FREIGHT TRANSPORT AND THE CROSS-CHANNEL MOVEMENT OF STEEL

by

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SUMMARY

This thesis provides a descriptive account of the movement of freight, and particularly the movement of steel, between the U.K. and the 'near-sea' countries of France, Belgium and Luxembourg, The Netherlands and West Germany. In addition it examines the alternative approaches to freight transport analysis with particular attention to disaggregate sectoral studies.

The thesis provides a brief analysis of the state of freight demand and inter-modal competition within the U.K. as a means of establishing the basic terminology and providing a base for comparison with the international freight transport market. This is followed by a description of the freight market that exists between the U.K. and the near-sea countries. This involves the definition of both the various modes of transport and the types of traffic that are encountered. A number of alternative classifications are considered. The major factors that are likely to influence modal competition are considered and the main determinants of trade and thereby overall transport demand are discussed.

The overall market is then examined in quantitative terms. Total tonnages moved are analysed by mode and commodity and the relationship between modal market shares and commodity types is examined. This enables the semi-bulk commodity sector to be identified as the one where inter-modal competition is generally greatest. This, and the importance of the sector in tonnage terms justifies a close analysis of a particular semi-bulk commodity.

The chosen commodity is steel. The production and demand characteristics of the commodity are discussed in general terms and the relevant structure and location characteristics of the steel industry are analysed. These points are related to the inter-regional flow pattern of steel between the U.K. and the 'near-sea' countries based on a survey of major steel producers. The impact of location and other factors such as consignment size, modal charges and product values on modal choice within the sector is discussed.

The major conclusion of the thesis is that disaggregate sector studies provide the fullest understanding of underlying determinants of transport demand and modal choice. However, the costs of data collection must necessarily limit their use to those circumstances where a detailed understanding is necessary.

Key Words: Transport, Freight, Trade, Europe, Steel.

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1.0 INTRODUCTION

1.1 Scope of the Study

The analysis of the industrial demand for transport has, with a few notable exceptions, been relatively ignored by researchers over the past decade. Unlike areas such as passenger transport demand, traffic flow analysis and energy and environmental issues the lack of data and the difficulties in using realistic modelling techniques have tended to make studies both expensive and time consuming. This is not to say that the sector is unimportant. Expenditure on goods transport in the U.K. amounted to 10% of Gross Domestic Product in 1974 and the sector occupies a position of strategic importance within many industries. (DOE. 1975).

As suggested above one of the major barriers to research in the area within the U.K. is paucity of data - particularly in relation to inter-regional flows of specific commodities. It has, therefore been extremely difficult to attempt to analyse the causal factors that determine freight demand at any other than a very aggregate level or without mounting major and costly survey exercises.

These problems are overcome to a certain extent when examining international freight transports. Trading between nations is subject to a high degree of government involvement through the medium of customs clearance and associated requirements. This in turn has created a high quality, up-to-date data source that in the case of U.K. movements provides information on movements by both commodity and mode. It is possible, therefore, to advance the study of freight traffic generation and associated considerations of mode and route choice within the international context by using available data. Furthermore this data then enables the more important sectors to be identified for a more disaggregate investigation.

In addition to these points the area of international freight transport is worthy of study in its own right.

The last decade has seen a major change in the pattern of trade between the U.K. and other countries. The entry of this country into the European Economic Community led to a re-orientation of trading away from the Commonwealth countries in favour of the Seven Community members in mainland Europe. Concurrently multi-national companies have increasingly spread their production and marketing activities throughout Europe leading to a growth in intra-company trading. Ford Motor Company for example treat their European operations as an entity frequently switching components and vehicles between their plant in England, West Germany and Belgium.

In addition to this change the relative decline of the manufacturing sector in the U.K., has led to increasing levels of import penetration in a number of sectors-mainly originating from elsewhere within the Community. There is also evidence of growing product specialisation within countries and increase in trade because of this.

These changes have been mirrored by major developments in the transport sector that serves the international market. One development has been the increasing use of road vehicles to perform the entire transport task between the U.K. and Europe. This roll-on/roll-off (ro/ro) traffic has grown from 1.9m tonnes moved to or from the U.K. in 1969 to 15.2m tonnes in 1979. There has been a parallel growth in ro/ro shipping services with the entry of a number of new operators on the so-called Near Sea[1] routes (i.e. those connecting the U.K. with France, Belgium, The Netherlands and West Germany) increasing competition and reducing the real costs of movement.

Another development has been the world-wide growth in containerisation. These multi-modal "boxes" have reduced handling costs and improved space utilisation though they have led to large investment requirements in both ports and ships thereby adding a further dimension to the competitive mix. Whilst this development has been most dramatic on the inter-continental "deep-sea" routes it has had an impact on U.K. - European movement, particularly where a relatively long sea crossing is involved.

The aims of this thesis are, therefore, twofold. Firstly, it attempts to provide a descriptive account of the movement of goods between the U.K. and the continent by examining both internal and external factors that determine traffic levels and modal market shares at different levels of disaggregation. Secondly, the thesis aims to illustrate alternative approaches to the area of freight transport analysis and points to the benefits of disaggregate industrial or commodity sectoral studies.

These two aims are inter-related to the extent that the taxonomy that is developed will vary according to the level of data disaggregation (i.e. methodology) that is adopted and the taxonomy will derive its utility according to the purpose to which it is put. In other words alternative levels of data disaggregation will generate different taxonomies and by implication differing levels of understanding as to the mechanisms of the freight market. The level of understanding required is in turn a function of the specific aspect of the freight market that is to be explained.

[1] See footnote at end of Chapter 1.

For example, if it is required to illustrate the role of the freight market relative to the total economy the level of disaggregation required will not be great. The taxonomy developed to facilitate this explanation will, therefore, be relatively simple. Essentially it would be necessary to define the transport sector as distinct from other sectors of the economy and use this definition to compare levels of expenditure, investment, employment between the transport sector, other sectors and the economy as a whole.

On the other hand, if it is desired to investigate the impact of a major change in transport infrastructure on the operation of the transport sector a more detailed taxonomy would have to be generated. It would be necessary to distinguish the various modes of transport in terms of their methods of operation, cost structures, market shares and other factors that contribute towards the competitive mix. In addition it is also helpful to develop a taxonomy of the market that the transport sector serves. This can be achieved by disaggregating traffics according to commodity type, value or physical characteristics - i.e. form, volume/weight ratio etc. This classification can be married to the transport taxonomy in order to identify specific commodity/mode relationships which provides additional criteria for the assessment of the infrastructural change.

A further dimension to the taxonomy/methodology framework exists with regard to the level of spatial disaggregation. At the broadest level of analysis the market for freight can be quantified in terms of tonnes (or whatever) moved and lifted within a given area. A

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more disaggregate approach would be to consider freight movements between areas. This in turn implies differing levels of disaggregation ranging from, for example, countries through zones to specific points of origin and destination.

This thesis will attempt to show that only by disaggregating the freight market according to these dimensions of transport, traffic and space is it possible to provide a framework for examining the overall operation of the freight market within a "near-sea" context. In order to reach the level of disaggregation required it is necessary to concentrate on a particular aspect of the overall market and to this end the latter part of this thesis deals with a case study of the movement of steel between the U.K. and the near-sea continent.

The purpose of the case study is two-fold and mirrors the overall aims of the thesis. Firstly, it provides a framework for assessing the appropriateness of a taxonomy developed for the overall freight market in a specific sector. For example, inter-modal competition may be categorised in general terms as a function of a number of modal characteristics such as price, speed and quality of services. The relevance of these criteria to a specific sector can be examined and if necessary modified. Secondly, the concentration on a specific sector facilitates consideration of that sector not only as an entity but also in terms of its interface with the overall transport market. Thus, by holding the commodity dimension "constant" it is possible to explore the individual characteristics of the sector with regard to its transport demand and pattern of movement and also to examine to what extent the overall transport system determines or shapes that pattern of movement and associated modal choice. The case study should therefore provide an indication of the relative "power" of the transport system and the market it serves in determining freight flows and modal choice. This in turn will provide an indication of the suitability of sectoral studies as a means of explaining the overall near-sea freight market.

In order to concentrate the scope of the thesis the study is primarily orientated towards U.K. trade with France, West Germany, Belgium and Luxembourg and the Netherlands. This group is hereafter referred to as the "near sea countries". It should be noted that in some publications the near sea group includes Eire though for the purposes of this study that country has been excluded. The four trading partners are all important importers from and exporters to the U.K. and all have broadly similar industrial and economic structures. Furthermore there is clear evidence of strong inter-modal competition in trading movements between the U.K. and the near sea countries thereby providing a good data base for comparative modal assessment.

The analytical method employed in this thesis is largely descriptive. The rationale for this approach is advanced in the following two sections. Section 1.4 describes the structure of the thesis.

1.2 Methods of Analysis of Freight Transport

The procedures associated with the analysis of both passenger and freight movements can be broadly simplified into a consideration of the following questions: Why is the mourney made? Where should the journey be made to? How should the journey be undertaken? What route should be taken? These questions can be investigated at both an individual firm level and an aggregate level and may not necessarily be considered in the order given.

The issue of why a journey is made is placed first since it is assumed that the need is perceived before a decision is taken to satisfy that need. Thus the individual may perceive a need for a larger or higher price market. At an aggregate level this would involve consideration of population characteristics and distribution, economic activity within households, employment levels etc., for passenger movements and industrial structure, input-output linkages and market configurations etc., for freight movements.

In considering where a journey should be made the analyst is essentially balancing a number of generations and attractions against the cost that arises from their spatial separation. Put simply we can conceive of an individual in search of work who is faced with opportunities of employment in three locations spatially separate from his location - i.e. the point at which the trip is generated. In deciding which location will maximise his utility the individual will compare the attractiveness of the various work locations (e.g. in terms of earnings, associated benefits, proximity to other locations etc) with the deterrence associated with travelling to them. This deterrence is usually expressed as a cost and is a function of out of pocket costs (fares etc), time, comfort, convenience and so on . At an aggregate level these generations and attractions are usually balanced through the medium of the gravity model which takes the above factors into account. For freight transport the theoretical considerations are broadly similar. The benefits of using new suppliers or serving new markets is compared with the costs in deciding on the optimum choice.

The question of how a journey should be undertaken is essentially one of modal choice. An individual trip-maker will trade-off alternative modal costs against their associated attributes such as speed, comfort, interchange penalties and soon. Similarly the sender of a freight consignment will choose the most appropriate mode for his requirements given alternative modal time/cost configurations. At an aggregate level passenger modal choice is a function of modal characteristics and trip maker characteristics. The latter includes measures such as journey purpose and car ownership and availability. Freight modal choice is usually considered as a function of factors such as commodity classification, consignment size, modal charges and transit times. Many researchers have pointed out that the modal choice decision cannot easily be separated from the choice of trip destination since the availability or otherwise of particular modes may strongly influence the latter decision. Accordingly the distribution/modal choice elements are combined through an interactive process.

Finally there is the issue of which route the journey should take. This question is of prime importance in terms of resource allocation. The procedure is essentially to aggregate all flows and assign them to the transport network on a link by link basis. This enables the analyst to determine those links on which demand exceeds the available capacity and possibly feed back the congestion affects (which will increase trip maker costs) to the distribution/modal split stage where an alternative destination may be chosen. On a road transport network both freight and passenger movements would be aggregated together though the criteria for route section may differ between the two.

The process of transport demand analysis therefore involves the following stages: (i) some process of generating the demand for movement as a function of needs (ii) a distribution procedure to determine the demands for movement in light of the deterrence to movement (iii) a modal split analysis to allocate trips to particular modes of transport and (iv) an assignment process to allocate trips to particular routes. Implicit within this procedure is the requirement to describe the various modal systems in terms of costs and other service factors. It is argued that this procedure enables the analyst to assess the impact of changes in both the transport system and the underlying patterns of demand (e.g. through alternative land use policies) and thereby predict the outcome in terms of effective demand for movement.

Turning specifically to the freight transport sector the stages outlined above can be described in the following terms:

(i) Analysis of industrial structure and location

(ii) Analysis of demand for movement

(iii) Analysis of modal split

(iv) Analysis of route choice

These stages are expanded upon below with particular reference to the applicability of mathematical modelling techniques. Before doing so, however, it is important to emphasise a recurrent theme throughout this thesis - namely the issue of disaggregation. Within a freight transport analysis context this issue is of prime importance in two areas: the appropriate level of commodity disaggregation and the appropriate level of industrial disaggregation. The importance of these considerations will be discussed in the sections below.

1.2.1 Industrial Structure and Location - the starting point for most freight transport studies is a consideration of the underlying industrial pattern. Immediately we are faced with the issue of data disaggregation since the level of commodity disaggregation we require will directly affect the level of industrial disaggregation. For example if we are simply concerned with the overall pattern of freight demand a broad analysis of the national economy (i.e. in terms of manufacturing industry proportion of GNP etc.) would probably suffice. If the movement of hazardous chemicals is to be investigated then a detailed analysis of certain segments of the chemical industry would be necessary.

The analysis of an industry is usually undertaken in both economic and spatial aspects. Economic issues include cost structure, firm size, levels of concentration, degrees of integration (horizontal, vertical and conglomerate) and associated conduct characteristics such as pricing agreements, marketing strategies and so on. The spatial dimension is primarily concerned with the geographic location of producing points relative to suppliers, markets and competitors. The application of modelling techniques to this area can not be divorced from the analysis of transport demand which is discussed in the following section.

1.2.2 Freight Transport Demand - the analysis of the actual demand for movement is again open to a number of levels of disaggregation. Freight movements can be considered in terms of total lifted (measured in tonnes) or moved (measured in tonne-kms) at a national level or disaggregated by mode of transport and/or commodity- the latter being itself subject to a variety of levels of disaggregation (see Chapter III). A further dimension involves the separation of total movements into inter-regional or even point to point flows.

The modelling approach to this problem involves two stages. The first stage requires the estimation of trip production and trip absorption (i.e. generations and attractions) from the relationship of volumes (usually between zones of activity) to such variables as employment levels, population distribution, regional or sectoral economic activity etc. The second stage involves the distribution of the generated volumes to attractions using, for example, gravity or linear programming models. The gravity model is based in its simplest form on the premise that the number of trips between two zones is related directly to the generative and attractive properties of the respective zones and inversely to the distance (or some other measure of deterrence) separating them. Through an interactive sequence the model can be applied such that the total volume of trips can be allocated subject to constraints mentioned above.

The linear programming approach is to minimise:

$$Z = \sum_{j=1}^{n} \sum_{i=1}^{m} C_{ij} \quad t_{ij}$$

where Z is the total cost of sending all flows C_{ij} from zone i to zone j at cost C_{ij} for n destinations and m origin zones. This objective function is subject to constraints such that the sum of the origins equals the sum of destinations and both equal the sum of the flows (Σt_{ij}). Pike et al (1978) have stated that a problem common to both approaches is the use of a zoning system, particularly when there are a limited number of origins. A zoning system would preclude the analysis of point to point flows and their relation to the plans and objectives of a particular firm thereby reducing explanatory power. Furthermore the size and shape of a zone will have a major bearing on costs, these costs are based on a single distance whereas in reality they form a frequency distribution. Two other problems with a zoning system are that aggregate measures such as economic output may bear little resemblance to the activity of an individual firm and the choice of a zone centroid may be unrelated to the actual points of freight generation. These objections are minimised where there are many origins and destinations - e.g. Food distribution - though for commodities with relatively few manufacturers and points of disposal a zone based approach is usually inappropriate.

The gravity model suffers from an additional drawback in that the detterence decay function is likely to differ by commodity type. Pike et al have shown that there is a wide variation in both the rate and shape of the decay of tonnage transported against distance between different commodity groups. This again argues for disaggregate approaches.

Linear programming models were used extensively in the Commodity Flow Study (Pike et al, 1978) undertaken for the Department of Transport. The study team found that the total movements (measure in ton-miles) generated by the model approximated well to the actual total. However the actual flows tend to show a wide variation in many cases. The most successful applications were with commodities with relatively few points of production and a large number of destinations.

1.2.3 Modal Split analysis - the issue of modal choice is fundamental to freight transport analysis. It is axiomatic that the level of disaggregation chosen for demand analysis will largely determine the level at which modal split is studied. Whilst freight modal choice might be said to be more "rational" than passenger modal choice the analysis is complicated by commodity influences, customer requirements and inflexibility created by distribution policies and associated infrastructure investments.

Essentially there are two approaches to modal split modelling in freight transport - the generalised cost method and the inter-related factors approach first developed by Bayliss and Edwards (1968).

The basic hypothesis of the generalised cost approach is that the shipper will choose a mode that minimises the generalised cost of shipment from origin to destination. Generalised cost includes not only the direct costs of moving the goods (i.e. the transport and handling elements) but more intangible elements such as speed, punctuality and freedom from damage.

The model can take a number of forms, though a general representation is:

$$P(X_A) = f \ (GC_A - GC_B)$$

Where: $P(X_A)$ = the probability of mode A being chosen

GC_A, GC_B = the generalised costs associated with modes A and B

The generalised cost function is calibrated on the basis of a given set of flows from which the overall level of probability of a mode being chosen may be calculated.

The inter-related factor approach was first adopted in a Ministry of Transport Study in the mid-1960's, conducted by Bayliss and Edwards (1970). The study was based on the assertion that the distribution of freight traffic between modes is dependent upon three broad classes of factors. These are:

(i) Factors associated with the consignment itself - e.g. weight, length of haul, type of commodity etc.

(ii) Factors relating to the form - e.g. location, ownership of transport facilities etc.

(iii) Subjective assessments of modal factors - e.g. speed, reliability, minimisation of damage etc.

Using data from a survey of over 700 companies, the study employed a multiple regression technique to determine the relative importance of a factor in explaining the use of one mode as opposed to another. In addition it was possible to determine by how much the occurrence (or non-occurrence) of a factor increases (or decreases) the likelihood of a consignment using a particular mode.

The analysis did not, therefore, attempt to rank the factors affecting modal choice, but to show how these factors influence the choice of a particular mode. The proability technique employed allowed for the simultaneous inter-action of a large variety of factors unlike previous studies, where the inter-relationship between factors had been ignored.

One of the most important aspects of this study was the emphasis on the need to investigate each individual freight consignment separately in order to determine why it travels by the mode observed. In other words the researchers argued for the ultimate level of disaggregation in order to provide the required explanatory power.

The difference between the two methods outlined above lies in the extent to which the modal choice decision is explained. The generalised cost method is a highly constrained and rigid form of analysis. The method assumes that only time and cost factors are perceived in modal choice decisions and that the shipper trades off speed against charges. By definition, the approach assumes that the non-rate and time factors are ignored in making the modal choice decision. The Bayliss and Edwards approach on the other hand stresses the importance of a much wider range of factors in making modal choice decisions including locational,distributional,product, and industrial characteristics. Furthermore, by rejecting the implied ratio measurement of generalised cost studies, the approach aimed at determining the full range of inter-relationship between factors in influencing the use of a chosen mode.

1.2.4 Route Choice - the assignment of origin - destination distributed flows onto a network of model routes is a process that normally involves the grouping of both freight and passenger movements in order to determine network usage levels and identify situation of under capacity. As such this element is of only minor interest to the freight analyst.

1.3 Analytical approach in this study

One of the recurring points from the above discussion is the importance of the levels of data disaggregation. Accordingly, when dealing with the near-sea freight market this study deals with a succession of levels of disaggregation in order to obtain the highest level of explanation possible for both the pattern of movement and model choice.

With regard to modelling freight movements there appears to be an inherent conflict whereby the complexity of organisations' operations and the effect of such factors as economies of scale and product specialisation tend to prevent the "small scale" modelling of freight flows. On the other hand the problems associated with aggregate modelling (e.g. zoning systems etc) are such as to inhibit any reasonable level of explanatory power. For this reason and the points made below, this study has not incorporated a model based approach in the analytical methodology. The generalised cost approach for modal split has been rejected since:

(i) Computed generalised cost would tend to overstate the weight attached to time and cost factors, failing to allow decisions to be modified by other important decision characteristics. In other words, it would not provide a behavioural explanation.

(ii) For international shipments there are certain factors (e.g. intra-company linkages or the perceived importance of sustaining non-home-based markets) that would outweigh the simple mode decision and would therefore lie outside a consideration of generalised cost.

(iii) Specific factors relating to individual commodities would tend to be understated or ignored.

The latter part of this thesis describes a case study of the UK-near sea movement of steel. The case study is based on a survey of major steel exporters in the countries concerned, which provides detailed data on revealed patterns of movement and modal choice decisions and the relationship between these factors is examined in the context of the location and structure of the steel industry.

The case study approach is adopted in order to enable the analysis to concentrate on the pattern of movements and their determinants at the most disaggregate level. By this means the inter-relationship of factors can be examined both within the sector's transport demand relative to the overall market - i.e. the extent to which the overall transport system shapes or is shaped by the specific requirements of the sector.

The use of a case study approach, however, does tend to further preclude the use of modelling techniques. The Bayliss and Edwards approach requires a large number of observations in order to derive a formalised relationship between modal choice criteria, and a sector such as steel, where the majority of movements are large flows between a limited number of points, does not generate the required number of observations. Despite this the steel sector is considered ideal for the case study since the commodity is relatively homogenous, (i.e. in terms of transit requirements and value, it is generated by an easily identified and specific industrial sector) and its movement within a near-sea context involves significant use of all the available modes. Furthermore, the sector accounts for a sizeable proportion of total U.K.-near sea tonnage and so is likely to be an influential factor in the determination of the structure of the overall transport market.

Whilst section 1.2.4. states that route choice is only of incidental interest to most freight analysis, it is considered in this study. This is mainly because of the concern with international movements whereby the choice of cross-sea service is de facto a route choice decision which reflects on such issues as port and shipping pricing and investment.

In conclusion the analytical approach in this study is largely descriptive. This is not to say that modelling approaches are dismissed completely rather that they are inappropriate to the particular aims of this study. The general framework of transport analysis is, however, followed and is best previewed by a brief description of the structure of the thesis which is contained in the following section.

1.4 Structure of the thesis

The previous section emphasised the importance of the issue of data disaggregation. This thesis can be construed as an examination of the near-sea freight market at increasingly disaggregate levels in order to develop a taxonomy of the various actors and influences that shape the total market.

Before considering the issue of international transport it is considered necessary to briefly review some of the issues that dominate the transport market from a national viewpoint. This provides an introduction to a number of concepts that are common to both national and international transport and also provides a useful base for comparison. Accordingly chapter 2 deals exclusively with the movement of freight within the U.K. It examines the structure and performance of the two dominant modes (road and rail) in terms of costs, market shares and the overall issue of freight movement in the U.K.

Chapter 3 turns to the international movement of freight and in particular the trade between the U.K. and the near-sea continental countries. This chapter is essentially a qualitative description of the important elements in this area of movement. This requires a statement of both transport and traffic definitions together with their constituent categories. This includes a consideration of the various modes that are used to effect near-sea movement and their characteristics in both operational and cost terms. In addition it is necessary to develop a classification of traffics and a variety of approaches are considered. The rationale for a commodity based approach is advanced. Finally the elements of traffic and transport are brought together in a description of the characteristics of the near-sea freight market in terms of generators, operators and associated actors such as ports and freight forwarders.

Chapter 4 attempts to quantify the nature of the near-sea freight market - again at different levels of disaggregation. Firstly aggregate movements by mode between the U.K. and nea-sea countries are analysed followed by movements by commodity. In this latter section the major commodity flows are identified. The various modal characteristics are then quantified in terms of costs, pricing and other service factors. The foregoing is then brought together in a discussion of identified commodity/mode relationships. The importance of the so-called semi-bulk market is highlighted and the rationale for the study of a specific semi-bulk commodity is advanced.

Chapters 5 and 6 are devoted to a case study of movements of steel between the U.K. - near sea countries. They are largely based on survey work undertaken by the author orientated towards the study year of 1978. The structure and location characteristics of the steel industries in the countries concerned are analysed and the aggregate trading patterns are reviewed. The results of the survey in terms of inter-regional flows and modal choice criteria are presented and discussed.

Finally chapter 7 summarises the thesis in terms of the main points and draws several conclusions concerning the utility of data disaggregation and the relationship between industrial structure and transport demand. In addition possible areas for future research are suggested.

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The study area has been confined to the near-sea countries and not widened to cover, for example, all Europe for a number of reasons. Primarily the sea movements involved are generally similar being of a "cross-channel" types of transit. The same is not the case with, for example, Italy where the choice of mode/route combinations is expanded to include direct shipping to the Mediterranean sea-board of Italy. It is thus less easy to directly compare a ro/ro movement to Italy using a cross-channel route with a charter ship consignment travelling via the Mediterranean.

Sea-crossing times to the near-sea countries rarely exceed 12 hours and usually average around six. This narrow range does not apply for other European countries. In addition to this point the tonnage trading levels between the U.K. and the near-sea countries are significant and exhibit a wide spread across by modes and commodity types. The economies of all the countries exhibit broadly similar characteristics and for the purposes of the sectoral study described in this thesis they are all significant steel producers.

2.0 THE U.K. FREIGHT MARKET

2.1 Introduction

This chapter examines some of the major features of the freight market that exists within the U.K. This is designed to provide an introduction to some of the terminology and concepts used in this thesis. In addition a brief investigation of a national freight market provides a useful base for comparison with international freight operations.

In discussing the structure of the freight transport industry an an initial distinction should be made with respect to mode. To assist in this distinction a breakdown of goods lifted and carried by different modes in 1978 is shown in Table 2.1 which shows, inter alia, that in 1978 over 1800 million tonnes of freight were lifted in the U.K.; this represents 129 thousand million tonne-kms in movement terms and about 20% of G.N.P. in terms of value added (DTP. 1980.)

Mode	Goods lifted			Goods moved		
	m.tonnes	%	% change 1968-78	Th.m.ton km.	%	% change 1968-78
Road	1494	82.7	-1.3	99.1	76.7	2.3
Rail	171	9.5	-2.1	20.0	15.5	
Coastal Shipping	55	3.0	0.5	n/a	n/a	n/a
Waterways	5	0.3	-4.9	0.1	0.1	-5.8
Pipelines	82	4.5	9.9	9.9	7.7	14.7
Total	1807	100.0	-1.1	129.1	100.0	2.0

Table 2.1 Goods Lifted and Moved by Mode in 1978

Source: Transport Statistics 1978.

It is apparent from Table 2.1 that the vast majority of goods are lifted by road and rail whilst coastal shipping (which accounts for 14% of goods moved) includes the movement of goods to Northern Ireland. Waterways account for a minute, and decreasing share of the freight market and whilst pipelines have shown significant growth they carry exclusively petroleum products. In the light of these statistics this chapter therefore concentrates on the movement of goods by road and rail.

2.2 Industrial structure and performance : road freight

The road freight transport industry comprises a wide variety of firm types ranging from individual hire and reward companies operating a small fleet to large scale publicly owned corporations with nationwide distribution networks. The traditional distinction that is made in the industry is between own-account and hire and reward operators, however the latter category can usefully be broken down to:

1. Hire and Reward only:- generally regionally based these operators are usually autonomous units offering straightforward collection and delivery services with little or no grouping of separate customers consignments.

2. Specialised Distribution Firms:- these companies are usually nationally based and in many cases offer additional services to hiring. These include vehicle leasing, provision of warehousing space and consultancy services. Many of these firms have grown from being the transport arm of large companies to distribution companies in their own right. They thus serve both their parent company and outside firms. Examples include Tate and Lyle Transport and S.P.D. (who are a subsidiary of the Unilever group).

3. Publicly-owned companies:- these are nearly all within

the umbrella of the NFC and are discussed in detail below. Prior to 1968 Transport Act this distinction between own account and hire and reward was embodied in the licensing system whereby "A" and "BP licence holders could engage in hire and reward to a greater or lesser extent whilst 'C' licence holders were restricted to own account operations. The 1968 Act replaced this system with Operators licences that made it much easier for own-account operators to engage in hire and reward activities. Accordingly it is no longer possible to distinguish precisely the proportion of professional hauliers out of the total number of road vehicle operators. The Price Commission in its report (1977) estimated that of the total number of operators licences held in 1977 79% were held by operators carrying exclusively or mainly for hire and reward. At this time some 138,000 licences were held; this had fallen to 124,000 licences in the following year. The Price Commission emphasises the fragmentation of the hire and reward sector in that 85% of firms operate 5 vehicles or less.

In terms of market share between the two sectors the Department of Transport statistics show that in terms of goods lifted there is almost an even split between the two sectors whilst in terms of goods moved the professional sector has a larger, and generally increasing, market share. Furthermore hire and reward tend to carry goods further and operate larger vehicles than the own-account sector. In fact professional hauliers carried over 80% of total tonnage moved on individual hauls of more than 150 miles in 1978. This confirms the general pattern of own-account operators concentrating on local distribution and major trunking movements whilst professional hauliers handle longer and geographically more dispersed workload.

Returning to the original distinction between own-account and hire and reward operators, table 2.2 gives the breakdown through time for goods lifted and moved by these two modes of working.

Type of Working	1966				1971				1975				1976			
	Lifted		Moved		Lifted		Moved		Lifted		Moved		Lifted		Moved	
	MT.	%	TMT/K	%	MT.	%	TMT/K	%	MT.	%	TMT/K	%	MT.	%	TMT/K	%
Public H'lge	721	44	42.8	58	775	49	50.6	59	851	53	60.5	63	798	53	60.1	63
Own Account	920	56	30.4	42	807	51	35.3	41	751	47	34.8	37	717	47	35.5	37
Total	1614	100	73.3	100	1582	100	85.9	100	1602	100	95.3	100	1516	100	95.6	100

Table 2.2: Goods lifted and moved by mode of working 1966-1976

Source: Transport Statistics. 1978.

