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COMMISSION OF THE EUROPEAN COMMUNITIES

STUDY OF THE COMMUNITY BENEFIT OF A FIXED CHANNEL CROSSING

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COOPERS & LYBRAND ASSOCIATES LIMITED

MANAGEMENT AND ECONOMIC CONSULTANTS

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INTRODUCTION

0.1 THE PREVIOUS CHANNEL STUDIES

There has, over the years, been a large number of studies of differing depth and complexity concerned with a fixed Channel crossing. The most important recent published work prior to those with which Coopers & Lybrand were concerned was the "Proposals for a Fixed Channel Link" published by HMSO (Cmnd. 2137) in September 1963. This was a report of a Working Group of British and French officials which examined the advantages of a Channel Tunnel compared with a Channel Bridge. The study found that a rail tunnel would provide a better economic return than a bridge. The expected economic rate of return varied between 7.4% and 14.4% depending upon the assumptions made as to the level of traffic using the Tunnel.

In February 1964, the Minister of Transport announced that as a result of studies jointly undertaken, the British and French Governments had agreed that the construction of a rail Channel Tunnel was technically possible, and that in economic terms it would represent a sound investment of the two countries' resources. Subject to further discussion of the legal and financial problems involved, the two Governments had therefore decided to proceed with the project. In July 1966 the British and French Prime Ministers announced that, "subject to finding a solution for the construction work on mutually acceptable terms, the two Governments have now taken a decision that the Tunnel should be built". In October 1966 it was announced that the Tunnel would be financed by a group of private financial interests which would also manage its construction. The completed Tunnel would then be handed over to an Anglo-French operating body who would be responsible for payments of capital and interest to the private group from the Tunnel revenues.

After prolonged negotiations between various financial groups, the British Channel Tunnel Company (BCTC) and the Societe Francaise du Tunnel sous la Manche (SFTM) were formed. Their proposals to finance the programme of studies and eventual construction of the Tunnel were accepted by the British and French Governments in March 1971.

Rio Tinto Zinc Development Enterprises (RTZDE) were appointed Project Managers to the BCTC and Situmer were Project Managers to SFTM.

The Preliminary Phase Studies

The Companies agreed with the Government to carry out between May 1971 and May 1972 Preliminary Studies, at the end of which the main features of the Project should be definitely settled and the decision made to undertake the Final Studies and the Initial Phase of the works with a view to starting the final works in as short a time as possible. The Preliminary Studies covered both Technical and Economic Studies. The brief for the Economic Studies was:-

(i) to perfect the methodology to be used both for surveys and for the drawing-up of the analyses;

(ii) to carry out a pilot survey at the frontier of passengers travelling by air and by sea;

(iii) to carry out a pilot home interview survey of individuals taking holidays abroad and on reasons for their journeys;

(iv) to analyse available documents having useful information about goods likely to be transported via the tunnel;

(v) to carry out a pilot survey of freight traffic;

(vi) to participate in the pursuit and evaluation of ancillary revenue from which the Tunnel Concessionary Company would profit;

(vii) according to the results of all the technical and economic studies outlined above, to update the cost-benefit analysis and the profit and risk analysis for the project;

(viii) finally, to propose the detailed contents and the programme for the Economic Studies to be completed during the next period, that of the Final Studies.

The respective Project Managements commissioned Coopers & Lybrand Associates Limited and SETEC-Economie to advise them on the economic and financial aspects of the work. The Consultants were set two main objectives in the Preliminary Phase. The principal objective was "to prepare with respect to both the data collection and at the methodological level, for the economic studies to be undertaken in the following phase", referred to as Phase I, but at the same time the opportunity was taken in the Preliminary Phase to update the profit and risk analysis and the cost-benefit analysis with respect to the project.

The work carried out in the Preliminary Phase is recorded in the document produced by Situmer and RTZDE entitled "Channel Tunnel Main Report, April 1972".

Phase I Studies

The Phase I Studies were carried out between September 1972 and May 1973. The Companies reappointed Coopers & Lybrand (C & L) and SETEC-Economie and agreed a programme of work which allowed each consultant to take maximum advantage of its work in the Preliminary Phase. It was agreed that each consultant would have specific responsibilities for forecasting particular elements of the total demand and diversion to the Tunnel. The division of responsibilities was as follows:-

Traffic Category	Total Demand	Diversion to Tunnel
British Holidaymakers	C & L	C & L
Continental Holidaymakers	SETEC	SETEC
UK Business Travellers	C & L	SETEC
Continental Business Travellers	SETEC	SETEC
Non-European Travellers	C & L	SETEC
Freight	SETEC	C & L

The work on ferry costs and charges and the financial analysis was carried out jointly by the two consultants. Each consultant produced separate fleet scheduling models.

The Phase I Studies are summarised in the "Channel Tunnel Summary Report, June 1973" produced by RTZDE and Situmer. The Economic Studies are described in more detail in the "Channel Tunnel Economic Report" produced at the same date. Both consultants' work is summarised in the Main Summary of the Economic Report. Separate reports were then prepared by each consultant describing in detail the methods used for those areas of the work for which they were responsible.

The portions of the work for which Coopers & Lybrand were responsible are summarised below. The "Passenger Studies, Main Report" gives a very full description of the method used to prepare those passenger forecasts for which C & L were responsible. It reviewed developments in the British holidaymaker market over the period 1962-71, then described the surveys carried out for the studies. In addition to the Depth Interview Survey, Household Survey and IPS Trailer Survey which were commissioned in the Preliminary Phase the following additional surveys were carried out:-

(a) The Non-Abroad Holidaymaker Survey, examining the reasons why some members of the adult population had never taken holidays abroad. A series of group discussions followed by structured interviews with a representative sample of 200 adults was carried out to probe the reasons why some people had never partaken of holidays abroad.

(b) The Random Individual Survey. A total of 4,546 interviews were carried out with households. The main information obtained was detailed of all holidays taken in the previous twelve months which could be cross-classified to the socio-economic characteristics of the households concerned.

(c) The Short Holidaymaker Survey. A total of 324 adults who had taken a short holiday abroad in the period 1970 to 1972 were interviewed.

(d) Car Holidaymaker Survey. After the completion of the Preliminary Phase when the very considerable importance of accompanied car holidaymakers to total Tunnel revenue prospects was apparent, it was decided to undertake a special survey to examine in more detail the characteristics and behaviour of this group of travellers. A total of 3,250 postal questionnaires were returned giving details of:-

   (i) the reasons for choice of cross-Channel routes;
   (ii) brief details of holidays abroad over the period 1963-1972;
   (iii) extensive factual details on the dimensions of the vehicles used for holidays abroad;
   (iv) attitudes to short holidays abroad;
   (v) socio-economic characteristics of the household.

(e) Tunnel Reactions Survey. A total of 16 group discussions were held with 110 respondents to help assess attitudes to travel through the Tunnel.

The Report summarises the results of these surveys. It then describes in detail the models and the exogenous assumptions used to produce forecasts for British leisure travel abroad, for British business travel abroad, and for non-European cross-Channel travellers, and the resulting forecsts. For British leisure travellers, models are also described, and forecasts produced, for the choice of Channel crossing in the presence of a Tunnel.

The work carried out to estimate the division of freight traffic to the tunnel is described in the "Freight Studies, Main Report". For this work a number of surveys were undertaken. The Special Commodities Survey was concerned essentially with those commodities which were not considered unitisable but which might use the Tunnel in full train loads. The Export Unitisable Survey supplemented and expanded upon the previous work on the pattern of UK exports carried out in the Preliminary Phase. The Import Unitisable survey replaced the pilot survey of British imports carried out at the time of the preliminary studies. A total of 412 interviews were carried out with importers. In addition, an extensive survey of costs and charges was carried out, the information from which was also used in the Fleet Scheduling Model (see below). From these data, models were developed to predict the choice of mode (roll-on/roll-off or container) and route for unitisable freight, and applied, using assumptions about future services.

C & L and SETEC prepared different Fleet Scheduling Models which were used to estimate the effect on the operators of cross-Channel ferries of the forecast changes occurring as a consequence of the Tunnel.

Given the forecasts produced, a financial analysis was undertaken. It was shown that on the basis of the low estimates of the growth in GDP then the financial internal rate of return on the Tunnel project was expected to be 14 per cent. Various sensitivity tests were also carried out and it was shown:-

(a) that the profitability of the Tunnel is relatively robust to major increases in construction costs or decreases in revenues: in the most adverse case considered, the return exceeded 10 per cent;

(b) operating profits were likely to be sufficient to cover loan interest payments except only in extreme and (in the Consultants' view) unlikely circumstances.

The United Kingdom Cost-Benefit Study

The Phase I studies, unlike the Preliminary Phase, did not include a cost-benefit analysis of the Tunnel project. During the course of Phase I the UK Department of the Environment decided that it was necessary to produce a transport cost-benefit study. Coopers & Lybrand were commissioned to carry out the study which considered the impact of the Channel Tunnel on transport costs and benefits to United Kingdom interests as compared with the continued development of the existing air and shipping services. In commissioning the study, the Department of the Environment directed that the consultants were to confine their attention to transport costs and benefits to the United Kingdom; other potential costs and benefits arising from the environmental impact of the Tunnel and its effects on regional employment and relative incomes or on the UK balance of payments were specifically excluded from the study.

The work carried out for this study is described in the report "The Channel Tunnel: A United Kingdom Transport Cost-Benefit Study", published by HMSO in May 1973. It was shown that on the basis of the assumptions adopted "the transport costs and benefits of the Tunnel discounted at 10 per cent per annum to 1973 gave a net present value to the Tunnel of £292 million which was equivalent to an internal rate of return of 17.6 per cent". The corresponding figures based on the low forecasts were £148 million and 14.6 per cent. A range of sensitivity tests was also carried out in order to test the sensitivity of the Tunnel cost-benefit. It was found that the rate of return was relatively robust to even marked changes in the basic assumptions on which the forecasts had been based.

The cost-benefit report was not surprisingly the subject of some controversy. The main assumptions in the report which were questioned were:-

(a) the treatment of hovercraft;

(b) the size of the shipping fleet required in the without Tunnel situation;

(c) the assumptions on the relative tariffs that could be charged by the shipping operators and the effect this would have on the percentage of the traffic using the Tunnel.

These points were considered in more detail in the Phase II Cost-Benefit Studies.

The Channel Tunnel: Its Economic and Social Impact on Kent

A study on the Economic and Social Impact of the Channel Tunnel in Kent was prepared by Economic Consultants Limited and published by HMSO in April 1973. The study concluded that, apart from an employment problem in Dover associated with a decline in the level of operations of the existing sea ferries, the Tunnel would have little social and economic impact on Kent unless large scale industrial development was permitted by the planning authorities.

The Channel Tunnel: (Cmnd. 5430)

This white paper was presented by the Secretary of State for the Environment to Parliament in September 1973 in order to set out the UK Government's view of the project. It was concluded "that a Channel Tunnel would accord with our national interest. It would be the cheapest and most satisfactory way in the long run of providing for the dramatic and continuing increase in cross-Channel traffic and would reduce the barrier the Channel presents to our trade". It was also stated that "a high quality rail link between the Tunnel portal and London with provision for through services to provincial centres is essential to the success of the project". The rail link was expected to cost about £120 million in 1973 prices. It was therefore decided to proceed with Phase II of the project.

The Monopolies Commission Report: Cross-Channel Car Ferry Services

In April 1974 the Monopolies Commission presented their report on Cross-Channel Car Ferry Services. This report examined the operations of the four British Cross-Channel operators who were:-

(a) the British Railways Board;
(b) European Ferries Limited;
(c) Southern Ferries Limited;
(d) Hoverlloyd Limited.

The report includes a detailed analysis of the profitability of these operators related to the pattern of service which was offered in 1973.

It was concluded that the monopoly positions of British Rail and European Ferries did not operate against the public interest. It was however stated that "the participation by cross-Channel ferry operators in collectively agreeing through the Harmonisation Conference to charge fares at not less than common minimum rates and their participation in pooling agreements operate and may be expected to operate against the public interest".

The implications of the seasonal variability of demand were examined in the report. It was stated that "It is the operators' policy to provide capacity to meet virtually the highest level of demand likely to occur on any day, while charging the same fares on days of maximum demand as on any other days during the peak season". The Commission considered that in their view "this policy contributes more than any other factor to the high costs of operation, particularly on the Dover Straits routes". The policy also leads "to the provision of a larger number of ships than would otherwise be needed and this results in a low average utilisation of ships throughout the year". It was the Commission's view that "the volume of resources involved in the provision of the services could be materially reduced by modification of the fare structure within the summer peak period".

Phase II Studies

The Phase II economic studies continued the series of Channel Tunnel Studies commenced in 1971 with the Preliminary Phase, followed by the Phase I studies which were completed by June 1973. The Phase II studies were carried out over the period from January 1974 to the cancellation of the Channel Tunnel Project in January 1975.

It was considered unnecessary to repeat the surveys carried out in Phase I or develop new models so soon after the completion of Phase I. The scope of the Phase II studies was therefore narrower than the previous phase, consisting primarily of:-

(a) sensitivity tests of the Phase I forecasts to changes in certain basic assumptions;

(b) updating the statistical basis used in the previous phases to take account of the most recent information available to produce new traffic forecasts;

(c) a more detailed study of the competitive position of the Tunnel in relation to the cross-Channel ferries.

The form of the models developed in Phase I was retained, with the exception of the competition study, for which new models were developed. The scope of the work to be undertaken was set out in detail in a contract between the British and French Channel Tunnel Companies and the Consultants, Coopers & Lybrand Associates Limited and SETEC-Economie, dated July 1974. The extent of the work carried out is summarised below.

Sensitivity Tests and Updating

In order to ensure that the Phase I models produced valid forecasts, various tests were undertaken in Phase II under alternative assumptions to indicate the sensitivity of the Phase I forecasts to the following changes:-

(a) the impact of the changes in transport costs arising from the increased price of energy;

(b) the effect of an increase in air journey times of half-an-hour to allow for increased congestion and security checks at airports;

(c) the effect of the development of a high-speed rail network in Western Europe;

(d) the effect of lower rates of economic growth.

The sensitivity tests were carried out for the Phase I forecasts based on low GNP growth rates, for 1980 and 1990. The effect of the introduction of a motorail service through the Tunnel was also examined.

The updating of the Phase I forecasts occupied a large part of the Phase II studies. This was necessary, partly because of the passage of time (the Phase I forecasts were based on 1970 and 1971), but mainly because of the considerable change in expectations of growth in all fields following the rise in energy prices.

The first requirement was therefore to reassess the economic growth assumptions used in the previous forecasts, in the light of the fuel price rises, and to propose new central case assumptions for study purposes. The next step was to examine the most recent trends in traffic and revise the data base to take account of the latest available information. At the same time, the characteristics of the traffic were examined in as much depth as possible in order to determine whether or not significant changes had occurred that might necessitate recalibration or reformulation of the models. However, it was not considered necessary or practicable to repeat the extensive surveys carried out in Phase I. The inputs to the demand models were updated to 1973 or 1974 values, depending upon the latest information available.

Competition Study

The development of a new model to study the competitive position between the Channel ferries and the Tunnel was the main innovation in the Phase II studies. The purpose of the competition study was to estimate more precisely the traffic that might be carried on the Tunnel, or ferries, at different tariff levels. To do so it was necessary to devise a model which could simulate ferry operations under alternative commercial policies.

In January 1975, the studies were cancelled as a result of the Tunnel project being shelved by the Governments. Because of this, the major innovative features of the Phase II Studies were not brought to completion.

Provision of Ferry Trains

At the same time as the Phase II studies were proceeding, Coopers & Lybrand were requested by project management to undertake an examination of the number of ferry trains which would be needed to carry vehicles through the Tunnel. The work extended the studies of traffic peaking, prepared by Situmer in 1973 and 1974 in an extensive re-analysis of the Phase I survey data. Future trends in passenger and freight vehicle traffic peaking were predicted from a consideration of the factors affecting monthly, daily and hourly peaking characteristics. A simulation model was developed to determine the optimum number of train sets required to meet specified service level criteria and a report on this work was presented to RTZDE in August 1974.

Phase II Cost-Benefit Study

Coopers & Lybrand were commissioned to repeat the Phase I cost-benefit studies. We were however, specifically requested to give attention to:-

(a) fleet size in the 'no Tunnel' situation, including the effect of peak pricing, alternative shipping technology and hovercraft;
(b) port and harbour infrastructure and operating costs;
(c) air, road and rail transport costs;
(d) revision of the route/mode assignment network for passengers and freight in the 'no Tunnel' situation;
(e) a clear presentation of transport costs and benefits in resource terms.

At the time of the cancellation of the Channel Tunnel Project we had just prepared a provisional estimate of the Tunnel costs and benefits. We were asked to continue with this work and to give advice on other topics of interest to the Channel Tunnel Adivsory Group which had been set up under the chairmanship of Sir Alec Cairncross (the Cairncross Committee). The work carried out was presented to the Department of the Environment as the "Channel Tunnel Provisional Estimates of Costs and Benefits", dated 18th April 1975. This gave, on the basis of the Preliminary Phase II forecasts, our best estimate of the overall transport costs and benefits to UK interests from the Tunnel. It was estimated that if the preliminary traffic forecasts from

Phase II were accepted, then the Tunnel project would have a positive net present value of £176 million at a 10 per cent discount rate. The NPV happened to be almost the same whether the Low Cost or the Intermediate Cost Strategy was adopted to provide rail connections from the Tunnel to London.

The Channel Tunnel and Alternative Cross-Channel Services (The Cairncross Report)

The Channel Tunnel Advisory Group was set up in the summer of 1974 by the Secretary of State for the Environment to determine whether "the various economic and financial studies, underway and planned, provided an adequate basis for deciding whether the Tunnel was in broad economic and commercial terms more advantageous to the UK than continued reliance on air and sea services and, if not, how these studies should be supplemented". This group, under the chairmanship of Sir Alec Cairncross, was asked to continue its work after the cancellation of the Channel Tunnel project and to report both on the original project and on the method of assessment to be used should such a venture be reviewed in the future. The report was published in July 1975 and comprised:-

(a) review of cross-Channel traffic and the alternative ways in which future growth could be handled;

(b) discussion of key issues concerned with the size of the shipping fleet, the role of hovercraft, and the UK rail link alternatives;

(c) various presentations of the physical resource costs and cost-benefit implications of the project;

(d) conclusions as to the studies undertaken, the project itself, and the co-ordination and planning issues raised by the project's abandonment.

Channel Tunnel Rail Link Intermediate Stops Study

This study was carried out by Coopers & Lybrand Associates Limited for a working party of officers of the Greater London Council, Kent County Council, Surrey County Council and the London Borough of Croydon. The report was completed in March 1975. In the study the route allocation model of British holidaymaker cross-Channel traffic originally prepared for the Phase I Channel Tunnel Studies was modified so that it could be used to prepare forecasts of the potential passenger demand at alternative intermediate stops on the proposed high speed rail link between London and the Channel Tunnel. A separate model for the allocation of British business trips was also developed.

It was shown that there was a considerable potential demand to use an out-of-town station at either East Croydon, on the M25 near Oxted, or at Tonbridge.

Forecasts of Cross-Channel Road Traffic Through Kent Ports

This report concerned with the future level of road traffic using the cross-Channel freight and passenger services operating from the Kent ports was prepared for the General Planning Highways Division of the Department of the Environment between April and September 1975. The forecasts were presented separately for 1981, 1986 and 1991 and 1996. A route allocation model based on the Phase I model for British holidaymakers, but with some minor amendments, was used to allocate the passenger traffic to alternative routes and the effect of port capacity constraints on both freight and passenger traffic at each of the Kent ports was then considered. The peaking characteristics of passenger and freight traffic were also examined.

0.2 OBJECTIVES OF THIS STUDY

On 29th December 1978, the Commission of the European Communities commissioned Coopers & Lybrand Associates Limited to undertake its share of a new study of the feasibility of a Channel Link. It was to be done in conjunction with SETEC of France. The division of work between the parties is described subsequently. This report is the Final Report provided for in the Contract of that date.

Annex I to the Contract specified two objectives:-

(a) to provide the commission with practical guidelines for the measurement of "Community interest" in major transport infrastructure projects. This should involve a consideration both in theory and practice of the nature of such benefit, and possibly costs, and how they might be assessed and quantified; and

(b) to provide a practical demonstration of the identification and measurement of Community interest by bringing up to date and re-assessing the case for a fixed link across the Channel between the UK and France. The case study is to be used as the example of the development of the concept of Community interest.

What distinguishes the study from the earlier ones discussed in 0.1 is:-

(a) the emphasis given to the conceptualisation of Community benefit;

(b) the need to revise all forecasts given the passing of time. This has been made particularly important by the combination of economic recession and inflation; the very great increases in energy costs that have occurred and may be predicted to occur in future; and Britain's entry into the Common Market;

(c) the need to revise costs; and

(d) the much greater number of alternatives the Study is required to consider, treating each on its merits.

It is also important to recognise what the study has been expected to achieve in another sense. The alternatives vary greatly in the extent to which they have been designed, their technical feasibility has been tested, and they have been costed in detail. Neither indeed was it part of the Consultants' remit to undertake an engineering or costing evaluation of the alternatives.

1

MODELLING TRAVEL BEHAVIOUR ACROSS THE CHANNEL

1.1 Preface

1.1.1 Objectives

To evaluate the impact of any major change in transport infrastructure, one must define the patterns of travel likely to develop first with and then without the change. To do this, one needs to examine past and present patterns of travel, and to derive from them models of travel behaviour which explain adequately the factors affecting that behaviour and therefore why people behave as they do, both as passengers and as consignors of freight. These will enable us to predict travel patterns in futures both with and without the new transport development.

A fixed link across the Channel alters the problem from that most frequently encountered in studies of this kind, in that the proposed development is not a replacement or an improvement of existing links or a new link of an existing mode, but an alternative to existing methods of transport (sea and air). One needs therefore to analyse the influence of the characteristics of existing modes and routes on travel behaviour and compare them with the corresponding characteristics of the new mode. This being so, the choice which it is most crucial to understand is the choice between routes. If we can adequately explain why a given traveller or consignor of goods chooses one route across the Channel rather than another, then we are likely to be able to predict their responses to a new link, provided we have described the routes in terms of carefully chosen relevant characteristics.

At present, the traveller (or freight consignor) between Great Britain and Continental Europe has a wide choice of possible routes open to him; this range of choice has increased greatly in recent years, and is still increasing. There is no a priori reason why a new link could not provide an alternative to any of these routes, although, of course, a new link across the Straits of Dover will be most competitive with the existing routes across the Straits.

Sea routes to France leave from many South coast ports, and to Belgium and the Netherlands from several East coast ports. In addition, there are longer ferry routes direct to Scandinavian, German, Spanish, and Portuguese ports. London is connected by air with a large number of Continental destinations, and, increasingly, so are Manchester and other airports outside London. The patterns of travel observed on these routes, and how they have developed, are described in Appendix A.

