of rail to the UK by passengers and goods. *b* Reasonable expectation, because the time-saving is enormous compared with today. Cologne will become the most important German international rail hub. Not only shift to rail, but generation of new traffic between Cologne and the UK. *c* The model predicts a 5% increase in the modal share of rail passengers. This increase is even more significant when seen together with increasing tourism and business travel (40% increase in cross-Channel passenger flows). There is a marginal shift in freight transport between Cologne and the UK from road to rail.
Extended network C1	Air	*a* Airport authority and Lufthansa do not expect any impact on air traffic to/from UK. *b* Air traffic to UK will be negatively affected, passengers will partly shift to rail as travel times by rail will become equivalent to air. But general growth in air traffic will compensate for this shift in the long term. *c* The model predicts a 6% shift from air to rail for trips between Cologne and the UK.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Cologne: Conclusions on transport flows

Cologne will attract all rail traffic from the Tunnel to Germany and northern and eastern Europe if the high-speed rail link Brussels-Cologne is built. In this case, there will be an increasing volume of rail passengers between Cologne and the UK as the time-saving is enormous compared with today. Besides Tunnel-generated traffic, there will also be a significant shift of cross-Channel air traffic towards rail. There will also be some shift of freight traffic to rail.

Table 6.7. Bremen: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* No impact on transport flows without improved transport infrastructure. *b* Reasonable expectation, the relative accessibility of the region will not change. *c* Results not available from the model.
Extended network C1	Sea freight transport	*a* No impact, because freight handled by Bremen has high affinity for sea transport. *b* No impact on sea-freight transport between Bremen and the UK. No shift of freight to the Tunnel. *c* No change predicted.
Extended network C1	Road	*a* No impact. Tunnel is no real alternative for goods transport by road between Bremen and the UK. *b* Reasonable expectation, because of long detour and the possibility for drivers to take required rest time on Dutch or Belgian ferries. *c* The shift from truck to rail for freight transport is insignificant. Not many car and coach passengers from Bremen to the UK will shift to rail, but many will use the Tunnel (40% for car and 70% for coach).
Extended network C1	Rail	*a* No impact. Shift to rail for freight to the UK not attractive because goods for the UK come by truck from nearby regions to Bremen ports. *b* Possibility of unbroken rail transport from/to the UK changes the transport cost balance in the more distant hinterland, but because of the small transport volume between the UK and Bremen, the impact is marginal. *c* The model predicts a 5% shift from air to rail between Bremen and the UK.
Extended network C1	Air	*a* No impact expected. *b* Reasonable expectation. *c* The model predicts a 5% shift from air to rail between Bremen and the UK.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Bremen: Conclusions on transport flows

Bremen will hardly be affected by the Tunnel in terms of transport flows. The pattern of sea transport to/from the UK will not change. However, there will be a slight increase in the use of rail by people travelling between Bremen and the UK as a combined effect of the European high-speed rail network and the Tunnel.

Table 6.8. Brittany: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* With the coastal motorway and the TGV linking Brittany to other European regions, but with a limited network in Great Britain and a mediocre quality of Tunnel services, the ports will keep the main part of their cross-Channel traffic. *b* Reasonable expectation. *c* Results not available from the model.
Extended network C1	Ferries	*a* Main regional concern that railway or road traffic from Brittany or Spain and the French south-west towards the UK could be diverted to other Channel ports or the Tunnel. It was also considered possible that the ferries may become unprofitable. *b* Fear that some traffic will bypass Breton ports seems reasonable. But the expected increase of traffic will probably maintain the level of Breton ferry traffic. *c* According to the model, Breton ports will not be negatively affected by the Tunnel. Compared with 1991, increased traffic flows are predicted: 71% for passengers and about 25% for ro-ro. Only when compared with the potential traffic without the Tunnel (Scenario C) are decreases predicted, with ports forecast to carry 10% less car and 50% less rail passengers.
Extended network C1	Road	*a* Concern that the region will become a transit region between south-east France and Spain and the Tunnel and Channel ports if networks outside the region, mainly in the UK are improved. *b* Possible, but depending on the destination in the UK and the services offered by the ports and ferries. *c* A 5% shift from car to rail is forecast for passenger traffic with the implementation of the Tunnel. Total passenger car traffic, however, does not decline because of the compensating effects of increased cross-Channel tourism. In fact, total passenger kilometres in Brittany increase by 8%. Only 8% of cross-Channel car traffic is forecast to use the Tunnel; 24% of coach traffic. The share of ro-ro freight traffic remains basically unchanged with approximately 15% of accompanied traffic using the Tunnel.
Extended network C1	Rail	*a* Implementation of the high-speed network outside the region could divert traffic to the UK away from Breton ports. An improved rail link between Saint-Malo and Rennes may counterbalance this. *b* Reasonable, but overall impact of rail only small. *c* The model predicts a 5% increase in cross-Channel passenger rail traffic; largely at the expense of car traffic. There is a slight shift from ro-ro to rail container traffic with the implementation of the Tunnel.
Extended network C1	Air	*a* No expectation of impacts reported. *b* No impacts. But air services are only good at a regional-national level. Improvements are necessary to reach international level services. *c* No impact.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Brittany: Conclusions on transport flows

Brittany fears a decline in its ferry lines to the UK. The model does predict losses due to the introduction of the Tunnel; however, these are more than compensated by growth in cross-Channel traffic with the result of an overall gain through time in the ferry business in the region.

Table 6.9. Piemonte: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* It is feared that the road network will become congested and that the traffic from and to the region will suffer if transalpine connections are not improved. No expectations from the Channel Tunnel itself. *b* The traffic increase might generate both a diversion towards Liguria-Côte-d'Azur and Lombardia, and growing road congestion. *c* Results not available from the model.
Extended network C1	Sea	*a* No perceived impact. *b* Most of the goods exchange with the UK being by sea, any land network improvement will divert part of these exchanges from sea to road or rail. *c* The model predicts a 10 to 15% shift from ship to rail for general value unitized goods.
Extended network C1	Road	*a* The fear of future congestion of alpine roads towards France and northern Europe is commonly expressed. It turns into a growing demand for new motorways and road tunnels. *b* Without a new Alpine tunnel crossing, Piemonte may be disadvantaged compared with other regions. *c* Little change of modal split between Piemonte and the UK, but 35% of cars and 70% of coaches will use Tunnel. 35% of accompanied and 15% of unaccompanied ro-ro traffic between Piemonte and the UK will shift to rail with the Tunnel.
Extended network C1	Rail	*a* There is a general distrust rail transport due to the situation and policy of Italian railways. It is not generally thought there will be a through high-speed rail connection between Turin and London through the Tunnel before 2015. *b* A TGV line reaching Turin may initiate a complete change in transport behaviour and policies against the supremacy of the car. *c* There will be a 5% shift of passengers from air to rail between Turin and London. In freight transport, the shift to rail will be 30 to 35% from ro-ro and 15% from shipping.
Extended network C1	Air	*a* A through TGV Turin-London might divert a part of tourist traffic from air to rail. *b* This change might be increased by the take-off/landing difficulties at Turin-Casella Airport. *c* There will be a 5% shift of passengers from air to rail between Turin and London.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Piemonte: Conclusions on transport flows

Piemonte fears increasing road congestion unless its transalpine rail and road connections are improved rather than an impact of the Tunnel. However, with an improved rail network, there will be a significant shift of cross-Channel passengers from air to rail, and a shift of unitized goods that dominate the trade of Piemonte with the UK from sea transport to rail. In this sense, Piemonte is a good example of an important synergy effect between the Channel Tunnel and other infrastructure developments such as the Alpine tunnels.

Table 6.10. Scotland: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* Without network improvements in the UK, there will hardly be a shift in modal split. *b* Reasonable expectation. *c* Results not available from the model
Extended network C1	Ferries	*a* No change expected. *b* No change expected. *c* No change is predicted.
Extended network C1	Road	*a* Shift to rail for some through traffic if prices are right. Road traffic will grow. *b* Plausible, unless road traffic restraint measures are used or public transport is subsidized on UK side. *c* In passenger transport between Scotland and the Continent there will be no significant shift from road to rail, but 25% of cars and 75% of coaches are forecast to use the Tunnel. In freight transport there will be a 5% shift from ro-ro to container rail. Nearly 70% of all lorries will use the Tunnel; this estimate may be somewhat inflated as the model does not take into account the possibility of drivers using the ferry crossings toward their required rest time.
Extended network C1	Rail	*a* Through rail may capture a little passenger or freight traffic if access is easy and prices are competitive. *b* Reasonable expectation. *c* There will be a 4% shift from air to rail through the Tunnel and a 5% shift from road to rail for containerized freight traffic between Scotland and the Continent.
Extended network C1	Air	*a* Unlikely to have much effect on air traffic between Scotland and mainland Europe. *b* Difficult to see any significant switch from air to rail. *c* The model predicts a 4% shift from air to rail traffic between Scotland and the Continent.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Scotland: Conclusions on transport flows

Scotland should expect no major shift in modal split, other than some change towards rail for both passengers and freight. However, this change depends on whether through trains will operate between Scotland and the Continent. Unaccompanied ro-ro traffic will continue to mainly use the north-east and Humberside ports. Lorries which now use the Dover route will switch to the Tunnel.

The situation of Scotland with respect to the Channel Tunnel highlights the critical importance of UK transport policy for the northerly UK regions. It would be interesting to speculate on the impacts of a clearer commitment of the British Government to modernizing British Rail even beyond the improvements now proposed on the location of northern England and Scotland in Europe, however, this is beyond the scope of this study.

Table 6.11. Ireland: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* Not much change in modal split between Ireland and the Continent expected unless road and rail links to and from west British ports are improved. *b* Depends on price and service offered. *c* Results not available from the model.
Extended network C1	Ferries	*a* Some switch to Tunnel by passengers, but ferries on direct routes to the Continent improve service to compete with Tunnel. With the Tunnel, increased potential for Irish ferries of winning back freight traffic now going to England via Northern Ireland. *b* Main impact of Tunnel will be improved ferry service. *c* According to the model, Irish ferries to mainland Europe will not be affected by the Tunnel. In particular the total numbers of passengers will continue to grow. The model also predicts a slight increase in rail and coach-ferry passengers travelling through Irish ports to the UK on their trips to the Continent.
Extended network C1	Road	*a* No shift from lo-lo freight traffic between Ireland and the Continent. Shift to Tunnel by ro-ro depends on price. There is likely to be some shift of passengers. *b* Plausible. *c* The share of people travelling by car or coach between Ireland and the Continent will remain almost unchanged; 15% of all cars and 70% of all coaches will use the Tunnel. There will be no shift of freight traffic between Ireland and the Continent, but 60% of all lorries will use the Tunnel. No change is forecast for lo-lo traffic.
Extended network C1	Rail	*a* In the short term no shift of freight to rail is likely. Lo-lo on direct routes to the Continent is quicker and cheaper. Perhaps there will be some shift of passengers to rail if price and service are good. *b* True due to lack of rail investment in the UK. *c* The model predicts a 3% shift of passengers between Ireland and the Continent from air to rail through the Tunnel.
Extended network B1	Air	*a* Unlikely to have much effect. b Maybe some loss to road by tourist traffic. *c* The model predicts a 3% shift of passengers between Ireland and the Continent from air to rail through the Tunnel.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Ireland: Conclusions on transport flows

Ireland will face no shift in modal split caused by the Tunnel unless road and rail links from and to the ports on the British west coast are improved. Even then, the direct ferries between Ireland and the Continent will not be affected, except in a decrease of growth potential. People travelling by car via the UK to mainland Europe and lorries on the same route will take advantage of the Tunnel.

Table 6.12. Pais Vasco: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* No significant change is expected to occur with the limited network, i.e. without a full connection of the region to the European high-speed rail system. *b* This does not look unreasonable. *c* Results not available from the model.
Extended network C1	Sea	*a* Port authorities are considering the challenge of the Tunnel at a theoretical level, but they believe it is a long-range problem. Firms providing maritime transport with the UK show no concern about rail and road competiton. *b* With the full rail connection, part of the sea traffic should be attracted by rail. The proportion of diverted sea traffic depends on the quality and diversity of the rail services offered. *c* No change predicted.
Extended network C1	Road	*a* The road-transport industry shows no specific concern since transport with the UK is very scarce at present. Thus business can only increase with the Tunnel. They see no threat from rail because of costs and inefficiency of the Spanish railways. *b* **Nevertheless road traffic should be affected by a high-speed rail connection with attractive services and competitive travel times.** *c* The model predicts no change in car passenger transport between Pais Vasco and the UK and only a slight increase in coach traffic; 70% of all coaches will use the Tunnel. Accompanied ro-ro continues to dominate the transport of high-value goods with 30% forecast to use the Tunnel.
Extended network C1	Rail	*a* It is not generally throught in the region that there will be a connection to the European high-speed rail system in the short or medium term. *b* **With the connection, there should be a deep change in the traffic orientation that will strongly benefit the rail mode.** *c* No change in passenger traffic predicted. No changes forecast for freight transport as ro-ro and **sea** transport continue to dominate.
Extended network C1	Air	*a* No mention of any significant change in air transport. *b* The flow of international passengers is very low and long-distance business travel is not likely to be diverted to rail. *c* Slight decrease in the share of air passengers between Pais Vasco and the UK in line with the decline of British tourism to Pais Vasco after the implementation of the Channel Tunnel.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Pais Vasco: Conclusion on transport flows

Pais Vasco should expect no change in modal split in cross-Channel traffic unless its access to the European high-speed rail network is improved. If a link between the Spanish and French railway systems is established, a shift from road to rail might occur. However, for freight transport, ro-ro and sea transport will continue to dominate. Only one third of the lorries going to the UK from Pais Vasco will take advantage of the Tunnel.

Table 6.13. Norte: impacts on transport flows

Policy	Flows	Impacts *a, b, c*
Limited network B1	All modes	*a* Few changes expected if the road and rail connection to the European motorway and railway systems are not completed. *b* Possibly true. But the sea-transport operators need to modernize their methods and equipments anyway. *c* Results not available from the model.
Extended network C1	Sea	*a* Long established practices of goods and passengers transport between Norte and the UK will change. Port actors are aware that they have to improve their organization and productivity. *b* **A diversion of sea traffic towards road and rail can be expected if the standard-gauge rail connection through Spain will be implemented.** *c* No change predicted.
Extended network C1	Road	*a* No significant increase of road traffic may be expected if there is no major improvement of the direct road link from Norte to the Spanish border and Pais Vasco. This improvement is not included in Scenario C1. *b* Reasonable expectation. *c* No change in car-passenger transport predicted. The share of coach travel between Norte and the UK does not change, however, 70% of it is forecast to travel via the Tunnel. There is a slight shift of high-value freight between Norte and the UK from ro-ro to rail; 25% of all lorries are forecast to use the Tunnel. Note that this forecast may be somewhat inflated as the model does not take into account drivers using ferry crossings as part of their required rest periods.
Extended network C1	Rail	*a* Nobody is expecting radical changes in rail-transport conditions. Local improvements might favour a slight growth of rail traffic. *b* **If the connection of Portugal and Norte to the high-speed rail network will occur without a simultaneous improvement of the road link to the European motorway system, then rail traffic will grow quite strongly.** *c* No shifts in passenger modal split between Norte and the UK as air continues to dominate for cross-Channel tourist and business travel. There is, however; a marginal shift from ro-ro to rail for high-value containerized goods transport across the Channel.
Extended network C1	Air	*a* No change expected. *b* No big change to be expected. *c* No change predicted.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Norte: Conclusions on transport flows

Norte is outside the Channel Tunnel's area of influence of transport flows. However, together with the improvement of the Iberian transport system, the Tunnel could reduce travel time from Portugal to the UK by nearly one day and make the land route competitive with the sea route, in particular for high-value goods transport. The main impact will be a slight shift from lorry to rail for high-value containerized goods.

Conclusion of the confrontation

The number of cross-Channel passengers (including air) was 67 million in 1986 and will rise to 84 million in 1991. According to the model, this numbers will steadily continue to increase with 107 million cross-Channel passengers predicted for 1996 and 135 million for 2001. These predictions of Meplan are higher than other forecasts. But the reason for this difference lies in different definitions of cross-Channel air passengers which in Meplan include passenger movements between the UK and Ireland and all continental airports.

These differences, however, do not affect cross-Channel surface trips which are unambiguously defined and reliably counted. As the section on validation in Chapter 5 (Table 5.14) has shown, the model with high accuracy reproduced the 23 million passengers that crossed the Channel by ferry in the year 1987. The model predicts that in 2001 about 55 million passengers will use either ferry or Tunnel, the remaining 80 million will go by air.

These forecasts represent a 100% increase over total pre-Tunnel passengers in 1986, but a 130% increase for surface trips over pre-Tunnel ferry passages. Cross-Channel air travel will increase by 80% from 43 million to 79 million per year. Of the 55 million surface travellers in the limited-network scenario B1, 34 million are predicted to use the Tunnel; of the 58 million surface travellers in the extended-network scenario C1, 39 million are predicted to use the Tunnel.

A corollary of this is that according to Meplan total ferry passenger volume, after a temporary loss of passengers in the years after the opening of the Tunnel, in 2001 is only down by 20% compared to pre-Tunnel volume in 1986 and will continue to grow thereafter. In other words, in the decade after its opening, the Tunnel will take over the growth in cross-Channel surface traffic. In fact if the Tunnel were not there, in 2001 the number of ferry passengers would be twice as large as in 1986. Air traffic, too, would nearly double without the Tunnel, but with the Tunnel it will still grow by 80%, the remaining passengers shifting to the Tunnel. About four million cross-Channel passages per year would be Tunnel-induced, i.e. would not be made without the Tunnel (the difference between Scenarios B1 and B or C1 and C).

In cross-Channel freight transport a similar picture emerges. The model reproduced with high accuracy the 2.1 million lorries and 29 000 rail wagons per year in 1986 (see Chapter 5, Table 5.15). It predicts that by 2001 the number of lorries crossing the Channel will grow by 140% to 5.5 million (in Scenario B1), of which 1.6 million or 30% will go by Tunnel (approximately 17 million tonnes). The forecasts for rail freight depend more on the introduction of a high-quality through-rail freight service via the Tunnel than on the Tunnel itself. If freight through-trains are introduced (Scenario C1), the model predicts a 16-fold increase of rail freight compared with 1986. Rail freight grows only by factor of three if no freight through-trains via the Tunnel are introduced.

These results are perfectly in line with the results of the regional analyses. It was confirmed by the model that most Tunnel passengers would be pulled away from the ferries, mainly from the short sea routes, but that due to the general growth in ferry traffic would soon return to its present level and grow afterwards. This is in agreement with the fact that all ferry companies and port authorities in the maritime regions Kent, Nord-Pas-de-Calais, West-Vlaanderen and Zeeland expect that there will be a secure future for Channel ferries after an intermediate period of passenger losses (see Chapter 4.3.2). The confident expectation of the ferry companies about their own future is mainly based on their excellent competitive situation in the future cross-Channel market, which has been clearly improved through investments in increasing productivity and comfort on board.

Similarly, it was confirmed by the model that only fast-train connections at either end of the Tunnel would draw a significant proportion of air passengers to the Tunnel. The model predicts that if the extended rail network of scenario C1 would be implemented, the number of through-rail passengers would grow by 4.6 million per year. In scenario C1 about 4.3 million of these would be air passengers (though they would represent only 5% of 2001 cross-Channel air traffic).

In freight transport the interesting question is whether the Tunnel will attract a substantial proportion of freight from road and air to rail. The hypothesis in the regional analyses was that this would only be the case if fast freight through-trains would connect major industrial centres on the British Isles and the Continent via the Tunnel. This hypothesis was clearly confirmed by the model as demonstrated by the differences between scenarios B1 and C1 in Tables 5.23. One other important result from the regional analysis, the expectation that longer Channel crossings between the Continent and east and north

England ports are not really affected by the Tunnel with respect to freight transport, was also clearly confirmed by the model.

6.2.2 Regional development

The forecasts of the Meplan model on regional economic development are both comprehensive and detailed. They include forecasts of regional production and value added by industry and/or economic sector for the years 1986, 1991, 1996 and 2001 for five scenarios of infrastructure improvement:

A — Present network without Tunnel,

B — Limited network improvements without Tunnel,

C — Extended network improvements without Tunnel,

B1 — Limited network improvements with Tunnel,

C1 — Extended network improvements with Tunnel.

Only a small subset of the regional development forecasts generated in the model could be presented in Chapter 5 of this report. Even in reduced form the information provided by the model is much more complex and specific than the corresponding information contained in the regional analyses, which mainly consist of qualitative statements about expected growth or decline of individual industries. These statements, however, are normally region-specific, i.e. refer to one of the case-study regions only, whereas the model results refer not only to the development of single regions but also to all other regions of the Community. However, mainly because of the qualitative statements of the regional analyses, the results are comparable only in a limited sense. The discussion will start with an inspection of economic development forecast for the 13 case-study regions.

Economic development by region

In this section summarizing conclusions on the impact of the Channel Tunnel on economic development will be presented for each of the 13 case-study regions. The presentation for each region consists of

a table summarizing the impacts (Tables 6.14 to 6.26),

a text box with a concluding interpretation, and

two graphs showing positive or negative impacts of the Tunnel by industry in absolute and in percentage terms (Figures 6.1 to 6.26).

In the table, three types of forecasts as represented in Chapters 4 and 5 are distinguished:

a the expectation of the regional actors interviewed,

b forecasts based on the regional analysis,

c forecasts of the Meplan model,

whereby the most significant impacts are highlighted. The text box contains a final concluding interpretation of the impacts on regional economic development with particular remarks in case the three kinds of forecasts differ.

However, as already indicated earlier, some cautionary remarks are necessary to guide the interpretation of the model:

(i) The model does not take intraregional differences into account; thus, the regional analyses results on intraregional balance have to be considered *per se* as long as they highlight particular demands to compensate for unequal effects of the new transport network within the region.

(ii) The forecasts from the model are in terms of value-added and not in terms of employment. This means that economic growth predicted for a certain region will not necessarily induce increasing employment in that region. As a consequence, there may be some differences between the modelling results on the predictible impact of the Channel Tunnel and the forecasts of other studies which are expressed in number of jobs.

(iii) The model as implemented for this project does not utilize information on investment decisions in particular sectors in the regions; more generally, it ignores supply policies when they anticipate demand; consequently, it does not say anything on possible feedback effects of regional strategies, whereas the regional analyses are open to the progressive integration of such elements. So, while the viewpoints a and b take regional dynamics into account, c indicates potential for economic growth only due to changes in transport costs.

(iv) The model produces forecasts based on the understanding of regional development as an effect of a macroeconomic balance; the regional analyses on the other hand proceed by considering all elements contributing to specific dynamics in the regions.

Table 6.14. Kent: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	Manufacturing	*a* Significant growth in some industries. *b* Reasonable expectation for main Kentish industries (brewing, paper). *c* Gains through the Tunnel (B1-B), largest in machinery (0.1%) and tobacco and beverage (0.4%). No impact of the network (B-A).
Limited network B1	Services	*a* Mixed views as to whether gains or losses would be expected. *b* Kent should be viewed as a relatively more attractive location for Europe-oriented services and should gain. *c* Gain of 0.09% through the Tunnel (B1-B) induced through gain in business and finance (1.76%), no impact from the network changes (B-A).
Limited network B1	Tourism	*a* Reasonable to expect increase in tourism. *b* Yes, especially with limited investment in connecting routes to other UK regions. *c* Substantial value-added increase (9.7%) in tourism from mainland Europe through Tunnel (B1-B). This increase translates into a 0.4% increase in the lodging and catering sector. The network effects on lodging and catering are small (B-A: 0.12%).
Extended network C1	All industries	*a* Gains accrue because of better access to the rest of UK and to other European 'Blue Banana' regions. *b* Main effect will be through the improved link to London, access to the Continent has never been an obstacle for Kent. *c* Gain based only on the improved link to London (C-A): 5.6%, mainly in industrial and food production (17.6%), machinery production (2.7%) and other manufacturing (2.8%). The Tunnel induces a total growth of 0.1% only (C1-C).
Extended network C1	Tourism	*a* Good connecting links to rest of UK reduce Kent's appeal to tourists, relative to limited network. *b* Reasonable expectation. *c* Slightly lower tourism benefits than with limited network. Gain of 9.4% in cross-Channel tourism leads to 0.4% increase in lodging and catering.
Extended network C1	Port industries	*a* Marginal effects at North Kent ports. These ports cater for unaccompanied trailers for which the Tunnel will not provide directly. Ramsgate does not expect to suffer significant traffic losses. Folkestone on the south coast will be more strongly affected. Dover is investing in larger vessels and clearly plans to compete, however, some job losses are expected. *b* Reasonable expectation. *c* No results for port industries.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Kent: Conclusions on regional development

Kent will benefit from the Tunnel but, being so close and so tightly linked to the London economy, the region will only grasp a part of the benefit. Remarkably, most of the gains of Kent are in the traditional industries. With respect to services, it is highly dependent on the London agglomeration. That may explain the differences between the viewpoints on services in the case of the limited network: there is no clear regional strategy about setting up high-level services, whereas Meplan predicts gains, however small, in absolute terms. It is worth noting that the possible gains for Kent largely depend on the development of Ashford international passenger station. Without it, Kent would not be integrated in the high-speed rail network and would benefit exclusively from London's expansion.

The extension of the transport network related to the Tunnel seems likely to have stronger impacts. In manufacturing, where Kent appears to benefit from the improved links to other regions of the UK, the model forecasts gains in all sectors, most significant in machinery, agriculture and food production and other manufacturing. However, the impact of the Tunnel is negligible. It does not exclude possible changes within the industrial branches, traditional activities being substituted by new ones. This is in agreement with the regional actors' expectations on increases due to a better access to the rest of the UK. In tourism, where the extended network increases the appeal of other UK destinations than Kent to continental tourists, a reduction in tourism is predicted, i.e. if regions north of London have better links to the Tunnel, then Kent might face the risk of not being a destination for continental trippers or businessmen, but may serve only as a pipeline to the North.

