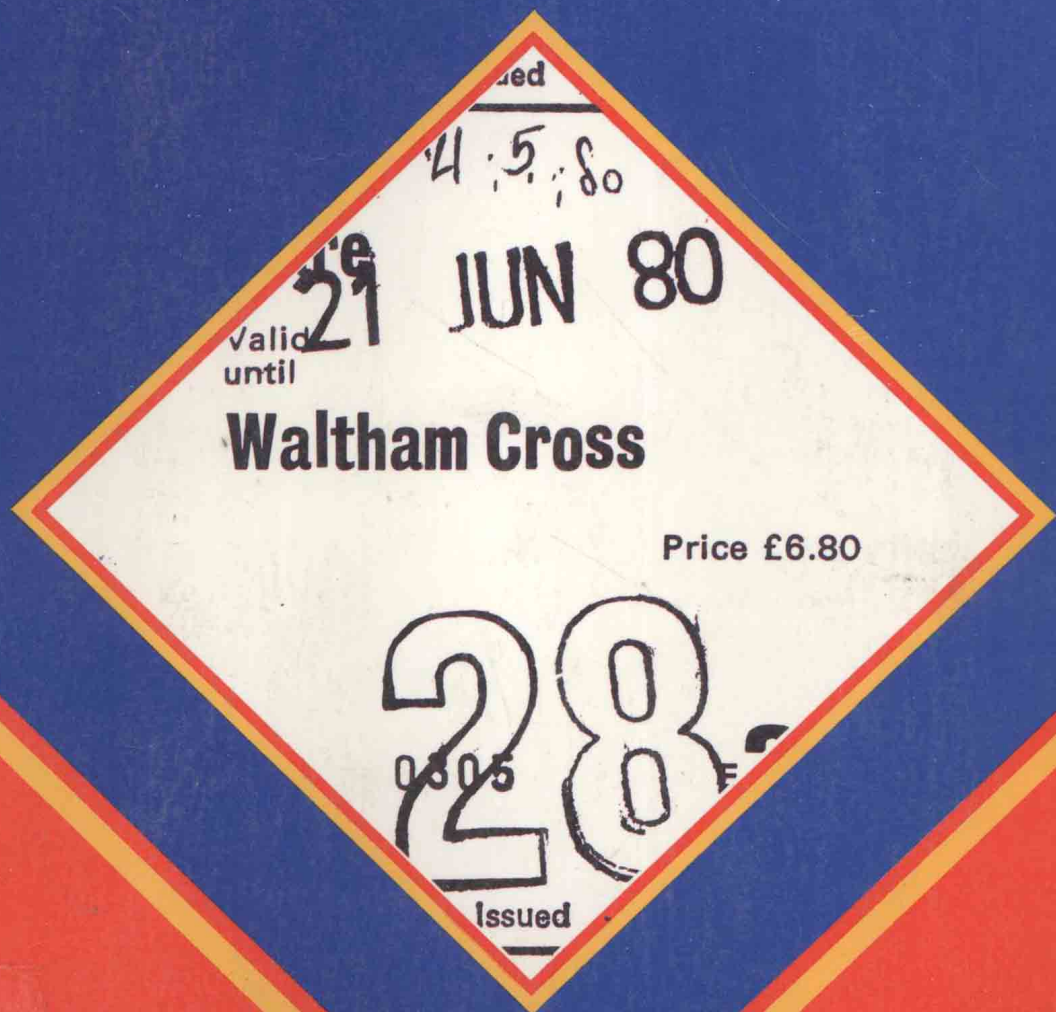


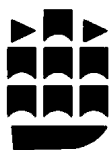
ECONOMICS OF PUBLIC TRANSPORT

C A Nash



Economics of public transport

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Preface

The aim of this book is to show how economic analysis may be used as an aid to decision-taking in both the long-run planning and day-to-day management of public transport systems. It concentrates on the conventional road- and rail-based systems which currently form, and for the foreseeable future will continue to form, the bulk of internal public transport throughout the world. Many of the same methods would, however, be applicable to other modes, including air and sea transport. The theme of the book is that a realistic appraisal of the circumstances of public transport shows purely commercial criteria to be grossly inadequate for decision-taking in this sector, but that this in no way negates the need for economic analysis of alternative decisions and for monitoring and financial control. The application of economic analysis to decisions such as fare structures and level, service planning and investment decisions are discussed, case studies and simplified numerical examples being used to illustrate the points at hand. Particular emphasis is placed on the relationship between objectives, external circumstances, organisation and policy.