1.1.2 Division of Modelling Responsibility

The models of travel behaviour were separately derived for different categories of traveller, some by Coopers & Lybrand and others by SETEC. Table 1.1.1 shows how their responsibilities were divided.

Table 1.1.1: Division of Modelling Responsibility

	Total Demand	Route Choice
UK leisure	C & L	C & L
Continental leisure	SETEC	SETEC
UK business	C & L	SETEC
Continental business	SETEC	SETEC
Non-Europeans	C & L	SETEC
Freight	SETEC	C & L

The models used by Coopers & Lybrand are described in subsequent sections.

1.2 The Models : UK Leisure Travel to Europe

1.2.1 Modelling UK Leisure Travel to Continental Europe

In previous Channel Tunnel studies, surveys of people's attitudes to holidays abroad suggested that it would be appropriate to model decisions about trips abroad in four stages. We have retained this structure, the four stages being:-

Stage 1: Trip Demand
The probability of taking a leisure trip abroad is assumed to be a function of certain socio-economic characteristics of an individual. Similarly the division of this demand between UK regions is assumed to depend on average characteristics of the population of each region.

Stage 2: Trip Type
The trips abroad arising in a given region are divided into three categories: accompanied car trips, independent non-car trips, and package non-car trips. Their division between regions again depends on characteristics of the population of each region.

Stage 3: Destination Choice
The proportion of trips to each country abroad in a given category is assumed primarily to change in response to variation in the relative cost of living.

Stage 4: Route Choice
Trips from the UK to countries abroad were assigned to the various crossings using a perturbed least generalised cost method.

The behaviour of travellers at each of these stages was analysed using three main sources of information:-

1. Surveys conducted for the previous Channel Tunnel Study;
2. Information published by the UK Department of Trade from the International Passenger Survey (IPS);
3. A detailed analysis of 1977 movements as revealed by the IPS.

At every stage, many variables and, in some cases, a number of functional forms were examined. The final equations were chosen as statistically the most significant, while retaining behavioural plausibility.

1.2.2 The Model of Demand for UK Leisure Trips to Europe

The data for the estimation of this model consist principally of a file of surveyed individuals on which are stored, for each individual, the number of leisure trips abroad taken in 1971, and a large number of socio-economic and geographical characteristics. Unfortunately, the information on the zone of residence of these individuals was no longer usable because of the local government reorganisation of 1974, so the allocation of trip-makers to UK zones of residence was modelled at a more aggregated level using the IPS tabulations of trips for 1977.

As a first stage, a linear model was fitted, with the number of trips abroad as the dependent variable, being explained as a linear function of the socio-economic characteristics. The form of the most suitable linear function is shown in Table 1.2.1. With seven independent explanatory variables, it explains 13.2% of the variance. It should be noted that the dependent variable here is a discrete variable (the number of leisure trips abroad taken by a household can take the values 0,1,2,3,4, etc) and thus the proportion of 13.2% of the variance explained with a continuous explanatory function is quite satisfactory.

Table 1.2.1: Linear Model for Total Holiday Demand

Variable	Coefficient	Contribution to r^2
intercept	-0.1721	
household income (thousand £)	0.0614	0.0598
friends & relatives abroad[a]	0.1051	0.0346
number in household	-0.0364	0.0144
age of completion of education[b]	0.0294	0.0086
UK travel impedance (equivalent minutes)	-0.0001609	0.0062
social grade of respondent	0.0361	0.0048
number of cars in household[c]	0.0359	0.0040
		0.1324

Notes: (a) This variable was defined to have the values:

1: No friends or relatives abroad

2: Friends or relating only outside Western Europe

3: Friends or relatives in Western Europe

(b) This variable was defined to have the values:

1: 14 years

2: 15 years

3: 16 or 17 years

4: 18-20 years

5: 21 years or older

(c) This variable was defined to have the values:

1: no cars

2: one car

3: two cars

4: three or more cars.

The relative importance of the variables can be seen from their marginal contribution to the proportion of the variance explained, given in the Table. The most important determinant of propensity to take a trip abroad is household income. In addition, households with friends and relatives abroad are more likely to go abroad than those without, and larger households are less likely to go abroad than smaller. Households in parts of the country remote from the most frequently used ports and airports are less likely to go abroad than those close to them, and car-owning households are more likely to take a trip abroad than those without a car. The variables "age of completion of education" and "social grade", while highly correlated with income, show an additional contribution to the observed cross-sectional variation in propensity. However, we feel that it would be unwise to use projected changes in these two variables in our forecasts, for reasons described below in Chapter 2.

The variables in the regression were all those recorded in the survey, with the exception of "UK travel impedance". This variable was inferred from the "mean egress distance" variable, which was the weighted average distance of the respondent's zone from the ports and airports, and the impedances associated with time and distance by the route choice model, suitably deflated to 1971 values. The formula used was

$$\text{UK travel impedance} = \text{egress distance} \times \left(\frac{1}{\text{speed}} + \frac{\text{cost per unit distance}}{\text{value of time}}\right)$$

The impedance is formulated as a generalised cost, and expressed in equivalent minutes. This is necessary when using this variable to predict in the future. If impedance were expressed as a generalised cost in money units then, as incomes rose, the value of time, and hence the cost of the average journey, would rise. This would lead, all other things being equal, to the implausible conclusion that as incomes rise, average trip lengths would fall. The generally accepted way round this difficulty is to express the impedance in units of equivalent time. The first term represents the actual time taken for the journey, and the second the cost of the journey, expressed as equivalent time. In 1971 these terms were in the ratio 1:0.57, where an average speed of 40 mph was assumed.

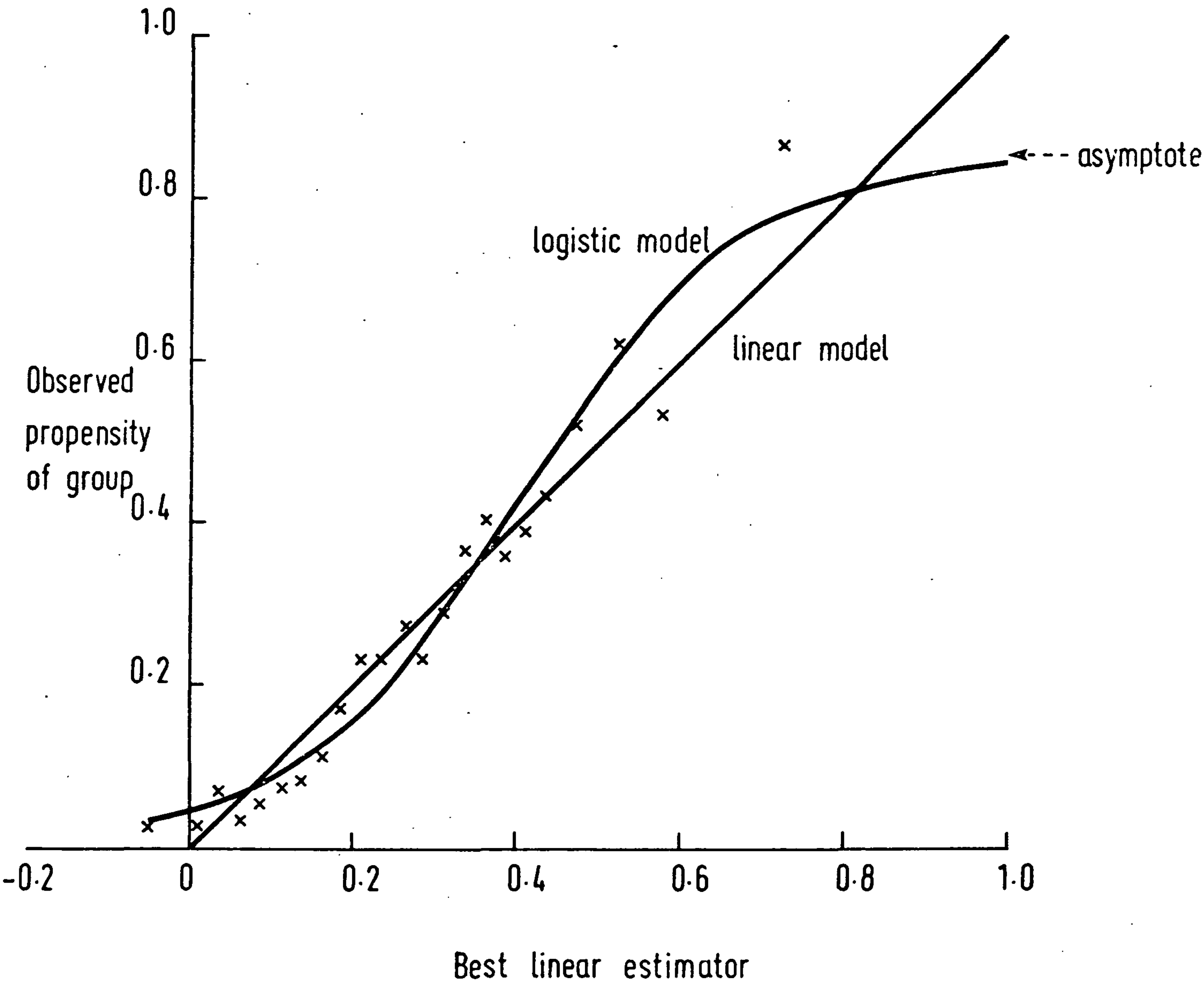
In order to test the effectiveness of the linear model, the observations were grouped by the value of the linear predictor given in Table 1.2.1 into twenty-four groups, each containing between 50 and 500 observations, representing between 50,000 and 500,000 trips taken. The observed average propensity to take a trip abroad is shown plotted against the value predicted from the linear model in Figure 1.2.1. As can be seen, although the linear model explains a large proportion (98.7%) of the variance in the observed average propensities, there is a tendency to overpredict at low values of the indicator, and to underpredict at high values. Furthermore, there is an important theoretical defect of the linear model, that it can (and does) predict negative propensities.

The method used to overcome these defects was as follows. The linear combination of socio-economic variables derived from the regression above gives us an indication of the direction in socio-economic space in which the systematic variation of propensity to take a leisure trip abroad is greatest. However, this variation is unlikely to be strictly linear. A function which has the correct properties to overcome the defects identified above is the logistic function. A non-linear estimation technique was used to estimate directly the three parameters of this function, using the twenty-four grouped observations. This technique gave the logistic function

$$\text{propensity} = \frac{1}{21.91e^{-7.259x} + 1.173}$$

where x is the best linear estimator, and increased the explanatory power to 99.3% of the variance. Given the more desirable asymptotic properties of this function, our use of it is justified. The best logistic predictor is plotted in Figure 1.2.1. The parameters estimated give an asymptotic propensity of 0.853 trips, a reasonable figure. However, we appreciate that it is important to know the reliability of such a critical parameter, and the sensitivity of our predictions to its value. Accordingly, we tested different models, re-estimating the other parameters, for a saturation level considerably higher (1.25), and for a function without saturation. The higher asymptote gives a fit nearly as good (0.9% unexplained variance, as opposed to 0.7%), but the non-saturating function gives a very much worse fit (2.1% unexplained variance). We are therefore confident that a model which tends to an asymptote is the best representation of the data, but the sensitivity of any predictions made to the value of this asypmtote ought to be considered.

Figure 1·2·1 Linear and logistic models of holiday demand (data from 1971 Household Survey)



1.2.3 Geographical Distribution of UK Leisure Trip Demand

A problem arises from the use of the 1971 data base in forecasting future geographical distribution of the demand for UK leisure trips abroad. The regions recorded on the 1971 survey file correspond to administrative boundaries in use in 1971. However, in 1974 and 1975, there was a general reorganisation of administrative boundaries in the UK, with the result that the zones and regions recorded in the survey could not be reconciled with those for which data are now available, both for validation and for forecasting exogenous variables. We therefore decided to forecast the regional distribution of UK leisure trip demand on a more aggregate basis, using data on average socio-economic characteristics for counties which were readily available from published statistics. The counties of Great Britain were aggregated into twenty-five zones, using uniformity of route choice variables for the Channel crossing as the principal criterion.

The zones chosen are shown in Figure 1.2.2. A model of propensity of to make a leisure trip abroad was estimated using the IPS 1977 statistics with socio-economic characteristics for counties obtained from the CSO publication, Regional Statistics. Variables found to be significant were an income variable, a car ownership variable, and a geographical variable. The final form selected was as follows:-

$$P = 1.136\, C^{0.5736}\, I^{1.396}\, D^{0.9135}$$

where P was the propensity to take a trip abroad (in return trips per person per year);

C was the car ownership for the zone (in cars per person);

I was a measure of income (the only readily available measure being average weekly earnings);

D was a measure of accessibility (the best found being 160 miles or distance from Dover, whichever was the smaller).

This form explained 94% of the variance of the logs of P, with 25 observations. Results of this regression are shown on Figure 1.2.3.

The total demand for leisure trips abroad will be forecast using the model described in the preceding section. The model in the present section will then be used to determine the allocation of this demand to origin zones; the propensities predicted will be normalised to the total demand given in the first stage.

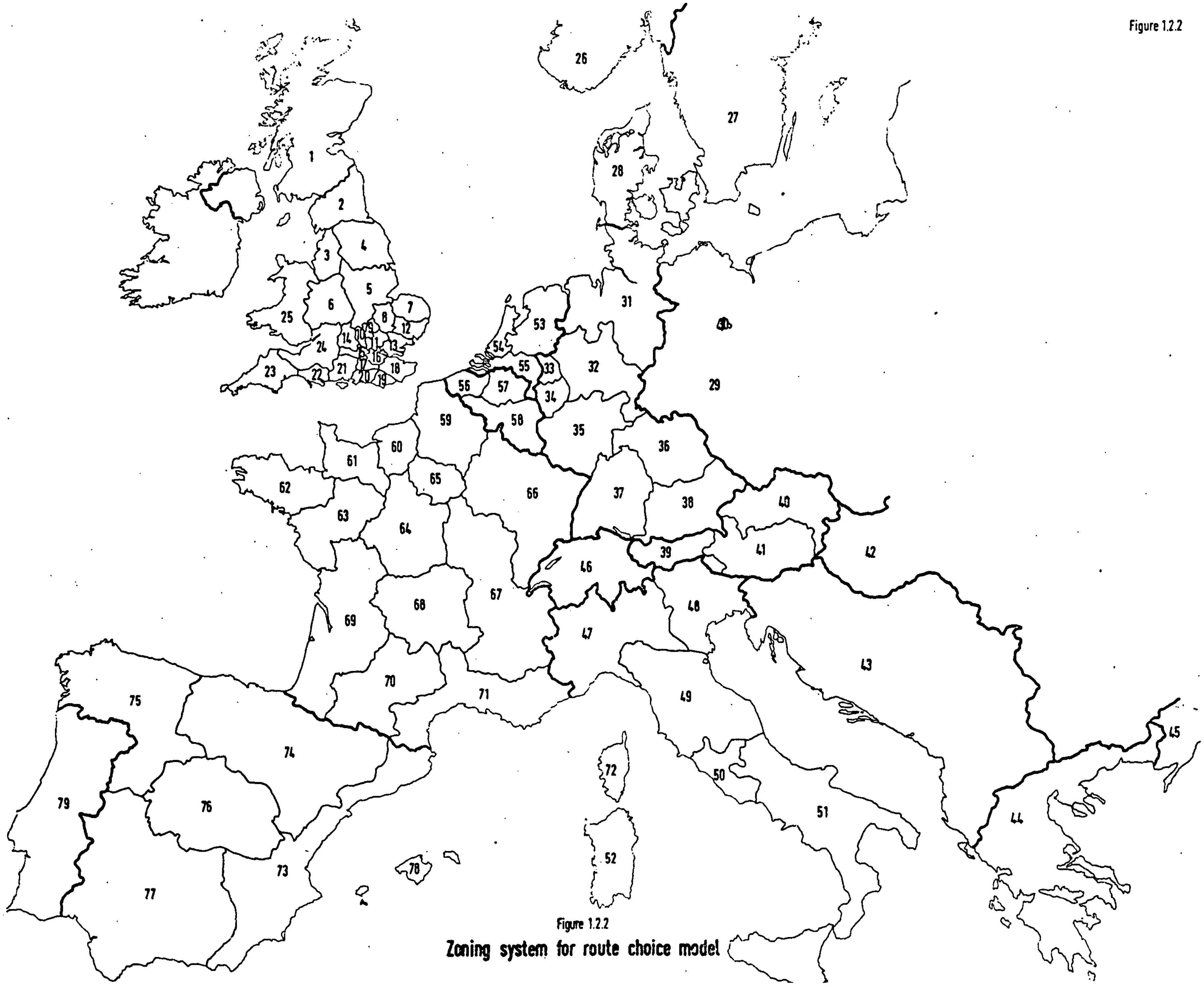
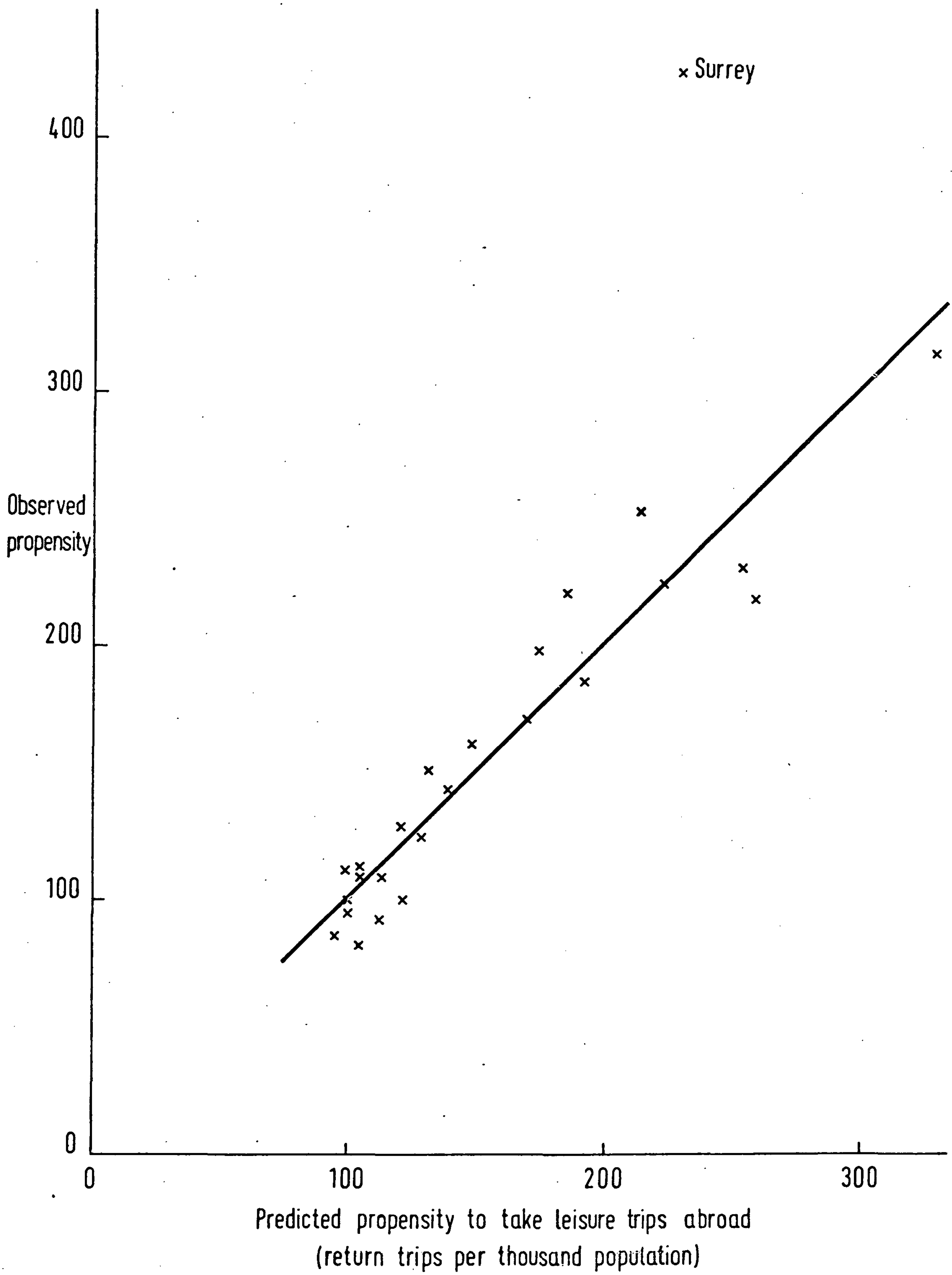


Figure 1.2.2
Zoning system for route choice model

Figure 1·2·3 Propensity to take leisure trips abroad by U.K. region (data from IPS tabulations, 1977)



1.2.4 The Model of Trip Type

Because of apparently large changes in the balance between different types of trip between the 1971 survey and 1977 IPS information, and a complete lack of time-series information, we decided to explain the split between the three types of trip - car, independent non-car, and package - using the 1977 IPS data, and using as explanatory variables zonal average socio-economic characteristics. The modelling was carried out in two stages; the first stage predicts the proportions of leisure trips from a given U.K. zone with and without a car, and in the second stage, the non-car trips are split into independent and package. In the first stage the explanatory variable was car ownership, and in the second, an index of accessibility to the continent. The regressions are summarised in Table 1.2.3. The proportions of the variance explained are 58.1% and 71% respectively which suggest that much of the measurable effect is being accounted for. The performance of the models is illustrated in Figures 1.2.4, 1.2.5 and 1.2.6.

At the first stage, it is found that, not surprisingly, the proportion of car trips rises with increasing car ownership. We found no systematic geographical variation in this proportion. For the split of non-car trips into independent and package, the important factor appears to be geographical. We examined the effect of distance from Dover, and found that at distances from Dover greater than 160 miles, non-car trips are split approximately 40% independent, 60% package. For zones nearer Dover, the proportion of independent trips increases. Other geographical variables were also examined, and found to give a less satisfactory explanation. It should be noted that for most of the country, distance from Dover is highly correlated with distance from Heathrow and Gatwick. The effect is probably attributable to an increasing number of shorter trips, which are mostly in the independent category.

