# Competition and Regulation in Grain Transport: Submission to Royal Commission, May 1987

## Occasional Paper

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## FOREWORD

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One of the objectives of the Commission is to investigate the efficiency with which grain is transported in Australia. To this end the Commission sought submissions from interested parties. The Federal Bureau of Transport Economics (BTE) has prepared this Paper in response to that request.

The Paper was prepared in the Economic Assessment Branch of the Bureau by Mr R. Bennett, Ms S. Austen, Dr H. Milloy, Mr S. Taylor, Mr B. Honu and Ms L. Aroia, with assistance from other Branch members.

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**Federal Bureau of Transport Economics**
Canberra
May 1987

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## SUMMARY


This Paper has been prepared as a submission to the Royal Commission into Grain Storage, Handling and Transport. The objectives of the Paper are to describe the current arrangements for the transport of grain, showing the significance of transport charges and their recent trends, and to identify the main transport issues and areas where scope for improved performance exists. Options for improved performance are assessed, with potential institutional constraints and other barriers to change being highlighted.

The main conclusion reached in the submission concerns the possible consequences of unrestricted road-rail competition for the transport of grain. While the relaxation of the present regulatory policies might result in a lowering of transport prices to growers in some areas, it is not certain that the final outcome will be beneficial from a national perspective. It also seems likely that such a change, under current road and rail financing arrangements, will increase the costs borne by other members of the community. This would occur primarily through higher rail freight rates on other traffic or on grain in particular regions and a reduction in the quality of rural roads, or through taxes to finance higher rail deficits and road maintenance costs.

Important features of the present grain transport arrangements include:

- The major role played by governments (especially State governments) in transport of grain, as well as in marketing, storage and handling.
- Country grain storage sites are widely dispersed, enabling growers to travel only a short distance to deliver their grain to the bulk handling authority. One consequence of this pattern of storage facilities is that it is expensive to transport each tonne of grain over many rail branch lines in country areas because traffic volumes are low.

- The majority of grain is transported by rail from country storage sites to port. Road transport is restricted in some States by law and in New South Wales by the lack of road receival facilities at ports.
- Rural local roads are the roads most often used by grain trucks and rural local governments are responsible for financing the majority of expenditure on these roads. The potential increase in road damage that would be caused by additional heavy, perhaps overloaded, grain trucks is a major concern of local governments.
- Grain transport services experience peaks and troughs in demand throughout the year. The pricing policies of some grain marketing and handling authorities and the non-availability of on-farm storage contribute to this problem. Aspects of this peak load problem include the use of overloaded grain trucks and queuing.
- Interstate transport of grain is restricted by differences in rail gauges and by pricing practices of State transport and grain handling authorities aimed at minimising 'leakages' of grain across State borders. Some 'leakages' do occur, however, and transport, handling and storage costs could be reduced by the adoption of a more national perspective.
- Each State has its own grain ports. The number ranges from two in New South Wales and Victoria to seven in South Australia. Ships servicing the smaller ports can be required to 'top-up' at another, larger port. This 'two-port loading' adds to the total costs of moving the grain to overseas markets.
- Land transport charges represent about 16 per cent of total grain production costs (including handling and storage charges). In recent years farm costs have been rising faster than rail freight rates.

The Terms of Reference for the Royal Commission sought means by which the efficiency of the arrangements for grain transport might be increased. Economic principles suggest the overall objective should be to provide economic incentives that encourage both technical and allocative efficiency, and that ideal arrangements would include:

- prices for specific services reflecting their own costs (rather than, for example, being based on average system costs);
- prices never lower than short-run marginal costs (that is, no cross-subsidisation between services); and
- prices increased to clear markets at times of congestion.

Competitive or ''contestable' environments are market structures which encourage these types of arrangements. However, institutional arrangements, grain marketing considerations and similar factors restrict the scope for creating truly competitive markets, and mean that the conditions necessary for 'contestability' to be present are unlikely to be achieved in practice. Nevertheless, advocates of contestability theory argue that any move towards contestability through reductions in barriers to entry and exit will still result in improvements in industry performance and in the allocation of resources.

Other reasons why an ideal competitive or contestable environment is unlikely to be present in the real world include imperfect information, economies of scale and scope, vertical integration, government ownership and externalities. Pricing problems can also occur for grain transport services due to fluctuations in demand.

The domestic grain land transport industry has some characteristics of a contestable market but Australian grain ports currently operate with only limited actual or potential competition. Road transport operations could be considered largely contestable because any sunk costs of road construction, that is, costs unable to be recovered, are incurred by governments, not by the truck operators. Road transport operators themselves can enter and leave the industry with relative ease. By contrast, the operators of rail transport are also effectively the owners of the rail track. Consequently, all sunk costs of both rail operations and railway construction will be incurred by rail transport operators. The possibility of rail transport, *per se,* being contestable under current ownership arrangements is, therefore, considerably less than for road transport. However, the presence of a competitor (road transport) can, in some circumstances, result in rail operators taking decisions in a manner similar to contestable market behaviour.

Given this current market structure and the pricing and operating practices followed, the main areas where efficiency of grain transport might be increased can be grouped under three headings:

- intermodal pricing and competition
  - consequences of rail charges that do not reflect costs
  - peak load pricing
  - full social cost of road transport operations
  - impact of State borders on the behaviour of railway authorities;

- interaction between grain transport, handling and storage operations; and
- competition between ports.

Rail charges that do not reflect costs can lead to inefficiencies not only in the rail system itself but throughout the economy. Cross-subsidisation, for example, can adversely affect the consumption and investment patterns of both the consumers being subsidised and the consumers or taxpayers providing the subsidy. Identifying cross-subsidies, however, will be difficult because of the inadequacy of rail cost data and the likely variations in cost and revenue between each situation.

Differences in charges for similar services are not, in themselves, evidence of cross-subsidisation. In fact, different charges can be justified on efficiency grounds to achieve cost recovery in a declining cost industry such as rail. Therefore, each case needs to be considered on its merits.

Rail charges that do not reflect costs or demand conditions can also obscure investment and disinvestment opportunities by providing signals to investors which are not based on proper valuations of the resources involved. These signals can affect investment in road as well as rail transport, and also have an impact on the need for new port, storage and handling facilities.

To the extent that road transport is not paying the full social cost of its operations, in the absence of regulation more resources will be attracted to road transport than would be the case in a competitive environment. Various studies into the recovery of road costs show that the heavy vehicle group in particular is not contributing revenue sufficient to cover the costs of the road damage it causes.

The costs considered in most studies of cost recovery relate only to the pavement damage costs caused by heavy axle load vehicles using arterial roads. A variety of social and other costs are associated with the use of vehicles with heavy axle loads to transport grain from farm to port. These are:

- The cost of heavy vehicles using local roads. Lower pavement strength on these roads will result in greater pavement damage from heavy vehicle usage.
- The environmental and other social costs of heavy vehicles using rural roads. Trucks travelling on unsealed roads in these areas add to problems with dust and contribute to the risk of road accidents.

- The environmental and other social costs of heavy vehicles travelling through urban areas on their way to port. For example, if 15 per cent of grain exports through Newcastle travelled by road as a result of provision of suitable port receival facilities, about 13 000 annual truck movements each way would be involved. Therefore, the impacts on noise and air pollution and on road congestion could be significant.
- The long-run incremental cost of heavy vehicles. These costs include those associated with providing stronger pavement strength, lesser grades and increased road widths to cater for heavy vehicles.

The efficient pricing of road use to cover at least the various short-run costs is a major problem. A pricing framework in accord with the cost recovery logic would, at a minimum, charge road users according to the various pavement, environmental and social costs they impose. This price, therefore, would in theory vary not only with the distance travelled and the axle load but also with the location of travel (that is, between local and arterial roads and between rural and urban areas).

Existing road pricing mechanisms do not allow this type of differentiation. In any case, such a system would need to apply to all road transport, not just grain. Some form of regulation of grain transport may, therefore, be justified as a means of achieving the modal split between rail and road which would occur if there were competition and if all the economic and social costs associated with road use by heavy vehicles were charged to the road operators. Clearly this does not mean a total ban on road transport of grain. All it implies is that in certain areas or across certain distances where the social costs of road transport of grain may greatly exceed prices paid, the appropriate policy response may be to restrict the use of roads by grain transport operators (but only when improved road pricing cannot be implemented). Restriction of grain receival facilities at ports located in major urban centres is an example of such a policy.

Intermodal competition is also greatly influenced by the presence of State borders and the limitations these impose on the actions of State rail authorities. A national approach has some potential for increased efficiency but there are two major difficulties:

- the desire of each State to maximise the use of its own infrastructure by transporting, handling and storing as much grain grown in that State as possible; and

- the rail systems of the different eastern States are largely incompatible because of the different rail gauges used.

A first step towards a more efficient system is ensuring that pricing of rail operations in border areas is at or above short-run marginal cost. The longer term solution would involve the removal of any artificial competition created by the presence of a border by adopting a truly national perspective to grain transport, handling and storage.

Charging at least short-run marginal costs for rail services in border areas might mean that some grain transport will be lost to interstate rail or road operations, but it should also assist in improving the allocative efficiency of transport resources (provided that road transport is also priced at no less than short-run marginal cost, including external costs). Efficiency is likely to be further improved if rail systems were able to extend their activities across borders into other States, take over other State rail authorities' track (for example, V/Line could take over the Narrandera-Tocumwal line should it be abandoned by the State Rail Authority of New South Wales), or operate inter-system services where such moves are justified on economic efficiency grounds.

The closely related nature of the transport, storage and handling systems means that the level of efficiency in the storage and handling tasks will affect the costs of transport operators. Technically inefficient loading and unloading facilities, for example, will discourage transport operators from investing in equipment of higher productivity. Similarly, a lack of road receival facilities at silos and port terminals will prevent road operators from competing with rail transport where such competition may be economically justifiable.

Unrestricted competition between ports is unlikely to be workable, particularly given the monopoly power which might be exploited. Given that some regulation of ports is to remain, it is important that decisions regarding port investment be made on the basis of a proper examination of relative costs and benefits from a social perspective, including a full assessment of alternatives, and that technical efficiency is pursued. A first step in this process would be for port authorities to clearly set out their objectives in terms of economic efficiency and social considerations.

A second step would be to ensure that all port authorities fully assess the costs of each of their operations. Although pricing to reflect these costs will not by itself ensure that technical efficiency is achieved, it would allow areas to be identified where improvements in technical efficiency could be made.

The development of a national approach to port investments is also required. The trend towards larger capacity ships for the transport of grain suggests that increased capacity of port facilities for grain may be economically warranted in the future. A more national approach to port investment, or at least more co-ordinated investment decisions between adjoining grain-growing States, would help reduce the risk of unnecessary duplication of grain facilities in ports.

The Paper also includes estimates of the cost structures of road and rail transport. Two rail examples are used to illustrate the differences in the cost structure in different circumstances. One example is a unit train running on a main line between a large inland grain storage facility and a port. The other example is a branch line operation servicing a sub-terminal.

In the main line example, track maintenance was the largest single component of long-run avoidable costs (29 per cent). This contrasts with the branch line example where track maintenance costs, at 97 per cent, almost completely dominated the total costs. For this reason, the financial cost per net tonne-kilometre for a dedicated grain operation on the branch line was estimated at around 80 cents whereas the corresponding figure for the main line was about 4 cents.

The cost structure of road transport operators was considered in two parts. These are the financial costs actually facing the operator and the underlying costs to the economy of the resources used. The main differences between the two are that resource costs exclude taxes but include road damage and other costs (such as environmental costs caused by grain trucks) of road transport operations. It was estimated that the financial costs per net tonne-kilometre (assuming no backloading) of six-axle articulated, three-axle rigid and two-axle rigid trucks were about 8 cents, 17 cents and 22 cents respectively. The corresponding resource cost figures are around 9 cents for six-axle articulated trucks, 17 cents for three-axle rigid trucks and 20 cents for a two-axle rigid truck.

These cost estimates indicate that rail transport is likely to have a significant cost advantage in the line haul task where there are few backloads available. Where backloading opportunities exist for road, the two modes may have more similar costs for the grain task. Road transport would appear to have an advantage over rail on branch line routes but the outcome depends largely on rail traffic volumes (of both grain and other freight) and on the conditions of local roads. The significant differences in the costs of main line rail and long haul road transport suggest that, even without regulation, rail would have a monopoly over the transport of grain from some areas. These cost differences raise a question about the need for some check on rail freight rates if economic regulations were relaxed, to ensure that fair rates are charged to growers in areas remote from ports where backloading opportunities are poor.

## CHAPTER 1 INTRODUCTION

On 13 October 1986 the Federal Minister for Primary Industry, The Honourable John Kerin, M.H.R., announced that a Royal Commission into Grain Storage, Handling and Transport would be held, headed by Mr J. C. McColl.

The Terms of Reference of the Royal Commission are, in summary, to report on:

- the nature of the most efficient and cost effective system that might be instituted in Australia for providing storage, handling, transport and port terminal services for grain growers and grain marketing authorities and organisations; and
- recommendations concerning measures, including legislative or administrative changes, that are necessary or desirable to implement such a system.

This submission has been prepared in response to the invitation by the Commission for interested parties to make submissions. One role of the Federal Bureau of Transport Economics (BTE) is to assist in the formulation of transport policies directed at reducing transport costs, improving efficiency and rationalising the planning of future transport facilities. An interest in the efficiency and cost effectiveness of Australian grain transport accords with this role.

The objective of this submission is to facilitate the Commission's investigations by contributing to the understanding of grain transport arrangements and economic considerations relevant to these arrangements. Chapter 2 contains a summary of key features of current grain transport arrangements and the importance of transport charges for the grain industry. Chapter 3 is concerned with the economic theories which may provide a guide to the most efficient transport system. Chapter 4 draws on these two chapters to highlight the major issues relating to the transport of grain.

In Chapter 5 an analysis is made of the scope for improvement in the performance of grain transport. This analysis draws on the economic theory and current practices outlined in the preceding chapters and in the appendices. Estimates are provided in Chapter 6 of the costs of road and rail transport in order to give an indication of possible modal shares of the grain transport task in a less regulated environment. Concluding comments are made in Chapter 7.

The chapters are supplemented by five appendices which provide more detail on grain transport arrangements (Appendix I), the recovery of road costs (Appendix II), road funding (Appendix III), the urban impacts of heavy vehicles (Appendix IV) and the results of previous investigations of the grain transport system (Appendix V).

# CHAPTER 2 OVERVIEW OF GRAIN TRANSPORT ARRANGEMENTS AND CHARGES

The main features of the existing grain transport task and the relative importance of the charges associated with this task are summarised in this chapter. It draws on the detailed information provided in Appendix I on grain production, the organisations involved in moving grain, the transport infrastructure employed and the charges for grain transport services.

## KEY FEATURES OF GRAIN TRANSPORT ARRANGEMENTS

The data in Appendix I provide an overview of the nature of the grain transport task in Australia. A number of key features stand out.

- Production of grain is widespread, occurring in all the mainland States of Australia.
- Cereal grain production is dominated by wheat. The requirements for the wheat crop provide the broad parameters within which the transport of other grains must be handled and in many ways dictate the networks and performance of the various rail systems.
- The overwhelming majority of cereal production is for export. This provides the rationale for Commonwealth Government interest in grain transport, handling and storage costs.
- The main organisations involved in grain transport comprise the State road and rail authorities, port authorities, the various public and private marketing authorities and the bulk handling authorities in each State.
- A major role is played by governments, especially State governments, in the transport of grain, as well as in storage, handling and marketing. Traditionally, State governments have played a key role in providing transport infrastructure.
- Small, general-purpose farm trucks, some overloaded, are used to deliver the grain over the short distance (a five-State average of around 20 kilometres) from farm to local silo. These trips are generally along rural local roads which are funded primarily by local governments.

- The majority of grain from country storages is transported by rail to a port within the same State. There are, however, some 'leakages' across State borders from New South Wales to Victoria and Queensland and between Victoria and South Australia. This suggests that in the absence of borders the demand pattern for transport services in border areas would be quite different. Thus, borders represent institutional barriers to increased transport efficiency.
- The demands on transport services experience peaks and troughs throughout the year. These fluctuations can add to costs by increasing congestion at silos and on roads during peaks and allowing capacity in expensive infrastructure to remain under-utilised in troughs.
- Road transport of grain is restricted by law in some States and by the lack of road receival facilities at ports in New South Wales. Only in South Australia are there no legal or infrastructure restrictions. Interstate road transport of grain is also not restricted.
- The average distance from country storage to port in each State varies from 150 kilometres in South Australia to 500 kilometres in New South Wales. The desire of State governments to keep transport of grain within their own borders might mean that in some instances grain is transported a greater distance than is necessary. In other cases, cost savings that could be obtained through interstate transport movements are not sought.
- Each State has its own grain ports. The number ranges from two in New South Wales and Victoria to seven in South Australia. Depth limitations in some ports can result in ship size being restricted and/or large ships being required to 'top-up' at another, larger port. This 'two-port loading' adds to the total costs of moving grain to overseas markets.