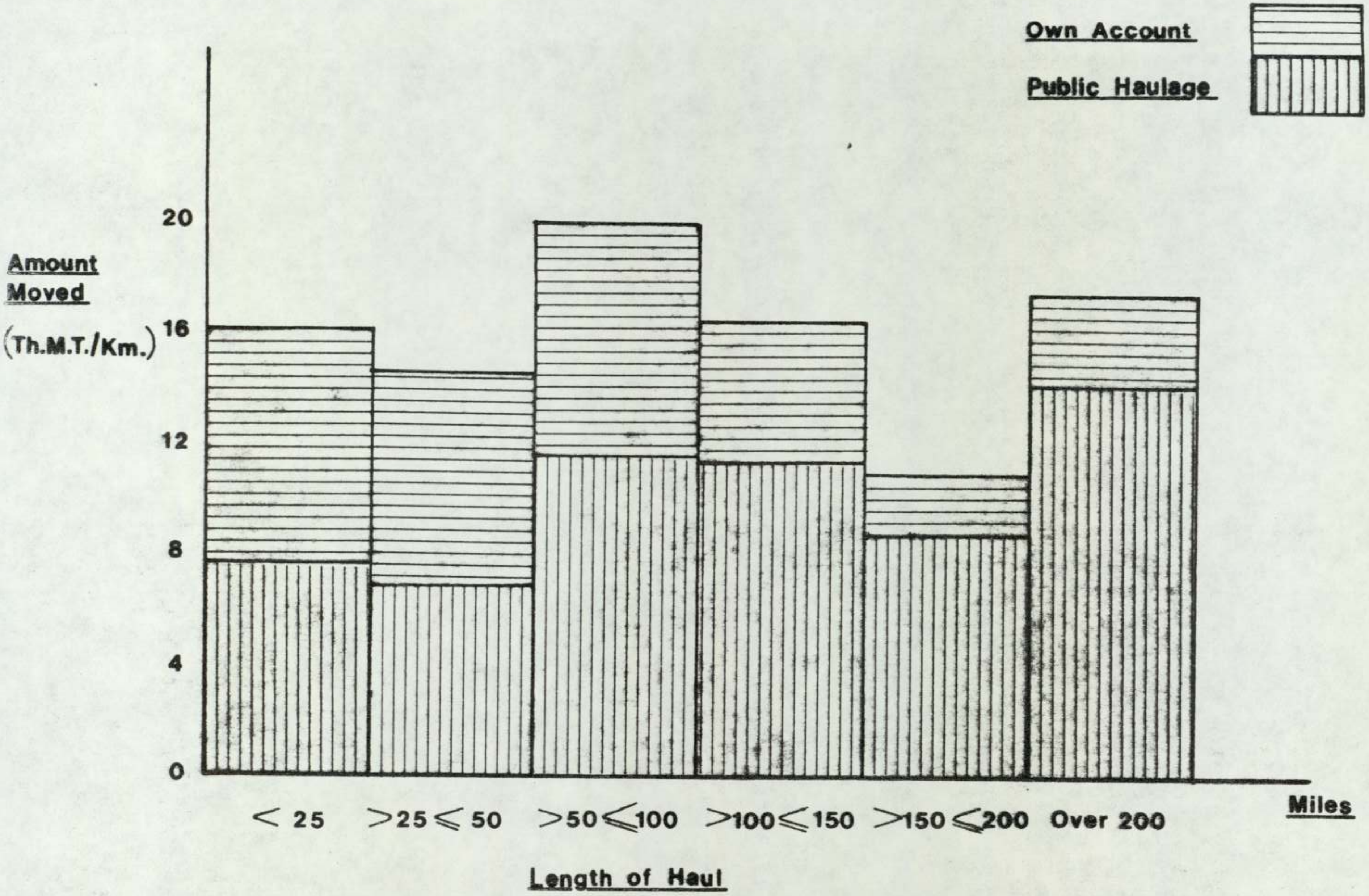
It is apparent that the haulage sectors share of the market has been increasing over the last decade both in terms of goods lifted and goods moved. Figure 2.1 shows that public haulage usage tends to increase with the length of haul rising from less than 50% of trips less than 25 miles in length to over 80% for trips of over 200 miles.

Many reasons have been advanced for the increasing use of outside hauliers though the majority stem from a heightened awareness of distribution costs during an era when company sales have stagnated or declined. Holier (1977) argues that static market conditions and declining profit levels have caused companies to examine every aspect of distribution costs. Hayhurst and Wills (1973) suggest that the age of the 'marketing guru', where high service levels regardless of cost were justified, is over. The public haulage firm is able to group loads from different customers and minimise empty running to a greater extent than the own account operator, his costs per unit are therefore less. Furthermore the capital costs of new road vehicles has risen to such an extent that own account operators are often faced with cash flow problems when renewing their fleet. Leasing or the use of outside transport reduces the cash demand as well as increasing short term flexibility.

This tendency for the road haulage industry to be highly fragmented appears to be increasing. Thompson (1978) notes that between 1973 and 1978 the number of operators owning more than 20 vehicles has declined from 2.8% to 2.5% and the percentage of all vehicles operated by these firms has fallen from 40.1 to 37.9%. Thompson has taken expenditure on road freight as a proportion of total expenditure over a ten year period to 1975. This shows the percentage rising steadily from 6.23 in 1966 to 7.09 in 1974 and

Figure 2·1 Goods moved by length of haul and mode of working. – 1976.

Source: Transport Statistics.



thenfalling to 6.67 in 1975. Accepting the problems involved with this type of data the suggested trend is for the relative costs of road haulage to increase. This should be seen against a number of improvements in technical efficiency. e.g. road improvements, particularly motorways, improved fuel efficiency and increased cruising speeds have all led to lower operating costs and better vehicle utilisation. However, the capital cost of road freight vehicles has increased by between 30% and 50% above the rise in the retail price index over the five years since 1972 and operating costs have increased by between 90 and 180% over the same period. On the other hand a study (Thompson, 1975) of a number of NFC companies show that the majority of rates charged to customers have risen by less than 90%.

In terms of return on capital employed what data is available suggests that many companies are receiving an inadequate return. A Dataquest survey (1978) of 150 major road haulage firms showed that over 50% surveyed were making a return of less than 10%. Thompson suggests that a return of 33% on a historical cost basis is the minimum required to maintain a haulage firm in the long run, i.e. able to replace its assets. Taking this standard it appears that over 75% of the firms in the survey are operating on a less than adequate rate of return.

As far as it is possible on the data available we can conclude that the road haulage industry at present is highly fragmented, serving a stagnant (or even declining) market and operating at a sub-optional level of capital utilisation. Whilst there have been significant increases in technical efficiency these have been largely passed on through lower rates to customers prolonging a situation of over competition which has resulted in declining profit levels and a high bankruptcy rate.

The Price Commission survey confirms this trend pointing to between 6-7% for tipper operators to over 20% for the larger carriers (all on a historic cost basis). The commission concluded that the industry was experiencing increasing difficulty in funding the purchase of new vehicles.

The 1968 Transport Act removed the quantity constraints on entry into the road haulage industry in allowing both new operators into the industry as well as enabling the own account operators to extend into the hire and reward sector. The Prince Commission notes that whilst the total number of licences has remained relatively steady there have been a significant number of new licences issued since 1968. The rate of entry has, however, dropped quite dramatically since 1975 reflecting both a re-stabilisation following the post 1968 'flood' of applications coupled with the impacts of the 1975-1978 recession. The barriers to entry are not great. The Price Commission survey found a number of small operators who were able to buy second-hand vehicles for a nominal sum or new vehicles on favourable hire-purchase terms.

Whilst there is no definite evidence the indications are that exit from the industry is equally easy. Thompson states that in 1976 there were over 400 filed bankruptcies in the industry and this is quite likely to understate the level of exits since many operators will simply cease trading when business conditions are unfavourable.

As one would expect the smaller operators are characterised by owner-driver type operations while even fairly large concerns are often run along 'domestic' lines with the owner and his family being the sole managers. Contrasting with this type of operation however are the limited number of large fleets which are often subsidiaries of other companies. The Price Commission classifies these types of companies as follows:

i) Major firms of professional hauliers who have grown through acquisition and retained a structure based on separate operating companies. Outside the public sector (discussed below) such firms include: William Cory and the Transport Development Group.

ii) Companies with more broadly based transport interests who have set up or acquired haulage interests. For example O.T.T. the multi-national shipping company have a number of U.K. based haulage and distributing companies.

iii) General Trading companies who have identified in road haulage opportunities for profitable diversification. For example the Lex group who acquired Wilkinsons the parcel carriers.

iv) Manufacturing or trading companies who's 'own account' operators have been hived off. Examples are Tate and Lyle Transport and SDP - the latter a subsidiary of Unilever. In many cases these subsidiaries have to compete with other companies for their parent's business. In addition to these companies there is a significant public sector presence in the form of the National Freight Corporation.

2.2.1 The National Freight Corporation

The 1968 Transport Act brought together a number of publicly owned road transport undertakings under the control of one corporation the N.F.C. The main companies involved were National Carriers Limited (formerly the sundries division of British Rail) B.R.S. and Pickfords. An outline of the principal operating subsidiaries in the N.F.C. is presented in Figure 2.2

Subsidiary	Gross Receipts 1977 £m	%	Profit (Loss 1977 £m	Profit (Loss 1976
Ftliners	46.1	11.9	1.4	1.5
BRS Group	109.8	28.5	6.8	5.8
NCL Group	88.6	22.9	0.5	(4.1)
Roadline UK[2]	53.9	13.9	0.8	(1.6)
Special Traffics Gp.	72.6	18.8	3.2	2.7
Internat'l Groups	10.9	2.8	1.0	.35
Other Groups	4.7	1.2	2.5	(.25)
Total	386.6	100.0	13.5[3]	4.4

Table 2.3 National Freight Corporation breakdown of performance: 1977
Source: N.F.C. Report and Accounts 1977.

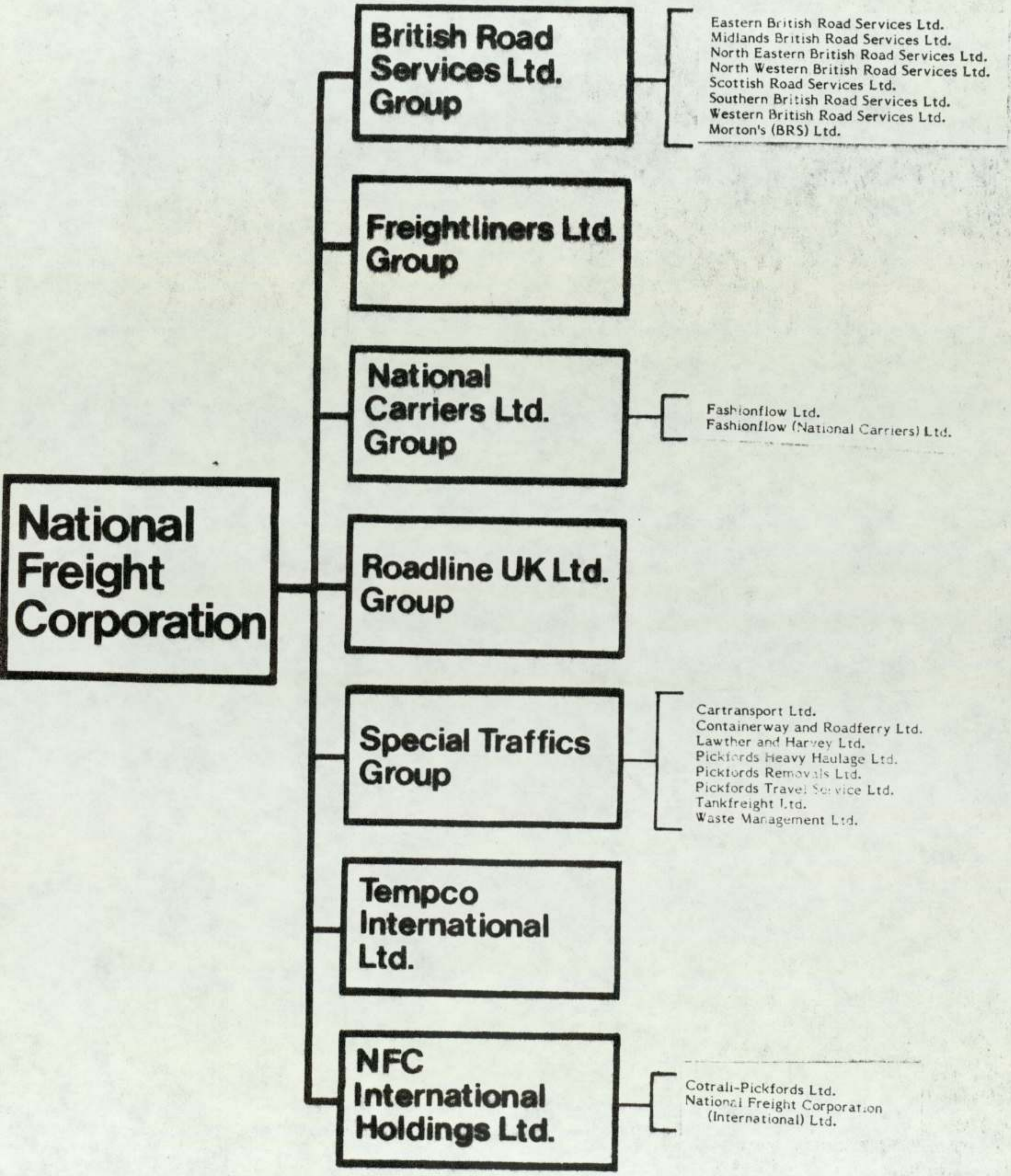
1. Includes other small freight and parcels companies
2. Net loss after interest was £9.5m, 1976 £15.3m

BRS parcels Ltd (a division of BRS) have always been under entirely separate management within the NFC and have recently been renamed Roadline.

The N.C.L. and Roadline groups are concerned mainly with parcels and small freight.

Fig. 2·2 NFC principal operating subsidiaries

as at 1st January 1978



Source: National Freight Corporation Annual Report 1978.

Freightliners were 49% owned by British Rail when these figures were produced. Subsequently British Rail have taken 100% control (reverting to the position prior to the 1968 Act) of the group. The British Road Services group comprises a number of regionally based companies dealing in general haulage and contract hire. In addition the group provides truck rental, warehousing, vehicle rescue and consultancy services. The special traffics group comprises Car Transport, Containerway, Road Ferry Ltd. (the latter two are primarily engaged in unit load operations to Ireland), Lowther and Harvey (road and air freight, warehousing and shipping company based in Belfast) Tankfreight Ltd (bulk liquid movements), Waste Management Ltd (industrial waste disposal and cleaning services) and the Pickfords group of companies (principally heavy haulage, removals and storage). The international group includes Cotrali-Pickfords Ltd (shipping and forwarding) NFC International Ltd (consultancy) and Tempco Ltd (frozen food storage and distribution).

Overall the trading position of NFC has improved over the past three years though they still made a net loss of £9.5m in 1977. The Chairman, Sir Dan Pettit, attributes this to unrealistically high interest charges related to assets employed (NFC 1978). Whilst the government has proposed capital reconstruction to remedy this, NFC have argued that this will be inadequate and that it will be required to make a return of 15% on capital employed in order to break even. To obtain this return, it feels, would render many NFC subsidiaries uncompetitive and make the corporation vulnerable in the face of a continued recession, furthermore there would be no provision in asset replacement. Assuming no further capital reconstruction is proposed it is unlikely, therefore, that NFC will move into a position of net-profit in the short-term.

NFC have argued strongly against the return of Freightliners to wholly British Rail ownership. The current position of freightliners is discussed in more detail in the section dealing with Britith Rail.

2.3 Rail Freight

British Railways was formed by the Nationalisation of the four private railway companies in 1948 and since that time British Rail has been responsible for the movement of all freight by rail in the U.K. It is convenient to separate rail freight into three areas though these are not necessarily mutually exclusive. These areas are:

(i) Wagon load traffic

(ii) Train load traffic

(iii) Freightliner traffic

2.3.1 Wagon load: this refers to movements of consignments in quantities insufficient to justify a full train movement. In other words a particular freight train would consist of a number of different consignments of wagon load traffic and therefore would comprise traffic with a variety of origins and destinations. This implies both a degree of marshalling and operation from common user terminals rather than a customers own siding. This in turn requires collection and delivery by road and, unless the rail haul is very long, a comparatively costly operation. The costs and delays assocted with wagon-load movements have tended to make them very much the poor relation in the rail-freight family. However, British Rail has over recent years developed scheduled services specifically catered for wagon load traffic operating between major centres at speeds of up to 70 m.p.h. Marketed under the Speedlink banner the services are designed to provide a high level of reliability coupled with competitive costs. In 1980 fifty eight such services wereoperated daily. They are generally orientated towards customers with private sidings since rail is most competitive under these conditions.

2.3.2 Trainload: this refers to major movements between private sidings of bulk traffics. The classic example of this type of flow is the movement of coal between pit and power station in so-called merry-go-round trains. Because of the large economies of scale this type of operations accrues it is quite common for train load movements to take place over surprisingly short distances. This is borne out by the fact that whilst the generally accepted minimum length of haul for rail to be competitive with road is between 100 and 150 miles the average length of haul for all rail movements was just over 70 miles in 1980 (BRB 1981).

2.3.3 Freightliners: The company, which is at present a wholly owned subsidiary of British Rail, was established to market and operate a rail based container system in Britain. In addition to 38 container terminals with facilities for transferring containers between road and rail the company operated a significant road fleet. The road vehicles are mainly used as feeders for the terminals though the company does engage in normal hire and reward activity. The growth in internal U.K. traffic has remained fairly stagnant over a number of years now though the deep sea based traffic continues to expand.

Table 2.4 gives a breakdown of rail Carryings by commodity for the last 2 years.

Commodity	1980		1979		1978	
	Tonnes	%	Tonnes	%	Tonnes	%
Coal and Coke	94.1	61.3	93.5	55.2	94.0	55.1
Iron and Steel	12.9[3]	8.5	25.1	14.8	24.7	14.5
Other[1]	38.9	25.3	43.1	25.5	44.3	26.0
Freightliner[2]	7.5	4.9	7.6	4.5	7.5	4.4
Total	153.5	.0	169.3	100.0	170.5	100.0

Table 2.4 British Rail Freight Carryings 1978-1980

Notes:

1. In 1978 "other" included Oil & Petroleum (17.2mt) Earth and stońes (15.1) Buildings Materials (4.6) Chemicals (4.2)
2. Estimated
3. Low carryings partly caused by the steel strike.

Source: DTp. Statistics at B.R.B. Report and Accounts.

It is apparent that rail carryings have suffered significantly from the current recession though what is perhaps more noticeable is the overwhelming dependence on and to a lesser extent steel by rail freight. The vulnerability of rail was demonstrated during the steel strike in 1979/80. Over the period of the strike BR lost approximately £20m revenue but was only able to make a marginal adjustment to its costs. The future of rail freight within the U.K. is, therefore, very largely tied up with the future of the steel and coal industries though B.R. is attempting to diversify as much as possible.

Performance indicators of the traditional type are difficult to determine in the case of rail freight due to the problems associated with joint costs and capital write-offs. However Table 2.5 gives some indication of a generally upraising trend.

Table 2.5 Performance indicators for rail-freight

Indicator	1976	1977	1978	1979	1980
Average Wagon Load (tonnes)	22.47	22.99	24.52	25.20	25.83
Freight revenue per wagon(£) (At 1976 Prices)	1495	1613	1719	1844	1818
Net Tonne - mile per loaded freight train mile.	307	324	331	343	338
Average Ft'liner receipts/ TEV (£) (At 1976 Prices)	42.8	43.6	45.8	46.2	45.4
Freightliner operating margin (%)	1.7	2.6	2.0	3.4	2.0

Source: British Rail Report and Accounts 1980.

2.4 Road/Rail Competition within the U.K.

By way of conclusion to this overview of U.K. freight operations, some of the factors determining the current competitive mix between road and rail are considered. These factors can be considered under the following headings:

(i) Commodity flows and the pattern of distribution

(ii) Cost structures

(iii) Institutional/legislative factors.

2.4.1 Commodity flows and the pattern of distribution.

The U.K. economy has a highly developed manufacturing industry with a complex locational structure. This complexity is reflected in the flow patterns relating to a particular industry or commodity. A study sponsored by the D.Tp. (Pike, 1979) examined the commodity flow patterns in a number of industries and illustrated how a variety of geographic, economic and cultural factors has combined to shape the existing flow pattern and - more importantly - how these patterns were constantly changing within a dynamic environment. The basic lesson is that rail has traditionally lacked the flexibility to adapt to these changing conditions. New industries have developed in areas that are not well served by rail and the high cost of investment has prevented rail from being able to compete with the door-to-door attractions of road vehicles. Furthermore as we have stated above the high level of fixed costs inherent in rail operations have meant that when the absolute market is in decline the rail operator has a far harder task in reducing his costs than the road operator.

2.4.2 Costs structure:

It is extremely difficult to obtain realistic comparisons between road and rail costs. It is important, however, to emphasise that the two modes face different cost structures. As far as the road operator is concerned his costs are confined to the vehicle and manpower; rail on the other hand has to provide its own way and cover the cost of doing so. Accordingly the fixed costs of rail operation are very much higher than for road. In addition to the provision of way there is often a requirement for specialist wagons and handling equipment. A contemporary example of this problem relates to the transport of ferrous scrap. At present ferrous scrap is moved about in surplus 16 tons capacity coal wagons. These wagons are life expired and are gradually being replaced by 32 ton capacity hopper wagons with bottom discharge facilities for merry-go-round operation. Scrap is usually grab discharged which is a technique that would damage the hopper wagons. So when all the 16 tonne wagons have been withdrawn there will be no suitable wagons available to carry scrap.

The British Scrap Federation in negotiation with B.R. has said that it is unable to buy its own wagons due to the already low margins they are operating under and B.R. has said the same thing for largely similar reasons!

The impasse results from the long term operation of a service at marginal cost which has failed to provide a fund for asset replacement. In fact it is quite likely that a number of the flows will cease all together due to the marginal nature of their existing operation.

In rail's favour however, is that mode's superior energy efficiency and the competitive edge that that gives.

In conclusion the cost structure of the two modes are such as to create a number of conflicting indications. Despite this the inherent flexibility of road is again seen as that modes major advantage.

2.4.3 Institutional/legislative factors.

There have been a number of Acts by government over the past decade that have influenced the competitive mix between road and rail. These instruments range from restriction on the use of heavy goods vehicles (HGV's) to subsidies to encourage the use of rail. The reasons behind these pllicies have generally been to reduce the environmental impact of HGV's and encourage the use of rail by overcoming some of the investment cost barriers referred to above.

One of the most effective pieces of legislation are the so called Section 8 grants available under the 1974 Railways Act. These grants provide funds for the construction of terminals, sidings and wagons to enable freight to move by rail that would otherwise have gone by road. At the end of 1980 the number of grants awarded totalled 98. These were worth a total of £29.2 million and involved an annual movement of 19.3 million tonnes of freight.

To conclude road has a number of inherent advantages over rail - the major one being its door to door flexibility. However the economies of scale associated with particular types of rail operation coupled with environmental and energy efficiency benefits should ensure the continued competition between the two modes in certain markets.

2.5 Summary of the U.K. Freight Market

Within the U.K. it is clear that road freight exerts a dominant role in overall terms. However, within particular sectors for example , coal movements, rail maintains a significant presence. There is therefore evidence of inter-model competition as well as inter-company competition within the road freight sector.

This discussion of the situation pertaining to the U.K. internal freight market has served to highlight a number of important general issues. Firstly the examination of industrial structure within the freight industry has shown the importance of ownership of transport facilities as a predeterminant of modal choice. For example a manufacturing firm with own-account transport facilities is likely to be less flexible in its modal choice decisions than a firm that uses exclusively outside carriers. This advantage is one of the reasons for the increasing share of third party road-hauliers in recent years.

Secondly what evidence there is suggests that profitability levels in the industry are generally low and that margins are continuing to decrease. With regard to rail freight this is partly explained by a high proportion of fixed costs and the difficulties in adjusting these in the face of declining demend. Road freight suffers from a predominance of outdated costing techniques which leads to an unrealistically low level of pricing.

Thirdly the consideration of firm types shows a range in size from one-man operations to nationalised companies. This variety of firm categories, each with their own policies and objectives can dinsoderably complicate analysis. Price cutting moves by a dominant company, such as the National Freight Corporation for example, can have a profound affect on the behaviour of other firms. Alternatively major consumers of freight transport can act in a monopsonistic manner if dealing with a group of small competing hauliers. In addition it is not always possible to generalise competition as, say, between road and rail. Different sectors of the road freight industry may present very different competitive problems to BRitish Rail. For example in the movement of consumer goods for a major producer British Rail is likely to compare with smaller nationally based road carriers. In the movement of aggregates between two points the competition is most likely to arise from small, locally based hauliers. Each situation, therefore, generates a different set of pricing criteria and competitiive responses.

This chapter has therefore demonstrated the importance of comparative modal cost structures and other influences in determining inter-modal competition as well as illustrating the importance of industrial structure and location in determining the nature of the freight transport market. In addition this chapter has provided an introduction to the terminology and some of the methods used in analysing freight movement which will be expanded upon in an international context in the following chapters.

3.0 FREIGHT TRANSPORT BETWEEN THE U.K. AND EUROPE

3.1. Introduction

Having considered the overall issues of distribution and freight transport in the U.K. we can now turn to the central part of this thesis. That is the transport of goods between the U.K. and Western Europe. This is essentially a special case of the general market described in the previous section. It is a special case for the following reasons:

Firstly, and obviously, any movement between the U.K. and the rest of Europe involves a sea journey. (Note that we are excluding air freight from this analysis - in tonnage terms it is insignificant). This in turn implies that with the exception of flows between coastally located origins and destinations all movements require some transfer between modes. This complicates the competitive mix and can lead to mis-allocation of resources and sub-optimal performance. Secondly, we are dealing with movements between nations. This implies not only a far greater amount of data available than, say, for inter-regional flows within the same country. Thirdly, because we are dealing with trade as much as transport there are a number of fiscal and industrial factors involved that might not be present in the case of intra-national flows. For example, exchange rates, comparative taxation policies, energy costs and relative growth can all have a significant impact on commodity flows within an international context.

However, it is important to note that the very factors that make U.K. - European transport a special case also complicate the analysis. For this reason, this study concentrates in detail on a specific sector within the overall market. Before this can be accomplished, it is necessary to define the broad parameters in qualitative and quantitative terms. This chapter examines the qualitative aspects, whilst Chapter 4 examines the overall market in quantitative terms.

There are three critical categories used in the analysis of U.K. - continental movement. These are country, commodity and mode of transport. The first group relates mainly to trading issues whilst the latter is obviously concerned with transport. It is argued that it is the commodity classification that acts as the interface between trade and transport, and indeed can be described in either terms. This chapter begins with a statement of transport definitions. This explores the alternative methods of categorising the means of movement. In addition the relative advantages and disadvantages of the competing modes is examined. The following section examines the means by which the traffic that is moved can be categorised, this looks at industry and commodity methods of classification. Section 3.4 examines the qualitative characteristics of the U.K. - near-sea transport market. This emphasises the potentially more complex nature of movement compared with a wholly internal freight trip. It describes the various "operators" including traffic generators, land based transport companies, shipping operators, ports and freight forwarders. The section then considers the most important determinants of modal competition. The factors are separated between those specific to the transport system and those imposed by external trading factors. This serves to illustrate the relationship between the demand for transport as a function of industrial location and conduct and modal choice. Section 3.5 briefly examines the macro-economic determinants of trading levels with specific reference to a tonnage based trade forecasting model. In addition the possibility of the transport system influencing trading levels is considered.

3.2. Transport Definitions

This section considers the means of moving the goods as opposed to the type of goods moved which is the prerogative of the following section which deals with traffic definitions.

As we have already noted all forms of U.K.-Near Sea movement involve the use of a sea mode. Because of this common factor it is most useful to consider the different type of ships available as a starting point for the analysis. The relationship between the sea mode and the inland mode(s) can then be dealt with. The National Ports Council (NPC) have adopted a method of classifying the sea mode that makes an initial distinction between general cargo shipping and bulk shipping.

The categories of ship mode used by the NPC are:

(i) General Cargo Shipping

1. Lo/Lo: ships specially constructed or adapted for the carriage of containers.
2. Ro/Ro: ships which have ramp loading. This category includes Ro/Ro car carriers.
3. Specialised: ships carrying a semibulk commodity in bulk form, generally in full ship loads. These vessels may be specifically designed for a particular commodity for example chemical tankers.
4. Conventional: ships designed to carry mainly break bulk or palletised traffic. They may also carry some containers.

(ii) Bulk Shipping Ships intended primarily for the transport of bulk commodities, usually in full ship loads.

However, when we are considering the situation prevailing in near sea movements the amount of conventional shipping within the general cargo category is very small and for our present purposes we can ignore the case of specialised ships since their application is limited to very few commodities. Accordingly within the general cargo category we are left with Lo/Lo (Lift On/Lift Off) and Ro/Ro (Roll On/Roll Off) ships. These are often termed unitised modes of shipping in that the cargo is loaded on and off the ship in units of common dimension - e.g. road vehicles, containers and rail wagons. In our analysis therefore we make the initial distinction between unitised and bulk shipping systems.

3.2.1 Unitised vessel systems. As suggested above we can further divide unitised vessel systems between Lo/Lo and Ro/Ro. However there are distinctionseven within these categories. For example Ro/Ro can be separated between road and rail vehicles and between accompanied and unaccompanied road trailers. All systems within the unitised category are similar in that the main objective is to minimise the time spent in loading and unloading vessels by unitising the goods and transferring that unit between ship and shore. This reduction in transfer time coupled with the associated easier handling leads to a reduction in handling costs and an improvement in transit times. A brief description of the two main methods is given below.

(i) Lift-on/Lift-off (Lo/Lo) - this system is based on the use of containers which are transferred from a land mode to a specialised container ship by crane. The containers are of standard dimensions to ensure compatibility and are constructed in a variety of configurations to include the containerisation of liquids, palletised goods and gases. The equipment needed to transfer the containers from shore to ship and vice versa is both specialised and costly - hence the number of U.K. ports with container handling facilities are fairly limited.

(ii) Roll-on-Roll/off (Ro-Ro) - as noted above this system can be further subdivided into rail and accompanied and unaccompanied road trailer[1]. All these sub-divisions however can work within the same vessel which is characterised by a ramp that allows the land vehicle to use its own wheels in moving on to and off the ship. The accompanied trailer method is when the tractor unit (and usually the driver) stays with the trailer throughout the journey. An unaccompanied trailer would be left at the port and towed on-board the vessel by a special tractor unit. Another tractor unit would be used at the destination port and the trailer would be parked to await collection. Rail ro/ro services simply require the provision of rail tracks on the vessels' vehicle deck and a rail link span to enable the rail wagons to be shunted on and off the vessel. The rail wagons used on ferry services are not dissimiliar to those in normal usage. The major additions are locations for chains to be attached to prevent movement whilst at sea and dual breaking systems to ensure compatibility between railway systems.

The prime difference between lo/lo and ro/ro systems is that containers are cheaper to buy and stow more easily though they are more expensive to load and unload. The mix between the two systems, therefore, is largely dictated by the type of service since, in general, the longer the sea-haul the more likely it is

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[1] Note: Distinction is usually made between trailers and semi-trailers. Trailers have axles at both ends and therefore can move independently of a tractor unit. Semi-trailers only have axles at the rear and when unaccompanied are supported by legs at the front.

that the capital costs of container handling will be outweighed by the more efficient use of the ships capacity. Accordingly on short-sea routes container services have tended to be in the minority.