Table 1.2.3: Fractions of Trips Abroad by Type

Stage	Holiday Type	Intercept	Car Ownership	Accessibility Index	% of Variance Explained
First	Car	-0.03701	0.61		58.1
	Non-Car	1.03701	-0.61		
Second	Independent	0.7498		-0.00220	70.1
	Package	0.2502		0.00220	

Figure 1·2·4 Leisure trips abroad by car as a percentage of all leisure trips abroad

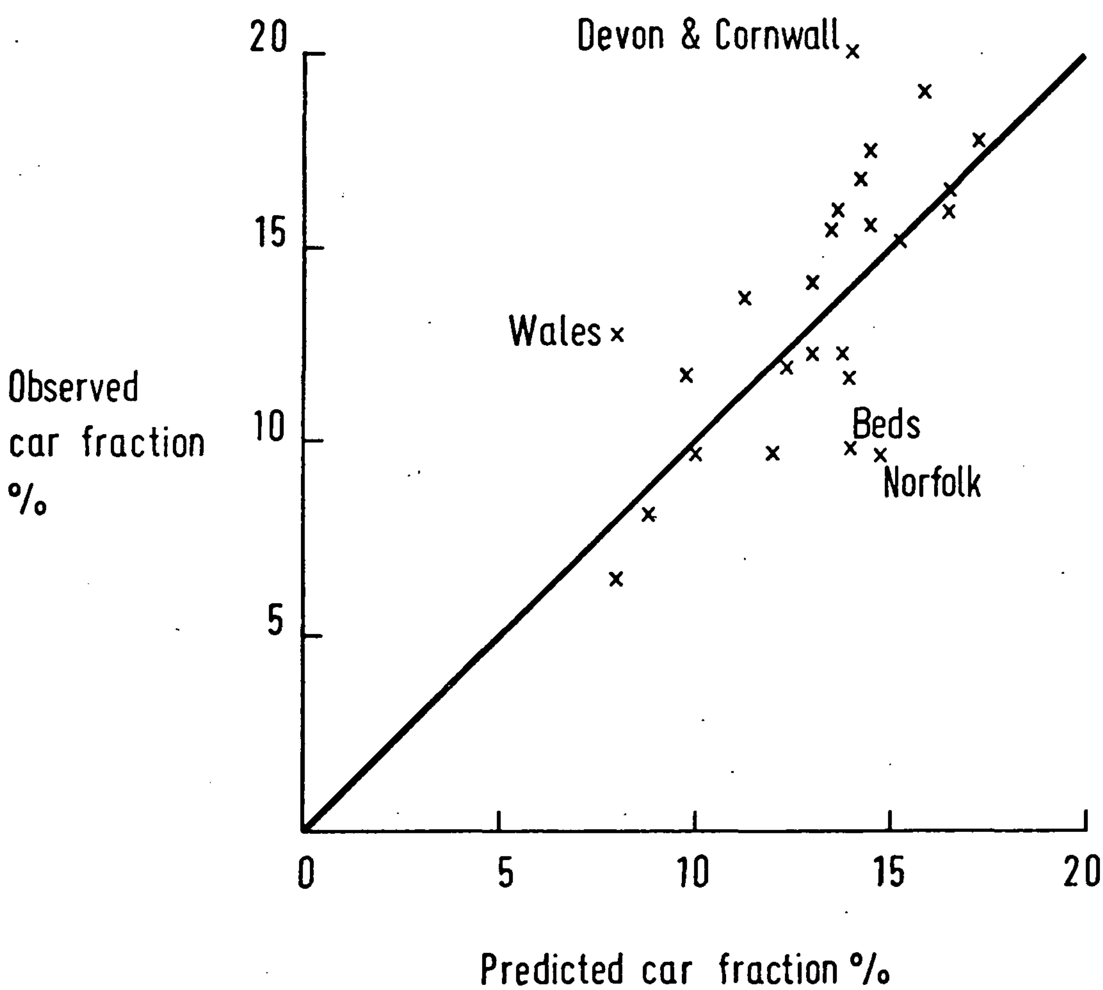


Figure 1·2·5 Independent non-car leisure trips abroad as a percentage of total non-car leisure trips abroad.

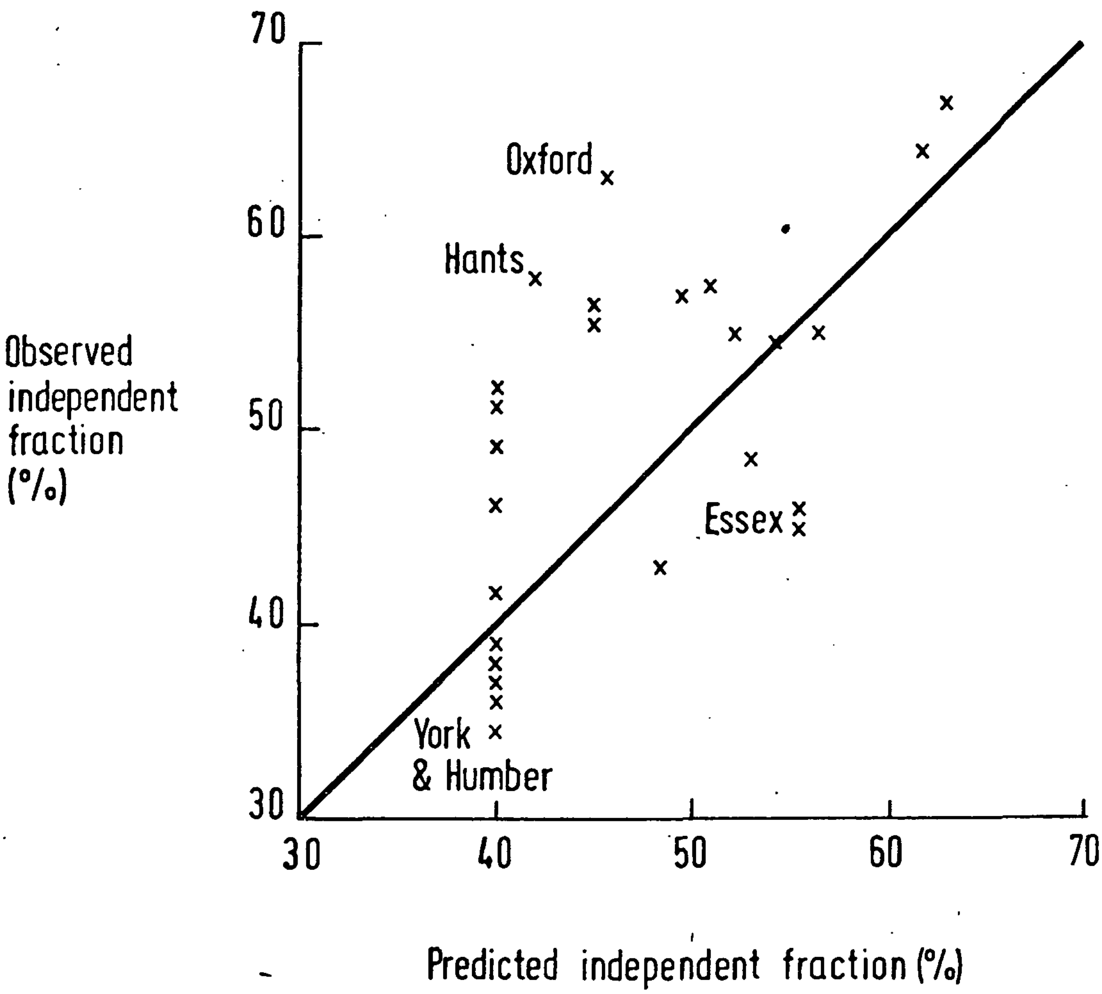
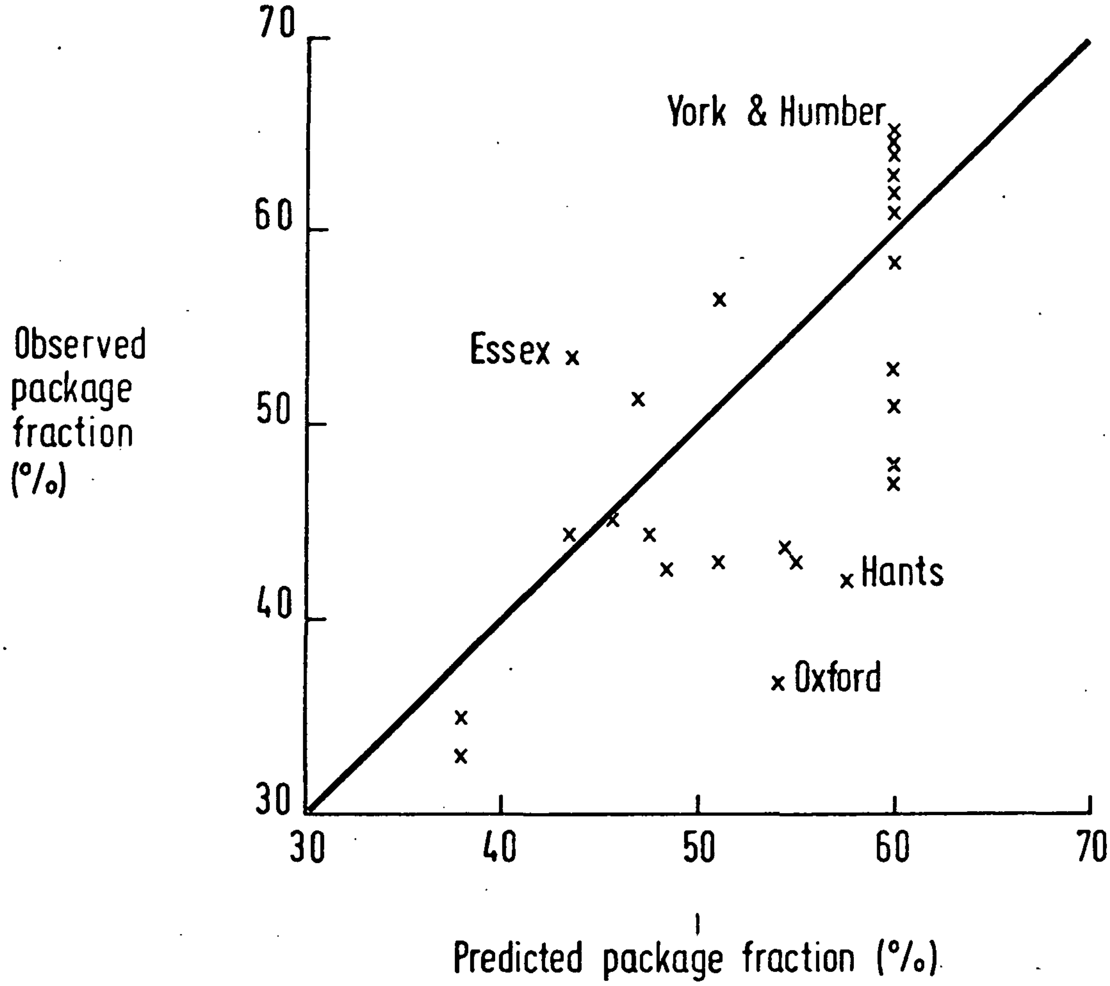


Figure 1·2·6 Package leisure trips abroad as a percentage of total non-car trips abroad.



Other possible explanatory variables examined included income, and different measures of proximity to urban centres. No useful relationship could be found with them.

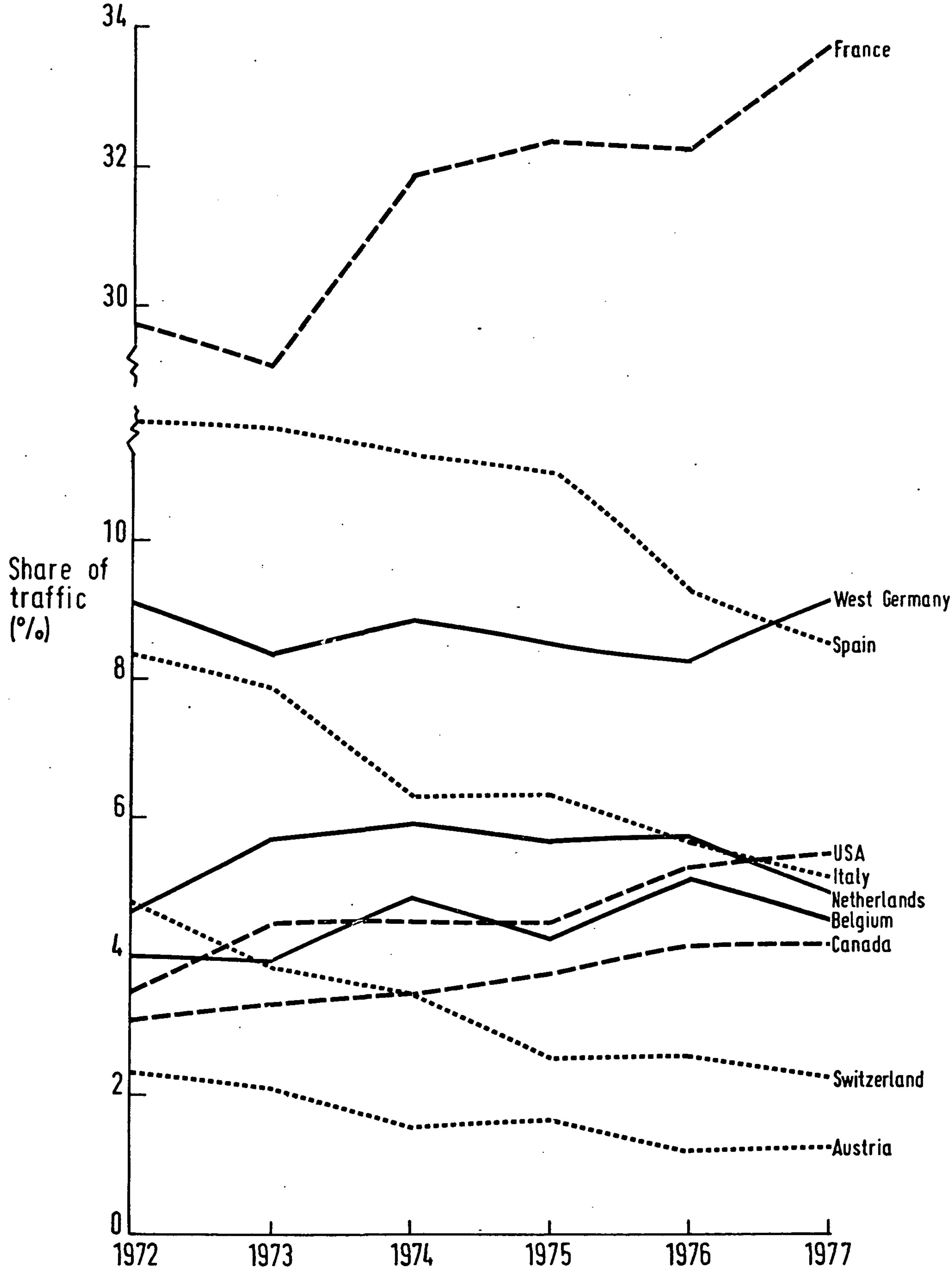
The model implies that independent and package holidays will remain in a ratio for each U.K. zone which does not change. This seems quite reasonable given the trend in independent and package holidays since 1972. It also implies that growth in the proportion of car holidays will level off at the same time as car ownership does.

1.2.5 The Model of Destination Choice

We examined the changes in the proportions of travellers in each category choosing a given destination country over the period 1972 - 1977. A number of variables were found to be useful in explaining variations between countries in attractiveness to UK leisure travellers. However, these variables represented unchanging factors such as presence of coastlines, and as such were not useful for predicting any changes in the patterns of destination choice which might occur, or for explaining those which had occurred. It was apparent that an important factor in determining these changes was the change in relative cost of living. Figures 1.2.7 and 1.2.8 show how destination choice has varied for independent and package holidays, and Figure 1.2.9 shows the variation in a relative cost-of-living variable. This is defined as the ratio of consumer price indices in the destination country and the UK, expressed relative to 1970 and corrected for exchange rate changes since 1970. Since there are only six observations per destination, it was not possible to examine each country separately. Furthermore, for most countries, (France, Belgium, West Germany, the Netherlands) the variation in both the price variable and the proportions were small. For Switzerland and Austria, and to a lesser extent Spain, an increase in cost had been accompanied by a drop in share, and for the US and Canada, a decrease in cost had been accompanied by an increase in share. However, Italy is a major exception to the expected pattern. While the cost of staying in Italy has declined since 1972, the proportion of travellers going to Italy has declined steadily also. This trend is part of a decline which has continued since the early 1960s.

Since, as will be seen, the scenarios agreed by the Commission for which predictions are needed postulate no change in this relative cost-of-living variable, we did not consider it important to examine the influence of this variable in detail.

Figure 1·2·7 Destination choice of UK leisure travellers (independent)



Key:

Rising shares (France, USA, Canada)

Constant shares (Germany, Netherlands, Belgium)

Falling shares (Spain, Italy, Switzerland, Austria)

Figure 1·2·8 Destination choice of UK leisure travellers (package)

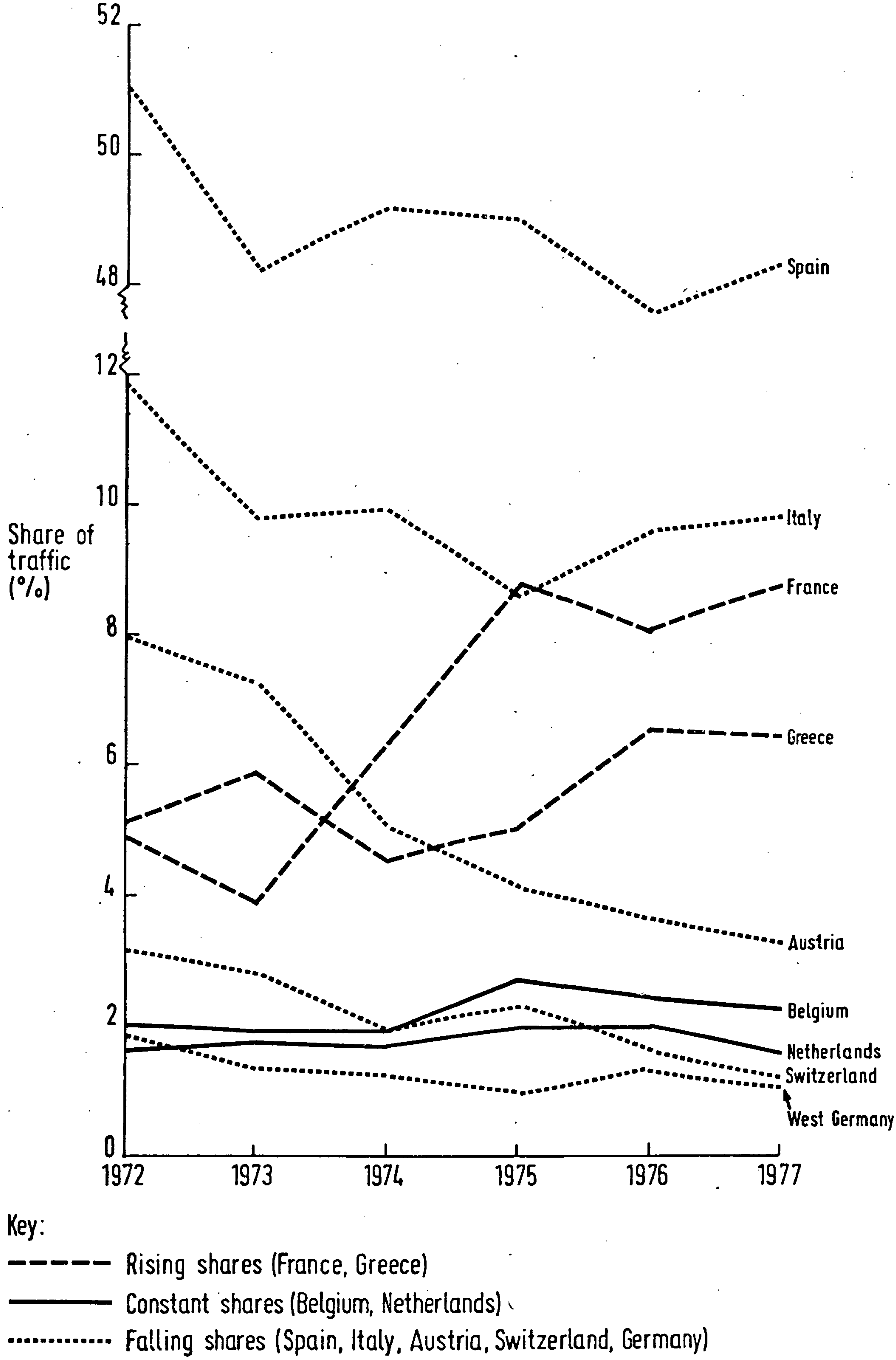
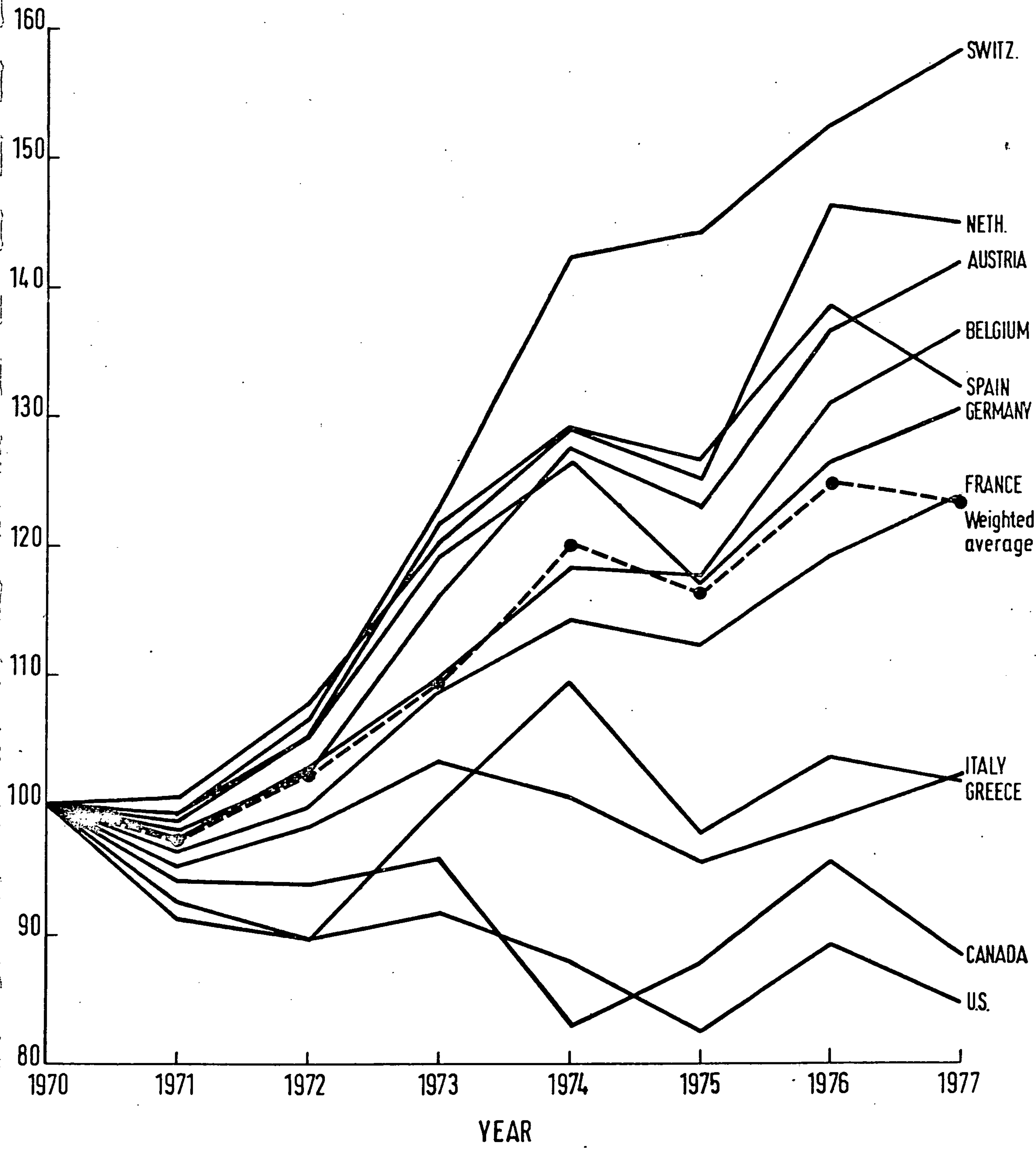


Figure 1·2·9 Index of real cost of staying abroad for UK residents (1970 = 100)



A question which deserves examination is the influence of travel cost differences on destination choice. There are two difficulties in examining this. The first is that of selecting a suitable independent variable which will accurately reflect changes in the cost of travel. The second is that the effect of variation in such a variable appears to be very small compared with the variations arising from unmeasured factors. We were unable to detect any such effect in the series examined.