**IMPORTANCE OF GRAIN TRANSPORT CHARGES**

Various measures of the significance of transport charges to the grain industry are also presented in Appendix I. There are a number of important conclusions which can be drawn from this material.

- Data from the 1978-79 input-output tables prepared by the Australian Bureau of Statistics (ABS) show that cereal domestic transport costs represent 12.5 per cent of the value of cereal grain output. Rail transport costs represent about 7 per cent of the value of cereal grain output. (More recent input-output data are now available but could not be analysed in time for this submission.)

- Total farm costs have been growing at a faster rate than rail freight charges. Over the period 1979-80 to 1984-85, total farm costs increased by 65 per cent, the Consumer Price Index (CPI) by 50 per cent and rail freight charges by 49 per cent (Table I.27). Consequently, rail charges have not been a major factor contributing to declining rural incomes.
- Ocean freight rates have been depressed by an oversupply of shipping tonnage. For example, freight rates for wheat from the east coast of Australia to the Middle East declined by 36 per cent in nominal terms between 1979 and 1986 (Table I.29).
- On a typical shipment of grain from a farm to an overseas port in 1984-85, transport charges represented around 21 per cent of the cost, insurance and freight (CIF) price of the grain. Sea freight accounted for about 50 per cent of these transport charges, rail freight for about 40 per cent and road freight for 10 per cent (Table I.30).

These observations provide a basis for the identification and examination of major issues confronting the efficiency of grain transport in Australia. These issues are discussed in Chapter 4, following an outline of relevant economic theory in the next chapter.

# CHAPTER 3 ECONOMIC CONSIDERATIONS IN GRAIN TRANSPORT

The conclusions of economic theory relevant to the efficient operation of industries are reviewed in this Chapter. Particular factors potentially hampering efficiency in the transport of grain are also discussed.

The first section summarises the features of an economically efficient system from a theoretical perspective. This is followed by a discussion of features which render difficult the achievement of efficiency in the current grain transport system, and the implications of these for an efficient system. The principles discussed in this chapter are used in Chapters 4 and 5 to assess more thoroughly the current domestic transport arrangements.

## FEATURES OF AN EFFICIENT TRANSPORT SYSTEM

An economic system is said to function optimally when it results in the maximisation of social welfare, in the sense of ensuring that the maximum benefit is achieved from the employment of any given amount of society's resources. Such a state of bliss occurs when that collection of goods and services is produced which best satisfies the preferences of consumers, and when this collection is produced in a technically and allocatively efficient manner. Economists have established a rigorous set of conditions for firms, industries, markets and consumers which are necessary for the achievement of optimum efficiency. These conditions, which are documented in Little (1957) and reviewed in BTE (1985b), require, for any industry, that output is produced at least-cost (that is, least economic or social cost) and that the level of output is determined by free or unrestricted exchange between profit-maximising producers and utility-maximising consumers. In other words, producers will profit by producing the goods consumers prefer and by producing them as cheaply as possible.

For producers to achieve efficient production and consumers to make the most satisfying choices, they must all be fully aware of the resources at their disposal, the prices at which the resources are available, and have unrestricted access to them. Moreover, resource prices need to reflect their true economic or social cost. Producers and consumers basing their choices on the existing set of prices will not be making allocatively efficient decisions if the price of factor inputs or final goods and services are distorted. This could occur, for example, through imposition of taxes, monopoly controls, exclusion of congestion or pollution costs, inability to account for preferences of future generations, or the difficulty of pricing appropriately the output of decreasing cost industries. In other words, if consumers and producers are able to respond freely to a set of 'correct' prices, then decisions made will ensure that the industry operates efficiently. The set of correct prices will be achieved when prices equal the marginal social costs of production both in the short-run and in the long-run.

When all of the possible distortions such as those mentioned above are absent, a 'perfectly competitive' market system will exist and will generate optimum welfare. If, however, some of the required conditions are lacking, a competitive system will not yield an efficient result and intervention or regulation may be desirable to improve the outcome. The unlikelihood, in reality, of the existence of the perfectly competitive system has resulted in considerable economic thought being devoted to establishing conditions which, in practice, will result in industries behaving in a manner similar to the perfectly competitive model. This has led to the theory of 'workable competition' and more recently to the notion of 'contestable' markets.

From the theories of workable competition and contestable markets it can be argued that even where firms are large and few in number, entry barriers can be low enough for the threat of potential competition to act as a restraint on the behaviour of existing firms, and ensure that they conform to competitive principles.

The conditions necessary for 'contestability' to be present are quite limiting. They relate particularly to firms in the industry and potential entrants having equal access to all customers and to the most efficient technology, and the absence of sunk costs (that is, entry and exit must be costless). These ideal conditions are unlikely to be achieved in practice. However, advocates of the theory argue that any move towards contestability through reductions in barriers to entry and exit will still result in improvements in industry performance and in the allocation of resources.

The grain transport industry has some of the fundamental characteristics of a contestable market. Entry and exit costs for road transport operators seem likely to be low. Rail transport, however, is controlled by statutory monopolies and entry is not really possible except in very special circumstances. Were entry to rail transport open, it is possible that the likelihood of large capital costs becoming sunk costs would restrain effective competition. Nevertheless, the presence of road competition in some areas of grain transport may result in railway operators taking decisions in a manner expected in a contestable market.

The scope for price distortions like those discussed above is extensive. Therefore, it is important to determine the existence and severity of such distortions in the grain transport industry. This provides the basis for identifying ways in which efficiency gains might be achieved. It is much more difficult, however, to establish the conditions for particular improvements in efficiency than to establish the conditions for an optimum. If, for example, prices are too low in a number of areas, a price increase in any one of these areas may result in socially more costly behaviour rather than increase the efficiency of resource allocation in the whole system.

The problems involved in finding a second-best solution have led to development of the theory of cost-benefit analysis designed to provide a methodology for measuring the social benefits of particular changes in economic conditions. It has also lead to some ad hoc rules for judging the desirability of policy measures designed to correct for distortions. An example of such a rule is to neglect economy-wide ramifications of policies for a particular industry where that industry produces a product which has limited substitutes or complements. Therefore, the extent to which grain transport, handling and storage activities complement each other is relevant to the examination of an individual activity such as transport.

## DEPARTURES FROM THE IDEAL COMPETITIVE MODEL

Some of the main features of grain transport arrangements which restrict the extent to which grain transport operates as a competitive industry and the impact and implications of these restrictions are discussed below.

### Imperfect information

A potential source of price distortion arises from imperfect knowledge. In particular, the multi-product nature of road and rail transport requires the allocation of joint costs between, for example, the laden and unladen legs of a journey. Pricing efficiently in this situation requires much more knowledge of supply and demand functions than would be required for a single product producer responding to a competitive industry price.

**Demand and supply fluctuations**

It is conceivable that droughts at one extreme and bumper crops at the other will cause large fluctuations in the demand for transport services. Even over a single year the seasonal nature of grain growing results in peaks and troughs in demand. In these circumstances, efficient resource allocation may be enhanced if, for example, long-term contracts or government directions do not prevent some price adjustment in response to market disequilibria (even though there may be costs associated with such price adjustments). This is because pricing flexibility should help to ensure that facilities are rationed to those users who value the service most when demand exceeds capacity and more fully utilised when demand is slack.

**Supply characteristics of the road transport industry**

As the road transport industry does not supply its own infrastructure, and is not the only consumer of this infrastructure, problems arise in allocating the appropriate level of fixed costs of roads to road transport operators. These problems are discussed in Chapter 5 and in Appendix II.

**Economies of scale and scope**

Economies of scale occur when a given increase in all inputs results in a more than proportionate increase in output. Hence, the average cost of each unit of output falls as the level of production is increased. Where this fall occurs over the whole range of output up to that which will satisfy market demand, the average unit cost of production of a monopolist will always be less than if there were more than one firm in the market. Economies of scope, in contrast, refer to the situation where it is possible to produce a service at a lower cost by producing it in combination with other services than is possible by producing it as a single product. In such circumstances a multi-product firm will always be able to provide a service at a lower cost than a single-product or specialist firm.

A similar situation arises when, due to the existence of indivisibilities in fixed capital, the efficient minimum scale of operation is large relative to market demand and the spreading of overheads over a range of outputs reduces unit costs. These latter economies of scale, which have been referred to as economies of density, are considered to be particularly important in railway operations (Harris 1977).

Economies of scale have traditionally been considered to be present in railway operations. The large initial outlay required on track construction and rolling stock relative to the costs of operation suggest that, once a railway is built, increased use will result in continuously falling average costs until capacity is reached.

An analogous situation arises with road construction. The high initial cost of major roads relative to maintenance costs suggests that average costs will decline with increased usage. Capacity of rural roads is generally rarely reached so that in most cases the average cost of road construction can be considered to fall over the relevant levels of output.

Road transport operations, by comparison, do not appear to have these characteristics. The initial fixed investment is smaller relative to variable operating costs and the capacity of each truck is quickly reached. Consequently, economies of scale are less important for road than for rail.

The possible presence of large economies of scale in railways and in road construction introduces a difficulty in determining an optimum pricing system. Since average costs are continuously falling, marginal cost will always be less than average cost. Pricing at marginal cost will therefore lead monopolists into making losses.

These circumstances can provide a justification for government intervention. Allowing monopolists a free hand would, according to economic theory, result in higher prices and lower output than the efficient outcome under competition. Regulating prices so that costs are just covered, that is, setting price equal to average cost, will have the same result, though not to the same extent. Only pricing at marginal cost will result in the efficient levels of price and output. However, if that occurred, price would be less than average cost and the gap would need to be made up somehow.

There are a number of possible approaches to this problem.

*Direct subsidy*

The government could provide a subsidy to the monopolist equal to the difference between the efficient price and the average cost of production. The subsidy would have to be financed by increased taxation, which itself imposes inefficiencies on the choices made by taxpayers. There is also an equity question involved because the taxpayers are usually quite different from the beneficiaries of the subsidy.

*A two-part tariff*

The objective of this is to minimise the efficiency loss by charging a price greater than marginal cost while still obtaining some returns from those who use the services. The two-part tariff does this by charging a lump sum for access to the service and then a price for each unit of the service consumed. If the deficit to be made up is relatively low and there are a large number of users, the required lump sum entry fee may be low enough to deter very few potential users. In such a case the efficiency losses would be similarly low.

*Regulating a fixed return on capital*

This form of regulation allows a monopolist to price so that its rate of profit is in line with other, more competitive, industries. Resources might then be allocated between the monopoly and the rest of the economy in the most efficient way. A problem with this type of regulation, however, is that it gives no strong incentive for technical efficiency to be achieved. As the amount of profit is still usually the most important consideration, the monopolist can adjust prices and output to achieve that profit, whatever the costs of production. Costs of production can be treated as an extraneous variable over which management need exercise little control.

*Price discrimination - Ramsey pricing*

Costs can be recovered and efficiency pursued if consumers can be separated according to their demand functions and prices charged which reflect each consumer's willingness to pay. Ramsey pricing has been put forward as an economically efficient means of allocating joint costs in multi-product industries such as railways and to recover the cost of road construction.

Ramsey pricing involves pricing such that the deviation of price from marginal cost for each product or service, as a proportion of price, is inversely proportional to the elasticity of demand (Tye & Leonard 1983, 439). However, problems have been found in the practical application of Ramsey pricing, to such an extent that many economists now conclude that the rule cannot be rigourously applied to industries like railways (Allen 1986). These reservations appear to apply equally as well to pricing for road cost recovery.

One of the major criticisms levelled at Ramsey pricing is that it offers no protection for 'captive' consumers. Under the rule these consumers would be allocated the majority of fixed costs[1], but the 'reasonableness' of this allocation is not questioned. No limit is imposed on the monopolist's rate-making or, more specifically, exploitation of captive consumers.

The most pressing practical problem with the rule, however, is its reliance on demand elasticities and the sensitivity of the resulting prices to the elasticity values used. Demand elasticities for freight transport are notoriously difficult to estimate with precision (see Tye & Leonard 1983, 441). Uncertainty increases the risk of unreasonable rates being levied on particular shippers and of efficiency losses. However, when this uncertainty is taken into account in the estimation of Ramsey prices (by such methods as those supplied by Baumol, Bradford and Bayes (Tye & Leonard 1983)), most of the theoretical advantages of Ramsey pricing are lost. A further problem with Ramsey pricing is that it does not allow for any distributional considerations. Ramsey pricing could allocate costs to low income groups and away from high income groups.

In summary, Ramsey pricing is a possible approach to pricing railway and road output which theoretically would allocate costs among users in the least distorting manner. However, if it were to be fully implemented it might need to be supplemented by various other regulations to ensure that the monopolist's capacity to exploit captive consumers was not abused.

Transport regulators are therefore faced with a number of problems. The means of pricing preferred on efficiency grounds, Ramsey pricing, suffers from problems of information deficiencies and possible inequities between consumers. The other possible forms of pricing, however, can lead to inefficiencies in the allocation of resources. Given that the level of actual and potential competition for grain transport is likely to differ between areas of Australia, removal of all forms of economic regulation of grain transport might lead to railways adopting Ramsey pricing principles, as has occurred in the United States. In such a situation the equity effects on captive consumers of rail services might need to be addressed.

*Stand-alone costs*

One approach to the problem of an organisation with economies of scale

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1. The US Staggers Rail Act only applies Ramsey pricing to 'captive' commodities. Other commodities are treated as competitive and priced substantially lower (Tye & Leonard 1983, 441).

or scope being able to charge higher prices than would occur in a more competitive environment is for governments to test ruling rates against a 'stand-alone cost'. 'Stand-alone costs' refer to the cost of a service to an individual consumer in isolation or to the cost of a particular service in a multi-service firm that hypothetically shuts down all other services (Tye 1985, 7). It is used by the Interstate Commerce Commission in the United States as a 'surrogate' for competition, to test the reasonableness of rates set by railway companies in markets where they have monopoly powers. Any charges above this level are considered to be unfair.

'Stand-alone costs' are a response to the recognised problem with Ramsey pricing that consumers in captive markets might be 'loaded up' with an 'unreasonable burden' of the fixed costs of the rail system. However, its relevance as a means of assessing the reasonableness of rates has been disputed (Tye 1984). The greater the economies of scope enjoyed by a multi-product firm the greater will be the difference between the costs of the multi-product firm and the stand-alone costs. As a result, the greater the economies of scope the less is the force of the stand-alone cost concept as a constraint on the pricing behaviour of multi-product firms.

**Monopolistic controls**

Monopoly control of rail operations and road infrastructure by State governments and the varied objectives of road and rail authorities provide scope for inefficient pricing practices and production processes. The potential for price discrimination by a monopolist could result in the persistence in some markets of prices below long-run marginal costs, even in the long run. Discriminatory prices could also generate revenue higher than is required to cover the total costs of operations, or prices which are too low and outputs which are too high compared with those which would arise if commercial practices were adopted.

An operation in which one firm controls more than one stage of production could provide a potential entrant with a considerable barrier to entry to any particular production stage. This could occur for two reasons. First, there could be economies in the integration through, for example, cheaper co-ordination of activities or access to guaranteed or cheaper inputs. Second, while one stage of the production process might appear contestable, another might be under the monopoly control of the vertically integrated firm. Any new entrant would need to overcome the monopoly as well as the contestable market to survive. The ownership by State rail authorities of land on which grain silos are situated and the lack of road access to some seaboard grain terminals are examples of how the market power of rail transport can extend beyond the transportation stage of production.

The problems for efficient allocation of resources can be compounded if different stages of a production chain are not behaving competitively. Competitive behaviour at one production stage (for example, transport) might not be the most appropriate means of attaining overall efficiency when there is not competitive behaviour at all other levels of production (for example, storage and handling). In the area of the transport, storage and handling of grain this problem has the potential to be extremely significant because of the amount of regulation involved at each stage.

**Destructive competition**

Another problem with the relevance of the perfect competition model to the grain transport industry is the possible susceptibility of the industry to 'destructive' competition. As a general definition, destructive competition is competition which does not lead to lower costs, especially in the long run, and which may only result in market instability. The major prerequisites for destructive competition are that firms act independently, prices are flexible, fixed or sunk costs are a large proportion of total costs and the industry is characterised by a capacity to produce which is greater than demand. The grain transport industry may be a candidate for destructive competition when the rail and road modes are considered together.