Figure 6.1. Kent: change in value-added, limited network

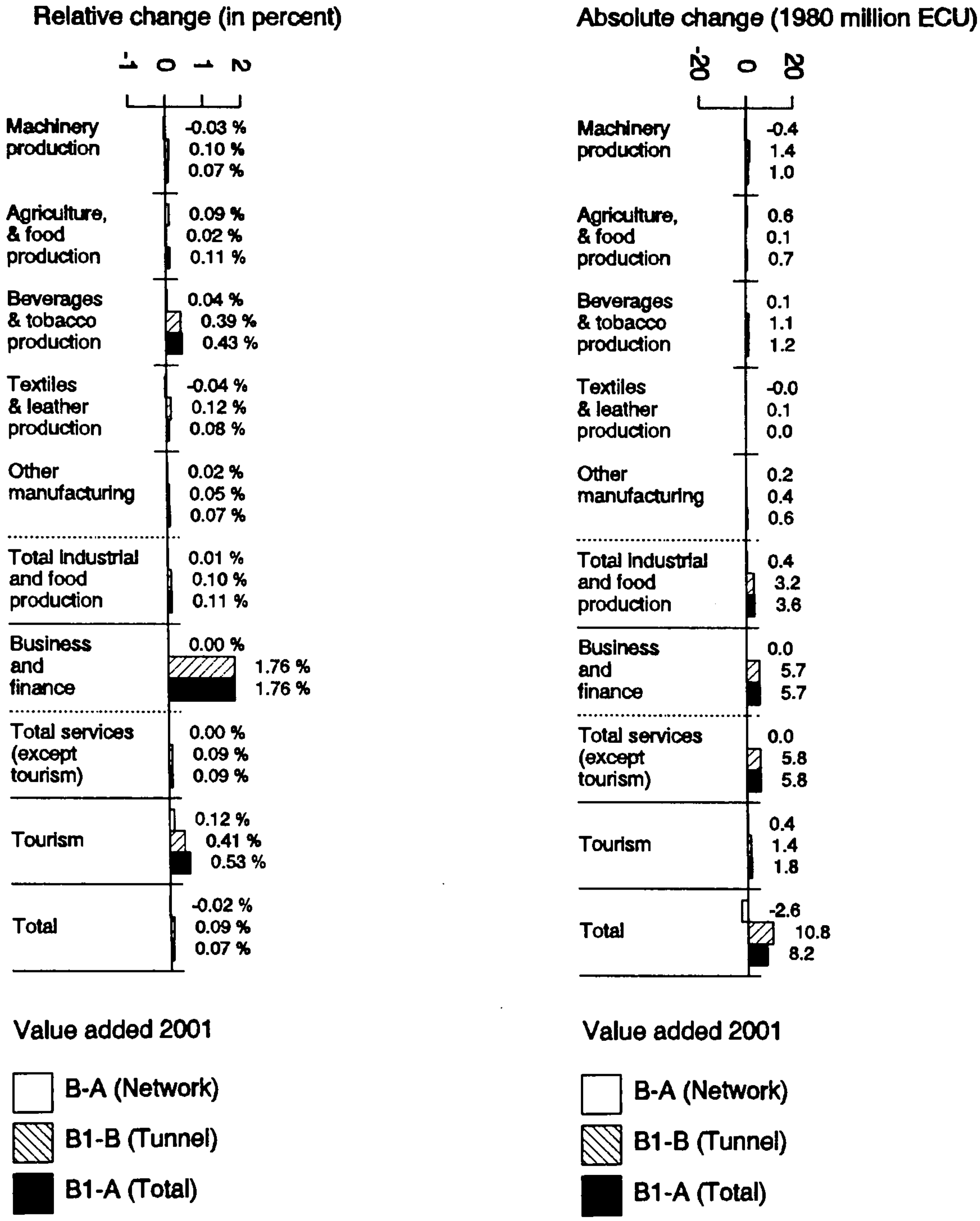
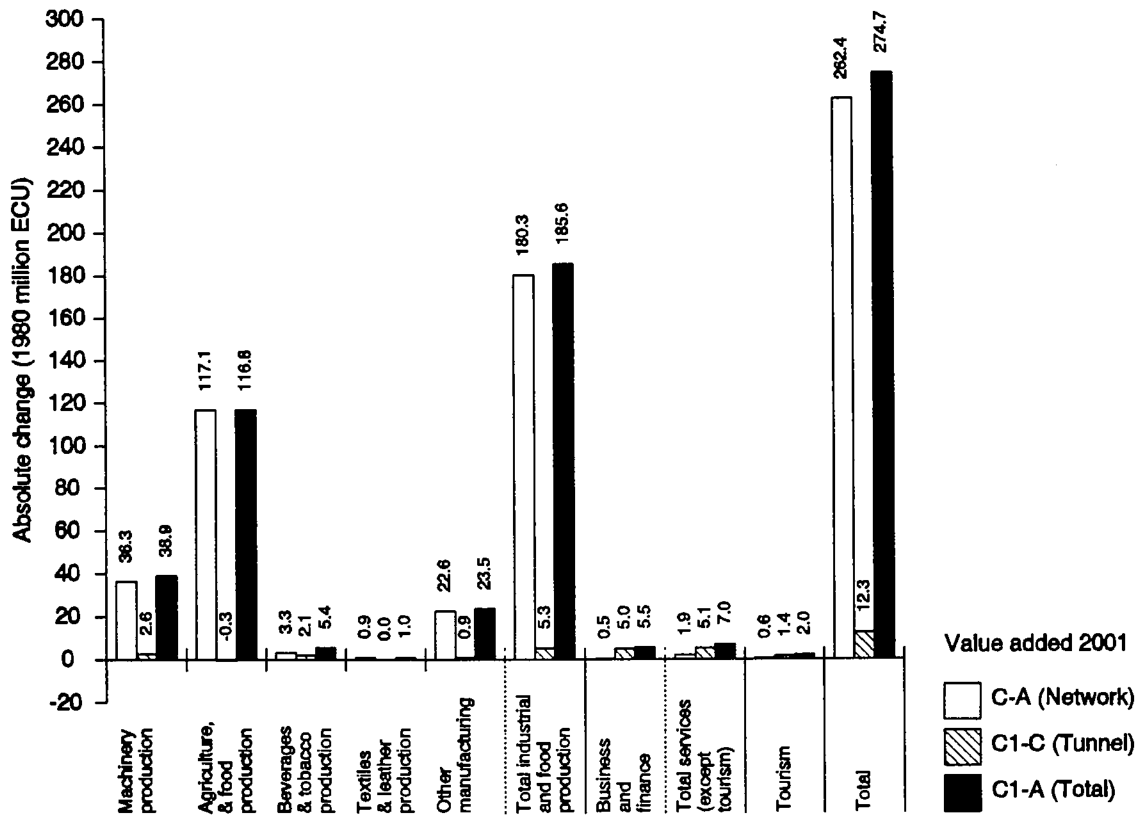


Figure 6.2. Kent: change in value-added, extended network



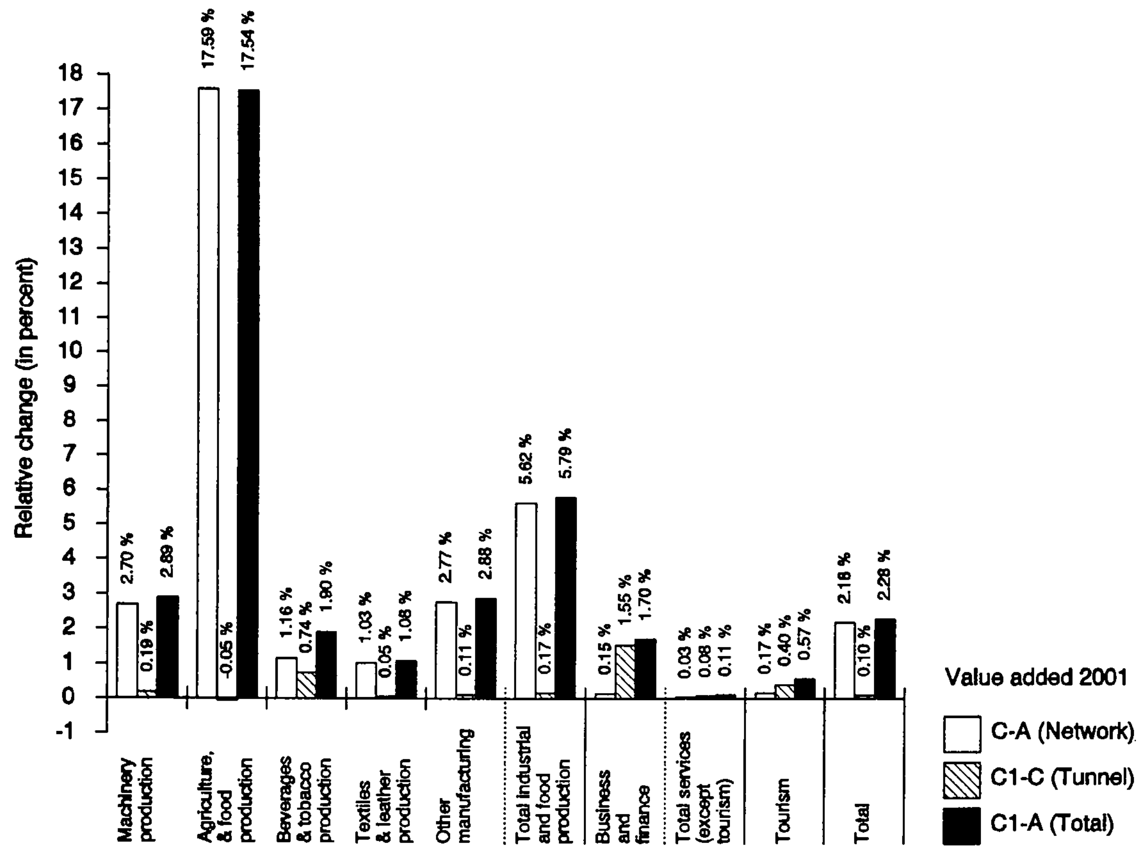


Table 6.15. Nord-Pas-de-Calais: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* Thanks to the Tunnel, the region is known by potential investors all over the world and that may reinforce the economic restructuring. *b* The region may become more attractive for European firms, and a second choice for Asian and American firms. *c* Gains when the Tunnel operates (B1-B: 0.17%), mainly through gains in business and finance (1.5%) and tourism (1.6%), London and West-Vlaanderen are the only regions that gain more through direct Tunnel effects.
Extended network C1	All industries	*a* No additional expectations from the extended network. *b* The limited network provides the region good enough rail and road links. *c* The extended network does not increase the total value added compared to B1, even less gains in business and finance, but larger in production.
Extended network C1	Manufacturing	*a* 1993 is thought to open a new age with the undergoing restructuring of the steel and textile industries and the creation of new activities. *b* Future industrial investments will undoubtedly prefer two types of spaces: nodes of infrastructure that will be traffic dispersal ports (Calais, Lille, Arras und Béthume) and the major seaports of Dunkirk and Calais. *c* Growth in all sectors save tobacco. Total gains of 0.14% from the Tunnel (C1-C), but only 0.05% from the network (C-A).
Extended network C1	Service industries	*a* Local and regional authorities plan to develop high value-added services, an important tertiary centre in Lille is under construction. *b* Transport logistics and financial services are necessary to bring the region up to the level of the active core of Europe. *c* Gains in value added are slightly lower than with the limited network. Business and finance gains by 1.01% (C1-C), total services by 0.13%.
Extended network C1	Tourism	*a* Promotion and marketing policy with various regional partners and with Kent relying on growing attractiveness for British tourists. *b* Reasonable expectation. However, improved services necessary. *c* The region will benefit from new tourists from the UK through the Tunnel. The increase of 25.9% (C1-C) in cross-Channel tourism leads to a gain of 1.7% in lodging and catering.
Extended network C1	Intraregional balance	*a* Even with the extended network, southeastern Nord-Pas-de-Calais remains outside the Tunnel-TGV effects as the main impacts are expected in Lille and on the coast. *b* The intraregional balance will be positively affected by the Tunnel and the coastal motorway by the opening up the formerly depressed littoral area. *c* No forecasts.

Extended network C1	Interregional balance	*a* The region is going to be better equipped with transport infrastructure than its neighbours, which is seen as the basis of a new economic growth. *b* Much will depend on the ability of the regional actors to give a strong image of the region and to develop joint strategies. *c* The region is among the major beneficiaries of the Tunnel.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Nord-Pas-de-Calais: Conclusions on regional development

Nord-Pas-de-Calais enjoys a strong internal symbolic effect of the Tunnel which is boosting the confidence of local actors in the undergoing restructuring of those traditional sectors that have not been closed down; primarily steel and textile industries. It results in significant gains in manufacturing, either in traditional sectors or in new ones. The Tunnel is also providing the region with a new self-image of a possible tertiary pole integrated in the London-Brussels-Paris triangle. However, the model predicts lower gains in services with an extended network than with a limited one. Such a forecast suggests, as a feedback on regional analysis, that competition within the triangle will be severe; it is thus questioning the regional capacity of pushing forward the development of Europe-oriented services. With the implementation of the Tunnel, lodging and catering is the sector that will gain the most as an increasing number of tourists from Great Britain travel to Nord-Pas-de-Calais.

The intraregional balance will be partly modified: strong effects are expected on the former depressed littoral which is now preparing for new economic functions, while the south-eastern Hainaut-Cambrésis will be left out of the new dynamics. One may foresee a polarization effect within the region in favour of Lille in the north-east and of the Boulogne-Calais-Dunkirk area on the west coast.

Figure 6.3. Nord-Pas-de-Calais: change in value-added, limited network

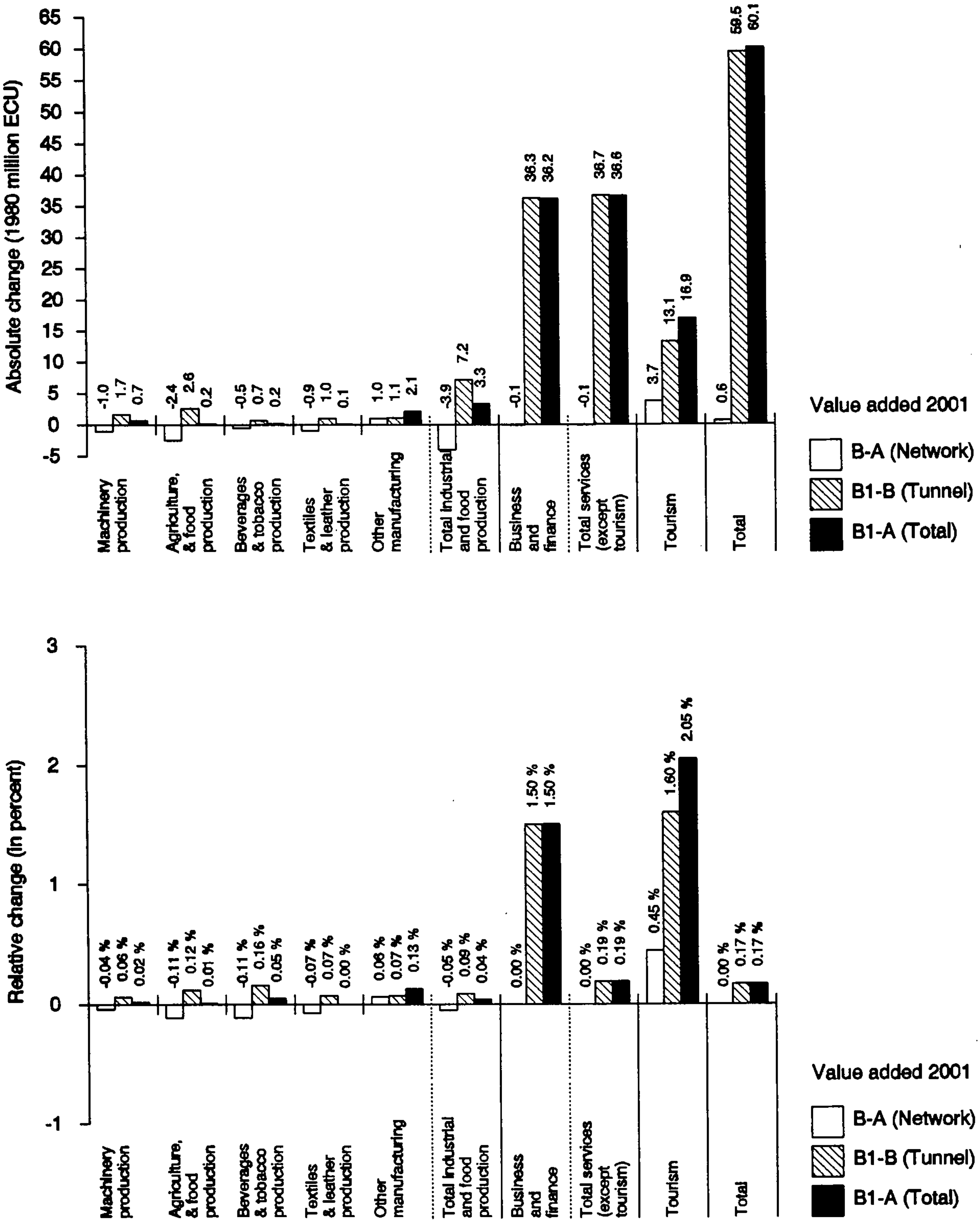
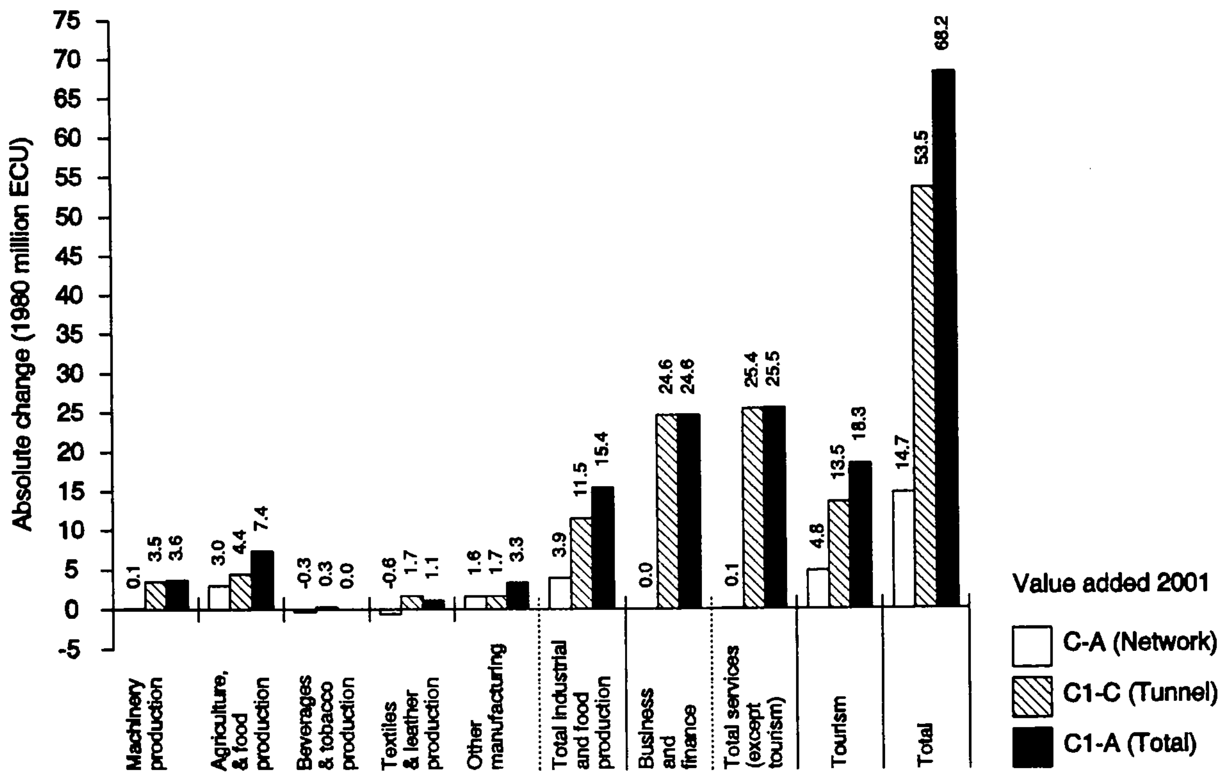


Figure 6.4. Nord-Pas-de-Calais: change in value-added, extended network



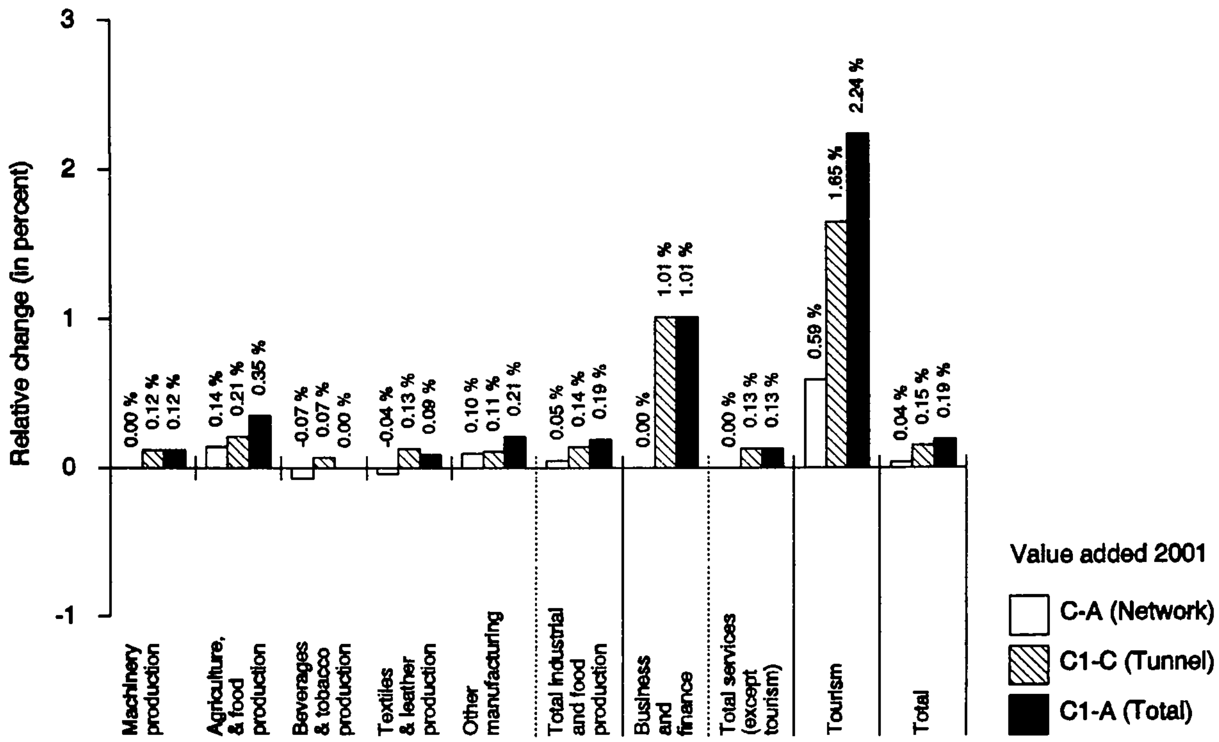


Table 6.16. West-Vlaanderen: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* No strong direct economic impacts. However together with the single European market the Tunnel might facilitate accessing markets in northern France and the UK. *b* Reasonable expectation. Main indirect benefits for the south of the region through positive development of Lille. *c* Growth of 0.25% through the Tunnel (B1-B) and 0.07% through the network (B-A).
Extended network C1	All industries	*a* Same impact as for limited network B1 because the most important infrastructure improvement, the coastal motorway to the Tunnel is already included in B1. *b* Reasonable expectation. *c* Tunnel-induced growth as in B1 (C1-C: 0.25%), but greater effect of the network (C-A: 0.13%).
Extended network C1	Manufacturing	*a* Positive impact mainly in the realm of the Lille agglomeration through participation in the expected growth of Nord-Pas-de-Calais. *b* Reasonable expectation. *c* Gain of 0.19% through the network (C-A) and 0.14% through the Tunnel (C1-C). Increases mainly in machinery production, agriculture and food production and textiles and leather production.
Extended network C1	Port industries	*a* Increasing unemployment in Ostend, Zeebrugge is less affected and will in addition become a more 'normal' deep-sea port with diversified port functions. *b* Reasonable expectation supported by the improvement of port facilities in Zeebrugge. *c* No results for port industries.
Extended network C1	Service industries	*a* Increasing attractiveness for distribution and transport-related firms, mainly in the area of the Lille agglomeration. *b* Reasonable expectation. *c* Tunnel-induced gain only in business and finance (C1-C: 1.18%). No effect as a result of network changes only.
Extended network C1	Tourism	*a* Increase of British tourists through spontaneous short-time journeys, but relatively small impact. *b* Reasonable, but scope of impacts uncertain. *c* Value-added by British tourists will grow by 8.4% through the network (C-A) plus 22.4% through the Tunnel (C1-C). This will lead to a growth in the lodging and catering sector of 7.7%: 2.1% through the network changes, plus 5.6% through the Tunnel.
Improvement of port facilities	Port and ferry industries	*a* Only with this improvement can the ports and ferries survive in competition with the Channel Tunnel and other Channel ports and ferries. *b* Reasonable expectation. This is true, in particular, for the ferry lines between West-Vlaanderen and Kent. *c* Policy not included in the model.

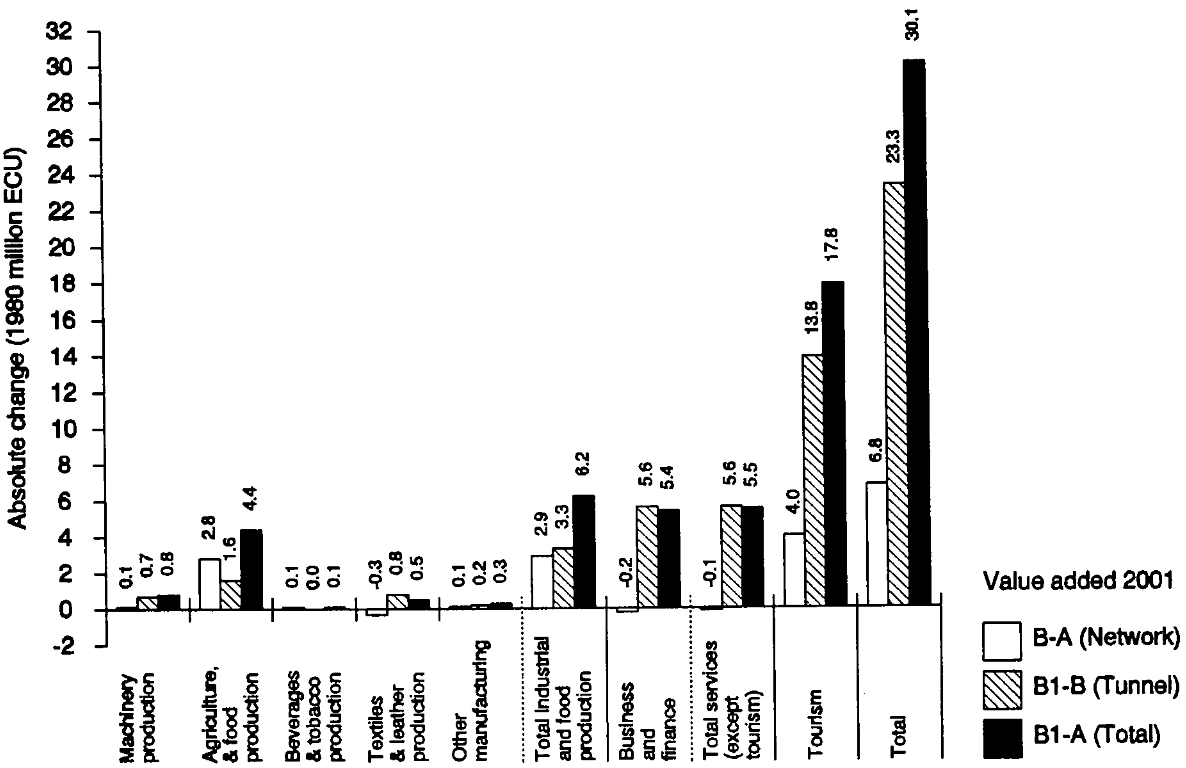
a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

West-Vlaanderen: Conclusions on regional development

According to the model results, West-Vlaanderen ranks first in percentage of total value-added growth with the implementation of the Tunnel. However, regional actors see their region as likely to benefit only indirectly from the new infrastructure. Their perception may not be ambitious enough as the model predicts a total value-added rate of growth larger than in Nord-Pas-de-Calais. However, the West-Vlaanderen total value-added starts at a lower base. The gain is mainly through increases in lodging/catering and business and finance services, but the production industries can also expect significant growth. The network alternatives are irrelevant for the results as the infrastructure most important for the region, the coastal motorway to Calais, is included in both options.

Port industries are already encountering difficulties and port authorities and ferry companies are trying to maintain themselves in the cross-Channel traffic market. The regional strategy seems to be mostly oriented towards the improvement of port facilities aimed at surviving the cross-Channel competition, and in developing other tasks of the ports. Zeebrugge should be successful in this endeavour; however, Ostend will face increasing difficulties, as its port activities mainly depend on a single ferry line that is seriously affected by the Tunnel.