The need for the book arises for the following reasons:

1. Existing texts on transport economics tend to discuss these issues only at an abstract level, giving the reader little idea of the practical circumstances and constraints which may modify the conclusions in practice, or indeed of how to set about such an implementation.
2. Acceptance of the case for taking objectives other than purely commercial ones into account raises all sorts of issues such as how to formulate those objectives, evaluate alternatives and monitor results, how to finance resulting deficits and how to divide managerial and financial responsibility between central government, local government and the operators concerned. The danger of such an approach is one of blurred responsibilities, with decisions being taken politically without adequate information on their consequences and with financial support taking the form of blanket deficit finance. In those countries where public transport support is of long standing, the viewing of public transport as a social service has tended to discourage the application of economic analysis to its problems.

3. The recent growth of computer-based data collection and analysis systems in public transport operation means that where public transport decision-takers have previously had to rely on judgements based on experience, they are now becoming sufficiently well informed to make use of more scientific decision-taking techniques. However, unless the scope and limitations of these techniques is well understood, there is a danger that their use may worsen, rather than improve, the quality of decision-taking in public transport operations.

Whilst this book is written primarily for advanced undergraduate and postgraduate economics students taking special subjects in transport economics, it is hoped that the book will be accessible to a wider audience, including transport students from other disciplines and students from local government and public transport operators preparing for professional examinations. The level of exposition requires no more than a knowledge of elementary economic theory, and of simple mathematical and statistical techniques such as differentiation and regression analysis, and much of the book will be intelligible without even that.

The book falls essentially into two parts. Chapters 1–6 deal with general issues in the economics of public transport regarding organisation, costing, pricing, service levels, finance and regulation. Chapters 7–10 look at the main sectors of the public transport market – urban, inter-urban and rural passenger and freight. Finally, Chapter 11 draws the threads together in the context of a brief discussion of the future of public transport.

A word is called for on the definition of public transport. Within passenger transport, the definition – including rail, bus and taxi services – is fairly straightforward. In freight, it is less so. We have adopted the standpoint that transport for hire and reward is public transport. However, this distinction is a little artificial, in that much hire and reward work is on behalf of a single operation. It is only where scheduled services and mixed loads are involved that the problems of road haulage become similar to those of other public transport modes. Coverage of the road haulage industry is therefore less comprehensive than that of the bus and coach and railway industries.

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Sponsorship of my current post by the British Railways Board has enabled me to devote most of my time over the last few years to the problems of public transport, and I am grateful to officers of British Rail and other transport operators for all they have taught me. In particular, Dr J. D. C. A. Prideaux, Mr S. D. Box and Mr R. Edgly have given valuable comments on the first draft of various chapters. I am also indebted to colleagues in the Institute for Transport Studies at Leeds University, especially Mr P. J. Mackie, to Mr M. Kerridge of the Confederation of British Road Passenger Transport and to the students on whom much of the material was tried out. Professor D. W. Pearce, as always, provided valuable advice at all stages. None of the above is in any way responsible for the final version and the views it contains. Without the speed and efficiency of my wife, Diane Petch and Pamela Rammell, who shared the typing, this book would have taken even longer to complete. Thanks are also due to Derek Heathcote for his help with the diagrams.