One form of destructive competition which may have particular relevance to the grain transport industry is that associated with fluctuations in demand. A market can be envisaged where the rail authority was a 'natural' monopoly, that is, it can transport grain at a lower long-run cost than any combination of road transport operators. As was described above, the efficient response of the railway to demand fluctuations is to vary prices according to changes in demand and short-run costs. This could mean that prices are set lower than average total costs (that is, loss making) when demand is low and greater than average total costs when demand is high. If, however, road operators enter the market when demand is high to capture some of the profits being made by the rail authority, the rail authority may be forced to price at average cost levels (or at a price which excludes road competition) in order to retain its market. The effect of competition in this circumstance will be either to restrict efficient pricing (that is, lower prices when demand falls) or to cause the rail authority to make a loss on its investment in the long run.

The latter consequence is particularly important because it may imply that the railway will disinvest in a later period. By definition, if the railway was a natural monopoly the removal of its presence from the market could result in higher long-run transport costs. However, the competitive nature of road transport may result in market prices for transport of grain by that mode being lower than would be the case where rail was present.

**Government and institutional constraints**

Government ownership of the transport facilities used to haul grain, coupled with the strong influence of governments on transport arrangements generally, has a number of potential effects.

- To the extent that rail transport is a natural monopoly, railway operators can be prevented from exploiting that position.
- Considerations of equity and public service obligations can be imposed on the pricing decisions of rail authorities.[2] Thus, rail prices might be set on the basis of distance from the seaboard terminals even though the distance might have very little relationship with the actual cost of transport. A consequence of this concept of equity is that users of efficient rail lines might subsidise users on inefficient lines. Similarly, pricing of roads based on equity considerations can lead to cross-subsidisation.
- Use of taxation revenue by a government to provide subsidies to users of grain transport can cause resource misallocation in both the area of the economy in which the tax is imposed and in the transport industry. The taxes and subsidies can distort the price signals received by consumers and investors in those industries, resulting in a less-than-efficient allocation of resources. The use of subsidies in one part of an industry, for example, rail transport, can alter the price to marginal cost ratio that provides signals for the efficient allocation of resources. A subsidy to other parts of the industry which produce substitute services, for example, road transport, could ensure that the ratio of price to marginal cost throughout those parts of the industry in competition remained at its pre-subsidy level. This would have the beneficial effect of preventing a misallocation of transport

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2. A related concept is that of the merit good. The commodity might consider a service, for example, grain transport, to be socially desirable. In such a case the subsidisation of the merit good might be justified. Other examples of merit goods might be branch railway lines to isolated communities and roads of a certain standard to rural communities.

resources between modes. At the same time, however, the subsidy may cause more total resources to flow into transport as a whole than would otherwise be the case, resulting in an inefficient allocation of resources between industries.

- The statutory monopoly given to rail for particular commodities in some States means that railway systems need not always concern themselves with potential competition. To the extent that potential competition increases the preparedness of operators to achieve and maintain allocative and technical efficiency, the statutory monopoly rights might prevent this from occurring. In addition, such rights on one commodity can have an impact on the costs for another through reducing the opportunities for backloads.
- State rail authorities are primarily interested in what happens within the borders of their State. Technical efficiency, therefore, may only be pursued within the limits of each State. Any efficiencies to be gained from having a more integrated national approach might consequently be difficult to achieve. As noted in Appendix I, one feature of the State rail systems is that distances for rail transport of grain are, on the whole, lower than they might be if State borders did not intervene. At the other extreme, some grain has to travel further by rail than is necessary to reach a port because the nearest port is not within the borders of the State in which the grain is produced.
- State borders also mean that such competitive behaviour as rail transport engages in often occurs near the border. Ideally, it should occur in areas where the costs of substitutable transport modes are similar. This is not necessarily at State borders.

## Externalities

The production or consumption of certain goods such as roads can have favourable or adverse effects on parties not directly involved with the production or consumption process. These effects, referred to as externalities, are not priced. Examples are pollution and congestion of road transport, and reduced dust due to road sealing. As these effects represent real changes in inputs and outputs, efficient allocation requires that they be taken into account in pricing, with prices reflecting social marginal costs, in contrast to private marginal costs, of production and consumption. These price adjustments usually involve the application of taxes or subsidies.

## Interaction with the storage and handling industry

The pricing and investment behaviour of the grain transport industry is intimately related to the behaviour of the storage and handling industry. The location, size and productivity of storage facilities will set the parameters for the behaviour of the transport industry. Thus, any economies of scale rail might have with respect to tonnage or distance might be unable to be realised if storage facilities are small, located on low-traffic branch lines or relatively close to each other. If this is the case, road transport, for which economies of scale are not as important, might benefit at the expense of rail.

It is desirable, therefore, that all stages of the transport, handling and storage chain receive efficient price signals and are able to respond to them. Where efficient operation is not possible for some reason in one part of the system then the efficient solution may not be the best course of action in the other parts, and second-best considerations will become important.

## REGULATION AND PRICING

The foregoing discussion indicates that some regulation of grain transport activities might be desirable to achieve, for example, pricing for externalities, correct charges for road infrastructure, or to control some pricing practices and guard against destabilising competition. Obviously, determination of the desirable level of regulation will require a detailed knowledge of the industry, including the extent to which workable competition or contestability, and hence appropriate competitive practices, exist. At this stage the following points can be made.

First, the sunk costs of road transport operators are less than for rail transport. Road transport operators should, therefore, be more easily able to enter and leave particular markets in response to changing supply and demand conditions. In other words, the road transport industry has some competitive characteristics.

Second, the economies of scale and scope of rail transport could allow it to limit the entry of competitors in some areas.

Third, the cost structures of road and rail (and of competing rail systems) will differ. For rail, the cost structure will depend on such factors as whether it is a branch line or a main line, how much traffic (of all types) is on the line and the productivity of the equipment used. Road costs will depend on such things as the type of equipment used and opportunities for backloads. Thus, the scope for competition between competing modes in any particular situation cannot be determined without specific study. Even in border areas where competition between rail systems might be thought inevitable, it could be that pricing down to short-run marginal cost on a branch line by one rail system will still leave it uncompetitive with a main line operation of another.

Notwithstanding the above-mentioned factors, the general pricing principles which should be encouraged in the grain transport industry are that prices, both short-run and long-run, should approximate the corresponding marginal social costs of production. Prices should ideally be adjusted to clear markets at all times. Hence, some variation in prices to correspond with peaks and troughs in demand is desirable. Where joint costs exist, they need to be recovered according to demand and supply for the separable services.

# CHAPTER 4 ISSUES IN GRAIN TRANSPORT

There have been many studies into the efficiency of grain transport arrangements in Australia. The major findings of a number of these are summarised in Appendix VI. These studies and analyses by the BTE indicate a range of problems with both equity and efficiency aspects of the existing system.

The common objective of past investigations has been to suggest means by which the transport of the grain harvest to port each year can be made to accord more closely with the economic objectives of efficiency outlined in Chapter 3, whilst maintaining standards of product quality and accommodating other interests of the grain growing community. Achieving gains in efficiency involves ensuring that:

- The economic and institutional mechanisms which distribute the grain transport task by road and rail between various port destinations are such that grain flows to the port and by the mode which minimises total transport, handling and storage costs.
- Resources within each of the road, rail and port systems are used in a technically efficient manner, after having regard to second-best factors.
- There is some discipline encouraging transport monopolies to minimise the costs of their operation, that is, to operate with technical efficiency.

Achieving the minimum total cost of transporting, handling and storing grain therefore has implications for both pricing decisions and longer term investment strategies in the transport sector. As was pointed out in Chapter 3, economic theory suggests that efficiency will be promoted if pricing in each mode is such that at least the avoidable costs associated with the use of existing transport infrastructure are recovered from the growers or authorities who are responsible for them. The common or joint costs should then be allocated among users according to their demand elasticities or willingness to pay. Longer term investment strategies concerned with the capacity or nature of the transport system would be most efficient if based on a full assessment of the costs and benefits of the main alternative projects. Ideally, pricing and investment policies would also have a national and intersystem perspective. The previous studies suggest that these principles have not always been followed closely by road, rail or port authorities.

Achievement of the best methods of transporting grain is, however, also dependent on efficiency in the storage and handling system and on the framework of grower payments. It has been suggested that past decisions on investment in storage and handling have been taken on grounds other than economic efficiency. This is important because the potential for increasing the efficiency of grain transport might be thwarted by continuing inefficiencies in storage and handling.

Changes to current transport arrangements will almost certainly have detrimental effects on some parts of the community. Consequently, even if all obstacles to an efficient market could be overcome, the extent and pace of movement towards a more efficient system could be limited by the resistance of growers, community groups and others adversely affected by the changes. This is because of the apparent willingness of some growers to tolerate a less-than-efficient system rather than allow changes which might price other growers out of the market.

Other major equity considerations relate to the use of cross-subsidies and the ability transport monopolists might have to charge unreasonable rates to 'captive' growers (that is, growers who have no transport alternatives). These and the efficiency issues involved in the grain transport system should become clearer in the discussion which follows. This discussion, for convenience, is organised into the 'farm to local silo', 'silo to port terminal' and 'ports and shipping' structure used in the overview of grain transport arrangements contained in Appendix I.

**FARM TO LOCAL SILO**

Growers are directly responsible for many of the costs incurred in this part of the transport chain. Typically, general-purpose farm trucks are used to transport grain over what are generally short distances from farms to local silos (see Table I.7). There are, however, some significant issues concerning this part of the transport chain. These include:

- The peak load problem which can occur at harvest time. This is aggravated by the policy of some grain handling authorities of discouraging on-farm storage and the system of grower payments by the Australian Wheat Board (AWB) which can encourage growers to deliver their grain to local silos as soon as it is harvested. Different pricing strategies at local storage facilities, such as peak load pricing, greater use of on-farm storage and a different grower payment system, are possible ways of alleviating some of these problems.

- The damage to rural local roads caused by grain trucks. The peak load problem during harvest can lead to the use of overloaded trucks which cause considerable damage to local roads. There are currently no direct mechanisms relating road usage by heavy vehicles to charges for road use and expenditure on rural local roads. The cost of this damage to rural local roads can be a significant burden on rural local government and, under present arrangements, is met to a large extent by general tax and rate payers. Alleviation of this problem appears to depend largely on the development of more effective means of detecting the overloading of trucks and on the adoption of pricing mechanisms more in accordance with cost recovery principles. Measures to reduce the peak load problem should also reduce the use of overloaded trucks.
- The extent to which the existing distribution of local silos is optimal. That is, would it be more efficient if grain were transported over longer road distances to larger silos (or even directly from farm to port terminals)? Previous studies have indicated that there may be significant benefits from a rationalisation of country storage sites. One important benefit suggested is the reduction in rail costs which would result from railways not servicing low-density, high-cost branch lines. Low traffic densities are a major restriction on the use of new, low-cost rail technologies such as block trains and high-capacity wagons. A consolidation of storage sites could also release resources for investment in sidings and train loading facilities which, likewise, are important in the use of low-cost rail technologies. However, there are costs associated with rationalising storage facilities, such as increased road maintenance and construction costs, and local communities might be adversely affected by closure of rail services.

## SILO TO PORT TERMINAL

The existing distribution of local silos and the current arrangements for providing transport services to them is also an important issue in the silo to port section of the grain transport chain. It is related closely to the general question of the efficient modal split of grain traffic which, as will be seen below, affects most aspects of grain transport arrangements.

A major question relating to the modal split of grain traffic is whether the existing system of regulation of road-rail competition in some States is efficient. It seems very likely that, by providing rail with an absolute monopoly position, the pressure for cost control and innovation is lost to a significant extent. However, there are a number of issues associated with unfettered road-rail competition that must be considered before the removal of all forms of regulation could be recommended as the best policy approach.

The most important issue concerns the presence of pricing mechanisms to ensure that, in a deregulated environment, an economically efficient allocation of traffic between the modes would occur. To achieve the most desirable allocation of grain traffic between the two modes it is necessary for prices to reflect costs (including environmental and other social costs). The question of cost recovery from road transport is particularly important. It is generally accepted that at present there is a significant level of under-recovery of road damage costs caused by very heavy axle loads. Open competition between the modes without improved means of directly pricing the use of roads by heavy vehicles with heavy axle loads could result in increased total transport costs to the community and a reduced level of economic welfare.

Some rail systems currently use pricing based on distance rather than cost. Distance-based pricing disguises many differences in costs that might occur, even for silos which are a similar distance from port. For example, a silo on a branch line with little traffic is likely to be more costly to provide with the same transport service than a silo on a main line, even though they may be an equal distance from a port. Distance-based pricing might involve the users of the latter silo cross-subsidising users of the former (or at least it might involve contributions to joint railway costs which may not in any way be related to 'what the market will bear'). It might also prevent pressure for the abandonment of high cost lines which are unprofitable to operate. However, as was mentioned in the introduction to this chapter, such rationalisation may not always be acceptable to the farming community.

When a large proportion of rail costs is shared between many different traffics, it is difficult to identify uniquely the costs incurred in transporting any one traffic such as grain. Consequently, there is considerable scope for both deliberate and unintentional cross-subsidisation between lines, between traffics and between shipments of grain made at different times of the year.

In the absence of cost-based pricing by road and rail transport it is difficult to determine over what distances or within what markets road is competitive with rail. Apart from the question of the possible efficiency losses resulting from pricing based on something other than costs, the lack of data on road and rail costs on particular branch and main line routes prevents a detailed analysis of the merits of allowing more competition. Some estimates of the magnitude of road and rail costs are provided in Chapter 6.

In certain areas rail might hold a natural monopoly position in grain transport. If there are some areas in which road is competitive with rail then removal of barriers to entry for road transport operators may improve overall transport efficiency by increasing the pressure for technical efficiency and innovation in those areas. In the parts of the market where rail continues to have a monopoly another set of regulations might be required to prevent exploitation of that monopoly power.

To the extent that rail operations are not subject to competitive pressures, there is the problem of devising means of encouraging railway authorities to employ the least-cost method of production, while at the same time limiting the extent to which they might exploit their monopoly position. There are a number of possible approaches, such as regulating for allowable rates of return or using the concept of stand-alone costs, although such approaches are not ideal substitutes for a competitive market and can have negative side effects. These possible approaches were mentioned in Chapter 3.

A further issue associated with the transport of grain in Australia concerns State borders. Rail transport of grain in Australia is generally confined within State boundaries. This may produce inefficiencies: first, because economies in rail operations due to scale (or density) could be lost; second, because grain will not necessarily be transported by rail across State boundaries using the least resource cost route to the nearest port; and third, because of the low rail freight rates sometimes charged to growers in border areas. These charges might involve cross-subsidisation from growers in other areas for the sole purpose of protecting a State railway from interstate competition. Alternatively, such a practice might merely be price discrimination aimed at maximising total returns within each State rail system. A nationally-based competitive system would not encourage these price differences at State borders. Rather, competition would occur where road and rail costs were similar.

Increased use of road transport between local silos and port terminals could have a considerable impact on urban areas through which trucks pass. The cost of pollution or congestion arising from this road transport should, ideally, be directly borne by the road transport operators.

An increase in the use of road transport could, of course, only come about if adequate road receival facilities are available at ports. This necessity highlights the close relationship between efficiency of transport and complementary efficiency in storage and handling facilities.

## PORTS AND SHIPPING

A major issue in this part of the transport chain is the size of ships which Australian ports can receive and the loading rates achieved at these ports. Related issues include the possible duplication of investment in ports located in adjoining States, the operation of a number of small ports within the same State and the practice of topping-up discussed in Chapter 2 and Appendix I.

There is a trend in shipping markets towards the use of larger bulk ships as they offer significant savings in transport costs. In the medium to long term especially, Australia's ability to receive large ships may become an important factor in determining the attractiveness of Australian grain to overseas buyers. Many Australian ports are currently unable to serve large ships and thus a co-ordinated program of upgrading or port rationalisation may be necessary for Australian grain to remain competitive on world markets. Loading rates at many ports likewise will need to be improved. The level of competition between the ports is one factor which can affect the efficiency of port operations.

## MAIN TRANSPORT ISSUES

It is apparent that many problems confront the transport of grain in Australia. The main issues can be grouped under three broad headings:

- Intermodal pricing and competition;
  - the consequences of rail charges that do not reflect costs
  - the possibility of peak load pricing
  - whether road transport is paying the full social cost of its operations

  - the impact of State borders on the behaviour of rail authorities
  - the impact on competition of vastly different cost structures in road and rail transport.
- The interaction between grain transport, storage and handling.
- Competition between ports.

The scope for increasing the performance of grain transport in each of these areas is addressed in the next chapter.

# CHAPTER 5 SCOPE FOR IMPROVED TRANSPORT PERFORMANCE

Much of the preceding discussion is brought together in this chapter. The principles derived from economic theory outlined in Chapter 3 are related to the issues discussed in Chapter 4. This is done against the background information on the current transport arrangements for grain transport presented in Chapter 2 and the appendixes. The conclusions reached are of a general nature, indicating the direction of changes required in grain transport arrangements if greater efficiency in the allocation of its resources is sought. No attempt is made in this chapter to provide definitive answers to the many vexing questions that have been raised. Such answers would require a great deal more information than is presently publicly available.