Figure 6.5. West-Vlaanderen: change in value-added, limited network



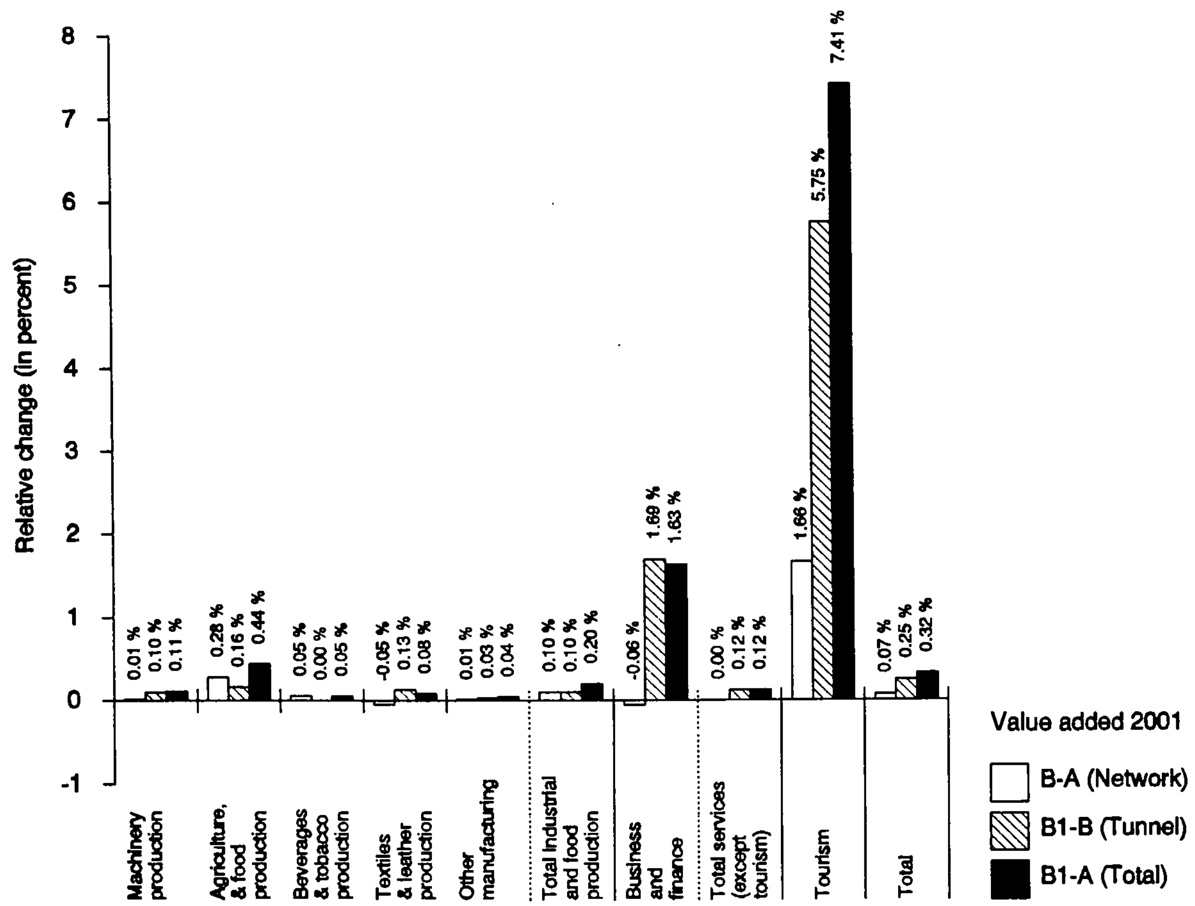


Figure 6.6. West-Vlaanderen: change in value-added, extended network

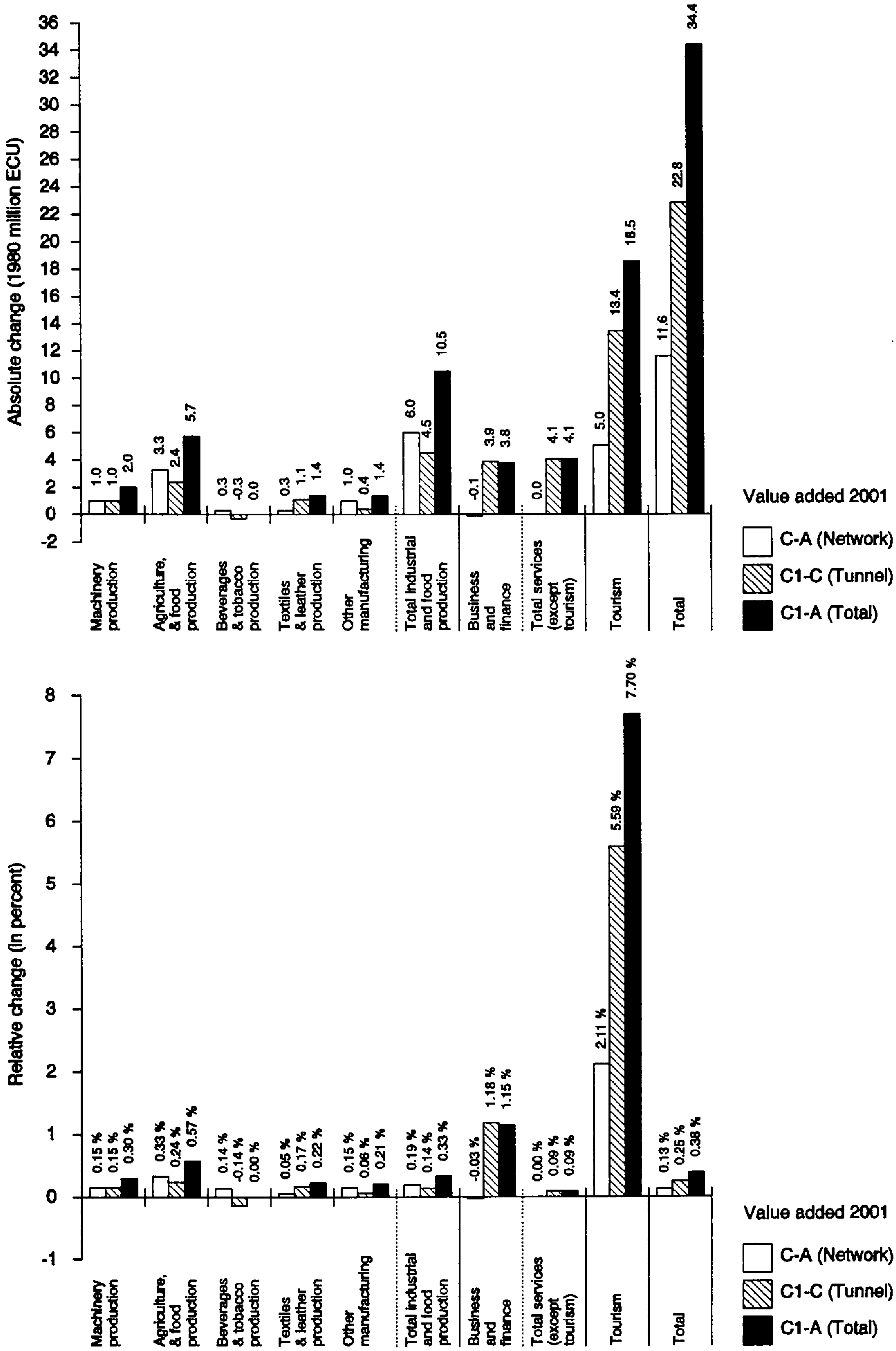


Table 6.17. Hainaut: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* Entrepreneurs are involved in cross-border cooperation aimed at finding new outlets on British, French and other markets. *b* Hainaut will have to rely on derived benefits from its cooperation with Nord-Pas-de-Calais rather than try to attract new firms. *c* Slight growth of total value-added through the Tunnel (B1-B: 0.09%). No impact as a result of network changes alone.
Extended network C1	All industries	*a* No particular expectations from the extended network. *b* The regional economy is not likely to derive much benefit, even from a new Lille-Brussels TGV line because there is no stop in Hainaut. *c* The extended network makes almost no difference in the economic growth of Hainaut, and there is only 0.09% additional growth through the Tunnel.
Extended network C1	Manufacturing	*a* Eurosynergy network initiated by the Belgian Fabrimetal managers' union in order to prepare for the single European market. *b* Effects through construction of TGV line that should mobilize the building and steel industry; TGV coaches will be built with Belgian participation. *c* The manufacturing industry will gain in nearly all sectors through the Tunnel (C1-C: 0.14%), but no effect from the network changes alone (B-A).
Extended network C1	Service industries	*a* Expectation to benefit from the Tunnel in the transport field, new multimodal freight platforms. A road service area is being developed in Tournai anticipating British clients, further projects in Mons and Charleroi. *b* Hainaut seems to be ready to enhance its logistics capacity, but no other high-value-added services. *c* The positive Tunnel effects with the extended network (C1-C: 0.06%) are less than with the limited network, mainly because of less value-added in business and finance. However, no impact of the network itself.
Extended network C1	Tourism	*a* The Tunnel-TGV system could encourage British tourism in a region where architectural features and natural sites have long been underexploited. *b* Reasonable, but modern tourist services necessary. Hotels and restaurants are capable of handling traditional tourism, but they are poorly adapted to growing flows of tourist groups. *c* Gain of 22% in cross-Channel tourism through the Tunnel resulting in a 0.54% gain in lodging/catering.
Extended network C1	Intraregional balance	*a* Mons and Charleroi fear to be left out of the new active European core, while Tournai and Mouscron rely upon the expected growth of Lille. *b* Reasonable, shift of Hainaut's economic focus towards the west. *c* No forecast.

Extended network C1	Interregional balance	*a* By crossing Hainaut without stopping the TGV will place the whole province relatively further away from major European centres. *b* The TGV could reinforce imbalances between Vlaanderen and Wallonie in Belgium unless new north-south traffic goes through Hainaut. *c* Closeness to the Tunnel benefits Hainaut, although absolute gains are insignificant. Improved networks in other regions reduce Hainaut's benefits.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Hainaut: Conclusions on regional development

Hainaut's assets might not be exploited because of the lack of regional strategy which in turn can be explained by the absence of regional status and power. It puts Hainaut in danger of not benefiting from the Tunnel-TGV system as much as its geographical position allows it to expect. This is confirmed by the model, which predicts no gains from the extended network scenario; Hainaut will grow only through a direct impact of the Tunnel. However, if a political and economic synergy does not take place, then goods carriers and businessmen are likely to be more attracted by services created or developed in neighbouring regions. In fact, Hainaut does not seem to be a strong and coherent economic entity. It is seriously dependent on external decisions and other regions and is more and more oriented towards Brussels, Lille and even West-Vlaanderen. The Tunnel and the new high-speed rail network will only stress this current tendency.

The shift towards western Hainaut, predicted by the regional analysis, is coherent with the reinforcement of West-Vlaanderen forecast by Meplan: even though there is no active co-operation between the two regions, there seems to be a concentration of impacts on both sides of the French-Belgian border. It is also coherent with the north-west/south-east axis induced by the Channel Tunnel, which tends to counterbalance the Blue Banana on the west, along a London-Paris-Rhône valley corridor.

Figure 6.7. Hainaut: change in value-added, limited network

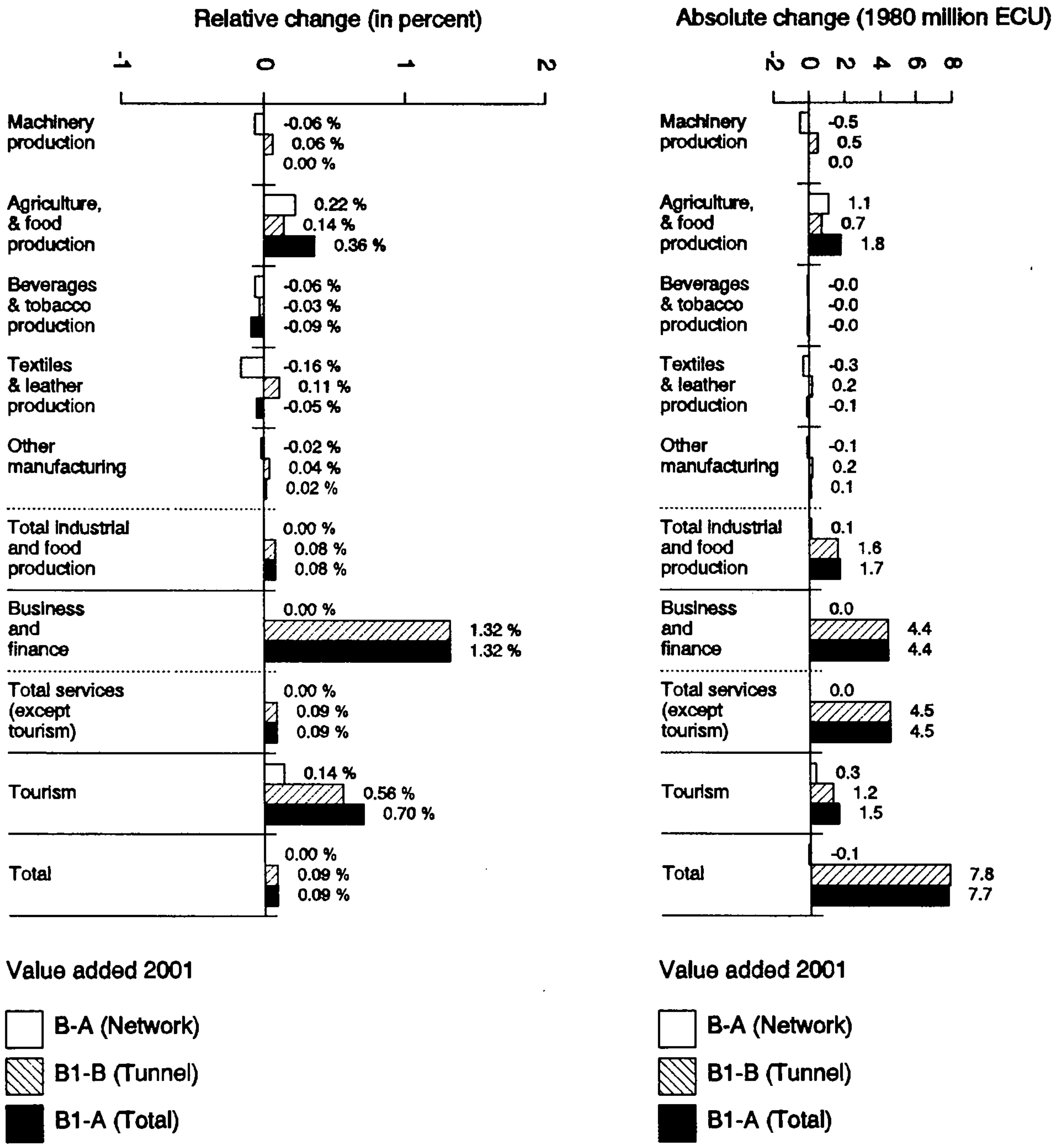


Figure 6.7. Hainaut: change in value-added, extended network

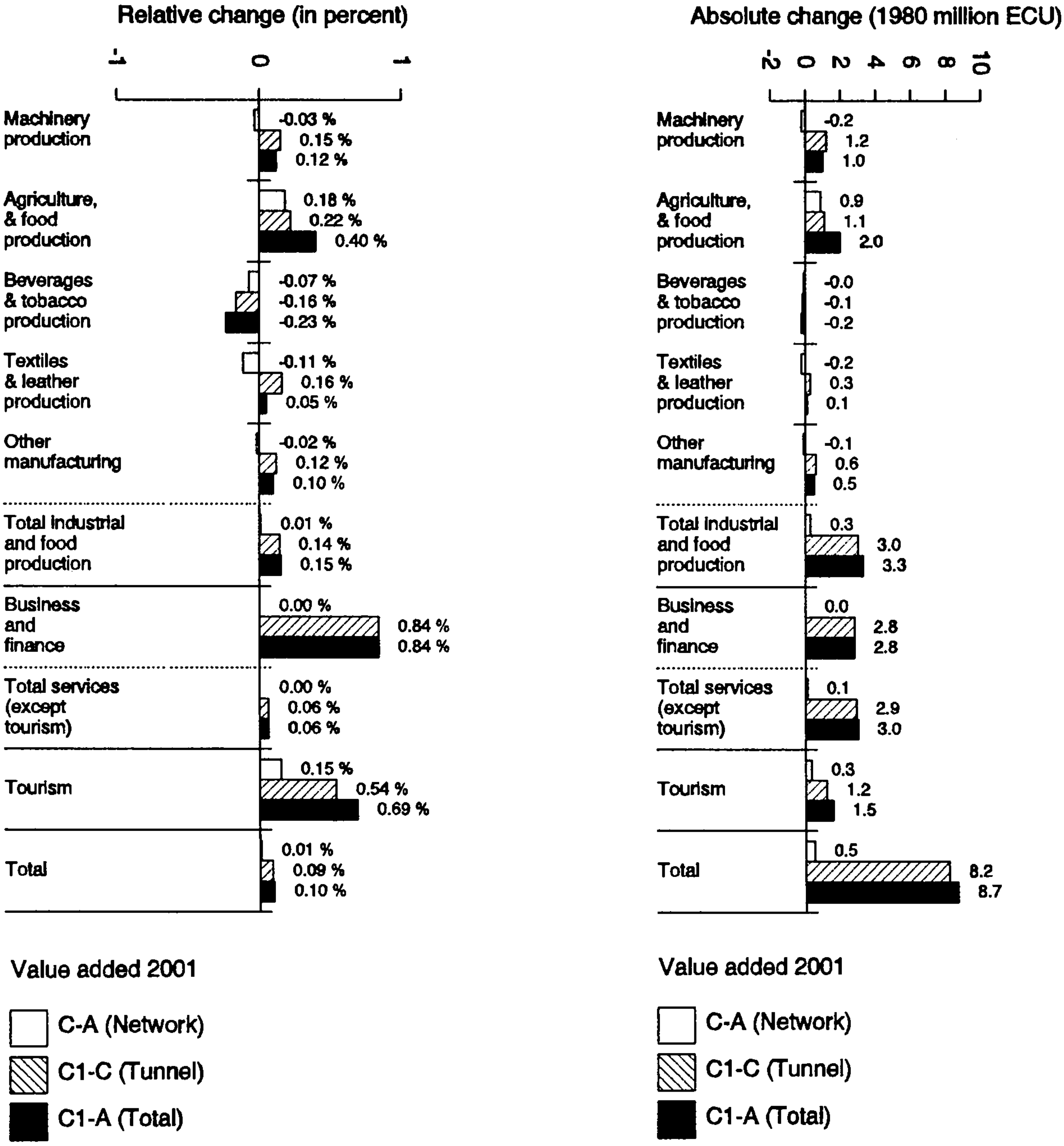


Table 6.18. Zeeland: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* Without the Westerschelde crossing (WOV) no impact on Mid-Zeeland, but firms south of the Westerschelde will enlarge markets in the UK. *b* Reasonable expectation. *c* No impact, except slight losses in manufacturing through the network (B-A: – 0.14%), mainly in machinery, agriculture and food production.
Limited network B1	Intraregional balance	*a* Without WOV the Tunnel will reinforce the spatial separation of Zeeland. *b* Reasonable expectation. *c* Intraregional balance not included in the model.
Extended network C1	All industries	*a* With WOV, benefits will come more from the expected Tunnel-induced growth in Belgium and northern France than from the Tunnel itself. *b* Reasonable expectation. Even with the Westerschelde crossing the sea-related industrial base will be hardly affected by the Tunnel. *c* 1.0% growth through improved network (C-A), but slight losses through the Tunnel (C1-C: – 0.03%).
Extended network C1	Manufacturing	*a* No impact on dominating chemical industry. *b* Reasonable expectation. High-tech industry may be attracted because of the new combination of locational advantages. *c* Growth of 3.2% through the network changes (C-A), only slightly positive impact of the Tunnel (C1-C: 0.07%).
Extended network C1	Service industries	*a* No impacts on port activities. *b* Road transport firms may be attracted by the enhanced location of Zeeland in north-west Europe. *c* With growth of 0.015% no impact of the WOV (C1-C), but loss of 0.06% with the Tunnel (C1-C).
Extended network C1	Tourism	*a* No real impact expected because Tunnel not important for tourism from the UK to Zeeland. *b* Reasonable, most tourism from the UK will come by ferry to Vlissingen. *c* The WOV (C-A) will bring an 8% increase in British tourists which will to a 2.7% growth in the lodging/catering sector (C-A). But the Tunnel itself (C1-C) will bring a loss of 1.8% in the lodging/catering sector through a decline of 5.2% in cross-Channel tourism.
Extended network C1	Interregional balance	*a* A wide range of development perspectives for Zeeland in north-west Europe is possible. *b* The future role of Zeeland in Europe mainly depends on the regional policy pursued. *c* Economic growth only with the WOV, but not caused by the Tunnel.
Regional development concept with international orientation	All industries	*a* Positive economic development, but also the opportunity to keep the 'good' of Zeeland. *b* Reasonable concept, if the conflict between economic development and ecological issues can be solved. *c* Regional policy not included in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Zeeland: Conclusions on regional development

Zeeland has only few assets in spite of its not being far away from the Tunnel exit. It is caught in two dependencies: on one side it depends on the Randstadt as forecasts from both the model and regional analyses tend to show; on the other side, it depends on northern France and on Belgium for derived benefits from cross-Channel traffic through the new infrastructure. If the WOV is built as part of the coastal motorway from Rotterdam to the Tunnel, the described dependency pattern will hardly change, but economic gains are expected. Only for this case, the model forecasts gains for Zeeland, however derived only from the network, not from the Tunnel itself. The removal of this barrier significantly reduces transport costs and will lead to additional growth, but one could doubt whether these gains are worth destroying the ecological balance of the Westerschelde area. If a balanced regional development policy is not applied, then the WOV will be more harmful than helpful.