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Chapter 1

The framework of public transport operations

1.1 Decision-taking in public transport

The most fundamental decisions facing any industry are the combination of price and level of output to choose for each product. The principles upon which this choice is based under different market structures are the subject of numerous texts on the theory of the firm, and will not be considered in detail here. Suffice it to say that, from the point of view of the transport sector, we may identify three crucial market structures:

Perfect competition

In most countries, the road haulage industry and in some, road passenger transport is characterised by a large number of small firms supplying similar products with relatively easy entry to the market (except where, as discussed in Ch. 5, the State chooses to restrict entry). This appears to be a sufficiently close approximation to perfect competition for us to expect such industries to be characterised by average cost pricing (but assuming an absence of scale economies, this should equal marginal cost as well) with the scale of output of the industry as a whole determined by demand at that price.

Monopoly

The railway industry is usually characterised by a single national network, plus a number of small specialised companies (for instance, local metros in urban areas), with no competition for the same traffic. (The major exception is, of course, the United States, where preservation of competition between at least two companies to all major points has long been a guiding principle, although recent mergers and bankruptcies have made this increasingly difficult.) In most European countries, bus companies are licensed on the basis of one per route, so that effectively these are also monopolies (and in many cases a single operator covers a wide area).

The general recommendation in the literature for a State-owned or regulated monopoly is a policy of marginal cost pricing. The problem which arises if there are economies of scale is that this implies a failure to cover costs from revenue. Consequently, either subsidies will be needed or departures from marginal cost pricing must be sanctioned. These might take the form of

a general shift to average cost pricing, or of departures designed to minimise net loss of benefits by following second-best pricing principles (in simple circumstances, this might mean making proportionate increases of price over marginal cost in inverse proportion to the ratio of own-price demand elasticities (Baumol and Bradford, 1970).

Oligopoly

Oligopoly exists in the transport sector where two or three railways or bus companies provide competing services. It is more common in air transport than in land-based modes. The literature contains a wide variety of solutions to oligopolistic market decisions, according to the degree of collusion and the formation of expectations as to the reactions of the rival. The result may vary from that of pure monopoly where there is complete collusion to that of perfect competition where there is no collusion and no response to price-cutting is expected from the rival.

Given the existence of theoretical models to apply to the principal forms of market structure found in the transport sector, the need to study public transport as a specialism at all may reasonably be questioned. Why not simply apply the models developed for general use? The answer to this question lies in the existence of a number of particular characteristics of public transport which, whilst by no means unique to the sector, make the direct application of the theoretical models less than straightforward.

A very large number of jointly produced products. Although in certain contexts it is reasonable to regard the output of public transport operators as comprising passenger miles and freight ton miles, this is a gross simplification. Customers actually wish to buy trips from a particular origin to a particular destination at a particular time. Thus a bus or rail network of 2,000 stations or stops produces some 4 m. products for each possible journey time, and may thus be involved in setting something greatly in excess of 4 m. fares. Clearly, simplifying formulae are necessary to make the task manageable. Moreover, many of these individual products will use common services for at least part of the journey, so that there is a problem of allocating joint costs. In fact, costing (as shown in Ch. 3) is normally related to services or service groups rather than to the individual trip. There is no obvious or unique way of working out the average cost of each possible distinct trip on the public transport system.

Output is subject to major indivisibilities and cannot be stored. In most simple models, output and sales are taken as synonymous. More sophisticated models may take account of discrepancies between the two as adjustments to stockholding. But in the transport field, production cannot be stored. If unsold, at the time of production, it is lost. Again, this is found in other sectors; services for instances, and virtually in electricity, where storage is possible but very expensive. What makes the problem worse is the importance of indivisibilities. It is not possible to adjust the number of seats in a vehicle rapidly to conform to fluctuations in demand even if these are

known in advance. Uncertainty adds to the problem. Thus capacity utilisation in public transport is rarely much above 50 per cent, and frequently much lower. This leads to a puzzle for anyone trying to apply marginal cost pricing, for it appears that marginal cost is always either zero (where there is spare capacity) or very high (where capacity is fully utilised). Nor is this merely true of short-run marginal cost; if demand and supply are steady over time, the position will persist even in the long run.

The consequence of these factors is that a wedge is driven between pricing decisions and output decisions; it is no longer the case that one necessarily determines the other, and indeed most public transport operators consider the two as separate distinct decisions. The most sensible practical approach to pricing decisions is not to base prices on estimates of costs, but to reverse the procedure and to consider the capacity and cost implications of alternative levels of price.