## INTERMODAL PRICING AND COMPETITION

A number of issues identified in the previous chapter can be examined under this heading.

### The consequences of rail charges that do not reflect costs

A starting point for an analysis of the efficiency with which resources are allocated is the measurement of costs per unit of output. As several studies have shown, such measurement is extremely difficult for rail systems. Rail operations are characterised by a high level of joint costs, that is, costs which are shared by all users of the rail system. The allocation of these costs between users is difficult and the method used may be somewhat arbitrary. Another complication is that the joint costs associated with transport of a given quantity of grain will not be the same for all locations, because on high traffic density lines the fixed costs of the rail operation can be spread over a larger traffic volume, thus lowering costs per tonne.

A number of departures from the theoretically ideal market can result when the costs of each service are not known. These departures include cross-subsidisation, obfuscation of investment and/or disinvestment opportunities and misallocation of resources between transport modes.

*Cross-subsidisation*
The economic theory outlined in Chapter 3 leads to the conclusion that if a service is being provided at a price below the marginal cost of its production, cross-subsidisation of that service is occurring. That is, resources are being allocated to the provision of this service when they could be used more profitably elsewhere. In the case of rail, the subsidy could be financied by charging some other rail users a rate higher than the marginal cost of production and/or from government taxation revenue. Either way, the economic efficiency of the consumption and investment patterns of those providing the subsidy will be adversely affected. A cross-subsidy, therefore, leads to misallocation of resources in both the subsidised and the subsidising area of the economy. Improved transport performance may thus be achieved if rail authorities which do not currently have mechanisms for properly assessing the costs of grain transport services implement appropriate systems to assess costs and act on the information obtained to remove any cross-subsidisation.

The wide variation in the costs of providing rail services between locations means, however, that costs will usually need to be examined on a case-by-case basis. Differences in prices for similar services are not, in themselves, evidence of cross-subsidisation. In the same way, prices based on just one factor contributing to the cost, such as distance, will only by accident reflect the real cost of providing a service.

*Obfuscation of investment opportunities*
Insufficient information about costs can obscure both the opportunities for further profitable investment and the areas from which resources should be withdrawn. The level of profit or loss usually provides the signal for scrapping services (because resources could be used more profitably elsewhere) or for further investment. Signals will not be visible in a situation where rail freight rates are set without taking full account of actual costs.

*Misallocation of transport resources*
Setting rail freight rates consistently above long-run average costs, either purposely or because of insufficient information about costs, might, in an unconstrained market, allow road transport to encroach on what could be economically efficient rail services (both routes and traffics). When rail systems allow this to happen there is the potential for an inefficient diversion of transport resources from rail to road transport.

Obtaining and using cost data as a basis for setting prices in a non-competitive industry is therefore a necessary first step towards increasing the efficiency with which resources are used. However, a mechanism needs to be found for ensuring that the relationship between costs and output is such that the operation is least-cost in both a technical and an allocative sense. In the theoretically ideal market, technical efficiency occurs naturally as a result of competition because firms are forced continually to seek out least-cost means of production. As the scope for road transport to compete with rail systems will vary widely between locations and traffics, the degree to which technical efficiency is achieved may also vary widely. Rail authorities, even in an unregulated market, may have monopoly powers and thus not be vulnerable to market disciplines which force cost efficiency.

In addition, the pressures for technical efficiency in an organisation which does not have clear objectives, such as profit maximisation, may be reduced. Providing stimulus for technical efficiency in rail operations in these circumstances is difficult. The key is to create an environment in which management and employees are encouraged to seek the lowest cost ways of producing services. One mechanism might be to require that rail authorities publish the costs of providing their services so that shippers, such as growers, can assess production costs and bring pressure to bear when inefficient practices are evident. Such a requirement may, however, affect the degree to which rail can engage in economically efficient pricing practices.

It can be argued that charges based on distance are in a sense more equitable than charges based on costs because growers who happen not to be located on the most efficient rail line should not be made to pay more for a similar service available to growers who have the good fortune to be located on a main line. As was pointed out, however, prices not based on costs are likely to distort the allocation of resources, in this case by making low-cost users contribute more and high-cost users less towards the total costs of the service than would be the case in a cost-based system.

Where the 'equalisation' of transport costs of grain growers is regarded as the over-riding objective, methods could be devised other than distance-based pricing, which would be less distortionary. For example, growers could initially be required to pay a price for rail services based on an assessed technically efficient cost of those services. This would ensure that the price signals provided for rail investment decisions were economically efficient. A levy could then be deducted from the proceeds of all grain marketed and the amount collected distributed to those growers perceived as being 'needy' (for whatever reason). Such a system would be an improvement on the more straightforward approach of basing charges on distance because it distorts only the consumption decision of growers. A charge based on distance alone distorts both the consumption decisions of growers and the production decisions of the rail authorities. The suggested system also would have the advantage of providing growers with information on the real costs of their transport. At the same time, information might lead to discontent among some growers whose grain is transported at relatively low cost and who are obliged to compensate growers in less 'favourable' locations.

A related issue with a move towards cost-based pricing involves possible short-term inequities arising from situations where facilities are of different standards and consequently have different cost structures. In these circumstances, growers who were fortunate in having the facilities they use upgraded under the old system may be advantaged through lower costs under cost-based pricing.

### The possibility of peak load pricing

The annual grain harvest is usually accompanied by a large increase in the demand for transport services to carry the grain to silos and ports. There is an equally large increase in demand for storage and handling services.

The economic theory outlined in Chapter 3 suggests that pricing of these services should be adjusted to take account of changes in demand throughout the year. The aim of this type of pricing would be to cover the annual contribution to fixed costs over the course of the year but to do so by varying prices according to changes in growers' willingness to pay (that is, their demand). The principle that prices should not fall below marginal cost is, of course, equally applicable in this context.

Improved efficiency in the use of transport resources may, therefore, follow introduction of peak load pricing. Since growers are likely to be prepared to pay more for transport services in periods of peak demand, higher prices can be charged in those periods. A greater proportion of fixed costs could, therefore, be obtained from growers in peak periods than in non-peak periods when demand is reduced.

Peak load pricing has two main advantages.

- The higher transport prices in the peak period will encourage some growers, to the extent they are able, to switch their demand to non-peak periods when prices are lower.
- The reduced capacity requirements needed to cope with peak periods and the more even spread of demand should mean greater utilisation of a reduced capacity throughout the year and lower fixed costs in

future years. This should be reflected in lower average prices for growers.

At the moment, the cost incurred by growers demanding transport, storage and handling services at peak times appears to be in the form of waiting in a queue. The cost of queuing is likely to vary between growers depending on how they value their time or the time of their employees. To some extent growers are encouraged to queue by the present payment system for wheat and by limited on-farm storage. Therefore, peak load pricing may, given current practice, have little effect on queue length, and such a policy may need to be accompanied by changes in other arrangements to be effective.

### Whether road transport is paying the full social cost of its operations

The merits of removing regulations on road-rail competition depend, *inter alia*, on the extent to which road and rail transport cover the full social costs of their grain operations. The importance of knowing railway costs and setting railway freight rates between certain boundaries was highlighted above. Similar distortions can occur if road transport services for grain are priced lower than the short-run marginal social cost of carrying grain by road. Where such pricing is supportable in a competitive environment, more grain would travel by road than is economically efficient or welfare maximising. This is because road transport may have an unfair competitive advantage over a rail authority which priced its grain services more in accordance with short-run marginal social costs. This distortion of grain traffic could result in a misallocation of resources between the two modes. It could also mean that the other road users who are paying at least the short-run marginal cost of their road use, or the taxpayer, would be effectively subsidising grain transport.

The various studies into the matter of the recovery of Australian road costs discussed in Appendix II have shown that the heavy vehicle group in particular is not contributing revenue sufficient to cover the costs of the road damage it causes. A BTE (1985a) study, for example, estimated that only about 40 per cent of the avoidable road costs caused by six-axle trucks were recovered from the operators of these vehicles.

The costs considered in most studies of cost recovery relate only to the pavement costs (that is, the increased rate of pavement deterioration) caused by vehicles with heavy axle loads using arterial roads. A variety of other costs are associated with the use of vehicles with heavy axle loads which may further reduce the revenue-cost ratio from this class of vehicle in the haulage of grain. These are:

- Damage caused to local roads by heavy vehicles. Lower pavement strength on these roads will result in greater pavement damage from heavy vehicle usage (see Appendix II).
- The environmental and other social costs of heavy vehicles using rural roads. Trucks travelling on unsealed roads in these areas add to problems with dust and may contribute to the risk of road accidents.
- The environmental and other social costs of heavy vehicles travelling through urban areas on their way to port. As discussed in Appendix V, if 15 per cent of grain exports travelled by road as a result of changed regulations or provision of suitable infrastructure, then a large number of additional truck movements would be experienced. In Newcastle, for example, even assuming no peak flow of grain, 8 trucks per hour would deliver grain to port. Counting return trips, this implies an additional 16 truck movements along the route to port each hour. Clearly, the impacts on noise and air pollution and on road congestion would be significant.
- The long-run incremental cost associated with heavy vehicles. These costs include those associated with providing additional pavement strength, reduced grades and increased road widths to cater for heavy vehicles.

The efficient pricing of road use to reflect the various short-run costs is a major problem. A pricing framework in accord with the cost recovery (or user pays) logic would, at a *minimum*, charge road users according to the various pavement, environmental and social costs they cause. This price, therefore, would vary not only with the distance travelled and the axle load but also with the functional and area class of the road.

Existing road pricing mechanisms do not allow for this type of differentiation. In any case, such a system would need to apply to all road transport, not just grain. Some form of regulation of grain transport may therefore be justified in this second-best situation, as a means of achieving the modal split between rail and road which would occur if there were competition and all the economic and social costs associated with road use by heavy vehicles were charged to the road operators. Clearly, this does not mean a total ban on road transport of grain. All it implies is that in certain areas or across certain distances where the social costs of road transport of grain may greatly exceed prices paid, the appropriate policy response may be to restrict the use of roads by grain transport operators (but only when the better solution of improved road pricing cannot be implemented). Restriction of grain receival facilities at ports located in major urban centres is an example of such a policy.

**The impact of State borders on the behaviour of railway authorities**

Railway systems in Australia are generally confined within the borders of individual States. The networks are, to a large extent, integrated with the storage and handling systems, which are also largely directed towards serving the needs of each State. Road transport operations, by contrast, whilst restricted in most intrastate markets, have, under Section 92 of the Australian Constitution, absolute freedom to travel across State borders.

There might be scope for increases in the efficiency of railway operations and/or lower total transport, handling and storage costs through a more national approach. These increases could come from economies based on density of traffic or the use of more efficient handling and storage facilities. Two factors, however, could limit any potential efficiency increases:

- the desire of each State to maximise the use of its own infrastructure by transporting, handling and storing as much of the grain grown in that State as possible; and
- the railway systems of the three eastern States are largely incompatible because of the different rail gauges used.

These factors may reduce the scope for efficiency gains. At the same time, they may provide incentives for resources to move into the interstate road transport of grain.

Competition for grain between rail systems occurs mainly in the border areas where the market for each system overlaps. It is in these areas also that competition between rail and road transport tends to occur. The competition between rail systems in these border areas might not reflect similar railway system cost structures but, rather, result from the desire of each State to maintain its market share at any price.

Without detailed information on the costs of rail operations in border areas it is not possible to know whether and to what extent prices in these areas, which have been forced down by competition, are contributing towards fixed costs. The costs are, however, likely to vary between specific rail lines reflecting the different traffic conditions.

A first step towards an efficient system, therefore, is for the principle of pricing rail operations at no less than short-run marginal cost to be applied at border areas. The longer term solution would involve the removal of any artificial market behaviour created by the presence of a border by adopting a truly national perspective in grain transport, handling and storage.

Charging short-run marginal costs for rail services in border areas might mean that some grain transport will be lost to road or interstate rail operations, but it should also result in transport resources being used more efficiently (provided that road use is also priced at no less than short-run marginal cost, including external costs).

Efficiency is likely to be further improved if rail systems were given the option of extending their activities across State borders by, for instance, taking over other systems' tracks (an example might be V/Line taking over the Narrandera-Tocumwal line should it be abandoned by the State Rail Authority of New South Wales), or by operating intersystem services where such moves are justified on economic efficiency grounds.

### The impact on competition of different cost structures in road and rail transport

The low barriers to entry into road transport operations suggest that there will be some competition in a less regulated environment. However, there might be instances where the monopoly of rail could be maintained. The extent of competition is influenced by so many factors that it is not possible to predict with certainty how road and rail transport operators might behave in an unconstrained environment. Nevertheless, some general points can be made.

In an efficient competitive environment prices would reflect the costs of production of both road and rail transport, where costs include the external as well as the private, internal costs of the operation. For road transport this means that the costs of road damage, pollution and congestion should be internalised into the cost structure of road transport operators. It also means that any external costs should be internalised for rail, and that production costs should not be subsidised by governments out of general tax revenue, especially in the long run.

Economic theory suggests that in a second-best situation an efficient allocation of transport resources between modes may occur as long as the ratio of price to marginal cost in each mode is the same, even though neither mode might be recovering its cost of production at these prices. While this point may have some merit in particular circumstances, under-recovery of costs can be inefficient in that it might encourage more resources in total to flow into transport than would otherwise be the case.

The costs facing road and rail transport operations will fluctuate for a number of reasons:

- The fixed costs of a road or rail track that must be allocated to each journey (or among all users) will depend on the amount of other traffic using the same road or track. The fixed costs that must be recovered from grain movements along a low-density branch line are therefore likely to be greater than the fixed costs that must be borne by a similar movement along (or users of) a high-density main line.
- Costs of loading and unloading will vary to some extent depending on the total demands being made on silos and port terminals by transport operators.
- The availability of backloads will influence the cost of each journey. Backloads provide a contribution to the costs of the return journey and may enable fixed costs to be spread over two journeys, thus reducing the cost of each individual journey.
- Economies of scale might be present in both road and rail operations. In general terms, the larger the truck or the train being used, the lower the cost per tonne.
- Economies associated with longer distance travelled will reduce average cost per kilometre.
- The level of efficiency in the storage and handling systems will affect the costs of transport operators. Technically inefficient loading and unloading facilities, for example, will discourage transport operators from investing in equipment of higher productivity. Similarly, a lack of road receival facilities at silos and port terminals will prevent road operators from competing with rail transport.

All these sources of cost variation should be reflected in the prices charged by the transport operators. Prices should also reflect the different elasticities of demand in the various transport markets. Pricing in one market at short-run marginal cost to meet strong competition is only sustainable if demand conditions in another market are such that pricing at above long-run marginal cost is possible.

The relative ease of entry to and exit from the road transport industry means that it is less likely that road transport operators will be able to price above long-run marginal cost in any market for very long. Rail transport, by contrast, might well be able to exploit its monopoly position to price on a regular basis at greater than long-run marginal cost in some markets. This suggests that there might be a need to limit the extent to which railways can exploit their monopoly position.

Any form of regulation of prices, however, needs to take account of the cost structure of railways. As the points above indicate, this structure is likely to be very complex and continually changing. The need for railways to compete with road transport in a number of markets when road has a quite different cost structure only increases the problem.

Increased performance in any industry will usually result from the forces of competition encouraging moves towards greater technical efficiency. In some areas of rail operations there is little chance of increased competition. Consequently, other means of continually encouraging technical efficiency may be needed.

## IMPORTANCE OF THE INTERACTION BETWEEN GRAIN TRANSPORT, HANDLING AND STORAGE

The transport of grain is closely related to the storage and handling activities. At the physical level the location and size of country and port storage sites, as well as the loading and unloading equipment provided at these sites, largely determine the nature of the grain transport system. At the organisational level the contractual arrangements which exist between the grain handling and railway authorities in some States increase the extent of this inter-relationship.

The importance of this interaction between grain transport and the storage and handling activities is mainly in the effects that the levels of investment and efficiency of operations in one sector have on the efficiency of operations in the other. Inefficiency in any one area might prevent the attainment of efficiency in other areas. Some examples of this interaction between storage, handling and transport are:

- The number and size of storage sites significantly affect the economies of traffic density that can be realised by rail systems.

Increased levels of traffic over a given route will produce cost savings on a per unit basis because of the high fixed operating costs of rail (that is, minimum amounts of engine running time, crew, track and rolling stock maintenance are required for any size of traffic). Small, dispersed storage sites result in low levels of traffic flowing over some route sections, thus preventing potential cost savings being achieved from greater traffic density. They also require more train stops, thus adding to costs associated with time (for example, labour costs), and reduce the level of train utilisation.