An alternative approach is to estimate the parameters of an explicit distribution model. Such a model explains the trips made from a given production zone (UK zone) to a given attraction zone (continental country) in terms of the total trips produced by the production zone, the total trips attracted by the attracting zone, and the disutility of or impedance to travel between the zones. Such a model has the added advantage of explaining the different patterns of destination choice observed for different UK zones. Examination of the 1977 IPS data for leisure car trips indicated that such a model, with an implicit elasticity to travel impedance of about -3, would be a good explanation of observed differences between UK zones in patterns of destination choice. However, we were unable to find such a pattern for non-car trips, and given that our data was only disaggregated to continental country level, and also the difficulty of combining this approach with our "top-down" demand models, it was decided to neglect the effect of changes in travel cost on destination choice.

To apply a route choice model sensibly, it is necessary to have some knowledge of destination choice at a more detailed level than country. There appears to be no source of information on this more recent than the IPS trailer survey undertaken for the previous study in 1971. Unless further information becomes available, the split of traffic in a given category going to a given country between its various regions must be assumed to be that observed in 1971. The zones used are shown in Figure 1.2.2.

1.2.6 The Model of Route Choice

The analysis of route choice behaviour in the context of Channel crossing differs from most studies in the large number of possible choices open to any individual traveller. Travellers from a given UK zone to a given continental zone are observed to use many of the available routes, and it is quite possible for a single individual to choose different routes for his outward and return journeys. Accordingly, it was necessary to use a non-deterministic model, in which the route chosen by a given traveller was not simply a function of his measured characteristics; instead, travellers with given characteristics are assigned probabilities of choosing a variety of routes.

For the purpose of route choice, we divided leisure travellers into three categories:

- car travellers;
- independent, non-car travellers;
- package travellers.

The models used for these three categories have the same basic structure, as does that for freight route choice.

1.2.7 <u>The Route Choice Model for Car Travellers</u>

Networks of transport links were constructed, which enabled us to calculate, for the traveller from UK zone i to Continental zone j, the characteristics of all the possible routes. These characteristics include:

- mean UK road distance;
- mean Continental road distance;
- mean time taken for crossing;
- mean crossing fare.

We assume that any individual wishing to drive to the Continent chooses a route by minimising some function of his crossing characteristics. However, his individual values will not be the same as the mean values calculated from the network. Furthermore, the form of each individual's impedance function may be different. We simulate this by postulating a form of an impedance function, into which we insert the mean values calculated as above. Such a function is:

$$I_{ij} = a_u D^u_{ip} + a_c D^c_{qj} + a_t T_k + a_f F_k$$

where I_{ij} is the mean impedance for travellers from zone i to zone j using crossing k;

- $D^u{}_{ip}$ is the UK road distance from zone i to the port p at the UK end of crossing k;
- $D^c{}_{qj}$ is the Continental road distance from the port q at the Continental end of crossing k;
- T_k is the time required for crossingk;
- F_k is a typical fare for crossing k;
- a_u is the impedance per unit of UK road distance;
- a_c is the impedance per unit of Continental road distance;
- a_t is the impedance per unit time;
- a_f is the impedance per unit of typical fare.

Values of D^u, D^c, T_k and F_k may be obtained from the network. The fare we have chosen is that for two adults and two children in a 14-foot car, on a summer weekday. The other variables, a_u, a_c, a_t and a_f are parameters to be determined from the observations. Clearly, they are not all four independent. It is convenient to set the average a_f to unity, so that the impedance is expressed in money units.

Variation in the routes chosen by individuals with common measured characteristics can arise from many sources. The parameters a_u and a_c represent the sum of two effects. They take account of the running costs of the car (which will, of course, vary with the size of the car) and of the perceived disutility of time spent travelling in the car, which will vary with the number in the party, and, subjectively, with their perceptions of time. Similarly, a_t will vary with the size of the party and with their perceptions of time spent on a ferry (for example, a_t will be high for an individual liable to sea-sickness, but low for one to whom it is a pleasure to travel by sea). The value of a_f will be low for an individual in a small car, or a shareholder claiming a concessionary fare, but high for a large party touring in a caravan. As well as parameter values, the values of the observable variables may differ from the mean; an individual in a zone may live nearer to further away from the port than the zone centroid.

It is clearly not practical to model all the sources of uncertainty described above individually. We have therefore chosen to simulate the uncertainty arising from all possible factors by assuming that individuals' impedances for all the routes are distributed about the means according to prescribed distributions. Each individual takes the route with the lowest impedance. For the population, the probability of taking a given route can be calculated. Details of the calculation, and other material pertinent to route choice, can be found in Appendix B.

Two crucial questions now arise:

- what is the structure of the distribution?
- what is the form of the impedance function?

We first consider the distribution of deviations from the mean. For reasons described in Appendix B, we have assumed that the distribution is normal, with standard derivation proportional to the mean. The approach suggested, if applied unmodified in the context of Channel crossing, can lead to somewhat implausible results, because the analysis assumes that the deviations from the mean for different routes are independently distributed. However, it is likely that the deviations from the mean for a pair of crossings like Dover-Calais and Dover-Boulogne (and similarly, for the new link) are highly correlated.

Our approach to this problem has been to split the route choice into more than one stage. At each stage we try to represent choices in which each one genuinely is irrelevant to choices between the others. The stages chosen for our car model are shown diagrammatically in Figure 1.2.10.

The formulation chosen does not lend itself to formal statistical estimation. The procedure used was to examine different forms of impedance function, and different parameter values, and to choose, by trial and error, the function which minimises the number of trips wrongly allocated to crossings.

The functional form arrived at was an additive generalised cost impedance function:

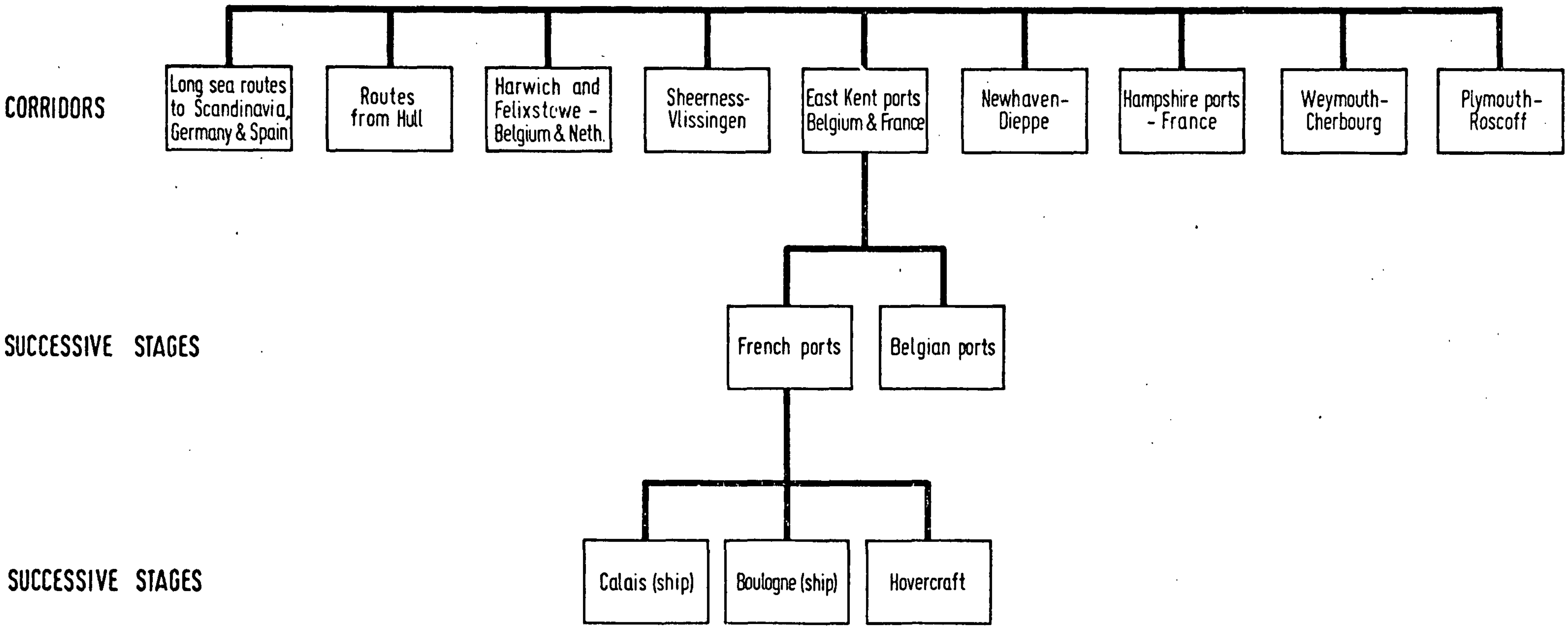
$$I = 0.14\ D_u + 0.1 D_c + F + 1.35T$$

where D_u was the road distance in the UK in miles;

- D_c was the road distance on the Continent in miles;
- F was the peak weekday fare for two adults and two children in a 14-foot car, in 1979 pounds sterling;
- T was the crossing time, up to a maximum of 12 hours.

Forms with the same coefficient for UK and Continental distance were tried, but found unsustainable.

Figure 1·2·10 Route choice stages for car travellers



The implications of the parameter values found are interesting, especially with regard to people's valuations or perceptions of time. The values of a_c and a_u subsume the perceived costs of monitoring and the disutility of time on the road. If a plausible average value of 4p per mile for the running costs is assumed, this leaves disutilities of time in the car of 10p per mile in the UK and 6p per mile on the Continent; that is, £4 per hour in the UK and £2.40 on the Continent, for the average car-load at an average speed of 40 mph. This difference perception of driving in the UK and the Continent accords with the findings of previous studies. With an average occupancy of just over three persons, the "values of time" found are higher than those usual in studies of shorter journeys, which is not at all surprising. A much lower disutility of time on the ferry is found, which again is intuitively reasonable, since on average travellers seem to enjoy the ferry trip more than they do driving.

The impedance function chosen to fit the split between corridors was also found to model adequately the second stage (the split between French and Belgian ports out of East Kent ports) and the third stage (the split between Boulogne and Calais out of Dover), provided that a factor allowing for the different frequencies is incorporated. Details of the fit are given in Appendix B. In addition, it was found necessary to allow for the fact that Calais had better road connections than Boulogne.

As expected, the coefficients of variation found in the three stages are different. For the choice of corridor, the best distribution was normal with a standard deviation 0.026 of the mean. For the choice between French and Belgian ports, a value of 0.016 was found. This lower value reflects the fact that routes via these crossings have a great deal in common, including the journey in the UK, and a common fare structure. For the split between Calais and Boulogne, the best value was 0.031, which, interestingly, is greater than that for the Belgian/French split. This may reflect the lack of information people have on the relative advantages of Calais and Boulogne, whereas those of the Belgian ports vis-a-vis the French ports may seem more obvious.

1.2.8 The Choice Between Ship and Hovercraft

Unfortunately, the only detailed data we possess on the patterns of use of the hovercraft and ships out of East Kent ports are for 1977, a year in which the Seaspeed hovercraft services were severely curtailed. No consistent pattern of choice between hovercraft and ship could be discerned in the data.

In the choice of hovercraft or ship were determined by the same impedance function we have used hitherto, the hovercraft could potentially attract a large share - perhaps 60% - of the short-sea market. This could indeed be the case, and the factor constraining the hovercraft share might simply be lack of capacity. On the other hand, the disutility of time spent on a hovercraft may well be different from that spent on a ship for reasons of discomfort, or unreliability. The data we have gave no way of determining this. Since 1977, the hovercraft operators have started to charge a small premium (about 3% on the standard car-load) for travellers in the peak period. In addition, the hovercraft are at present running at a loss, or, at best, making a very small return on their capital. Thus it is likely that they will in future charge perhaps 5-10% more than the ferries, and take a correspondingly smaller market share.

1.2.9 The Route Choice Model for Independent Non-Car Travellers

For this category of travellers, we have adopted a model of the same form as that just described for car travellers. Data were again assembled and stored as a transport network, details of which are given in Appendix B.

Scheduled rail and air services were used, with some non-scheduled air services where large flows were observed on a route where no scheduled service existed, for example between Manchester and Spain. Explicit allowance was made for waiting and transfer time.

Crossings were grouped into corridors as for car travellers, with the addition of corridors for air travellers (one for each UK airport considered, save the London airports which were treated as a single corridor). Factors were incorporated to allow for the different proportions of charter flights available from different airports.

The impedance function finally used was:-

$$I = T + \frac{C}{V}$$

where T is the through time including rail time, air or ferry time, time for access to railhead or airport, and waiting time;

C is the through cost, including rail, air and ferry fares; and

V is a parameter, the "value of time".

In principle, this impedance function could be formulated to allow V to be different for different types of time, e.g. time in train, time in ship, time in flight, waiting time. However, this complication was not found helpful.

The parameters of the model were V and the coefficient of variance. The standard deviations of the impedance distributions were assumed proportional to the means throughout. The best values of these parameters were found by searching for those which minimise the trips recorded in the 1977 IPS tabulation wrongly allocated to a corridor.

A modification was necessary as it became apparent that, for example, the disutility of a fifteen-hour train journey was much more than three times that of a five-hour journey. Thus values of time which gave an acceptable rail-air split for short journeys, e.g. to Belgium, the Netherlands and Northern France, gave implausibily high proportions on rail to Austria, Italy and Spain. After investigation of a number of possibilities to find the best explanation, this was overcome by increasing the disutility per unit time by 50% for journeys over eight hours. This factor reflects in part the cost of sleeper accommodation, etc., and in part the sheer discomfort of long train journeys. It should also be borne in mind that the journeys considered are usually part of a holiday which has a fixed total time allocated to it. This factor will certainly increase the travellers' resistance to spending a very long time on a train.

The value of the parameters which gave the best fit were a value of time of £1.50 per hour for an individual, and a standard deviation of 7% of the mean impedance. The value of time implied is much higher than those found in many other studies, and is higher than that found for car travellers abroad. However, this is not surprising, given the constraint on the total time which usually applies to holidays; thus time spent travelling is holiday lost. In addition, it should be recalled that this value of time is expressed relative to full scheduled fare, and that in practice a large proportion of travellers will avail themselves of discounts and cheap fares. Thus the "real" value of time, that is, that which should be used for evaluation of benefits arising from reductions in travel time for this category of traveller will be proportionately lower.

1.2.10 The Route Choice Model for Package Travellers

The behaviour of this category of traveller is more difficult to model than that of the independent traveller because, by definition, the information on fare paid is not available. The characteristics of the package traveller are that:

- he tends to travel more by air;
- he tends to use regional airports rather than Heathrow; and
- when travelling by sea, he tends to use the longer sea crossings to a greater extend than the independent traveller, at the expense of the French and Belgian straits routes.

These characteristics have interesting implications. If package travellers were assumed to pay the same fares as independent travellers they would appear to have a higher value of time parameter. A more likely explanation is that there is, in fact, a substantial reduction in the fares actually or implicitly paid, which would have the same effect. Another factor working in the same direction is the fact that a much larger proportion of package travellers use coach, a slower, cheaper mode than rail. These implicit reductions in fare would tend to shift travellers from sea to air, and, for those using sea crossings, away from the cheaper crossings (the French and Belgian straits).

We have chosen tc model this behaviour using the same network and the same functional form as for the independent non-car travellers, but with the relative importance of fare reduced. The best parameter values found are £2.10 per hour for the value of time, and 0.1 for the coefficient of variation; again, of course, this is relative to scheduled fares, and the "real" value of time required for evaluating benefits will be considerably lower.

1.3 The Models: The SETEC Model for Continental Leisure Travel to the UK

The models of demand and of route choice for Continental leisure travellers are described in the Phase 1 and Phase 2 reports by SETEC Economie.

1.4 The Models : Business Travel Across the Channel

1.4.1 The Model of UK Business Travel Demand

The data from which this model was derived came from published IPS statistics. It should be noted that IPS published statistics for business travel include lorry drivers, and exclude certain purposes which we would classify as "business" (e.g. travel to take up employment). However, we have assumed that these can be accounted for as a fixed proportion of the published figures for each destination country.

The model used explained the number of UK-origin business trips to a given country in terms of the GDP of the destination country and the value of UK exports to that country.

$$T_j = A_j \, G_j^{0.2127} \, X_j^{0.4780}$$

where T_j is the number of business trips (thousands of return trips) made by UK residents to country j;

A_j is a country-specific attraction factor;

G_j is the value of the gross domestic product of country j, expressed in billions of 1975 US$;

X_j is the value of exports from the UK to country J, expressed in billions of 1975 US$.

The model was estimated using data from 1972 to 1977, for the nine countries which contributed most to those business trips likely to use a fixed crossing: France, Belgium and Luxembourg, Netherlands, West Germany, Italy, Denmark, Spain, Switzerland and Austria.

Earlier models tested included the value of the UK GDP, and the value of UK imports from the country, as explanatory variables; these were not found to have any significant explanatory power. A model without the country-specific factor A_j was found which explained 90% of the variance of the logarithms of T_j. However, we noticed that the average of the residuals for this model showed a significant between-country variance. The country-specific factors were therefore introduced, and improved the explanation to 99% of the variance. The values of A_j found are listed in Table 1.4.1, and the predicted and observed numbers of trips are compared in Figures 1.4.1 and 1.4.2 for the seven most important destinations.