Figure 6.9. Zeeland: change in value-added, limited network

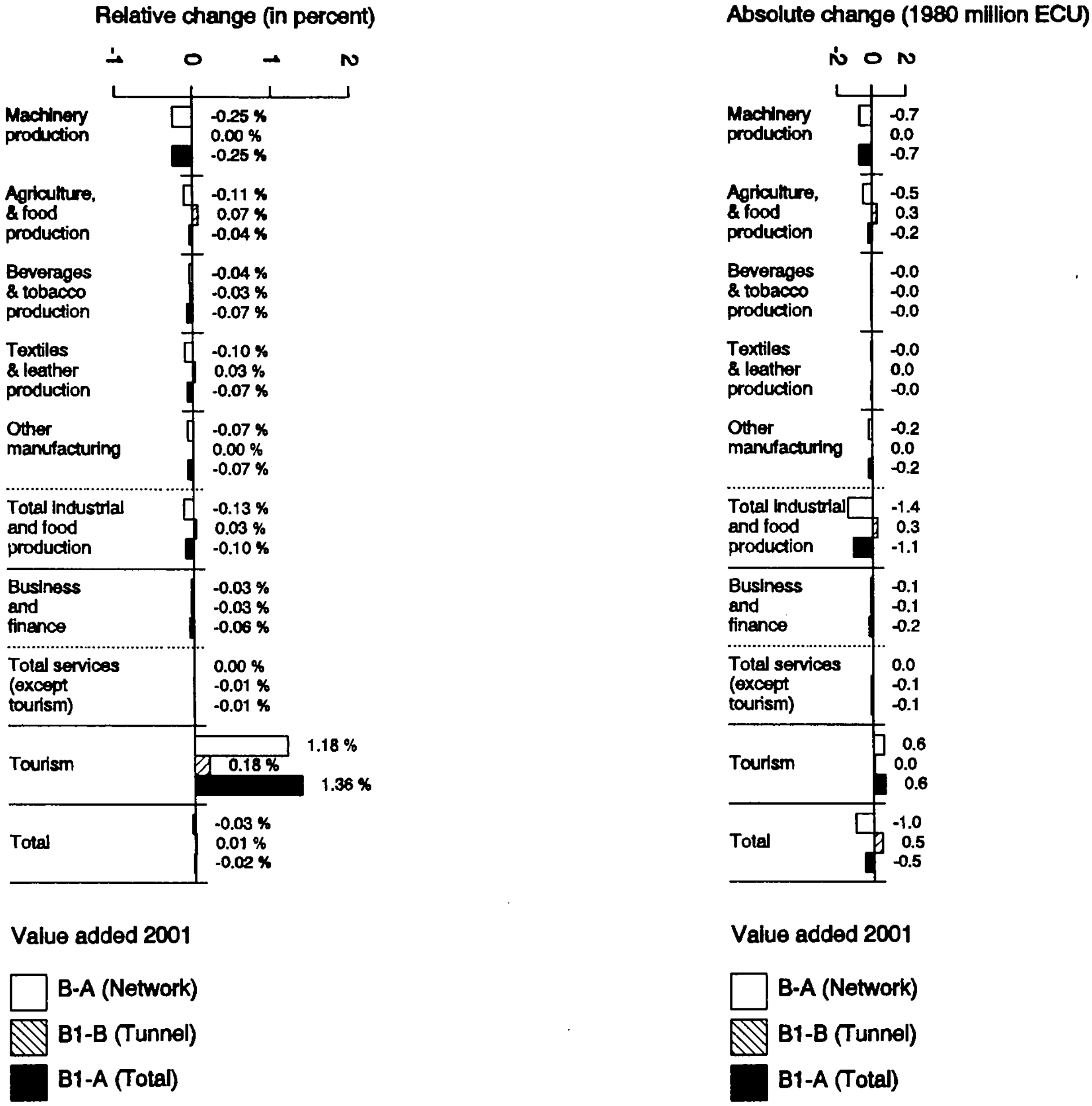


Figure 6.10. Zeeland: change in value-added, extended network

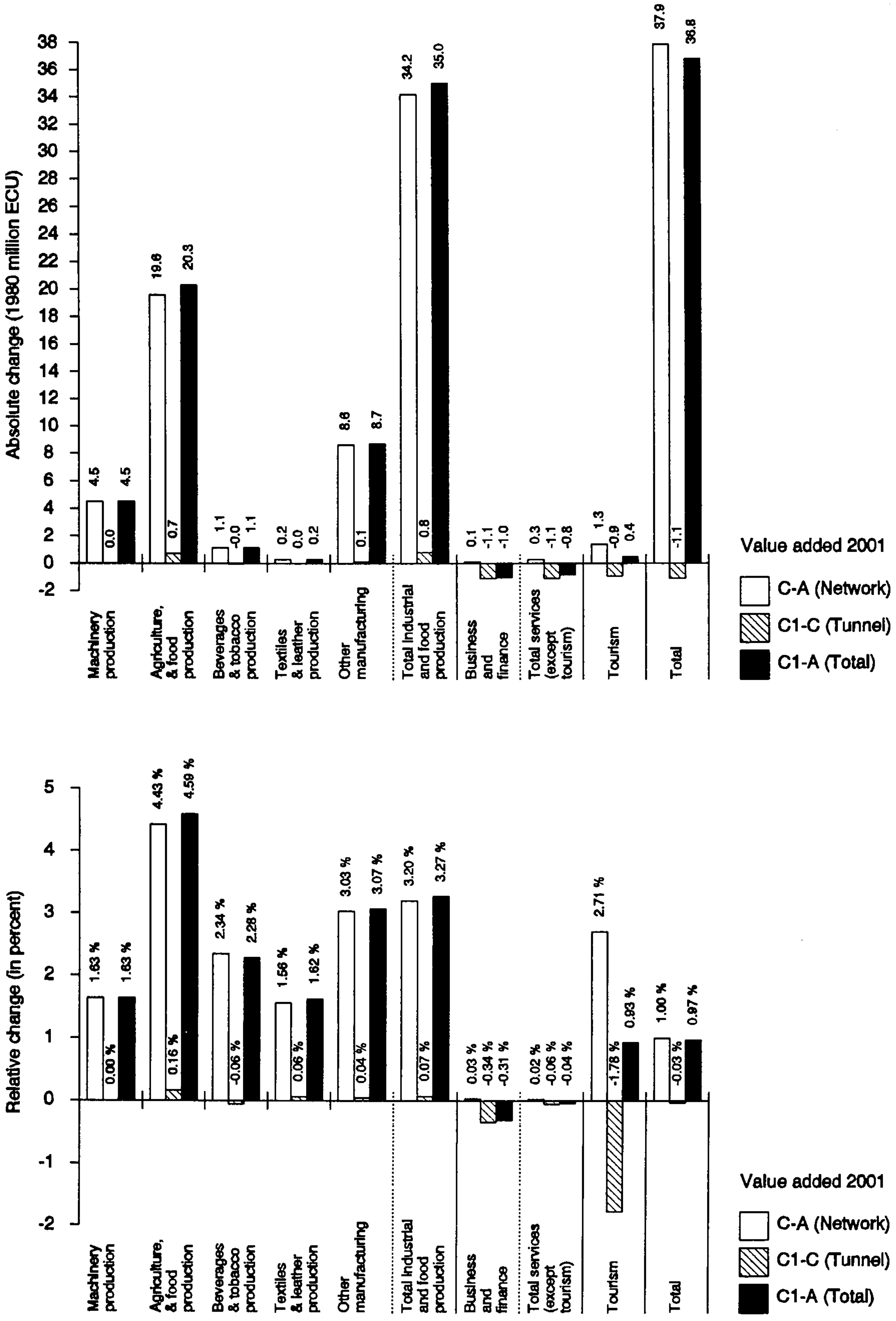


Table 6.19. Cologne: impacts on regional development

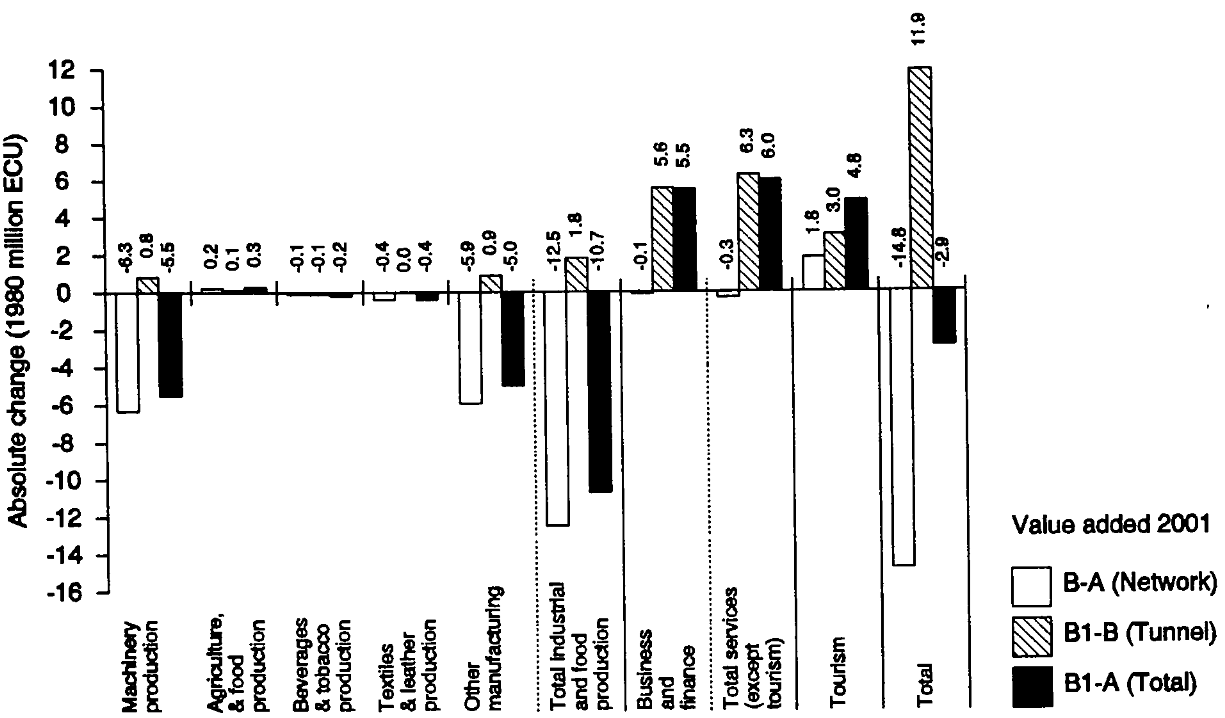
Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* No positive impact, maybe loss of some economic activities to other agglomerations which are better linked to the high-speed rail network. The delayed implementation of the high-speed rail line Brussels-Cologne is the main concern in the region. *b* Reasonable expectation. *c* A small loss of economic development through the network (B-A) is compensated by a small gain due to the Tunnel (C1-C).
Extended network C1	All industries	*a* Benefits primarily for firms already internationally oriented. *b* Reasonable expectation. Accessibility of the region will increase, leading to an intensification of international business contacts. *c* Magnitude and pattern of changes as in B1.
Extended network C1	Manufacturing	*a* No impact because manufacturing industries have other locational requirements. *b* Reasonable expectation, except for high-tech industries and other firms producing high-value goods. *c* Loss of 0.12% due to the network changes (C-A), but slight gains through the Tunnel (C1-C: 0.04%), both largely a result of changes in machinery production.
Extended network C1	Service industries	*a* New opportunities to establish service businesses, in particular, high-level services (advertising, consulting, media and arts). *b* Reasonable expectation, already confirmed through success of the *Mediapark Köln*. *c* No impact of the network, but slight gains because of the Tunnel (C1-C: 0.013%), mainly in business and finance (0.13%).
Extended network C1	Tourism	*a* Cologne will attract more UK tourists. *b* Reasonable expectation, especially for short holiday and weekend trips. *c* Growth in value-added by British tourists of 9.8% through the network (C-A) and additional 11.2% through the Tunnel (C1-C). This will lead to a total growth in the lodging/catering sector of 1.1%.
Extended network C1 and integrated concepts of regional development	All industries	*a* Regional cooperation enhances benefits from infrastructure improvements. *b* Reasonable expectation. Intraregional cooperation necessary to distribute the benefits over the whole region. *c* Regional policy not included in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Cologne: Conclusions on regional development

Cologne is showing a great concern to be quickly connected to the European high-speed rail network. This attitude has to be understood as an aspect of a growing awareness of the need for intraregional cooperation as a way to strengthen the region. As Meplan does not take these strategies into account, it may underestimate the amount by which the region will benefit from the new infrastructure. For instance, the model forecasts slight gains in services, while regional actors are preparing for the settlement of high-level services and thus expect Cologne to be an alternative location choice for advertising, consulting and other tertiary international firms. However, all viewpoints agree that Cologne belongs to the regions most benefiting from cross-Channel tourism.

Figure 6.11. Cologne: change in value-added, limited network



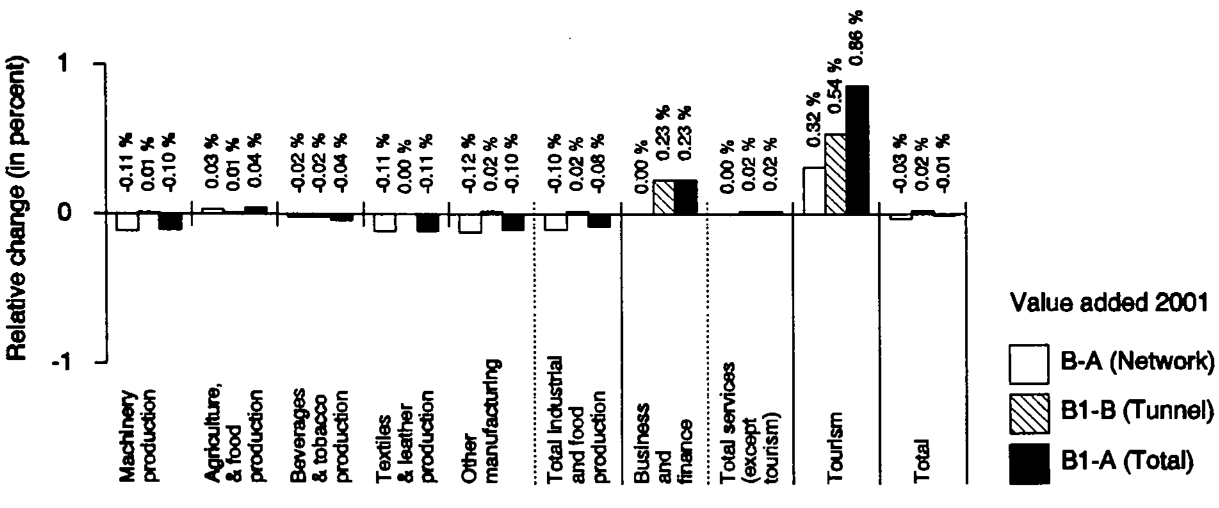
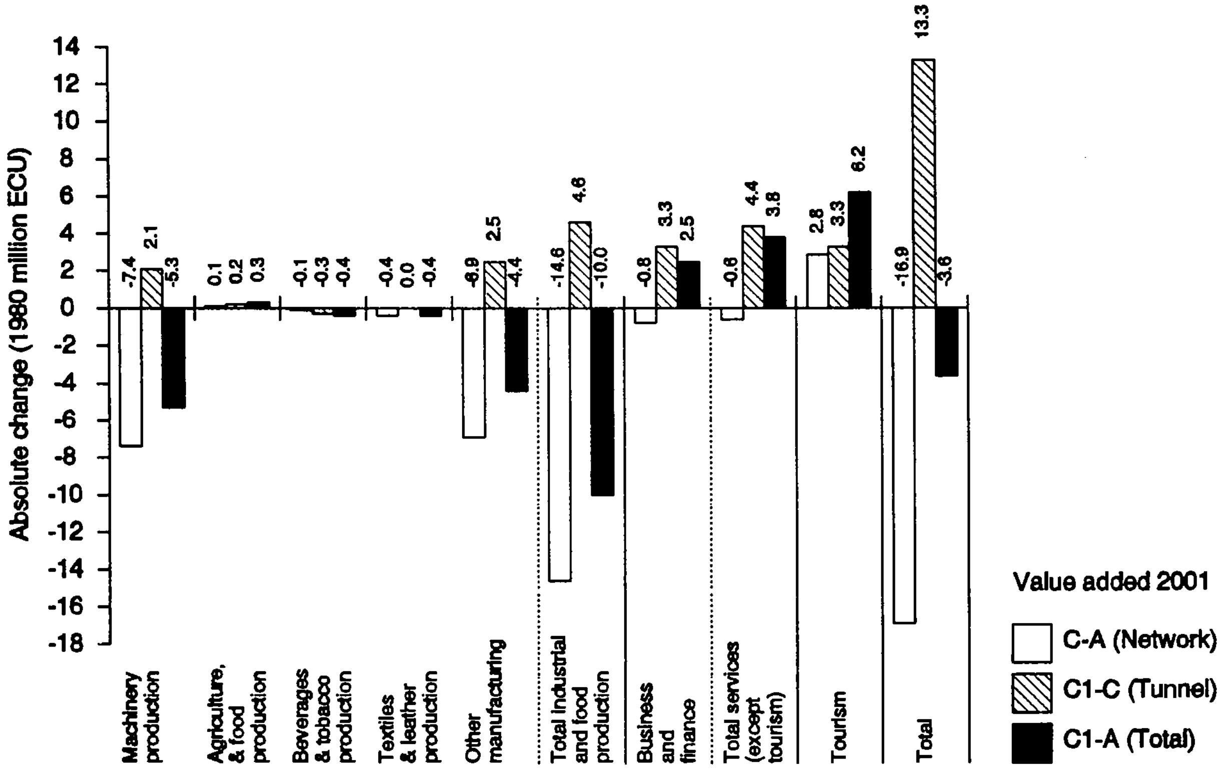


Figure 6.12. Cologne: change in value-added, extended network



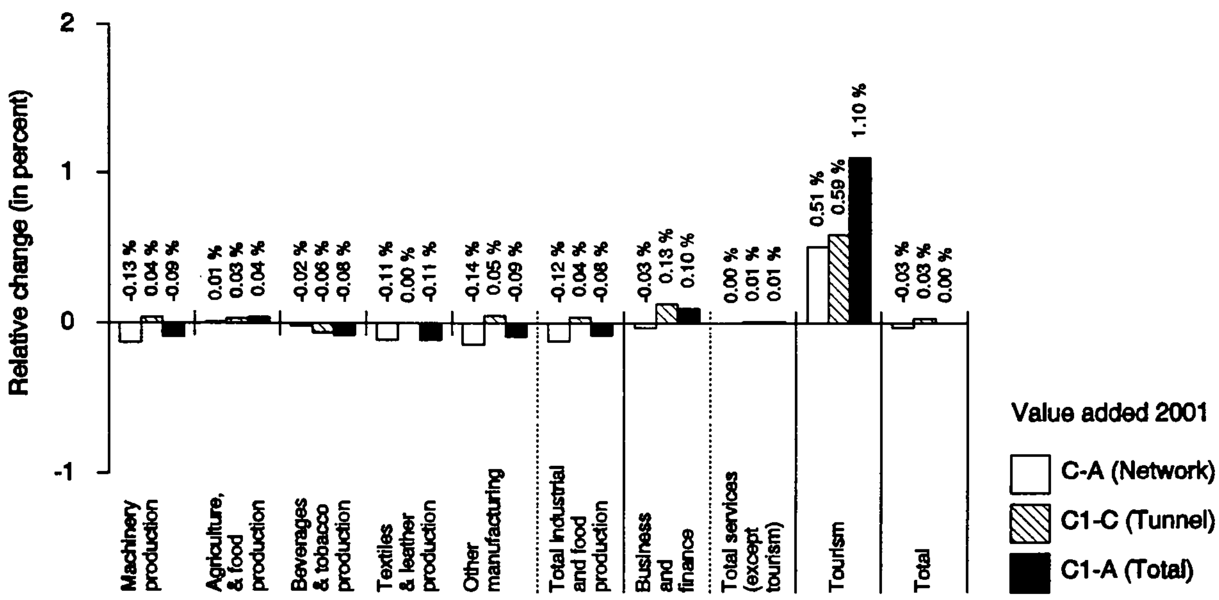


Table 6.20. Bremen: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* No impact. *b* Reasonable expectation, the Tunnel will, if at all, affect Bremen only if accompanied by improved infrastructure between Bremen and the Tunnel. *c* No impact, except slight losses (–0.11%) in machinery production due to the network changes (B-A).
Extended network C1	All industries	*a* Possible negative impact as other regions benefit much more from the improved transport infrastructure. *b* Reasonable expectation. Increasing difficulties to attract firms because of relative decline of accessibility. Loss of economic growth potential. *c* Slight losses in machinery production due to the network changes (C-A: – 0.15%) which account for most of the marginal total losses (– 0.03%). No impact of the Tunnel.
Extended network C1	Shipbuilding industry	*a* Because of a worldwide growing demand for ships, no negative impact even if Channel ferry business should suffer because of the Tunnel. *b* Reasonable expectation. Possible indirect impact of the Channel Tunnel has to be seen against this background. *c* No results for shipbuilding industry.
Extended network C1	Service industries	*a* New functions of the Bremen ports provided through production-oriented value-added services will offset any losses. *b* Reasonable expectation, advanced logistics and specialization are the main assets of the Bremen ports. *c* No impact on services.
Extended network C1	Tourism	*a* No impact on tourism. *b* Reasonable expectation. c Gain of only 0.1% in the lodging/catering sector through increase of cross-Channel tourism.
Extended network C1	Interregional balance	*a* Competition among North Sea ports more important than Tunnel. Developments in eastern Europe may strengthen German North Sea ports. *b* Reasonable, but Tunnel plus high-speed rail will make Bremen more peripheral in Europe. *c* Tunnel has no impact on Bremen's economy.
Regional economic development plan	All industries	*a* The regional economic development plan will reinforce the seaport and distribution functions and the position of Bremen as a location for high-level services and research institutions. *b* Reasonable, integrated strategy needed to offset the decline in industrial employment. *c* Regional policy not included in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Bremen: Conclusions on regional development

Bremen does not show great concern for the Tunnel and related infrastructure which do not connect the region better to the rest of Europe. Regional dynamics aim at counteracting such peripheralization by taking up the challenge of the North Sea ports competition and of the opening-up of eastern Europe. In that context the regional actors hope that high-value-added services will offset possible losses. In order to make their hope reality, they should set up strong policies so that the Bremen ports could exploit their advanced logistics and specialization. However, all viewpoints agree that the impact of the Channel Tunnel on Bremen is negligible and, if at all, has to be seen more as a slight loss of growth potential. Beyond competing with other North Sea ports and maintaining the shipbuilding industry, Bremen regional actors have a development strategy oriented towards research and high-level services, which seems reasonable in the regional analysis without feedback from the model.

Figure 6.13. Bremen: change in value-added, limited network

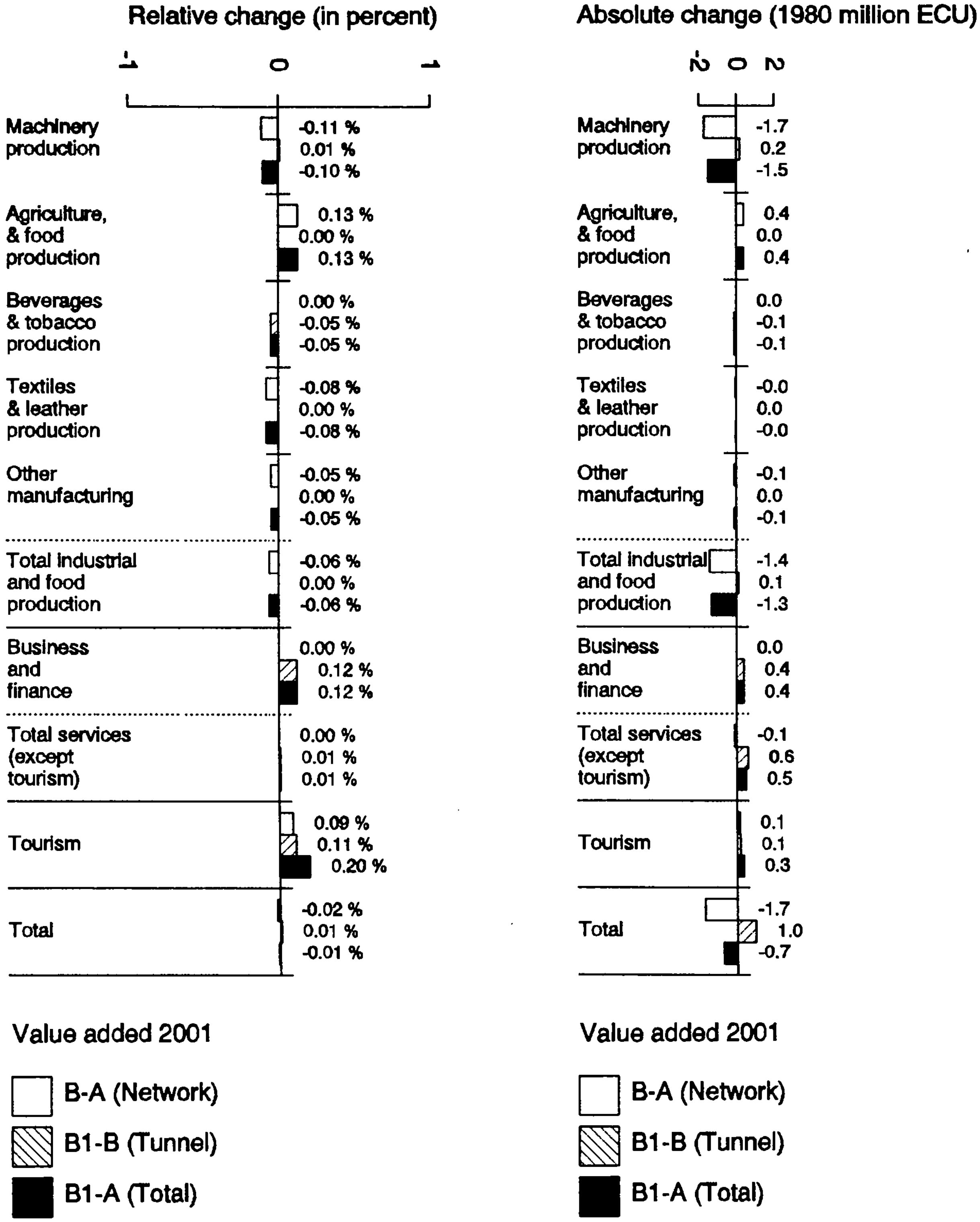


Figure 6.14. Bremen: change in value-added, extended network

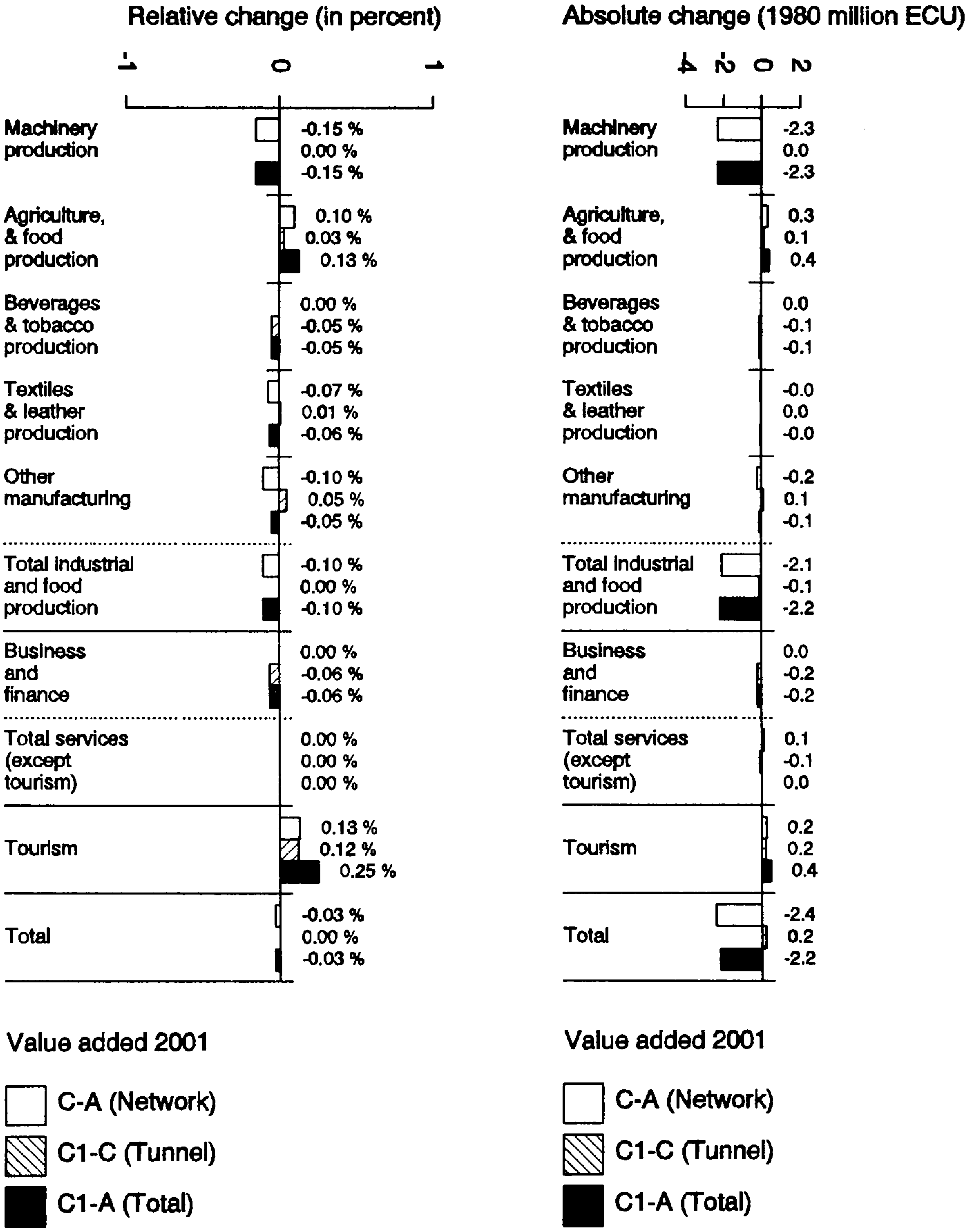


Table 6.21. Brittany: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* Fear that, with mediocre links with the core of Europe, Brittany will become more peripheral. *b* There is no limited network for Brittany as all main new rail and road links will be completed by 1996. But any delay in improving the British network is good for regional ferries between Brittany and UK. *c* Slight losses of – 0.02% through the Tunnel (B1-B), but gains of 0.41% through the network (B-A) caused through gains in industrial and food production (1.26%).
Extended network C1	All industries	*a* The ferry industry is concerned about the Tunnel effect. Brittany actors do not think that the Tunnel will have a significant impact on other industries. They are expecting much more from the coastal motorway. *b* The economic structure and trends do not indicate any major predict-able impact of the Tunnel, either positive or negative. Britanny will benefit from the improvement of the network. *c* Same magnitude and pattern of changes as in B1.
Extended network C1	Manufacturing	*a* No fears about impacts of the new transport system on manufac-turing and no expectation of any serious impact of the Tunnel. *b* The manufacturing industry is partly technology-oriented and, though qualitatively feeble, may gain from a better European connection. *c* No great impact of the Tunnel (C1-C: 0.03%), but the region gains from the network changes (C-A: 1.23%) in all sectors of production.
Extended network C1	Service industry	*a* No major impact expected. *b* Industry does not seem Europe-oriented, except R&D and related services. *c* No impact of the network, but Tunnel itself (C1-C) has negative impact (– 0.14%) caused by loss in business and finance (– 0.9%).
Extended network C1	Tourism	*a* There is some expectation in this field. *b* The present attractiveness of Brittany for British tourists may in-crease. *c* The Tunnel alone (C1-C) induces a 2.1% increase in value-added in lodging and catering through a 21% growth in cross-Channel tourism.
Extended network C1	Intraregional balance	*a* The areas most concerned are the northern ports of Roscoff and Saint-Malo which fear for their ferry industry. *b* Rennes and some other well-connected cities may benefit from the new transport network. Western areas should not expect much of it. *c* The model does not deal with intraregional balance.

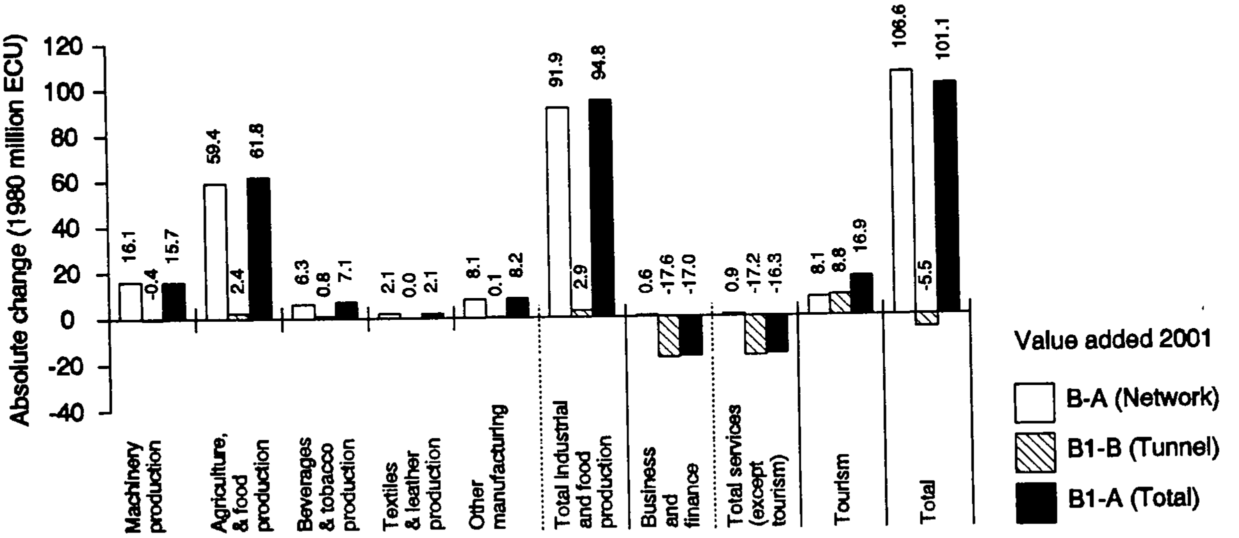
Extended network C1	Interregional balance	*a* The concern of regional actors for the Tunnel network is recent. They fear that the Blue Banana will become even more powerful. Their expectation is in cooperation with the regions of the 'Atlantic Arch'. *b* The risk of increased peripherality diminishes with the ongoing improvements of modern transport infrastructure. *c* Brittany is among the regions relatively close to the Tunnel which will not gain and maybe will lose. However, it will benefit much more from the new European transport system.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Brittany: Conclusions on regional development

Brittany is a region where the Tunnel and other transport infrastructure might have opposite effects. Regional actors tend to fear the Tunnel and to rely on both the TGV and the coastal motorway as growth factors, although the road link leaves out the western part of the region. This is confirmed by the model which forecasts negative impacts of the Tunnel and rather positive impacts of the transport network, be it limited or extended. But Meplan, by assessing the impacts of the two ranges of infrastructure in scenarios B1 and C1, predicts slightly increasing negative effects in services, slightly decreasing positive effects in manufacturing, gains mainly based on agriculture and food production, and growing benefits only in cross-Channel tourism. The regional actors could build strategies out of these predictions. In fact at least one strategy is already emerging: the making of the Atlantic Arch in order to counterbalance the possible polarization effect of both the Blue Banana and the Channel Tunnel. In that view, the completion of the coastal motorway is of high importance.