- The length of sidings at silos determines the number of shunts each train has to make when loading grain. Shunting adds to time-related costs and also militates against the use of long block trains which can offer significant cost savings.
- The provision of crossing loops allow trains to pass each other at the port terminals and influences the time taken to unload trains. Unloading delays add directly to costs and reduce utilisation rates.
- Inadequate storage capacity at ports may require the use of hinterland storage sites. This adds to transport costs because double-handling is required.
- The availability and size of road receival facilities at ports determines the maximum amount of grain that can travel by road in a deregulated environment.

Some of the features of the present organisation of grain transport may reduce the pressure for reduction of the costs at the storage and transport interface. One such feature is the relationship that exists between the grain handling and rail authorities. In those States where these organisations have virtual monopoly powers over their section of the grain distribution chain, discipline for technical efficiency might be lacking. For example, the rail authority may be able to absorb or pass on higher costs caused by problems in the storage sector, while the grain handling authority has no threat of an alternative handling and storage organisation competing for its market.

The role of the Australian Wheat Board is also important in this context because, by assuming responsibility for rail freight rates and remuneration of the bulk handling authorities, it removes any direct market contact between the storage and transport sectors. This problem is exacerbated if the rail authorities do not practise efficient cost-based pricing. Efficient transport prices would assist the Australian Wheat Board and the bulk handling authorities in their negotiations to obtain a more efficient storage and handling system.

**COMPETITION BETWEEN PORTS**

The ultimate objective of any change in the operations of Australian grain ports would be to encourage greater technical efficiency and the expansion and/or replacement of grain loading facilities in those ports which have an economic advantage because of physical attributes or location relative to the grain producing areas. Economic theory suggests that this objective might best be achieved by promoting competition between ports. The structure of the port 'industry' in Australia, however, does not lend itself to a great deal of competition. Like railways, the construction of ports involves a considerable amount of capital costs which may become sunk. It also involves economies arising from scale (and density of traffic). The contestability of the port 'industry' must, therefore, be doubted. Ports will always tend to retain some monopoly power over users in nearby areas.

Encouraging competition between ports in grain handling while regulating other port operations could lead to over-investment in grain-handling infrastructure. The incentive to maximise technical efficiency is reduced in such a situation because any inefficient investment decisions could be paid for by cross-subsidisation from other, regulated, port activities or from general government revenue. Therefore, the case for more competition should involve all port traffic, not just grain.

In practice, however, completely open competition between all ports is unlikely to be workable, particularly given the monopoly power which might be exploited. Thus, if some regulation of ports is to remain it is important that decisions regarding port investment be made on the basis of a proper assessment of relative costs and benefits from a social perspective (including a full examination of alternatives) and that technical efficiency be pursued. A first step in this process would be for port authorities to set out clearly their objectives in terms of economic efficiency and social considerations.

A second step would be to ensure that all port authorities fully assess the costs of each of their operations. Although pricing to reflect these costs will not by itself ensure that technical efficiency is achieved, it would allow areas to be identified where improvements in technical efficiency could be made.

The development of a more national approach to port use and investments is also required. The trend towards larger capacity ships for the transport of grain suggests that increases in the capacity of port facilities for grain may warrant future consideration. A more national approach to port investment, or at least more co-ordination of investment decisions between adjoining grain-producing States, would help reduce the risk of unnecessary duplication of grain facilities between ports.

The efficiency of port facilities will have ramifications for efficiency of other parts of the transport, handling and storage chain. The readiness with which these other areas react to increases in port efficiency will influence the pace at which any improvements can proceed.

# CHAPTER 6 ROAD-RAIL COMPETITION

The future balance between road and rail transport of grain was identified in Chapter 4 a very important transport issue. Any changes to the regulatory environment, pricing policies, transport industry cost structures or transport, storage and handling infrastructure are likely to lead to changes in the modal split between road and rail. The purpose of this chapter is to provide cost estimates for road and rail transport operations and to discuss what these might mean for intermodal competition.

## RAIL COSTS

Grain is an important source of revenue for the rail systems in Australia and much of the rail infrastructure was developed to service grain growing areas (see Appendix I). On a national basis, grain movements represent between 10 and 15 per cent of the net tonne-kilometres undertaken by the rail authorities, with the exact percentage varying with the size of the harvest. Over the past decade the relative magnitude of the grain task has declined as mineral movements, which dominate the national rail freight task, have increased.

The relative magnitude of the grain task varies considerably between States. For example, grain transport represents the largest proportion of V/Line freight tonne-kilometres in good harvest years. On the Australian National and Queensland Railways systems, the largest commodity groups are general freight and minerals respectively and grain accounts for only a small percentage of the freight task. For the State Rail Authority of New South Wales and Westrail systems, grain is an important commodity and grain revenue is second only to the revenue from minerals.

There are few publicly available sources of data on the costs of providing transport services, partly for reasons of commercial sensitivity, partly because of the expense of data collection and partly because many information systems designed for traditional accounting purposes cannot identify the economic costs of individual activities. In the case of railway operations, data are particularly scarce. The situation may improve in the future as many of the rail authorities are developing flexible costing procedures to analyse the profitability of specific tasks and network links.

There were two main sources of rail cost data used in the preparation of this submission. The first was the *Study of Grain Handling and Transport in the State of Victoria* prepared by CANAC Consultants (1984). The second was work undertaken in preparing the Commonwealth Grants Commission (1985) *Report on Tax Sharing Relativities, 1985.* These were complemented by data from the Independent Economic Inquiry into Transport Services to the Northern Territory (1984) and previous BTE publications and consultants' reports.

The objective of the CANAC Consultants' study was

> ...to determine the most efficient and cost effective method of handling grain within the Victorian grain handling and transport system from the farms and other sources to domestic markets or into ships at ports of export. (CANAC Consultants 1984).

To help meet this objective, the consultants developed a data base of unit costs for estimating the long-term avoidable (or attributable) costs of transporting grain on specific parts of the rail network, particularly branch lines used exclusively for grain transport. The unit costs were developed from an analysis of V/Line records and thus reflected financial rather than resource costs. In this section the CANAC unit costs, converted into December quarter 1986 prices using the CPI, are discussed and compared where possible with other sources of data.

One of the main purposes of the transport consultancy prepared for the Commonwealth Grants Commission (CGC) was to '...undertake the calculation of the modifications to budgetary impacts of transport...to exclude those differences between States due to differences in pricing policies, efficiency, standards of service and other policies,' (Commonwealth Grants Commission 1985). To meet this objective, the consultant analysed the published expenditure accounts of the four State railway authorities and derived unit cost estimates for many of the parameters required for this Paper. The unit costs quoted in subsequent sections of this chapter were based on 1983-84 financial data and rail task statistics, but have been converted into December quarter 1986 price levels using the CPI.

The costs which can be attributed to the provision of a railway service can be conveniently classified in terms of the following components:

- train operating costs
  - capital (locomotives, wagons)
  - fuel
  - crew (wages, superannuation and other on-costs)
  - maintenance (locomotives, wagons);
- track maintenance;
- overheads; and
- terminals.

The magnitude of each of these cost components depends on a large number of factors which in practice are very difficult to quantify (apart from any data base management constraints). It is for this reason that the use of unit costs based on aggregate data is often the only available alternative.

**Train operating costs**

*Capital*

If surplus rolling stock capacity does not exist within a railway system then the avoidable cost of each task has a capital cost component which reflects rolling stock replacement costs. In this study the conventional annuity approach was used to estimate the capital costs of locomotives and wagons. The method results in a constant real annual capital charge made up of interest and depreciation components. The annual interest charge, which represents the opportunity cost of the asset, decreases with time as the asset depreciates and the annual depreciation charge increases with time to maintain a constant annual capital charge. The real annual capital cost, A, is related to the original purchase cost, P, by the expression

$$A = Pi + (i(P-R)/((1+i)^n-1)),$$

where i is the real interest rate,
n is the life of the asset before resale, and
R is the resale value.

The purchase cost of bottom discharge grain hopper wagons (tare 20 tonnes, gross 75 tonnes) was taken to be $100 000. The life of these wagons was taken to be 25 years and zero resale value was assumed. On the basis of these assumptions and a real interest rate of 5 per cent per year, the annual capital cost of a bottom discharge wagon was $7 100.

On the basis of the CANAC analysis the purchase cost for a C Class locomotive (3300 hp) was $2.6m and for an A Class (2450 hp) was $2.2m. For locomotives between A Class and Y Class (650 hp) the cost was taken to be $0.9m per 1000 hp. Locomotives were assumed to have a 25 year life and zero resale value.

*Fuel*

The quantity of fuel used in a train operation depends on variables such as load, distance, speed, grades and locomotive fuel efficiency. In many instances the dependence of fuel consumption on these variables is not accurately known and it is necessary to use a more simplistic approach based on the assumption that fuel consumption depends linearly on the gross tonne-kilometres (GTK) of the train. This latter approach was used by both CANAC Consultants (1984) and the Independent Economic Inquiry into Transport Services to the Northern Territory (1984), where the fuel consumption of main line locomotives was taken to be about 4.6 litres per 1000 GTK. This figure is consistent with the fuel cost estimates derived from the analysis of railway systems' accounts and task statistics. The fuel consumption for each of the four State systems was between $2.40 and $2.50 per 1000 GTK (in 1986 dollars). Assuming a fuel consumption of 4.6 litres per 1000 GTK, this corresponds with a fuel price of about 53 cents per litre. The consistency between fuel cost estimates from the different sources is not surprising as fuel consumption can be measured accurately. Perhaps more surprising, in view of terrain and other differences, was the agreement between railway systems.

*Crew*

There are two difficulties in estimating the avoidable costs of crewing a train. The first is the practical problem of collecting reliable data not only on wages, penalties and allowances but also a series of on-costs such as:

- superannuation
- long service leave
- workers' compensation
- annual leave
- payroll tax
- sick leave
- administrative overheads.

The second difficulty is to assess the avoidable component of total costs. In the short run, locomotive crew costs (with the exception of some penalty and allowance payments) are unavoidable as workforce levels cannot be adjusted to reflect short-run demand changes. In the long run crew costs are all avoidable as workforce levels can be adjusted by retraining and natural wastage. The difficulty for the analyst is to find the appropriate balance between these short-run and long-run extremes and further research into this topic is required. In this submission a long-run perspective was taken and it was assumed that all locomotive crew costs were avoidable.

The crew costs derived in CANAC Consultants (1984) were built up or synthesised from estimates of the cost components listed above. The results of this 'bottom-up' approach reflected the wage rates and conditions existing in V/Line in 1984. For the purposes of comparison with other estimates the CANAC costs were adjusted for two-man crews and it was assumed that railway operations were carried out seven days a week. The CANAC crew cost estimates (in 1986 dollars) are detailed as a function of gross trailing weight in Table 6.1.

TABLE 6.1 CANAC TRAIN CREW COST ESTIMATES, 1986 PRICES

| *Gross trailing tonnes* | *Cost/crew/hr*[a] *(dollars)* |
|---|---|
| 0 - 1 000 | 39 |
| 1 000 - 1 249 | 41 |
| 1 250 - 1 799 | 43 |
| 1 800 - 2 249 | 47 |
| 2 250 - 2 699 | 49 |
| 2 700 - 3 145 | 51 |
| 3 150 - 3 599 | 53 |
| 3 600 - 4 049 | 55 |
| 4 050 - 4 499 | 57 |
| 4 500 - 4 949 | 59 |

a. Two-man crews assumed.

*Sources* CANAC Consultants (1984). BTE estimates.

Large differences were found between the CANAC crew costs and those estimated from railway systems' accounts and task statistics. That is, there was a discrepancy between the estimates synthesised from wage rates and on-costs and the estimates based on total freight crew costs and the freight tasks performed. The latter estimates, adjusted for two-man crews, varied between systems from $2.50 to $3.70 per train-kilometre, with an average of $3.20 per train-kilometre. When the accounts were analysed in terms of GTK the estimates ranged from $2.00 to $2.90 per 1000 GTK, with an average of $2.60 per 1000 GTK. Although strict comparisons are difficult to make, it appears that the synthesised (or bottom-up) estimates were about half the 'top-down' estimates based on system accounts.

There appear to be two main explanations for this large discrepancy, both of which cast doubt on the validity of the bottom-up estimates. First, it was assumed in the bottom-up approach that, at any one time, all train crews are involved in on-train work. In practice, demand for on-train work fluctuates and crew numbers reflect peak demand conditions. In other words, there is an oversupply of crew at some times of the year. This must be taken into account when long-term avoidable costs are considered.

Second, it is difficult in the bottom-up approach to account satisfactorily for the complex allowances and penalties in labour agreements.

*Rolling stock maintenance*

It is sometimes argued that rolling stock maintenance costs (for both locomotives and wagons) have a time dependent and a distance dependent component. The time dependent component reflects major overhauls carried out on a scheduled basis and the distance dependent component corresponds to unscheduled maintenance or running repairs. It was argued persuasively in the report by CANAC Consultants (1984) that this distinction is more a reflection of maintenance practice than a description of maintenance requirements in terms of wear and tear. As an alternative approach it was suggested that maintenance costs were related to distance travelled and gross weight and that the most meaningful parameter of maintenance requirements is GTK.

From the CANAC Consultants' analysis of V/Line records it was estimated that the maintenance costs of GH and VHGY or VHHY wagons were $3.60 and $1.60 per 1000 GTK respectively. Locomotive maintenance costs were estimated to be $1.60 per 1000 GTK.

From the analysis of railway systems' accounts it was estimated that wagon maintenance costs varied between systems from $2.20 to $3.90 per

1000 trailing tonne-kilometres (TTK), with an average of $2.60 per 1000 TTK. Locomotive maintenance costs were in the range $2.00 to $3.10 per 1000 GTK, with an average of $2.60 per 1000 GTK.

**Track maintenance costs**

The term 'track maintenance' is used here to cover all of the work required to keep the track structure in good repair, including maintenance of the rails, sleepers, ballast, subgrade, drainage, track fastenings, points, and so on, plus work required on bridges, tunnels, and earthworks adjacent to the track itself.

The costs of track maintenance are affected by the mass of the rolling stock traversing the line, distance travelled, axle loads, speed, track stiffness, curvature of track, traffic density, whether the rail is jointed or continuous welded, and several other less important factors. The modelling of these parameters requires a great deal of detailed information on the design and condition of the track, as well as on the trains using it and, in practice, this approach is rarely pursued. The more conventional approach is to assume that track maintenance costs have fixed and variable components, the latter being proportional to GTK.

The track maintenance cost equations derived in CANAC Consultants (1984) and inflated to 1986 dollars are as follows:

- branch line costs ($/km/year) = 7700 + 1.6/1000 GT
- main line costs ($/km/year) = 8400 + 1.6/1000 GT

These expressions include an allowance for track relaying which was estimated in the CANAC Consultants' analysis to be $0.51 per 1000 gross tonnes (GT). In some circumstances the track relaying cost may not be appropriate for costing branch line operations.

The track maintenance cost figures derived from the CANAC Consultants' analysis appear to be consistent with the figure of $7 500 per kilometre quoted by officials of the State Rail Authority of New South Wales for the annual maintenance cost of branch lines in New South Wales (State Rail Authority of New South Wales 1987).

The Commonwealth Grants Commission's (1985) consultant used the following formula for non-metropolitan track maintenance costs:

- track costs ($/km/year) = 3600 + 2.4/1000 GT.

Clearly this formula has lower fixed and higher variable cost components than the CANAC formulae.

It can be seen from these equations that the fixed costs of track maintenance are high. The reasons for high fixed costs are that weather and time play a large part in track degradation and in practice the costs incurred depend on the way track deteriorates and consequent safety requirements.

### Overheads

Rail cost analysis is greatly complicated by the existence of numerous indirect joint and common costs which are incurred by the railway system as a whole and which can only be attributed to individual traffics on the basis of arbitrary cost allocation procedures. Examples of these overhead costs include:

- management and administration;
- building construction and maintenance; and
- safe working practices.

Overhead costs were discussed by CANAC Consultants but were not included in the cost estimates. Administration and general overheads were estimated by the Independent Economic Inquiry into Transport Services to the Northern Territory (1984) to vary from 13 to 25 per cent of train operating costs and track maintenance costs, depending on the traffic volume. Surprisingly, the proportion accounted for by overheads increased with traffic volume. For this work it was assumed that overhead costs were 10 per cent of train operating costs. The sensitivity of the cost estimates to this arbitrary assumption is discussed later.

### Summary of rail unit costs

A summary of the rail cost data discussed above is given in Table 6.2.

The rationale for the 'best-estimate' costs in Table 6.2 was as follows. The top-down crew costs derived from the consultant's report to the Commonwealth Grants Commission were chosen for the reasons discussed earlier. The CANAC Consultants' track maintenance costs were adopted because they agreed closely with the recent State Rail Authority of New South Wales' estimates. For wagon maintenance costs and fuel costs the estimates of the CANAC Consultants and the CGC were consistent and no choice was necessary. The best-estimate locomotive maintenance cost was taken to be the average of the estimates of the CANAC Consultants and the CGC.