Figure 1·4·1 UK business trips abroad, predicted and observed

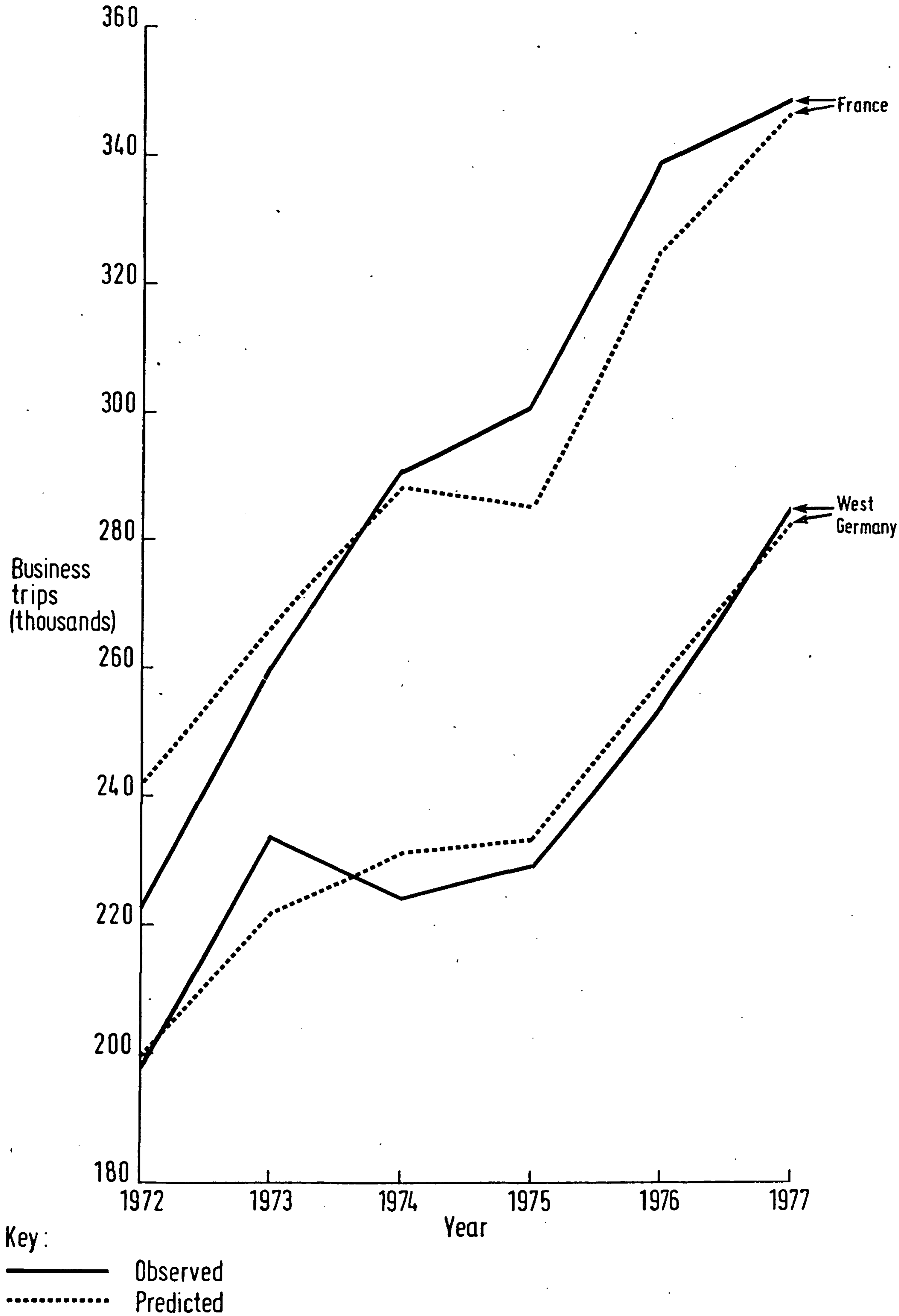
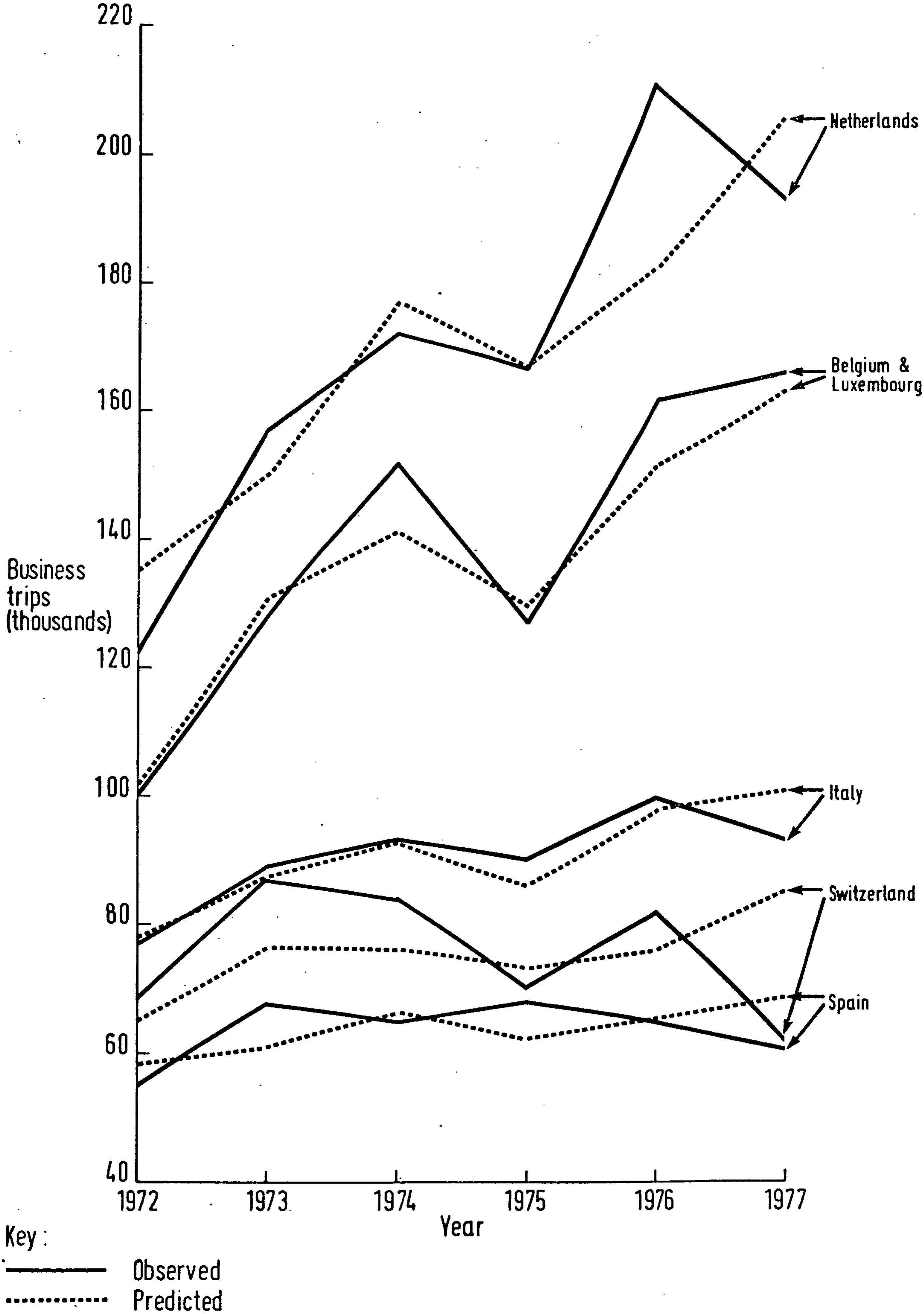


Figure 1·4·2 UK business trips abroad, predicted and observed



To correct these figures for the inclusion of lorry-drivers, and the exclusion of emigrants etc., from the IPS published figures, we used the proportions falling into these categories for each country in 1977. They are shown, together with the modified attraction factors, in Table 1.4.2.

Table 1.4.1: Country-Specific Business Travel Attraction Factors

Destination	Attraction factor A_j (thousands of return trips)
France	49.7
Belgium & Luxembourg	36.3
Netherlands	39.9
West Germany	36.3
Italy	24.3
Denmark	12.7
Spain	26.9
Switzerland	22.4
Austria	12.4

Table 1.4.2: Business Travellers in 1977: IPS and our Definitions

Destination	Business trips (IPS) (thousands)	Business trips (our definition) (thousands)	Modified attraction factor
France	349	306	43.6
Belgium & Luxembourg	166	154	33.6
Netherlands	193	179	37.0
West Germany	285	280	35.7
Italy	93	83	21.7
Denmark	33	33	12.7
Spain	61	60	26.5
Switzerland	61	60	22.0
Austria	20	20	12.4
Total	1261	1175	

The attraction factors obtained vary over a wide range (12.4 to 43.6). It has been found that much of this variation can be explained by the relative proximity of the country to the UK. The variable we have used to measure this is the air fare (1977 scheduled air fare) between Heathrow and an appropriate commercial centre. The centres chosen were Paris, Brussels, Amsterdam, Koln, Milan, Copenhagen, Madrid, Zurich and Wien.

The most appropriate simple model form appears to be:

$$A_j = a_j e^{-bF_j}$$

where F_j is the air fare.

This has better asymptotic properties than the alternative linear or log-log forms. The A_j values found are well represented by this relationship, save those for Spain and Italy. We therefore take into account variations in air transport costs in forecasting the A values, by using:

$$A_j^{(t)} = A_j^{(o)} \; e^{-b(F_j^{(t)} - F_j^{(o)})}$$

We have assumed that the residual variation found in the A_j values is due to some factor which will remain, on average, constant.

IPS figures for 1977 also give us the breakdown of business travel by UK origin. These figures are shown in Table 1.4.3. In the absence of further data, we assume that these proportions remain fixed in the future.

Table 1.4.3: UK Business Trips by Origin, 1977

Origin	Business trips (thousands)	% of UK Total
Scotland	41	3.5%
North	21	1.8%
North-west, NI, IOM	97	8.3%
Yorks & Humberside	54	4.6%
East Midlands	58	5.0%
West Midlands	92	7.9%
Norfolk	7	0.6%
Cambs	17	1.5%
Beds	15	1.3%
Bucks	35	3.0%
Herts	46	3.9%
Suffolk	13	1.1%
Essex	57	4.9%
Oxon	15	1.3%
Berks	37	3.2%
London	247	21.1%
Surrey	103	8.8%
Kent	68	5.8%
East Sussex	17	1.5%
West Sussex	26	2.2%
Hants & IOW	37	3.2%
Dorset	8	0.7%
Devon & Cornwall	5	0.4%
Rest of South west	36	3.1%
Wales	17	1.5%
Total	1169	100.0%

Notes: (a) Business trips are defined as return trips to the nine destinations in Tables 1.4.1 and 1.4.2; they correspond to our definition;

(b) The total does not correspond to that in Table 1.4.2 becasue the latter includes 2,500 trips originating in the Channel Islands, which will go by air, and 4,500 "dont't know origin" trips.

1.5 The Models : Non-European Travel Across the Channel

1.5.1 The Model of Non-European Travel Demand

An attempt to construct a model of the demand for travel between the U.K. and continental Europe by non-Europeans is beset by considerable problems. First, and most important, there appears to be no source of data on the level of demand. Secondly, what data there are on the movements of non-Europeans within Europe, are only available on a very patchy basis; each data source uses a different aggregation of countries, and different definitions.

We have relied on four data sources:-

- IPS published statistics;
- OECD travel and tourism statistics;
- USA and Australian data on departure for Europe; and
- surveys undertaken for previous Channel Tunnel studies.

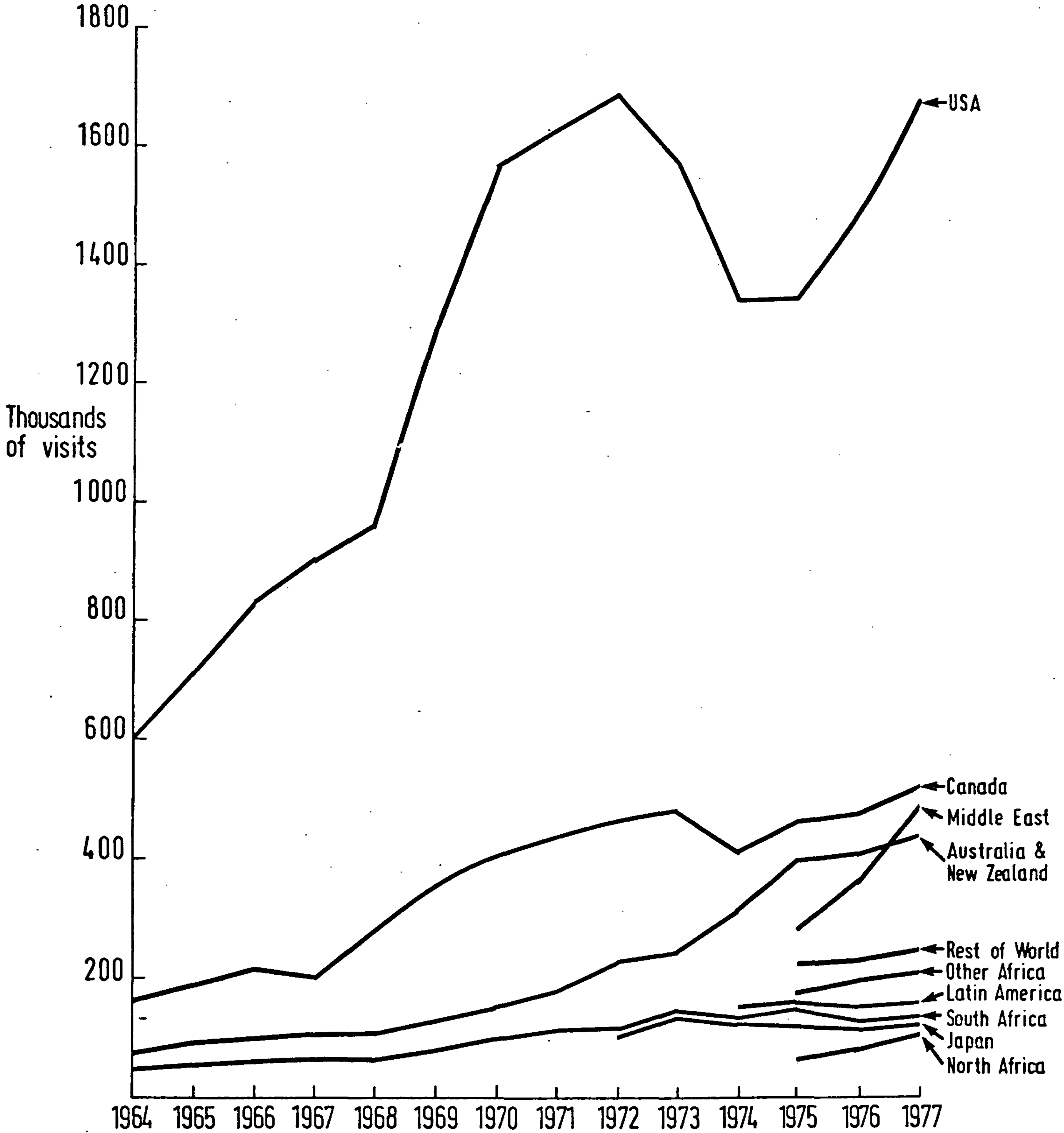
IPS published statistics give the number of non-Europeans entering Britain, but do not break these numbers down into those arriving from Europe and those arriving from outside Europe.

The classification of non-Europeans is not consistent from year to year, but long series are available from the USA, Canada, Australia and New Zealand together, and South Africa. More recently visits from Japan and Latin America have been given, and very recently, series for the Middle East, North Africa, and Other Africa. The series are shown in Figure 1.5.1. The USA provides the major source of non-European visitors (41%) but totals dropped after a rapid rise in the late 1960's. Visitors from Canada and Australia also rose rapidly over the same period, and the Australasians were apparently not affected by the factors which caused the drop in North American visitors.

The rise in the number of visitors from the Middle East has been exceedingly rapid since 1975, when it was first published. Of the over four million non-Europeans visiting the U.K., it is difficult to determine what proportion will make the crossing to Continental Europe.

The OECD publication, Travel and Tourism Statistics, publishes some figures collected by the member nations. Nations vary in how they collect tourism data; for example, most give numbers of foreign guests registering in hotels etc. Some, however, for example the U.K., count frontier crossings and others, for example Belgium, give only the number of nights spent in accommodation. Furthermore, the nations differ in the extent to which they aggregate non-European visitors; France and Spain give separate details of a large number of origin countries, while Belgium only uses four categories.

Figure 1·5·1 Non-European visitors to Britain (source: IPS)



By making plausible assumptions where data are inadequate, and neglecting those visitors who do not stay in tourist accommodation, it is possible to estimate the numbers of frontier crossings by non-Europeans for 1976, the latest year for which figures are available. They are given in Table 1.5.1.

Table 1.5.1: Estimated Frontier Crossings by non-Europeans, 1976

	Frontier Crossing (thousands)
USA	10749
Canada	2150
Australia & N.Z.	1264
Japan	1570
Latin America	1715
Rest of World	4530

Source: OECD Travel and Tourism Statistics, 1977.

Countries included are: Austria, Belgium, Denmark, France, West Germany, Greece, Italy, Netherlands, Portugal, Spain, Switzerland, U.K., Yugoslavia.

For the previous Channel Tunnel Studies, information was provided by certain non-European nations on the number of their nationals visiting Europe. For this study, this information was only available from the USA and Australia, and only the USA could provide a long time series. This time series was used to test a modification of the model used in the previous study:

$$T = T_o P^{0.51} I^{0.97} C^{-0.90}$$

where T is the number of trips from an overseas region to Europe;

P is the population of the region;

I is its GDP per head; and

C is the cost of a European holiday from that region.

The performance of this model can be tested as the US Department of Commerce supplies data on the series of costs as well as on trips. The performance is shown by the dashed line in Figure 1.5.2. An even better agreement it obtained by using the travel cost for C; this is shown as the dotted line. This is also more plausible behaviourally, since the main determinant of holiday cost is length of stay, which the traveller is himself largely free to choose. The performance of this model makes it quite acceptable as a forecasting method.

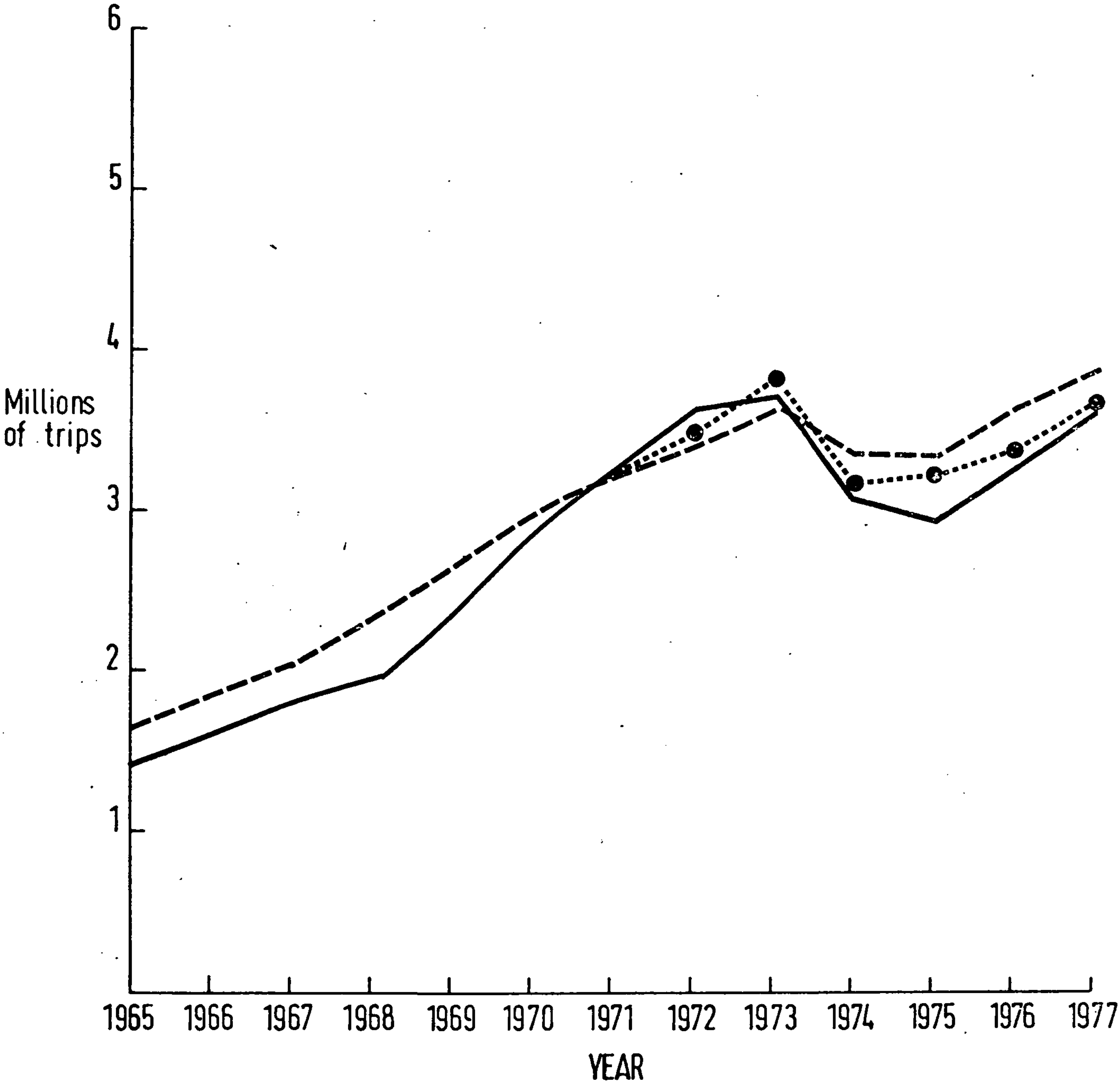
The figures for visitors to Europe from the USA and Australia, when combined with those for the number of frontier crossings, enable us to infer an average number of countries visited. In 1976 this was 3.3 for USA residents, and 3.9 for Australians. This compares with the 1971 figures of 3.8 for USA and 4.0 for Australia and New Zealand taken together. However, these figures included an "estimate for countries not recorded". Divergences are not too great for us to accept the 1971 estimates for countries per trip for other parts of the world. Our estimates of numbers of non-Europeans visiting Europe are given in Table 1.5.2.

Table 1.5.2: Estimated Trips to Europe by Non-Europeans, 1976

	Countries per trip	Estimated trips (thousands)
USA	3.3	3257
Canada	2.9	741
Australia & N.Z.	3.9	414
Japan	5.5	285
Latin America	6.0	286
Rest of World	6.0	755
		5738

The final step required is to calculate how many trips from continental Europe to Britain are generated by these travellers. The method used is to assume that each time a non-European traveller enters a continental country, there is a fixed probability that either his next destination will be Britain, or his immediate origin was Britain. These probabilities are derived from the 1971 surveys.

Figure 1·5·2 US travellers to Europe (source: US Dept of Commerce)



Key:

Observed

Predicted (model with holiday cost)

Predicted (model with travel cost)

The model proposed can be summarised as follows:

1. Trips from a non-European origin to Europe depend upon the population of the origin region, its GDP per head, and the cost of travel to Europe.
2. These travellers are assumed to visit European countries in the same patterns as they did in 1976; these patterns are summarised in Table 1.5.3.
3. Each arrival in a given continental country is assumed to generate a fixed probability of a trip to the U.K.; these probabilities are given in Table 1.5.3.

Results of applying this procedure in 1976 are shown in Table 1.5.3. They are consistent with (i.e. always considerably less than twice) the numbers of return trips to the U.K., recorded by the IPS. In addition, a realistic maximum value on the number of sea crossings can be set by considering crossing to or from countries within a realistic day's journey of a port connecting with Britain. These are France, Belgium, the Netherlands, and West Germany and Scandinavia; this suggests that the number of single sea crossings made by non-Europeans cannot be greater than 1,650,000. This again is consistent with IPS figures, which give 3,661,000 visits to Britain made by non-Europeans of which 677,000 are by sea, which implies at most, 1,345,000 single crossings (probably less because of direct sea passengers).

1.6 The Models : Freight

1.6.1 The SETEC Model for Demand for Freight

This is described in the reports of Phase 1 and Phase 2 by SETEC Economie.

1.6.2 Route Choice for Freight Traffic

The problem of forecasting the patterns of travel of freight traffic in futures with and without a new fixed Channel link is in many ways similar to that for passengers. There is, however, an additional difficulty in that there is no single, consistent, source of data on freight movements at the level required, corresponding to IPS for passengers. An additional first stage in the derivation of a model of freight route choice was therefore the production of a breakdown of the freight movement patterns in the base year, 1977, consistent as far as was possible with the sources of data, with which the route choice model's performance could be compared.

The development of a route choice model for freight movements between the UK and Continental Europe required the following operations:-

(a) analysis of the patterns of cross-Channel freight movement in the base year, 1977;

(b) examination of those characteristics of existing methods of transport (principally cost and time) which were thought to determine route choice; and

(c) derivation of a structure, and estimation of the parameters, of a model which explained adequately the patterns found in (a), and was able to represent the relevant characteristics of a new link.

Examination of the data available suggested that three transport modes for freight should be distinguished. These were:-

(a) ro-ro (roll-on, roll-off) traffic, where road vehicles carrying the freight were "rolled" on and off the vessel;

(b) lo-lo (lift-on, lift-off) traffic, where containers were lifted on and off the vessel, regardless of the mode used to transport the containers to the port; and

(c) rail wagon traffic, where rail vehicles were rolled on and off the vessel.

The second category, lo-lo traffic, will sometimes loosely be referred to as "container" traffic, because of the specalised nature of the vessels required. However, it should be remembered that much of the traffic in the other two modes will be containerised.

Non-unitised traffic has been regarded as not suitable for a new fixed link and therefore its route choice has not been considered. It has been necessary, therefore, to consider the proportion of future trade which will be unitised.

1.6.3 Patterns of Freight Movement in 1977

Three principal data sources were used:-

(a) National Ports Council (NPC) published data;

(b) unpublished, but freely available, data collected by HM Customs and Excise, which gave UK imports and exports to specified countries, by UK port and by commodity; and

(c) a pilot survey undertaken in 1976 for the Department of Transport by the National Ports Council; the full survey took place in 1978 and 1% of all traffic was sampled, but results were not ready in time for use in this study.