Figure 6.15. Brittany: change in value-added, limited network



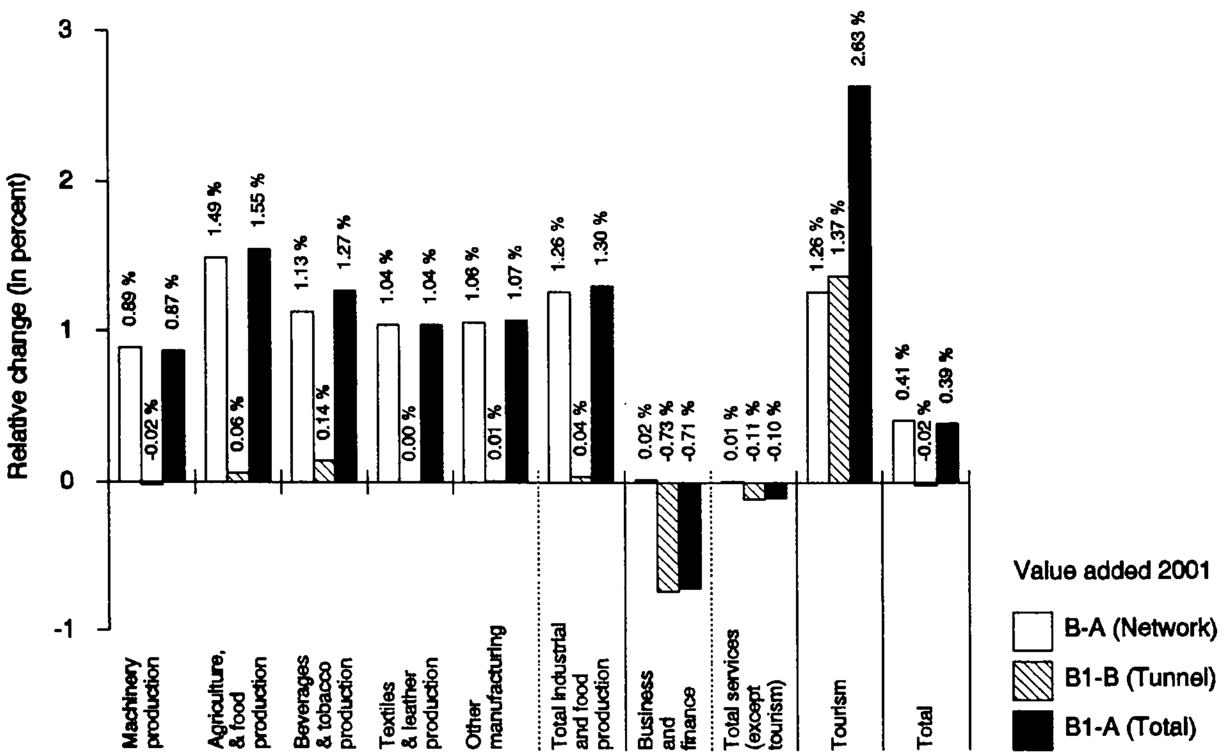


Figure 6.16. Brittany: change in value-added, extended network

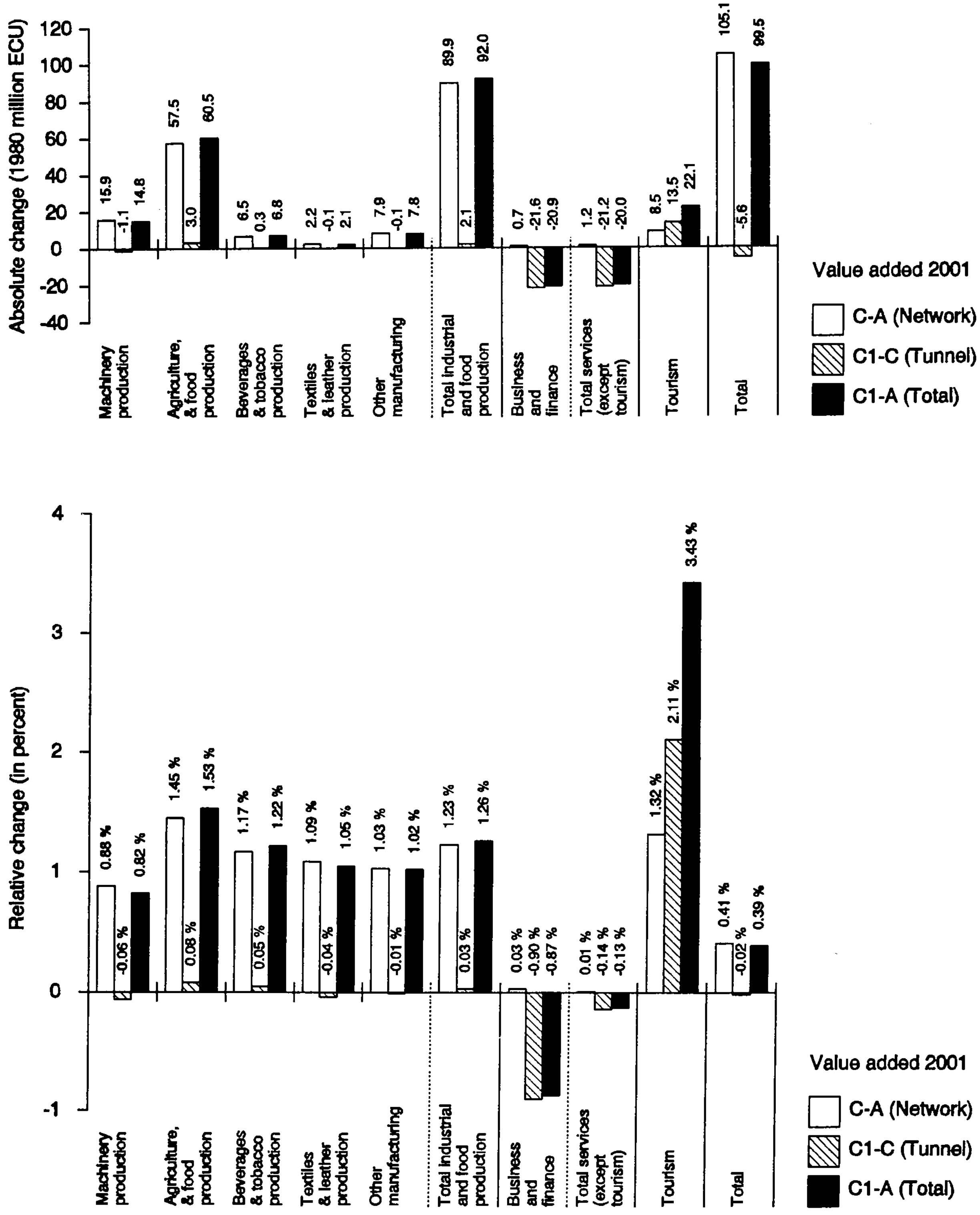


Table 6.22. Piemonte: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* Without improved transalpine crossings, no change is expected from the Tunnel. *b* The increasing trade between Piemonte and the UK may benefit from improvements of the French network and the Tunnel. *c* Piemonte's economy is markedly gaining from the limited network changes (B-A: 0.1%), while there will be practically no effect from the Tunnel.
Extended network C1	All industries	*a* The extended network will only affect rail, while the expressed needs call for new transalpine tunnels and motorways. *b* All industries depending on passenger rail traffic will gain from through-trains between Turin and London and a good connection to the European high-speed rail network. *c* The network effect is the same as with the limited network (0.1%). But with the Lyon-Turin TGV link, the Tunnel will increase the total value-added of the region by nearly 0.1% (C1-C).
Extended network C1	Manufacturing	*a* Nothing expected for manufacturing (automobile and office equipment) which mainly uses the road network, which will remain unchanged. *b* Manufacturing industries will gain as will all sectors needing quick delivery especially for spare parts. *c* Manufacturing industry will gain more than 0.1% value-added (C1-C), largely a result of increases in machinery and textile production.
Extended network C1	Service industries	*a* No mention of expectations for this sector. *b* Relations and business with France may increase and benefit the service industry. However, traffic with the UK and Ireland will remain by air. *c* A slight gain of 0.05% is forecast with the implementation of the Tunnel (C1-C), mainly through business and finance increases (0.35%); not from improvements in the high-speed rail network itself (C-A: 0.01%).
Extended network C1	Tourism	*a* More tourists are expected by train. *b* The connection of Piemonte to the high-speed train network will bring more tourists, especially for short holidays and business. *c* The Tunnel (C1-C) will bring a 0.27% increase in lodging and catering through 8.9% more cross-Channel tourism. The network effect (C-A) on lodging and catering is 0.22% growth.
Extended network C1	Intraregional balance	*a* No perception of impacts on intraregional balance. *b* The zones with more active external economic relations (especially the Turin province) might be more affected than the others. There will be a growing polarization around the TGV stations and nodes. *c* No forecasts in this field.

Extended network C1	Interregional balance	*a* No expectation or fear has been perceived. But the necessity of keeping the best connections with the main European markets is clearly expressed. *b* The risk of being peripheralized does exist if the road links through the Alps are not substantially improved. c Piemonte belongs to the regions benefiting from the Tunnel.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Piemonte: Conclusions on regional development

Piemonte is the principal Italian region gaining from the new transport network, following the model forecast. Despite the distance from the Tunnel, Piemonte is integrated in the realm of the Blue Banana and it is located on the north-west/south-east corridor of European traffic affected by the Tunnel. Without network improvements the Tunnel itself does not seem likely to have much impact on the region's economy, but this may be dynamized by the Lyon-Turin TGV and by the improvement of road links through the Alps. Regional actors do not share optimistic view of the model, which forecasts gains in all sectors, especially in the manufacturing industry where percentages of expected growth in machinery and textile are among the highest.

They seem to be more concerned by the possibility of building a new south-western trans-alpine road tunnel (Mescla-Vésubie or Cuneo-Côte d'Azur) which could contribute to reducing traffic in the congested Aosta and Susa valleys. While hoping for a shift from road to rail, the Piemontese believe that it could only be marginal and that therefore they need new tunnel and motorways projects. Regional actors are very much Europe-oriented; thus they tend to cut themselves off from the rest of their country, along with other northern regions but without common strategies.

Figure 6.17. Piemonte: change in value-added, limited network

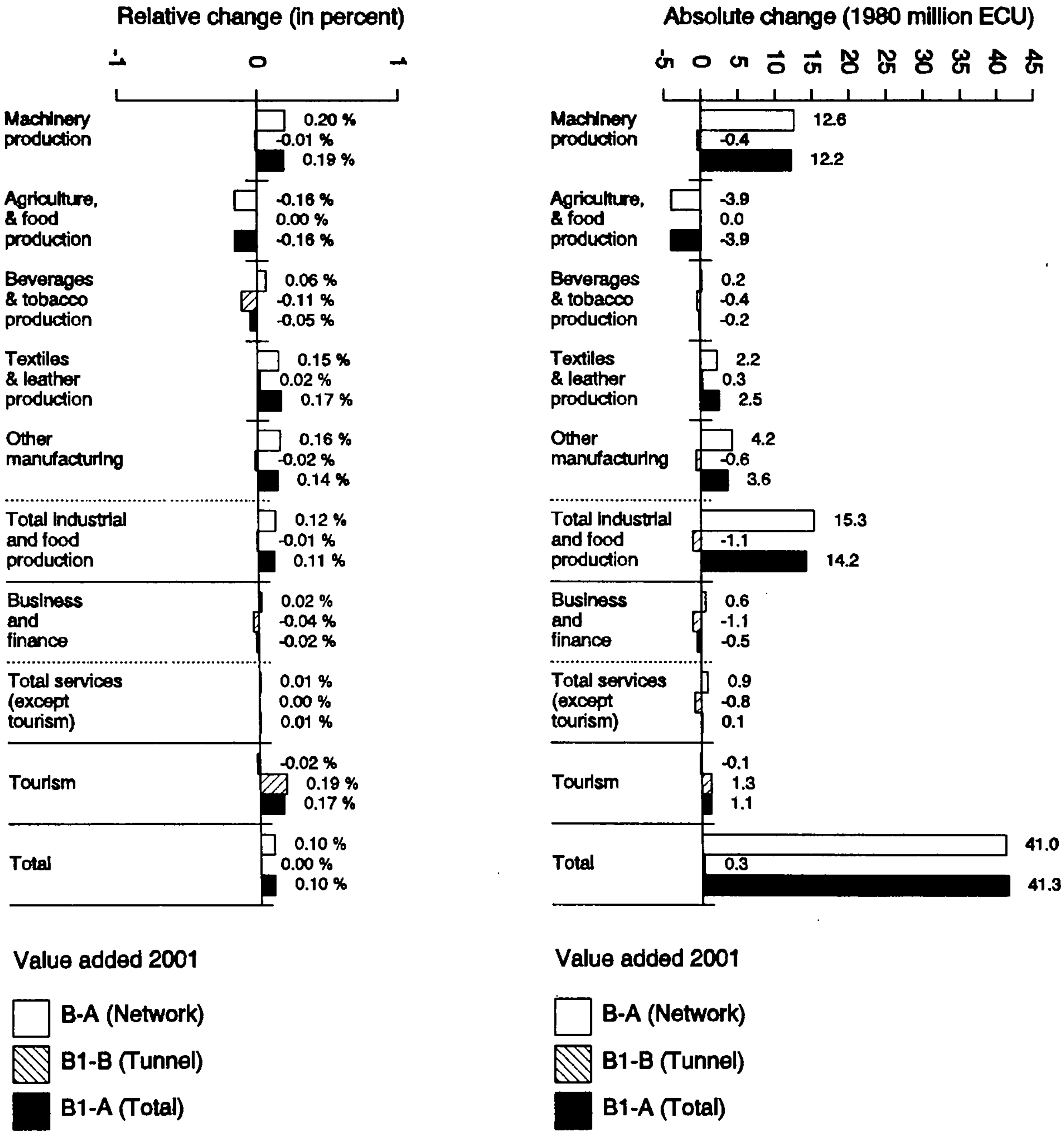
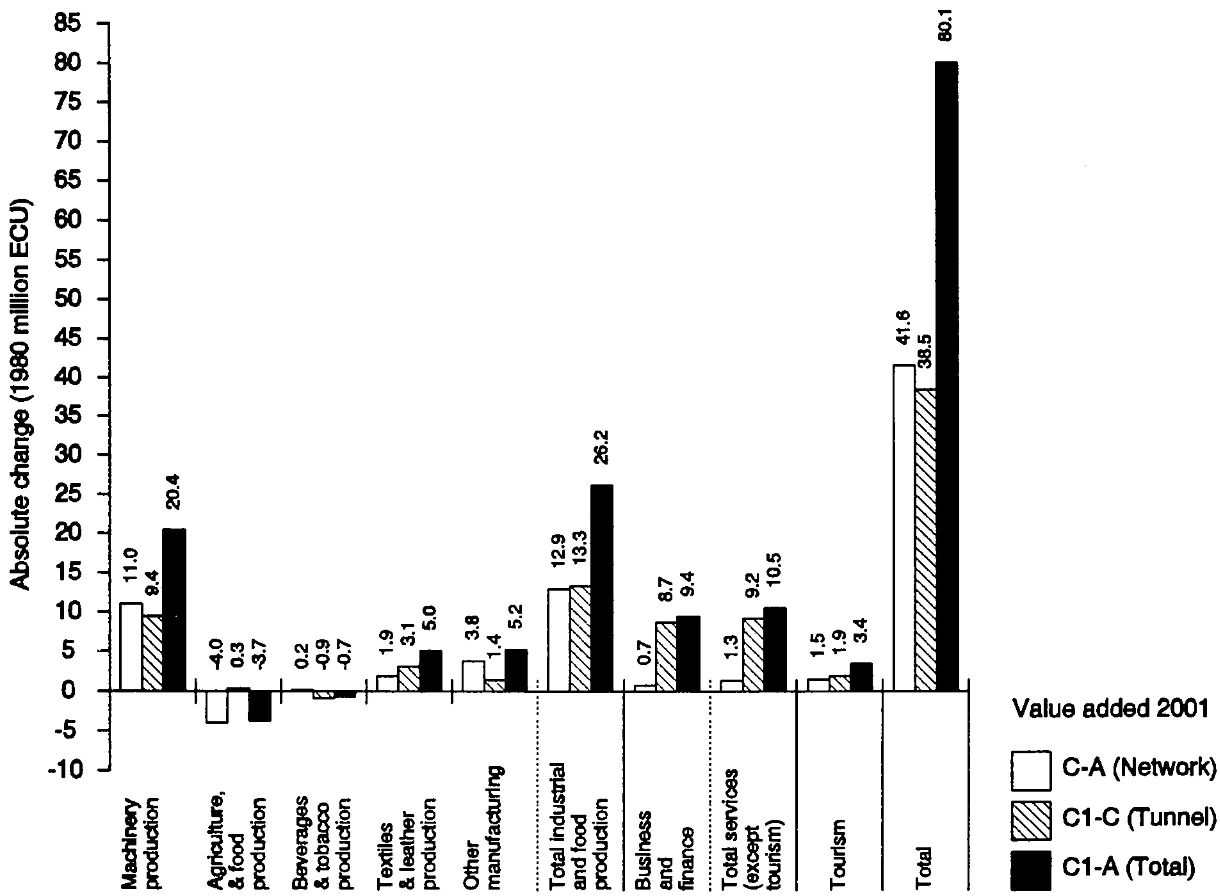


Figure 6.18. Piemonte: change in value-added, extended network



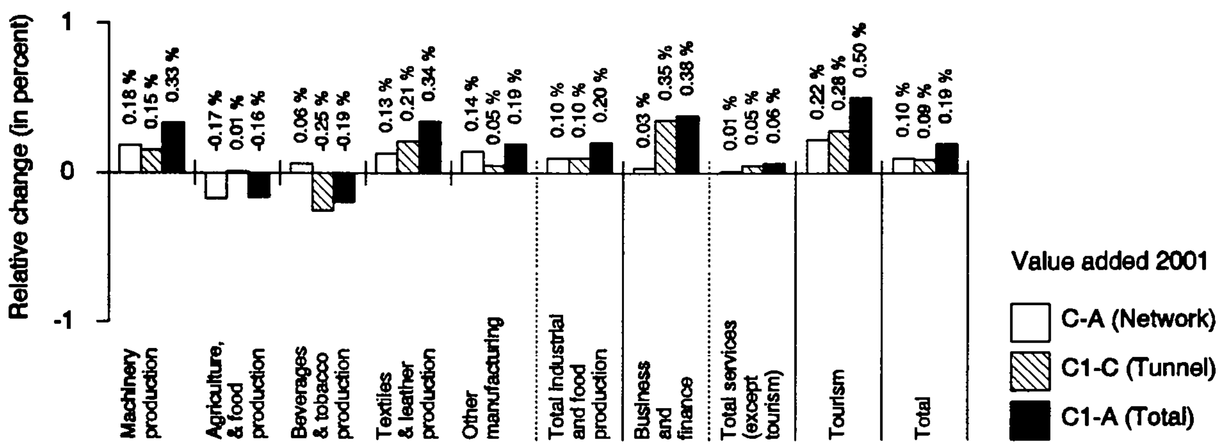


Table 6.23. Scotland: impacts on regional development

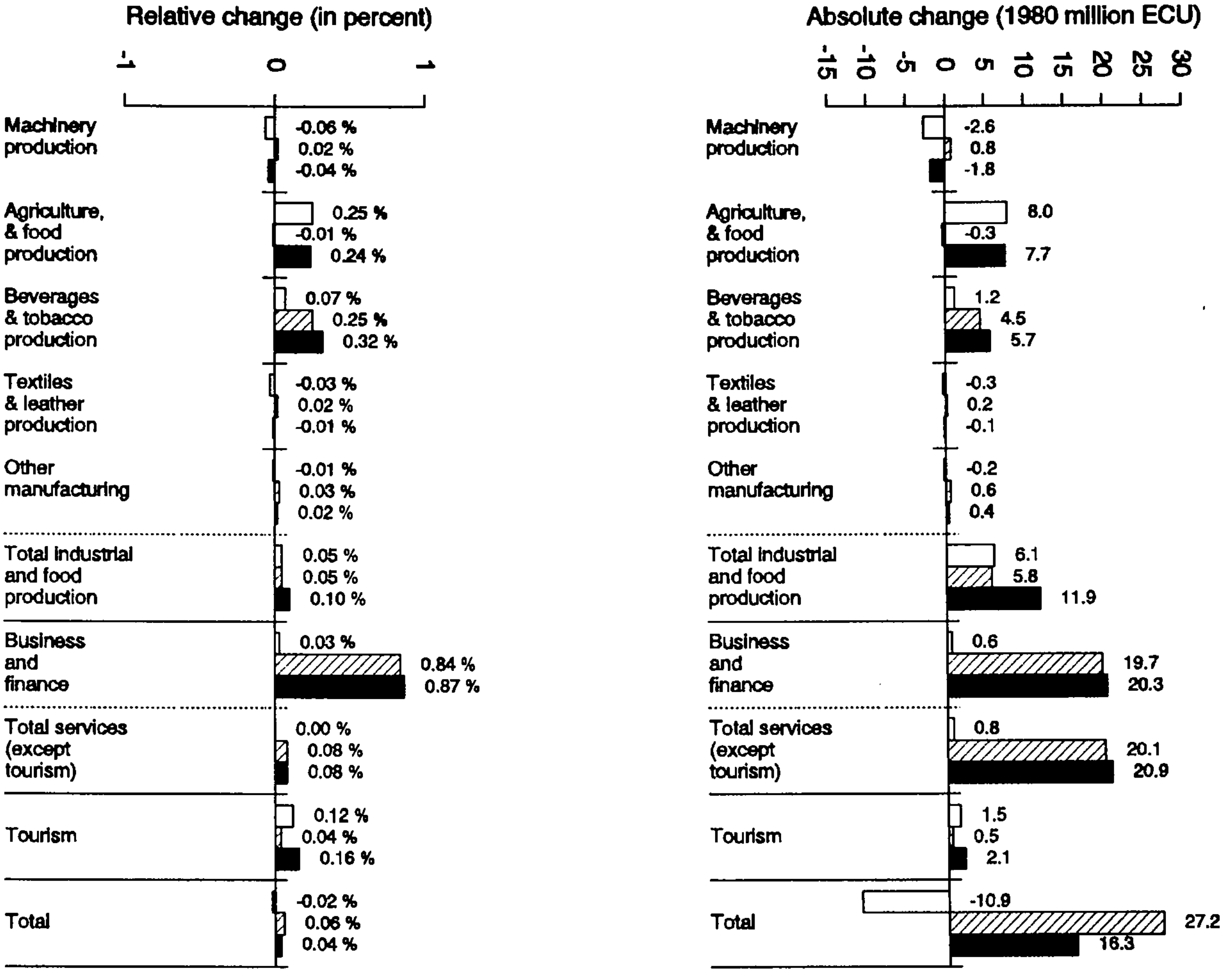
Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* Although Scotland will be closer to European markets with the implementation of the Channel Tunnel, without improved connections to the Tunnel marginal decline is expected in many industries as Scotland must compete with south-east England for Continental markets and the Continent for south-east England markets. There is some expectation of growth in key industries such as beverages and electronics. *b* Reasonable, as some cost/time savings are possible on current trade flows. *c* Overall gain in value-added of 0.06% through Tunnel (B1-B), whith significant gains from beverages/tobacco production (B1-B: 0.25%) and business and finance (B1-B: 0.84%). The impact of the network changes is slightly negative (B-A: – 0.02%).
Extended network C1	All industries	*a* The extended network is not seen as offering any improvement in Scotland's position unless efficient through-trains to and from Scotland are implemented. *b* This is a reasonable conclusion. *c* Overall, the model predicts a slightly smaller gain due to the Tunnel than with the limited network (C1-C: 0.04%) as a result of Scotland's position becoming increasingly peripheral relative to zones nearer the Tunnel. However, for the production industries significant losses are predicted for the machinery, agriculture and food sectors, whereas gains are predicted in the beverages and tobacco industries. The overall network impact (C-A) is more negative, than with the limited network (– 0.07%).
Extended network C1	Services	*a* Some respondents expect gains because of Scotland's high-quality service sector. *b* This seems a surprising result. *c* Services grow by 0.07% through the Tunnel (C1-C) caused by growth in the business and finance services (0.77%). No impact of the network changes only.
Extended network C1	Tourism	*a* Reasonable to expect small increase in tourism. *b* Yes, especially with investment in through-trains. *c* With the Tunnel (C1-C) a gain of 2% is predicted in Continental tourism, resulting in an increase of 0.05% in the lodging and catering sector.
Further network improvements in the UK	All industries	*a* Key problem is Scotland's reliance on the UK for improvements of rail and road links to the Tunnel. *b* The extent to which the opening of the Channel Tunnel affects transport between Scotland and southern England and continental Europe depends on the implementation of through-trains. Particularly, Scotland would be in a position to benefit from rail freight economies, however the UK loading gauge problem must be addressed. *c* Not explicitly tested in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Scotland: Conclusions on regional development

Scotland may derive some benefits from the Tunnel: a few regional actors expect gains in key industries such as beverages and electronics, services and tourism. Meplan predicts some growth in all those sectors, particularly in the beverage and tobacco industry and in business and finance. But the extension of the rail and road network on the Continent results in slight losses or at least smaller gains, with regard to all sectors except beverage and tobacco industries and tourism as Scotland's relative peripherality is increased. Scottish actors fear competition from London and southern UK regions both in conquering new markets on the Continent and in trying to attract tourism and business; because with the extended network Scotland will not be better connected than with the limited network. The model confirms Scottish mixed expectations, since the Tunnel is making it less peripheral, while the extension of the network on the Continent is likely to benefit more central regions and to further increase the gap between core and periphery.