### Terminals

The cost estimates discussed here refer to the costs incurred by railway systems in terminal activities such as shunting and

TABLE 6.2 SUMMARY OF RAIL UNIT COST DATA, 1986

| | Unit cost | | |
|---|---|---|---|
| *Cost component* | *CANAC* | *CGC* | *Best estimate* |
| Locomotive capital ($m) | | | |
| C Class (3 300 hp) | 2.6 | .. | 2.6 |
| A Class (2 450 hp) | 2.2 | .. | 2.2 |
| T Class | 0.9 | .. | 0.9 |
| Wagon capital ($m) | | | |
| Bottom discharge | 0.1 | .. | 0.1 |
| Fuel (litres/1000 GTK) | 4.6 | 4.6 | 4.6 |
| Crew ($/train km) | 1.6 | 3.2 | 3.2 |
| Locomotive maintenance ($/1000 GTK) | 1.6 | 2.6 | 2.1 |
| Wagon maintenance ($/1000 TTK) | | | |
| Bottom discharge | 1.6 | .. | 1.6 |
| Open 4 wheel | 3.6 | .. | 3.6 |
| Fleet average | .. | 2.6 | 2.6 |
| Track maintenance ($/km/yr) | | | |
| Fixed ($/year) | 7 700 | 3 600 | 7 700 |
| Variable ($/1000 GTK) | 1.6 | 2.4 | 1.6 |

.. Not applicable.

*Sources* BTE estimates based on CANAC Consultants (1984). Commonwealth Grants Commission (1985).

marshalling and the opportunity cost of rolling stock capital as grain is loaded or discharged. No account is taken of the cost of grain handling and storage facilities or other costs incurred by grain handling authorities.

The main difficulty with costing any kind of transport terminal is that most terminals have unique physical and operational characteristics. These features may reflect the geographic position of the terminal site, local industrial practices and terminal design and operation.

Despite these difficulties an order-of-magnitude estimate of the

TABLE 6.3 COST ESTIMATES FOR RAIL LOADING AND DISCHARGE AT TERMINALS, 1986

*(dollars)*

| | Train operation | |
|---|---|---|
| *Cost component* | *Loading* | *Discharge* |
| Train operating costs | | |
| Locomotive capital | 770 | 300 |
| Wagon capital | 470 | 180 |
| Fuel[a] | 130 | 30 |
| Crew | 480 | 190 |
| Total | 1 850 | 700 |
| Overheads[b] | 185 | 70 |
| Cost per tonne | 1.2 | 0.5 |

a. Based on $20 per hour for duration of loading and discharge operations.
b. Overheads assumed to be 10 per cent of train operating costs.

*Source* BTE estimates.

terminal costs of a unit train operation was developed for this submission. This estimate was based on the following assumptions:

- thirty bottom discharge grain wagons;
- two Class C locomotives;
- loading rate at silo of 250 tonnes per hour;
- movement of wagons through balloon loops, with continuous discharge at the receiving terminal;
- average discharge rate of 1000 tonnes per hour; and
- 'dead' time of 45 minutes before and after loading and discharge operations.

The avoidable cost estimates for these terminal activities are summarised in Table 6.3, where it can be seen that $1.20 per tonne and $0.50 per tonne were incurred at the loading and discharge terminals respectively. In the estimation of these costs no account was taken of rolling stock or track maintenance costs as the distances travelled within terminals of this type are usually very small.

Although the results in Table 6.3 are order-of-magnitude estimates only they illustrate the need for a 'total-cost' approach to grain transport, storage and handling. The cost to the rail system of train loading (or discharge) could be reduced by increasing the loading rate but this would involve the handling authority in additional investment in plant and facilities.

**Rail costing examples**

Two examples are used to illustrate the use of the unit cost data in Table 6.2 and to highlight some general features of train operating costs. The first of these is the operation of a unit train running on a main line between a large inland grain storage facility and a seaboard terminal. The second example is a branch line operation servicing a grain sub-terminal. The technical specifications of these tasks are given in Table 6.4.

The avoidable financial costs incurred by a rail system performing these tasks are estimated in Table 6.5. In the estimation of these costs it has been assumed that wagons travel fully laden in one direction and empty on the return journey.

In the unit train example the costs were distributed between track maintenance (29 per cent), rolling stock capital (25 per cent), rolling stock maintenance (19 per cent), fuel (12 per cent), overheads (6 per cent) and crew (9 per cent). The overall labour component of the avoidable cost is unknown, but it is likely that track and rolling stock maintenance costs have large labour components.

Both examples illustrate the significance of fixed track maintenance costs in bulk train operations. These costs were estimated in each example by multiplying the total annual fixed cost by the ratio of train gross tonnes to the total annual gross tonnes assumed for the line (refer Table 6.4). Even in the case of the unit train example, the fixed track maintenance cost was the largest single cost component of the task, and this was for a track assumed to carry about 1 million cargo tonnes per year. To put this traffic volume in perspective a total of about 1.2 million tonnes flowed from New South Wales to Victoria on the main line in 1979-80 (BTE 1983).

In the branch line example the costs were almost completely dominated by the fixed track maintenance costs. It was assumed that this line was used to carry 10 000 tonnes of grain in a year (or 80 trains of the specification used). The sensitivity of the cost estimates to changes in annual branch line traffic is illustrated in Figure 6.1, where the cost per net tonne is plotted as a function of annual branch

TABLE 6.4 EXAMPLES OF GRAIN TRAIN OPERATIONS: TASK SPECIFICATIONS

| | Train operation[a] | |
|---|---|---|
| Specification | Unit train on main line | Local train on branch line |
| Locomotives | | |
| Class A (2450 hp) | 2 | .. |
| Class T (1000 hp) | .. | 1 |
| Wagons | | |
| Bottom discharge | 36 | .. |
| Open 4 wheel | .. | 12 |
| Train gross weight (tonnes) | 2 900 | 484 |
| Train tare weight (tonnes) | 920 | 220 |
| Locomotive utilisation (km/yr) | 80 000 | 60 000 |
| Wagon utilisation (km/yr) | 50 000 | 30 000 |
| Fuel consumption (litres/1000 GTK) | 4.6 | 6.0 |
| Crew size | 2 | 2 |
| Traffic volume (1000 gross tonnes/yr) | 1 910 | 28 |

a. Assumed that grain wagons travel fully laden in one direction and empty on the return journey.
.. Not applicable.

*Source* BTE estimates.

line throughput. It can be seen from this figure that there appear to be significant economies of traffic volume on branch lines where traffic volumes are unconstrained by track capacity.

The examples discussed in this section also provide some insights into the economies of train size. Figure 6.2 shows the cost per GTK and the cost per net tonne-kilometres (NTK) as a function of train size. The data in this figure are based on the unit train example (refer Tables 6.4 and 6.5).

The discontinuities in Figure 6.2 correspond to changes in locomotive size. It was assumed that two A Class locomotives were used for trains in excess of 1700 gross tonnes laden weight, one A Class locomotive for trains between 950 and 1700 gross tonnes laden weight and one T Class locomotive for trains less than 950 gross tonnes laden weight.

It was also assumed in the preparation of Figure 6.2 that total annual traffic volume on the line was independent of train size. As a

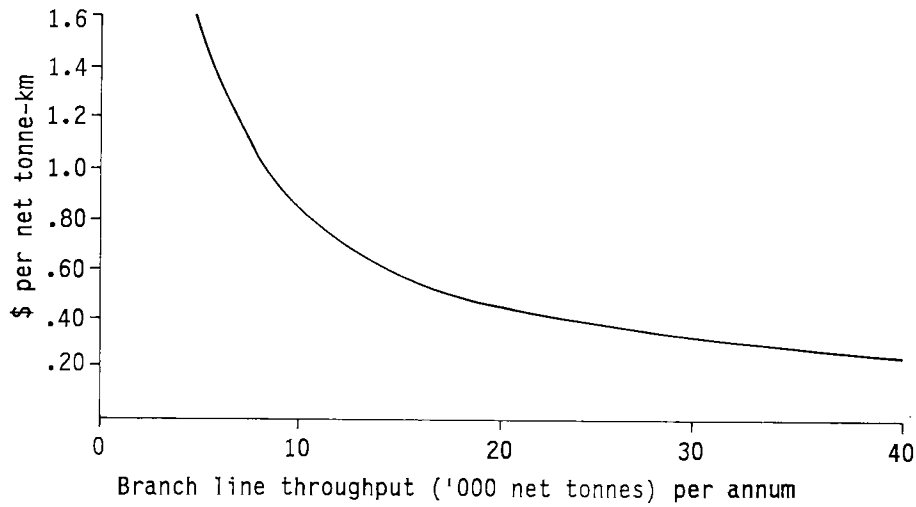


**Figure 6.1 Branch line economies of traffic volume: illustrative example**

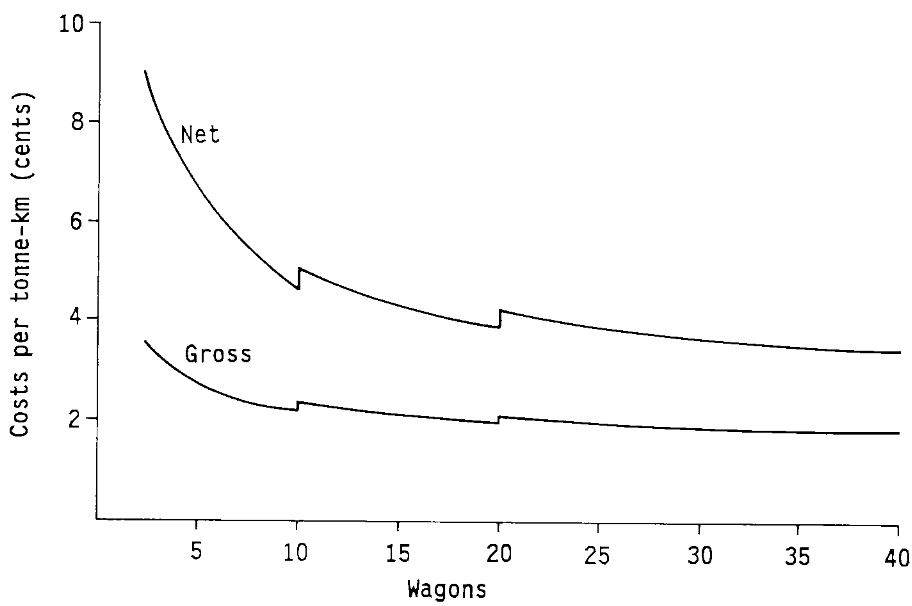


**Figure 6.2 Economies of train size: illustrative example based on unit train operations**

TABLE 6.5 EXAMPLES OF GRAIN TRAIN OPERATIONS: LONG-TERM AVOIDABLE FINANCIAL COSTS FOR A TWO-WAY TRIP
*(1986 prices)*

| | *Train operation* | | | |
|---|---|---|---|---|
| | *Unit train on main line* | | *Local train on branch line* | |
| *Cost category* | *($/train km)* | *(per cent)* | *($/train km)* | *(per cent)* |
| Train operating costs | | | | |
| Locomotive capital | 3.9 | 11 | 1.1 | 1 |
| Wagon capital | 5.1 | 14 | a | 0 |
| Fuel[b] | 4.3 | 12 | 1.0 | 1 |
| Crew[c] | 3.2 | 9 | 3.2 | 3 |
| Locomotive maintenance | 4.0 | 12 | 0.8 | 1 |
| Wagon maintenance | 2.7 | 7 | 0.9 | 1 |
| Total | 23.2 | 64 | 7.0 | 7 |
| Overheads | 2.3 | 6 | 0.7 | 1 |
| Track maintenance | | | | |
| Fixed[d] | 7.7 | 21 | 96.0 | 92 |
| Variable | 3.1 | 8 | 0.6 | 1 |
| Total | 36.3 | 100 | 104.3 | 100 |
| Cost per GTK | 1.9¢ | | 30¢ | |
| Cost per NTK | 3.6¢ | | 79¢ | |

a. Open four-wheel wagons were assumed to have no capital value.
b. Distillate price assumed to be 49 cents per litre.
c. Two-man crews assumed.
d. Traffic volumes were equivalent to 500 and 40 round trip train journeys per year for main line and branch line operations respectively.

*Note* Figures may not match exactly to totals due to rounding.

*Source* BTE estimates.

consequence of this assumption the fixed track maintenance cost per gross tonne-kilometre was independent of train size.

For the unit train example illustrated in Figure 6.2 there was little evidence of economies of train size for trains greater than ten wagons (550 net tonnes). The reason for this is that many of the cost components, such as fuel consumption, rolling stock maintenance and variable track maintenance, are linearly dependent on gross tonnage. Only crew costs are taken to be independent of gross tonnage. This example may under-estimate economies of train size as no account was taken of any scale effects in train scheduling, train examinations or safe working practices. However, any economies of train size from these areas may be small.

## ROAD COSTS

The road costs developed in this section are based on the estimates presented in CANAC Consultants (1984), with appropriate adjustments by the BTE to reflect the outcome of discussions with industry participants, and more current statistics. As with rail cost information, the CPI was used to convert all estimates from 1984 prices to 1986 prices.

The costs cover the two main arrangements for hauling grain by road from the farm to the bulk handling authority storage sites. These are:

- carriage by specialised contractors - these normally carry the grain over the longer distances and use the services of employee-drivers; and
- owner operators - these are farmers who use their own farm truck or a rented truck, usually driven by a family member or a hired farm hand who also does other farm work.

Both financial and real resource costs have been developed for each type of operation. The estimates of financial costs are relevant for examining the relative efficiency of the road transport of grain from the grain grower's viewpoint. To the extent that road freight charges reflect financial costs, these costs are an important determinant of modal choice between road and rail. The estimates of resource costs, in contrast, by excluding all transfer payments such as sales taxes and excise charges, and by including other costs such as damage to roads, measure the extent of real resource use in the transport activity and are, therefore, the relevant consideration from society's viewpoint.

Three broad cost types are relevant, namely, vehicle operating costs, the cost of damage to the road and the cost of externalities. Vehicle operating costs include those items directly paid for by the truck operator, whereas the components of the cost of damage to roads and externalities (for example, air and noise pollution) are costs attributable to the operation of trucks but are generally not paid for directly by the truck operator. Such costs are, however, recovered to various extents from truck operators in the form of annual registration fees and taxes and charges unique to vehicle ownership and use.

Included in vehicle operating costs are:

- fixed costs
  - capital (vehicle and trailer (where applicable))
  - registration and insurance
  - loading and unloading (which are fixed costs per trip);
- variable costs[1]
  - fuel
  - tyres
  - maintenance and repairs
  - wages and overheads;
- the cost of damage to the road (mainly pavement damage);
- the externalities and other costs arising from truck operations
  - cost of strengthening bridges
  - air and noise pollution
  - avoidable elements of traffic control
  - long-run incremental costs such as cost of constructing roads with reduced grades and more passing lanes.

Although all the components of the cost of damage to the road and the cost of externalities are relevant for estimating the resource costs

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1. The distinction between fixed and variable costs is over-simplified in the case of some items, such as labour costs, which may have both fixed and variable components. For example, the cost of employing a full-time driver may be fixed on an annual basis whereas the cost of subcontracted labour might be variable. The overhead component of labour costs is also essentially fixed.

associated with trucking operations, only the costs of pavement damage are considered below because of the lack of data on all these externalities. Some of the cost items excluded may become important in the future should a relaxation of intrastate regulations or closure of some branch lines result in a shift towards a larger share for road transport in the haulage of grain.

Estimating the cost of hauling grain by road is complicated by the diversity of truck types, the varying extent of overloading (which is reported by CANAC Consultants (1984) to be widespread), a wide range of utilisation rates, the differing vehicle purchasing or leasing arrangements and the assumed debt-equity ratio. Consequently, cost estimates depend on a number of factors and it is impractical to provide cost estimates for all types of trucks and all types of financial and organisational arrangements that prevail in the industry. Thus, cost estimates are presented for only three vehicle types identified by CANAC Consultants (1984) as typical of the grain industry. The specifications of these vehicles are reported in Table 6.6.

**Financial costs of truck operations**

From the financial point of view only the cost items that feature in the operator's decision-making are relevant. Thus, of the cost items listed above, only the fixed and variable cost components are of concern.

*Fixed costs*

Capital

This is the cost of the vehicle and trailer (where applicable). The usual approach in estimating capital costs is to employ a capital recovery formula (such as used above for rail). This requires assumptions being made about the purchase price of the vehicle, interest rates, the make of the vehicle, the service life and the residual value of the vehicle.

Based on the assumptions outlined in Table 6.6 and using a 5 per cent real interest rate, the annualised cost of the six-axle articulated truck was estimated as $21 800. Corresponding figures for the three-axle rigid and the two-axle rigid trucks are $2 900 and $1 850 respectively.