To calibrate the test freight route choice models, it was necessary to produce a breakdown of freight flows by UK zone of origin or destination, by Continental zone of origin or destination, and by mode and route of crossing. No single source of data could supply this information. It was necessary to combine information from the various sources mentioned, and to make inferences where there was no direct source of information.

The tabulations provided by HM Customs and Excise provided flows from each UK port to each Continental country, classified by commodity and by mode; they only distinguished ro-ro (road and rail) from lo-lo traffic. However, detailed information on rail wagon flows was provided by British Rail. Customs information suffered from some important drawbacks:-

(a) it is measured in "net" tonnes, that is, exclusive of packaging;

(b) it excluded flows of motor vehicles for import and export, and other freight rolled onto vessels by vehicles belonging to the ship or the port;

(c) it excluded entrepot traffic with ultimate destination beyond our study zone, which we regarded as divertible to a fixed link; and

(d) it excluded Irish traffic crossing via the UK.

Adjustments to the HM Customs figures were made to allow for these factors, so that totals for port throughput were the same as those given in NPC published data. Details of these adjustments are given in Appendix C.

The breakdown of flows by UK region of origin or destination was deduced by examining the 1976 pilot survey data. Traffic travelling through a given port was split between UK economic planning regions in the same proportions as found in that survey. Where UK zones were subdivisions of economic planning regions, the flows were split in proportion to population for imports, and in proportion to employment in agriculture, mining and manufacturing for exports. The same method was used to split the flows to Continental countries into zones.

Largely because of the lack of data, we decided to model route choice for freight as a single unitised commodity. For some aspects of the studies, this is a drawback, because there is a wide variability in average load by commodity; also, freight charges are generally levied per vehicle, rather than per tonne. However, the lack of information on the UK regional distribution of origins and destinations of different commodities precluded our going into such detail. In any case, the variation in loadability was expected to apply more or less equally to all modes, so that the distortion introduced by aggregating all unitised commodities should not be too large.

1.6.4 The Costs of Various Modes of Freight Transport

The following sections describe the results of surveys and analysis of haulage costs we carried out. Problems in ascertaining average tariff rates were:-

(a) the lack of published data;

(b) the complexity of the market;

(c) different methods of expressing rates, by various agencies;
(d) variations in discount schemes;
(e) variations with size of consignment, consignor, product types, and season;
(f) variations between import and export rates; and
(g) carriers' concern over confidentiality.

Following sections give the estimates we adopted after discussions with freight forwarders and operators. The rates analysed were principally those for export. Factors such as differential backloading between countries were known to cause differences between import and export rates. We were unable to obtain precise import rates to the UK; however, we felt able to assume that the general pattern of rates was similar. The tariffs deduced were therefore used for both imports and exports. All rates were expressed as charges per tonne.

1.6.5 Ro-ro Haulage Charges

We carried out a survey of road hauliers in the UK, asking the costs of haulage for a variety of routes. Analysis of the response suggested that costs were approximately linear with road distance. NPC statistics suggest an average load of 12.4 tonnes for all ro-ro traffic. Using this figure, the following formulae were derived from the road hauliers' response:-

Cost per tonne of road haulage
(in 1979, but expressed in 1977 prices)

Great Britain:	£2.23 + £0.032 per mile
Continent:	£4.01 + £0.037 per mile

1.6.6 Lo-lo Container Haulage Charges

For this mode, the haulage charges had to reflect the fact that these containers could be hauled to port by road or rail. For road haulage, information from hauliers was consistent with our formulae for ro-ro given in the preceding section. Allowances were made, after discussions with freight forwarders, for average discounts, cost of hire, and cost of terminal cartage for the container. NPC statistics gave an average weight of 12.7 tonnes per lifted-on container. For rail haulage, an analysis was made of Freightliner costs, which proved to be approximately linear with total road distance (UK plus Continental). The weighted average of road and rail haulage to port was calculated, giving a cost per tonne of:-

£3.40 + £0.0338 per mile

1.6.7 Road Vehicle Ro-ro and Lo-lo Container Sea Crossing Tariffs

A survey was made of sea-crossing tariffs for these modes. These were converted to 1977 prices, an allowance made for average discount (10%), and expressed as a charge per tonne. Information was also obtained on ferry operators' receipts per ro-ro vehicle in 1977. These were found to be generally similar to the charges calculated above, and as they appeared to be from a more reliable source we decided to use them. Details of the charges obtained are given in Appendix D.

1.6.8 Rail Haulage and Sea-Crossing Tariffs

Rail haulage charges were found to be complex and needed extensive scrutiny. Rates charged were usually found to be country-specific, and varied greatly. The main sources of information were the B.R. Shipping and International Services Division (SISD) and rail freight tariff books, which were analysed to develop rail haulage charges (see Appendix D). Tariff books were available for France, Germany, Holland, Austria, Belgium and Switzerland. Tariffs to other countries have to be worked out by SISD on an individual basis.

A total international rail tariff may be viewed as being made up of the following elements:-

(a) British section charges;
(b) sea ferry charges;
(c) intermediate country section charges (if any); and
(d) final Continental country section charges.

A single flat formula (fixed charge, plus total land distance times variable charge rate) was used for "Near Sea" countries such as Belgium, Holland and France. More distant countries tend to have more complex tariffs. They may have two parts like the Austrian tariff (the British and sea-crossing section and the Continental section) or three parts like the German tariff (British and sea, intermediate country, and German sections). For the more distant countries, charges across intervening countries are individually negotiated.

The charges are usually set by wagon type (i.e. 2-axle, more than 2-axle, etc.). Anaysis of B.R. statistics showed 13 tonnes to be the average wagon weight for U.K. international traffic (allowing for emply running). Approximately 80% of traffic is 2-axle, and therefore was taken as the average for calculation. The charge rates were generally inclusive of sea-crossing and border charges, but they did not include terminal and delivery costs. Discounts granted vary greatly with commodity, load size, type of haul, destination country, and the general state of the market.

The tariffs reviewed were effective from April 1979, and are revised yearly. According to B.R., tariffs had been increased by approximately 12.5% in 1977, and 22.0% in 1978. The tariff rates to various points within a country were analysed, and a deduction made for:-

(a) the sea-crossing charge; and
(b) an average discount.

This left the charge for rail haulage in the U.K. and on the Continent. Using regression, the following formula form was fitted to all data:-

Total charge = Fixed charge + (Variable Charge per mile x Total U.K. and Continental road mileage).

This yielded the results shown in Table 1.6.1, expressed in 1977 prices.

Table 1.6.1 Rail Haulage Charges

Continental Country	Fixed Charge (£ per tonne)	Variable Charge per mile (£ per tonne)
France	5.54	0.0236
Belgium	7.44	0.0151
Holland	11.74	0.0151
Switzerland	25.27	0.0273
Germany	17.26	0.0160
Austria	21.29	0.0094

As can be seen in Table 1.6.1, charge rates by country vary greatly. for the other countries for which no fixed tariff rate exists, the following assumptions were made: for Portugal, Spain and Italy, the French tariff was used; for Denmark and for Eastern Europe, the German tariff. Our studies suggested that using the tariff rates of these countries was the most appropriate method of representing the non-published tariff rates.

1.6.9 Summary of Haulage Costs

The comparison of the haulage costs of the alternative modes is given below in Table 1.6.2.

Table 1.6.2 Comparison of Haulage Costs

Mode	1977 Prices Costs per Tonne	
	Fixed (£)	Variable Cost per Mile (£)
Ro-ro - U.K. haulage	2.23	0.032
- Continental haulage	4.01	0.037
Container: U.K. - Continent	3.4	0.034
Rail Wagons:		
U.K. - France	5.54	0.0236
U.K. - Switzerland	25.57	0.0273
U.K. - Germany	17.26	0.0160

In general the ro-ro mode has a lower fixed charge, but a higher cost per mile. The most noticeable feature is the wide variation of the rail haulage costs between countries. As noted, these figures are all based on flows from the U.K. to the Continent. Reference was made to other studies and agreement for the general form of the above tariff formulae was found, although it was not possible to find directly comparable work to validate our average rates.

1.6.10 Transit Times for Various Modes

We felt that time of transit was likely to be an important determinant of route choice. For modes other than road-hauled ro-ro, we found there was often a significant difference between timetabled and actual times. A small but significant proportion of these traffics suffered long delays in transit. These arose from delays in marshalling and from goods being lost in transit "for days or weeks". The delays experienced by some traffics greatly affected the mean transit times we used.

Information was collected from freight forwarders on road ro-ro transit times from London to various Continental destinations. This included the sea-crossing and port times. Deducting these, and regressing time taken against total land mileage (U.K. plus Continental) gave a result of:-

16.0 hours + 0.058 hours per mile

The fixed element includes all fixed times, other than the sea crossing and port times. The data are summarised in Appendix E.

As with ro-ro, information was collected from freight forwarders on container transit times from U.K. origins to U.K. ports, and from Continental ports to Continental destinations. As for the costs, a weighted average of road haulage and rail haulage times was taken. These were again found to be approximately linear with distance; the best formula obtained was:-

24.00 hours + 0.104 hours per mile

The fixed time includes collection and delivery times.

The transit times for the Iberian Peninsula were not consistent with our general linear formula. Verification from the previous Channel Tunnel studies, and from other sources, confirmed that transit speeds to Iberia were at present slower than average. An additional fixed time for Iberia of 96 hours was therefore assumed, to allow for this.

Information was provided by B.R. on timetabled wagon transit times to 51 Continental destinations from the U.K. (see Appendix E). Port times and sea-crossing times were deducted from these to give haulage times. A linear relationship with distance was found, and while small variations in the coefficients between different countries were found, we decided, in view of the small number of observations, to derive a general formula. This was:-

29.4 hours + 0.09 hours per mile

Confidential information obtained from other sources and from the British Rail Operational Research Division, however, indicated that actual rail wagon transit times were, in practice, much longer. The U.K. - Continental transit formula finally adopted for use was:-

48.0 hours + 0.288 hours per mile

Transit times for the different modes are summarised in Table 1.6.3.

Table 1.6.3 Comparison of Transit Times

Mode	Transit Times	
	Fixed (hours)	Variable (hours per mile)
Ro-ro	16.0	0.058
Container	24.0	0.104
Rail Wagon	48.0	0.288

1.6.11 Port and Sea-Crossing Times

The total transit time will include the sea-crossing time, and port-time. Average crossing times were obtained for each sea-route from the ferry operators, and the frequency of service from each port. In considering the frequency of service from a port it was necessary to take account of services offered by Deep Sea ships, offering Short Sea capacity. Unfortunately we were not able to gain fully comprehensive information on these services, due partly to the marginal and occasional nature of some of them. However, note was taken of the more regular services offered on Deep Sea vessels, and these are included in Appendix E.

Examination of freight route choice showed that crossing frequency appeared to be a relevant factor. We took this into account by adding an average waiting time of half the average inter-ship time.

Port times we adopted included allowance for:-

(a) movement in port area;
(b) all waiting periods;
(c) customs clearance;
(d) loading onto vessel.

Information from freight forwarders showed that port times for lo-lo container and rail wagons were significantly longer than for ro-ro, primarily due to delays associated with Customs and loading. A large proportion of this traffic passed through on timetabled times. However, a small, but significant proportion of the traffic experienced through-port transit times that were much greater than the mode (i.e. most common) time. This greatly affected the average times taken at U.K. and Continental ports, as shown in Table 1.6.4.

Table 1.6.4 Average Time per Port

Mode	Total port hours
Ro-ro	1.5 hrs.
Container	66.0 hrs.
Rail Wagon	56.0 hrs.

These times were doubled to give the total port times incurred on a sea crossing. It is thought that times at Continental ports were slightly quicker; but we were not able to gain precise information on this.

1.6.12 The Model of Route Choice for Freight

The route choice model for freight movements is based on the same principles as those for passengers, described above in Section 1.2.2. The freight consignor is assumed to choose the mode and route which minimises some function of the characteristics of the journey. We again acknowledge that the measured journey characteristics and average parameters cannot take account of the diversity of criteria consignors actually use; we therefore assume that the impedances or disutilities of a journey for freight consignors with the same measured characteristics form a distribution about a mean value. Thus freight movements with given measured characteristics are assigned probabilities of using several modes or routes.

The impedance function used was a generalised cost function, and was made up of two elements:-

(a) the actual cost; and
(b) the total journey time taken.

The parameter governing the relative importance of these terms, the value of time, is determined by examining which value gives the best fit to 1977 observations.

The actual cost is made up of a number of elements:-

(a) the U.K. haulage cost (including terminal costs);
(b) the sea-crossing cost (including port costs); and
(c) the Continental haulage costs (including terminal costs).

These were derived from the formulae described above.

The total journey time is made up of the following elements:-

(a) the U.K. haulage time, including terminal collection and delivery;

(b) the port-associated times at the U.K. ports including Customs and waiting;

(c) waiting time at port (taken to be a function of frequency);

(d) the sea-crossing times;

(e) the port associated times at the Continental port, including Customs and waiting; and

(f) the Continental haulage time, including terminal collection/delivery.

Times were calculated for the different modes from the formulae given above.

As for the passenger models, the distribution of impedances was assumed to be normal, with a standard deviation proportional to the mean. The constant of proportionality was assumed to be constant throughout. This constant, and the value of time, were the parameters of the model. The values that gave the best explanation of the 1977 patterns of freight movement were 3.4 pence per hour per tonne (1979 prices), for the value of time, and 0.04 for the coefficient of variation of the impedance distribution.

The fit of this model against observations is shown in Table 1.6.5. It can be seen that the overall totals by mode agree fairly well with the actuals. For most routes a fairly good match between actual and predicted was also obtained.

1.6.13 The Application of the Freight Route Choice Models

Forecasts of total trade by commodity between the U.K. and the study zone were supplied by SETEC. These forecasts also included figures for the growth of Irish trade with Continental Europe, and figures for entrepot trade between the U.K. and regions outside Europe which used Continental entrepot ports.

We had therefore to derive from these forecasts the flows of unitised freight between our U.K. zones and Continental zones, in both directions. SETEC's original data base was the OECD published trade statistics which, while similar to HM Customs and excise figures for most commodities, included flows of off-shore aggregates and other minerals which did not pass throught the port of the country of origin. These were excluded from our consideration as not suitable for diversion to a fixed link. The remaining trade was compared to our unitised trade matrix, and rates of unitisation for each commodity determined.

To obtain future unitised trade flows, we had to forecast how the fractions unitised would change. Studies of trends in unitisation (details given in Appendix F) showed that unitised fractions for Near Sea traffic in foodstuffs and in manufactured goods were already very high, the increase in unitisation having ceased in the 1970s. On the other hand, basic materials were still largely unitised, except for a few commodities which, unlike most in this class, had a high value per unit weight.

A special study was made of those commodities for which it has been suggested that the presence of a a new link would induce their change to a unitised mode. This study is summarised in Appendix F. We find that the potential for such induced unitisation is low, because of:-

(a) high investment in existing facilities; and

(b) a low value per unit weight for such commodities, which means that they would only be attracted by a much cheaper form of transport.

Such commodities are typically semi-bulk or bulk, originating from and destined for port-side installations. Contrary to initial expectation they were found to have little or no potential for diversion.

Table 1.6.5 Fit of Freight Route Choice Model

1977 (thousands of tonnes)

No.	Crossing Description	Imports Estimated Actual	Imports Model	Exports Estimated Actual	Exports Model
1	Hull-Hamburg	114	259	103	199
2	Hull-Rotterdam	747	638	726	473
3	Haven-Hook	1488	1191	899	775
4	Haven-Zeebrugge, Dunkirk	825	831	730	618
5	Harwich-Hamburg	343	416	169	267
6	Belgian Straits	1090	1388	835	905
7	French Straits	1458	1648	1119	1004
8	Newhaven-Dieppe	382	632	205	358
9	Soton-Le Havre, Cherbourg	848	1070	558	705
	Total Ro-Ro	7613	8072	5485	5304
10	Hull-Hamburg	99	106	102	62
11	Hull-Rotterdam	268	298	190	292
12	Haven-Zeebrugge, Dunkirk	898	797	954	791
13	Haven-Rotterdam	775	420	593	444
14	Harwich-Hamburg	280	386	187	227
15	Tilbury-Rotterdam	455	466	407	464
16	Soton-Cherbourg	88	44	66	320
	Total Container	2863	2517	2499	2600
17	Dover-Dunkirk	400	356	118	235
18	Harwich-Zeebrugge	191	152	139	113
19	Harwich-Dunkirk	30	0	14	0
	Total Rail Wagon	621	508	271	348
	Total	11097	11097	8254	8254

Having determined the forecast unitised flows, we split them by UK zone and by zone within Continental country in the same proportions as in the base year. The resulting flows are the inputs to the route choice model.

The route choice model also requires forecasts of any changes in times and costs of the existing modes, and the characteristics of the link. The changes in costs of existing modes are given by the agreed price scenarios, set out below in Section 2.2.3. The charges made by the link are determined in relation to the charges on the French Straits shipping routes; however, we allow for competitive changes in charges both there and on other crossings. Any changes in frequency occuring in response to the presence of the link must be incorporated. For links which carry ro-ro vehicles, that is, the double-track tunnel and the road bridge, an allowance must also be made for the saving of driver time which results from the use of a faster crossing.

The model is then used to predict, for each zone-zone pair, the tonnages by each crossing, with and without the various links, and other useful information like the generalised cost per tonne, and the land mileage, by mode.

2

THE BASE FORECASTS

2.1 Preface

2.1.1 Division of Responsibility

The division of responsibility for production of forecasts was the same as that for the modelling of travel demand, as described in section 1.1.2.

2.1.2 The Use of the Models in Forecasting

The models already described have been used to generate forecasts in the following way. Values of the exogenous, that is, externally determined, variables will be obtained, where available, from the prescribed scenarios. Where these are not available, plausible assumptions about the evolution of these variables will have to be made. Total trip demand for the prescribed category can then be calculated. This demand is then assigned to geographical regions, using the given scenarios of population change, and our exogenous forecasts of the economic variables for the regions. In the second stage in some cases, demand arising in each region is divided into the three categories, car, independent non-car and package non-car, according to the forecast economic characteristics of the region. In the third stage, the trips in each category are assigned to destination countries according to the proportions prevalent in 1977, and to zones within continental countries according to the proportions found in the 1971 surveys.

For the forecasting of route choice, assumptions must be made about how journey characteristics change in the future, both with and without the link, and also how the parameters will change. We have assumed that value of time type parameters will change as personal income changes. Assumptions about surface and air transport costs are part of our prescribed scenarios. As for the parameters found in the impedance function for car travellers, the "disutility of distance" parameters are assumed to arise from two sources: an actual perceived cost of distance element, which again will change according to our scenarios, and a "disutility of time" element, which is assumed to be proportional to personal income.

Changes in journey characteristics which will occur in the absence of the link have been incorporated by modifications to the network. Chief among them is the introduction of much faster train services between Paris and the South of France, Switzerland and Italy. The effect of these planned improvements has been incorporated into the forecasts both with and without the link, so benefits arising from them have not been attributed to the link.

Other technological developments are possible. Among those which might be considered are a major extension of jetfoil services. Another important change would be a reduction in air fares similar to those recently experienced on the North Atlantic. At the end of the report we recommend that sensitivity tests should be undertaken to examine these possibilities.

When considering the addition of the link, there must of course also be added any associated improvements in surface transport on either side of the Channel. An important issue here is whether these improvements, for example, fast rail links to Paris and Brussels, are accessible to travellers not using the link.

The final issue to be considered here is the possibility of traffic generation by the link. While our models include an influence of travel cost on total demand, the model structure is such that incorporation of the effect of the link at this stage would influence all demand equally, including that which is not divertible to the link (e.g. car demand in the single-track tunnel case). We feel that the effect of the link in generating traffic will be strongly dependent on the journey characteristics, and have estimated generated traffic separately for each origin-destination pair, and for each type of traffic. For each origin-destination flow, traffic is assumed to be generated by the reduction in impedance resulting from the presence of the link, and any concomitant fare reductions. The elasticity assumed is that found for the 1977 car travellers, namely -3.08; in the absence of any direct evidence for non-car travellers, we have assumed that this elasticity applies to them also.

2.1.3 Developments in Passenger Traffic 1972-1977

An indication of the changes that have taken place in the passenger traffic between the UK and Continental Europe in the recent past can be obtained from the statistics published from the International Passenger Survey. Table 2.1.1 shows the traffic between Britain and the countries of Western Europe most likely to be affected by a fixed Channel crossing (the countries of the EEC, excluding the Irish Republic, plus Austria, Spain and Switzerland).

A number of significant points emerge from these tables. Firstly, total traffic volumes have grown but erratically. The level of traffic fell between 1973 and 1974, but growth rates exceeded 10% between 1974 and 1975. The fall in traffic in 1974 can be explained by the 1973 oil price rise, and its repercussions on travel costs and economic growth rates. At the end of the period, traffic growth rates are lower than those experienced at the beginning of the period, but there is evidence of a new momentum in cross-Channel traffic in the last three years, with growth rates rising.

Table 2.1.1

Visits Between the UK and Western Europe 1971 to 1977 (Thousands)

Year	UK Residents Visiting Western Europe			Residents of Western Europe Visiting UK			Total Traffic Between UK and Western Europe		
	Air Travellers	Sea Travellers	Total	Air Travellers	Sea Travellers	Total	Air Travellers	Sea Travellers	Total
1971	3748	2365	6112	1408	1353	2761	5156	3718	8873
1972	4698	2472	7170	1509	1329	2838	6207	3801	10008
1973	5048	2516	7564	1648	1638	3286	6696	4154	10850
1974	4078	2750	6828	1806	1823	3629	5884	4573	10457
1975	4275	3389	7663	1826	2304	4129	6101	5693	11792
1976	4058	3071	7130	2066	2784	4851	6124	5855	11981
1977	3995	2971	6962	2320	3242	5561	6315	6213	12523
Traffic Growth Rates (% per year)									
1971 - 1972	25.3	4.5	17.3	7.2	-1.8	2.8	20.4	2.2	12.8
1972 - 1973	7.4	1.8	5.5	9.2	23.3	15.8	7.9	9.3	8.4
1973 - 1974	-19.2	9.3	-9.7	9.6	11.3	10.4	-12.1	10.1	-3.6
1974 - 1975	4.8	23.2	12.2	1.1	26.4	13.8	3.7	24.5	12.8
1975 - 1976	-5.1	-9.4	-7.0	13.1	20.8	17.5	0.4	2.8	1.6
1976 - 1977	-1.5	-3.3	-2.4	12.3	16.5	14.6	3.1	6.1	4.5
Annual Average 1971 to 1977	1.1	3.9	2.2	8.7	15.7	12.4	3.4	8.9	5.9

Secondly, sea traffic levels have grown at a faster rate than air traffic levels every year since 1972. As a result, the percentage of passengers crossing the Channel by sea has risen from 42% in 1971, and a low point of 38% in 1972 to 50% in 1977. In large measure, these trends are a reflection of rising energy prices which pushed up air fares particularly sharply in 1974. In 1977, the number of cross-Channel visits made by air was still below the 1973 level.