Figure 6.19. Scotland: change in value-added, limited network



Value added 2001

B-A (Network)

B1-B (Tunnel)

B1-A (Total)

Value added 2001

B-A (Network)

B1-B (Tunnel)

B1-A (Total)

Figure 6.20. Scotland: change in value-added, extended network

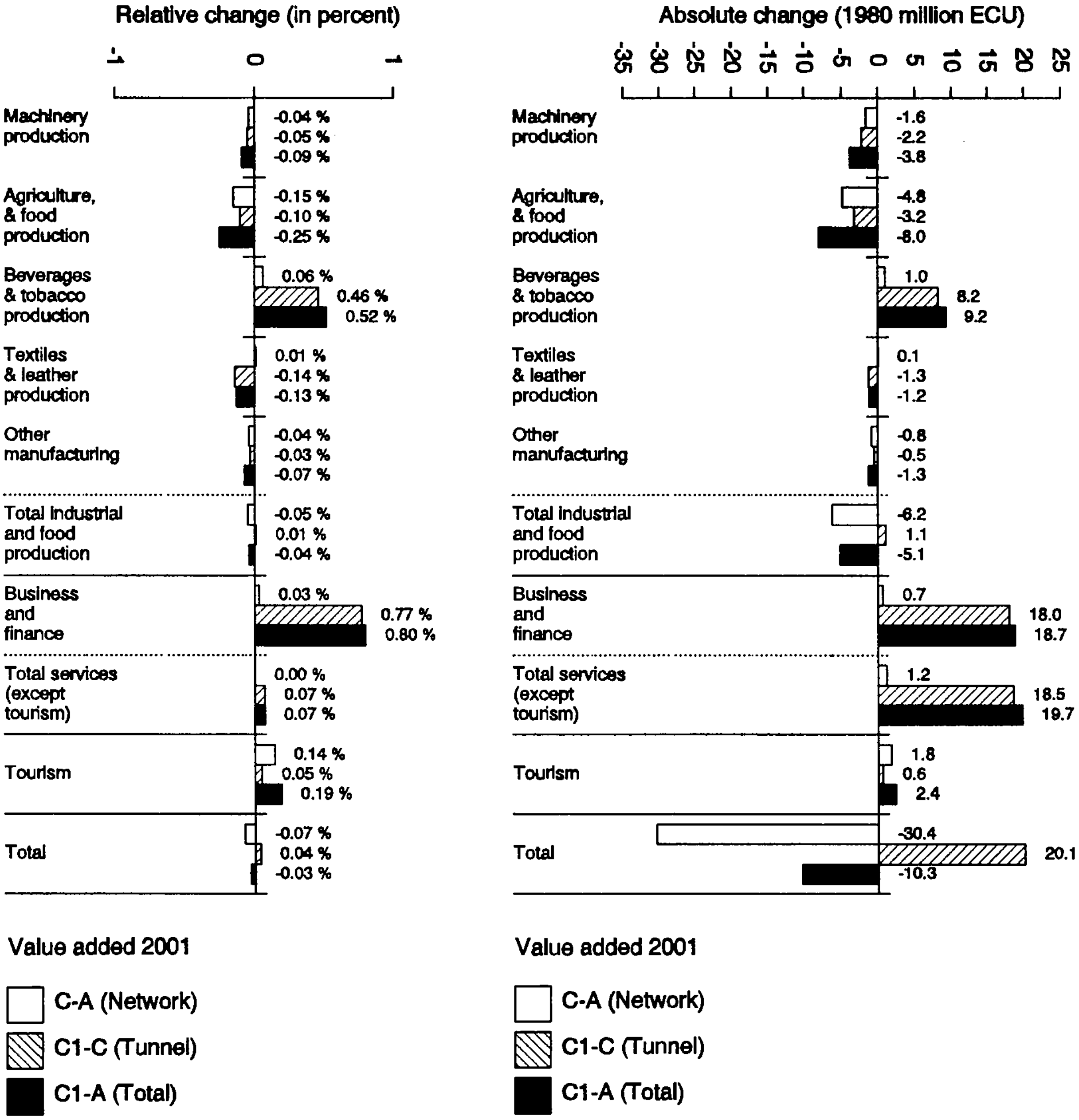


Table 6.24. Ireland: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* The differences between the limited and extended rail networks are of little direct relevance to Ireland since it is unlikely that the rail lines connecting the ferry terminals in Wales to the Tunnel would be substantially upgraded. *b* With the limited network improvements in other regions, Ireland's relative peripherality is not exacerbated as much as with the extended network. *c* No impact as a result of network changes only (B-A). The Tunnel itself (B1-B) generates overall growth of 0.03%, the net result of losses in services and gains in production industries.
Extended network C1	All industries	*a* Access transport costs and times need to be reduced for Ireland. *b* Since road and rail investment within Europe will improve accessibility between the mainland countries, Ireland will need to improve its transport services in Europe substantially just to retain its current relative situation. *c* Magnitude and pattern of changes caused by the Tunnel (C1-C) as with limited network. With the extended network (C-A), the network effect is negative (– 0.07%); mainly through losses in the production industries (– 0.25%). Overall, the Tunnel reduces, but does not overcome, the losses in Ireland.
Extended network C1	Manufacturing	*a* Ireland may become a relatively less attractive location for large firms due to high access transport costs and times. *b* Yes, but some benefits from the Tunnel for accompanied trucks to Europe travelling via Northern Ireland using the short ferry crossing to Scotland. *c* Gain of 0.17% caused by the Tunnel (C1-C), mainly through gains in machinery (0.27%), agriculture and food (0.15%) and textiles and leather (0.44%). Negative effects (– 0.25%) of the network (C-A), in nearly all industries except textiles and leather.
Extended network C1	Services	*a* No effect because Ireland is too far from the Tunnel. *b* For business travellers to Ireland, the Tunnel is unlikely to be used because of poor surface connections between the UK and Ireland. *c* Loss of – 0.02% through the Tunnel (C1-C) because of losses in business and finance (– 0.82%).
Extended network C1	Tourism	*a* Being the only region entirely depending on sea and air transport puts Ireland at a disadvantage. Fear that tourists will stay in the UK. *b* Reasonable, main obstacles are poor through-rail connections and the need for surface passengers to make the long sea crossing from Wales to Ireland. *c* Loss of 3% Continental tourism due to the Tunnel (C1-C), a major growth market in recent years, leading to loss of 0.24% in lodging and catering.

Extended network C1	Interregional balance	*a* Ireland has high imports and exports relative to GDP but greater physical barriers to trade with the EC than other EC countries. *b* With the removal of administrative boundaries by the single European market, physical barriers will be of greater relative importance, so that Ireland would need to reduce physical barriers through improved sea and air services if it is not to lose out to the more central regions. c Not explicitly tested in the model.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Ireland: Conclusions on regional development

Ireland is in a situation similar to that of Scotland, with more handicaps. The Tunnel, with better road and rail access does not really represent a faster connection between Ireland and the Continent, except for freight traffic going through the northern corridor and using land infrastructure from Scotland to Dover. Irish authorities and businessmen express little confidence in the Channel Tunnel and related infrastructure as factors of economic growth; on the contrary, they fear more severe competition from UK regions on Continental markets and from French food products on south-east England markets. Meplan results lead to more optimism, forecasting substantial increases in machinery production as well as in the textile and leather industry, and a small gain in agriculture and food production. However, impacts on services and tourism are negative.

Surprisingly enough, from a manufacturing perspective, Ireland appears to be part of the central zone of influence of the Channel Tunnel and related infrastructure, as a result of the model forecasts. This is because Ireland is a very open economy in terms of the high proportion of imported inputs to industry and of exported outputs from industry. Accordingly the benefits of improved access to the Continent are amplified by comparison with countries with less open economies. Nevertheless, under the extended network scenario, the Tunnel is still insufficient to counterbalance the losses in manufacturing in Ireland due to its increase in relative peripherality.

Figure 6.21. Ireland: change in value-added, limited network

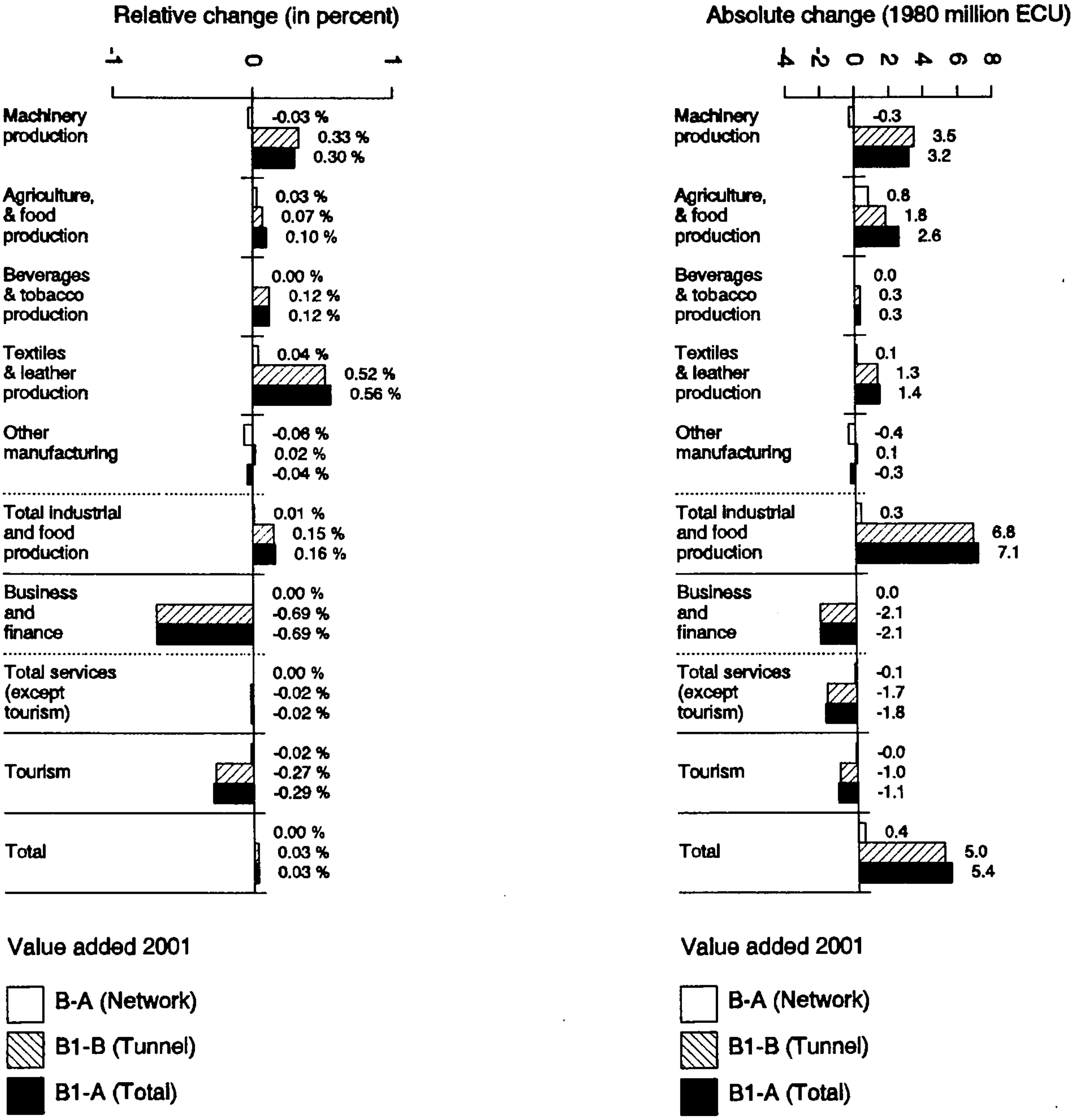


Figure 6.22. Ireland: change in value-added, extended network

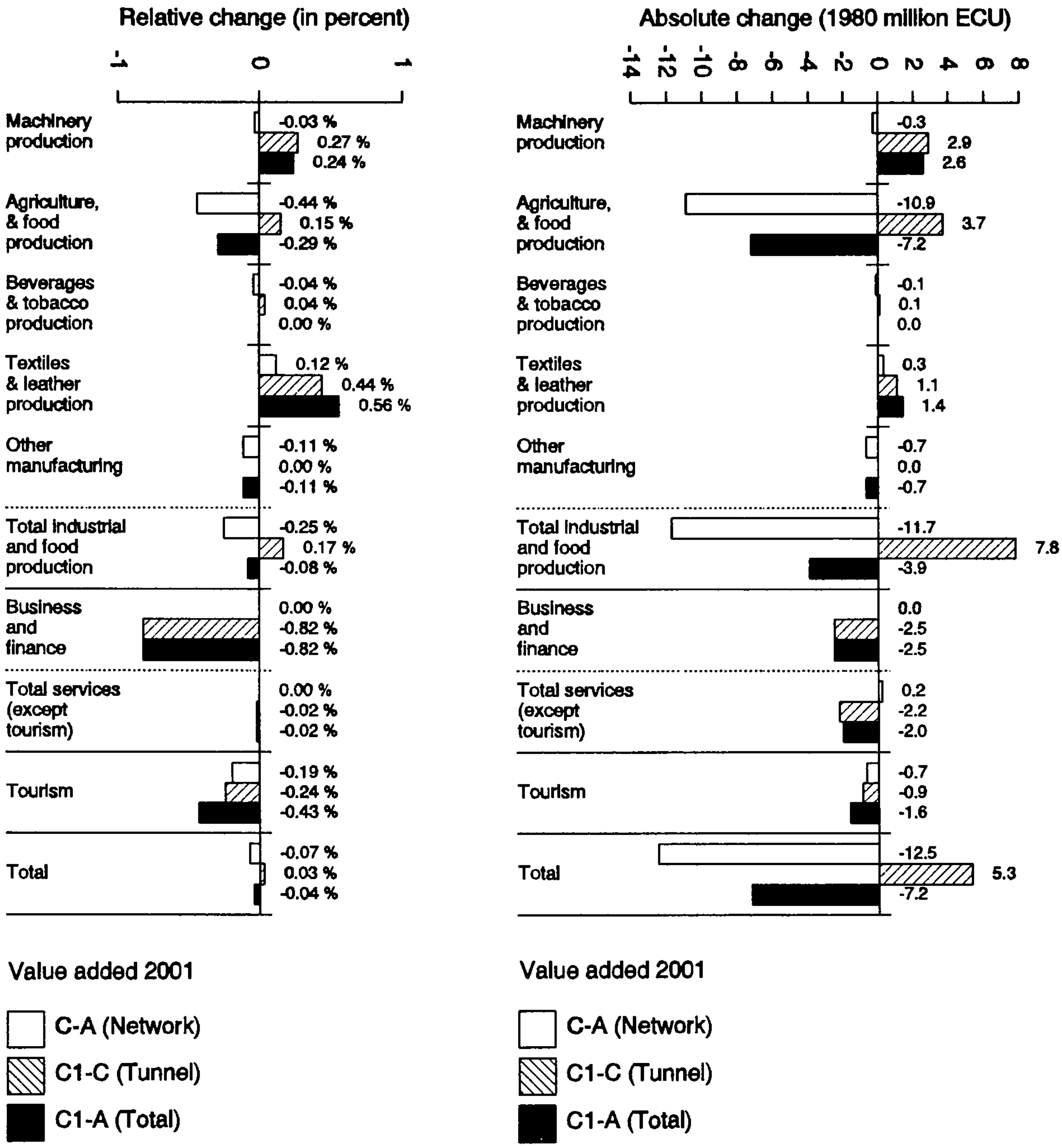


Table 6.25. Basque Country: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* With no direct rail connection between the Basque Country and the European core, there is no expectation for economic changes except negative impacts of increased relative peripherality. *b* This threat seems to be underestimated by Basque actors and experts. *c* Negative effect of the Tunnel (B1-B) of – 0.09% of total value-added. However, slightly positive effect of 0.03% from network changes (B-A).
Extended network C1	All industries	*a* The Basque economy is neither perceived as threatened nor as favoured by the new transport network. *b* Even the rail connection with France will possibly not fully compensate the more advantageous position of central regions in Europe. *c* No real impact as result of network changes, but negative impact of – 0.1% of the Tunnel (C1-C) caused by declines in business and finance and tourism.
Extended network C1	Manufacturing	*a* Manufacturing industry does not feel really concerned by the Channel Tunnel, therefore it adopts a 'wait-and-see' attitude. *b* Reasonable expectation. The modernization is going on very fast. *c* All production industries negatively affected by the Tunnel (C1-C: – 0.09%).
Extended network C1	Service industries	*a* No mention of any expectation for services which are in a rapid process of modernization. *b* It is an open question whether the modernization of the Basque service industry will be sufficient to compensate, in relative terms, the growing synergy of services in the European core. *c* Loss of 0.1% through the Tunnel (C1-C), this loss is due to decreases in the business and finance sector (C1-C: – 1.73%).
Extended network C1	Tourism	*a* British tourism is not very important and no change is expected, neither positive nor negative. *b* There may be a decrease. *c* Loss of 0.5% in lodging and catering (C1-C) through 3.1% loss of cross-Channel tourism.
Extended network C1	Intraregional balance	*a* The Basque 'Y', the full integration of the region into the high-speed rail network, will give the same possibilities to the different parts of the region. *b* This expectation is likely. *c* No forecasts by the model

Extended network C1	Interregional balance	*a* Basque actors and experts believe they are more or less masters of their economic destinies and tend to underestimate the effects of growing unbalance between core and periphery. *b* There are two dangers: The first is coming from the faster growth of core regions; the response should be a better connection. The second is the emergence of a Mediterranean axis: the response seems to be the development of the 'Atlantic Arch'. *c* Despite its proximity to south-west France, Pais Vasco is one of the losing regions.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Basque Country: Conclusions on regional development

Although distant from the Tunnel, the Basque Country is not immune to its influence. The Tunnel opening is likely to have negative impacts on almost all sectors and this effect is amplified with the extension of its related transport network; Meplan forecasts show a slightly increasing negative impact. But as the Basque economy is expected to continue its recovery and growth, the impact of the Channel Tunnel has to be interpreted as a slight reduction of overall growth. Regional actors, however, tend to feel completely unconcerned. They know they cannot expect gains from this transport network and they even mention the risk of an increased relative peripherality of the Basque Country in Europe; but their conclusion is that the Channel Tunnel will have no effect at all on the Basque economy. By thinking that way, they misinterpret how European regions relate to each other and how the whole interregional balance is likely to change under the effect of any major change within the Community territory. It is true that the Channel Tunnel will have no direct effect on the Basque economy, it will nevertheless induce a polarization effect along its main axis in the European Community, from which the Iberian peninsula will be excluded.

Even though they underestimate that polarization effect, Basque actors tend to be Europe-oriented and the key issue for them is to be connected to the core as well as, or possibly better than, Catalonia, their main rival.

Figure 6.23. Basque Country: change in value-added, limited network

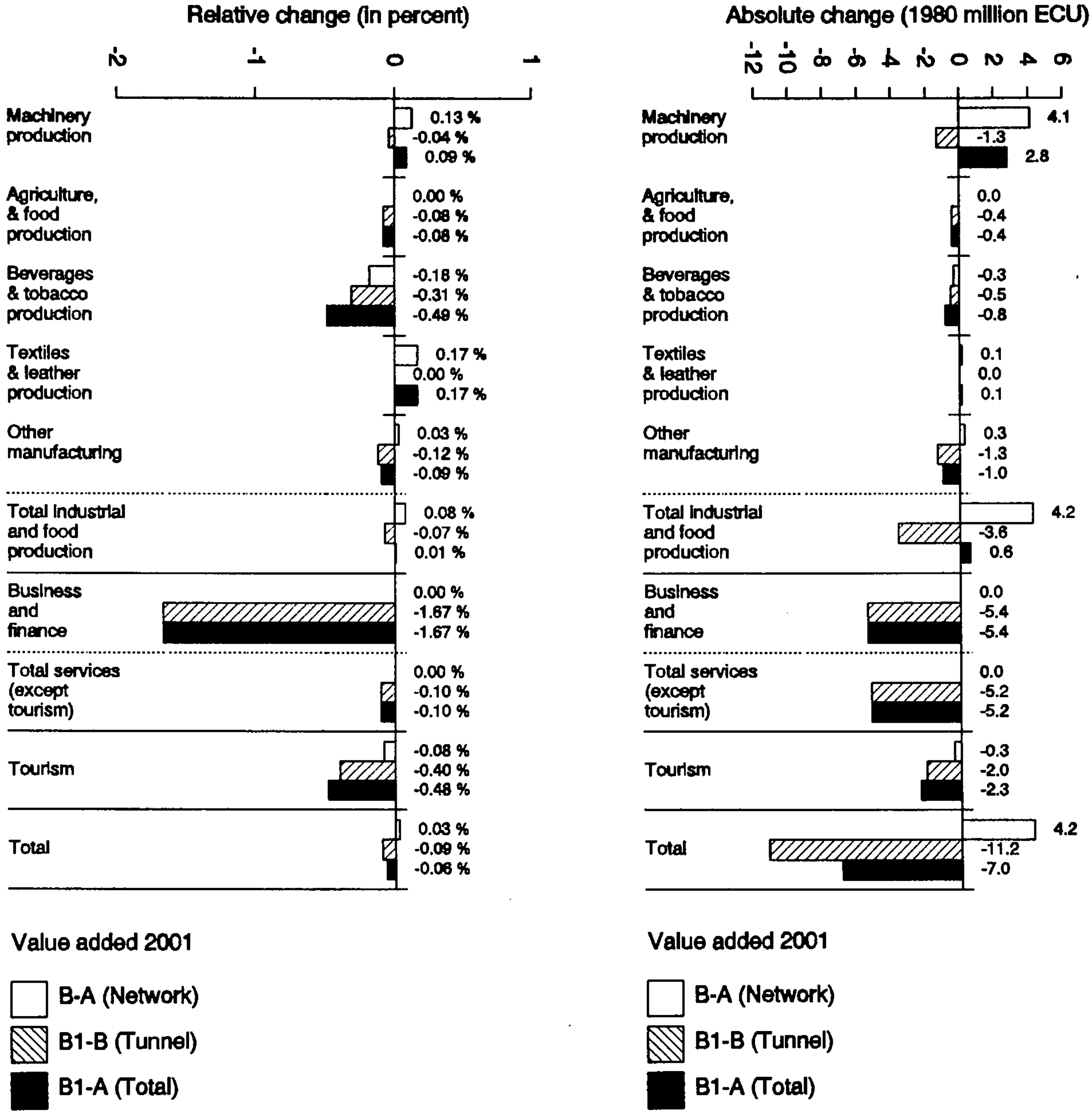


Figure 6.24. Basque Country: change in value-added, extended network

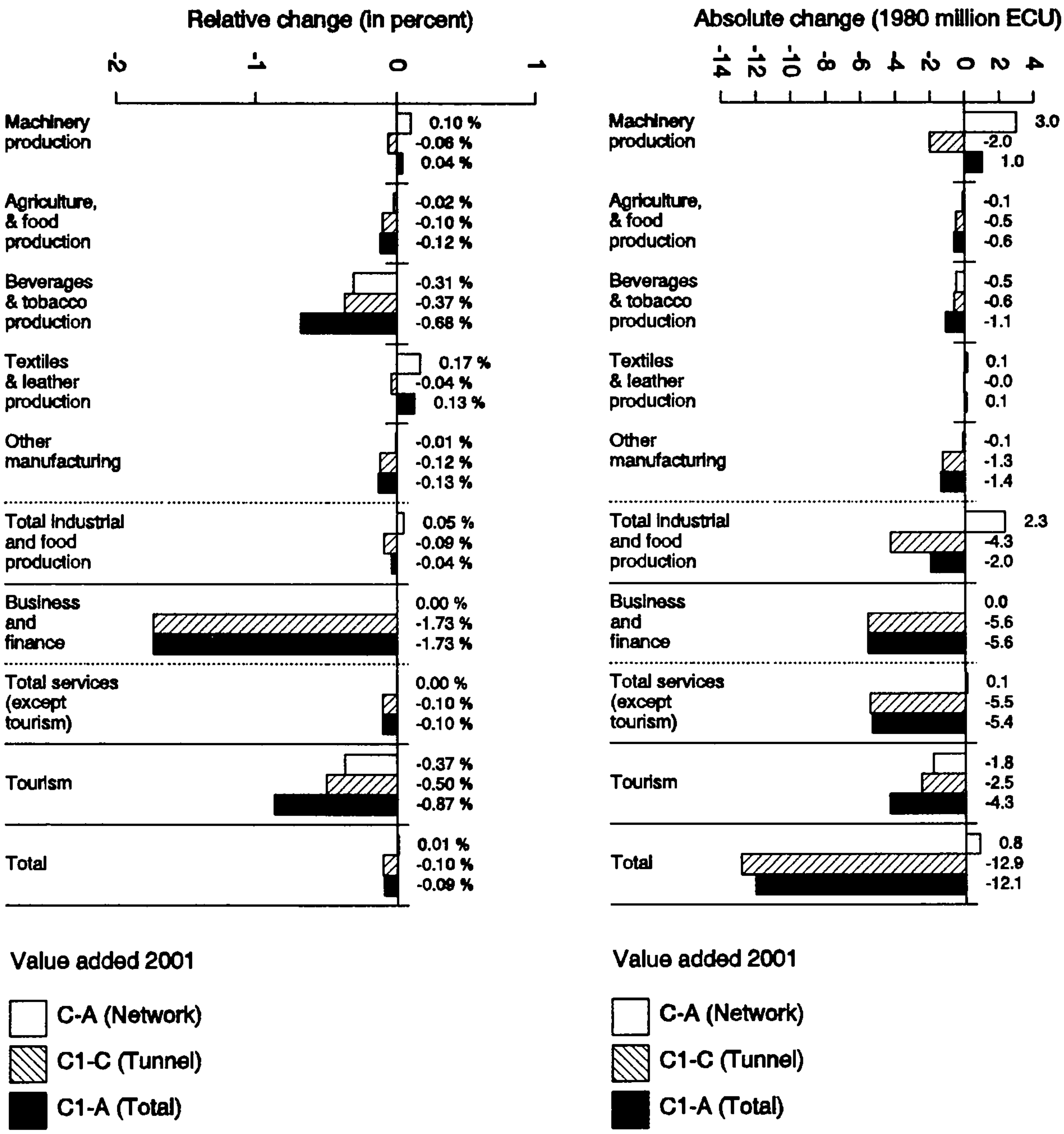


Table 6.26. Norte: impacts on regional development

Policy	Industry	Impacts *a, b, c*
Limited network B1	All industries	*a* No current concerns about direct impacts of the Tunnel on the economy, but fears of isolation of Norte from the new European transport system. Therefore, strong demand for the completion of road and rail links to Spain and the rest of Europe. *b* The non-completion of the full road connection with the Europe central network would disadvantage Norte. *c* Negligible impact as result of the network changes (B-A), but clear negative effect of – 0.02% as result of the Tunnel (B1-B).
Extended network C1	All industries	*a* There is no expectation for new markets, new investors and more generally for any impact on regional development. *b* The likely savings in generalized costs of transport will not compensate for the relative disadvantage *vis-à-vis* the gains of central regions. *c* Even the extended network (C1-A) will hardly affect Norte (– 0.04%). The Tunnel itself (C1-C) will have a negative impact on regional value added (– 0.2%).
Extended network C1	Manufacturing	*a* Fears of increased competition from more central regions. *b* The greater advantages of other regions will strongly affect an industrial sector which has not completed its modernization and restructuring. *c* Negative impact of the Tunnel (C1-C) of – 0.13%, especially in agriculture and food production (– 0.2%) and beverages and tobacco (– 0.95%).
Extended network C1	Service industries	*a* No mention of any expectation with respect to services *b* Low level of services puts Norte down in interregional competition. *c* Negative impact of Tunnel (C1-C: – 0.18%), mainly through a loss of 2.05% in the business and finance sector. No impact as a result of the network changes only.
Extended network C1	Tourism	*a* Slight increase in tourism with diversion from air to road expected. *b* Without direct connection to the new European passenger transport system, Norte will become less attractive for the main tourism markets. *c* Loss of 6.4% in cross-Channel tourism through the Tunnel (C1-C) leads to a decrease of 3.3% in lodging and catering, additional loss of 1.99% through the network (C-A).
Extended network C1	Intraregional balance	*a* The less developed areas will become more accessible, improving the intraregional balance. *b* Exact, especially those close to the Spanish border. *c* No forecasts from the model.

Extended network C1	Interregional balance	*a* Other regions may benefit more than Norte from improvement in the European transport system. For that reason, there is a danger of increased migrations from Norte to central regions of the EC. *b* Norte does not seem in a very good position in the new European economic space if it is not appropriately connected with the European core at least by rail and road through Spain and France. *c* As a whole, the Norte economy will suffer.

a Expectation of regional actors.
b Forecasts based on regional analyses.
c Meplan forecasts for 2001.
Most significant impacts.

Norte: Conclusions on regional development

Norte is the most remote region with regards to the Tunnel, of the 13 case-study regions. It has also long been a depressed area with emigrations to industrial European and American countries. Finally, it is not an authentic region provided with regional power, since the long discussed regionalization law has not yet been enacted in Portugal. These features are not assets in the competition for benefits from the communication network to be built around the Channel Tunnel, although Norte is engaged in the modernization of its industry with EC support. The Tunnel is seen by regional actors as one more element tightening up the core regions of the EC and leaving out the periphery to which they belong. Therefore, they insist upon the necessity of completing the road link to Europe through Spain and are asking for EC compensation. The only field where they would expect some gains is tourism. Unfortunately, such expectations result from an underestimation of the Tunnel effects on the interregional balance. Meplan forecasts the greatest negative impacts among all 13 regions on Norte: on such long distances, in the absence of direct through trains or road links, the time saving allowed by the Tunnel is too small. Car or train travel from the UK and Ireland to Norte is therefore unlikely to increase. On the contrary, some British and Irish tourists are flying to closer continental countries. But as the Norte economy is expected to grow in general, the impact of the Channel Tunnel has to be interpreted as a slight reduction of overall growth.