Registration and insurance

Intrastate registration charges in all States are based on the tare weight or horsepower of the vehicle and also on whether the vehicle is garaged in the country or in a metropolitan centre. There are also

TABLE 6.6 TYPICAL ROAD VEHICLE TYPES AND SPECIFICATIONS FOR TRANSPORT OF GRAIN

| | *Contractor* | | | |
|---|---|---|---|---|
| | *6-axle articulated configuration* | | *Owner operator* | |
| *Item* | *Three-axle prime mover* | *Three-axle trailer* | *Three-axle rigid tipper* | *Two-axle rigid tipper* |
| Vehicle | | | | |
| Engine type | diesel | .. | petrol | petrol |
| Rear axle configuration | 2 x dual wheels | all dual wheels | 2 x dual wheels | dual wheels |
| Tare mass (tonnes, including fuel) | 8.5 | 6[a] | 7 | 5.4 |
| Age at purchase (years) | 0 | 0 | 6 | 6 |
| Purchase price (dollars, 1986 prices) | 135 000[b] | 45 000[c] | 22 500[d] | 14 300[d] |
| Residual value (per cent) | 60 | 60 | 0 | 0 |
| Load (including 5 per cent overload) (tonnes) | 24 | f | 13.4 | 9.2 |
| Gross vehicle mass (tonnes) | 38.5 | f | 20.4 | 14.6 |

TABLE 6.6 (Cont.) TYPICAL ROAD VEHICLE TYPES AND SPECIFICATIONS FOR TRANSPORT OF GRAIN

| | *Contractor* | | | |
|---|---|---|---|---|
| | *6-axle articulated configuration* | | *Owner operator* | |
| *Item* | *Three-axle prime mover* | *Three-axle trailer* | *Three-axle rigid tipper* | *Two-axle rigid tipper* |
| Life of vehicle (in-farm service, years) | 4 | 8[g] | 10[h] | 10[h] |
| Utilisation (km/year) | 150 000 | 150 000 | 9 000 | 9 000 |
| Average speed (km/hour) | 70[i] | 70[i] | 40 | 40 |

a. Does not have any fuel.
b. Original estimate by CANAC Consultants was $110 000 in 1984 prices (or $124 300 in 1986 prices).
c. Approximately equal to the original CANAC Consultants' estimate of $40 000 updated to 1986 prices using the CPI.
d. The price includes stamp duty.
f. Shown with prime mover.
g. CANAC Consultants used 12 years.
h. CANAC Consultants used 9 years.
i. CANAC Consultants used 75 kilometres per hour.
.. Not applicable.

*Note* All costs are financial costs.

*Source* Based on CANAC Consultants (1984) but adjusted by BTE on the basis of current information.

reduced rates for primary producers. The actual charges vary between the States.

Table 6.7 presents the 1986 country and primary producer registration and third party insurance charges for the three typical truck types. On the basis of the figures in Table 6.7, the estimates of registration charges derived by CANAC Consultants (1984) cannot be considered to be representative. Therefore, the annual registration charge for a six-axle articulated truck was assumed to be $2 100 in

TABLE 6.7 ESTIMATES OF ANNUAL REGISTRATION AND THIRD PARTY INSURANCE CHARGES FOR TYPICAL GRAIN TRUCKS, BY STATE, DECEMBER 1986[a]
*(dollars)*

| *Vehicle category* | *NSW* | *Vic* | *Qld* | *WA* | *SA* |
|---|---|---|---|---|---|
| Country rate for commerical vehicles | | | | | |
| Three-axle prime mover | | | | | |
| Registration | 1 542 | 1 585[b] | 1 404 | 1 256 | 1 662[c] |
| 3rd party insurance | 270 | 405 | 447 | 90 | 191 |
| Trailer | | | | | |
| Registration | 1 088 | d | 98 | 615 | d |
| 3rd party insurance | 3 | d | 53 | 3 | d |
| Three-axle rigid trucks | | | | | |
| Registration | 1 271 | 866 | 1 139 | 1 186 | 750 |
| 3rd party insurance | 270 | 203 | 447 | 90 | 191 |
| Two-axle rigid trucks | | | | | |
| Registration | 730 | 653 | 717 | 553 | 636 |
| 3rd party insurance | 270 | 203 | 447 | 90 | 191 |
| Primary producer rates | | | | | |
| Three-axle rigid trucks | | | | | |
| Registration | 677 | 866 | 66 | 593 | 374 |
| 3rd party insurance | 38 | 64 | 37 | 90 | 47 |
| Two-axle rigid trucks | | | | | |
| Registration | 537 | 653 | 66 | 277 | 317 |
| 3rd party insurance | 38 | 64 | 37 | 90 | 47 |

a. Applied to vehicle specifications presented in Table 6.6.
b. Includes trailer but trailer can be registered separately.
c. Registration includes trailer.
d. Included in prime mover charges.

*Source* Based on information obtained from State motor registries.

1986. This is much lower than the $2 470 in 1984 prices (or $2 791 in 1986 prices) estimated by CANAC Consultants (1984).

The reduced primary producer rates for registration apply only to owner-operators. In 1986 these rates averaged $515 per annum for the three-axle rigid truck and $370 per year for the two-axle rigid truck.

Average third party insurance cost for the six-axle articulated truck is $280 per year. In addition to the compulsory third party insurance, contractors may also take comprehensive insurance policies. The cost of comprehensive insurance varies with the age and value of the vehicle and on a variety of no-claim discounts. However, recent studies, such as BTE (1984b) and CANAC Consultants (1984), indicate that the cost of comprehensive insurance is generally between 5 and 7 per cent of the vehicle's market value.

Assuming an average rate of 6 per cent of the market price of the vehicle, a 22.5 per cent depreciation rate (applied to the reducing balance) and a purchase price of $180 000, the average comprehensive insurance premium for an articulated truck was estimated to be $7 250 per annum, making total annual insurance costs $7 530.

It is assumed that owner-operators carry a $55 annual compulsory third party insurance premium and a third party property insurance premium of approximately $250 per annum, making a total annual insurance cost for the rigid trucks of $300. A summary of the annual registration and insurance costs is presented in Table 6.8.

TABLE 6.8 SUMMARY OF REGISTRATION AND INSURANCE CHARGES FOR TYPICAL GRAIN TRUCKS
*(1986 prices)*

| *Type of truck* | *Registration*[a] | *Insurance*[b] |
|---|---|---|
| Six-axle | 2 100 | 7 530 |
| Three-axle rigid | 515 | 300 |
| Two-axle rigid | 370 | 300 |

a. Excludes third party insurance.
b. Includes third party insurance.

*Source* Based on Table 6.7 and information obtained from truck operators.

Loading and unloading

The cost of loading and unloading is fixed per trip and involves the driver's wage when the truck is being loaded at the farm or unloaded at the silo. This cost will obviously vary with waiting time. Although large variations occur in loading and unloading time, the CANAC Consultants (1984) argue that a streamlined operation could reduce this time to 45 minutes for loading and 45 minutes for unloading, which includes time for weighing in and out and for sampling if necessary. This waiting time works out, at the wage cost of $23 per hour for employee-drivers and $9 for drivers of farm trucks, to be $35 per trip for employee-drivers and $14 per trip for owner-drivers, both measured in 1986 prices (see later section on labour costs and CANAC Consultants (1984)).

*Variable costs*

Fuel

Fuel usage varies with load, engine horsepower, the mechanical condition and age of the truck, driving speed and the condition of the road. Thus, grain truck fuel usage will depend greatly on the assumptions made about backloading.

Fuel usage is reported to vary by as much as 10 to 12 per cent among operators using similar trucks because of the large variations in these factors (CANAC Consultants 1984). The same study estimated fuel consumption for a six-axle articulated truck (as specified in Table 6.6) to be 1.8 kilometres per litre fully loaded and 2.2 kilometres per litre when empty. This represents an average of 2 kilometres per litre. The same fuel consumption was assumed for the three-axle and two-axle rigid trucks, as specified in Table 6.6, reflecting the relatively poor economy of petrol engines and the generally poor conditions of the roads used by farm trucks.

The price of petrol in 1986 was assumed to be 49.7 cents per litre and that of diesel 50.1 cents per litre. These prices represent the average maximum recommended by the Prices Surveillance Authority for Sydney, Melbourne, Brisbane, Adelaide and Perth. These figures may, therefore, be conservative compared with prices paid in rural areas.

Using these unit fuel prices, the cost of fuel (diesel) per kilometre was estimated for the six-axle articulated truck to be 27.9 cents when loaded and 22.8 cents when empty. For both types of rigid trucks the cost of fuel (petrol) was estimated to be 27.6 cents when loaded and 22.6 cents when empty.

Labour

Contractors have various arrangements for paying their employee-drivers. Some drivers are paid on a per trip basis while others are paid on a per tonne basis or at a flat yearly rate regardless of hours worked. Some drivers are also paid incentives when a journey is completed within a certain time limit.

Farm trucks are normally driven by the farmer himself, a family member or a hired farm hand. Family members are not usually paid directly but for costing purposes the time spent by the farmer or his family members is valued at its opportunity cost.

The basic transport workers award in December 1986 was $317.80 per forty-hour week or $7.95 per hour. This award rate, however, understates the true cost of an employee-driver on two counts. First, it does not include overtime payments and trip allowances. Second, there are overheads additional to the award wage, to cover annual leave, public holidays, sick leave, payroll tax and superannuation. The overhead component of labour costs was estimated to equal approximately 35 per cent of the wage rate (CANAC Consultants 1984, BTE 1984b). Thus there is a significant fixed component of labour costs. No overheads specific to the grain transport task apply in the case of a hired farm hand, the farmer or his family members.

BTE (1984b), taking account of overtime and trip allowance payments, estimated the wage of an employee-driver as $500 per forty-hour week in 1982. This is equivalent to $675 per week in 1986 prices. To this figure is added the overhead labour cost, making the total cost of an employee-driver $911 per week or $23 per hour.

The wage rate imputed to a hired farm hand when driving the truck is usually adjusted downwards to reflect the fact that a farm hand is normally engaged in other work on the farm. CANAC Consultants (1984) estimated the hourly wage rate in 1984 prices to be $8 per hour for drivers of farm trucks. This is equivalent to $9 per hour in 1986 prices.

The wage rates thus obtained can then be converted into labour costs per kilometre by assuming an average speed. CANAC Consultants (1984) assumed an average speed of 75 kilometres per hour for the six-axle articulated truck and 40 kilometres per hour for each of the two types of farm trucks. Operators contacted during the course of this BTE study indicated that an average speed of 70 kilometres per hour was more representative for six-axle articulated trucks.

Using 70 kilometres per hour as the average speed for the six-axle articulated trucks and 40 kilometres per hour for farm trucks, the cost of an employee-driver becomes 32.9 cents per kilometre. The corresponding cost of an owner-operator is 22.5 cents.

Maintenance and repairs

The cost of maintenance varies widely, depending on:

- the age and make of vehicle; and
- whether the repair and maintenance work is contracted out, or done by a hired full-time mechanic.

The make of vehicle affects maintenance and repair costs through the reliability of the vehicle and the cost of parts. It has been reported that some trucks, although expensive to buy, are more reliable, requiring less repairs (CANAC Consultants 1984). For owner-operators repairs and maintenance are normally carried out on the farm.

CANAC Consultants (1984) estimated maintenance and repair costs for a six-axle articulated truck in 1984 prices to be approximately $12 000 per year (or $13 560 in 1986 prices.) The corresponding 1984 figure for a three-axle rigid truck is $1 000 per vehicle per year, which translates into $1 130 per vehicle per year in 1986 prices. The repair and maintenance costs for the two-axle rigid truck were assumed to be the same as that for the three-axle rigid truck.

Tyres

To estimate the cost of tyres used per kilometre, information about the total life of a tyre is required; that is, the initial life plus retreading life. The costing procedure involves assumptions about the purchase price of tyres, the cost of retreading, and the number of times a tyre can be retreaded.

Tyre life is significantly affected by road conditions. It is normal, therefore, to assume a shorter life and a smaller number of retreads for owner-operated farm trucks to reflect the relatively poorer road conditions over which these vehicles are run. Information obtained from operators suggests that the tyre-costing parameter values estimated by CANAC Consultants (1984) are not representative of current practice. For example, operators indicated that retreads are seldom used on the prime mover and that one retreading is the norm.

On the basis of this information and information provided by tyre

TABLE 6.9 PARAMETER VALUES FOR ESTIMATING TYRE COSTS, 1986 PRICES

| | *Type of truck* | | | |
|---|---|---|---|---|
| | *Six-axle articulated* | | | |
| *Item* | *Three-axle prime mover (10 tyres)* | *Three-axle trailer (12 tyres)* | *Three-axle rigid (10 tyres)* | *Two-axle rigid (6 tyres)* |
| Type of tyre | radial | radial | radial | radial |
| Initial cost ($/tyre) | 400 | 400 | 350 | 350 |
| Initial life (km) | 100 000 | 100 000 | 20 000 | 20 000 |
| Retreading cost ($/tyre) | .. | 150 | 110 | 110 |
| Retreading life (km) | .. | 75 000 | 15 000 | 15 000 |
| Number of retreadings | .. | 1 | 1 | 1 |
| Total tyre life (km) | 100 000 | 175 000 | 35 000 | 35 000 |
| Total tyre financial cost (¢/km) | 4.0 | 3.8 | 13.0 | 7.9 |
| Total tyre resource cost (¢/km)[a] | 3.3 | 3.3 | 11.4 | 6.9 |

a. This cost excludes the 20 per cent sales tax levied on the initial purchase price of the tyre.
.. Not applicable.

*Source* Based on CANAC Consultants (1984) with adjustments by BTE to reflect current information.

dealers on tyre prices, adjustments were made to the values derived by CANAC Consultants (1984). The revised figures are presented in Table 6.9.

Administration

This is directly relevant only for the contractor, and likely to vary with the number of vehicles operated. Normally, a value is imputed for time spent by the contractor's family and the employee-driver in administrative work. Administration costs were estimated by the CANAC Consultants (1984) to be $5 000 per vehicle per year (in 1984 prices) for a six-axle articulated truck. This represents $5 650 per year in 1986 prices.

### Summary of truck costs

Table 6.10 presents a summary of the financial cost components of operating the typical trucks.

The cost estimates presented in Table 6.10 were converted into a cost per kilometre using yearly utilisation rates of 150 000 and 9000 kilometres per year respectively for articulated trucks and the two types of farm truck. The results are shown in Table 6.11.

The relatively high capital cost per kilometre for the two types of farm trucks is due mainly to the relatively low utilisation rates assumed for these vehicles. Total vehicle operating cost per tonne-kilometre for a return journey with no backload can be obtained by

TABLE 6.10 SUMMARY OF FINANCIAL COSTS OF TYPICAL GRAIN TRUCK OPERATIONS, 1986 PRICES

| | *Type of truck* | | |
|---|---|---|---|
| *Cost item* | *Six-axle articulated* | *Three-axle rigid* | *Two-axle rigid* |
| Fixed costs ($/year) | | | |
| Vehicle | 18 300 | 2 900 | 1 850 |
| Trailer | 3 500 | .. | .. |
| Registration | 2 100 | 515 | 370 |
| Insurance | 7 530 | 300 | 300 |
| Variable costs | | | |
| Fuel (cents/km)[a] | 27.9 | 27.6 | 27.6 |
| | (22.8) | (22.6) | (22.6) |
| Tyres (cents/km) | 7.8[b] | 13.0 | 7.9 |
| Maintenance and repairs ($/year) | 13 650 | 1 130 | 1 130 |
| Wages and overheads ($/hour) | 23 | 9 | 9 |
| Administration ($/year) | 5 560 | .. | .. |

a. Figures in parentheses denote fuel cost when truck is empty.
b. This is the average tyre cost per kilometre for the prime mover and the trailer.
.. Not applicable.

*Sources* BTE estimates. CANAC Consultants (1984).

TABLE 6.11 UNIT FINANCIAL OPERATING COSTS FOR TYPICAL GRAIN TRUCKS, 1986 PRICES[a]

| | *Type of truck* | | | | | |
|---|---|---|---|---|---|---|
| | *Six-axle articulated* | | *Three-axle rigid* | | *Two-axle rigid* | |
| *Cost item* | *(¢/km)* | *(per cent)* | *(¢/km)* | *(per cent)* | *(¢/km)* | *(per cent)* |
| Capital | | | | | | |
| Vehicle | 12.2 | 12.2 | 32.2 | 28.1 | 20.6 | 21.4 |
| Trailer | 2.3 | 2.3 | .. | .. | .. | .. |
| Registration | 1.4 | 1.4 | 5.7 | 5.0 | 4.1 | 4.3 |
| Insurance | 5.0 | 5.0 | 3.3 | 2.9 | 3.3 | 3.4 |
| Fuel[b] | 25.4 | 25.4 | 25.1 | 21.9 | 25.1 | 26.1 |
| Wages and overheads | 32.9 | 33.0 | 22.5 | 19.7 | 22.5 | 23.4 |
| Maintenance and repairs | 9.1 | 9.0 | 12.6 | 11.0 | 12.6 | 13.1 |
| Tyres | 7.8 | 7.8 | 13.0 | 4.4 | 7.9 | 8.2 |
| Administration | 3.8 | 3.8 | .. | .. | .. | .. |
| Total | 99.9 | 100.0 | 114.4 | 100.0 | 96.1 | 100.0 |
| Loading and unloading cost ($/trip) | 35 | .. | 14 | .. | 14 | .. |

a. Assumed utilisation rates are 150 000 kilometres per year for the six-axle articulated vehicle and 9000 kilometres per year for the rigid vehicles.
b. Average of fuel consumption when loaded and when empty.
.. Not applicable.