Allcock (1980) states that the pre-eminence of ro/ro over containers on the short-sea trades is due to a number of factors. Firstly the multi-modal capability of containers extends to some extent to trailers in Europe where kangaroo and piggy-back type operations enable the advantages of rail over long distances to be exploited. Secondly a standard 12 metre "tilt" trailer offers a pay-load advantage of about 20% in cubic capacity and 10% weight compared to a standard 40ft. container. Thirdly a ro-ro vessel will have a faster turn-round time than a container vessel thus improving port efficiency. Fourthly trailer transits tend to be quicker- particularly if driver accompanied and finally the lower levels of investment required means that both entry into and exit from the market is relatively easy and the operators are able to adjust more rapidly to fluctuations in demand thereby minimising total costs. Associated with this last point is the greater flexibility for ro-ro vessel operators in the face of changing patterns of demand. For example the capital costs and lead times in establishing a ro-ro service from a particular port are much less than the construction of a container handling terminal. The decision to go ahead with the latter is, therefore, only likely to be undertaken in the most favourable conditions.

Rail Ro-Ro systems whilst falling within the overall Ro-Ro category are characterised by a number of special features. Firstly, the port requirements (i.e. a rail link span - often with tidal lock features) and on-ship requirements are such that the services are only available from two ports in the U.K. Dover, which serves Dunkirk and Harwich with services to Zeebrugge and Dunkirk. All these services are operated by Sealink - the shipping consortium of four national rail operators[1]. This limited availability coupled with the fact that there is no alternative operator has tended to limit the use of these services with the exception of a number of specific traffics (these are discussed in greater detail when the overall near-sea traffic is analysed). A further limiting factor has been the relative lack of rail connected freight origins and destinations in Great Britain - generally the traffic is not competitive if transhipment is involved. In addition the qualtiy of service associated with the system has historically been poor though there have been recent improvements and both transit times and reliability are reported as being more competitive. In cost terms the system can have significant advantages since unit loads are generally higher than road vehicles. For example there are general cargo wagons available on lease from companies such as VTG in Germany with a carrying capacity in excess of 55 tonnes. In overall terms therefore rail represents a relatively insignificant part of the total near sea traffics though as we shall see it has an important role to play in certain commodity sectors.

3.2.2 Bulk shipping systems - to arrive at a precise definition of bulk shipping systems is often both difficult and meaningless. In this context all shipping systems that do not operate a unitised method as previously described are grouped together. Within the

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[1]Namely British Rail, S.N.C.F., S.N.C.B. and S.M.Z.

context of near sea trade the major types can be classified into conventional self propelled ships or barges and push/tow systems. The former can be further divided according to vessel size. Whilst in many cases bulk shipping provides only one link in a transport chain connecting two inland points the extend to which smaller ships are able to penetrate inland in mainland Europe, and to a lesser extent the U.K., should not be overlooked. For example in Europe barges of up to 1000 t. deadweight are able to reach Basle in Switzerland and Strasbourg in France. For this reason a broad division of vessels between those less than 1000 t. deadweight and those of a greater tonnage is useful since the latter are generally unlikely to be able to serve points located inland.

The size of conventional shipping vessels used is therefore a three-way trade-off between unit cost minimisation, loading and unloading costs and geographic market structure - i.e. the proximity and relative importance of destinations etc. It is obvious that costs per tonne-mile will tend to fall with increasing vessel size due to increasing returns to scale. However the larger the vessel the longer the loading and unloading times and the shorter the available effective sea time. Also, unless average consignment sizes are very high larger vessels may have to visit a number of ports to load and unload thus further increasing costs. Furthermore larger vessels will not have the same level of accessibility to certain ports, wharves and channels as smaller ships. There is therefore a conflict between increasing vessel size to reduce costs and reducing it to improve flexibility, market adaptability and port occupation times.

A study of inland and coastal shipping undertaken by the University of Leicester (1979) suggests that for these reasons the optimum size for most vessels on short and near sea routes is within the range 700 to 2000 tonnes deadweight. For some traffics with a high handling rate, i.e. where port occupation times can be minimised, this figure could be exceeded. For example crude fertilizers may be carried on short sea trips in vessels of 30,000 tonnes deadweight. Other commodities with rapid handling rates include petroleum and grain. It is, however, interesting to note that the largest crude-oil carriers currently in operation on deep sea routes exceed 450,000 t.d.w. The Leicester Study found that the average consignment size for most sea-borne traffics fell within a fairly narrow band of between 600 and 800 tonnes. The exceptions were found to be i) where the nature of the commodity allowed rapid loading discharge and ii) the volume of traffic was such to justify investment in purpose built facilities - for example the movement of coal from the U.K. to France.

Push/tow systems whereby a tug propels a number of "dumb" barges are generally most cost effective when handling times are high since the tractive unit can be rapidly released and utilised more effectively. The barges have an inferior hull configuration so speeds are slower and fixed costs higher. However this feature means they can usually penetrate further inland and are less susceptible to variations in water level which might lead to seasonal restrictions on other larger vessels. Accordingly unit costs are reduced by increasing the proportion of total journey length by the cheaper water based mode. This system can be combined with a large carrying vessel for sea going use though as stated above the system is only competitive when very slow handling rates are involved. This reason combined with the limited areas of application within the U.K. and the opposition of ports has meant that the system is seldom used for short sea movements.

3.2.3 Ports - incidental to the above discussion on shipping systems is the technology involved in port systems. As shown above the degree of investment in port facilities ranges from high cost container handling terminals to minimal cost wharves for bulk discharge of conventional shipping.

Whilst much of the costs of port operation tend to be fixed in the short run the variation of costs with throughput is minimal. However in most cases the shipping operators do not own their own port facilities and accordingly have to pay for port usage often on a basis of tonnage or vehicle throughput. Accordingly as far as the shipping operator is concerned in many cases port costs can be treated as a variable item. The role of port charges is considered in greater detail when discussing the structure of the transport market.

3.2.4 Inland segments of near-sea movements - a final area in this categorisation is the relationship between cross-sea mode and the mode used to connect the origin with the port and the port with the final destination. The market factors influencing this relationship are considered in the section on market structure, here I wish to consider only the physical features. It is axiomatic that in certain cases the choice of cross-sea mode will predetermine the modes for inland movement - and of course vice versa. This is most obviously the case for road based ro-ro movements where the entire journey is likely to be performed by one unit. Rail based ro-ro movements can also fall into this category though there are many instances of the very first or very last part of the movement being by road due to the absence of private siding facilities. Inland movements of containers travelling by lo-lo services are usually undertaken by road or rail though the use of the latter is restricted by the absence of rail connections to many container handling ports (Warner & Joy,1971). In addition the strategic location pattern of inland rail container terminals means that a road vehicle is almost always needed for the initial/final part of the journey. To overcome this specific problem a relatively recent development has been the use of collapsible frame containers - for locations where the installation of conatiner handling equipment can not be justified yet otherwise single mode container movement is viable. The consignment is loaded on to a container "flatrack"[1] mounted on a rail wagon. Metal upright and cross-piece sections are then bolted to this to create a frame of standard ISO container dimensions. At the port the container shaped frame is transferred to the ship in the standard way. Thus a throughout movement by rail from origin to port is accomplished without the need for container handling equipment at the origin.

Inland movements for conventional shipping services can be accomplished by road, rail or waterway though transhipment to or from the latter more usually takes plave on mainland Europe than in Britain. In addition there are a number of bulk movements that take place between coastally located origins and destinations that involve no other mode. Finally it should be noted that the relationships expressed above are only generalisationsand a number

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[1] A flatrack is essentially a metal pallet with ISO container fitting.

of permutations are possible. Firstly it is not unusual for a different inland mode to be used either side of the sea crossing. One particularly common mix is rail from continental origin to port, conventional ship from port to port and then road from U.K. port to final destination. Secondly there are cases of a multiplicity of modes being used for one movement. In 1978 a major flow of Steel from Austria to the U.K. took the following route: barge from Linz to Regensburg (Germany), rail from Regensburg to Hamburg, conventional ship from Hamburg to Hull, road from Hull to final destination in the West Midlands.

3.3 Traffic Defininitions

Having considered some of the physical characteristics of the types of transport operating on near sea routes it is now necessary to develop a classification of the types of traffic that are being moved. Since the overall orientation of this study is towards transport it is important to recognise that in dealing with the classification and measurement of trade it is necessary to adopt tonnage rather than value as a base. This is so because transport provision is very much a function of the amount of goods to be moved rather than their value. The initial step therefore is to define traffic by form rather than value.

In disaggregating traffic two basic methods are available:

1. By industry
2. By commodity

These approaches which are not mutually exclusive are discussed below.

3.3.1 Disaggregation by producing industry - this method would analyse the transport of goods either by producing or consuming industrial sector. A simple classification of industrial sectors would be between primary, secondary and tertiary sectors whilst a more detailed classification based on 17 industrial sectors is shown at table 3.1.

Considering the three-way classification first we may hypothesise the following as an ideal type. The primary sector produces various raw materials that are shipped to the secondary or manufacturing sector which processes these materials to produce a finished good. This in turn is transported to the consumer However a number of problems arise with this approach. Firstly it is not always apparent which industries fall within which category. For example steel is a product of the secondary sector in that it is derived from the conversion of iron ore, power etc. However it is supplied almost exclusively to other secondary sector industries and so could be considered a primary sector commodity. Secondly different industrial structures exist within each sector and these diffences can distort the classification. Factors such as economies of scale, levels of concentration, patterns of integration and the presence of conglomerates can all effect the location, production patterns and consequently transport requirements. Accordingly within each sector there is wide variation in both commodity type and transport device and a more disaggregate approach is needed to facilitate proper analysis.

An example of a more disaggregate breakdown of industrial sectors is shown in table 3.1. Whilst this overcomes many of the problems associated with the simple classification described above it is

Table 3.1 Example of 17 Sector industrial classification with example of commodities produced and consumed.

Industrial Sector	Example of Commodity Produced	Example of Commodity Consumed
Agriculture	Dairy Produce	Chemical Fertilizers
Mining and Quarrying	Coal	Machinery
Cereal Processing	Flour	Grain
Food n.e.s.	Sugar	Sugar Beet
Drink and Tobacco	Beverages	Grain
Chemicals	Fertilizers	Ethylene
Iron and Steel	Steel	Iron Ore
Non-Ferrous Metals	Aluminium Billets	Bauxite
Engineering	Machinery	Steel
Motor vehicles	Cars	Steel
Metals n.e.s.	Aluminium Castings	Aluminium Billets
Textiles	Textiles	Textile Fibres
Building Materials	Bricks	Sand and Gravel
Pottery and Glass	Glass	Clay
Timber	Wooden Manufacturers	Timber
Paper	Paper	Pulp Paper
Other Manufacturers	Misc.	Misc.

Source: Department of Industry

still unsatisfactory from a transportation analysis viewpoint. For example whilst the motor vehicles sector produces a commodity - i.e. motor vehicles - which from a transport viewpoint is homogenous the same can not be said of sectors such as chemicals, agriculature or mining and quarrying. The latter for example covers a wide range of commodities including coal, iron-ore, earths and stones and clay. Each of which is virtually an industrial sector in its own right serving different markets with different flow patterns and locational characteristics. The level of disaggregation to highlight these features would reach such a point that a defacto commodity classification would be arrived at. Accordingly it is both more logical and convenient to make a commodity classification the starting point of the analysis and then attempt to identify the commodities with specific producing and consuming sectors.

3.3.2 Disaggregation by commodities - There are a great number of commodity classifications available though for the purposes of this study I shall use only the Standard International Trade Classification (Revision II). The SITC comprises four major commodity groups which in turn are broken down into divisions. Within each division is an exhaustive list of five digit commodities. Table 3.2 below provides some examples of the two digit divisions.

Table 3.2 SITC (II) Commodity Classification
- Examples of divisions within commodity groups.

Major Commodity Group	Example of Division	No of Divisions
1. Food & Live Animals	Q3 Fish and preparations 11 Beverages	12
2. Basic Materials	23 Crude Rubber 28 Ores and Scrap 41 Animal Oils and Fats	12
3. Chemicals	51 Organic Chemicals 58 Plastics	9
4. Other Manufactures	71 Non-electrical machinery 67 Iron and Steel	26

Source: H.M. Customs and Excise 1978.

This approach still gives rise to a number of anomalies and problems in analysis. Two major problems occur in i) allocation of certain commodities within two digit divisions - particularly for finished articles and ii) in allocating two digit commodity groupings to producing industries. The latter is a problem even in apparently closely related commodity-industry pairings. To consider commodity 67, iron and steel, it would appear that this division would be a sole product of the iron and steel industry. However, the grouping includes certain forgings and castings that would normally be produced by the forges and foundries sector. However, despite these problems (which in tonnage terms are mostly insignificant), it is argued that the commodities approach is the most suitable starting point for analysis in that it allows aggregation to both industrial level and transport type whilst maintaining a common link between the two. The problems of allocating commodities to industrial sectors is one that tends to increase with the number of transformations that any particular commodity has undergone and when dealing with the so-called semi-bulk commodities it is not of such importance.

When dealing with the aggregation of commodities according to transport characteristics the National Ports Council has adopted a three way split. The first distinction is between bulk and general cargo commodities. The former comprising commodities such as iron ore and unmilled cereals. There are however, commodities within the general cargo category, that for particular flows have the characteristics of bulk traffic. These are termed semi-bulk commodities and comprise forest products, iron and steel, chemicals and animal and vegetable oils. The remainder of the general cargo category are termed as unitisable traffic in that they would generally travel by a unitised mode. This grouping reflects the fact that there are a number of generalisations that can be made about a commoditiy group that reflects its own characteristics as well as the characteristics of the most common transport mode used. For example, a bulk commodity would generally be a primary product - that is an input to some form of manufacturing process rather than an item for final consumption. It would usually have both a low value to weight ratio and a low inventory cost. It would also probably be less susceptible to damage than most commodities. A unitised commodity on the other hand, is likely to be a finished product of high value and likely to be easily damaged. These characteristics do of course strongly suggest the type of mode that is likely to be used. A commodity moving to a producer is likely to do so in relatively large consignments. Because it is of low value transport cost is likely to be a significant proportion of total costs and therefore needs to be kept to a minimum. Furthermore, low inventory cost means that transit time is less important if the commodity is being sold delivered.[1.] Finally, the resistance to damage through transhipment or climate are likely to reduce storage facility costs and make techniques such as grab discharge feasible.

The characteristics of a bulk commodity listed above suggest the use of modes such as charter shipping and inland waterway. The unitisable commodity on the other hand seems most suitable for containerisation. However, the relationship between commodity group and mode used is not unique - particularly, as might be expected with the semi bulk

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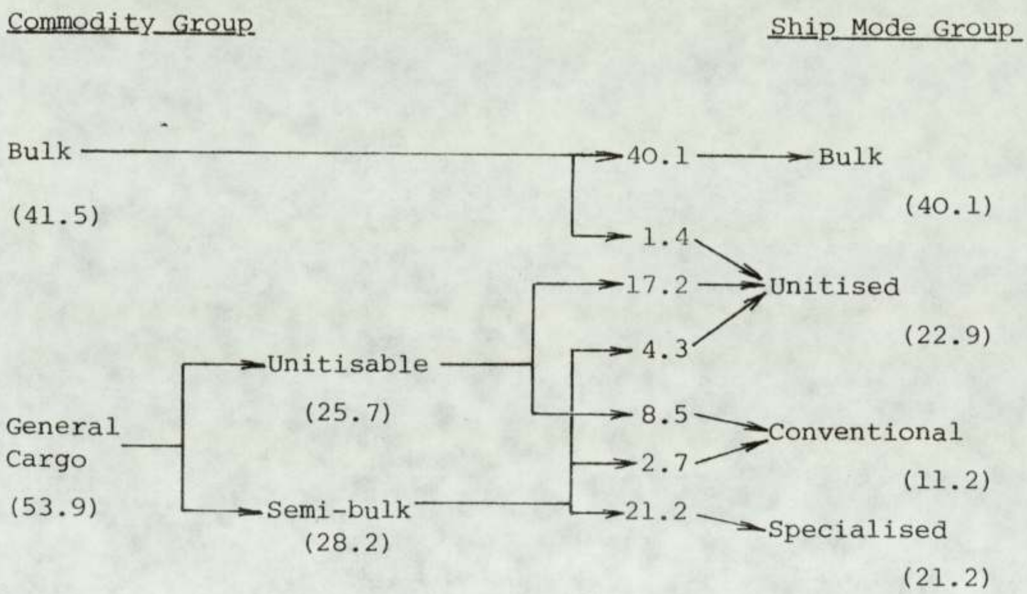
1. See Section 3.4

commodities - and so a further modal categorisation is necessary.

This is the split by shipping type described in Section 3.2. As we would expect, there are a number of exceptions to the generalised commodity/mode relationship. The situation for <u>all</u> U.K. trade in 1975 is shown in table 3.3.

Table 3.3. Commodity/Mode Split for All U.K. Trade (i.e. Imports + Exports) in 1975. Figures in brackets are in millions of tonnes.



Source: N.P.C.

This information is represented in a different form in Table 3.4.

Table 3.4. Percentage Breakdown of Commodities By Mode for All U.K. Trade 1975.

Commodity Group	% of Total Tonnage by:			
	Bulk	Unitised	Conventional	Special
Bulk	97	3	-	-
Unitisable	-	67	33	-
Semi-bulk	-	15	10	75

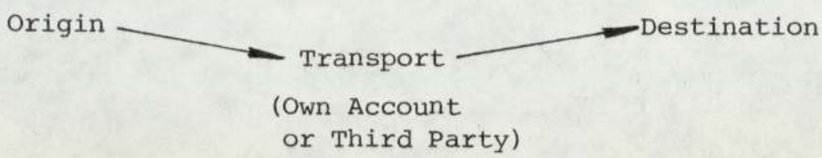
Source: N.P.C.

It can be seen that the commodity/mode relationships are generally true. It is also apparent that in the semi-bulk commodities a sizeable proportion are moved by the unitised mode. Having established the overall framework for analysis the following sections concentrate on the situation pertaining to trade between the U.K. and the "near sea continent". Firstly, the structure of the transport market is considered and this is followed by an analysis of the overall determinants of competition. Finally, attention is focused on the determinants of trade.

3.4. Characteristics of U.K. - Near Sea Transport

This section approaches the analysis of U.K. near-sea trade from two points. Firstly, it considers the structure of the operators who more or less are otherwise engaged in the traffic of goods and secondly, at the characteristics of both the trade and transport elements that may influence the nature of the movement. The second aspect assumes the overall volume of trade to be determined exogenously and concentrates more on such issues as modal and route choice.

3.4.1. <u>The operators</u> - in its simplest form we could represent the movement of goods between an origin and destination in Fig. 3.1.



<u>Fig. 3.1.</u> <u>Simplistic Representation of Freight Transport</u>

However, even within a solely U.K. context, this situation can be complicated by the use of third party storage agencies, intermediate changes of mode (e.g. between road and rail) and the hire of ancilliary equipment. For a movement between the U.K. and the Continent the movement is likely to be even more complex. One possible representation is shown in Figure 2.2.

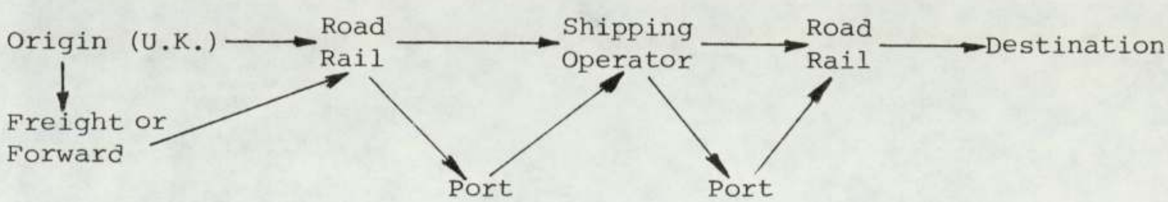


Fig. 3.2. <u>Representation of Possible Sequence in Movement of Goods Between a U.K. Origin and Overseas Destination</u>

It will be seen in Figure 3.2. that unlike the wholly U.K. movement, this movement involves at least one change of mode and in most cases the involvement of more than one operator. In addition the port is usually owned by a separate entity and must be dealt with accordingly.

These factors are complicated by statutory requirements to file customs declarations and settle any duties and in many cases the services of a freight forwarder would be utilsed both to cover these points and to arrange transportation. Whilst a broad understanding of the mechanics of freight movement are necessary in this context it is not proposed to deal with the subject in any great detail due to the complexities involved. A brief outline of the major points involved is presented below from a U.K. orientation. They are considered under the following headings:

(i) Traffic originators

(ii) Land based operators

(iii) Shipping Operators

(iv) Port Operators

(v) Freight Forwarders

(i) Traffic Originators - unlike the situation for wholly U.K. movements the use of own-account vehicles for international movements is most unlikely. Whilst own vehicles may be used to move the goods to the port of shipment or inland terminal most senders use the services of third party carriers throughout.

The prime determinant of the involvement of the originators in the movement of goods to their customers are the conditions of sale. The three most important categories are:

(i) Delivered - the producer arranges the delivery of the goods to the customer and incorporates the costs of transport within the final selling price.

(ii) F.O.B. - the producer contracts to provide the goods Free on Board (FOB) to a certain point. For example a British manufacturer may sell goods to a customer in Belgium "F.O.B. Antwerp". In other words the producer will arrange and pay for the transport of the goods as far as Antwerp. From thereon the delivery of the goods is the responsibility of the purchaser.

(iii) Ex works - in this case the producer has involvement in the transport of his goods to customers. The latter have to arrange and pay for transport from the point of manufacture.

F.O.B. arrangements are often made where a company has a large number of small customers in a fairly confined geographical area. It thus allows the producer to take advantage of the economies of scale associated with the common stem portion of the movement whilst leaving the more costly and complicated final delivery to another party. Exworks conditions are often specified for small or one-off consignments to areas where the producer does not normally deliver. This enables the producer to avoid the necessity of guaranteeing deliveries under conditions that may be both difficult and costly. We shall, however, normally be dealing with consignments that are sold delivered. This means that the producer has sole control over choice of route and mode and is the most usual method of dealing in near-sea trade.

The extent to which the producer selling delivered is actually involved in the movement of his products varies according to a variety of factors. A small company whose international sales account for only a small proportion of total sales is most likely to use a freight forwarder to procure the means of transport and arrange documentation. At the other end of the scale there are companies who are both large and strongly committed to international movements who may actually own and operate transport facilities. An example of this situation exists in the oil industry where most multinational oil companies operate their own tanker fleets and terminals. Even so many oil companies still make use of third parties - through time charter of tankers for example - and it is very rare for a company to handle its total international transport needs in-house. The most common arrangement for a company trading internationally is for that company to have a shipping or transport department with responsibility for choosing modes (and possibly routes), negotiating rates, arrangeing documentation and monitoring deliveries. The company may use its own transport for the initial stage to the port and may even own port facilities. There are also a number of instances where a company will own transport facilities such as containers or rail wagons which will be used for the full journey via a third party operator.

(ii) Land Based Operators - these can be divided into road and rail companies.

The 1979 Freight Yearbook lists over 120 British road haulage Companies who engage in international transport. (Robins, 1980).

They range in size from operators with no more than 10 vehicles to those with over 100. T he majority do not engage solely in international transport though a number are divisions or subsidiaries of large transport companies such as SPD and P & O. Most companies offer a door to door service to destinations in Europe and the Middle East. The most common method of operation is for consignments to be driver accompanied using tilt semi-trailers and tractor units. In addition some companies use unaccompanied trailer services in co-operation with hauliers based on the mainland of Europe.

Larger road companies - e.g. MAT and Ferrymasters - will act as their own forwarders in that they will negotiate directly with ports and shipping companies often obtaining sizeable discounts. Operators have stated that in some cases shipping companies have offered discounts of over 50%. Smaller road hauliers will often arrange shipping space through a freight forwarder and thereby obtain an indirect, albeit smaller, discount. The structure is similar in most near-sea countries the main differences being in the process of procuring transport and consigning traffic.

Rail operators in all near-sea countries are state-owned national undertakings. All of the organisations provide throughout movement of rail wagons and U.K. - continental services are accomplished through the use of a train ferry. Three such services are in operation:- Harwich to Zeebrugge and Dunkirk and Dover to Dunkirk. Whilst the wagons in transit may be owned privately - either by a leasing or forwarding company or the actual sender - the rail system is operated exclusively by the state companies who are responsible for rate fixing. In addition the ferry services are owned and operated by Sealink U.K. a subsidiary of British Rail. The rail operators main handicaps come in the form of wagon provision and private sidings availability. The latter is a particular problem in the U.K. where a number of major companies are not directly rail connected.

(iii) <u>Shipping Companies</u> - these can be separated into three categories of transport type - viz. unitised ro-ro, unitised lo-lo and bulk shipping.

Unitised ro-ro services on the near-sea routes are dominated by three operators. Sealink, the consortium of state owned companies comprising British Rail, Stoomvaart Mautschappij Zealand (Netherlands), French Railways and Belgian Ferries. Townsend Thorenson, a member of the European Ferries Group and Normandy Ferries who as part of P. and O. are relatively recent entrants to the market as major operators. All three operate multi-purpose ro-ro services. In other words the ships they operate are designed to carry both freight vehicles and private cars and their passengers. This is a major advantage in that the peak volume private car demand help to off-set the summer decline in freight demand and facilities can be combined in a number of instances in order to reduce unit costs. Up to the mid 1970's the short-sea cross channel routes were dominated by Sealink and Townsend-Thorensen. The revenue pooling arrangement the two companies operated for passenger car traffic was investigated by the Monopolies and Mergers Commission in 1974 and whilst it was allowed to continue the report (1976) signalled the start of an intensive period of competition in both freight and passenger markets. A number of new services were introduced by both existing operators and new entrants. The 1979 situation in terms of major ro-ro services on near-sea routes and their operators is shown in table 3.5. There are a small number of shipping companies who operate exclusive freight services. An example is the Poole-Cherbourg Service operated by the Paris based company Truckline Ferries. To overcome the problems of greater vulnerability through dealing in just the freight market the company has concentrated on providing high standards of comfort for ro-ro drivers.

Other companies such as Norfolk lines have integrated vertically to provide trailers that are sent unaccompanied on their shipping services and moved by third partyroad operators on land. Other examples of vertical integration include Sealink and European Ferries who both own port facilities.

Between		Operator
Dover	Calais/Boulogne/Dunkirk	Sealink
Dover	Ostend	Sealink/Schiaffino
Dover	Calais/Zeebrugge	Townsend Thorenson
Dover	Boulogne	P & O Ferries
Felixstowe	Zeebrugge/Rotterdam	Townsend Thorenson
Folkestone	Calais/Boulogne/Dunkirk	Sealink
Great Yarmouth	Scheveningham	Norfolk Lines
Harwich	Antwerp	Cobelfret
Harwich	Hook of Holland	Sealink
Hull	Rotterdam/Zeebrugge	North Sea Ferries
Hull/Immingham	Zeebrugge	ROTO Line
Immingham	Rotterdam	Tor Lloyd
Ipswich	Rotterdam	P & O/North Sea Ferries
Medway (Sheerness)	Flushing	Olau Line
Newhaven	Dieppe	Sealink
Plymouth	Roscoff	Brittany Ferries
Poole	Cherbourg	Truckline Ferries
Portsmouth	Cherbourg	Townsend Thorenson
Portsmouth	St. Malo	Brittany Ferries
Ramsgate	Dunkirk	Sally Lines
Shoreham	Dieppe	Schiaffino
Southampton	Le Havre	Townsend/P. & O.
Weymouth	Cherbourg	Sealink

Table 3.5 Major Near-Sea Ro-Ro Services and Operators

Unitised lo-lo services are more difficult to enumerate because a number of deep sea operators call at British and Near-sea continant ports and carry containers between the two. For example United States Lines operate a U.S.A. to Europe Service that links Felixtowe with Rotterdam, Hamburg and Le Havre as well as Bilbao and Lisbon. The number of potential lo-lo services on near sea routes is therefore enormous. However, the number of exclusive near sea services is fairly limited and as stated before confined to the longer sea routes. The main operators of these services are Sealink (Harwich-Zeebrugge), Sealand (Felixstowe-Rotterdam and elsewhere), Comar Container and P.A.O. (both London-Rotterdam), Bell Lines (Middlesbrough, London and Newport to Rotterdam) Geest North Sea (Ipswich-Rotterdam) and Lovell Line (Ipswich-Flushing). Due to the generally less favourable economics of short-sea container operation and the high capital requirements of port facilities the entry of new operators has been minimal over the last five years and this trend is likely to continue.

On short sea routes conventional shipping services are rarely operated on a regular basis for casual customers. Companies who do not use a unitised mode generally ship in such bulk as to justify ship load movements. Accordingly these companies will either operate their own shipping fleet (e.g. oil companies) or charter vessels over varying periods. The structure of the charter shipping industry is difficult to define within a near sea context and is considered in greater detail when reviewing the semi-bulk market.

(iv) Port Operators - In both the U.K. and the near sea continent most ports are in some form of public ownership. On the continent and in many U.K. ports this takes the form of a managing authority with responsibilities for the financing and operation of a specific port. In addition in the U.K. two nationalised industries have significant port interests and a small number are privately owned.

Examples of publicly held local ownership and control in the U.K. include the Dover Harbour Board, the Port of London Authority and the Mersey Docks and Harbour Board. Whilst these undertakings are meant to be self-financing a number here faced increasing problems. A combination of changing patterns of traffic, resistence of work-force to more capital intensive methods of operation and generally lower levels of traffic has led to large operating losses being incurred in many ports - particularly on the West coast of the U.K.

The state-owned British Transport Docks Board owns and manages 19 ports in the U.K. These include Southampton, Swansea, Kings Lynn, Hull and the Immingham oil terminal. In value terms BTDB accounted for 23% of all U.K. trade through ports in 1979 (Brown , H.B. 1980). In 1979 the company achieved a return on capital employed of 15.1%.

Another state-owned company with extensive port facilities is British Rail which through its Sealink subsidiary owns and manages seven ports including Folkestone, Newhaven and Harwich Parkestone Quay. The ports handle mainly Sealink Services though other operators do use them. For example DFDS and Fred Olsen/Bergen Lines both operate regular ro-ro Services from Harwich to Scandinavia.

Finally within the U.K. ports sector are the privately owned ports. Most are fairly small locations or take the form of long term leased facilities at publicly owned ports. For example, a number of private shipping companies have leased terminals in the Port of London- often to handle special commodities such as forestry products imported from Sweden. A major port in private ownership is Felixstowe which is controlled by European Ferries Ltd. who have substantial shipping interests via their Townsend Thorensen subsidiary. The port is equipped for both ro-ro and container handling and handles both near sea and oceanic services.

It is not proposed to provide an exhaustive inventory of port facilities in the U.K. Briefly there is a simple hierarchy whereby virtually all ports have wharfage facilities, may offer ro-ro services but very few have container handling equipment.