Figure 6.25. Norte: change in value-added, limited network

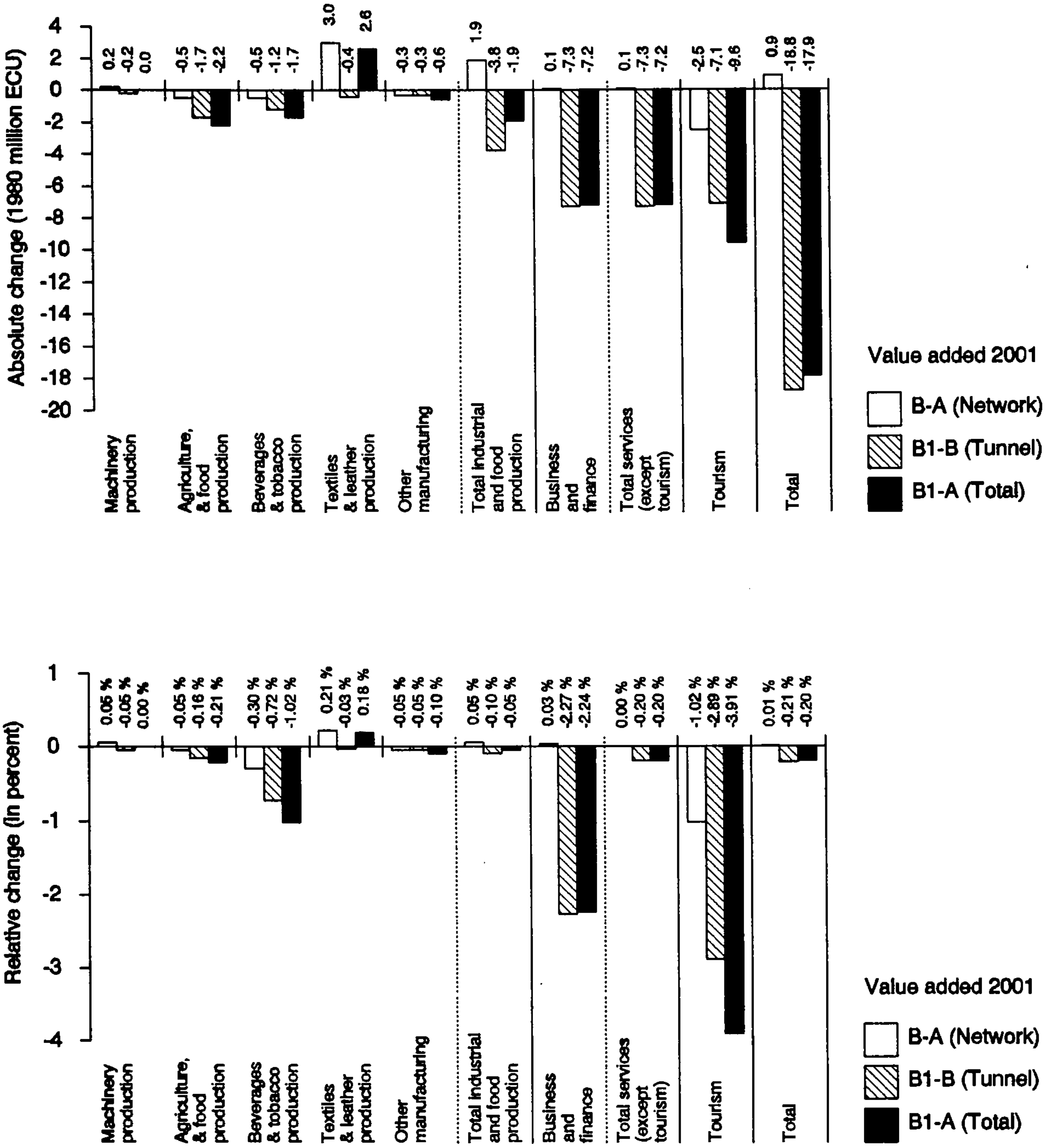
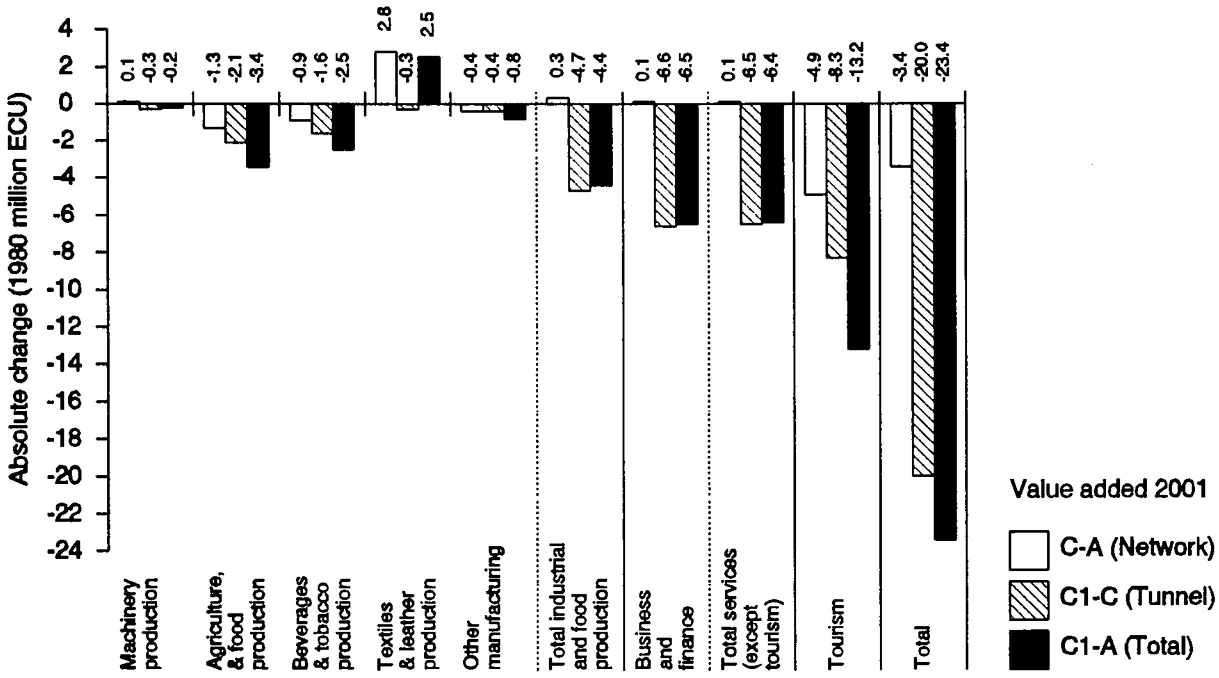
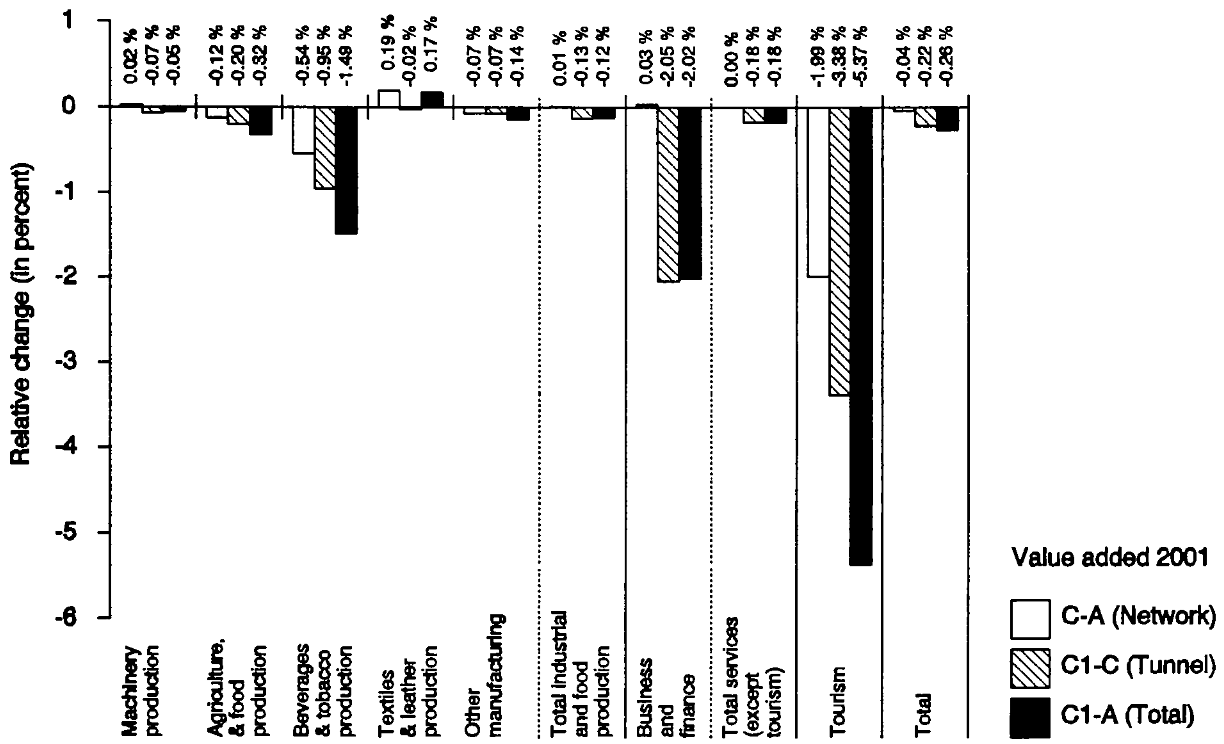


Figure 6.26. Norte: change in value-added, extended network





Conclusion of the confrontation

The regional analyses forecast positive impacts on regions situated at a distance of up to 400 km from the Tunnel, save Hainaut, and no or negative impacts beyond that distance. The regional monographs make a distinction between regional actors' expectations and analysis conclusions, taking into account the economic situation and prospects. Regional representatives tend sometimes to overestimate the likely Tunnel impacts on the closest regions and to underestimate them in the remotest regions. Some of this is coherent with the model results, but in several cases, there are some gaps between the model and the regional analyses forecasts. These differences can be explained in two ways:

(i) The model predicts gains while the regional analyses predict losses, for example, Hainaut, Scotland and Ireland. On the model side, it can be said that perhaps the transport costs changes are given too much weight at the expense of goods-carriers' strategies, in the case of Ireland for instance; on the regional analyses side, gaps are explained through lack of regional power, or lack of synergy between national and regional authorities and between public authorities and businessmen. Generally speaking, the differences here lie in referring to the equilibrium paradigm, on the part of the model and in referring to the polarization paradigm on the part of the regional analyses (see 6.1.1);

(ii) The model predicts losses and the regional actors forecast no effects, for example, the Basque Country and Norte. This is a regional bias, failing to evaluate how even remote places can be affected by major changes in the European transport network; the model results are then useful to make regional actors aware of the risks they may face.

Specific investigations have been made, through regional analyses, on the responses of regional actors to the expected impacts. They show a correlation between expected impacts and responses: the latter are more numerous where the former are seen as positive, following the abovementioned pattern relying on differences between close and remote regions and oppositely for the peripheral regions, namely Scotland, Ireland and the Basque Country. This can be considered as coherent with the model. But very active responses are also given in peripheral regions, namely Scotland, Ireland and the Basque Country.

Scotland and Ireland, fearing negative impacts are dedicated to lobbying, trying to maintain pressure on the British Government, in order to obtain better rail, road and ferry links to the Tunnel. The Basque Country, less concerned by the Tunnel, has nevertheless a European strategy, particularly in the field of transport infrastructure; like Piemonte, the region is looking outside its own country towards nothern Europe. In such a situation, the regional actors took the opportunity during the interviews on the impact of the Channel Tunnel to raise questions about the future European transport network and how they could expand their markets within the EC.

Eight reasons were found to be more or less reponsive to the Tunnel issue following the regional analyses, the other five are mainly found in the periphery, with the exception of Hainaut which belongs to the core area; the low level of responses in that case is largely due to the fact that Hainaut is not really a region. Piemonte has to be mentioned as a specific situation where the global response is weak, although businessmen do have strategies; the weakness comes primarily from regional institutions who have not managed, so far, to build up strategies and policies out of their European concern. Bremen, Brittany and Norte are much less concerned, Bremen being more interested in the opening between eastern and western Europe, Brittany in the Atlantic Arch and Norte in being recognized as a region by its own central government and in modernizing its industry.

It shall be recalled that only the regional monographs may consider the Tunnel impacts on intraregional balance. In this matter, it can be said that the new high-speed transport system, specially the railway one, will create polarizations at the nodes and the ends of the network. This may be observed in Hainaut and Brittany for instance. The Hainaut case is interesting, because it shows the likely split of the region whose economy being attracted partly by Lille and Brussels, and more slightly by the neighbouring West-Vlaanderen.

6.2.3. Conclusions on the case-study regions

The regional analysis part of this study proposed at the beginning of Chapter 4 an initial typology of the case-study regions based on the current situation of the regions with respect to their economic state, strategic capacity and degree of centrality in Europe (see Table 4.8). If we go back to this typology now, how is it affected by the results of both regional and model analyses on the impacts of the Channel Tunnel? Will individual regions change their position within this framework or will they remain at their previous position?

Within the Blue Banana, among the three regions having faced economic difficulties in the recent past, Nord-Pas-de-Calais will probably enjoy the most positive effects and use them to consolidate its economic situation, if the regional authorities and economic actors join their efforts. The future of Kent and Hainaut is more uncertain because of lack of regional identity and strategic capacity. However, the model forecasts that both regions have the potential to grow, in particular Kent, though more through improved links to London and the rest of the UK than through the Tunnel.

Among the four regions in the Blue Banana classified as being in good economic condition, the benefits of the Tunnel and related infrastructure will primarily be in favour of West-Vlaanderen. Zeeland will gain only in conjunction with the Westerschelde crossing. Cologne and Piemonte will have to fight to be rapidly and/or well connected to the European transport network. But in the long term both regions maintain their position as major transport hubs in their countries towards the Benelux, France, and, of course, the UK and Ireland.

Outside the Blue Banana, the so-called 'easily linkable' regions, Brittany and Bremen, may be slightly more peripheralized. However, they are already putting their stakes on alternative European developments, the strategy of the Atlantic Arch for Brittany and the east-west opening for Bremen.

Among the peripheral regions, one has to separate the peripheral regions on the Continent from those on the other side of the Tunnel. Scotland and Ireland can derive positive impacts from the new infrastructure and, though they might suffer in their own view the competition of south-east England, they will eventually become less peripheral. On the other hand, the Basque Country and Norte will be more peripheral. So the expected increasing peripheralization of regions already decentrally located will only take place on the Continent, whereas this is not the case for remote regions at the other end of the Tunnel.

The above developments introduce considerable changes into the typology of regions. Table 6.27 is a revised representation of the typology where the arrows indicate the direction of change in the position of the individual regions. However, Nord-Pas-de-Calais is the only region really moving from one category to another taking advantage of its potential hub functions in north-west Europe. All other regions remain more or less inside their previous category; all, however, are affected by the Tunnel either tending to move or maintain their position. The latter is true for Cologne, Piemonte, West-Vlaanderen and Zeeland. Kent, Hainaut, Ireland and Scotland have the opportunity to improve their economic situation, but this depends mainly on their pursued strategies or on decisions and support from outside. All regions classified as situated along a pipe, Zeeland, West-Vlaanderen, Hainaut and Kent, will face increasing transit traffic through their regions without gaining too many opportunities from it. However, the function of West-Vlaanderen as a major freight hub for cross-Channel ferry transport will be maintained. Bremen and, even more so the Basque Country and Norte, are relatively drifting away; but Bremen has confident perspectives based on the opening-up of eastern Europe.

It therefore appears that the transport network to be built in conjunction with the Channel Tunnel will to a certain degree modify positions of the regions with regard to core and periphery, under a double effect of polarization and diffusion: tightening up the core area on one side and spreading out positive impacts from a north-west/south-east central corridor. These effects will be more thoroughly examined in the following section on generalization of the results of the case-studies.

Finally, it is important to point out that the above positive impact of the Tunnel and the avoidance or minimization of its negative effects will require intensive and coordinated policy action by the affected regions as well as by national governments and the European Community. The policy issues arising from the analysis of the regional impacts of the Channel Tunnel will be discussed in the final section of this chapter.

6.3. Generalization to all EC regions

What can be learned from the case-studies with respect to the impacts of the Channel Tunnel on the whole territory of the European Community? Both approaches have built-in opportunities for a generalization to all EC regions. The case-study regions of the regional analyses have been selected not as representatives regions of the EC, but as regions with representative problems or

Table 6.27. Revised typology of the case-study regions

Prosperity		Centrality			
		Inside 'Blue Banana'		Outside 'Blue Banana'	
Economic state	Strategic capacity	at a hub	along a pipe	easily linkable	separated
good	high	Köln		Bremen →	
			Zeeland		
	low	Piemonte	West-Vlaanderen		
	high		Nord-Pas-de-Calais	Bretagne	Ireland
					Scotland
difficult			Kent		Pais Vasco →
	low		Hainaut		Norte →

characteristics with regard to the impacts of the Channel Tunnel. In this sense, generalization of the results of the case-study regions can be made in a rather straightforward manner. The model results are by nature available for all regions of the Community. Generalization of the model results is made easier by the organization of the regions within the model into contiguous groups of regions.

This section, as the previous one, starts with the impacts of the Channel Tunnel on transport flows. This will be done first with regard to different modes of transport for passenger and freight. Then, it will attempt to group the regions with respect to transport issues in a comparable way. After that, impacts on regional development will be assessed. This begins with generalized results for main economic sectors, the production sector, services and tourism. Finally, a typology of European regions affected by the Channel Tunnel will be presented.

6.3.1 Impacts on transport flows in Europe

The following discussion describes the impact of the Channel Tunnel on transport flows in the whole territory of the European Community. This reflection will, of course, focus on cross-Channel transport flows. However, as the Channel Tunnel cannot be seen as an isolated project, the related infrastructure developments, in particular the emerging European high-speed rail network, are part of the discussion.

The effects of the Tunnel result from many complex, interacting influences and it is therefore not surprising that the impacts forecast are not confined to the regions close to the Tunnel, nor do the impacts decrease in a simple way with distance from the Tunnel; rather a more complex picture of interaction of travel time, modal characteristics, regional characteristics and orientation with respect to the Tunnel emerges. The differences in the effects of the Channel Tunnel on the various transport modes must be examined in this light.

Passenger travel

With regard to cross-Channel passenger travel little effect is observed on the total modal shares of car or coach, even with the assumption of high-speed rail service in the extended network. Losses due to the Tunnel are generally more than compensated for by the growth in cross-Channel tourism and business travel which, of course, in part results from the implementation of the Tunnel. However, significant numbers of cars and coaches will use the Tunnel.

The pattern of shift to the Tunnel by car is concentrated along the lengthened Tunnel axis on either side, with closer regions showing larger shifts towards the Tunnel and the effects decreasing as the distance from the Tunnel increases, e.g. in the south-east France or northern Italy. This means the Tunnel will be used primarily by those car drivers, who, at present, for geographical reasons take advantage of the short ferry crossings from Nord-Pas-de-Calais. As the subsection on changes in travel times (5.5.2.5) has shown, the relative time savings for car passengers provided by the Tunnel are only modest, in particular for regions far from the Tunnel axis.

Significantly higher shifts to the Tunnel are forecast for coaches. The most significant shifts (15 to 20%) are in journeys to and from Continental coastal regions such as Brittany, Normandy, Nord-Pas-de-Calais, West-Vlaanderen and Zeeland. Typical cross-Channel coach journey times for these regions are of the order of six to seven hours. Tunnel usage decreases as travel time to the Tunnel increases, with the effect that distant zones, even those located along the Tunnel axis, show only marginal Tunnel usage (e.g. Piemonte, Italy).

Additional reasons for the different Tunnel usage patterns for car and coach reflect the differences in car and coach trip characteristics. For instance, as coaches are mainly used for touristic purposes, typical cross-Channel coach destinations tend to be concentrated in the coastal areas (Brittany, Normandy, West-Vlaanderen, Zeeland) and major city centres (Paris, London) where a Dover-Calais crossing may be more attractive with the implementation of the Tunnel; whereas car origins and destinations tend to be more dispersed, perhaps making ferry crossings at other ports more attractive.

Increase in the modal share of rail are in general of the order of 4 to 5%. If in the future there are high-speed rail systems in Germany and France, the changes will not only be concentrated in the Blue Banana regions but will include much of the rest of those countries. The shift towards rail is not surprising as rail is the mode with the greatest time savings through the Tunnel. As has been shown, travel times by rail between the UK and the Continent will be halved for many, making the train the fastest surface mode in Europe. It is interesting to note that regions which are geographically close to the Tunnel experience losses in rail share with its implementation (e.g. Normandy and Zeeland). However, these are regions that are not very well integrated in the future high-speed rail network leading to the Tunnel.

In general, rail gains are at the expense of air. The loss of air passengers due to the Tunnel, however, are marginal and tend to be more than compensated by growth in tourist and business travel. In regions where tourism declines due to the Tunnel, i.e. Spain, Portugal and Greece, the shifts from air are slightly amplified.

Passengers ferries are in direct competition with the Channel Tunnel and therefore the mode affected by its implementation. In general, the Tunnel is expected to cause a reduction in car ferry passengers for the short sea crossings and an even stronger reduction in coach and foot passengers. However, even these large shifts must be seen against the backdrop of the concurrent general growth in cross-Channel traffic.

The effects on individual ports and ferry routes depend on their distance from the Tunnel and, even more, on their special market segment. Most affected by the Tunnel competition are ferry routes ending on both sides of the Channel in ports in the vicinity of the Tunnel. Routes that end at one side in the vicinity of the Tunnel and at the other in more distant regions (most ferry services from Zeebrugge) are only marginally affected. This means that ports or ferry companies depending on a single passenger ferry service and with a route seriously affected by the Tunnel (e.g. Ostend) will face problems maintaining this service, if no compensatory strategy is pursued.

For 2001 the forecasts show 10% fewer passengers at the Brittany ports with the Tunnel than without it and nearly 40% less at Nord-Pas-de-Calais ports. Differences of the order of 35% are predicted for the West-Vlaanderen and Zeeland ports. However, the general growth in cross-Channel passenger traffic will reduce or even overcompensate for these losses. Car passenger volumes at Kent and Nord-Pas-de-Calais ports are estimated to recover to about 85% of present levels in 2001 (after initial larger losses). These ports, however, will suffer large losses in coach and foot passengers (a decrease of 50% is predicted). West-Vlaanderen and Zeeland are forecast to have more car passengers in 2001 than today and Brittany substantially more. Due to this overall gain in cross-Channel transport the losses for most ports or ferry operators have to be considered only as a loss of growth potential.

Freight transport

Europe has to face increasing amounts of freight to be transported between Ireland and the UK and the European mainland. The reasons are to be found in the increasing European integration caused by the removal of administrative and physical barriers. For cross-Channel transport the

Tunnel is, of course, removing a very important physical barrier.

Apart from bulk goods, most freight will be transported by lorries as at present. A very significant portion of accompanied ro-ro vehicles will use the Tunnel. The largest shifts of the Tunnel are expected to and from the Blue Banana regions. For instance, shifts in the order of 60% towards the Tunnel are forecast for Nord-Pas-de-Calais, Hainaut or regions in the south-east of France. This percentage decreases with growing distance to the Tunnel as some freight transport shifts to rail, and, with growing distance from the Channel Tunnel axis, other ferry options become more attractive.

Losses of potential ro-ro freight traffic at the Channel ports due to this diversion of lorry traffic to the Tunnel are much more significant and are estimated to be in the order of 30 to 35%. Even higher losses are predicted for Brittany ports with 40% for Kent, Nord-Pas-de-Calais, West-Vlaanderen and Zeeland ports with 70%. However, these are the forecasts of the model, and it may be recalled that the model tends to underestimate the attractiveness of ferries for lorry drivers because of their required rest periods.

Losses for the transport of lorries on ferries are most pronounced in the Tunnel-access regions. Compared to present-day figures, Kent and Nord-Pas-de-Calais will face decreases of about 65% in accompanied ro-ro traffic in the beginning of the next century. West-Vlaanderen will have the same relative losses, but accompanied ro-ro is much less important for West-Vlaanderen ports than unaccompanied ro-ro. This will grow by about 15% in that region. In general, unaccompanied ro-ro traffic on ferries is not as much affected by the Tunnel. In all regions, unaccompanied ro-ro traffic will continue to grow, except in Nord-Pas-de-Calais, where the total numbers are insignificant anyway. The loss of growth potential is much more significant; this hypothetical loss of accompanied ro-ro will be about 70% in nearly all Channel regions.

To summarize the impact of the Channel Tunnel on the transport of ro-ro traffic on ferries, it is emphasized that short sea crossings are the most significantly affected — the traditional routes of lorries. Consequently, the drivers of lorries partly take advantage of the Tunnel, but as it is also true for passenger traffic, this depends on the origin and destination of the freight.

Increases in rail transport are forecast particularly for high-value unitized goods. On average, in the European Community, a 10% shift from lorry to rail is forecast (a 5% shift in other container transport is predicted). The largest shifts to rail are seen in the more peripheral regions along the lengthened Tunnel axis, concentrated in regions located far enough from the Tunnel for rail transport to become attractive (i.e. Scotland, Piemonte). However, large amounts of investments in the rail infrastructure with particular regard to the needs of freight transport are necessary for these shifts.

Transport flows: Summary

As can be seen from the above section, different transport modes are affected in different ways by the Tunnel. There will be shifts in modal split for both passenger and freight transport, but the increasing volume of traffic will in general offset most of the losses for any mode. However, different regions will be differently affected by these changes in transport flows. This subsection will group the regions with respect to transport impacts of the Tunnel. The categories, explained below, are not exclusive, so one region can appear in different groups. The result is sketched out in Figure 6.27.

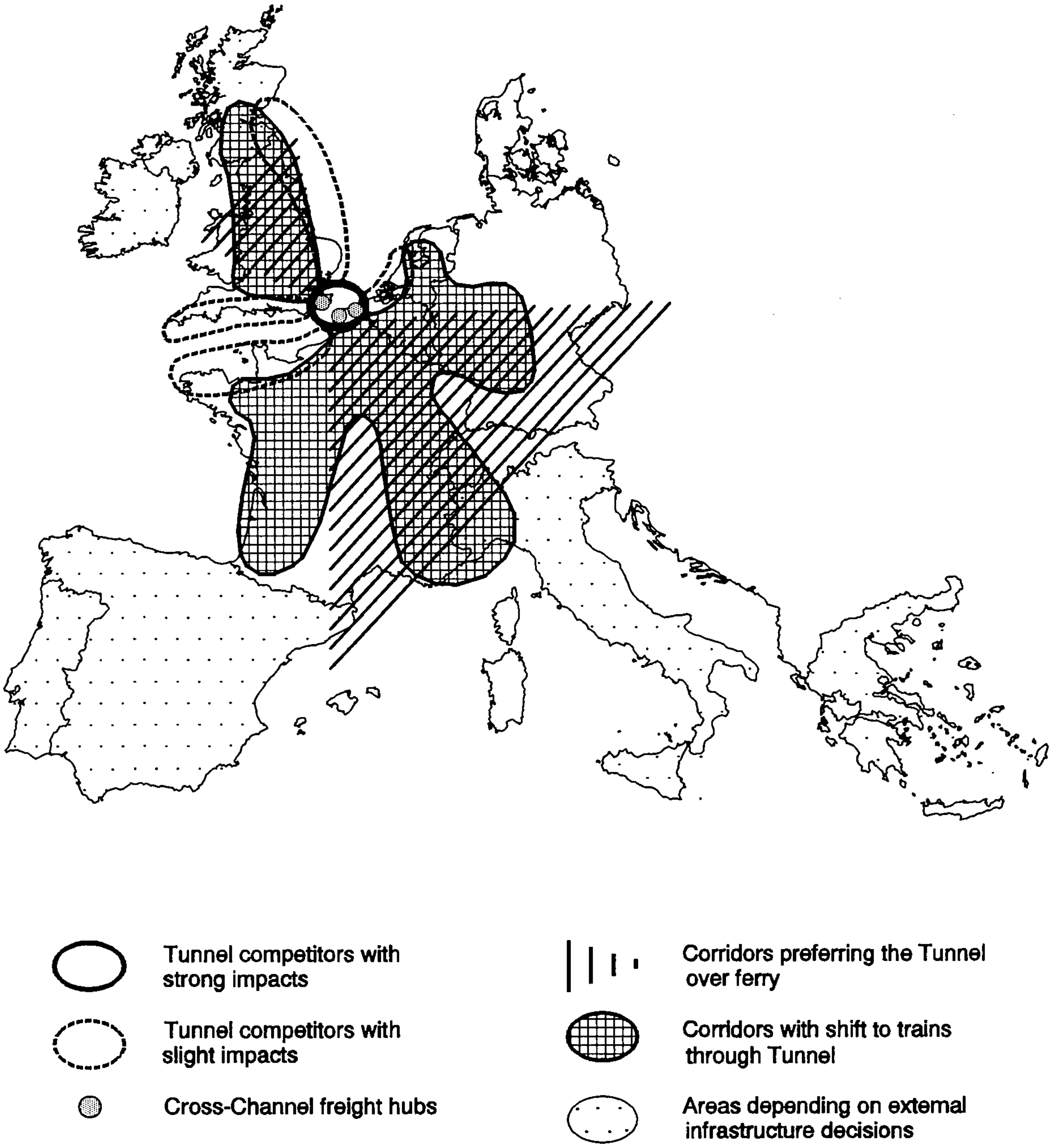
Tunnel competitors with strong impacts

Ferries are in direct competition with the Channel Tunnel for cross-Channel transport. However, the impacts depend on geographical characteristics of the single routes. Therefore, regions with cross-Channel transport are not touched in the same manner. Only in its vicinity, the Tunnel will cause a major reduction of transport volume for short sea crossings. The Tunnel has its strongest impacts on ferry lines with both ports within the regions of Kent, Nord-Pas-de-Calais and also, but to a lesser extent, West-Vlaanderen. In the first years after the Tunnel starts operating, these ferry lines will lose passengers, in particular coach and foot passengers, and lorry traffic. This traffic, for which, at present, short ferry trips are the preferred alternative to cross the Channel, will take advantage of the time savings provided by the Tunnel. However, because surface cross-Channel transport volume will grow significantly, there will be a secure future for these companies and ports it they survive in the first years of Tunnel operation. A less desirable side effect of the Channel Tunnel will be the large increases in road traffic in its two access regions, Kent and Nord-Pas-de-Calais.