Thirdly, the more dynamic sector over the seven years has been traffic from the Continent to Britain, which grew 10% per annum faster than traffic in the opposite direction. In 1971, residents of the U.K. accounted for 69% of cross-Channel passenger movements. This rose to 72% in 1972, but fell steadily to 56% in 1977. Britain's slow economic growth rate, and the rising levels of real costs which Britain visitors encountered when travelling abroad, are undoubtedly the major factors behind this development.

2.2 The Economic and Demographic Assumptions Mode

We have forecast traffic crossing the Channel for two alternative scenarios of economic development. The economic and demographic assumptions on which they are based have been agreed between the representatives of the Commission and the consultants.

2.2.1 Population Growth

The population growth rates assumed are given in Table 2.2.1. They are the same in both scenarios.

2.2.2 Gross Domestic Product and Consumers' Expenditure

We present forecasts for two scenarios of GDP growth, a 'low' scenario and a 'high' one. The growth rates adopted are given in Table 2.2.2. A divergence between countries is envisaged in both scenarios over the period 1977-1985. Thereafter a convergence of growth rates is assumed for all countries.

Consumers' income and expenditure per head are assumed to change at the same rate as GDP per head in the low growth scenario, but more slowly in the high growth scenario. These assumptions are summarised in Table 2.2.3.

Table 2.2.2 Proposed GDP Growth Rates
(% p.a.)

Country	1977 - 1985		1985 - 2000	
	Low	High	Low	High
Germany	1.6	3.0	2.90	3.5
France	2.0	3.7	2.0	3.5
Netherlands	1.7	3.1	2.0	3.5
Belgium/Luxembourg	1.3	2.4	2.0	3.5
Italy	1.3	2.4	2.0	3.5
Austria	2.0	3.8	2.0	3.5
Spain	2.3	4.3	2.0	3.5
Switzerland	1.4	2.7	2.0	3.5
United Kingdom	1.5	2.8	2.0	3.5
Others	1.7	3.2	2.0	3.5

Table 2.2.1 Population Levels (Thousands) and Growth Rates (% per year)

Assumed Scenarios

Country	1985 Population	Growth Rate 1977 - 1985	2000 Population	Growth Rate 1985 - 2000
Germany	60100	-0.3	57200	-0.3
France	55900	0.6	59000	0.4
Netherlands	14700	0.7	15600	0.4
Belgium/Luxembourg	10400	0.3	10400	0.0
Italy	58800	0.5	61200	0.3
Austria	7700	0.3	8000	0.3
Spain	39100	0.8	45300	1.0
Switzerland	6900	1.1	7600	0.6
United Kingdom	58600	0.6	60000	0.2
Other countries	-	0.4	-	0.3

Table 2.2.3 Consumers' Income and Expenditure Growth Rate (As % p.a. relative to GDP % p.a.)

	1977 - 1985		1985 - 2000	
	Low	High	Low	High
All Countries	0.0	-0.3	00	-0.3

2.2.3 Changes in Relative Prices

Changes in relative price levels can be separated into two effects. Firstly, the general price level in one country may rise or fall, relative to that in another. This effect is likely to have a strong influence on holiday-taking behaviour. Secondly, within a country, the relative prices of some goods will rise, while those of others fall.

It is assumed under both our scenarios that any differences in the rates of inflation between countries will be compensated for by adjustments in the exchange rates. Thus, the relative cost of visiting one country for residents of another will not change in real terms.

Changes in the real relative prices of certain goods will undoubtedly occur during the period covered by the study, and some of these changes will be of importance to our conclusions. The relative prices of the relevant goods will be influenced by the following factors:-

- costs of inputs;
- costs of distribution;
- technical progress;
- costs of labour; and
- taxes and subsidies

In addition, forecasts of "real" prices have to satisfy the constraint that some price index is constant. In principle, therefore, the price of a single class of goods cannot be defined as an element in a scenario without reference to the prices of other goods, unless the demand for this good is very small compared to the total economy. We can, however, overcome this difficulty, by considering changes relative to the average in the economy. Of the influences on changes in relative prices, we consider the effect of differential technical progress, and that of the cost of fuel inputs, to be of greatest importance.

The effect of technical progress will be that, all other things being equal, the price of goods produced by sectors where technical progress is faster than average will tend to fall, whereas that of goods produced by sectors where technical progress is lower than average (usually labour-intensive sectors) will tend to rise. Investigations of past trends suggest that the prices of most manufactured goods are likely to fall with continued technical progress, while those of services, government, and housing are likely to rise.

Superimposed on these changes arising from technical progress will be those arising from fuel price changes. It was felt that the effect of fuel prices was so prominent that their likely increase was discussed with officials of the Commission, and it was agreed to associate a fuel price scenario with each GDP growth scenario. Under the 'low growth' scenario, it is assumed that the relative cost of fuel will rise by 3% p.a. to 1985, and by 1.5% p.a. thereafter. The assumption in the 'high growth' scenario is that the relative cost of energy will remain unchanged up to 2000; in view of the considerable rise in the cost of energy experienced from 1977 to date, we have applied these rates of increase to the levels prevailing in July 1979, and have used the observed increase from 1977 up to that date. The assumptions underlying these scenarios were that the continued availability of relatively cheap fuel, at no higher cost than that at mid-1979, might be a prerequisite of a higher growth rate. We would argue that, given recent experience, there is a case for testing the sensitivity of the results to an even higher rate of price increase - say 3% to the end of the period.

It is important to notice that the effect of this cannot simply be inferred by considering the proportion of a sector's costs which arise from fuel, and imposing a corresponding increase. The effect of "renormalising" prices, so that some price index is constant, cannot be ignored. Thus, given a fuel-price increase, the prices of those goods for which the energy intensity is higher than that in the economy as a whole, will be higher than they would otherwise have been, and those of goods with a lower-than-average energy intensity will be lower than they would have been.

A detailed analysis of all these factors is clearly outside the scope of the present study. In addition, certain trends, notably the cost of rail transport, appear to be in different directions in different countries. Given the difficulties, scenarios of the important price changes are set out in Table 2.2.4. They are mostly based on fuel intensity, although in the car manufacture and scheduled air transport sectors, faster-than-average technical progress has been allowed for. The scenarios have been agreed between the consultants, except that we feel doubtful in accepting the SNCF prediction that rail costs will fall in real terms over the study periods.

2.2.4 Other Exogenous Variables

Variables other than those specified in the agreed scenarios which are required as input to the travel demand models are:-

- household size;
- friends and relatives abroad;
- age of completion of education;
- average social grade;
- travel cost, by mode: car, rail, bus, ship and air;
- car ownership.

We have attempted to use, as far as possible, accepted models or projections of these variables, and to establish consistency between the evolution of these variables and those specified in the agreed scenario.

2.2.5 Household Size

The projections of the number of households in the U.K. have been published by the Department of the Environment (Housing Policy: Technical Volume, Part I: HMSO 1977). These are given with the corresponding demographic projections, in Table 2.2.5.

Table 2.2.4 Price Scenarios
(Jan. 79 price = 100)

	High		Low	
	1985	2000	1985	2000
Sea transport - passengers	106	106	109	113
- freight	106	106	109	113
Port charges	100	100	100	100
Air transport - scheduled	104.5	96.9	111.0	111.0
- package	108.0	108.0	117.4	126.5
Rail passengers	100	100	100	100
Rail freight - UK	100	100	100	100
- continent	94.1	84.1	95.6	88.7
Road passengers UK	133	133	155	198
Road freight haulage	105	105	108	112
Cars	96	90	96	90

Table 2.2.5 DOE Household and Population Projections

Year	Households	Population	Average Number in Household	One-Person Households	Average Number in Multi-person Households
1971	16,779	55.6	3.31	3,330	3.89
1976	17,574	55.9	3.18	3,932	3.81
1981	18,254	56.3	3.08	4,497	3.77
1986	18,929	57.2	3.02	4,953	3.73

There is a substantial decline projected in household size, most of which arises from an increase in the proportion of single-person households.

We have used these projections of average household sizes although our demographic projections are different from those used; after 1985 we assume the average household size remains constant.

Our projections of household size, population growth, and income growth enable us to infer scenarios of income per household and per person. These are shown in Table 2.2.6.

Table 2.2.6 Income Per Household and Per Person in the U.K.

Scenario	Growth of Income per Person (% per year) 1977-85	1985-2000	Growth of Income per Household (% per year) 1977-85	1985-2000
High Growth	1.9	3.0	1.2	3.0
Low Growth	0.9	1.8	0.2	1.8

2.2.6 Car Ownership

To forecast car ownership levels in the UK, we used a model developed by Bates et al[1] for the UK Department of Transport. This was a model of household car ownership and was estimated using time series and cross-sectional data between 1969 and 1975. The explanatory variables were household income and car purchase costs. Reservations about the use of this model include:-

(a) no dependence on running costs is included; and
(b) the response to car purchase price is instantaneous, which is behaviourally implausible.

Dealing with the first point, no influence of running costs was detectable during the estimation period, 1969-75, during which substantial changes in running costs did occur, but it has been suggested that inclusion of such a variable might give a better explanation of the rise in car ownership in 1976 and 1977, when real purchase prices were rising and real income was falling, but running costs were also falling. As for the second point, during the estimation period, the purchase price of cars fell steadily, so it was understandable that no lagged effect was detectable. We feel that these effects are an adequate explanation of the fact that the 1977 car ownership figures are higher than forecast using the Bates model. Given that the effect of car purchase and income will be primarily on car purchase, we would expect the fall in car ownership predicted by the Bates model in 1975-77 actually to happen somewhat later.

1. Bates, J, Gunn, R. and Roberts, M., 1977: A disaggregate model of household car ownership: Departments of the Environment and Transport, Research Report 20.

The forecast car ownership levels per person, based on the Bates model and on the scenarios of household income and car purchase price given above, are shown in Table 2.2.7.

Table 2.2.7 Forecasts of UK Car Ownership (cars per person)

Scenario	1985	2000
High	0.262	0.367
Low	0.236	0.298

2.2.7 Travel Impedance in the UK

This variable has two components, as described in section 1.2.2; the actual time taken, and the equivalent time of the costs incurred. For forecasting purposes we assume that there has been no change in average speeds, nor in the average distance travelled in the UK. The change in the cost per unit distance will be a weighted average of the changes, given in section 2.2.3 above, in the costs of car transport, other surface transport, and air transport. We have also incorporated a change in impedance for those changes in sea transport costs assumed to occur in our scenarios.

2.2.8 Friends and Relatives Abroad

The period 1971-77 showed a very rapid rise in the number of UK residents' visits to friends and relatives abroad, especially to those outside Europe. This suggests that the importance of this variable has increased. We have assumed that the proportion of households with friends or relatives abroad increases to 1.5 times its 1971 value by 1990 (as in the previous study) and continues to increase at the same rate. We assume that this increase applies equally to friends and relatives inside and outside Europe.

2.2.9 Miscellaneous

We believe that the explanatory power found in the cross-sectional analysis for the variables "social grade" and "age of completion of education" is rather an indication of their role in representing "position" in society, and we do not believe that any changes in the values of these variables which will occur (eg, as more and more of the population has been educated up to 16 rather than 15) should be assumed to cause changes in travel behaviour. Accordingly, we have held the values of these explanatory variables constant throughout the forecast period.

2.3. The Base Forecast of UK Leisure Trips Abroad

2.3.1 The Base Forecast of Total Demand

The logistic model described in Section 1.2.2 was fitted to the average propensity to travel abroad observed in 23 groups of surveyed individuals, the individuals being grouped by the linear combination of socio-economic characteristics which best explained the variance in trip-making propensity. For forecasting purpose, it was assumed that the distribution of values of the explanatory variables was such that the mean values for each of these groups would change by the same proportion as the mean for the population as a whole. Since the logistic equation was estimated on the mean properties of these groups, it was necessary to forecast propensities for similar groups, rather than for surveyed individuals or for the population as a whole. The results from this process are shown in Table 2.3.1. These figures have been adjusted for the small (1.5%) difference between the forecast for 1977 and the value observed in 1977; this difference is attributed to price changes and other effects.

Table 2.3.1 Forecasts of UK Leisure Trips Abroad (thousands of return trips)

	1977	High		Low	
		1985	2000	1985	2000
Forecast trips	7745	9344	14730	8444	11528
Implicit Annual Growth rate		2.4%	3.1%	1.1%	2.1%

It is important to have some idea how sensitive these values are to the assumption made about saturation levels. The "best" value of the saturation parameter in a least squares sense, is 0.853; this value was used to obtain the figures above. However, we tested different models, re-estimating the other parameters, for a saturation level fixed at 1.25 (close to that used in the previous study), and for a saturation level tending to infinity. Results for the high growth scenario are shown in Table 2.3.2. As can be seen, the model with saturation level 1.25 is nearly as good a fit as the best model, and makes relatively little difference to the forecast. The model with no saturation gives a very much worse fit, (worse even than a straight line) and a substantially higher forecast.

Table 2.3.2 Sensitivity of Forecasts to Saturation Assumptions

Assumption	High Growth Scenario			Unexplained Variance (1971)
	1985 Trips	2000 Trips	1985-2000 Annual Growth Rate	
Saturation at 0.853	9344	14730	3.1%	0.7%
Saturation at 1.25	9517	15386	3.2%	0.9%
No saturation	9606	17590	4.1%	2.1%

2.3.2 Geographical Distribution of UK Demand

We assume that the income growth described in the scenarios applied equally to all the geographical divisions of the UK.

The car ownership model used is estimated on national data and the authors explicitly state that it should not be used to forecast changing car ownership patterns for regions within the UK. They do suggest that a similar functional form, with different parameters, would be useful for this, but explicit models are not available. Given the absence of a suitable model, we are forced to assume that the UK growth rates of car ownership apply equally to all geographical divisions.

The interpretation of the geographical variable in the model of distribution over origins of UK demand is open to question, when used for forecasting purposes. It may be interpreted as purely a geographical effect, in which case there is no reason to forecast any change with time. On the other hand, "distance from Dover" may be a measurable proxy for "travel impedance to foreign destinations", in which case its effect on propensity to travel abroad might be expected to change. The question then arises of how to treat the observed flattening out of the distance effect beyond 160 miles. Given these difficulties, we have chosen to assume that the effect is purely geographical, and hence have forecast no change in its effect. We have no time series of propensities to travel abroad by UK regions, so these hypotheses are not testable.

Given the assumption of uniform growth in car ownership and income, it would appear that our forecasts of propensity to travel abroad will change uniformly over the whole UK. The only contribution of differential holiday demand will be changes in the distribution of population about the UK. The Office of Population Censuses and Surveys (OPCS) publishes population projections for planning regions, in which the population growth between 1975 and 1991 was assumed to be confined to the South of England, the Midlands, East Anglia and Wales, with no growth in Scotland, Northern England, or Northern Ireland. Greater London is projected to decline in population. Our scenario of total population is different from the OPCS projection, but we use the split of their projected population to infer growth rates consistent with our scenario. These are shown in Table 2.3.3.

Table 2.3.3 Forecast Population Growth by Region

Region	Share of UK Population 1977	1985	1991	Inferred Population (Millions) 1985	2000	Inferred Annual Growth Rate 1977-1985	1985 2000
Scotland	9.3%	9.2%	9.1%	5.4	5.4	0.5%	0.0%
North	5.6%	5.5%	5.4%	3.2	3.2	0.4%	0.0%
North West	11.6%	11.5%	11.4%	6.8	6.8	0.6%	0.0%
Yorks & Humberside	8.8%	8.7%	8.6%	5.1	5.2	0.5%	0.1%
East Midlands	6.6%	6.9%	7.0%	4.0	4.2	1.0%	0.3%
West Midlands	9.3%	9.3%	9.3%	5.4	5.6	0.5%	0.2%
East Anglia	3.2%	3.6%	3.7%	2.2	2.2	2.5%	0.0%
Greater London	12.5%	11.0%	10.5%	6.4	6.3	1.1%	-0.1%
Rest of South East	17.7%	18.6%	19.1%	10.9	11.5	1.2%	0.4%
South West	7.7%	8.0%	8.2%	4.7	4.9	1.1%	0.3%
Wales	5.0%	5.0%	5.1%	2.9	3.1	0.4%	0.4%
Northern Ireland	2.7%	2.7%	2.6%	1.6	1.6	0.8%	0.0%
TOTAL UK	100.0%	100.0%	100.0%	58.6	60.0	0.6%	0.2%

The proportions derived from the OPCS projections for 1986 are assumed to apply for 1985, and those for 1991 are assumed to apply for future years. The numbers of leisure trips generated in each of these regions in the forecast years can then be calculated; these are then assigned to our zones on the assumption that the population of all zones within a planning region grow at the same rate.

2.3.3 Forecasts of UK Leisure Trip Demand by Type

The model of holiday type given in section 1.2 was used to preduct the fraction of leisure trips from every UK zone in each of our three holiday categories. These fractions were then applied to the predicted UK demand for leisure trips abroad by zone. The changes in the proportion of leisure trips abroad going by car follow closely the car ownership scenario described above. In both scenarios this fraction is substantially higher by 2000 than at present. The split of non-car trips between independent and package trips remains roughly constant, the variation being due to changes in the geographical distribution of population. The forecast split between the three categories is shown in Table 2.3.4.

Table 2.3.4 Forecasts of the Percentage Split by Type of UK Leisure Trips

		High		Low	
	1977	1885	2000	1985	2000
Car	12.4	12.8	20.6	10.9	15.5
Independent	43.1	40.4	36.7	41.3	39.1
Package	44.5	46.8	42.6	47.8	45.3

Forecasts of U.K. Leisure Trip Demand by Destination

As described in section 1.2, the main influence on the destination choice of U.K. leisure travellers appears to be relative costs of living. As mentioned above, the agreed scenario has relative costs of living unchanged. Our forecasts of destination choice within each category of traveller will therefore be of unchanged proportions.

For car travellers, we have found a significant dependence of destination choice on travel impedance, using 1977 regional data. The effects of this would be fairly small for the car forecasts, as far as total numbers to a given country are concerned. Since the correct interpretation of this finding in the context of our "top-down" model structure is not clear, and we were unable to find a similar relationship for non-car travellers, we have not taken this into account in the without-link forecasts. We have, however, used the elasticity thus determined to estimate generated traffic, as described below.

2.4 The Base Forecast of Continental Leisure Trips to the UK

(Summary of SETEC Rapport de Phase 3, sections 4.2 and 5.1)

The proportions of total leisure travel originating in each country are not expected to have varied greatly between 1977 and 2000 in either the low or high growth case.

In 1977 27% were packaged trips, 46% independent and 26% were car-accompanied. Before allowing for any traffic generated by a fixed link, the proportions are predicted to change to the following by 2000.

	Package	Independent	Car-Accompanied
Low growth	12	43	34
High growth	18	44	38

As may be seen the major change is from package to car-accompanied and this is strongly related to growing incomes.

2.5 Summary of Base Forecasts of Leisure Trips

The forecasts are brought together in Table 2.5.1. In 1977 51% of leisure trips across the channel were British. By 2000 the proportion is expected to have fallen to 40% in the low growth scenario or 33% in the high growth. While the propensity of someone from the UK of a given income group to travel to Continental Europe will remain higher than that of anyone from a similar income group from a Continental country, the growth of Continental incomes relative to those of the UK will mean that by 1985 the number of Continental travellers coming to Britain will exceed UK leisure passengers to the Continent. By the end of the century on the high growth scenario 11.5 million from the UK will be going to the Continent while nearly 20 million from the Continent and 3.5 million from the rest of the world will be coming to Europe. The proportions and absolute numbers would alter of course if UK income growth increased relative to that of other countries. One would expect more travellers to the Continent and fewer from it. While independent travellers may be increasingly attracted to destinations further from their home countries, this will be offset by rising energy costs and the inconvenience of driving far to the increasing proportion of car accompanied passengers. The absolute increase in the number of tourists is considerable: in the UK from just above 6 million in 1977 to 9.5 million in 1985 and 23 million in 2000 on the high growth scenario; but it should be remembered that growing affluence does lead to more tourism and that an increasing proportion of these journeys will not be in the summer peak as second and third holidays become more common. The growth is less dramatic in the low growth case: from 6 million in 1977 to 7.5 million in 1985 and 13 million in 2000.

Table 2.5.1 Summary of Demand Forecasts

	Low growth		High growth	
	1985	2000	1985	2000
UK residents: leisure				
- with a car	921	1795	1200	3054
- without a car	6057	7835	6555	9404
UK residents: business				
- with a car	147	213	715	335
- without a car	1292	1831	1537	2910
Continental residents: leisure				
- with a car or coach	2466	4769	3130	8732
- on foot	3574	6298	4383	11117
Continental residents: business				
- with a car or coach	107	204	136	401
- on foot	1204	2238	1513	4396
Non-European residents	1623	2120	1960	3400

Notes: (a) Units are thousands of return trips;

(b) "UK residents: leisure" includes travel to all Continental European destinations;

(c) "UK residents: business" includes travel to <u>all</u> destinations outside the UK;

(d) "Continental residents" includes travellers resident in the countries of the EEC (excluding the Irish Republic), Switzerland, Austria, Spain, Portugal, Greece and Yugoslavia.

2.6 The Base Forecast of the Demand for Business Trips

2.6.1 Business Trips by UK Residents

The model of UK residents' business trips to continental Europe is formulated as described in section 1.4 with the equation:-

where T_j is the number of return business trips, in thousands, made to country j by U.K. residents;

a_j is a country-specific attraction factor;

F_j is the scheduled air fare from Heathrow to an appropriate commercial centre in country j;

G_j is the value of the annual gross domestic product of country j, expressed in billions of 1975 US$;

X_j is the value of the annual exports from the U.K., to country j, expressed in billions of 1975 US$.

Forecasts of the explanatory variable X_j are given by SETEC, and are summarised in Table 2.6.1. Forecasts of GDP and of air fare changes are given above. The resulting forecasts of business trips are given in Table 2.6.2.