(v) Freight Forwarders- finally I wish to briefly mention freight forwarders who play an intermediarary role between two or more components in the movement of near sea trade. They are used by originators to procure transport and/or handle documentation, by road operators to arrange shipping space and port fees and clearance and by shipping and port operators to attract traffic and handle documentation. Their role is both varying and complex and their importance depends on a number of factors including customer type, traffic and service characteristics. An unpublished study commissioned by British Rail in 1979 showed that a majority of U.K. companies never used freight forwarders when exporting to Western Europe though the reverse was true for European based importers to the U.K.

Table 3.6 Companies using freight-forwarders in 1978 (%).

Whether freight forwarder used	Companies exporting from U.K. to W.Europe	Companies exporting from W.Europe to U.K.
Always	39	73
Sometimes	16	11
Never	45	16

Source: Unpublished study commissioned by B.R. Results are based on a survey of over 600 companies in U.K. and W. Europe.

Table 3.6 shows the wide variability in the usage of freight forwarders between importers and exporters and underlines the difficulty in defining the role of forwarders with any degree of certainty. It should be noted that all the companies surveyed used mainly unitised modes for export and import.

3.4.2 Determinants of competition in U.K. - Near Sea Transport

This section considers the various factors that can influence performance and competitiveness in near sea - U.K. transport. Implicit in the discussion is a fixed distribution of traffic flows - in other words it is assumed that the actual levels of traffic and origins and destinations are determined exogenously to and independently of the transport systems. This assumption will be relaxed later when considering whether transport characteristics can influence the aggregate level of trade.

The competitive factors under consideration can be grouped into two broad areas: Internal factors that are a function of the transport system and external factors that arise from one characteristics of the traffic flow. Internally derived factors include:

- (i) Modal charges
- (ii) Journey times and speeds
- (iii) Degree of investment in equipment and permits.
- (iv) Port and shipping costs
- (v) Handling factors
- (vi) Availability

The separation of modal charges and port and shipping costs is a reflection of the latters importance in determining route rather than mode. External factors include:

(i) Commodity characteristics

(ii) Consignment size/flow volume.

(iii) Inland distances

(iv) Trade imbalances

(v) Route Flexibility

(vi) Institutional factors

These factors are considered in turn below.

(i) Modal Charges - the price of transport is an important determinant in the choice of mode though it can be outweighed by other considerations such as speed, reliability and quality of service. It is often the commodity type and the markets served that dictate the precise ranking of these requirements. The factors governing pricing in the near-sea market are similar to those that prevail in the U.K. and were discussed in Chapter 2. Again an important factor is the ability of an operator to adjust his pricing to suit market conditions and the enormous growth in both road and sea operators in the near-sea market over the past five years has led to intense price competition.

Traditional transport theory (Lee and Lalwani, 1977) states that in choosing a transport mode a company will trade-off inventory costs against transport costs. This reflects the fact that, in general, a faster movement whilst being more costly will reduce the time between despatch and sale of the goods thus in turn reducing the time that capital is "tied-up" in inventory costs. This relationship is represented diagramatically in Figure 3.3.

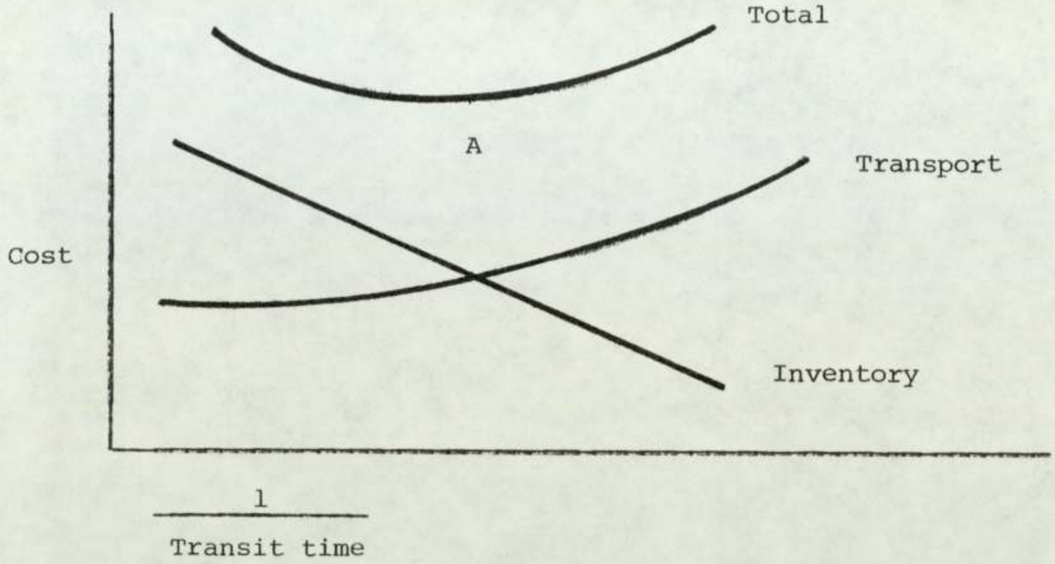


Figure 3.3. Time/cost Trade-off between modes

Following a criteria of cost-minimisation a company in these circumstances would choose the mode that minimised the sum of transport and inventory costs (shown as total cost in Fig. 3.3) at point A. This representation is complicated by the difference in inventory costs between commodities and, more importantly, the wider range of factors that impinge upon modal choice. A modification of the theory[1] states that firms who generate transport demand will select the 'best' mode of transport for a movement of goods such that:

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1 Hayter & Wingfield 1981.

$$Tm = f(S, R, C, Sp, Ld).$$

where Tm = transport mode selection

S = Service

R = Reliability

C = Cost

Sp = Speed (re. transit time)

Ld = Potential loss or damage

It is apparent therefore that a wide range of considerations can enter the modal choice process of which cost is only one factor. As Hayter and Wingfield (1981) state, these, often subjective, criteria are so diverse and the range of options open to the firm so wide that in practise it is virtually impossible to optimise in modal choice. The conclusion is that transport charges are a determinant of modal choice though their importance varies not only with commodity but also with the other characteristics of the mode in question. The role of freight forwarders should also be remembered and if modal choice is delegated to them a different set of criteria may apply. As suggested earlier the importance of transport charges tends to increase with decreasing product value and when dealing with the semi-bulk sector it will be clear that in <u>most</u> cases price is the dominant factor.

To return to the issue of response it is evident that in a highly competitive market the ability to adjust prices rapidly to meet differences in supply and demand conditions is at a premium. Whilst most operators publish tarrifs these are usually subject to negotiation and discounts in excess of 50% are not uncommon. The level of discount is generally a function of flow size and regularity though competitive factors can also be important. Actual charges for modes are presented and discussed in the following chapter.

(ii) Transit time and other service features - in addition to transit time, reliability, likelihood of loss or damage and quality of service are all considerations. The importance of these factors, as with charges, tend to vary between commodities and with the exception of transit time they are all fairly subjective considerations.

The role of transit time relative to inventory cost has already been discussed though it is also important with regard to route choice by the transport operator. For example the transport operator will tend to minimise journey times in order to maximise vehicle utilisation. In addition considerations such as drivers legislation limiting the effective working time of a single driver, port clearance time and acceptance times and final destination will all influence route choice. For example a road operator may choose to use a slower shipping route in order to allow his driver the required period of rest and thereby avoid "doubling-up" on drivers.

(iii) Degree of Investment in Transport Equipment - a central issue under this heading is the modal choice inflexibility that may face the firm particularly when traffic movements are regular. Whiteing (1979) has suggested that this inflexibility is the result of two, possibly inter-related factors.

(i) High investment costs in both vehicles and plant. This includes the investment in transport equipment such as road vehicles, rail wagons and containers. In addition handling equipment and its location within a given plant configuration may restrict the use of common modes without costly alterations.

(ii) Joint cost considerations. These can arise in a number of areas. For example the provision of rail facilities such as sidings and rolling stock, the operation and maintenance of 'own-account' road vehicles are both instances where the sharing of fixed costs may justify the use of a particular mode since fixed costs should generally be spread over as many operations as possible. In addition both utilisation and load factors will tend to increase by concentrating on a single mode.

The conclusion is that not only is there the possibility of considerable inflexibility in the choice of transport mode but also that under these circumstances it is more appropriate to consider the modal choice decision as a long-term choice based on investment rather than a short-term reaction to a variety of factors. This inflexibility can also exist in the medium term even when the level of investment is low. For example in order to obtain the highest discount possible a firm may sign a haulage contract for one year thereby denying itself the opportunity to change modes during that period.

(iv) Port and Shipping Costs - these costs are considered in terms of their relevance to the transport operator rather than the firm generating the transport demand. In these circumstances these costs have a greater bearing on route rather than mode costs though they are reflected in the total transport price and so may indirectly affect modal choice. The role of port and shipping costs facing the road or container operator is similar to that of transport price facing the firm and it is often traded off against other service factors. Hayter and Wingfieed point out that for road operators serving near continental areas ferry costs can amount to some 50-65% of total journey costs and so are a vital consideration. The quantitative affect of these costs is discussed in more detail in chapter 4 where the importance of discounts is also considered.

(v) Availability - this factor relates to the time lag that exists between requesting a movement and that movement being effected. It tends to arise as an important consideration when movements are irregular and where the value of the consignment is high. The latter case is likely since customers tend to keep stocks of high value items as low as possible and so require immediate replacement to prevent 'stock-outs'. For small consignment sizes (i.e less than a unit load) same day despatch using road groupage services is generally possible to major continental destinations. The immediate availability for larger consignments is harder to arrange though ro-ro is most favoured as its availability is generally greater than other modes. For low value commodities moved in bulk the issue of availability is very rarely an important factor.

(vi) Commodity Characteristics - this factor has been considered in Section 3.3 where it is argued that the nature of a commodity is fundamental to an analysis of freight transport demand. In general terms the most important features of a commodity are its value to weight (or volume) ratio, its handling characteristics, its susceptibility to damage and its propensity for division. The issue of value was discussed under modal charges in this section. Handling characteristics relate to the form of the commodity as to whether it is liquid, a granular free-flowing solid (e.g. grain or cement which is often loaded and discharged as if it were a lquid) or a bulk solid. Bulk solids can range from scrap iron to computers and obviously differential handling and transportation methods need to be adopted. Associated with this is the susceptibility to damage. For example steel re-inforcing bars can be stored in the open and moved on open ships - a different approach is necessary for, say, television sets. Finally is the issue concerning divisibility. Some commodities - e.g. trade motor cars - can only be carried on specialised vehicles since a unit can not be "split up" to accommodate standard configuration vehicles. This can also affect loading factors: for example a popular unit for the sale of steel coil is 12 tonnes. With a net weight limit of 20 tonnes currently in force in the U.K. it is apparent that a movement of this load by road would result in a capacity utilisation of only 60%.

(vii) Consignment Size and Flow volume - consignment size relates to the size of an individual despatch whilst flow volume refers to a number of despatches over a period of time - usually a year. Consignment size is often a function of other factors - e.g. commodity value, divisibility etc - though it can be a crucial determinant of modal choice. For example it is unlikely that ro-ro vehicles could physically handle a consignment of 20,000 tonnes of potash from Rotterdam to Cleveland; similarly the sender of 5 tonnes of forgings is unlikely to charter a ship.

Flow size is more difficult to identify since the actual definition of a flow is not easy. Is it correct for example to treat two movements from a firm in the West Midlands to different parts of Paris as the same flow? If it is can we group movements to Paris and Lyon? Most companies appear to group their consignments into areas (which can be as aggregate as countries) when deciding on the most appropriate mode even though they are despatched individually. For example a company may decide to send all its traffic to the Netherlands by ro-ro since its business with that country is fairly small whilst it would use charter ship for its major customers in France. There is no absolute scale but the evidence is that with increasing flow size the proportion of goods moving by conventional shipping increases. This is illustrated in Chapter 5.

(viii) Inland Distances - b oth the choice of mode and route for near sea movements can be influenced by the distance from the origin to the port of exit and from the port of entry to the final destination. As a general rule the shipper will attempt to minimise costs on that portion of the route (i.e. land or sea) that accounts for the majority of total costs. For example, a bulk movement from say, Ipswich to Lille will usually go by charter ship as this is by far the cheapest mode. However, an equivalent flow originating in Birmingham may travel by road or rail throughout since the advantages of bulk shipping are outweighed by the costs of transhipment which do not occur using a ro-ro mode. In terms of route selection there is evidence that particularly in the case of ro/ro movements ferry costs outweigh the issue of inland movement. For example, Dover receives over 50% of its traffic from origins (and destinations) over 300 kilometres away. Here it is clear that the tendency for shipping capacity to be concentrated on relatively few routes is a major factor. Against this survey evidence presented in chapter 5 suggests that certainly in the case of charter ship and to a lesser extent with unitised modes the objective is to minimise inland distances.

(ix) Trade Imbalances - put simply this factors occurs when the import/export ratio between regions or countries is significantly greater or less than 1. The result is a significant volume of empty vehicles moving in a particular direction which can in turn precipitate a favourable market situation for firms wishing to move goods in the "counter-peak" direction. A good example of this situation exists in the movement of fruit and vegetables from Spain to the U.K. In 1979 216,000 tonnes were moved to the U.K. by rail whilst the contra flow was virtually zero. The potential for 'back-loading' at marginal cost is clearly enormous and indeed Transfesa, the company who own the rail wagons, are actively engaged in marketing this service to companies in the U.K. Whilst this example is extreme it is by no means isolated. Hayter and Wingfield quote on import/export ratio of 1.46:1 for all ro-ro movements between the U.K. and France. Such an imbalance has led to a major distortion between the ro-ro markets in the two countries.

(x) <u>Route Flexibility</u> - this is generally a fairly minor competitive factor though it can increase in importance in the event of industrial disputes, poor weather etc. Clearly rail ro-ro and container ships are fairly restricted in the number of ports they can use and so a change of route is more difficult to accomplish than for conventional and road ro-ro ships. In the face of such disruptions the latter two would, therefore, be generally preferred.

(xi) <u>Institutional Factors</u> : - these influences on modal competition can be both complex and subtle. The most important can be summarised as follows:

- Customs clearance: particularly the relative speeds that this can be accomplised at different locations and the availability of inland clearance facilities to avoid bottlenecks at ports.
- Driving hours legislation: this factor may increase the cost of long distance accompanied ro-ro movements and influence the choise of sea route to enable drivers to take the required rest period.
- Restrictions on the movement of hazardous cargoes:- certain commodities (e.g. inflannable or explosive chemicals) are restricted in the type of ship that they

can be moved in. For example many chemicals are not allowed to be transported in enclosed holds and so tend to be moved by a train ferry with open deck stowage. Mode and route choice is accordingly restricted.

3.5 Determinants of trade

3.5.1 The Economic determinants of trade

The final section of this chapter briefly reviews the major determinants of trading levels and to consider whether, in general terms, the nature of the transport system can influence trading patterns in an aggregate sense.

It is necessary to emphasise again that we are considering trading levels predominantly from a tonnage or volume viewpoint. The most comprehensive analysis of trading volume and its determinants has been undertakne by the National Ports Council (1976) who have developed a model for corecasting trade volumes by country and commodity. Whilst this thesis is not directly concerned with forecasting it is instructive to briefly examine the structure of the N.P.C. model since it provides an excellent overview of the most important relationships. The interactions will only be discussed in general terms at this stage and it should be noted that in practise some of the formal modelled relationships have been found to be inappropriate and a more pragmatic approach based on market research has been adopted. An example of such an instance will be given in Chapter 5.

The underlying economic theory of the model assumes a market mechanism in international trade, equilibrium being achieved through the variation of price acting on the demand for, and supply of, the goods involved. In order to explain, in simple terms, the constituents of the model it is most useful to consider three main elements. These are: the demand function, the U.K. sector models and the foreign country models.

The demand for imports of a particular commodity is mainly dependent upon the level of activity in the industrial sector which uses the commodity, and the price of the goods both at home and abroad. Activity is measured by either GDP, total investment or total output in the sector or sectors using the commodity. The latter can provide a higher explanatory power but the occasions on which it is possible to relate the demand for a commodity with a particular industrial sector are limited. This relationship between demand and activity may be disturbed by temporary structural imbalances in the sector under consideration and this effect can be measured by including a demand pressure variable.

The price effect is measured as the ratio of the import price to the price of the U.K. - produced substitute. Import price is determined endogenously by the model and is treated as a function of world prices, the U.K. effective exchange rate, home prices and demand pressure. Home output price is linked to the sector models, outlined below, through the estimation of productivity (measured in terms of output and capital stock levels) and is also a function of inflation (accounted for by the GDP deflator), the price of key imported inputs and the level of demand.

These relationships are shown in equations (1) for import demand, (6) for home output price and (6a) for import price. Equation (2) shows the estimation of demand for imports from a particular country and includes variances to identify the extent of competition between imports from country i and elsewhere (through a ration of that country's export price and the U.K's average import price) and demand pressure in the exporting country. Note all equations are shown in Appendix 1.

The export demand functions are similar in concept to those for import demand. Activity is represented by world GNP, with price effects taken to be U.K. export prices relative to those of the industrialised world. U.K. export price formation is based on the assumption, as for home output prices, that firms determine their total output and its allocation to home and export markets on the basis of marginal costs and revenues in each market. Export price is therefore a function of producivity, inflation, price of key imported inputs and world prices. This is shown is equation (5) whilst equation (3) presents the export demand function. Equation (4) shows the export demand function for individual countries.

The U.K. sector models link supply and demand through the impact of investment and producivity in the form of a production function. Investment in each of the 17 sectors is determined by demand in both home and export markets, (there is evidence to suggest that entrepreneurial expectations differ between home and foreign markets), rate of technological change and lagged investment response. Productivity measured in terms of capital stock is assumed in the long-run to be dependent on investment, with short-run effects arising from output levels leading to possible scale economies and other variables such as technological change. The two relevant equations are (7) and (8).

The foreign country models are based on a simple Keynesian income determination system. Consumption and investment functions are estimated in the standard manner, equation (9) and (10). Imports are assumed to be determined by economic activity in the importing country and their price relative - equation (11). Exports are treated similarly - equation (12), activity being represented by world exports. The national income identity - equation (13), comprises the four components above, plus government expenditure and stock changes. Forecasts of growth for individual countries obtained in this way enable the allocation of total U.K. exports and imports to particular countries.

It is apparent that the modelling process is based on a series of complex interactions which may or may not reflect the actual mechanism of trade. Indeed, there are many instances of events - such as the entry of the U.K. into the EEC - that creates such a sea-change in trading patterns as to make any formalised mathematical relationship meaningless. The need for constant integration of the modelling process with market intelligence is therefore of paramount importance.

A simple example illustrates the dangers of assuming a too simple relationship between economic activity and trade or transport. Tulpule (1971) found a high correlation (R^2 = 0.75) between total freight movements in the U.K. (measured in tonne-miles) and U.K. GDP. However Chisholm and O'Sullivan (1973) extended the period of analysis from 1953 to 1968 for a variety of series and found consistently lower values of R^2. For example as low as 0.1 when using road freight measured in tonnes. Brown and Maltby (1974) amongst others point to the uncertainty in using the relationship for predictive purposes.

Turning to elasticities Bayliss (1976) established an elasticity between total tonne-kms and GNP in the U.K. of 0.56 for the period 1952-1960, and 0.96 for the period 1960-1967.

Roudier (1977) states that in general we should expect an elasticity of below unity in developed countries whilst in developing countries (with a lower level of tertiary activity) it would normally be much higher. However he states that these relationships are unlikely to prove robust enough in the long term and, due to their aggregation, they may not reflect the true pattern of activity due to countervailing trends balancing each other out.

Table 3.7 demonstrates this latter point very clearly. In 1978 GDP grew by 3.2% on the previous year. However when disaggregated it is apparent that there were major sectoral differences.

Sector	% change on 1977
Agriculture	7.0
Mining & Quarrying[1]	23.7
Food and Drink	1.4
Chemicals	0.9
Metal Manufactors	-1.1
Engineering - Mechanical	-1.7
" - Electrical	5.2
Vehicles	-2.1
Textiles	-1.6
Clothing and Footwear	2.1
Building Materials	1.9
Construction	6.9
Public Utilities	2.9
Services	2.9
Gross Domestic Product	3.2

Table 3.7 Growth in sectoral output for U.K. economy 1978.

Source: Department of Industry, Output Statistics.

Note. [1]includes oil production from the North Sea.

It would be clearly erroneous to use solely GDP as a predictor for U.K. trade during a period when mnaufacturing industry only grew by 0.4% and some important export sectors actually contracted. To conclude it can be seen that the general relationship between economic activity and both transport and trade is not a simple one and that too broad a level of aggregation can obscure many important factors.

3.5.2 The Influence of the Transport System on Trading levels.

This section considers the issue of traffic generation. Specifically this refers to the hypothesis that the introduction of new transport infrastructure is accompanied by the creation of new demand solely associated with the change in infrastructure. In the light of this change firms may decide to rearrange their distribution system and possibly their production and locational strategies in order to take advantage of lower transport costs and improved accessibility. Within a near-sea trading context many of the major flows are part of firms European production and marketing strategies. Location is a key factor and the siting of manufacturing plant in relation to both suppliers and markets is critical in minimising costs. A change in transport facilties, if significant, could clearly impact upon these policies though generally lead times are extensive. There are also a variety of non-transport factors that come into play and in an analysis of traffic generation affects associated with a proposed channel tunnel (the study is described in section 5.1) it was concluded that it would be at least 10 years after the tunnel was opened before any significant generation of traffic was apparent.

3.6 Summary of the qualitative aspects of the U.K. - Near Sea Freight Market.

This chapter has shown the complex nature of movement between the U.K. and the continent compared with a similar journey undertaken wholly within one country. The latter type of freight movement is usually likely to involve a maximum of one third party. Conversely a trans-national freight movement can involve both land and sea-based transport operators as well as port authorities and freighting agencies. Furthermore the linkages between the various participants are by no means uniform. Examples have been given of companies with interests in both shipping and ports and shipping and road haulage. In addition the nationalised railway undertakings operate their own shipping services for road, rail and container movement.

It is therefore not possible to generalise the procedure that is followed in effecting an international freight movement. It was shown, for example, that the use of freight forwarding agencies to procure transport and handle documentation is not universal. This in turn suggests that the "decision making unit" in modal choice may differ between firms using freight forwarders and those who make their own arrangements. In addition it is quite likely that the variety of transport methods, routes and operators is such that many companies are operating in a climate of imperfect information and so perceived "best" options may be sub-optimal.

The number of alternative factors that can influence inter-modal competition listed in Section 3.4.2 again emphasises the complex nature of the near-sea market. Whilst the factors listed are unlikely to all exert an affect in any one case they can range in importance between individual movements. They can also interact - for example large consignment sizes create a situation where the cost advantages of conventional shipping can be exploited. It is also necessary to re-iterate the fact that modal competition is a function of both the characteristics of the individual modes and the markets that they serve. Accordingly the ability that any one mode has to respond to externally generated changes in the market can be an important competitive factor.

Section 3.5 discusses some of the economic determinants of trade and again the complex stature of the interactions involved was illustrated. Furthermore the need for disaggregation in order to identify causal relationships and thereby forecast future levels was demonstrated.

This chapter has therefore illustrated the complex nature of both trade and transport between the U.K. and the near-sea countries. This argues strongly for a well defined taxonomy of both the methods of movement and the goods that are moved. This in turn implies a high level of disaggregation in order to derive a reasonable understanding of the interactions involved. This is dealt with in chapters 5 and 6 when the steel sector is considered. The following chapter looks at some of the quantitative aspects of the overall market to further illustrate the points made above.

4.0. THE U.K. NEAR-SEA FREIGHT MARKET: ANALYSIS OF MOVEMENTS

4.1 Introduction

This chapter develops the discussion in chaper 3 towards a quantitative analysis of the near-sea freight market in an attempt to illustrate the trade and transport features mentioned. Firstly the overall modal split (using the modal categories defined) is examined. This is followed by an analysis of commodities moved though concentration is focused on the relatively few commodity groups that in tonnage terms account for the majority of traffic. Thirdly some of the modal factors are presented - these include costs, charges, transit times and other service features. These three areas will be drawn together in a consideration of broad commodity-mode relationships in the near sea market. Finally section 4.6 will illustrate the importance of the semi-bulk market and provide a rationale for concentrating on its analysis which is undertaken through means of a specific sectoral case study described in Chapter 5.

1978 is used as the base year for most of the data presented in this and the following chapter. It can be described as a "normal" year to the extent that there were no major industrial disputes disrupting trade, transport or the collection of statistics[1]. Furthermore most of the U.K. industrial sectors (which are an important determinant of trade levels) achieved modest growth in output so there were no overt recessional features. Finally 1978 represented the last full year for which statistics were available when the study commenced. Trade and transport statistics for this year were primarily derived from an analysis of unpublished data held by H.M. Customs and Excise together with published statistics from the

National Ports Council and the Department of Trade.

4.2. Movements by Mode

In disaggregating near-sea movements by mode I shall be using the modal categories previously defined - namely unitised which is subdivided into road ro-ro, rail ro-ro and lo-lo and conventional shipping. The latter term covers all forms of shipping that are not ro-ro or lo-lo vessels and so includes specialised ships such as liquid tankers. It is conventional to separate fuel movements from all other trade since fuel (i.e. crude oil,petroleum products and coal) accounts for a significant proportion of total trade (46.6% of all U.K. - near-sea trade in 1978) and the majority moves in specialised ships between refineries.

Table 4.1 and 4.2 presents the total non-fuel trade picture for both imports and exports between the U.K. and the near sea countries broken down by country. Table 4.3 compares near sea trade with U.K. world trade for the same period.

Country	Year			
	1975	1976	1977	1978
West Germany	3252	3497	3835	4307
Netherlands	6332	6770	5097	4027
Belgium/Lux	3012	2769	2475	2459
France	4045	4450	5017	4637
Total Near Sea	16641	17486	16424	15430

Table 4.1: Near Sea - U.K. Non-fuel Imports 1975-1978 ('000 Tonnes)

Source: National Ports Council (NDC)

Country	Year			
	1975	1976	1977	1978
West Germany	2617	2634	3086	3373
Netherlands	3318	3212	2741	4593
Belgium/Lux	1748	1834	1988	4191
France	1714	1796	1993	3697
Total Near Sea	9397	9476	9808	15854

Table 4.2: U.K. - Near Sea Non-fuel Exports 1975-1978 ('000 Tonnes)

Source: N.P.C.

	1975	1976	1977	1978
U.K. World Trade	97.3	109.3	109.4	111.5
U.K. Near Sea Trade	26.0	27.0	26.2	31.3
Near Sea asa% of World Trade.	26.7	24.7	23.9	28.1

Table 4.3 Comparison of U.K. World and U.K. Near Sea Non-fuel Trade 1975-1978 (Million Tonnes)

Source: N.P.C.

A number of points can be made from these three tables. Firstly in tonnage terms near-sea trade accounts for a significant proportion of U.K.-world trade - an average of approximately 25% over the period 1975 to 1978. Secondly, with the exception of 1978 the period was characterised by a considerable surplus of imports over exports creating a significant trade imbalance with the near-sea countries. Thirdly, in total terms there has been an average annual growth in near-sea trade of 4.6% (compared with an annual growth in world-trade of 3.5% over the same period) though imports actually declined. Disaggregating by country there has been differential growth. Exports to West Germany grew at 6.5% per annum over the period whilst to France they grew by 21% per annum. Imports from West Germany grew by 7.2% whilst from the Netherlands they fell at an average annual rate of - 10.7%. There is, therefore, no consistent trend and a greater level of disaggregation is necessary before any causal factors can be identified. There is therefore prima facie evidence for a more disaggregate approach in attempting to gain an understanding of the underlying patterns of trade.

Adopting a disaggregation by mode approach tables 4.4 and 4.5 shows imports and exports by near sea countries and modes for 1978. These and subsequent tables are based on an analysis of H.M.Customs and Excise tabulations.

Country	Mode							
	Lo/Lo		Road Ro/Ro		Rail Ro/Ro		Other[1]	
	1000 Tonnes	%	1000 Tonnes	%	1000 Tonnes	%	1000 Tonnes	%
West Germany	591.9	14	1364.2	32	58.5	1	2292.1	53
Netherlands	516.4	13	1022.2	25	37.9	1	2452.6	61
Belgium/Lux	194.8	8	860.1	35	43.3	2	1360.4	55
France	2352.7	5	1598.8	35	99.5	2	2702.9	58
Total Near Sea	1538.8	10	4845.3	31	239.2	2	8808.0	57

Table 4.4 Near Sea - U.K. Non-Fuel Imports by country and mode.

Source: H.M. Customs and Excise

[1] Other refers to conventional shipping and air freight. The latter accounts for 72,000 tonnes of near-sea trade in 1978. This represents 0.35% of "other" and so has been ignored.

Country	Mode							
	Lo/Lo		Road Ro/Ro		Rail Ro/Ro		Other	
	1000 Tonnes	%	1000 Tonnes	%	1000 Tonnes	%	1000 Tonnes	%
West Germany	361.8	11	881.2	26	5.7[1]	-	2124.9	63
Netherlands	209.7	5	753.0	16	1.5	-	3638.6	79
Belgium/Lux	172.3	4	612.3	15	2.4	-	3403.9	81
France	111.1	3	1060.1	29	3.8[1]	-	2522.6	68
Total Near Sea	854.9	5	3306.6	21	13.4	-	11690.0	74

Table 4.5 U.K. Near Sea Non-Fuel Exports - 1978 by country and mode.

Source: H.M. Customs and Excise.

[1]Note: These figures for rail movement are undoubtedly incorrect and are most probably a result of transcription errors at the point of recording. The market study described in Chapter 5 identified positively steel movements to France and West Germany by rail of 19 and 9 thousand tonnes respectively. The total rail carryings are thus likely to be a good deal higher though even if the figures above are wrong by a factor of 20 the rail share of total carryings would still be less than2%.

It is noticeable that rail accounts for an extremely small proportion of total movement (though see the note to table 4.5) and that there is a wide range in the proportion of traffic using conventional shipping. This ranges from 53% of West German imports to 81% of exports to Belgium. Generally conventional shipping is more predominant in export flows. There is also a marginal increase in container usage for West German and Dutch traffic possibly reflecting the greater sea distances involved. This is emphasised in 4.6 which presents part of an analysis made by Hayter and Wingfield of the 1978 unitised freight market.

Country	Percentage by			
	Container	Accompanied Trailer	Un-acc. Trailer	Rail
W. Germany	28.4	25.4	41.8	4.3[1]
Netherlands	29.3	27.7	41.4	1.5
Belgium/Lux	19.8	36.1	40.1	3.9
France	11.5	59.8	25.5	3.2[1]

Table 4.6 U.K. Near Sea Unitised Trade by country and unitised mode - 1978.

Source: Hayter & Wingfield (1981) Based on H.M.Customs & Excise Data.