The importance of product quality and its correlation with output. Again, the importance of product quality decisions is by no means confined to transport. What is unusual, however, is the way in which product quality in public transport is correlated with output. Whenever talking about scheduled services, it is the case that an important aspect of quality is the frequency with which the service operates. However, given the existence of economies of vehicle size (Ch. 3), for any given level of traffic, it is only possible to provide an enhanced frequency at increased unit costs. Consequently, increases in traffic levels either produce economies of scale from the use of larger vehicles or improved quality of service from a higher frequency. Either way, the impact is one of increasing returns to scale in terms of the total social cost of the transport facility. This near universality of increasing returns to scale to total output (which may co-exist with increasing, zero or decreasing returns to scale at the level of the individual firm) means that the conflict between marginal cost pricing and breaking even or achieving a given financial target referred to above will always be present to a greater or lesser degree. This, plus the practical impossibility of any close relationship between price and marginal cost for each distinct product, means that public transport is an area ripe for the application of second-best theory even before external costs and benefits are taken into account (section 1.3).

A further complication in the public transport field is the extreme political sensitivity which pricing and output decisions often have. A change in the product line of a public transport operator may leave some sectors of the population unable to get to work, school, shops, doctors, etc. except at greatly increased cost (e.g. taxi) or inconvenience. Freight transport withdrawals may pose similar difficulties for firms, leading in extreme cases to a change in location or liquidation, and thus to unemployment for workers. Similarly, because in many contexts the public transport user feels trapped into using the services of a monopoly producer (frequently the State), fares are always liable to become a contentious issue. Before the development of widespread private and own-account transport these points were, of course,

all the more important in the proportion of consumers and firms to which they applied.

A consequence of this is that political authorities have become far more heavily involved in pricing and output decisions in the transport field than in many others, and public transport operators often find themselves taking decisions under constraints which appear totally irrational to the economic theorist. For instance, most railways require government permission to change fares, routes operated and sometimes even quite minor service level changes. Bus companies face similar restrictions through regulatory bodies, or from their ownership or control by local authorities. Fares adjustments to raise fares where marginal costs are high or where demand elasticities are low relative to elsewhere may be forbidden as discrimination, and so forth. Thus a student of public transport needs to study not just the operators themselves, but a whole range of political bodies which may be in a position to influence or to control the decisions of the operator.

1.2 The organisation of public transport operators

There are five main characteristics of transport operators to be taken into account in considering organisational issues:

1. Size and size distribution of competitors.
2. Ownership and control.
3. Types of traffic handled.
4. Mode or modes of transport operated.
5. Geographical area covered.

At one extreme we have the one-man, one vehicle operation, which is still common in road freight, private hire coach and taxi businesses and in the provision of bus services in many countries. Such an operation will almost inevitably be privately owned, restricted to road transport and very limited in terms of type of traffic and geographical area covered. It may deal directly with customers, work through an agency or be entirely contracted out to other operators. The same individual can take responsibility for all decisions with respect to pricing, scheduling, marketing and engineering.

As we turn to bigger firms dealing solely with road transport, the same organisational principles could still be adopted. Each driver could still be responsible for all the functions relating to an individual vehicle, although some form of general management and financial stewardship would obviously be needed, together with a way of providing incentives (bonuses, profit-sharing). In practice, this rarely happens, for two main reasons:

1. It fails to exploit the scale economies and other advantages of specialisation.
2. Competition between individual elements of the same firm may worsen the firm's overall performance by lowering price, leading to poorer utilisation, etc.

Thus, there is usually a division of responsibilities by function. At the simplest level, this may take the form of a split into just two or three departments (e.g.

traffic, engineering and finance) together with some form of co-ordinating mechanism, which may take the form of a quasi-market (with, for instance, the traffic department 'buying' services from the other two) or an administrative procedure involving central planning and/or an inter-departmental committee structure.