Table 2.6.1 Forecasts of Explanatory Variables for Business Travel Demand Model

Scenario	Country	1985 GDP (1977=100)	1985 Exports From UK (1977=100)	2000 GDP (1977=100)	2000 Exports From UK (1977=100)
High Growth	France	133.7	171.8	224.0	448.2
	Belgium & Lux	120.9	155.8	202.5	487.4
	Netherlands	127.7	158.2	213.9	418.4
	W. Germany	126.7	170.5	212.3	518.9
	Italy	132.7	182.4	222.3	562.6
	Switzerland	123.7	127.7	207.2	277.0
	Austria	134.8	143.3	225.8	285.4
	Spain	140.0	143.3	234.4	265.6
	Rest of World	128.7	139.0	215.6	305.9
Low Growth	France	117.2	139.0	157.7	250.3
	Belgium & Lux	110.9	131.7	149.3	262.3
	Netherlands	114.4	132.7	154.0	239.0
	W. Germany	113.5	139.0	152.8	272.8
	Italy	116.3	142.2	156.5	283.2
	Switzerland	118.8	114.4	150.5	178.3
	Austria	117.2	122.8	157.7	183.1
	Spain	120.0	121.8	161.5	173.9
	Rest of World	144.4	120.9	154.0	191.1

Source: SETEC Economie

Table 2.6.2

Forecasts of U.K. Business Travel Demand (Thousands of Return Trips)

Country	1977	High Growth		Low Growth	
		1985	2000	1985	2000
France	306	439	803	370	523
Belgium & Luxembourg	154	206	417	180	266
Netherlands	179	245	452	211	298
West Germany	280	398	789	337	495
Italy	83	129	269	101	150
Switzerland	60	76	130	66	86
Austria	19	27	45	22	28
Spain	60	85	139	69	87
Sub-total	1,141	1,605	3,044	1,356	1,933
Rest of World	863	1,253	2,348	972	1,289
TOTAL	2,004	2,858	5,392	2,328	3,222

2.6.2 Business Trips by Continental Residents

(Summary of SETEC Rapport, Phase 3, section 5.12)

For business trips originating in Continental Europe, the changes in the proportions originating in each country will be greater than for leisure travel. The French proportion is forecast to be almost constant. The proportions of Germans and Italians are forecast to increase substantially, especially the first, while those from the Netherlands, Switzerland and Spain will fall. These trends will be less marked in the low growth case.

2.6.3 Summary of the Forecasts of Business Trips

The consultants' separate forecasts of business trips are brought together and summarised in Table 2.6.3, which also shows SETEC's forecast of how many in each category travel with a car.

The proportion of British business travellers abroad falls sharply from just under 50% in 1977 to 42% in 2000 on the low growth scenario and 37% on the high growth scenario. This is because our research showed that the volume of business travel from the UK is strongly related to its exports; and on the basis of the economic growth assumption adopted here, UK imports from Europe increase much faster than UK exports to Europe. If UK exports were to increase at a faster rate, so would its business travel.

The proportion of business travel by car is not expected to vary much on either scenario. Business travel by car is about 5 to 6% of passengers but only 5% of vehicles.

Table 2.6.3 Forecasts of the Demand for Business Trips
(thousands of return trips)

Categories of Traffic	1977	1985		2000	
		High growth scenario	Low growth scenario	High growth scenario	Low growth scenario
1. UK					
Without a car	1090	1537	1292	2910	1831
Car-accompanied	123	175	147	335	213
Number of vehicles accompanied	59	83	70	160	101
2. CONTINENTAL					
Without a car	912	1513	1204	4396	2238
Car-accompanied	81	136	107	401	204
Number of vehicles accompanied	39	65	51	191	97
3. OUTSIDE EUROPE					
Without a car	271	354	301	617	392
Car-accompanied	4	5	4	9	5
Number of vehicles accompanied	2	2	2	4	2
TOTAL (1 + 2 + 3)	2481	3720	3055	8668	4883
TOTAL:					
UK	1213	1712	1439	3245	2044
(%)	48.9	46.0	47.1	37.4	41.9
Continental	993	1649	1311	4797	2422
(%)	40.0	44.3	42.9	55.3	50.0
Outside Europe	275	359	305	626	397
(%)	11.1	9.7	10.0	7.2	8.1
TOTAL (Without a car	2273	3404	2797	7923	4461
((%)	91.6	91.5	91.6	91.4	91.4
TOTAL (Car-accompanied	208	316	258	745	422
(%)	8.4	8.5	8.4	8.6	8.6
TOTAL VEHICLES	100	150	123	355	200

2.7 The Base Forecast of the Demand for Travel by Non-Europeans

The model for these travellers is set out in section 1.5; the model expresses the demand for travel to Europe in terms of the population of the overseas region, its GDP per head, and the cost of travel to Europe. Our scenarios give a uniform growth rate of population and GDP for all countries outside Europe. We will assume that these travellers get to Europe by air, and that the price of air travel moves uniformly for all such travellers, as described above. The growth will therefore be the same for all categories of non-European travellers, and we will assume that the number of trips between the U.K. and continental Europe generated by each traveller remains constant. The results of this are shown in Tables 2.7.1.

Table 2.7.1 Forecasts of Non-European Trips between UK and Continental Europe

(thousands of single trips)

	High Growth		Low Growth	
Country	1985	2000	185	2000
France	624	1,083	517	675
Belgium & Luxembourg	203	353	168	220
Netherlands	393	682	326	426
West Germany	407	706	337	440
Italy	760	1,318	629	822
Denmark	203	353	168	220
Switzerland	258	447	213	279
Austria	149	259	124	161
Spain	149	259	124	161
Portugal	27	47	22	29
Greece	326	565	270	352
Yugoslavia	27	47	22	29
Norway, Sweden & Finland	393	682	326	426
	3,919	6,801	3,246	4,250

2.8 The Base Forecast for Freight Traffic

The base forecast of freight traffic is carried out by:-

(a) forecasting total trade between the UK and continental countries; and then

(b) forecasting the "unitised" element of these total trade flows.

2.8.1 Total Trade Flows

SETEC have produced forecasts of trade between the UK and continental countries by commodity, by country, by import/export for both of the scenarios for the years 1985 and 2000. These are expressed in tonnage terms, net of packaging. The base years for these forecasts is 1976.

2.8.2 Unitised Trade Flows

A fixed link will carry only unitised traffic, that is, ro-ro container or rail wagon, as appropriate to the nature of the link. The potential trade divertible to a fixed link is therefore trade flows that are expected to be unitised. In the previous Channel tunnel studies, a detailed analysis was made of the possibility of the existence of a fixed link giving rise to induced unitisation of traffic. The conclusion of this exercise was this would be minimal, and we have assumed it to be nil in this current study.

Unitised trade flows were forecast by the application of forecast unitisation rates to SETEC's forecast commodity flows. The levels of unitisation in the base year were derived. SETEC's base year was 1976. The detailed unitised flows derived for the calibration of the freight route choice model used 1977 as the base year. In order to derive base year unitisation rates the common year of 1976 was adopted.

Estimates of the unitised trade flows for 1976 were calculated by applying the overall change in trade between the UK and the countries considered, as given by HMC & E data, to the unitised flows derived for 1977. These conversion factors are given at Appendix G. This implicitly assumes no change occurred in the overall levels of unitisation between the two years for trade between the UK and each continental country.

We therefore had for 1976, for each country, and for imports and exports:-

(a) an estimate of unitised trade, over all commodities, expressed in NPC tonnage terms, i.e. inclusive of packaging; and

(b) the total trade flows by commodity, expressed in net tonnage terms.

In addition, the HM C & E data for 1977 provided estimates of the penetration of unitisation at the broad commodity classification of:-

(a) foodstuffs;

(b) manufactured good; and

(c) basic materials;

which therefore provided an approximate commodity breakdown of the unitised flows, after allowing for a packaging factor. We also had access to the working papers of a detailed NPC study[1] which analysed unitisation rates at a more detailed commodity level. With this information we were able to derive the unitisation rates that existed in the base year. These unitisation rates, which are presented at Appendix G, represent a 'composite rate' in that the single rate allows for both the "true" level of unitisation and also an allowance for packaging. Thus, if out of a total flow of 100 tonnes, excluding packaging, the unitised trade was 55 tonnes, including packaging, a rate of 55% was derived which would represent, say, a true rate of 50%, plus, say, a 10% allowance for packaging.

It was assumed that the discrepancy in trade in basic commodities that exists between the HM C & E and the OECD figures, as used by SETEC, relates to non-unitised trade. Therefore, our derived unitisation rate, relative to the HM C & E estimate of the penetration of unitisation, reflects the use of a different base tonnage figure.

2.8.3 The Forecast of Unitisation

Having derived the unitisation rates for the base year of 1976, it was necessary to forecast the values for the years 1985 and 2000. This had regard to the NPC Report No. 11 and discussions with NPC personnel. Their opinion was that the considerable increase in penetration over the past decade

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1. NPC Report No. 11 : GB Non-Fuel Traffic: Forecasts for 1980 and 1985 (November 1977)

is now approaching a plateau. It was considered therefore that a conservative reasonable estimate of the future unitisation rates would be:-

(a) an increase of two percentage points for each commodity group by the year 1985;

(b) a further increase of two percentage points for each commodity group by the year 200.

In view of the uncertainty surrounding the detailed commodity unitisation rates for 1976, these assumptions were applied at the three broad commodity classifications.

In addition to the countries for which SETEC provided detailed commodity forecasts, it was necessary to include also:-

(a) forecasts of Irish unitised trade with continental countries that used Great Britain as a land-bridge;

(b) forecasts of unitised trade to countries in the secondary zone; and

(c) forecasts of entrepot traffic, i.e. unitised trade between the UK and other countries in the world that is routed through continental ports.

With respect to Irish traffic, SETEC provided forecast of trade between Ireland and the EEC (other than the UK). It was assumed that the unitised element of such trade via the UK would grow at the same rate as overall trade, while allowing for a small growth in unitisation rates. Unitised trade between the UK and Eastern European countries not included in the SETEC forecast was assumed to grow at the same rate as unitised trade with the SETEC forecast area. Forecasts of unitised entrepot trade were provided explicitly by SETEC.

The overall forecasts of unitised trade are shown below in Tables 2.8.1 and 2.8.2.

It is assumed that the UK regional breakdown for trade with each continental country is the same as in the base year, 1977, and the regional breakdown within each continental country, where appropriate, is also the same as that assumed for the base year. In the absence of better information, Irish traffic via the UK is assumed to have the same continental origin or destination as all UK traffic, excluding entrepot. The UK origin or destination of such traffic is assumed to be Wales and North West of England.

Table 2.8.1: Forecasts of Unitised Trade : Imports

(000 tonnes)

COUNTRY	1977	1985 LOW	1985 HIGH	2000 LOW	2000 HIGH
Belgium/Luxembourg	1,233	1,668	1,828	2,517	3,762
Denmark	737	835	896	1,051	1,268
France	2,140	2,517	2,862	3,409	4,583
Italy	1,060	1,455	1,683	2,487	4,237
Netherlands	1,618	2,634	2,921	3,993	5,294
West Germany	2,160	2,624	3,055	4,243	6,624
Total EEC	8,948	11,733	13,245	17,700	25,768
Austria	252	317	345	393	551
Switzerland	157	176	182	239	329
Spain	494	582	660	741	954
Total Primary	9,851	12,808	14,432	19,073	27,602
Secondary Zone	371	511	585	771	1,126
Entrepot Trade:-					
Belgium	161	182	201	256	365
France	33	38	42	53	76
Netherlands	412	468	518	658	942
	606	688	761	967	1,383
Irish via UK	269	342	398	514	777
Total	11,097	14,349	16,175	21,323	30,889
Index	100.0	129.3	145.8	192.2	278.4

Table 2.8.2: Forecasts of Unitised Trade : Exports

(000 tonnes)

COUNTRY	1977	1985 LOW	1985 HIGH	2000 LOW	2000 HIGH
Belgium/Luxembourg	953	1,197	1,449	2,447	4,063
Denmark	482	600	709	1,029	1,672
France	1,330	1,745	2,162	3,054	5,132
Italy	636	887	1,119	1,323	2,477
Netherlands	1,124	1,834	2,153	3,163	4,853
West Germany	1,315	1,611	1,963	3,156	5,625
Total EEC	5,840	7,874	9,555	14,172	23,822
Austria	234	241	280	339	548
Switzerland	216	200	218	316	478
Spain	222	205	237	269	401
Total Primary Zone	6,812	8,520	10,290	15,096	25,249
Secondary Zone	364	476	573	689	1,151
Entrepot Trade:-					
Belgium	289	331	366	467	665
France	311	356	394	502	716
Netherlands	506	579	641	816	1,164
	1,106	1,266	1,401	1,785	2,545
Irish via UK	219	267	307	381	508
Total	8,201	10,531	12,571	17,951	29,452
Index	100.0	128.4	153.3	218.9	359.1

3

ROUTE CHOICE IN THE ABSENCE OF A LINK

3.1 Cross-Channel Services in the Absence of a Link

The recent rapid developments in the number and variety of cross-Channel services available give an indication of the risk in trying to forecast what services will be available to the leisure passenger in 1985 and 2000, even in the absence of a new fixed link. For our forecasts, we have taken the conservative assumption that any new services offered can be regarded as providing a similar service to some existing ferry. It is worth noting that had this assumption been made in 1973, the advent of the Sheerness-Vlissingen service and the ferries to Brittany ports would have made the assumption invalid. However. the present coverage of South and East coast ports is now so complete that it is difficult to see how a new service could be introduced that offers a substantially different alternative, appreciably improving journey times to any destinations.

The obvious exception to this is the possibility of jetfoil services becoming established. Even if they operate from ports at or near those presently in use, as does the Brighton-Dieppe jetfoil, they offer a service which is substantially faster than the comparable ship. However, more importantly, jetfoil services may soon operate regularly from a port in Central London, which would make a radical difference to the range of services offered.

A related problem is the competition from air services. Again, we have adopted a conservative position, assuming no change in air transit times, and fare changes based solely on technological changes and on fuel prices. However, it is widely believed that the short-haul European air travel market is on the verge of two dramatic changes. Firstly, it is likely that the London to Paris, Brussels and Amsterdam services will in the near future adopt a "shuttle" system, which will considerably diminish presently unavoidable waiting time. This change has had important effects on the competitiveness of air services vis-a-vis rail on such routes as London-Glasgow. Secondly, there has recently been much speculation that the dramatic fare reductions recently observed on transatlantic air routes could occur on European routes, following increased competition from small, independent airlines and the resultant breakdown of the pricing cartel. Suggested fare reductions have been as great as 60%. This development would clearly have a great effect on the potential demand for a link, at least from passengers without cars. However, it is questionable to what extent air traffic on these routes would then be constrained by airport capacity. It has not been within our terms of reference to consider what pattern or amount of airport development might be optimal in this respect.

We have assumed that car ferry services will exist offering:-

(a) direct services from Harwich and Newcastle to Norway and Denmark;

(b) direct services from Harwich or Felixstowe to Sweden and North Germany;

(c) a direct service to Spain - we have assumed it operates out of Plymouth, as in 1979, rather than Southampton as in 1977;

(d) services from Hull to Rotterdam and Zeebrugge;

(e) services from Harwich or Felixstowe to Belgium and Netherlands ports (East Coast);

(f) Sheerness-Vlissingen;

(g) Dover, Folkstone or Ramsgate to Ostend or Zeebrugge (Belgian Straits);

(h) Dover, Folkstone or Ramsgate to Dunkerque, Calais or Boulogne (French Straits);

(i) Newhaven-Dieppe;

(j) Southampton, Portsmouth or Weymouth to Le Havre or Cherbourg (South Coast);

(k) Portsmouth or Plymouth to ports in Brittany.

For non-car travellers, the choice is less critical since the more peripheral routes are less patronised by these travellers. We have simply assumed services comparable to those in 1977 operate. No new air services have been introduced.

We have also assumed that present fare relativities between the ferries are maintained, with one exception. Hovercraft services are at present offering a speedier service at prices roughly the same as the corresponding ship services, and are making a loss or at best a poor return on capital. It seemed unreasonable to postulate increasing traffic with investment necessary to replace existing craft for a sector in such a position. Accordingly, we assumed that the hovercraft services would charge a premium fare for car travellers, namely 110% of the corresponding ship fare, except in 1985 in the low growth scenario where the factor was 105%.

Certain very recent developments may appear to call into question the validity of some of our assumptions about the ferry services. Firstly, the tariffs announced by the operators for the 1980 season appear to indicate at least a partial breakdown of their cartel, with consequent price reductions; this aspect has been heavily emphasised in their advertising. However, closer examination of the tariffs shows that the increased competition is largely confined to off-peak travel, with the peak rates increasing in a similar fashion to that forecast. Also, the price war may be a transitory effect caused by the introduction of a number of new vessels at the same time, by both Townsend-Thoresen and Sealink. A second and rather more serious development is the claim by Townsend-Thoresen to be able to cut the Dover-Calais crosing time by 15 minutes, and to cut waiting and clearance time by "up to" 30 minutes by improved loading and unloading procedures on their new vessels. These improvements, if sustainable, would certainly improve the competitiveness of the ferries vis-a-vis a new link, but we feel that the increased speeds may well incur substantially higher fuel costs, and thence a more rapid rate of fare increase. These developments may merit further consideration.

3.2 UK Leisure Traffic

3.2.1 Car Travellers

The patterns of route choice predicted for our two scenarios in the absence of a link are shown in Table 3.2.1. The changes in exogenous circumstances which bring about changes in route choice patterns are:-

(a) changes in relative costs of road travel and sea travel; and
(b) changes in the relative disutility of money and time.

In the low growth scenario, both ferry costs and road costs increase, as a result of increasing fuel costs, but the increase in road costs is slightly higher. This will have the effect of transferring traffic from the shorter sea routes to the longer, which generally involve less road travel. The increase in value of time will reinforce this change, since the disutility of time on the road is greater than that on the ferry, and the longer ferries have higher fares. In the high growth scenario, the first effect does not occur, but the second effect is stronger. Thus in both scenarios we see that the increase in traffic on the shorter routes, the French and Belgian Straits, is less than that on the longer routes. These changes are a continuation of the trends observed in the recent past.

3.2.2 Independent Non-Car Travellers

Table 3.2.1 also shows the patterns of route choice predicted for independent non-car travellers. For these travellers, the principal factors bringing about changes in route choice patterns are:-

(a) changes in the relative costs of air and surface transport; and
(b) changes in the relative disutility of time and money.

In the low growth scenario, air fares are forecast to rise faster than those for surface transport because of higher energy costs. This will tend to favour surface modes. However, the increased value of time will more than counteract this effect, and we find that the increase in traffic in this category is mostly air traffic. In the high growth scenario, the switch to air is accentuated by a substantial fall in air fares since in this scenario, the faster-than-average technical progress assumed for air travel has not been compensated for by increased fuel prices. This causes a large decline in the numbers in this category using surface transport, the numbers becoming negligible in the year 2000 on all but the most central routes. Within the air travellers, there is a slightly increased tendency to use regional airports, largely because of the relative decline in London's population.

Table 3.2.1: Route choice for UK leisure travellers in the absence of a fixed link

Crossing Group	Car travellers				Independent non-car travellers				Package non-car travellers			
	Low		High		Low		High		Low		High	
	1985	2000	1985	2000	1985	2000	1985	2000	1985	2000	1985	2000
Norway & Sweden direct	24.4	47.8	31.5	81.3	*	*	*	*	*	*	*	*
Denmark direct	23.9	46.5	31.3	79.3	11.3	7.1	9.1	2.0	3.4	2.9	2.4	0.7
Germany direct	7.7	23.4	8.6	30.7	3.4	1.1	1.8	0.0	0.7	0.5	0.4	0.0
Spain direct	16.1	42.9	18.1	59.9	0.1	0.0	0.0	0.0	0.2	0.0	0.1	0.0
Hull routes	28.4	114.3	36.8	175.0	3.8	0.9	1.6	0.1	1.7	1.6	0.7	0.1
Haven-Belg, Netherlands	82.6	148.6	110.0	260.5	94.5	55.7	61.0	11.8	35.4	30.2	21.2	7.5
Sheerness-Vlissingen	18.1	44.1	25.8	58.8	7.1	3.4	4.1	0.3	9.0	2.8	1.9	0.3
Belgian Straits	88.2	161.0	113.6	208.0	194.8	180.0	165.6	105.2	90.4	98.1	72.7	55.1
French Straits (ship)	230.3	355.1	331.8	693.9	837.1	902.7	758.6	450.0	399.3	487.3	317.7	229.0
" " (hover)	47.4	27.5	18.6	72.8								
Newhaven-Dieppe	128.1	308.4	181.7	542.6	94.2	71.8	71.8	22.4	86.6	87.6	57.6	23.7
South Coast	155.9	288.2	204.7	557.0	48.0	38.5	37.3	18.8	61.4	61.2	40.4	17.5
Brittany	69.5	187.4	87.4	234.4	8.1	4.2	5.1	1.1	4.6	3.7	2.6	0.9
Total surface	920.6	1795.2	1199.9	3054.2	1302.7	1266.3	1116.0	611.7	692.7	775.9	517.7	334.8
Air-via London					1017.8	1661.5	1345.7	2725.0	2443.1	3267.3	2835.1	4404.1
Air-not via London					222.2	358.5	290.4	603.7	379.4	504.0	450.1	725.1
Total Air					1240.0	2021.0	1636.1	3328.7	2822.5	3771.3	3285.2	5129.2
Total					2542.7	3287.3	2752.1	3940.4	3515.2	4547.2	3802.9	5464.0

Notes:
1. Destinations outside Europe excluded.
2. Units are thousands of return trips.
3. "Haven-Belg, Neth" comprises crossings from Harwich and Felixstowe to ports in Belgium and the Netherlands.
4. "South Coast" comprises crossings from Southampton, Portsmouth and Weymouth to LeHavre and Cherbourg.
5. "Brittany" comprises crossings from British ports to St Malo and Roscoff.
6. * indicates that traffic on these routes was not considered in the route choice model.

3.2.3 Package Travellers

For these travellers, the swing to air travel is not so marked as for independent travellers, as our scenarios postulate limited scope for technical improvements and hence for further falls price for package air travel. Nevertheless, the same conclusion applies, that competition from air will reduce travellers on certain routes to negligible proportions by 2000. This projection probably represents too strong a conclusion, since the operators of these routes themselves offer a large number of packages. However, most of these, in recent years, have been aimed at car travellers.

3.6 Freight Route Choice

The results of the route choice forecasts in the absence of the link are shown below in Table 3.6.1. These indicate the influence of the price scenarios. The increase in the share of rail wagon traffic reflects the decrease in the relative price of rail haulage, whilst the relative price of other modes is increasing, as described in section 2.2.3. This is most marked in the 'low GDP' growth scenario.

Table 3.6.1 Route Choice Model Results: No-Link Situation
(thousands of tonnes, import & exports combined)

		1985		2000	
	1977	LOW	HIGH	LOW	HIGH
Ro-ro	13,349	13,756	17,287	18,438	32,601
Container	5,105	6,665	7,553	9,656	15,320
Rail wagon	855	4,417	3,856	11,107	12,303
	19,309	24,837	28,696	39,201	60,224