Note: [1] See Note 1 to table 4.5

It is interesting to note that with the exception of France the unaccompanied trailer is the most popular unitised mode. It is probable that for French traffic the sea distances are so short as to make the cost advantages of unaccompanied trailer shipment less apparent. What is apparent is that road and conventional shipping dominate the near-sea freight movement though their shares can vary considerably between countries. In order to attempt to explain these variation it is necessary to consider firstly the commodity breakdown of trade and secondly to quantify modal costs and charges.

4.3 Movements by Commodity

As explained in chapter 3 I have adopted the SITC (Rev.II) classification of commodities. At a two digit level of disaggregation there are in excess of 60 groups. To tabulate all these groups by country would not be particularly helpful. I have therefore selected the major non-fuel commodity flows (i.e. in excess of 100,000 tonnes in 1978) for each trading partner. These are shown in table 4.7 for imports and 4.8 for exports. For both imports and exports it is clear that relatively few commodities account for the majority of movements in tonnage terms. Commodity flows in excess of 100,000 tonnes account for between 64.2% (Exports to West Germany) and 85.1% (Exports to Belgium) of non fuel trade movements. It is also apparent that a number of commodities occur in nearly all the country columns. In particular there are major flows of crude minerals, iron and steel, cereals, chemicals and plastics and road vehicles between the U.K. and some or all of the near-sea countries.

It is possible to identify a number of linkages at this level of disaggregation. The majority of crude mineral exports from the U.K. are marine dredged aggregates such as stones, sand and gravel. The flow of organic chemicals from the U.K. to the Netherlands, is balanced to some extent by organic chemicals from that country. This is partly due to companies such as ICI who are constantly transferring materials between their plant at Teeside in England and Rosenburg near Rotterdam. The cereal imports from the Netherlands are largely a reflection of entrepot activity at Rotterdam whilst a proportion of road vehicle flows arise from companies such as Ford and General Motors transferring components and "knocked down" cars between plant.

Country											
West Germany			Netherlands			Belgium/Lux.			France		
Commodity	'000 Tonnes	% of N-F Trade	Commodity	'000 Tonnes	% of N-F Trade	Commodity	'000 Tonnes	% of N-F Trade	Commodity	'000 Tonnes	% of N-F Trade
Iron & Steel	721.1	16.7	Organic Chemicals	534.5	13.3	Iron & Steel	432.2	17.6	Cereals	1442.1	31.1
Road Vehicles	377.4	8.8	Iron & Steel	525.2	13.0	Fertilizers	301.3	12.2	Crude Minerals	441.1	9.5
Animal Feeds	358.2	8.3	Cereals	445.6	11.1	Wood & Cork Manufacturers	207.1	8.4	Iron & Steel	360.9	7.8
Fertilizers	292.2	6.8	Animal Feeds	270.0	6.7	Crude Minerals	205.0	8.3	Fruit & Veg	312.7	6.7
Organic Chemicals	242.2	5.6	Fruit & Vegetables	259.8	6.4	Plastics	140.2	5.7	Organic Chemicals	270.5	5.8
Cereals	225.7	5.2	Mnfd.Fertilizers	227.3	5.6	Road Vehicles	124.3	5.0	Road Vehicles	212.3	4.6
Plastic	199.0	4.6	Inorganic Chemicals	191.5	4.8	Organic Chemical	119.3	4.9	Beverages	132.6	2.9
Inorganic Chemicals	171.1	4.0	Plastics	187.9	4.7	Cereals	112.1	4.6	Plastics	120.6	2.6
Paper Prods	159.3	3.7	Chemicals n.e.s	166.3	4.1	Total for 8 commodities	1641.5	66.8	Paper Prod.	119.4	2.6
Non-Ferrous Metals	115.8	2.7	Crude MInerals	120.6	3.0				Sugar	109.9	2.4
Other mineral Manufacturers	102.1	2.4	Paper Products	118.0	2.9				Chemicals n.e.s	107.4	2.3
Total for 11 commodities	2964.1	68.8	Meat & Preparations	107.2	2.7				Total for 11 Commodities	3629.5	78.3
			Total for 12 Commodities	3153.9	78.3						

Table 4.7 Near-Sea - U.K. Imports by country and major commodity - 1978.

Source: H.M. Customs & Excise.

Country											
West Germany			Netherlands			Belgium/Lux.			France		
Commodity	'000 Tonnes	% of N-F Trade	Commodity	'000 Tonnes	% of N-F Trade	Commodity	'000 Tonnes	% of N-F Trade	Commodity	'000 Tonnes	% of N-F Trade
Crude Minerals	1136.1	33.7	Crude Minerals	2034.1	44.3	Crude Minerals	2536.5	60.5	Crude Minerals	1722.4	46.6
Iron & Steel	337.0	10.0	Organic Chemicals	883.2	19.2	Cereals	293.9	7.0	Cereals	361.0	9.8
Cereals	289.9	8.6	Cereals	180.9	3.9	Organic Chemicals	288.6	6.9	Iron & Steel	204.6	5.5
Ores & Scrap	261.5	7.8	Iron & Steel	173.6	3.8	Road Vehicles	217.7	5.2	Organic Chemicals	193.4	5.2
Road Vehicles	141.5	4.2	Fruit & Veg.	111.5	2.4	Ores & Scrap	118.6	2.8	Total for 4 Commodities	2481.4	67.1
Total for 5 Commodities	2166.0	64.2	Non-ferrous Metals	100.1	2.2	Iron & Steel	112.4	2.7			
			Total for 6 Commodities	3483.4	75.8	Total for 6 Commodities	3567.7	85.1			

Table 4.8 U.K. - Near-Sea Exports by country and major commodity - 1978.

Source: H.M. Customs & Excise.

It is still necessary, however, to effect a higher level of disaggregation in order to gain a better understanding of the relationship to transport demand. This is done in section 4.5 when commodity/mode relationships are examined. Before that I wish to quantify some of the features of the transport modes within the near-sea trading context.

4.4 Modal Characteristics

In this section I wish to consider the costs, charges and other service factors that exist in the near-sea transport market. I propose to cover road ro/ro, containers, rail ro/ro and conventional shipping in considering the main factors.

4.4.1 Road Ro/Ro - as we have seen there are two operational alternatives for this mode; i.e. whether the trailer is accompanied by a tractor unit and driver for the sea crossing or whether it is shipped alone. The former results in higher costs (both fixed and marginal) over the entire trip whilst the latter only incurs this level of costs for the portion of the trip between ports and inland points. Hayter and Wingfield state that the advantage of sending trailers accompanied from an operational viewpoint arise through greater flexibility in acquiring return loads where there are traffic imbalances and a faster transit and turnround time leading to improved profitability. In addition the income (allowing for agents fees, ferry costs etc) remains in the hands of a single haulier rather than being split between two operators. Delay to unaccompanied trailers can be much greater though the costs of delay in terms of equipment are obviously less than an equivalent delay to accompanied units. For this reason the latter would tend to avoid the longer sea journeys which result in high fixed costs for each trip and reduced vehicle productivity. This trend was noted in section 4.2 where the greatest proportion of accompanied vehicles was on the French routes where sea crossings are relatively short. Table 4.9 gives some costs comparisons compiled by Hayter and Wingfield.

Voyage in hours	Total Trip Costs[1] (£)		Cost in £/tonne[2]	
	Trailer	Accompanied	Trailer	Accompanied
1.5	133.56	206.78	10.39	16.09
2.5	134.05	214.89	10.43	16.72
4.5	134.88	231.11	10.49	17.98
6.5	135.91	247.33	10.57	19.24
8.5	136.96	263.55	10.65	20.51
10.5	138.06	279.76	10.74	21.77

Table 4.9 Ro/Ro costs by operating method and ferry crossing times - 1978 prices.

Source: Hayter and Wingfield 1981

Notes: [1]These are costs for the cross sea trip excluding ferry, port and documentation charges.

[2]Based on an average load of 12.85 tonnes per unit

Return loads are assumed available in all cases.

It is clear that accompanied vehicle costs are much more sensitive to crossing time. However it should be noted that if an empty return cost is incorporated with trailer costs (since this is more likely to happen with unaccompanied units) then costs per tonne almost double.

With regard to charges a recent study (Coopers and Lybrand, 1980) surveyed road hauliers who operate Services between the U.K. and the the continent. The results are shown in table 4.10 which includes surveyed estimates for container and rail movements for comparison.

Mode	Costs per tonne[1]
Road Ro/Ro	£3.12 + 0.034 per mile
Lo/Lo	£3.40 + 0.0338 " "
Rail Ro/Ro[2]	£5.54 + 0.0236 " "

Table 4.10 Surveyed Modal Charges - 1979

Source: Cooper & Lybrand Report to the EEC.

Notes: [1] In 1979 prices

[2] Charges shown are for France. Charge for Germany was £17.26 + 0.016 per mile.

Whilst it is apparent from table 4.10 that road is marginally more expensive than the other two unitised modes it is not clear to what extent disoounts have been included. A possibly more meaningful presentation is shown in figure 4.1 which presents a series of 'rate bands" based on a ro-ro trip emanating from Birmingham to major continental locations. The rates are based on published tariffs for unit load movements suppled by a number of U.K. hauliers. It is not possible to construct similar figures for rail and lo/lo due to the paucity of information though it is likely that they will be of the same order of magnitude.

The other major quantifiable factor is transit times and table 4.11 presents estimates by Coopers and Lybrand (1980) for the three unitised modes.

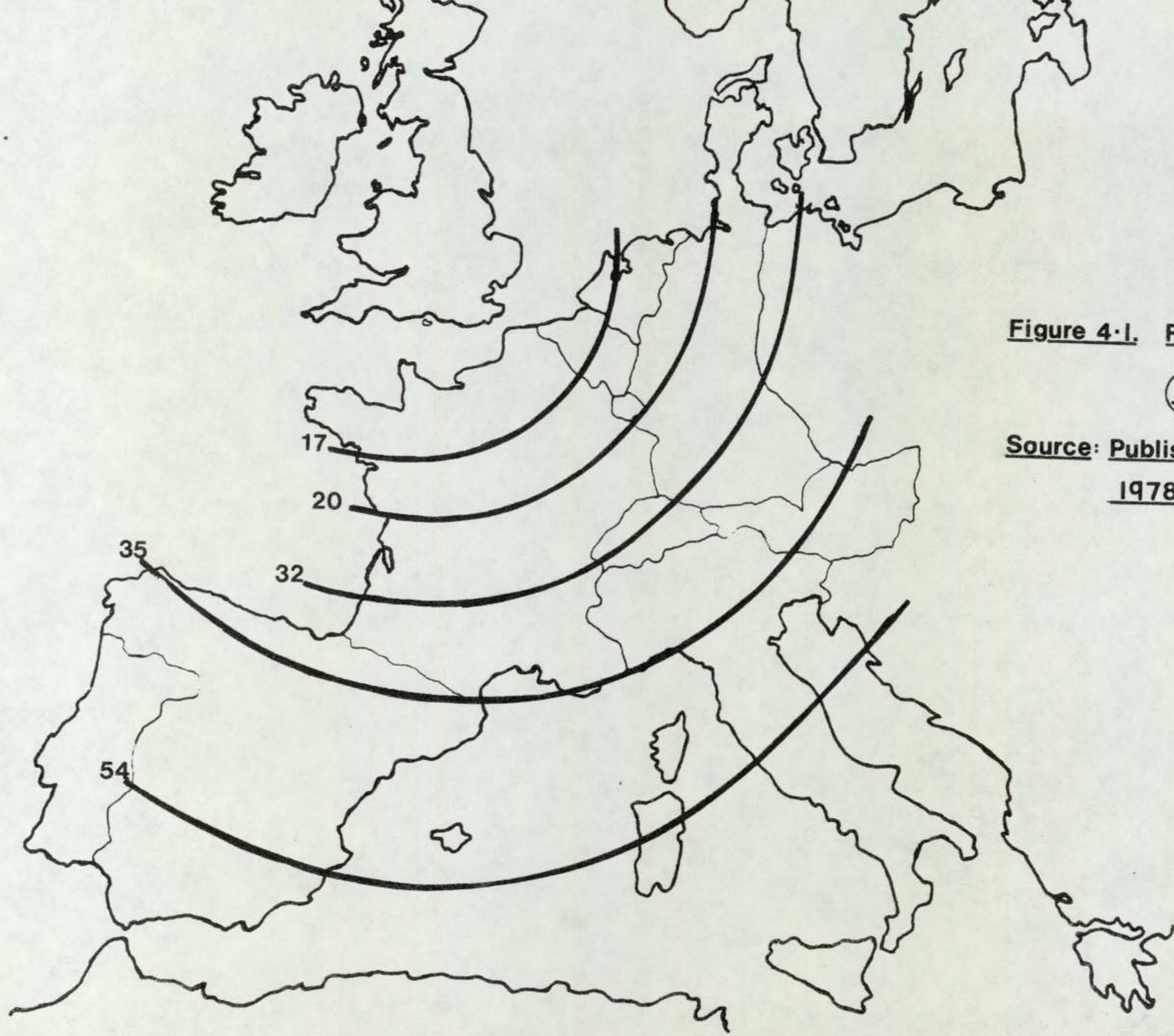

Figure 4·1. Rate bands: RO-RO
(£ per tonne)

Source: Published Road Haulage Rates 1978.

Mode	Transit Time[1] (in hours)	Port Time (in hours)
Road Ro/Ro	16.0 + 0.058/mile	1.5
Lo/Lo	24.00 + 0.104/mile	66.0
Rail Ro/Ro	48.00 + 0.288/mile	56.0

Table 4.11 Surveyed Modal Transit Times for U.K. - Continental Movements.

Source: Coopers & Lybrand 1980

Note [1]Sea crossing time is excluded

It is clear from this evidence that road has a major advantage in this field though it is likely that the port times for unaccompanied trailers would be somewhat greater than 1.5 hours.

4.4.2 Container Lo/Lo - cost structure for container movements are not dissimilar to those faced by trailers- particularly in that both can suffer from the absence of backloads on extended journeys. Containers can be moved inland by either rail,road or waterway and so have the advantage of being able to utilise which ever is the most cost-effective mode. In addition the choice in container sizes (re. 20' and 40'). means that for commodities with a high volume to weight ratio the smaller unit can be used thereby reducing the required shipping space and possibly allowing for consolidation on inland movements - i.e. two 20' units travelling on one 40' trailer. Hayter and Wingfield (1981) have compared the inland delivery costs of containers and trailers which are shown in table 4.12.

Inland Distance km.	Total Delivered cost for container[1]		Trailer Cost[2]
	By Road £	By Rail £	£
100	253	267	278
200	307	307	332
300	361	353	386
400	394	390	419

Table 4.12 Cost comparison between container and trailer delivery 1978 prices

Source: Hayter and Wingfield 1981

Note: 1 Based on Freightliner charges for 40' containers including port and terminal elements.

2 Based on costs for unaccompanied trailers

The broad similarities between trailers and containers supports the contention made in Section 4 .4.1 that the difference in rates between two will not be great. However as table 4.11 shows the difference in transit times can be substantial. Other factors that may influence the use of containers include the ownership and maintenance of "in-house" contracts (though most are supplied by the operators) and possible advantages relating to security and protection from damage.

4.4.3 Rail Ro/Ro - cost information on train ferry movements is not directly available though it is likely that in common with most rail freight the lower cost of movement is balanced by higher terminal costs and so the mode is generally most cost-effective when flow volumes are high. As we have seen transit times are considerably greater than ro/ro and so vehicle utilization is much lower.

As regards charging ferry wagon pricing is achieved through published tariffs agreed with railway administrations. The tariffs relate to wagon loads moved in railway owned wagons; privately owned wagons are subject to a loaded journey rebate.

Crucially, the tariffs are subject to rebates, allowable without reference to the participating continental railway authority up to agreed limites. This leads to a wide range of charges levied between the published tariffs and maximum rebates, and it appears that full details of rebates negotiated over and above the 'non-reference' level are not always disclosed between railway administrations.

The tariffs generally comprise a fixed charge relating to the cross chennel-elements, and a basic charge for each participating-railway representing terminal charges - and a charge per kilometre for the inland U.K. leg and the inland continental leg.

A major consideration is the availability of a private siding to enable the firm to load or unload directly to or from the rail wagon. If a change of mode is necessary in order to ship by rail it is quite likely that an alternative will prove cheaper. Accordingly it is apparent that rail can only be expected to compete in a fairly limited area fo the market though as we shall see in chapter five its presence in this area can be substantial.

4.4.4 Conventional Shipping - section 3.2.2 discussed the major cost elements associated with this mode and due to the wide variety of influential factors (e.g. inland distance, flow size, commodity characteristics etc) it is not considered possible to provide any meaningful quantification of costs in this section. Figure 4.2 presents a series of rate-bands for movements by this mode for flows

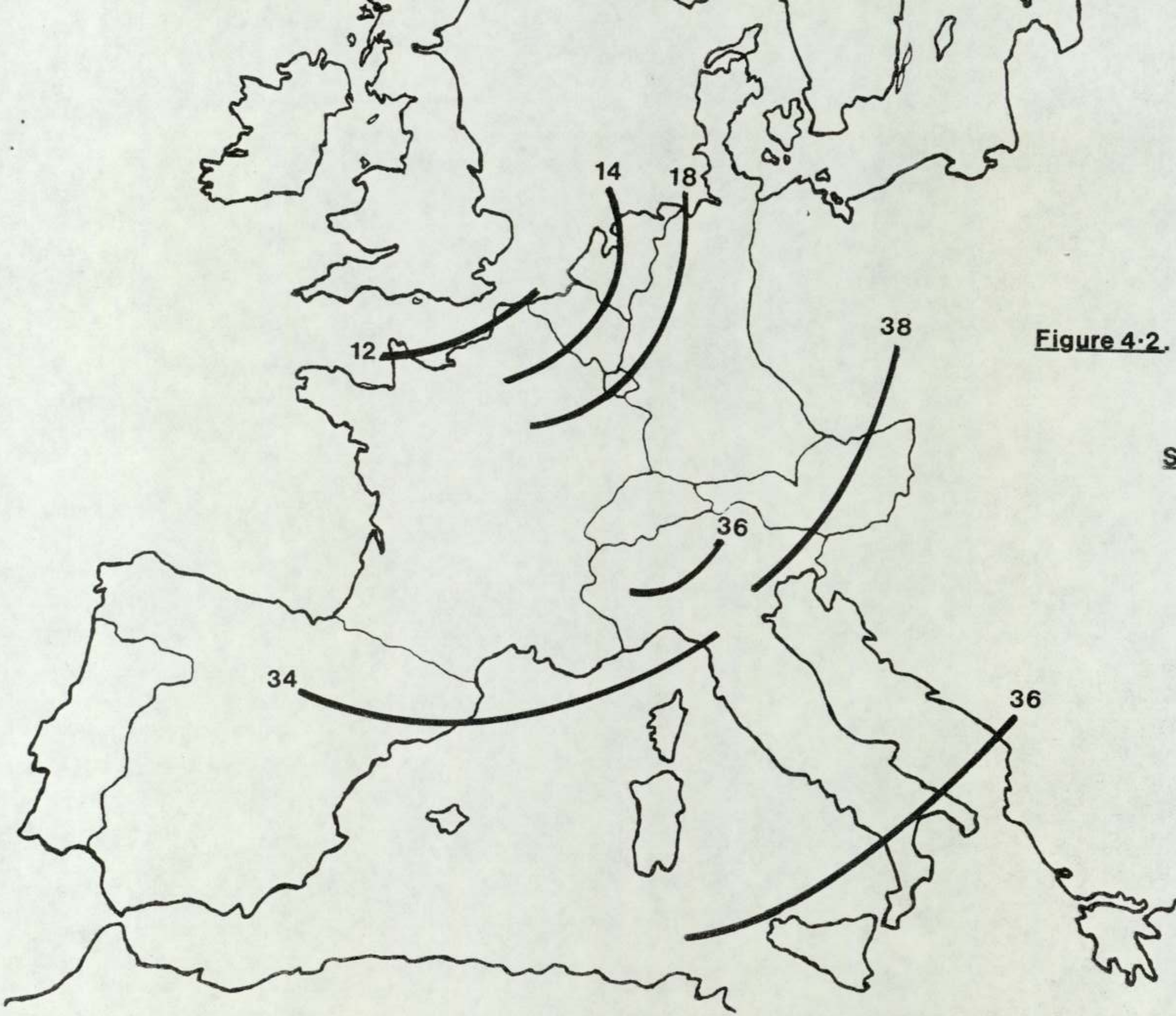

Figure 4·2. Rate bands: Charter Shipping (£ per tonne)

Source: Transmark 1979

in excess of 15,000 tonnes from English coastal origins to various continental distinations. It is clear that there are considerable cost advantages over ro/ro where locations and flow sizes are suitable. Transit times are almost always longer though often not a determining factor. In addition commodites are more susceptible to damage or deterioration when sent by this mode.

Those flows that are suitable for conventional shipping movement are, therefore, most likely to meet competition from other modes when there is a considerable inland distance to be covered.

4.5 Commodity/Mode Relationships - this section draws together the previous discussion in order to determine to what extent the nature of a commodity is related to modal choice and vice versa. Tables 4.13 and 4.14 show the modal breakdown for major non-fuel commodity flows between the U.K. and the near-sea continent. It is apparent that there is a wide range in modal shares between commodities. For example 95% of cereals imports from the Netherlands move by conventional shipping whilst only 12% of Dutch imports of fruit and vegetables use this mode. The flow sizes are both large (445,000 and 260,000 tonnes in 1978 respectively) so the nature of the commodities themselves must be an important determinant of modal choice. To a lesser extent there are differences within a commodity flow between countries. For example the conventional shipping share of organic chemical imports ranges from 56% (West Germany) to 81% (France) and for steel exports between 37% (France) and 70% (West Gernmany). Generally however there is a measure of consistency whereby most of the commodities listed tend to a particular mode.

Commodity	Country															
	West Germany				Netherlands				Belgium/Lux.				France			
	Lo/Lo	Ro/Ro	Rail	Conv. Ship	Lo/Lo	Ro/Ro	Rail	Conv. Ship	Lo/Lo	Ro/Ro	Rail	Conv. Ship	Lo/Lo	Ro/Ro	Rail	Conv. Ship
Cereals	3.8	1.2	0.2	94.8	4.1	0.6	-	95.3	15.0	3.0	-	82.0	3.9	0.2	0.5	95.4
Iron & Steel	5.7	9.9	0.4	84.0	1.0	4.5	-	94.5	3.7	7.9	8.7	79.7	6.6	22.0	4.0	68.4
Fertilizers	1.4	0.4	0.8	97.4	26.5	1.0	-	72.5	1.6	-	0.8	97.6	6.3	3.6	5.6	84.5
Organic Chemicals	8.6	35.3	0.6	55.5	8.0	9.8	1.6	80.6	7.9	34.3	0.6	51.2	1.2	17.2	0.7	80.9
Road Vehicles	11.1	20.5	0.4	68.0	4.2	33.7	-	62.1	10.9	42.0	0.8	47.3	-	38.5	-	61.5
Fruit & Veg	+	+	+	+	14.0	74.0	-	12.0	9.4	84.2	-	6.4	1.0	93.7	3.7	1.6
Animal Feeds	0.9	0.9	-	98.2	4.8	4.8	-	90.4	+	+	+	+	1.4	13.7	-	84.9
Plastics	16.8	80.3	0.9	2.0	19.9	68.7	1.3	10.1	19.8	76.8	0.7	1.6	3.5	94.7	-	1.8
Inorganic Chemicals	23.8	21.6	2.7	51.9	20.2	8.8	-	71.0	9.3	10.5	-	80.2	20.9	37.8	7.2	34.9
Paper Prods.	21.8	73.9	1.0	3.3	9.8	64.1	-	26.1	8.8	82.9	-	8.3	2.5	92.7	-	4.8
Crude Minerals	10.8	9.8	2.4	77.0	12.4	1.7	-	85.9	0.2	1.8	-	98.0	2.6	2.5	5.7	89.2
Non-ferrous Metals	4.8	42.3	1.6	51.3	34.2	17.1	37.0	11.7	9.4	39.0	-	51.6	13.3	78.9	-	7.8

Table 4.13 U.K. - Near-Sea Imports - 1978. Major non-fuel commodities by mode (percentages)

Source: H.M. Customs & Excise.

\+ Total flows < 25,000 tonnes.

Commodity	Country															
	West Germany				Netherlands				Belgium/Lux.				France			
	Lo/Lo	Ro/Ro	Rail	Conv. Ship	Lo/Lo	Ro/Ro	Rail	Conv. Ship	Lo/Lo	Ro/Ro	Rail	Conv. Ship	Lo/Lo	Ro/Ro	Rail	Conv. Ship
Crude Minerals	2.0	1.0	-	97.0	3.8	4.2	-	92.0	1.0	4.5	-	94.5	0.4	0.9	-	98.7
Iron & Steel	11.8	18.4	0.2	69.6	6.3	29.8	-	63.9	3.7	29.3	0.4	66.1	4.3	58.5	-	37.2
Organic Chemicals	6.6	32.9	0.1	60.4	2.0	3.0	-	95.0	0.8	5.6	-	93.6	1.2	17.8	-	80.8
Cereals	1.5	4.3	-	94.2	3.1	4.0	-	92.9	0.6	0.9	-	98.5	0.2	3.8	-	95.3
Ores & Scrap	5.5	13.8	0.1	80.6	+	+	+	+	7.0	7.0	-	86.0	6.6	6.0	-	87.4
Road Vehicles	41.1	36.5	0.4	22.0	7.4	50.7	0.5	41.4	29.4	54.2	0.2	16.2	2.0	64.9	-	33.1
Fruit & Veg	16.5	67.8	-	15.7	3.3	25.6	-	71.1	+	+	+	+	2.1	45.0	-	52.9
Non-ferrous Metals	28.1	31.5	0.1	40.3	12.8	76.0	-	11.2	+	+	+	+	15.3	54.6	2.0	28.1

Table 4.14 U.K. Near-Sea Exports - 1978. Major non-fuel commodities by mode (percentage).

Source: H.M. Customs & Excise

+ Flow < 25,000 Tonnes

Table 4.15 summarises the share of unitised modes for all near-sea trade for the 13 largest non-fuel commodity flows. It has already been established that modal split between ro/ro and lo/lo may well be determined by sea distances and so in considering commodity relationships it is most useful to compare the combined unitised modes with conventional or chartered shipping. Table 4.15 also provides the National Ports Council "traffic definition" of each commodity division and a pattern does emerge. Generally the penetration of unitised modes into the "bulk" commodity flows is very limited. The exception are animal feed exports and ore and scrap imports though in both cases the total flows are relatively small and can be discounted. Otherwise conventional shipping accounts for at least 80% of all movements in this sector.

Unitised mode penetration in the unitised commodity market is generally high. The major exceptions non-ferrous metal exports and road vehicle imports. The former include flows of semi-finished aluminium in ingot form from Anglesey Aluminium in North Wales and British Aluminium in Scotland to the Netherlands, aluminium is therefore really a semi-bulk commodity within the non-ferrous metals division. The apparent low penetration of unitised modes in the import of road vehicles is essentially a definitional problem. Trade cars etc. in finished form are usually driven on and off ships under their own power. If the shipping service is a conventional ro/ro operation the modal classification used by H.M.Customs is ro/ro. However, if the vessel is chartered exclusively for the movement of trade cars the classification used is "other". In both cases the cross-sea mode is ro/ro. The modal shares for the semi-bulk flows are less susceptible to generalisation and are discussed in the following section.

Commodity			Tonnes 1978 ('000)		% by unitised modes	
Division	Type	Class[1]	Imports	Exports	Imports	Exports
04	Cereals	B	2225.5	1075.7	5.3	4.8
05	Fruit & Veg.	U	630.9	179.3	93.2	40.3
08	Animal Feeds	B	955.0	104.8	4.6	30.4
27	Crude Minerals	B	834.2	7429.1	10.6	1.4
28	Ores & Scrap	B	205.0	468.9	33.5	18.9
51	Organic Chemicals	SB	1166.5	1449.6	26.9	9.1
52	Inorganic Chemicals	SB	525.4	107.4	38.6	70.9
56	Fertilizers	SB	879.8	222.3	9.8	2.7
58	Plastics	U	647.6	231.0	95.4	93.4
64	Paper Products	U[2]	436.5	184.9	89.9	86.6
67	Iron & Steel	SB	2039.4	827.6	17.0	40.1
68	Non-Ferrous Metals	U	306.5	243.7	65.2	43.1
78	Road Vehicles	U	744.9	520.1	37.6	75.4

Table 4.15 Summary of major non-fuel commodities moved on U.K. - Near-Sea routes in 1978.

Source: H.M. Customs & Excise.

Notes: [1] Where B = Bulk
U = Unitised
SB 2 Semi-Bulk
Based on NPC definitions

[2] This commodity is normally classed as semi-bulk due to the major flows of newsprint etc. from Scandinavia. Within a near-sea context however they can be classified as unitised.

In conclusion an overall relationship between commodity and mode does exist. The National Ports Council (1977) have made an extensive analysis of the relationship between unitised penetration and commodity value for U.K. overseas trade. Their conclusion was that whilst there was a strong relationship between low unitised penetration for very low value commodities (and vice versa for very high value commodities) this relationship was much weaker for commodities with less extreme unitised penetration or value. There are of course other influences such as perishability, susceptibility to damage and security are all important commodity characteristics that may determine modal choice. It is therefore possible to identify causal links between commodity and mode at this level of aggregation though the number of exceptions and inconsistencies are such that a more detailed examination is necessary. This is undertaken in chapter 5.

4.6 Semi-bulk commodities - these can be defined as commodities that would normally be classified as unitisable but which for particular flows have the characteristics of bulk traffic. These commodities include iron and steel and chemicals and in total account for around half of all U.K. trade. Table 4.15 underlines the importance of the group within a near sea context where they account for 30% of the top 13 commodity flows.

The four commodities shown in table 4.15 do not exhibit any pattern with regard to unitised penetration. This figure ranges from 3% for exports of fertilizers to 71% for exports of inorganic chemicals. Indeed it could be argued that the former should be placed within the bulk category due to the extremely low level of penetration by unitised modes. The modal shares however are distorted by the high volume of intra company movements between the U.K. and near sea countries which utilise conventional shipping. Flows of this commodity to other countries generally exhibit unitised characteristics. Otherwise it is apparent that there is a considerable variance between modes within the group though in nearly all cases conventional shipping accounts for a significant share.

This is the most important characteristic of the semi-bulk sector from an analytical viewpoint in that it is with these commodity flows that competition between unitised and bulk modes is likely to be greatest. Analysis of the semi-bulk sector is therefore likely to provide the most comprehensive coverage of modal choice criteria.