In the big transport organisation, be it publicly or privately owned, there are many more alternatives for organisational structure. In general, organisation of the large firm depends on the range of products and markets in which the firm is operating; and on the degree of interdependence (in terms of the technology used or of substitution/complementary relations between goods) between them. A firm producing a number of independent products will be likely to adopt a product-division structure (or even that of a holding company and a number of subsidiaries). If it is operating in a number of separate markets (for instance in different areas), it is likely to adopt a market area structure, at least for marketing and selling (and for production, too, if there are insufficient economies of scale to justify serving all markets from a common pool of resources). A firm producing a single product, or a set of closely related products, is more likely to adopt a functional structure. If the interdependence is solely technological, a functional structure for production may be combined with a product-division structure for marketing and selling; with perhaps the latter divisions actually buying output from the production departments.

As examples, the structures adopted in the late 1970s by three British nationalised operators are illustrated in Figs. 1.1–1.3. The National Bus Company operates throughout England and Wales, with around 17,500 vehicles and whilst certain functions, such as purchasing and finance, and certain types of product, such as some express services and tours, are dealt with at headquarters, there is strong decentralisation on a regional basis, reflecting the fact that it is operating in separate regional markets with no significant economies of scale. The National Freight Corporation, with 24,000 vehicles, on the other hand, divides directly into product groups before decentralising on a regional basis. Railway organisation provides perhaps the greatest problem. Joint use of assets and the need to timetable the use of infrastructure leads to interdependence between seemingly unrelated types of traffic, whilst the fact that much traffic is long-distance means that, if the system is strongly connected geographically, a large proportion of traffic is likely to cross the boundaries of any regional structure and require inter-regional co-ordination. Most railways have a mixture of functional, product and regional decentralisation, as in the organisation chart for BR as in August 1978 (Fig. 1.3) (see Bonavia, 1971).

It may be thought that the internal organisation of the public transport operator is of little concern with respect to the subject-matter of this book. This is far from the truth. In subsequent chapters, we shall be considering how to take the type of decisions faced by all public transport operators on what prices to charge, what services to offer and how to produce them. But the quality of these decisions depends very much on who is

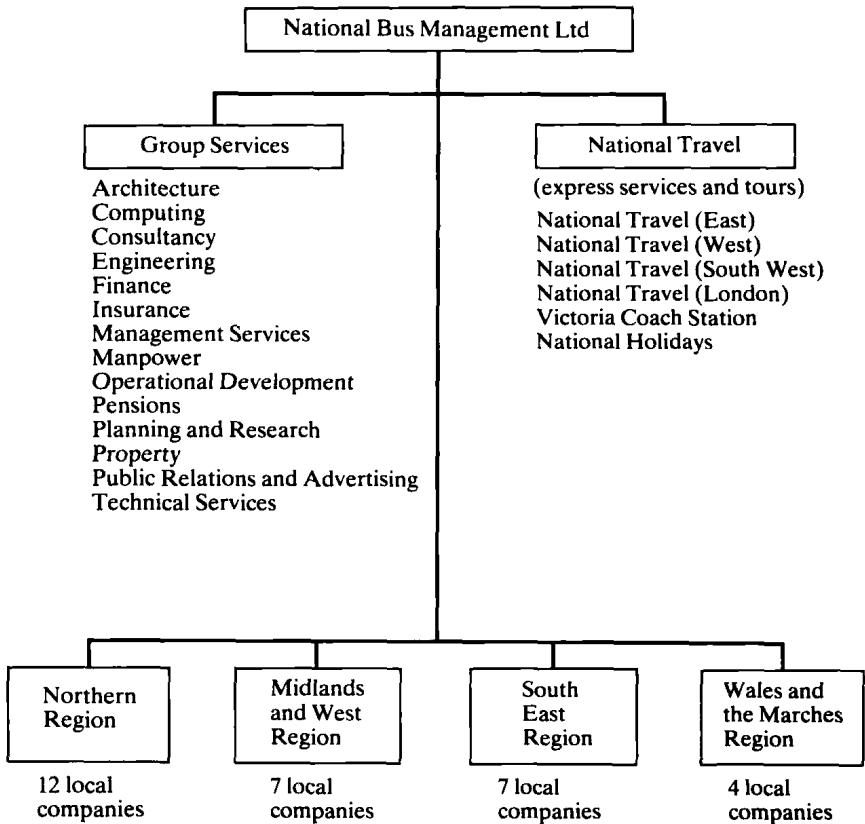


Fig.1.1 National Bus Company as in 1978 (Source: Annual Report, 1978).