Tunnel competitors with slight impacts

Most of the regions with cross-Channel transport are much less affected by the Tunnel. This

Figure 6.27. Impacts of the Channel Tunnel and the related transport infrastructure on transport flows



is true for areas along the western Channel (south-east England port regions, Normandy, and Brittany), mid- and north England ports, parts of West-Vlaanderen and the Netherlands. Here, ferry lines will have slightly decreasing transport volumes if the second port is located in one of the above regions with strong Tunnel impacts. However, this initial decrease will soon be offset by the total growth in cross-Channel transport. For other ferry routes there will be only a slight reduction in growth potential, i.e. growth would be even more pronounced without the Tunnel.

Cross-Channel freight hubs
Three regions will serve, as at present, as main freight hubs between mainland Europe and the UK: on the Continent, Nord-Pas-de-Calais for lorry traffic going through the Tunnel, and West-Vlaanderen for unaccompanied ro-ro traffic going to or coming from the Thames estuary and mid-England ports; in the UK, Kent for both kinds of ro-ro, Dover for lorry traffic going through the Tunnel and, with less importance, north Kent ports for unaccompanied ro-ro traffic. For lorries there will be a shift within Kent and Nord-Pas-de-Calais from the ports to the Tunnel. In the three regions, it depends primarily on the regional strategies whether their hub functions for freight transport can be enlarged and used as a base for future economic growth.

Corridors preferring the Tunnel over ferry
There is a clear pattern of regions that prefer the Tunnel over the ferries for cross-Channel road transport. In general, these regions are the ones that presently prefer short ferry crossing. They are located in a central corridor along the extended Tunnel axis on both sides of the Channel. With growing distance of both trip origin and destination from the Tunnel and from this extended Tunnel axis other ferries become more attractive.

Corridors with shift to trains through Tunnel
The future European high-speed rail network will significantly reduce cross-Channel travel times for many regions. Particularly along the high-speed rail lines in France, Belgium, the Netherlands and Germany, but also in Piemonte and parts of the UK, the Tunnel will induce a shift towards rail for cross-Channel passenger transport. There will also be a shift of some freight towards rail in these zones, but again, this depends on the implementation of appropriate links and services.

Areas depending on external infrastructure decisions
The study has shown that the area of influence of the Tunnel on transport flows is limited. Many areas in the European periphery are more or less excluded from the improved communication network in the European core regions. Scotland and Ireland, Spain, Portugal and Greece, but also Italy to a certain extent, belong to this group. But at the same time these areas are dependent on infrastructure decisions to be taken mostly outside their own nation if they are to be physically included in the ongoing integration of Europe.

6.3.2 Impacts on regional development in Europe

After looking at forecasts from both the regional analyses and the model for each of the 13 case-study regions, the impacts of the Tunnel and related infrastructure can be considered for the whole Community. This generalization will be made first by looking at main industrial sectors. Then a final typology of regions based on the results will be presented.

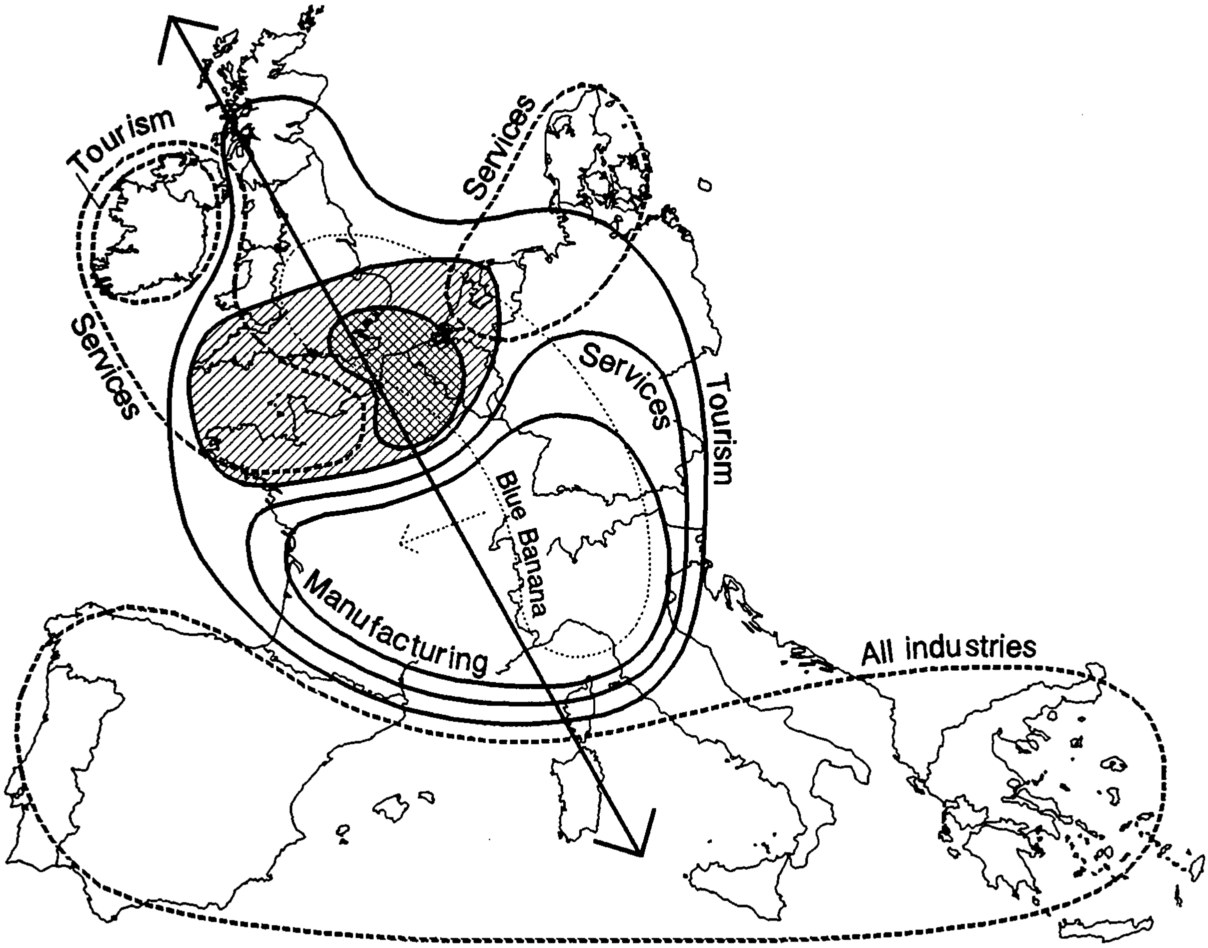
Figure 6.28 is an attempt to show the main areas of relative growth and decline of value-added induced by the Channel Tunnel and the related transport infrastructure for manufacturing, service and tourism. It must be recalled once again that, in this study, all changes are measured in value-added. It means that a positive economic impact may have good as well as bad consequences on employment according to the role of effectiveness gains.

Economic development and the Channel Tunnel

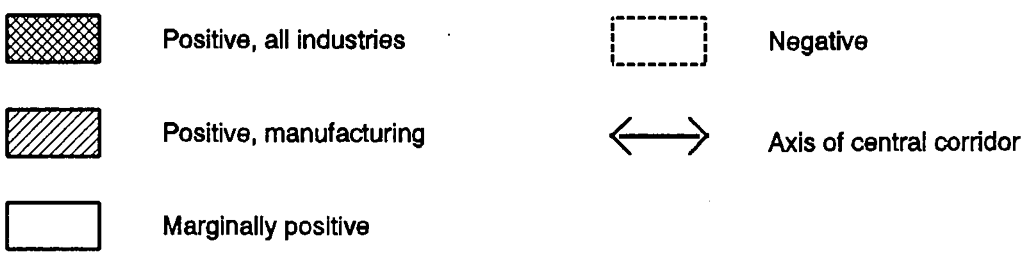
Manufacturing
The changes in industrial value added due to the Tunnel will be relatively small. Meplan predicts changes ranging from − 0.17% in Portugal (except Norte) to + 0.17% for Ireland in 2001.

With equal access to the Channel Tunnel, one could expect an advantage in those British and Irish regions which depend on cross-Channel transport more than Continental regions. The evolution of high-speed transport systems, however, will give Continental regions better access to the Channel Tunnel, so in 2001 they tend to show higher gains then the UK regions. It is not surprising that Scottish regional actors are very concerned about access to the Tunnel. The regions benefiting most are not only among the closest to

Figures 6.28. Impacts of the Channel Tunnel and the related transport infrastructure on economic development



Relative impact of the Channel Tunnel and the related infrastructure on value added



the Tunnel. Forecasts 2001 put Ireland, south-east France and Piemonte in top positions, along with Kent, Nord-Pas-de-Calais, West-Vlaanderen, Hainaut, and the rest of Belgium, despite scepticism encountered in Piemonte and Ireland about such impacts.

For manufacturing industries, four kinds of zones can be distinguished (see Figure 6.28):

(i) The Channel and North Sea regions will all increase their industrial production, except Bremen and North-Germany.

(ii) Regions located on both sides of a London-French-Italian Mediterranean border axis will also improve their industrial gains, particularly south-east France and Piemonte.

(iii) Eastern Community regions and British regions north of south-east England will have a close to zero industrial growth.

(iv) Greece, south Italy and the Iberian peninsula will lose, particularly Portugal.

Services
Because Meplan results are based on transport costs, the impact of the Tunnel on services predicted by the model appears very low and likely underestimated. High-speed trains should allow easier travel over medium distances and induce a development of services activities. The new network will generate new passenger traffic. That should be especially true for activities related to business, finance, media and culture, where direct personal contacts are necessary. One should not forget this when considering Meplan forecasts. According to the model, regions like London, Nord-Pas-de-Calais, Ile-de-France and mid-France will clearly benefit, however, with a maximum gain in value-added of less than 0.2% in 2001.

These predictions have to be confronted with the results of the regional analyses which show that the new passenger services should favour services in 'hub regions' like Cologne and Nord-Pas-de-Calais. The same should occur in the London, Paris and Brussels regions. Indeed, we see such cities as Cologne or Lille quite aware of the new opportunities offered by the Tunnel in the service sector; they have designed very active policies, public and private, for taking advantage of this opportunity. As a result, the concentration trend in services will be reinforced.

This concentration pattern has to be moderated by looking at regional dynamics: one can observe that the concentration of service industries in metropolitan areas tends to slow down in the long range; over the same period, on the eastern and western fringes of the north-west/south-east main axis of development, London-Marseille (the extended Tunnel axis), negative effects tend to become smaller (north Italy, south Germany and Normandy), the same being true for all Spain and Portugal, while positive effects grow in mid-Germany and Piemonte. This may be a result of the extension of the high-speed rail network. It might also be linked to new trends in firms' location under the opening-up of eastern European markets, this being an hypothesis derived from regional analyses and not from the model forecasts.

Figure 6.28 accordingly shows a concentration of positive impacts on services along the London-Marseille axis:

— The greatest gains are concentrated in the central area comprising London, Nord-Pas-de-Calais and Ile-de-France.

— The value-added of services increases also in the center of the Blue Banana (all Belgium and south Germany), north-west and south-east France and Piemonte.

— The growth in value-added in close to zero in regions neighbouring the main concentrations of services.

— Negative impacts are affecting some of the littoral regions that are gaining in industry, like Brittany, Zeeland, Denmark, or other regions close to the concentration of services and the south-eastern and south-western European periphery.

— The case of Cologne could be discussed. While Meplan predicts no significant growth in services, the regional analysis suggests in particular services related to the media and culture will benefit from Cologne's hub position.

Tourism
Tourism does not exist as a statistical category, so Meplan only forecasts the change in lodging and catering. Besides, it predicts changes in cross-Channel tourist flows due to changes in the transport system. The changes of these flows predicted by the model are rather high, but it should be kept in mind that they refer only to flows of tourists

between the UK and Ireland on the one hand and the Continent on the other.

The Tunnel and the extended rail and road networks tend to redistribute tourist flows away from their traditional destinations, especially for British tourists who appear likely to turn away from air travel to Mediterranean Europe in favour of road and rail travel to France, Germany and the Netherlands. But compared to other sectors, the impacts on tourism are more polarized, and the gaps between losers and winners are greater. However, gains are spread out in a greater number of regions than in services or industry.

The regional analyses are mostly consistent with the model results. Representatives of the closest regions expressed their confidence in growing flows of tourists through the Tunnel. These expectations look reasonable. In peripheral regions the regional actors are not fully aware of what may occur. Scotland and Ireland fear to be left behind in the competition and in fact, the benefits forecast by the model for them are negative in the case of Ireland or much smaller than those of London or Kent in the case of Scotland; neither Brittany nor Piemonte seem to be prepared for increases in tourism-related activities as forecast by the model; conversely, Norte or the Basque Country do not appear to be conscious of the competition from the Tunnel.

Figure 6.28 shows the impacts of the Tunnel and the related infrastructure on tourism:

— Littoral regions on the Channel, on the North Sea and the Mediterranean increase their cross-Channel tourism, save Ireland and Denmark and the more peripheral regions on the Mediterranean.

— Continental regions gain, particularly when they are located on new rail or road links.

— The peripheral losers are the same as for industry and services: Spain, Portugal and Greece, even though they used to be traditional destinations for British tourists.

Regional impacts: Summary

It has been suggested at the end of Subsection 6.2.2, that the Tunnel and related infrastructure will broadly have a twofold effect of polarization and diffusion. These effects can now be extended to the whole Community territory by classifying the regions into groups with similar impacts. Figure 6.28 summarizes the result.

Cross-Channel space: The most advantaged triangle

The greatest impacts will be concentrated in the London-Brussels-Paris triangle, with positive value-added increases for London, Kent, Nord-Pas-de-Calais, West-Vlaanderen and Ile-de-France. Although Hainaut and parts of Normandy are included in this triangle in a geographical sense, they do not fully participate in this growth due to reasons stated earlier.

The central corridor and its expansion

The Tunnel axis has a west-east orientation that may have been seen in the first place as linking London with the active core of Europe, that is the Randstad, Brussels, Cologne and Frankfurt. But the Tunnel cannot be considered alone, without taking into account its related infrastructure which is primarily a high-speed network and a motorway network. The French TGV network is the most advanced high-speed rail system in Europe and has to be seen as a very important factor of change: it pulls the axis of influence of the Tunnel from a west-east line to a north-west/south-east orientation, along the Calais-Paris-Lyon-Marseille TGV line. This is responsible for an expansion of the so-called Blue Banana towards Paris and Lyon and for a diffusion of the positive impacts of the Tunnel across France, except for interstitial Normandy and peripheral Brittany. The future extension of high-speed rail networks in Belgium, Germany and Italy will benefit all Belgium, Cologne, mid and south Germany and Piemonte. More distant destinations should not derive much from the combined effects of the Channel Tunnel and its related infrastructure — Bremen, south Germany and north Italy for instance.

Grey service zones at the Tunnel exits

The polarization effect tends to deprive regions next to the core of positive impacts on both sides of the Tunnel exits. In this sense, the Tunnel and the related infrastructure create certain economic grey zones, in particular with respect to service industries. Thus Normandy, Zeeland and the rest of Netherlands, though close to the Tunnel, should encounter problems in the interregional competition. Normandy appears to be one of those regions lying 'within the geographic core of Europe without being fully part of its economic core' (Hoolidy *et al.*, 1991). It can also be qualified by the concept of interstitial space proposed by Metge and Potel (1987). The Channel Tunnel creates such interstitial spaces on both sides of the core area along the continental sea shore. Our tentative explanation is that the Tunnel tends to exert a centripetal effect at its two exits, concentrating all positive impacts in a restricted zone and that these impacts start to be diffused on each side of the main axis beyond a certain distance from the Tunnel.

Increasing relative peripherality
The likely impact of the Channel Tunnel is to tend to tighten up the core in a way, while the polarization effect induces even negative trends in regions which may be close and relatively active, like north Italy, north Germany, Denmark, the Basque Country and part of the rest of Spain including Madrid and Barcelona. The Community periphery thus starts in this sense in direct proximity of the central corridor.

The southern peripheral regions will suffer in all economic sectors not only from not being connected but also from lack of special planning policies and/or means to support such policies. Ireland, Northern Ireland and northern Scotland can expect different impacts of the Tunnel on different industrial sectors; in particular in Ireland small benefits in manufacturing through the Tunnel will be outweighed by negative impacts on services and tourism.

6.4 Conclusions

The main purpose of the study is to examine the way in which different types of regions in the Community and different sectors in those regions would be affected by the development of a major new infrastructure. This objective has been addressed in Subsection 6.3 containing summary results of the study with respect to the impacts of the Channel Tunnel on the regions of the Community.

The second important objective of the study was to assess ways in which policy could be developed to ensure that maximum possible benefits of the Tunnel would be derived and negative effects minimized. This objective will be addressed in this final section. The section consists of two parts. The first part summarizes the expectations of the case-study regions for Community policy as expressed by the regional actors in the regional analyses. The second part will present issues for supranational policy and will sketch out possible courses of Community action.

6.4.1. Expectations from the regions

A first approach towards issues arising for Community action can be drawn from the regional analyses as such policy issues have been a specific part of the investigation process (see Subsection 4.5). However, the demand for supraregional policy expressed by the regional actors interviewed is based only on their own perception of the likely impacts of the Channel Tunnel on their region, which, as it has been shown in the previous sections, is not necessarily consistent with the more objective results of the study. In addition, as already stated, earlier regional actors tend to overinterpret the negative aspects in order to justify the required support for their region.

However, all regions see a necessity for Community action with respect to the impacts of the Channel Tunnel. This can be understood in two different ways: on the one hand, regions are eager to maximize the expected benefits from the new infrastructures; on the other hand, regions attempt to compensate for anticipated losses. It became apparent that the more negative the expected effects appeared in the eyes of the regional actors, the more insistent were the regional demands for supraregional support.

The demands for external policy action expressed in the regions in the interviews can be grouped into the following three categories:

Investments in transport infrastructure
Positive decisions about the implementation of transport infrastructure such as road and rail links and port facilities are the demands most often verbalized. With regard to the Channel Tunnel, there are several reasons for this: at first, even regions located in the central area of positive influence of the Tunnel see a lack of sufficient integration in the future transport network or fear that the network will be implemented too slowly; or they are more or less conscious that there is a risk for them to become mere transit areas if only infrastructure is built without special help to enhance their region's potential. Second, regions fearing to become more peripheralized are trying to counteract this process through better links to the European core; investments in port facilities or rail or road connections are required either to improve the competitive situation against the Tunnel or to become closer to the European core regions.

However, most case-study regions are dependent on external decisions to be connected to the new transport networks and doubt whether such decisions will be made. For that reason they hope for support from the Community. Among them, there are two different situations. Some regions hope that EC intervention will compensate a national infrastructure policy which is more concerned about balancing the regional development inside the national territory than about connecting each region with the economic core of Europe. Other regions depend for their connection with the new transport system on national policies of other countries which do not give priority to the missing links; they expect compensation from the EC.

Support of regional development projects
Financial support for regional development projects is another frequent demand. Within this framework, the impacts of the Channel Tunnel are often mentioned as a kind of development context of such projects. Of course, these demands refer to Community intervention within the framework of the reform of the Structural Funds or are related to other Community programmes. In regions located within the cross-Channel space, transborder projects in the context of the Interreg programme are mentioned to take into account anticipated impacts of the Tunnel. Regions located outside the European core, but also regions in the 'Banana skin', express their demand for a more balanced European regional policy that compensates for the anticipated further concentration of economic activities inside the Community through the Tunnel.

Fair competition in cross-Channel business
To maintain fair competition in the cross-Channel business is another demand for supraregionai policy. Tunnel competition does not frighten coastal regions provided that the rules of fair competition are respected between the various transport modes, including the Tunnel. The EC is considered as the main institution to guarantee this.

The above expectations for external action are a useful contribution of the regional analyses to the discussion on the impacts of the Tunnel on regional development. The model results alone could lead to the conclusion that all regions in the central corridor will benefit from the Tunnel and need no support. But the regional analyses give a complementary perception of fragile zones within this central corridor. On the other hand, the model gives a more objective and comprehensive overview of the relative magnitude and spatial distribution of the Tunnel impacts. The subsequent final conclusions of the study take the results of both approaches into account.

6.4.2. Main issues arising

This final part of the study presents main issues arising from the study. These issues with regard to the impacts of the Channel Tunnel on the territory of the Community should result in policy action at a supranational level. Ways are presented in which policy could be developed to ensure that maximum possible benefits of the Tunnel would be derived and negative effects minimized. These start with general issues and actions for all European regions based on the overall findings of the study. Then specific issues for certain regions or groups of regions affected by the Tunnel are outlined. Table 6.28 presents these issues and possible ways of action in summarized form.

General issues
The following general issues for policy action on a European level apply to all European regions:

No general action programme needed
The changes in regional development induced by the Tunnel are small compared with general growth in the regions. In particular, the negative impacts are very small: in no region are the total losses of economic activity due to the Tunnel greater than one half percent by 2001. Therefore no general programme of the Commission to compensate for negative economic impacts of the Channel Tunnel needs to be established. However, there will be specific negative impacts of the Tunnel on individual industries in a few regions which may require Community action. Those specific cases will be discussed below.

Cross-border infrastructure development
More generally, the Commission should contribute to improving cross-border cooperation in infrastructure development, in particular towards a European high-speed rail network. Thinking and acting in terms of a whole European network have to be encouraged. Special attention should be given to the network incoherences resulting from nationally oriented policies and to border effects. This will not be corrected through bilateral transborder operations alone, but necessitates a general transport infrastructure scheme for the whole Community territory.

Linking peripheral regions
It has to be recognized, however, that the high-speed infrastructure networks will contribute to reinforcing the dominant position of the already fast-growing regions in the European core and to a further polarization between core and peripheral

Table 6.28. Main issues and policy actions

General issues

- No general action programme necessary to compensate for small negative impacts of the Tunnel.
- Transport infrastructure scheme for the European Community to coordinate nationally oriented policies.
- Linking of peripheral regions to the European core to counteract peripheralization process.
- Strong regional policy of the Community to counteract polarization tendencies of high-speed infrastructure.
- Support of cross-border projects in order to stimulate European awareness in regional policy-making.
- Environmental protection measures to match negative consequences of Tunnel-related infrastructure.
- Fair competitive conditions in cross-Channel business to guarantee alternatives to the Tunnel.

Specific issues

- Strengthen peripheral Continental regions by supporting the modernization of industries and ports.
- Help Ireland and Scotland to get better transport connections to Continental Europe through England.
- Promote quick implementation of Tunnel access infrastructure to enable regions to benefit from the Tunnel.
- Assist Channel port regions to adjust their port activities to the competition of the Tunnel.
- Counteract negative impacts of overagglomeration in large metropolitan areas.

regions in Europe. Therefore, the demands of these regions to be better connected to the European core should be given serious consideration.

Strong regional policy
Also with respect to the increasing polarization, the European regions need a continued and strong regional policy of the Community through the Structural Funds. However, the regions have to be convinced to develop a vision of their own regional development that goes beyond thinking in terms of individual projects for which financial support is required.

Support of cross-border projects
The study has shown that the European space has been enlarged but that the mentality of many national and regional actors has not followed. Although people talk European, they do not act European. However, in many case-study regions the Interreg programme already stimulates cross-border relations. In particular, in the regions of the cross-Channel space the Tunnel is seen as a physical expression of the economic and social integration of Europe that has to be intensified through other cross-border projects of regional development.

Environmental protection
In part, the new transport links will have negative environmental consequences for some regions. Kent and Nord-Pas-de-Calais have already suffered from the construction works, and it is not

certain that after the Tunnel opens, sites will be restored to their original state. Those two regions as well as West-Vlaanderen, Hainaut and Zeeland are also likely to be harmed by the impact on the environment of increased road traffic linked to the Tunnel and to the new European transport network. For instance, the Tunnel alone will increase passenger kilometres travelled in Nord-Pas-de-Calais by 25% (in 2001, compared with a hypothetic situation without the Tunnel) despite a slight modal shift from car to rail. Therefore the Commission needs to take measures to ensure that the infrastructure improvements are accompanied by appropriate environmental protection measures.

Fair competitive conditions in the cross-Channel business
The demand for guaranteeing fair competitive conditions in the cross-Channel business should not be ignored. The forecasts of the regional analyses and the model that the ferry companies will stay in business is based on the assumption of reasonable prices for using the Tunnel. Dumping prices of the Tunnel to throw the ferry companies out of business cannot be accepted. Those companies are important for their regional economies and will have an indispensable function for future cross-Channel transport.

Specific issues

The second kind of issues is more specifically related to certain regions or groups of regions affected by the Tunnel in different ways:

Continental peripheral regions
For regions on the Continent in danger of being increasingly peripheralized by the Tunnel and the related infrastructure, there is a need to strengthen their resistance through modernization of their industries, and/or by directly compensating for possibly negative impacts of the Tunnel, e.g. through modernization of ports. These regions are located in the belt of disadvantaged regions ranging from Portugal in the West across most of Spain and southern Italy to Greece (see Figure 6.28). To improve their accessibility in the European context, these regions should be linked to the core regions by better connections, particularly through an integration in the European high-speed rail network. In addition, most of these regions need an enhancement of their strategic capability through reinforcement of regional authorities.

Peripheral regions in the UK and Ireland
Peripheral regions on the other side of the Tunnel, Ireland and Scotland, need support for improvement of their ports. They also depend crucially on the willingness of the British authorities to build better links through Wales and England to the Tunnel in order to enhance their relative position and to take advantage of the opportunities provided by the Tunnel. It would be an important responsibility of the Community to influence the decisions to implement these links by the British Government and if necessary support the financing of these links.

Quick implementation of access infrastructure
It has been shown that the benefits of the Channel Tunnel will only fully materialize if the connecting high-speed infrastructure on both sides of the Tunnel (high-speed rail and motorways) are implemented not too long after the Tunnel opening. In addition, the regions in the cross-Channel space on the Continent, except the Tunnel access region Nord-Pas-de-Calais, need the coastal motorway to benefit from the Tunnel, as they are not integrated in the high-speed rail network. Therefore the Commission should make every effort to promote the implementation of the following infrastructure links:

High-speed rail:	Folkestone-London Lille-Brussels-Cologne Lyon-Turin
Motorways:	Coastal motorway Bordeaux-Rotterdam.

Channel port regions
The regions on the Continental Channel coasts most affected by the competition of the Tunnel may require support to overcome the period of market readjustment after the opening of the Tunnel. Even though most of these regions can expect to recover their present volume of ferry business after an initial period of decline, they will in the long run suffer a loss of growth potential. In particular, ports such as Boulogne and Ostend, also need support for improvement of their port facilities in order to compete in the ferry business and develop alternative port activities.

Large metropolitan areas
Regions benefiting from the Tunnel do not need support if the general conclusions stated above are be followed. However, in the Paris and London areas efforts are necessary to counteract negative aspects of overagglomeration. In particular in these two metropolises the expected

benefits have to be diffused by regional networks to the whole areas. Improved regional networks are necessary also in other benefiting regions in order to counteract intraregional disparities possibly produced by the centre-oriented high-speed rail links. More generally, in these areas, attention should be given to the possible polarization effects of the new high-speed networks, favouring the more dynamic metropolitan regions at the expense of the economically less active ones. An appropriate EC policy should be based on both encouraging connection infrastructure and regional transport systems and supporting the modernization of activities.

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