The semi-bulk sector is also important for the following reasons:

(i) Total flow sizes tend to be significant

(ii) Many of the commodities are of an intermediate nature - i.e. they will normally undergo further processing. Accordingly they are mainly to manufacturing industries who may themselves be able to influence the modal choice decision

(iii) Due to their semi-finished nature they do hold a somewhat higher value per tonne than bulk commodities but a lower one than most unitised commodities. It is therefore often not possible to attribute modal choice on a basis of commodity value alone. Furthermore most semi-bulk commodities exhibit a wide range of unit values within each division thereby complicating analysis.

(iv) The commodities also tend to be despatched in a wide range of consignment sizes - a factor that is likely to have considerable bearing on modal choice.

Whilst the semi-bulk commodities can be seen to exhibit a number of common factors there are a number of significant differences between commodities within the sector (e.g. physical characteristics, industrial structure and location etc) that create analytical difficulties. It is argued, therefore, that in order to gain a full understanding of the factors determining flow patterns and modal and route choice it is necessary to treat each commodity and its associated flows individually. This is undertaken in the following two chapters when the case of steel trade is examined in detail.

5.0 THE U.K. - NEAR SEA MOVEMENTS OF STEEL

5.1 Introduction

This chapter and the following one concentrates on a specific industrial/ commodity sector in an attempt to establish the relevance of some of the hypotheses regarding transport demand and modal and route choice made in the previous chapters. The sector chosen is iron and steel (SITC commodity division 67) for the following reasons:

(i) There are significant movements of the commodity between the U.K. and all the near-sea countries

(ii) There are relatively few major steel producers in each country and so difficulties of adequate market research coverage are lessened.

(iii) The steel industry is one that is fairly self contained. In other words there are few instances of conglomerates involving steel companies in the study area. Accordingly corporate influences emanating from outside the industry are rare.

(iv) The commodity is, in transport terms, relatively homogenous so most companies are producing the same type of steel, and are competing in the same market.

(v) Whilst steel has a wide range of uses the major customers are the automotive, engineering, construction and energy sectors. Industrial linkages can therefore be made for the majority of steel output.

As stated in Chapter 1 the analysis of freight movements can be divided into three areas: analysis of total demand, analysis of inter-regional flows and the analysis of modal split. This chapter and the following follow this general line of approach. Following a discussion of steel demand section 5.3 examines the industrial structure and location of the steel industries and identifies the major producers in the U.K. and the near sea countries. This is followed by an analysis of iron and steel movements between the U.K. and these in aggregate terms. Section 5.4 is based on a market survey of major steel producers in the study area and presents an analysis of inter-regional flows. Chapter 6 examines the criteria that govern modal and route choice and attempts to identify some of the factors that may influence future trading and transport patterns.

Much of the data presented in these two chapters was obtained by the author whilst working on a study commissioned by the BRitish Railways Board to determine the likely market shares of the proposed fixed rail link between the U.K. and France. The study covered a number of bulk commodities and was undertaken by Transmark - the BRB's consultancy subsidiary. The author had special responsibility for the iron and steel sector. In order to preserve undertakings of confidentiality it is not possible to detail individual flows. However consideration of flows at an inter-regional level of aggregation is quite sufficient for the purposes of this analysis.

5.2 Steel Production and Demand

As an introduction to the analysis it is useful to briefly consider some of the underlying factors that influence the movement of steel: in particular the production of and demand for steel.

The demand for steel is very much a derived demand. In other words it.is required as an input to a manufacturing process in order to produce some other good. Gielnik and Phipps (1977) have derived a generalised breakdown of sectoral industrial consumption of steel for a "typical" industrialised country. This is shown in Table 5.1.

Industrial Sector	Type of Steel consumed	Percentage of total steel consumption (range)
Construction	rod,sections and wire	25-35
Engineering (inc.energy)	Plate, sheet and Tubes	15-25
Automotive	Sheet & bars	15-30
Other (mainly shipbuilding, containers domestic appliances)	Various	25-35

Table 5.1 Sectoral steel consumption in a typical industrialised country.

Source: Gielnik and Phipps.

The demand for steel is therefore very much dependent on demand in the consuming industries. Furthermore Rowley (1973) has pointed out that the unit demand for steel will tend to decline after some point in a country's economic development due to the substitution of more efficient or cheaper materials (e.g. Aluminium and plastic), improved efficiencyin design (e.g. box girder bridges etc) and a change in consumption patterns. This can be shown through the use of a "steel intensity" factor that expresses the relationship between steel consumption and per capita GNP. Table 5.2 shows this factor for three areas at differing stages of industrial development.

Area	Steel Intensity (kg. of steel/GNP per capita[3])				
	1956-1960	1961-1965	1966-70	1972	1980[1]
EEC	.247	.241	.241	.229	.224
Latin America	.134	.135	.150	.162	.200
Africa[2]	.089	.092	.096	.118	.128

Table 5.2 Steel intensity over time for selected areas

Source: Rowley (1973)

Notes [1] Forecast

[2] Excludes South Africa

[3] In dollars at 1963 prices

Rowley concludes that there are four stages in steel consumption. Before economic "take-off"[1] steel intensity is very low, it then rises rapidly reflecting investment in construction and other infrastructure. This is then followed by a period of stability after which steel intensity will tend to decline as an economy moves out of the more basic industrial sectors to high technology products and services.

The general synopsis is therefore for a decline in relative steel consumption in the study area. Long term forecasts for most consuming sectors also point to either lower growth or actual decline in output. There has been therefore the prospect of absolute decline in steel demand as well.

These factors have led to a major (and continuing) upheaval in the steel industry within the study area since the factors above have combined with a lengthy period of recession to produce an unprecedented fall in the demand for steel. Table 5.3 illustrates the

[1] See Rostow (1960)

situation over the period 1974-1977 within the EEC.

Indicator	Period (Jan - June)		
	1974	1976	1977
Production (m. tonnes crude steel)	78.4	67.3	65.0
% capacity utilisation	87.6	68.1	64.5
Order book (m.t. product)	60.6	49.6	47.5
Imports (m.t. crude steel)	4.0	6.2	6.0
Exports (m.t. crude steel)	15.0	9.1	11.4

Table 5.3 EEC Steel Indicators

Source: EEC

These uneconomic levels of capacity utilisation have led to plant closures, redundancies and short-time working throughout the study area together with widespread price cutting and accusations of "dumping". The situation is exacerbated by the continued use of obsolete plant leading to poor productivity levels, the extensive lead times in bringing new plant on stream and the emergence of low cost exporters in South America and the Far East.

The EEC decided that these factors justify some form of regulation and under the Davignon plan "voluntary delivery quotas" and "guideline minimum prices" were introduced in 1977. The aim of this plan was to attempt to ameliorate the immediate effects of the crisis but also to bring about a structural change within the industry by removing obsolete surplus capacity and regulating new investment. The extent to which these efforts will be successful is not yet apparent.

Whilst the foregoing is only of incidental interest in, say, the determination of modal choice, it is of crucial importance in determining future flow levels and is returned to in Section 5.6

5.3. Structure and Location

This section investigates the industrial structure of steel production within the U.K. and the near-sea countries. This will provide a basis for relating location patterns and structure to the demand for transport. Each country is considered in turn to gain an initial overview the most recent figures for steel production are presented in Table 5.4.

Table 5.4. Study Area Countries Steel Production Figures 1978 ('000 Tonnes) [1]

Method of Production	Country				
	UK	West Germany	Belgium Luxembourg	France	The Netherlands
Open Hearth	1764	4523	-	425	-
Oxygen	11336	30764	12047	17864	5278
Electric Arc	7200	5968	551	3440	312
Other	11	-	3	1085	-
TOTAL	20311	41253	12601	22841	5590
Total Finished Steel[2]	15305	30198	9680	19372	3692

Source : EEC

Notes: 1. Figures are for liquid steel

2. This includes hot rolled semi-finished steel not re-rolled by the steel industry.

It will be noted that both the U.K. and West Germany were still producing significant amounts of steel by the obsolete open hearth method. This is estimated by Cockerill (1976) to increase unit production costs by as much as 40% over the basic oxygen process. As already mentioned the industry has undergone a sustained period of rationalisation in an attempt to adjust capacity to a lower level of demand. The series of mergers and closures that have resulted are still in progress though the following discussion relates to the situation in 1978 unless otherwise stated.

5.3.1. The U.K. Steel Industry

The U.K. is dominated by the British Steel Corporation which accounted for 85% of this country's liquid steel production in 1978. The breakdown of production for the period 1973 to 1977 is shown in Table 5.5.

Table 5.5. U.K. Liquid Steel Production by Sector 1973-1977

M. Tonnes Liquid Steel	1973	1974	1975	1976	1977
B.S.C.	23.0	20.8	17.2	19.7	17.4
Private	3.6	1.5	2.9	2.6	3.0
Total	26.6	22.3	20.1	22.3	20.4

Source: Iron and Steel Annual Statistics, 1977 (ISSB, 1978).

Despite the dominance of BSC there are a number of significant private producers though their product range is rather limited.

i) BSC - Organisation and Structure - The corporation has been subject to a number of organisational changes since its creation in 1966. These have attempted to obtain the correct blend of production and marketing orientation. At present the organisation is split into 6 divisions that are, predominantly, geographically designated around one or two major plants. It is apparent from Table 5.6 however, that in certain cases plant is allocated to a Division on a product basis. In addition the corporation has established a number of product units responsible for both marketing and plant loadings.

Table 5.6 BSC Division's, Major Plant and Products

Division	Major Plant	Main Products
Scottish	Ravenscraig, Gartcosh Dalziell	Plate, Hot rolled and Rolled Coil, Angles, Flats
Scunthorpe	Scunthorpe, Shelton	Plate, Wire Rod, Billets
Sheffield	Rotherham, Stocks-bridge and Tinsley Park, Panteg, Wolverhampton and Bilston	Special Steels in all form (including stainless)
Teeside	Lackenby, South Bank Consett, Redcar	Plate, H.R. & C.R. Coil, Special Sections
Tubes	Corby, Hartlepool	Tubes
Welsh	Llanwern, Port Talbot Ebbw Vale, Shotton	H.R. and C.R. sheet and coil, coated steels

The investment strategy of BSC over the past eight years has been to concentrate on the development of very large steel-works on or near the coast. This philosophy has attempted to obtain maximum economies of scale both in production and in the procurement of raw materials. Thus, it is argued, coastal steelworks are able to take full advantage of bulk shipments of iron ore and coal and thus further reduce unit costs. This development has meant the closure of a number of outdated steelworks situated inland - though in many cases finishing facilities have been retained with a consequent increase in the movement of semi-finished steel within the Corporation.

The Sheffield division is a major exception to this general rule in that the majority of investment has been inland in the Sheffield area. This is mainly due to the divisions exclusive use of electric arc steel furnaces which are reliant on scrap as their major raw material. Ferrous scrap is generated within the U.K., mainly in the West Midlands and Sheffield regions.

ii) The U.K. Private Sector - There are a number of very large private sector firms producing steel though all exhibit a high degree of forward integration into engineering, fabrication and stockholding. There are in addition a number of small specialist producers and finishers producing high quality steels. Table 5.7 lists the main private sector companies.

Table 5.7. U.K. Private Sector Steel Producers

Company	Location	Capacity [1]	% of Total P.S. Capacity
Alphasteel	Newport	1000	25
Dunford-Hadfields	Sheffield	175	4
Duport	West Bromwich, Llanelli	500	12
GKN	Brymbo, West Midlands	450	11
Round Oak Steel Works	Brierley Hill	715	18
Sheerness Steel	Sheerness	450	11
T.I. [2]	West Midlands	-	

Notes:

[1] Capacity in '000 Tonnes of liquid steel p.a.

[2] T.I. are tube manufacturers and do not produce any raw steel as such. They do, however, have a 50% holding in Round Oak. B.S.C. hold the other 50%.

The major locations for the private sector are Sheffield, South Wales and the West Midlands. The plant is generally smaller than BSC's as they deal mainly in special steels. For this reason they were not nationalised in 1966. Some of the newer plant has been constructed away from these areas (noteably Sheerness) to take advantage of locally available scrap supplies.

5.3.2. France

The major French steel producers are listed in Table 5.8. It is apparent that Usinor and Sacilor dominate the industry, accounting for over 80% of actual production. In addition both have significant holdings in other French steel companies - including Sollac and Solmer, the 3rd and 4th largest companies.

Table 5.8 French Steel Producers

Company	Location	Capacity [1]
Usinor	Dunkirk, Longwy, Mardyck	11.7
Sacilor	E. France (Hayange, Metz)	4.1
Solmer	Fos-sur-Mer	3.5
Sollac	Seremange (nr. Longwy)	2.4
Chiers-Chatillon	Longwy, Metz	2.0
Creusot-Loire	Dunkirk, St. Etienne	1.5
Ugine Aciers	Ugine, Fos-sur-Mer	1.0
Pompey	Pompey (nr. Metz)	1.0

Note: [1] Capacity in million tonnes liquid steel

Source: Metal Bulletin

The degree of concentration, therefore, is very high with the only large independent steel producer being Chiers-Chatillon. The remaining three producers listed above are all special steel manufacturers. Creusot-Loire have integrated forward into, amongst other things, heavy engineering and kitchenware. Ugine Aciers are part of the PUK group (a metals and chemicals conglomerate) whilst Pompey were taken over by Sacilor in 1979.

Historically French steel production has been concentrated in the Metz, Thionville, Longwy region of Eastern France. More recently, however, there have been large scale investments in coastal sites at Dunkirk in the north and Fos-sur-mer near Marseille in the south. There is also some production by smaller companies located in Normandy and St. Etienne. The recent rationalisation in the industry suggests that future production will be concentrated on the newer coastal plants at the expense of the traditional areas in the east.

5.3.3. West Germany

Whilst there has been a spate of take-overs and mergers in the West German steel industry within the last decade there are still a number of large independent producers. The major companies are listed in Table 5.9.

Table 5.9. West German Steel Producers

COMPANY	LOCATION	CAPACITY (m.t.l.s.)
Thyssen	Duisburg, Krefeld	18.4
Krupp	Bochum	6.5
Hoesch	Dortmund	6.4
Mannesmann	Duisburg, Dusseldorf	5.4
Peine. Saltzgitter	Peine	5.3
Klockner	Duisburg, Bremen	4.8
Rochling-Burbach	Saarland	4.5

Source: Metal Bulletin

All of the major companies display a high degree of both vertical and horizontal integration. Thyssen, for example have large engineering subsidiaries as well as dealing in chemicals and cement. As mentioned above most of the big companies are independent though Hoesch is owned by Estel, which also controls the Dutch producer, Hoogovens. In addition, most of the majors have substantial holdings in smaller steel companies both in Germany and elsewhere in Europe.

The vast majority of German steel production is concentrated in the Ruhr area around Duisburg and Bochum. Other significant areas of production are Bremen, Peine and the Saarland. Generally the German steel industry has fared better than most and with the exception of the Saar region, rationalisation has been comparatively minor. In the Saarland the three main producers were taken over in 1978 by the Luxembourg producer, Arbed, who with Federal assistance intend to concentrate production on the Volklingen plant of Rochling-Burbach.

5.3.4. Belgium and Luxembourg

The major steel producers are listed in Table 5.10 - for comparative purposes, the only major Dutch producer has also been included.

Table 5.10 Major Benelux Steel Producers

Company	Location	Capacity (m.t.l.s.)
Arbed	Luxembourg	10.6
Hoogovens	Ijmuiden (Neth)	7.1
Cockerill	Liege	6.6
Hainaut-Sambre	Charleroi	3.5
Sidmar	Ghent	3.2
U.G. Boel	La Louviere	2.1
Forges de Trual	Marcinelle	2.1
Phenix Works	Flemalle	1.7
Forges de Clabecq	Clabecq	1.7
Carlam	Chatelineau	1.2
Laminors de Jemappe	Mons	1.0

Source: Metal Bulletin

The Belgian steel industry is characterised by a minimal degree of vertical integration, but a developing level of horizontal integration due mainly to government inspired rationalisation. Of those companies listed in Table 1.7, Cockerill, S.A. own Phenix Works whilst Hainaut-Sambre control TMM and Carlam. In addition Arbed have a majority holding in Sidmar.

The rationalisation has to a large extent been performed on geographical lines with the Hainaut-Sambre group being formed around Charteroi and the Cockerill group in the Meuse Valley near Liege. The other main producer is located at Ghent in Flanders with some production being carried out in La Louviere and near Mons.

The Luxêmbourg industry is dominated by Arbed who are the only significant producers. In addition to their four plants in the principality, the Group also control a number of West German producers in neighbouring Saarland as well as having a majority holding in Sidmar at Ghent.

5.3.5 The Netherlands

The only major Dutch producer is Hoogovens who are wholly owned by the metals conglomerate, Estel. Hoogovens' plant is situated at Ijmuiden on the coast. The next largest Dutch producer is NKF, whose capacity is only 0.3 million tonnes of liquid steel per annum. NKF are wholly owned by Thyssen the West German producer.

5.3.6 Summary of location characteristics

It is important to emphasise that the preceding description is essentially a "snap shot" of the situation prevailing in 1978. As stated in section 5.2 the European steel industry is in a continuous state of flux and this is reflected in a number of mergers and plant closures that have occured since 1978. For example a number of the smaller BSC plants have either closed (e.g. Consett) or severely rationalised (e.g. Shotton and Corby). This process of change does not severely affect the validity of the analysis in this study since the trading patterns examined all relate to 1978. It does, though, make the process of projecting forward more complex.

Generally the trend in industrial structure is to higher levels of concentration and increasing state intervention in the form of ownership and subsidies. Much of this change has been forced by declining markets, reduced profitability and difficulties in funding new investment in order to reduce unit operating costs. The production pattern throughout the study area is generally towards either larger producing units generally coastally located or small new electric arc furnaces located close to markets. The larger steel plants are designed to minimise unit production costs whilst reducing the transport costs of imported raw materials (particularly iron ore) through locating at or near deep water harbour facilities. The new "market" mills (Sheerness Steel in the U.K. is a good example) are small electric arc furnaces that utilise scrap metal as an input. They are located close to consuming markets in order to reduce transport costs. Another trend in production is towards higher value steels such as coated and engineering steels.

There is also evidence of increasing diversification by steel producing firms. This has taken the form of vertical integration into stockholding, transport and associated industries such as plant engineering, holloware and machinery.

The general production and location characteristics of the near sea steel industry has therefore been established. This provides a framework for the analysis of trading patterns that follows in the next section.

5.4 Trading Patterns

The U.K. near sea exports and imports of steel industry products are shown in table 5.11 and 5.12. It can be seen that both movements have increased over the period 1973 - 1978 though exports have increased at a faster rate.

Exports have risen over the period shown with a slight dip in 1975 - this was mainly due to production and labour problems at some of BSC's larger plant and during this period there were difficulties in supplying both the home and overseas market. The main growth area has been in exports to West Germany - predominantly of high quality special steels.

Regarding imports, it should be noted that between 1974 and 1976 imports were at a very high level. This is mainly accounted for by BSC importing steel from Belgium to meet short term supply difficulties in their own plant. The overall trend is, however, upwards and is mainly a reflection of BSC's declining market share rather than any real increase in absolute demand. Over the period 1971 to 1977 BSC's share of the UK market fell from 65% to 55%.

Table 5.11 Steel exports : UK to Near sea countries 1973-1978 ('000 Tonnes)

COUNTRY	Year						% Change
	1973	1974	1975	1976	1977	1978	
Belgium/Lux.	91.6	104.2	81.6	76.8	98.4	106.8	+16
France	113.9	101.1	99.1	147.7	269.2	181.8	+60
W. Germany	154.1	133.6	158.4	237.6	262.5	303.6	+97
Netherlands	117.9	103.6	103.2	102.9	141.6	159.8	+35
Total Near Sea	477.6	442.5	442.3	565.0	586.6	752.0	+57
Total World-Wide	4000.0	3100.0	3000.0	3500.0	4200.0	4200.0	+5

Table 5.12 <u>Steel Imports: Near Sea Countries to UK 1973-1978</u>

('000 Tonnes)

COUNTRY	Year						% Change
	1973	1974	1975	1976	1977	1978	
Belgium/Lux	294.2	632.1	594.1	384.0	357.6	401.9	+ 37
France	102.3	186.7	243.6	289.2	260.3	319.9	+214
W. Germany	564.0	1016.2	777.6	735.6	787.2	651.6	+ 15
Netherlands	421.2	684.2	741.6	865.2	630.0	483.9	+ 15
Total Near Sea	1381.7	2519.3	2356.9	2274.0	2029.1	1857.3	+ 34
Total World-wide	2800.0	3800.0	3700.0	4100.0	3700.0	3700.0	+ 32

Source for both tables : ISSB

Tables 5.11 and 5.12 are based on movements of commodity group 67 to the countries concerned. The steel is not necessarily a product of the steel industry - it may be castings from the foundry industry or ferrous alloys. Furthermore, the country listed may not be the initial origin or final destination due to entreport activities. However, in most cases the differences are marginal. Where a significant variation occurs it is mentioned below. Tables 5.13 and 5.14 give the main product breakdowns for steel industry exports and imports.

Table 5.13 Main Steel Industry Products Exported from U.K. to Near Sea Countries: 1978 (By country of consignment '000 Tonnes)

COUNTRY	Semi-Finished Billet, Bar and Rod	Wire Rod, Bars and Rod	Sheet and Plate	Tubes	% of Total Exports
Belgium/Lux	16.1	55.1	22.3	9.4	92%
France	33.1	57.7	52.7	24.6	82%
W. Germany	49.1	103.8	126.8	9.0	86%
Netherlands	1.5	93.0	33.1	33.6	93%

Table 5.14 Main Steel Industry Products Imported to U.K. from Near Sea Countries 1978 (By country of consignment in '000 Tonnes)

COUNTRY	Semi Finished Coil	Wire Rod Bar and Rod	Sections	Sheet and Plate	Tubes	% of Total Imports
Belgium/Lux	64.6	11.1	49.1	218.8	16.8	85%
France	35.3	56.4	7.1	170.1	14.4	81%
W. Germany	76.2	57.5	16.2	370.0	58.7	80%
Netherlands	130.5	40.8	1.9	286.7	57.7	100%

Source for both Tables: ISSB.

The following points emerge from the above tables. Exports to near sea countries accounted for almost 18% of U.K. world exports of steel in 1978. Since 1973 they have grown at an annual rate of 7.8% compared to a growth in world-wide exports of only 0.8% per annum. Over this period the share of near sea exports has grown from 12% to 18%. Thus exports to near-sea countries have grown both relatively and absolutely. Whilst exports to all near-sea countries grew over the period 1973 - 1978 there was a range in growth from 2.5% for Belgium to almost 12% p.a. for West Germany. The major product types exported were wire rod, rod and bar and sheet and plate. The average value per tonne of world-wide steel exports was £217.7 in 1978.

Imports on the other hand largely mirrored the growth in world-wide imports though again there were marked fluctuations. Over the 1973-1978 period France more than trebled her steel exports to the U.K.

Over 50% of iron and steel imports from the near sea countries are sheet and plate with coil for re-rolling accounting for a further 14%. Other significant imports were bars and rod (10%) tubes (7%) and sections (5%).

In quality terms the U.K. imported 45% of its alloy steel consumption and 21.5% of its non-alloy requirements. Near sea countries accounted for 55% of alloy steel imports.

The average value per tonne for steel industry products imported (world-wide) during 1978 was £239.2. This ranged from £131.5 for ingots etc. through £973.5 for stainless to £1,545.0 for tyres, wheels and axles. For iron and non-steel industry products (e.g. steel tube fittings) the average value of imports was £323.6/tonne ranging from £90 for pig iron to over £6,300 for some ferro-alloys.

5.5. Inter-regional Flows

This section briefly describes the market survey conducted as part of the Transmark Bulk Commodity Channel Tunnel Study(1980). This is followed by a short descriptive account of the major inter-regional flows identified by the survey. Finally the results are compared with a more wide ranging survey conducted by the Department of the Environment in 1978 (1981).

5.5.1. The Market Survey - the prime objective of the market study was to identify rail traffic potential for bulk steel movements. The orientation was, therefore towards the larger producers since it was anticipated these would provide the largest flows. However, it soon became clear that there was no consistent relationship between company size (however measured) and export flows. It was necessary therefore to adopt a more ad hoc approach in assembling the final survey frame. A total of 32 steel companies were personally interviewed. Twelve in the U.K. and the remainder on the continent.

In the U.K. it was, of course, essential to interview all of the divisions of the British Steel Corporation due to their dominant role within the industry. Contact was made at transport/shipping manager level within each division.

For the private sector companies a list of 105 steel producers and finishers was drawn up. These were contacted by letter with a subsequent phone call to determine levels of export (if any) and willingness to take part in the survey. Of the companies contacted, 39 exported steel to near-sea countries though many amounts were very small. Depending upon the size of the flow, the details were either taken over the phone or a postal questionnaire was despatched. For larger flows an interview with the company concerned was arranged.

For the continental steel producers the original list was based on the major companies in each country - that is those with an annual capacity of over 500,000 tonnes. Where UK representatives of these companies were identified, initial contact was made to assess the magnitude of their exports. In addition, the list was revised following discussions with British Rail freight representatives in Europe and a letter was sent subsequently to those companies selected.

Whilst all of the companies approached agreed to cooperate with the survey the level of information they were willing to divulge tended to vary considerably. Many respondents were reluctant to identify precise destinations, product types and rates paid for transport. However, in terms of inter-regional flows the data base is of a reasonably consistent standard.

It was decided at an early stage to exclude steel stock-holders from the survey. Whilst those operating internationally do account for large movements in total, the individual operations are generally small. Furthermore, the movements tend to be irregular in response to a variety of supply and demand factors that are subject to rapid short term changes. Accordingly, the survey was confined to manufacturers and finishers of steel and third parties were excluded. It should also be noted that the past five years have seen a number of steel producers integrate forward into stock-holding - notably BSC and GKN - thereby reducing the number of independent stockholder exports. Finally, the spate of price cutting that has characterised steel marketing recently has tended to make stockholders international operations less profitable.

In terms of coverage perhaps the most effective measure is to compare the 1978 flows identified by the survey with the 1978 flows recorded by H.M. Customs. Table 5.15 presents the relevant information. The results of the survey are discussed by country below.

5.5.2. France - Exports

The survey identified 61% of all movements between the U.K. and France. 13,000 tonnes of steel consigned to France was in fact destined elsewhere - probably a deep sea destination. When this tonnage is excluded a coverage of 63% is obtained. The remaining shortfall is largely explained by the activity of stockholders and small specialist steel producers not covered by the survey. In most cases these consignments are likely to be individually small - representing flows of less than 1000 tonnes per annum each.

Inter-regional flows identified between the U.K. and France are shown in Table 5.16 and total nearly 54,000 tonnes - this represents about 43% of all movements identified by the survey. The major inter-regional flows were from Wales to Northern France (9.5) and the Paris region (8.5) and the North East (5.0) and from the West Midlands to the Paris region (8.0). All figures are thousands of tonnes.

Major originating points in the U.K. were the BSC plants at Port Talbot, Scunthorpe, andShotton andprivate sector plants in Sheffield andBrierley Hill and Wolverhampton in the West Midlands.

Paris dominated the flows as the major destination in France (over 30,000 tonnes from the U.K.) though there were significant flows destined for Dunkirk, the Nancy area, Mulhouse, Lyons and Bordeaux.

5.5.3. West Germany - Exports

The survey covered 230,000 tonnes of the total U.K. to Germany steel movement of 337,000 tonnes - approximately 68% coverage. Some of the shortfall represents a flow of 20,000 of pig iron that was not identified by the survey. Since all the pig iron manufacturers in the U.K. were interviewed it is possible that this flow is plate iron (a by-product created at the blast-furnace stage) handled by third parties. The low value of this product suggests it would be transported by conventional shipping services and it is likely to be an irregular movement. The remaining shortfall is, as was the case regarding movements to France, likely to be explained by stock-holders and small specialist producers.

The inter regional flows identified between the U.K. and Germany totalled 102,000 tonnes - about 45% of total movements established by the survey. The inter-regional flows are presented in Table 5.16. The major ones were to the Rhine/Ruhr area from Yorkshire and Humberside (33,000 tonnes) Wales (19,000 tonnes) and the North (5,000 tonnes) the Baden-Wurtenburg region from Yorkshire and Humberside (28,000 tonnes) and to Northern Germany from the North (5,000 tonnes).

EXPORTS	COUNTRY			
	France	Germany	Belgium/ Luxembourg	Netherlands
Total Unitised				
Market Study	83.9	76.1	27.7	33.2
Customs	128.5	102.6	38.1	62.7
Charter Ship				
Market Study	41.0	154.2	18.1	29.7
Customs	76.2	234.5	74.3	118.9
Total SITC 67				
Market Study	124.9	230.3	45.8	62.9
Customs	204.5	337.0	112.4	173.6
%Coverage	61	68	41	37

IMPORTS

Total Unitised				
Market Study	55.0	33.1	39.6	-
Customs	114.2	115.9	87.6	29.0
Charter Ship				
Market Study	110.3	289.0	339.3	361.0
Customs	246.7	605.2	344.6	496.2
Total SITC 67				
Market Study	165.3	322.1	378.9	361.0
Customs	360.9	721.1	432.2	525.2
% Coverage	46	45	88	69

Table 5.15 Comparison of iron and steel exports and imports identified by the market study with total flows recorded by H.M.Customs. ('000 Tonnes).

Major originating points in the U.K. were the BSC plants at Shotton and Port Talbot in Wales, Scunthorpe and Lackenby (near Middlesborough). Significant flows also originated from private sector plant in Sheffield and at Brierley Hill.

Major destinations in Germany were Dusseldorf, Dortmund, Duisburg, the VW plant at Kassel, Stuttgart and Breman.

5.5.4. Belgium/Luxembourg - Exports

The market study identified over 45,000 tonnes out of a total movement to Belgium and Luxembourg of 112,000 tonnes. This lower coverage of 41% is probably due to the fact that stockholder activity is quite significant in view of the proximity of the two countries.

21,700 tonnes of the identified movements have been allocated to inter-regional flows - some 50% of all movements identified: The major flows identified were to Wallonia from Yorkshire and South Humberside (8,200 tonnes) and Wales (4,200 tonnes) and to Flanders from the East Midlands (4,000 tonnes).

The major originating points in the U.K. were the BSC tube mills at Corby in Northamptonshire and the BSC plants at Port Talbot and Scunthorpe who despatched tinplate and wire rod in coil respectively. There was also a minor flow of bars from private sector plant at Brierley Hill.

The major destinations in Belgium were Lokeren (near Ghent) Antwerp, Brussels and Liege. The latter was the major destination and includes many smaller locations in the Meuse Valley.

5.5.5. The Netherlands - Exports

The market study identified 63,000 tonnes of steel moving to the Netherlands out of a total recorded movement of over 173,000 tonnes. This represents a coverage of only 37% which is surprisingly low. Some 7,000 tonnes of iron castings should be discounted as these are likely to originate from foundries which were not included in the survey as their individual output tends to be very small. The remaining gap is likely, once again, to represent the activities of stockholders and other third parties operating on an agency basis.