involved in taking them with what objectives and on the basis of what information. There is much to be said in favour of a decentralisation of transport operations on the basis of products or markets. Such an organisation encourages management to adopt a strongly marketing-orientated approach; that is, to start with the demands of his customers and explore how best to meet them, and enables measurement of achievement to be directly based on market performance. However, correct decisions on the latter depend critically on his being provided with reliable cost data. Where there are significant joint costs, it may be impossible to do this for a particular product in isolation. This is a major problem in rail transport, and has tended to lead to a more centralised organisation, with greater influence being given to the functions providing jointly consumed services. One result of this organisation is the accusation in many countries that railway management is too 'production orientated' (Wyckoff, 1976).

The organisation of the publicly owned transport sector is a particularly difficult problem. A number of central issues emerge.

1. Should separate organisations provide services by the separate transport modes?

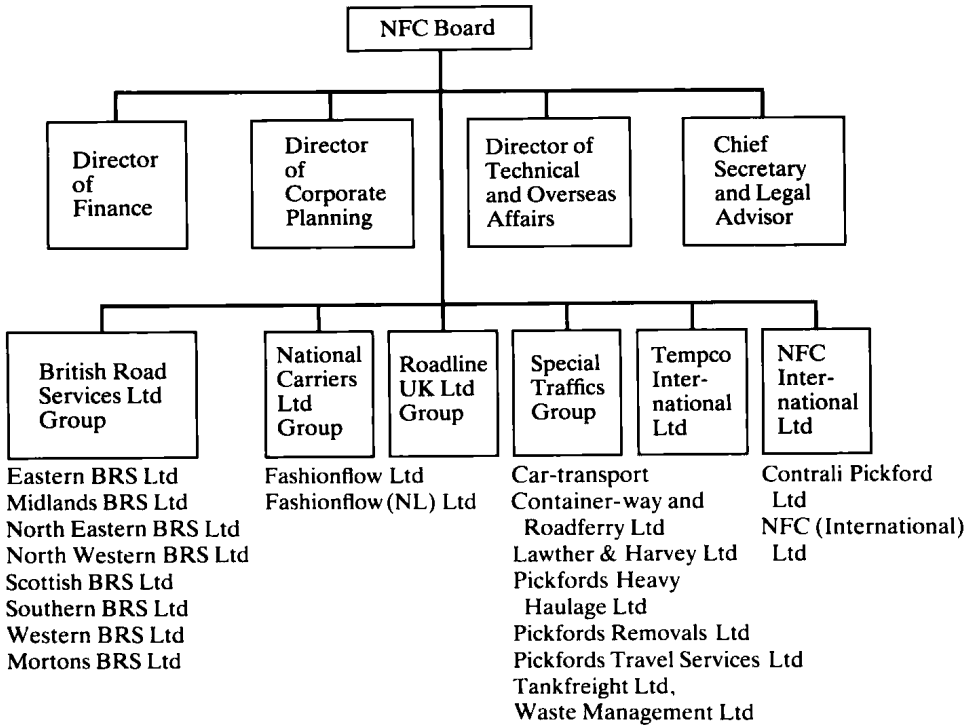


Fig. 1.2 National Freight Corporation as at 31 December 1978 (Source: Annual Report, 1978).

This approach has the attraction of separating off operations which are totally independent in terms of production, but leads to other severe difficulties where the different modes do not serve distinct markets. Confining operators to a particular mode means that they will approach markets with a distinct technology in mind, rather than trying to exploit the opportunity in question in the best way possible. Opportunities which require close integration between modes are especially likely to suffer.

2. Should competition be encouraged or suppressed between publicly owned operators themselves and with privately owned operators?