44% of those movements identified have been allocated to inter-regional flows. Of the total 28,500 tonnes so allocated, the vast majority was destined for the Rhine/Maas area in southern Holland with flows from Wales (13,800 Tonnes), the East Midlands (7,000 Tonnes) and the West Midlands (4,300 Tonnes) being the major ones.

Apart from Rotterdam which attracted well over 90% of the flows the only major destination in Holland was Enschede on the border with NorthernGermany.

Flows originated from the BSC plants at Port Talbot (Cold Rolled Coil and Tin plate), the tube mill at Corby (rectangular hollow sections) and Lackenby near Middlesbrough (coiled sheet). There was also a movement of steel bars originating in Brierley Hill.

5.5.6. France - Imports

As can be seen from Table 5.15, 46% of all steel movements in 1978 were covered by the survey. However, from the total of 247 thousand tonnes of steel moving in to the U.K., some 11,000 tonnes originated from outside France - this is most likely to be steel entering Europe by a deep-sea route and being re-distributed to the U.K. There is also evidence of some steel from Luxembourg being consigned from France though the amounts are fairly small. A further 11,000 tonnes represent ferro-alloys despatched by specialist producers who were not included in the original sampling frame. In addition, 4,000 tonnes of pig iron were moved into the U.K. from France - most likely from coastal plant as this low value product can only bear minimal transport costs.

The slightly lower coverage in France also reflects, to a degree, the nature of concentration in the steel industry there. Whilst there are two large dominant producers who between them account for over two thirds of total steel out-ut, there are a number of significant smaller companies of which only a sample were contacted. It is also likely that in view of the proximity to the U.K. market French stock-holders are utilised by U.K. consumers as an alternative source of supply. The region to region flows between France and the U.K. are shown in Table 5.17. Of the 165,000 tonnes identified by the survey, some 113,000 tonnes have been so allocated.

The remaining flows tend to be diverse and irregular and for this reason most responding firms have been unable to identify them. By far the most important flows are from North Eastern France to the West Midlands (50,000 tonnes) and London (16,000 tonnes), and from the Northern coastal region to the West Midlands (15,000 tonnes) London and Yorkshire and Humberside (6,000 tonnes each). Other significant flows are from these areas in France to N.W. England and Scotland.

The major generating regions in France are therefore the North and North-East. With regard to Northern France the main generator is Dunkirk where both Usinor and Creusot-Loire have major plant whilst in North-Eastern France the traffic arises from plant located in Metz, Thionville, Longwy and Pompey. Both Usinor and Sacilor have plant here as well as a number of medium sized producers who export to the U.K. The only major flow identified outside these regions comes from Fos near Marseille in Southern France.

The major destinations in the U.K. are in the West Midlands and the South East. With regard to the former, Birmingham and the Black Country locations such as Cradley and Tipton are the main attraction points with some traffic going to Stoke-on-Trent.

In London and the South-East Ford at Dagenham are the major attractors with the remaining traffic going to a variety of stockholders in the London area. Flows to Yorkshire and Humberside are mainly for Leeds whilst Liverpool (including Halewood) and Manchester are the main destinations in the north. In Scotland, Aberdeen is the major attractor of those flows identified.

5.5.7. West Germany - Imports

Approximately 45% of total steel movements between West Germany and the U.K. were covered by the survey. Whilst all of the steel consigned in West Germany actually originated there, some of the shortfall can be explained by the failure to identify the 46,000 tonnes of pig iron sent in 1978. This did not originate from any of the major companies covered in the survey but, as in France, it is likely that this low value product would move by charter shipping services destined for foundries in the West Midlands and South Yorkshire. It is also probable that activity amongst third parties (i.e. stockholders) accounts for some of the shortfall.

Of the 332,000 tonnes covered, some 242,000 tonnes have been allocated to specific inter-regional flows. In certain cases respondents were able to provide extremely precise data concerning destinations in the U.K. Analysis of this information confirmed the intuitive view that between 25 and 30% of movements were either too small or destined for such a wide spread of customers to make any allocation virtually meaningless.

The main co rridors of movement identified were from Northern Germany to London and the S.E. (50 thousand tonnes) to the North West (50 thousand tonnes) and to Yorkshire and Humberside (10 thousand tonnes) and from the Rhine/Ruhr area to the West Midlands (62 thousand tonnes), London and the South East (44 thousand tonnes) and Yorkshire and Humberside (11 thousand tonnes). There were also flows from this area destined for Scotland (7 thousand tonnes) and Wales (6 thousand tonnes).

In Northern Germany most of the flows were generated from Bremen on the north west coast though 10,000 tonnes originated in Osnabruck to the south of the region. There are a number of major generators in the Rhine/Ruhr region - these include Duisburg, Bochum and Cologne. In addition smaller flows originated from Dortmund, Hagen and Troisdorf (between Cologne and Bonn). It should be noted that one respondent was unable to pin-point the precise originating point for his company's flow though all were within 50 km of Bochum. It should also be noted that the Saarland region (the other major area of steel production in Germany) appeared to generate no traffic at all for the U.K. This was explained by

a) the high cost of transport from this region and
b) the obsolescent methods of production leading to lower levels of output.

The major attractors of German steel in the London area were Ford at Dagenham, Crittals at Reading and a number of stock-holders and light engineering companies in and around the capital. In the West Midlands stockholders in Birmingham, Tipton and Darleston and T.I. tubes in Birmingham were the main destinations. Major destinations in Yorkshire were Sheffield, Leeds and Hull, whilst Scottish traffic was mainly tube destined for North Sea Oil installations on the East coast.

5.5.8. Belgium/Luxembourg - Imports

The Belgium steel industry is characterised by a limited number of medium/large producers all of whom were interviewed. This type of structure and consequent approach is mirrored in the extremely high level of coverage - 88% of total movements. However, this coverage was not uniform across all modes; much lower levels were attained for ro-ro and containerised movements - use of these modes being concentrated amongst the smaller specialist producers and stockholders. It should also be noted that some 9,000 tonnes of steel was consigned from Belgium that did not originate there - as in France reflecting the entreport activity at Belgium ports.

The major corridors of movement identified were between Wallonia and the sea. West Midlands (66.1 thousand tonnes), Yorks and Humberside (55.7 thousand tonnes), the North West (52.0 thousand tonnes). Flanders generated flows to the East Midlands (42.0 thousand tonnes) and Yorks and Humberside (6.5 thousand tonnes).

In Wallonia the major generators are concentrated on Liege and Charleroi. Whilst in Flanders most steel is produced in Ghent with other significant flows arising from La Louviere which is near Mons.

Major U.K. destinations include the Ford plants at Halewood and Dagenham, end-users in Sutton-in-Ashfield and Leeds and stockholders in Birmingham and Leicester.

5.5.9 The Netherlands - Imports

As mentioned in Section 5.2.5. there is only one significant producer of steel in the Netherlands which accounts for virtually all that country's production. However some 164,000 tonnes of steel from the Netherlands to the U.K. (31% of total movements) was not covered by the survey. 37,000 tonnes of steel consigned in the Netherlands originated elsewhere and almost certainly represents entreport activity at Rotterdam. The remaining shortfall is probably explained by movements from small specialist intermediate producers - re-rollers, tube makers and fabricators - and from stockholders.

Hoogovens, the major producer, are situated at Ijmuiden on the North Sea coast south of Amsterdam. The major flows are to the West Midlands (150 thousand tonnes), the East Midlands (50 thousand tonnes), the South-West (40 thousand tonnes), Wales (41 thousand tonnes) and London and the South East (30 thousand tonnes). These flows represent some 86% of total coverage in this country.

Hoogovens produce a zero carbon vitrified steel that is used in the manufacture of white goods (washing machines, refrigerators, cookers, etc) and is not available from U.K. producers. Much of the output therefore, is destined for white goods manufacturers in the West Midlands (Parkinson-Cowan at Stechford, Cannon at Bilston) South Wales (Hoover at Merthyr Tydfil) and the London area. Other major destinations are Swindon, Luton and Dagenham (B.L., G.M. and Ford respectively) and Leicester in the East Midlands.

5.6 Summary

This section summarises the inter-regional flow data described above and compares the results with a Department Transport/NPC (1980) Study which was based on a sample of consignment note. Table 5.16 compares the two Studies in terms of imports whilst Table 5.17 deals with exports. In order to facilitate comparison only percentages are shown and the regions in the near sea continental country have not been disaggregated. The U.K. regions are based on the standard economic planning regions though Northern Ireland has been excluded.

At first sight it would appear that there is a considerable variation between the two studies. This arises for two main reasons. Firstly the orientation of the two studies was different. The market study described above was orientated towards major producers and so flows emanating from smaller companies and stockholders were not covered. The DTp/NPG survey was based on a sample of all consignments so overall coverage was greater though it is likely that the coverage of bulk flows was not as detailed. Secondly some of the information supplied by continental producers was not detailed enough to enable allocation to regions within the U.K. So whilst the two studies are not directly comparable the orders of magnitude are broadly similar. Both studies point to the West Midlands as the major destination for steel imports which reflects that region's industrial profile. It may also reflect the fact that there are no major general steel producers in that area.

The pattern of origins of exports largely reflects the location of steel producers in the U.K. - in particular Sheffield and Scunthorpe in the Yorkshire and Humberside region and Wales. The DTp/NPC Study shows a surprisingly high percentage emanating from the London and South East area. Some of this tonnage is likely to arise from Sheerness Steel who were not covered in the market Study. The remainder is assumed to arise from stockholder activity. Table 5.18 shows the results of an MCA survey (1972) of bulk movement and gives the regional breakdown of steel exports in 1970. Unfortunately the regions used are not directly comparable though it is clear that the joint role of the Midlands at the beginning of the decade has

To U.K. Region	From Near Sea Country							
	Belgium/Lux.		France		Netherlands		W. Germany	
	Market Study %	DoE %	Market Study %	DoE %	Market Study %	DoE %	Market Study %	DoE %
North		2.6	-	3.3	-	8.3	-	4.7
Yorkshire & Humberside	20.7	11.8	5.4	17.9	-	7.2	8.6	9.2
East Midlands	17.3	0.5	2.9	5.8	12.2	1.9	0.6	4.0
East Anglia	0.1	1.3	-	-	-	2.1	-	0.7
London & South East	4.4	13.6	20.5	12.4	7.3	15.8	39.0	22.4
South West		2.8	-	2.7	9.7	4.9	-	1.2
West Midlands	35.9	40.4	60.2	29.4	60.8	26.7	26.7	40.8
North West	17.3	18.0	4.5	14.8	-	5.6	20.7	9.0
Wales	4.6	2.8	-	9.1	10.0	19.4	2.4	3.2
Scotland	2.2	6.2	4.9	4.8	-	8.8	3.0	4.8
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5.16 Near-Sea - U.K. Inter-regional Steel Flows 1978 - Comparison between Market Study and DTp/NPC Study

(unallocated flows excluded)

From U.K. Region	Belgium/Lux.		France		Netherlands		W. Germany	
	Market Study %	DTP %	Market Study %	DTP %	Market Study %	DTP %	Market Study %	DTP %
North	6.0	4.8	1.9	2.9	3.9	7.5	9.7	5.8
Yorkshire & Humberside	37.8	34.3	30.6	33.8	-	20.6	63.7	76.2
East Midlands	18.4	1.9	-	1.9	24.6	9.5	-	1.7
East Anglia	-	1.0	-	-	-	1.5	-	0.4
London & South East	-	25.7	-	6.7	-	30.1	-	9.4
South West	-	-	-	-	-	-	-	-
West Midlands	6.5	4.8	22.5	21.4	19.6	5.0	5.4	16.2
North West	-	4.8	-	2.9	-	2.0	-	3.4
Wales	26.3	22.9	44.0	28.1	48.4	9.5	18.5	23.8
Scotland	5.1	1.0	0.5	2.4	-	11.6	2.6	1.7
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 5.17 Near-Sea - U.K. Inter-regional steel flows 1978 - Comparison between Market Study and DTp/NCP Study (Unallocated flows excluded)

declined considerably in favour of the Yorkshire and Humberside region (part of the North East region in table 5.18) where much new investment in steel making has been made.

Region of Origin	Country of Destination			
	Belgium/Lux	France	Netherlands	West Germany
North East	28.4	21.5	13.1	13.0
North West	20.3	2.9	18.0	10.0
Midlands	38.2	48.6	57.9	30.9
Wales	5.0	11.8	2.9	36.3
Scotland	8.1	15.2	7.8	9.6

Table 5.18 Regional origins of U.K. bulk steel exports in 1970 (%)
Source: MCA - based on a survey of major U.K. Steel producers.

Scotland has also declined as an exporting region to the near-sea countries whilst the proportion emanating from Wales has increased. The decline of the North-West as an exporting region reflects the virtual cessation of steel-making in that area. It is therefore, possible to identify the affects that changing industrial location and development can have on transport demand - albeit in general terms.

The implications of these conclusions with respect to the modal choice decision making process are discussed in detail in chapter 6. One of the major factors is the relationship between origin location and the sea port. The length of inland movement and the ratio of this distance to the overall movement distance are crucial determinants of modal choice. It will be seen that generally the higher this ratio the more likely will be the use of unitised modes throughout. However, the size of the consignment is an important additional consideration. How these factors interact is considered in the following chapter.

This chapter has concentrated the preceding discussion of the near-sea freight market in general terms towards a consideration of a specific disaggregate sector. The chapter has examined the structure of the steel industry within the study area together with the general framework of production and demand. This was then related to the actual pattern of steel movement between the U.K. and the near sea countries. Accordingly the two aims of this thesis have been accomplished from a transport demand viewpoint. Firstly, a descriptive account of the movement of goods at different levels of disaggregation has been provided. This has included a consideration of the relationship between various factors and the overall levels of transport demand presented in this chapter. Secondly, the alternative ways of analysing transport demand have been illustrated and the benefits of using a disaggregate approach through the medium of a sectoral study have been demonstrated. The achievement of these aims with respect to modal choice are finalised in the following chapter.

6.0 MODAL CHOICE FOR STEEL MOVEMENTS

This chapter examines the major factors that were shown by the market study to be influential in the choice of mode and/or route. The factors considered are location - particularly with respect to distances from ports, frequency of shipment, consignment size, modal charges and product values. These and other factors are summarised and the suitability of the mode/route decision is considered. Finally some likely future incluences on transport and mode patterns are discussed.

6.1 Location of production - U.K.

The fact that location is very often a prime consideration in modal choice suggests an analysis of flows by areas of generation within each country. Accordingly modal split has been considered for individual steel producing areas in the U.K. (this section) and the other near-sea countries (Section 6.2). The areas of interest in the U.K. are Humberside (i.e. Scunthorpe), Sheffield, West Midlands, East Midlands (i.e. Corby), Teeside, Scotland and Wales.

6.1.1 Humberside

When considering the Humberside area we are of course dealing exclusively with the BSC plant at Scunthorpe. The plant is located approximately 8 miles from a BSC owned wharf at Flixborough which is able to take sea-going vessels with a carrying capacity of up to 2500 tons, this makes charter shipping a cost-effective mode for most export traffic. The influence of this locational factor is emphasised when looking at the breakdown of exports by mode. Of the total tonnage exported to the study area over 90% used charter shipping. The remaining flows moved by road vehicle throughout -

generally these were flows of less than 3,000 tonnes per year though one movement of over 8,000 + p.a. moved by this mode at the request of the customer.

The exit port is rail connected and the size of the tonnages involved make rail the most attractive method for moving steel to the wharf - in fact over 90% of steel using this route is transported to the ship by rail wagon. At the other end of the sea leg of the journey rail or barge are used almost exclusively for on-transport to the customer. In most cases barge is preferred if the customer has facilities to receive by this mode.

6.1.2 Sheffield

This area comprises a number of BSC plant producing special steels as well as a number of significant private producers. A precise breakdown of the BSC tonnages from this area was not available but it is estimated that about 80% moves by charter ship from Flixborough wharf which is some 45 miles from Sheffield. The remaining tonnage moves by road vehicle throughout mainly to France, West Germany and Belgium - generally to customers whose location renders the use of charter shipping too costly. The main mode used to Flixborough is rail (about 80%) the rest travelling by road vehicle.

There are a number of private sector producers in the Sheffield area though only a handful generate significant export flows to the tunnel zone countries. The flows totalled 16,000 tonnes arising from four producers and virtually all the traffic went by road vehicle throughout. There was some movement by container (road/ship) and rail ferry-wagon though each accounted for less than 250 tonnes p.a. It is interesting that even flows exceedubg 5,000 + p.a. were not considered sufficient to justify the use of charter shipping and road was used.

6.1.3 West Midlands

The West Midlands is very much dominated by the private sector with G.K.N., Round Oak, T.I., and Duport accounting for significant tonnages, of which about 60% travels by road vehicle transport. The next most used mode is rail ferry-wagon; the modal share figures for France and Germany are 29% abd 33% respectively. There were no recorded rail movements to the Netherlands. There was evidence of some small amounts travelling by road/ship container though it amounted to only 7% of total.

6.1.4 East Midlands

The only significant steel producing and finishing capacity in this region are the five BSC mills at Corby in Northamptonshire. As with plant in the Birmingham area charter shipping does not appear to be a realistic alternative and all of the exports move by road vehicle throughout. Much of the traffic was despatched on a regular basis using hauliers and scheduled shipping services mainly from Great Yarmouth.

6.1.5 Teeside

Once again this area is dominated by BSC plant, in this case located within the vicinity of Middlesbrough. Whilst the plant is only a few miles from good port facilities; of the total exports to the study area only approximately 25% travels by conventional shipping services. Furthermore flows by this mode are by no means individually the largest. Some 20,500 moves to the near sea countries (mainly W. Germany) by rail/ship container moving through Harwich and Flushing.

This range of modes is to some extent related to country of destination. For example all consignments to the Netherlands go by charter ship whilst all steel to Germany goes by container. Flow size is, however, not significant and bears little relation to mode chosen. It was suggested that the modes chosen were a very accurate reflection of the relative costs at the time and the usual advantage of charter shipping did not always apply due to the number of small consignments and the high quality of handling required.

Regarding modal choice for the inland legs of conventional shipping movements it appearedthat rail was used almost exclusively in the U.K. On the continent barge was generally used in France and Belgium whilst rail wa favoured in the other receiving countries. The containers were rail borne on both sides of the channel.

6.1.6 Scotland

Steel making in Scotland is, with the exception of few specialist finishers, confined to the BSC Scottish Division whose plant is located South of the Clyde around Motherwell and Kilmarnock, Tonnages exported to the near sea countries are comparatively small and the division exported less than 10,000 tonnes in 1978.

A precise breakdown by mode was not available but it is estimated that about 20% tonnes was despatched by charter shipping to Germany.

These movements usually utilised the port of Grangemouth situated on the east coast some 25 miles from most of the plants. The use of charter shipping appeared to be both irregular and infrequent. The mode used to both ports was road vehicle whilst movements on the continent tended to be by rail.

The remaining 80% moves by road vehicle throughout though individual flows were generally small. The largest flow travelling by this mode was 1100 tonnes p.a. to Belgium.

6.1.7 Wales

Whilst there is a private sector presence in Wales the amounts exported to the tunnel zone countries were found to be minimal (this excludes GKN Brymbo for which flow data was not available). The majority of flows therefore originated from BSC plant in Shotton in the north and Port Talbot, Llanwern (near Newport) and Ebbw Vale in the south. Precise details relating to modal split of flows from Llanwern and Ebbw Vale is not available; it is estimated that the vast majority of the tonnage exported to the near sea countries goes by charter ship from Newport and Cardiff.

The west Wales installations at Port Talbot, Velindre and Bryngwyn exported a total of 50,000 tonnes to the near-sea countries in 1978 of this some 25% used charter shipping from Swansea to W. Germany. The mode used to reach the port of exit is split fairly evenly between road and rail whilst on carriage is usually by rail.

Of the remaining tonnage rail ferry-wagon accounted for 9% of all movements, road vehicles for 38% and containers for 18%. Rail wagons were used mainly for movements to West Germany with a small movement to France. Road vehicles were used throughout on movements to all of the near sea countries with the major flow by this mode destined for France. Containers were used for cold reduced and coated steels destined for France, Germany, and the Netherlands. The majority of containers were road borne to the port of exit with about 10% going by rail.

At Shotton in north Wales, a total of 45,000 was exported in the 12 months ending June 1979. It should be noted that there has been a major change in modes used from Shotton when the plant switched to the use of container for many movements in September 1978. The percentages mentioned here are estimated modal splits for 1979.

The split for 1979 was rail ferry wagons 5%, road vehicle throughout 16%, container 79%. Rail wagons were used mainly for minor consignments to W. Germany and France. Road vehicles were used exclusively for movements to Holland and Belgium via east coast ports. Containers were used to deliver to West Germany and France. The containers were 95% rail borne and used scheduled Freightliner services from Garston to Felixstowe. On-carriage on the continent was generally by rail though road was used when the customer did not have rail facilities. It should be noted that whilst Shotton has its own wharfage facilities the tidal situation is such that large vessels can only be accommodated infrequently. Charter shipping is not therefore a reasonable alternative mode.

6.2. Location of Production - Other Near Sea Countries

6.2.1. France

Of the 145,000 tonnes identified by the survey the modal split was as follows:- charter shipping 73%, road vehicle throughout 23%, rail ferry wagon and container 2% each. This high proportion for charter shipping (68% of all steel movements between France and U.K. were recorded as moving by conventional shipping services) reflects the nature of the sample. Indeed both the major producers who between them exported 101,000 tonnes of steel to the U.K. in 1978 rely almost exclusively on charter shipping. Their major plant is either at coastal sites in Northern and Southern France or around Metz and Longwy in the east.

In the former case the companies generally loaded direct from factory to ship or were located within 5 miles of suitable wharfage facilities. The plant located in eastern France either utilised barge or rail transport to connect with ships from Antwerp, Brussels or Rotterdam or sent their steel by rail to Dunkirk and then on to the U.K. by vessel. The preferred method is barge and approximately 70% of U.K. exports originating in eastern France went by this means.

When considering the smaller companies it is apparent that charter shipping is less dominant. Of the 44,000 tonnes identified as exports to the U.K. from those medium sized companies, only 23% was carried by charter ship. This was generated by Vallourec and Creusot-loire who both have plant located at Dunkirk. Much of the remainder (58%) went by road vehicle throughout, including much of the steel from the Dunkirk area where individual flows were not sufficient to justify charter ship loads. Inland at Pompey, Decazeville and Valencienne a combination of small loads and distance from a sea-port led to a use of either road or rail ferry wagon - the latter transporting 12% of the smaller companies U.K. exports. Finally some 7% of steel exports to the U.K. went by container (rail/ship) though this was all destined for Belfast and the sea leg was from Antwerp direct to Northern Ireland.

6.2.2. West Germany

The five companies contacted in the market study exported a total of 321,000 tonnes of steel to the U.K. in 1978. All of the respondents had plant located in the North-Rhine-Westfalia region and nearly all were on or near either the Rhine or Ruhr. This fact is reflected in the modal split for U.K. steel by charter vessel. The high tonnages involved and the proximity to the Rhine were clearly major factors in modal choice, and most companies' operations were geared to a movement of both raw materials and finished products by sea going vessel. For example, Thyssen at Duisberg have two wharfs, one of which is covered, capable of handling vessels with a 2000 tonne capacity. One respondent had plant located at Bremen but this also had wharfage facilities and charter shipping was the most favoured mode. On-carriage in the U.K. was nearly always by road vehicle.

Of the other modes 15% of the respondents U.K. traffic moved by road vehicle with 2% moving by container (both road and rail borne to port) and less than 1% in train ferry wagons. The movements by these modes generally arose from the respondents smaller plant or where the customer requested a particular mode.

6.2.3. Belgium/Luxembourg

The high level of coverage of Belgian - UK steel movements (over 91%) means that the position established by the survey concerning modal split is a fair reflection of the situation regarding all steel movements into the U.K. from Belgium.

The flows identified reveal a high dependence on charter ship - over 86% of all respondents consignments to the U.K. went by this mode in 1978. As in Germany this figure reflects the location of many steelworks alongside major waterways. Two respondents in Liege and one near Mons who exported over 150,000 tonnes per year to the U.K. between them used charter shipping exlusively for their U.K. shipments. Generally they were loaded direct to ship from the works though in the case of one respondent they are shipped by barge or rail some 25 miles to port facilities at Brussels. The other two major respondents in Belgium used about 80% charter shipping, the remainder going by rail. In Luxembourg Arbed were sufficiently far inland to make the cost difference between road/rail and charter ship minimal:- this is reflected in a modal split of 75, 18 and 7 for ship, road and rail respectively. The remaining respondents were all minor producers with flows to the U.K. of less than 5,000 tonnes per year. These companies used road vehicle throughout in nearly all cases.

6.2.4. The Netherlands

As mentioned previously, the only significant steel producer in Holland is Hoogovens. The company's plant is situated at Ijmuiden on the north sea coast and is able to load directly from the works on to ships. Not surprisingly, in view of the tonnages involved (the company exported 36,000 tonnes to the U.K. in 1978), all of the U.K. traffic is despatched by charter ship.

The main U.K. ports used ar Rochester and Kings Lynn with smaller flows going to Grangemouth, Seaham, Whitby and Poole. With the exception of traffic for BL going through Poole, to Swindon, which moves by rail, all transport within the U.K. is handled by road.

It is of interest to note that due to difficulties in arranging road transport from the U.K. ports to inland destinations the company had considered using rail for movement to steel terminals - particularly in the West Midlands - and then effecting final delivery through own-account road vehicles. This option was, however, rejected due to the lack of availability of rail wagons and the companies unwillingness to invest in their own fleet of rail vehicles.

6.3. Frequency of Shipment

Two main factors govern frequency of shipment and in general these apply to all countries within the study area. The factors concerned are:

1) Type of mode
2) Type of customer

When considering the role of modal type it is obvious that for a given quantity of steel the larger the carrying capacity of a unit mode the less frequent the shipments will be. So for say a flow of 1,000 tons per week the frequency of shipments could range from 1 per week for charter shipping to an excess of 50 shipments per week if road vehicles are used. Modal choice is governed by a number of factors and this issue is discussed further below.

Customers of steel producers can be classified as stockholders or end-users. If the latter but direct from steel producers they will tend to order regular amounts for fairly lengthy periods - often longer than a year. Stockholders on the other hand may operate on a more flexible basis and move between producers to take advantage of shortfalls in demand and surpluses of supply. However it should be borne in mind that in many cases a stockholder will have a number of customers whom he supplies on regular basis and this would be reflected by some degree of regularity in ordering.

Other factors that may influence frequency of shipment such as distance of plant from port, availability or warehousing, pattern of production and the availability of third party transport services are discussed in greater detail below.

Information obtained from the survey has suggested that by and large most shipments are very regular - particularly those that have been identified as major flows. This is understandable since for a purchaser to be able to gain any volume discount it is necessary to order for a long period and most producers have both their production and transportation systems geared for regular despatches. Respondents who despatched large flows to the U.K. all spoke of regular despatches varying by minimal amounts from one month to the next (though August was generally lower) and any variation was caused by extreme factors such as strikes, breakdowns, etc. One exception in regularity of consignments arose in the case of the smaller specialist companies producing large forging, castings and high value special steels. In the former case many of the orders were "one off" whilst some of the high value steels are bought in such small quantities that no regular patterns were apparent.

6.4 Range of Consignment Size

As with frequency of shipments the range of consignment size is largely determined by mode though of course the total size of the flow is an important pre-determinant in modal choice which will effect consignment size.

Where flows are large enough and other factors favourable, companies will nearly always use charter shipping services to move their steel in order to obtain maximum economies of scale. There is however a trade-off between cost reduction and flexibility. Thus whilst a company may be able to minimise sea transport costs by using large vessels if it has a number of customers spread over the U.K., it will lose the flexibility of being able to use a number of ports and thereby reduce overall transport cost. There is a tendency therefore for those companies with a number of destinations to use small vessels - ranging from 600 to 1,500 tonnes carrying capacity. It should also be noted that in the case of some German and Belgian companies consignment size by ship is restricted by the available draft on the Rhine/Maas which can fluctuate quite considerably - for this reason ships with a capacity in the region of 1,000 tonnes are used.

Pay loads for rail ferry wagons were found to range from 20 tonnes up to 55 tonnes with the new VTG wagon. In most cases producers tended to send a rake of wagons and consignments tended to fall into range of 50 to 200 tonnes.

When road vehicles were used they were consigned individually and sizes tended to lie between 18 tonnes and the U.K. maximum load of 20 tonnes. In certain cases where products had a high unit weight (as in certain types of coil) or were of an awkward shape (e.g. sections) consignment size could be as low as 14 tonnes per vehicle.

6.5. Modal Charges

Problems of confidentiality of information inevitably constrained the level of coverage concerning modal charges and transport costs in general. The information obtained is therefore uneven and in many cases it is not possible to present realistic comparisons between modes for particular routes. The tables below set out the information obtained and for most country to country flows it is possible to obtain a fairly accurate picture of the relative competitiveness of the various modes used.

6.6. Range of Product Values and the Ratio of Transport Costs

The majority of steel products have a value concentrated within a fairly narrow range - approximately £180 to £250 per tonne. However, some types of steel such as stainless and tool steels can be as much as £5,000 per tonne. The table below gives the identified price range for selected types of steel.

Table 6.1 Charter Shipping Costs: U.K./Near Sea (£/Tonne) 1978 prices.

Near-Sea Origin - Destination	U.K. Origin - Destination			
	West Midlands	London	Scotland	South Wales
France				
- N.E. France	19.7	14.5-16.6		
West Germany				
- Ruhr	18.4-28.8	15.7	19.2-21.0	17.9-18.7
Netherlands				
- Ijmuiden	14.0	16.5	16.0	16.0
Belgium/Lux.				
- Mons	13.9			
- Leige	14.9			

Table 6.2 Ro-Ro Costs: U.K./Near Sea (£/Tonne) 1978 Prices

Near-Sea Origin - Destination	U.K. Origin - Destination			
	Sheffield	W.Midlands	E. Midlands	N.Wales
France				
- Paris	40.0	17.0		
- E. France	27.0			
- N.W. France	30.0			
West Germany				
- Ruhr	18.5	20.0		28.9
Netherlands				
- Rotterdam		17.0	23.0	
Belgium/Lux.				
- Brussels/Leige		19.0	13.5	

Table 6.3 Container Costs: U.K./Near Sea (£/Tonne) 1978 Prices

NEAR -SEA Origin - Destination	U.K. Origin - Destination			
	Sheffield	London	South Yorks	North Wales
France - N.W. France	30.0	-	-	-
West Germany -Cologne	18.5	-	-	22.9

Table 6.4 Rail Ferry Wagon Costs: U.K./Near Sea (£/Tonne) 1978 Prices

Near - Sea Origin - Destination	U.K. Origin - Destination			
	London	W.Midlands	Wales	Scotland
France - Paris/Metz	-	17.0	24.0	29.0
West Germany - Ruhr	21.0	20.0	25.0	-

Table 6.5. Steel Product Prices

Type of Steel	Price Range (£/Tonne
Commercial grade steels (coil,bar,etc)	180 - 210
Commercial Tube Steel	270 - 300
Coated Steels and Tin Plate (in coil)	300 - 500
Special Steel (High Carbon and Alloy)	220 - 270
Stainless Steel	1000 - 1250
Quality Tube and RHS	1500 - 2000
Mining/Tool Steels in bar	1500 - 1700
High Speed Steels	2000 - 5000

Source: I.S.S.B.

It is apparent that the wide range of product values shown above and the range of transport costs presented in the previous section make it extremely difficult to make any concise statements regarding the ratio between the two. Some respondents who were willing to divulge transport costs did speak in terms of a ratio between 5 and 10% for most steels though special steel producers transport costs fell within the narrower range of 7 - 8%. These ranges are broadly consistent with the information presented above.

What is important to note, is that with the exception of the higher priced special steels (i.e. those over £1,000 per tonne), all respondents considered transport costs to be a very important element of total costs. Even those despatching high value steel were operating on fairly slim margins and transport costs were a vital consideration, though they were generally outweighed by inventory costs.

6.7. Summary of Factors Affecting Choice of Mode

It is accepted that to a greater or lesser extent most modal choice decisions in the sphere of freight transit involve a trade-off between transport cost and inventory cost. In other words, a trade-off exists between the cost of holding an item in stock and the cost of moving it to a customer more quickly. Whilst this relationship undoubtedly exists within the steel industry, the comparatively low value of most steel products makes transport cost the more important factor. Furthermore, the continuation of a high level of surplus capacity and a declining market that exists at present in the European steel industry has increased competition and reduced margins to an extent that any on-cost to production has to be kept to an absolute minimum.

It can be regarded as a fairly safe hypothesis therefore, that steel will normally by transported by the cheapest means possible. This statement was born out by the market study where only two respondents gave factors other than the lowest possible level of cost as their main reasons for choosing a particular mode. (The two exceptions were continental steel companies dealing in high value special steels that were in short supply and hence transit time was the deciding factor). Unfortunately, this does not tell the whole story, - many respondents added the rider "providing the quality of service is right".

Indeed quality of service covers a wide range of factors, including transit times, certainty of arrival within an expected time and minimisation of loss or damage during transit. Most respondents were reluctant to qualify these factors so an attempt was made to rank the criteria in order of importance in the modal choice. The results are presented below.

Table 6.6. Ranking of Factors Considered in Modal Choice (percentages breakdown)

Factor Considered	Cost	Reliability	Transit Time	Frequency	Handling Standards
1st Consideration	100	-	-	-	-
2nd Consideration	-	75	25	5	-
3rd Consideration	-	15	65	5	15

Most steel movements identified by the market study were sold delivered, and so it could be assumed that transit times are an important factor as they will directly effect cash flow. However, in many cases, and particularly amongst the larger producers, transit times were relatively unimportant. It was argued that once the flow had been established and was shown to be reliable, the transport of steel from works to customer became an extension of the production process. Therefore providing the method was reliable, decision makers were willing to accept fairly lengthy transit times in order to obtain a lower cost of transport. Furthermore, one respondent stated that transit time was irrelevant since it took four weeks from the date of despatch to invoice the client!

The issue of loss or damage during transit was most relevant to those producers despatching finished rather than semi-finished steel, for example, cold reduced coil, coated steel and merchant bar. The issues here are two-fold - firstly finished products are generally more susceptible to damage and secondly the absolute cost of the product is higher and so there is a greater sum at risk. In some cases a trade-off was evident between the cost of packaging and the increased cost of using a unitised mode such as containers. In one or two cases (alloy bar from Italy for example) transport was only feasible by container as the quality of the steel was maintained during transit.

Two other factors were identified as elements in the modal choice decision. Firstly there was the issue of ownership of transport facilities. This usually related to the ownership of wharfage facilities, that led to a further reduction in costs of conventional shipping services. Secondly, there was the issue of availability of private sidings amongst customers. A number of continental respondents expressed a preference of rail over road when the costs of the two modes were similar - their plant configuration and production methods were generally geared to rail movement of finished products. However, in most cases only 5% of the respondents customers had private aiding facilities and in the remaining cases the costs of transhipment made rail an unfeasible alternative.

6.8 Factors Affecting Choice of Route

To a very large extent, route choice was predetermined by mode choice, so the factors governing route choice have been considered by mode.

With regard to the charter ship mode, the port of exit choice was nearly always governed by distance from plant to port - this being minimised where possible. Of course many of the larger companies had plant situated at coastal sites or on major waterways with their own wharfage facilities, so choice relating to port of exit was predetermined. In cases where loads were sent on a groupage basis, port of exit was chosen according to the availability of shipping services.

Port of entry was determined by the ultimate destination and a minimisation of handling and other port costs. Thus steel movements by ship from the U.K. to Southern Germany, for example, would dock at Rotterdam or Antwerp for trans-shipment on to Rhine barge. In the other direction, many examples exist - Hoogovens, the Dutch producer, use 6 different U.K. ports according to the final destination for the steel. In a number of cases ports were chosen for their lower berthing costs, even though overall distance was increased.

Route choice regarding the rail and road modes was largely governed by the decision of the haulier and in some cases respondents were not able to identify the precise routes used. One U.K. exporter (BSC at Corby) had been able to begotiate an agreed flat rate with a shipping company and accordingly all hauliers were instructed to use this route - this however, was the only case of its type identified.

Much of the same case applies to container movements. Most of the containers used were owned by shipping companies and the routes accordingly utilised their services.

The conclusion therefore is that route choice is largely governed by choice of mode. Where any choice does exist regarding route to be used, cost reduction is the main criteria.

6.9 Stability of Modal/Route Choice Decisions

Well over 95% of the flows identified had remained stable regarding chosen mode for at least two years. Most of the recent changes appeared to have occurred with small flows where the companies concerned were more exposed to external factors (e.g. shortage of ships offering groupage facilities, decline in the number of local hauliers, etc.) or were flexible enough to take advantage of short-term market distortions - this usually relating to the incidence of cheaper transport arising from "back-load"operation.

Only three U.K. respondents who shipped major quantities had made significant changes in their choice of mode. These were: BSC at Shotton who had changed from rail ferry wagon to rail/ship container to reduce costs and improve flexibility; GKN who have increased their use of ro-ro container at the expense of charter shipping mainly due to availability problems regarding the latter; and BSC Wales, who had again decreased their use of charter ship in favour of road and rail due mainly to declining volume.

There was also evidence of a decline in rail usage in favour of ro-ro due to problems with rail transit times and wagon availability.

With the exception of Krupp, and Sidmar, all the major continental respondents showed surprising stability regarding mode chosen. Krupp and Sidmar increased their use of rail at the expense of charter shipping due mainly to the requirements of Ford - one of their major U.K. customers. In fact it appears that Ford may in future require all their steel imports to use rail, though the time-scale for this change has not yet been established. This decision has been taken to reduce their stock-holdings since deliveries will be of a smaller volume.

This is a rare instance of a customer being powerful enough to influence the modal choice of its suppliers.

Whilst, therefore, the situation regarding use of modes can be said to be stable, most respondents stated that they were flexible and able to take advantage of any long-term change in relative competitiveness. Many respondents quoted one month as the minimum time to achieve such a change.

Stability regarding route choice was less evident - particularly regarding charter shipping and the chosen port of entry for the destination country. Many shipping offices considered this a major function in order to reduce total transport costs by taking the steel as close to their major customers as possible. This factor indicentally was important in the respondents' general preference for smaller ships (less than 1000 tonnes) as it increased flexibility in routing decisions.

Route choice flexibility for the other modes was found to be inevitably constrained and any changes were usually made independently by the carriers.

6.10 Future Influences

As part of the channel tunnel market research study a series of "Delphi" discussions were held with industrial and transport experts in a variety of commodity. Some of the main points of the Steel Delphi discussions are summarised in this section to provide a possible insight into future developments in the trading and transport of steel within a near sea context.

As an introduction to the discussion which was mainly held to discuss future trading levels the following points were made:

It must be recognised that, within Europe, steel is generally exported at prices below full cost - it is estimated by B.S.C. that exports on this basis could account for no more than 25% of production if plant is to remain viable.

Steel producers within the EEC operate under the so called Davignon agreement whereby minimum price levels have been set for intra-EEC trading in steel. Furthermore, the agreement has placed quotas on third country imports and, if the plan persists, any increase in this trade is unlikely.

A point specific to the U.K. is that the private sector (which accounts for 25% of all U.K. steel exports) is not a recipient of state assistance, unlike most of the other steel producers in Western Europe. Under these conditions of non-assistance, the U.K. provate sector is unlikely to be able to maintain its present form.

The financial problems facing B.S.C. make a radical restructuring of the corporation's activities increasingly likely. It is quite possible therefore to envisage a major reduction in steel producing capacity in the U.K.

The extent to which this reduction is likely is, however, crucially dependent upon the future of the U.K. steel consuming industries - particularly the automotive industry. If there is a major collapse in one or more of the major steel using industries, the continuation of U.K. steel production in its present form would be placed in even greater jeopardy.

Finally, with regard to steel imports, it has been argued, notably by B.S.C., that the rise in the 1970's was a once and for all reaction to supply problems within the U.K. and imports are unlikely to grow to any major extent in the future.

The meeting then went on to discuss the forecasts developed by Transmark and the National Ports Council using the NPC trade model. It is of interest to note that due to the change in B.S.C. export policy (mentioned below) it was not possible to model exports in the short-term and a market research based approach was necessary.

The following points were raised in the subsequent discussion:

80% of steel industry products are destined for the automotive (35%), machine (25%) and metal goods (20%) industries. If the decline in these sectors continues, the impact on the steel industry will be disastrous. The only major growth area is likely to be in processing plant construction. The overall level of U.K. demand is expected to continue to decline in the short-term, i.e. from the current 15 million tonnes p.a. to 14-14.5 million tonnes p.a. The outturn of the next 18 months will be critical to the long term viability of the industry.

The share of home demand going to B.S.C. and the private sector has remained fairly static over the last 3 years. It was felt that import controls will be generally applied within two or three years -

probably in the form of a subsidy to U.K. manufacturers. Without the Davignon agreement imports are likely to increase - mainly from third countries.

B.S.C. is currently reducing capacity in line with lower levels of demand. The private sector has been investing more heavily, though it is not getting an adequate rate of return. As private sector companies are generally part of larger engineering conglomerates who are not receiving an adequate rate of return from these steel subsidiaries, it is likely that much of the steel making activity will be discontinued completely or transferred elsewhere (e.g. G.K.N. are now investing in the U.S.).

Continental producers are in much the same position. It was suggested that the Germans could experience the greatest problems due to the age of their plant. The Italians are in a relatively good position due to their mini-mills whilst Belgium and French companies are both rationalising rapidly.

Investment in the U.K. is unlikely to be on a major scale in the near future though, if B.S.C. survives, some investment will be necessary in the finishing end. If B.S.C. does not survive it is quite likely that the Sheffield division at least will remain as a viable entity.

It was considered that there will be increased specialisation in manufacture by particular plants, though no major changes were foreseen.

Exports do not cover full costs and it is only possible to export 25% of output and remain viable. Accordingly, B.S.C. is planning to reduce exports to 1.5 to 2.0m t.p.a. from the current level of 3m. tonnes p.a. (These cuts will apparently be made in all markets). The precise time scale for this is very dependent on capacity cutbacks. No growth in private sector exports is foreseen and there could well be a major decline in this area due to plant closures.

Cost will continue to be the major determinant in mode choice. The following emergent trends were noted:-

- Increased packing requirements to preserve quality
- Customers demanding smaller deliveries
- Possible increase in movement due to specialisation by individual producers.

6.11 Summary

This chapter has been largely devoted to a consideration of the factors that can influence modal choice for the movement of steel. It has shown that whilst price is most often the prime consideration there is a complex interaction of other factors that can have a significant if not overwhelming influence on ultimate choice.

Modal choice for international movements is an important strategic consideration for three main reasons:

(i) It provides an input in the evaluation of major public investments. For example new roads to port locations and new port infrastructure.

(ii) It may indicate areas where sudsidies are justified for social reasons. For example in order to reduce road mileage by H.G.V's by subsidising a particular ro-ro service or a rail alternative.

(iii) It may point to areas where other forms of intervention are justified. For example the use of "Kangaroo" and "pick-a-back" services by continental rail administrators. This reduces road vehicle presence whilst improving efficiency. Another example is the regulation of ferry pricing where local monopolies may exist.

In addition modal choice analysis is of vital importance to individual operators for business forecasting, service planning and pricing policies. This chapter has therefore concluded the consideration of modal choice by disaggregate analysis of a particular commodity sector and thereby addressed the second of the two aims of this thesis. Specifically it has considered the description of modal choice issues at varying levels of disaggregation and illustrated a disaggregate approach in analysis. The overall thesis is summarised in the following chapter.

7.0 CONCLUSIONS

7.1 General Summary of Study

This thesis has attempted to describe the overall pattern of trade and transport between the U.K. and a selected group of near sea countries at a number of different levels of data disaggregation. In particular it has examined these factors with regard to steel. It has also reviewed a number of alternative methods of analysis and commented on their utility.

Following a brief analysis of freight transport within the U.K. in Chapter 2, chapter 3 presented a qualitative description of international freight movements with particular attention to the U.K.- "near-sea" situation. It was emphasised that when considering U.K. based movements of freight it was necessary, de facto, to include a consideration of the cross-sea element of the journey. Indeed it was shown that this element was often of over-riding concern in determining modal choice.

Chapter 3 was essentially concerned with developing a taxonomy of international transport. This was accomplished through the separate consideration of <u>transport</u> and <u>trade</u> definitions. The definition of transport systems was primarily orientated towards shipping systems which in large part can determine the mode used for the inland segments of a journey. Initial distinction was made between bulk and unitised vessel systems and the latter were subdivided between roll-on/roll-off (ro/ro) and lift-on/lift-off (lo/lo) techniques. In addition the role of ports and the influence of the ratio of inland to sea distances was briefly discussed.

The section on the definitions of traffic considered the two basic methods of disaggregation - by commodity and by industry. The generally greater robustness of a commodity based classification was illustrated in that the groupings could be allocated both by form (e.g. iron and steel or motor vehicles) and by transport characteristics - i.e. bulk, semi-bulk or unitised.

Chapter 3 then turned to a consideration of the qualitative aspects of the U.K. - near-sea freight market. Firstly the "actors" involved in the total movement were discussed. These participants were broken down to the generators (or originators) of the transport demand, the "land-based" transport operators - i.e. road and rail, the shipping comapnies, the port operators and the freight forwarders. It was pointed out that these distinctions were not always clear cut. For example many shipping companies had extensive interests in international road haulage and/or owned their own port facilities. The determinants of competition were then examined and a split between internal and external factors was made. Internally derived factors included modal charges, journey lines, investment in transport equipment and terminals, port and shipping costs and availability. Externally derived determinants of modal choice covered commodity characteristics, consignment size, inland distances, trade imbalances, route flexibility and institutional factors and legal factors. It was illustrated how the relative importance of these factors could vary considerably between consignments.

Finally chapter 3 briefly considered the non-transport determinants of trade. In order to simplify this extremely complex area the National Ports Council trade volume forecasting models were used in order to identify the major determinants. However it was shown that even highly sophisticated modelling techniques can fail to reflect the true interactions in certain cases.

Chapter 4 developed the previous discussion towards a quantitative analysis of the near-sea freight market. Firstly the modal split of aggregate movements was considered using 1978 as the base year. It was shown that near-sea movements had increased both absolutely in the 4 years up to 1978 and relative to total U.K. world trade. In terms of modal shares the dominant role of road ro/ro and conventional shipping was depicted. In 1978 these two modes accounted for 88% of total near-sea import tonnage whilst the shares of container lo/lo and rail ro/ro were 10% and 2% respectively. Further disaggregation however showed that the splits were not uniform for individual trading partners.

The following section analysed near-sea movements by commodity. It was shown that in most cases 10 or less commodity groups accounted for in excess of 70% of all non-fuel tonnage flows between specific trading countries. The characteristics of the competing modes were then quantified in terms of costs, charges and service factors. The difficulties of generalisation were emphasised and the importance of factors such as consignment size and inland distances was highlighted. These factors could outweigh either the transit time benefits of ro/ro or the cost advantages of bulk shipping. The relationship between commodities and modes was then considered in an attempt to shed further light on the criteria that determine modal choice. It was shown that for many major commodity flows there was a reasonable relationship between the categorisation of a commodity by transport mode and the prevailing modal shares.

However, inconsistencies were still present particularly in the semi-bulk sector and the rationale for a more detailed examination of a commodity within this group was developed.

Chapters 5 and 6 presented a study of one such commodity - steel. The overall nature of demand for steel was briefly described and its importance as an intermediate good was illustrated. The industrial structure and location characteristics of the steel industries in the U.K. and the near-sea continental countries was described. The following sections presented an analysis on the movement of steel based largely on market research work undertaken by the author whilst working on a Transmark Study commissioned by the British Railways Board. A matrix of inter-regional flows was developed and these were compared with alternative data sources. Modal choice was then considered as a function of location, frequency and size of shipments, modal charges and product values. Whilst transport generators stated that cost was nearly always the prime determinant of modal choice the transport cost structure that these firms faced were largely externally derived by location and consignment characteristics. Furthermore the importance of cost was often subject to minimum levels of service (i.e. reliability, transit time etc.) and these levels could preclude low cost modes from the original decision.

The aims of this thesis have been:

(i) to develop a taxonomy of the transport and traffic elements of freight movement between the U.K. and the near-sea continent at different levels of disaggregation and,

ii) to explore the relevance of the taxonomies developed as a means of analysing the movement of freight and in particular to examine the benefits of a disaggregate case study approach both in understanding the mechanics of a particular sector and in forming a basis for making generalisations about the overall market. In addition the case study has sought to assess the extent to which an important commodity sector can impose its transport demands upon the overall transport system.

The first aim has been accomplished through an analysis of the three critical dimensions of freight movement - i.e. the transport system, the demand for movement and spatial separation - at both a total market level and with regard to a specific industrial/commodity sector. These three dimensions have been merged to assess both the pattern of movement and the choice of mode. The achievement of the second aim relating more specifically to the benefits of a case study approach is discussed in Section 7.2.

7.2 The Utility of Sectoral Studies

Throughout this thesis a continuing theme has been the issue of data disaggregation. It has been argued that in order to obtain as full an understanding as possible of the causal factors that underlie both the demand for movement and the mode and route chosen in effecting that movement, it is necessary to deal with disaggregate data even to the extent of considering individual consignments. However, this can be a costly and time-consuming approach and contingencies may necessitate a less detailed approach.

The over-riding determinant should always be the purpose for which the analysis is required though from a near-sea transport viewpoint. It is argued that any strategic decision making should be based on a number of key industrial/commodity sectors that in tonnage terms account for the majority of movements.

The simplest method of analysing freight transport is in terms of total movements within a total area. Thus, we can consider total U.K. freight movements in tonnes or tonne-kilometers - apart from an indicator of total activity these measures are of little value. The next stage is to disaggregate either by mode or commodity or both. Again these measures are only very general indicators of comparative model performance and industrial activity. In order to develop a more useful data set it is vital to gain information on origins and destinations - for example, inter-regional flows. This however can be a difficult if not impossible task.

Fortunately when analysing the U.K. - near-sea freight market this major problem is partly overcome in that we are dealing with flows between nations. Even so a freight movement from Southampton to Le Havre is likely to be very different from one from Birmingham to Lyons. If possible, therefore, a disaggregation below the national level is still required.

Analysis of total movements by commodity has shown that a relatively small number of commodities account for the majority of flows. By focussing attention on these key sectors it is therefore possible to obtain a significant measure of understanding of the underlying determinants of transport demand. Furthermore, if concentration is further focussed on the semi-bulk sector where the competition between modes appears to be greatest the issue of modal choice can be effectively examined. In concentrating on the steel industry sector it has been illustrated how market structure and location factors determine the demand for transport and how these issues combined with other transport and non-transport factors can influence modal choice.

It can be argued that the application of modelling techniques enables the analyst to generalise on the basis of relatively small data sets. However, in order to provide a realistic set of causal relationships that reflect behavioural patterns it is often necessary to disaggregate to such a level that modelling becomes spurious. It is quite feasible to develop a modal choice model for total U.K. - near-sea movements. However, as Bayliss and Edwards have shown in order to satisfactorily explain this relationship it is necessary to include a number of variables including consignment size, commodity value etc. We are therefore faced with a requirement for highly disaggregate data. As was pointed out in the introduction, if such a level of disaggregation is required, the usefulness of a modelled approach is questionable.

Within the context of the case study described in this thesis, the use of a modelling approach was further constrained by a number of factors. Firstly, the number of observations was limited in that a relatively small number of flows accounted for a high proportion of total movements. The issue of consignment size would tend therefore to dominate the analysis. Secondly, and more importantly, the data obtained was not always directly comparable. For example, some respondents were unwilling or unable to delineate precisely between customers and in many cases destinations were aggregated to a semi-regional basis. In other cases flows originated from a variety of different points (e.g. in the case of steel companies with a number of spatially dispersed finishing plants) and a breakdown by origin was not available. Some respondents were not clear as to the mode used in the country of destination where this was the responsibility of local agents and many respondents were unwilling to disclose information relating to freight rates. Thirdly, there was considerable evidence that modal choice for all movements to a particular region were dictated by the requirements or circumstances of one or two major customers rather than the optimum method for each consignment.

There is no doubt that due to its size and variety of transport requirements the steel sector is worthy of study in its own right. However, the extent to which the findings of the case study can be generalised to the overall freight market is limited by a number of factors. With regard to the generation of demand it is clear that a detailed analysis of each sector's production and location characteristics is necessary. For example, the location characteristics of the steel industry are likely to be very different from those of the chemical or paper industries. It should be noted, however, that where the overall tonnage moved for a particular commodity is small, or if it arises for a highly spatially dispersed group of producers this may not be justified. Modal choice conclusions may however be more easily generalised. It is quite likely for example that the non-ferrous metals, timber, paper and chemicals sectors all exhibit similar modal choice characteristics to the steel industry, - particularly concerning the importance of freight rates. White goods, for example, on the other hand are likely to be very different. This is precisely the approach of the National Ports Council when using the categories of bulk, semi-bulk and unitised commodities in determining modal shares. Nevertheless, it is inevitably that even this limited generalisation will lead to some loss of explanatory power.

Finally, a further aim of the case study approach was to assess the "power" of the steel sector relative to the overall transport system serving near-sea trade. Put another way, this examines whether the transport users within the sector were making a sub-optimal choice either because the optimum method was not obtainable or not identi Generally, the evidence suggested that this was not the case. Many of the larger companies had made significant investments in storage and handling facilities geared to charter shipping and so were independent of changes that may occur in the overall transport system. However, some respondents had expressed concern over the lack of rail facilities to reach their customers in the U.K. making them over dependent on road transport for on-carriage to the final destination. Those companies relying on ro-ro transport for their movements were generally able to take advantage of the competitive market and the development of collapsable containers had increased their modal choice flesibility. There was no evidence of a company withdrawing from a particular market due to the disappearance or deterioration in the transport systems available.

In conclusion it can be seen that in order to provide the greatest level of explanation for both transport demand and associated modal choice decisions a high degree of data disaggregation is required. The identification of the key sectors may well prove the most cost-effective method of analysing the majority of the market. In either event the use of industrial/commodity sectors for analysis is a useful compromise between aggregate studies and detailed flow by flow examination.

7.3 Concluding Remarks and Directions for Future Research

The movement of freight between the U.K. and the near-sea continent can be seen to embody a number of characteristics that are general to U.K. based international freight. In addition the volume of trade between the U.K. and the near sea countries, the high levels of intermodal competition and the similarities between the national economies of the countries concerned make the area a useful framework for the development of a taxonomy of freight transit in an international setting.

It is apparent from this study that the objectives of a freight transportation system (be they cost minimisation, speedy transits or whatever) within an international context do not differ markedly from the objectives that prevail within a nationally based freight transport system. What does differ of course, is the means whereby these objectives are met. Generally the movement of goods between the U.K. and the near-sea countries involves more participants and is therefore more costly and more complex than an equivalent journey that is undertaken wholly within the U.K. This can impact upon the behaviour of the firm in a number of ways. Firstly the firm may devote greater energies towards searching for the most cost-effective transport - more so than they would for an intra-national movement. This in turn is likely to make international operators more competitive than their nationally based counter-parts. Alternatively the firm may find the procedures involved in procuring transport and despatching consignments too complex and thus delegate the entire operation to a freighting agent. On the other hand the firm may decide that international movement is either too complex or too costly and decide to concentrate only on the home markets. Accordingly it is possible to envisage transportation factors influencing the market conduct of a company within an international context.

On the other hand there is strong evidence of both industrial structure and market conduct influencing transport demand and inter-modal competition. The location pattern of industries and associated factors such as intra-company linkages has a major effect on the origin-destination matrix of freight demand. Issues of firm conduct such as differential pricing between markets, export policies and costing methods can influence both transport demand and model choice. A final understanding of these issues is best accomplished through a disaggregate analysis as shown in the investigation of the steel sector.

In discussing areas for further research the problems associated with data deficiencies are recognised. Working within this constraint the two most promising areas would appear to be allocation of resources and time series analysis of the relationship between industrial structure and transport demand.

The issue of resource allocation is one that arises from the increasing levels of competition that have arisen on the near-sea routes over the past decade associated with the growth in trade. It is apparent from work undertaken by the University of Leicester (Hayter and Wingfield, 1981) that there are distortions in transport pricing that considerably influence modal and route choice - possibly leading to situations of sub-optimal utilisation.

Furthermore the problems of adjusting transport supply to meet changing patterns of demand results in surplus capacity at certain times. How these factors interact in both modal choice decisions and route selection at a disaggregate level would prove a useful development of the work described in this thesis.

The relationship between industrial structure and transport demand has been touched upon in this thesis. For example the role of plant location policies within a particular company. What is less clear is how changes in structure characteristics (and associated market conduct) overtime will influence the pattern of transport demand and modal choice decision criteria. Concomitant with this is how a major transport development (for example a fixed cross-channel link) would affect modal and route choice and whether there was any significant generation of freight traffic. The steel industry would prove a useful vehicle for such a study in that there has been a major upheaval in the production pattern of the steel industry in the study area countries whilst levels of international movement have continued to be significant.

APPENDIX ONE

NATIONAL PORTS COUNCIL TRADE FORECASTING MODEL-EQUATIONS

A1 IMPORTS

1. WORLD :

$$M_{uk} = M_{uk} \left(A_u, PM_{uk} / PH_{us}, Q_{ts}, D_{us} \right)$$

2. COUNTRY

$$M_{uki} = M_{uki} \left(A_u, PM_{uk} / PH_{us}, PX_{ij} / PM_{uk}, Q_{ts}, D_{us} \right)$$

WHERE :

M_{uk} - U.K. imports of commodity k

A_u - Economic activity in U.K.

PM_{uk}/ - import price relative : ration of commodity k

PM_{ua} import price to modestic prices in sector s.

M_{uki} - U.K. imports of commodity k from trading partner i

PX_{ij}/ - price competitiveness of country i for commodity group j,

PM_{uk} - kej Ratio of country i export price for commodity j, to U.K. domestic price

Q_{ts} - total output of sector s

D_{us} - demand pressure in sector s

Note : import prices c.i.f.,plus tariffs

EXPORTS

3. WORLD

$$X_{uk} = X_{uk} \left(Y_w, PX_{uk} / PX_{wj} \right)$$

4. COUNTRY

$$X_{uki} = X_{uki} \left(Y_i, PX_{uk} / PX_{wj} / PH_{ij} \right)$$

WHERE :

X_{uk} - U.K. exports (tonnes) of commodity k

Y_w - World GNP

PX_{uk} / PX_{wj} - Price competitiveness of U.K. exports : ratio of U.K. export price (f.o.b.) of commodity k to world prices of commodity group j.

PRICE

$$5. \quad PX_{uk} = PX_{uk} \left(K_{us}, P_u, PM_{ul}, PX_{wj} \right)$$

$$6. \quad PH_{us} = PH_{us} \left(K_{us}, P_u, PM_{ul}, D_{us} \right)$$

$$6a \quad PM^{£}_{uk} = PM^{£}_{uk} \left(PX^{\$}_{wj}, ER, PH_{us}, D_{us} \right)$$

WHERE :

PX_{uk} - U.K. export price of commodity j

K_{us} - U.K. productivity in sector 3.

P_u - U.K. GDP deflator

PM_{ul} - U.K. import price of key input (raw or semi-finished materials) to a sector s

PX_{wj} - world price of commodity group j, kej

PH_{us} - U.K. (domestic) prices for sector s output

D_{us} - Demand pressure in sector s (at time t)

PM_{uk} - U.K. import price (c.i.f. + tariff) of commodity k

$PX^{\$}_{wj}$ - World trading price of commodity group j, U.S. dollars

ER - effective exchange rate, U.S. dollars/sterling (ratio of U.K. to OECD prices)

$$7.\quad I_{us} = I_{us}\left(I_{us}(L),\ QH_{us},\ X_{us},\ t,\ KS \right)$$

$$8.\quad K_{us} = K_{us}\left(KS,\ t,\ D_{us} \right)$$

$$K_{us}\left(I_{us}(L),\ QH_{us},\ X_{us} \right) \quad \text{(fall-back)}$$

WHERE ;

I_{us} - U.K. investment in sector s

I_{us} (L) - time lagged U.K. investment insector s

QH_{us} - U.K. domestic output in sector s

X_{us} - U.K. export tonnes from sector s

t - time

KS - capital stock

D_{us} - demand pressure in sector s

COUNTRY MODELS

9. $C_i = C_i \left(Y_i - T_i), C_i (L) \right)$

10. $I_i = I_i \left(Y_i, I_i (L) \right)$

11. $M_i = M_i \left(Y_i, PM_i / PH_i \right)$

12. $X_i = X_i \left(X_w, PX_i / PX_w \right)$

13. $Y_i = C_i + I_i + G_i + G_i - M_i + Z_1$

WHERE :

C_i - Consumption in country i

Y_i - GNP in trading partner i

T_i - Taxation in trading partner i

$C_i (L)$ - Time-lagged consumption in trading partner i

I_i - Investment in trading partner i

$I_i (L)$ - Time-lagged investment in trading partner i

M_i - Imports into trading partner i

PM_i / PH_i - Import price relative; ratio of import prices to prices of domestic output in i

X_i - Trading partner i exports

PX_i / PX_w - Relative price competitiveness of country i's export; ration of i's export prices to world prices

Z_i - change in stocks

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