This is clearly a key issue about the organisation of the transport market which will need further consideration (Ch. 5). Some degree of competition may well be desirable as a means of stimulating management and promoting innovation. As a generalisation, however, competition between publicly owned operators leads to inefficient duplication of services and hampers co-operation and integration of services; where more competition than that provided by private transport is deemed desirable, it may be better to allow privately owned operators into the market for specific traffics or services.

3. Should public sector operators be centrally or locally owned and financed?

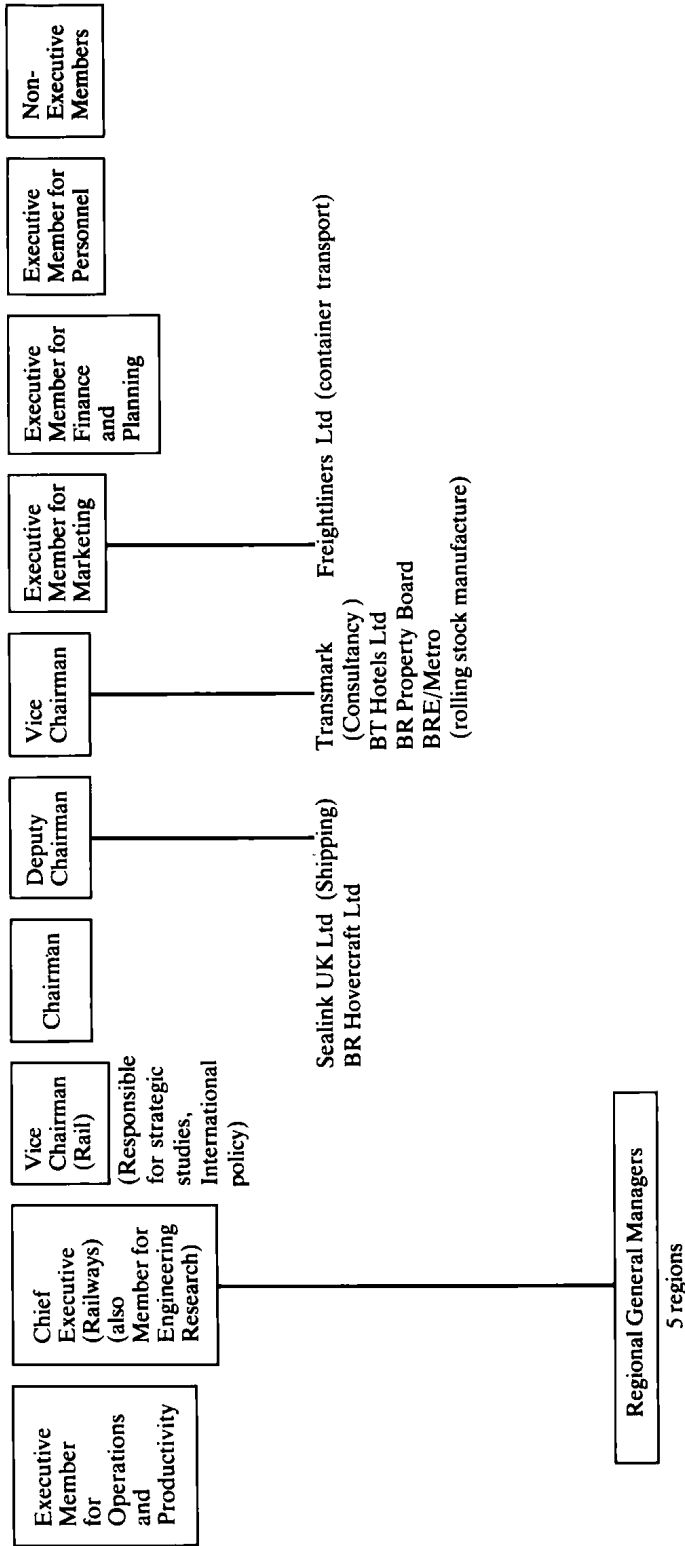


Fig. 1.3 British Railways Board as in August 1978 (Source: BRB, private communication).