*Note* Figures may not add to totals due to rounding.

*Source* Based on Table 6.10.

dividing the total vehicle operating costs presented in Table 6.11 by half the load capacity of the corresponding vehicle.

Assuming 24 tonnes, 13.4 tonnes and 9.2 tonnes respectively as the load capacity of the six-axle articulated, the three-axle and the two-axle rigid, and ignoring loading and unloading costs, the total vehicle operating cost per kilometre translates as 8.3 cents per tonne-kilometre for the articulated truck, 17.1 cents per tonne-kilometre for the three-axle and 20.9 cents per tonne-kilometre for the two-axle rigid truck.

**Resource costs of truck operations**

The financial cost estimates presented in Table 6.11 were based on retail prices which included various taxes and transfer payments, such as vehicle registration charges, but excluded other relevant costs such as the cost of pavement damage. Therefore, the estimate of total financial cost does not necessarily reflect the true cost of resources actually expended. The first step in deriving resource costs is to adjust retail prices for taxes and subsidies. Table 6.12 contains such adjustments to the purchase price of vehicles, fuel and tyres. In addition to these adjustments, vehicle registration charges are excluded because they are essentially transfers from truck owners to State governments. Third party and comprehensive insurance charges are, however, included to reflect the cost of accidents.

Whereas adjusting for the significant transfer payments is relatively straightforward, estimating the cost of pavement damage is complicated by many factors. Consequently, there is disagreement on the pavement damage attributable to different weight categories of vehicles. Additional problems in calculating pavement damage costs arise due to illegal overloading of trucks and the variation of damage costs with different initial pavement types and conditions.

Notwithstanding these problems, recent estimates derived by the BTE based on several approaches and work previously done by various other researchers suggest that 8 cents to 15 cents per equivalent standard axle-load (ESAL)[2] kilometre is a reasonable approximation of the cost of pavement damage (Luck & Martin 1987). Using the load specifications of the typical trucks given in Table 6.6, the cost of pavement damage attributable to a fully loaded six-axle articulated truck ranges from 30.2 cents to 56.6 cents per kilometre. For the three-axle and the two-axle rigid trucks, pavement damage costs range, respectively, from 26.4 cents to 49.5 cents per kilometre and 16.4 cents to 30.8 cents per kilometre.

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2. An ESAL is the load on a given axle configuration which causes an amount of damage to a road equivalent to that caused by an 8.2 tonne load on a single axle with two sets of dual tyres.

TABLE 6.12 ADJUSTMENTS TO VEHICLE CAPITAL AND OPERATING FINANCIAL COSTS TO DERIVE RESOURCE COSTS, 1986 PRICES

| *Cost item* | *Purchase price* | *Tax (per cent)* | *Resource cost* |
|---|---|---|---|
| Capital ($) | | | |
| Six-axle articulated | | | |
| Vehicle | 135 000 | 20 | 112 500 |
| Trailer | 45 000 | 20 | 37 000 |
| Three-axle rigid truck | 22 500 | 2.3[a] | 22 000 |
| Two-axle rigid truck | 14 300 | 2.1[a] | 14 000 |
| Fuel (cents/litre) | | | |
| Petrol | 49.72 | 55.4[b] | 32.0 |
| Diesel | 50.14 | 54.7[b] | 32.4 |
| Tyres ($) | | | |
| Six-axle articulated | 400 | 20 | 330 |
| Three-axle rigid truck | 350 | 20 | 290 |
| Two-axle rigid truck | 350 | 20 | 290 |

a. The stamp duty paid on second hand trucks is normally expressed as dollars per 100 dollars of purchase price. In this table the stamp duty paid is expressed as a percentage of the purchase price.
b. This is the average of Commonwealth excise taxes and State franchise fees of 17.73 cents per litre expressed as a percentage of price. The retail price is taken as the average for Sydney, Melbourne, Brisbane, Adelaide and Perth in 1986.

*Sources* Australian Customs Service, (pers. comm., 1987). Australian Taxation Office, (pers. comm., 1987). Based on Tables 6.6 and 6.9.

Using methodology similar to that employed in estimating the financial costs, the resource costs of operating the three typical trucks were estimated. Table 6.13 presents the results.

Applying the load capacities of the three types of truck and assuming a return journey with no backload and that pavement damage only occurs when the vehicle is loaded, the resource cost ranges per tonne-kilometre for the six-axle articulated truck, the three-axle rigid truck and the two-axle rigid truck respectively are 8.4 cents to 9.5 cents, 16.6 cents to 18.3 cents and 19.6 cents to 21.2 cents.

There are two important qualifications that need to be taken into consideration when interpreting the resource cost estimates. The first is that labour costs were not adjusted to make an allowance for payroll taxes. Thus, true labour costs are likely to be overstated. The second is the failure to adjust maintenance and repair costs for taxes paid on spare parts. This is also likely to lead to overstatement of the true resource costs.

## ROAD-RAIL MODAL SHARES

The data presented in the previous sections of this chapter illustrate the marked differences between the cost structures of rail and road transport. Rail transport is characterised by large fixed and sunk

TABLE 6.13 SUMMARY OF RESOURCE COSTS OF TYPICAL GRAIN TRUCK OPERATIONS, 1986 PRICES
*(cents per kilometre)*

| | *Type of truck* | | |
|---|---|---|---|
| *Cost item* | *Six-axle articulated* | *Three-axle rigid* | *Two-axle rigid* |
| Capital | | | |
| Vehicle | 10.1 | 31.7 | 20.1 |
| Trailer | 2.1 | .. | .. |
| Insurance | 5.0 | 3.3 | 3.8 |
| Fuel | 16.4 | 16.2 | 16.2 |
| Tyres | 6.6 | 11.4 | 6.9 |
| Wages and overheads | 32.9 | 22.5 | 22.5 |
| Maintenance and repairs | 9.0 | 12.6 | 12.6 |
| Administration | 3.8 | .. | .. |
| Pavement damage cost[a] | 15.1-28.3 | 13.2-24.8 | 8.2-15.4 |
| Total resource cost | 101.0-114.3 | 110.9-122.5 | 90.3-97.5 |

a. Pavement damage cost estimates are based on Luck & Martin (1987). It is assumed that there is no backloading and that pavement damage occurs only when trucks are fully laden, that is, for one kilometre in every two kilometres travelled.
.. Not applicable.

*Sources* Luck & Martin (1987). Table 6.12.

costs relative to the variable costs of operation. Consequently, there is scope for rail to gain some economies of scale with respect to traffic density. Road transport operations, by contrast, are characterised by a much greater proportion of variable costs and a lesser proportion of sunk costs than railways. This means that the most efficient size of road transport operations is more quickly reached so the economies arising from size are smaller than for rail transport.

The significance of fixed costs for railway operations is shown in Table 6.5. Branch line costs per net tonne-kilometre are overwhelmingly dominated by fixed track maintenance costs because of the low traffic density on these lines. Fixed costs are also of some importance for main line hauls but not to the same extent.

This cost structure can be contrasted with that of road transport operators. For private financial costs facing operators of six-axle articulated trucks, fixed costs are only 21 per cent of total costs, compared with variable costs of 79 per cent. For smaller three-axle and two-axle trucks travelling generally shorter distances, the proportions are approximately 33 per cent and 67 per cent respectively.

The financial costs per tonne-kilometre of the two modes are summarised in Table 6.14. It can be seen that the costs of main line rail hauls are less than half the costs of transport by six-axle articulated road vehicles (assuming no backload). This suggests that in a less regulated environment there may not be much competition between the two modes on main line routes because rail transport should be able to undercut road rates and still cover avoidable costs. Road operators may, however, have an advantage over shorter distances where traffic volumes are low.

It must be remembered that these figures are based on 'average' or 'typical' costs. Costs on individual rail lines and roads can vary markedly depending on such things as the density of traffic, the loads carried and the state of the track or road. Thus, it might be the case that a branch rail line can compete with road transport with respect to grain transport because the branch line carries a significant level of traffic and the competing road transport is over very poor roads which inhibit the use of the most efficient road transport vehicles. Based on these costs, a general statement about the future viability of rail branch lines cannot be made. Each case must be considered on its own merits.

The results of testing the sensitivity of the cost figures to road vehicle utilisation rates and to branch and main line tonnages show the importance of separate examination of each situation. For six-axle articulated trucks, the effect of increasing (decreasing) the yearly utilisation rate by 50 000 kilometres (33 per cent) is to decrease (increase) the financial cost per tonne-kilometre by only about 11 per cent. For rigid trucks, increasing the yearly utilisation rate from 9000 kilometres to 20 000 kilometres (120 per cent) lowers the financial cost per tonne-kilometre from 19 cents to 14 cents (that is, by 26 per cent). Lowering the utilisation rate to 5000 kilometres per year (40 per cent) increases the cost per tonne-kilometre to 26 cents (that is, by 37 per cent).

The cost per net tonne-kilometre for trains on main lines was also found to be relatively insensitive to changes in throughput. Doubling the throughput from one million net tonnes to two million net tonnes decreases financial cost per net tonne-kilometre by only 11 per cent (from 3.6 cents per net tonne-kilometre to 3.2 cents per net tonne-kilometre), whereas halving it to 500 000 net tonnes increases the cost per net tonne-kilometre by 22 per cent. In contrast, the financial cost of branch lines is very sensitive to assumed tonnages (as is shown in Figure 6.1). Doubling throughput on these lines from 10 000 net tonnes to 20 000 net tonnes per year results in halving of the cost per net tonne-kilometre from 83 cents to 45 cents, whereas halving throughput results in the doubling of cost per net tonne-kilometre from 83 cents to 160 cents.

A major distinguishing feature of rail transport is that the rail authorities own both the vehicles and the track on which they run. This is in marked contrast to road transport, where ownership of vehicle and track are in different hands. To the extent that road transport operators are not paying the full costs of roads, road transport operators have an unfair cost advantage over those rail authorities that are attempting to cover the full costs of their operations. An efficient pricing mechanism would ensure that all relevant costs were included in the cost structure of road transport and that the costs were, therefore, reflected in the pricing policies of road operators.

The difference that the inclusion of road damage costs and exclusion of taxes and charges might make to the costs of road transport is shown in Table 6.15. It is clear from these data that the cost of road transport using the larger trucks may increase significantly if

TABLE 6.14 UNIT FINANCIAL COSTS OF RAIL AND ROAD TRANSPORT, 1986 PRICES
*(cents per net tonne-kilometre)*

| | *Transport mode* | | | | |
|---|---|---|---|---|---|
| | *Rail* | | *Road* | | |
| *Unit* *Unit* | *Branch line* | *Main line* | *Six-axle articulated truck* | *Three-axle rigid truck* | *Two-axle rigid truck* |
| Cost per tonne-kilometre | 79[a] | 3.6 | 8.3 | 17.1 | 20.9 |

a. Track maintenance dominates this cost.

*Source* BTE estimates.

TABLE 6.15 UNIT RESOURCE COSTS AND FINANCIAL COSTS OF ROAD TRANSPORT, 1986 PRICES
*(cents per net tonne-kilometre)*

| | *Type of truck* | | |
|---|---|---|---|
| *Category* | *Six-axle articulated* | *Three-axle rigid* | *Two-axle rigid* |
| Financial cost | 8.3 | 17.1 | 20.9 |
| Resource cost | 8.4-9.5 | 16.6-18.3 | 19.6-21.2 |

*Source* BTE estimates.

TABLE 6.16 ESTIMATED ROAD DAMAGE CAUSED BY TRUCKS[a] TRAVELLING TO SELECTED PORTS WITH 15 PER CENT OF GRAIN EXPORTS, 1986 PRICES

| *Port* | *Vehicle trips per year* | *Average distance to port (km)*[b] | *Road damage costs per kilometre (cents)*[c] | *Total road damage cost*[d] *($ million)* |
|---|---|---|---|---|
| Sydney | 17 140 | 500 | 30.2-57.0 | 2.6-4.9 |
| Newcastle | 13 317 | 500 | 30.2-57.0 | 2.0-3.8 |
| Geelong | 15 306 | 330 | 30.2-57.0 | 1.5-2.9 |
| Brisbane | 13 746 | 380 | 30.2-57.0 | 1.6-3.0 |
| Fremantle | 17 837 | 270 | 30.2-57.0 | 1.4-2.7 |

a. Six-axle articulated truck.
b. In practice, road trips would generally be over distances less than the average.
c. Based on 8 cents to 15 cents per ESAL kilometre.
d. Based on the assumption that the truck is fully laden one way and empty the other way. Damage when empty is assumed to be negligible.

*Sources* Tables 6.13, V.2, I.8.

operators were forced to pay the cost of road damage caused by their trucks. The competitive position of line haul rail transport would, in general, be improved if these pricing policies were practiced. Again, however, it is important to note that each situation needs to be examined individually.

An indication of the magnitude of road damage costs can be found by combining the data on road damage in Table 6.13 with an assumed number of vehicle trips by road in a less constrained environment (see Appendix IV) and the average distance travelled (see Appendix I). The results are presented in Table 6.16. They show that trucks moving 15 per cent of grain exported through Newcastle could cause road damage of the order of $2 million to $4 million per annum.

## CHAPTER 7 CONCLUDING COMMENTS

Market pressures for greater efficiency in the grain transport system may not always be present. 'Constraints' exist on the efficiency of the national system in the form of State borders, absence of adequate market signals, monopoly powers in the storage, handling and transport sectors and the importance attached to equity.

These institutional and political factors sometimes act to prevent the closure of uneconomic rail lines or impede the most economically efficient use of roads. Policy makers seeking the most efficient grain transport system need to recognise this situation and attempt to optimise the efficiency of the system within this framework.

The objective of minimising total transport, handling and storage costs for grain requires two major transport problems to be addressed. The first problem is that of ensuring that prices charged in whatever mode of land transport is used by growers and in port operations properly reflect the underlying costs of providing the service. When cost-based pricing is adopted the decisions of growers and handling authorities regarding road or rail transport and export ports will tend to minimise resource requirements. The second problem is that some means of encouraging technical efficiency in all facets of grain transport needs to be determined.

An initial step in solving the first problem would be for railways to develop a means of assessing the costs of grain and other freight transport tasks. The first step for road transport would be the introduction of mechanisms by which truck operators are directly charged for the road damage and other external costs they impose. This information and the reactions of growers and handling authorities to cost-based charges would provide a sound basis for efficient investment and disinvestment decisions.

Although it is desirable that prices reflect costs, at the same time they should be responsive to changes in demand. Theoretically, the encouragement of a competitive environment will promote the most efficient pricing practices. While relaxation of the present State regulations might encourage road operators to enter the grain transport market it is not certain that such an action by itself will be beneficial from a national perspective, given other considerations such as current road pricing practices. In addition, it seems likely that the benefits and costs flowing from such changes could be very unevenly distributed across the community.

The estimates provided in Chapter 6 suggest that the rail mode is likely to have a cost advantage in the line haul task. Given the monopoly position of railway systems, this suggests that there is a need for some check on railway freight rates in areas remote from ports to ensure that charges on growers are fair. Road transport appears to be more efficient than rail on low volume rail branch line routes but the outcome in each situation will depend on the traffic volumes (of both grain and other freight) on the branch line and the condition of local roads.

A key consideration in the determination of both the effects of less economic regulation of grain transport and branch line closure is the damage to local roads following such actions. The ability of local governments to cope with a significant increase in road expenditure requirements under present road financing arrangements is questionable. The net effect could be a substantial reduction in the quality of local roads in the affected areas.

Even a relatively small modal shift to road transport from grain growing areas closer to ports could create a large increase in grain trucks passing through built-up areas around ports and through rural towns. For example, road delivery of 15 per cent of the grain crop currently exported through Newcastle would result in over 13 000 one-way truck movements each year. The corresponding figure for Geelong is 15 000 movements. The present port and urban road infrastructure in some centres may have difficulty in coping with such an increase.

The second problem facing policy makers, outlined earlier, was the need to encourage technical efficiency in transport provision. As noted above, open competition could allow rail transport to exploit unfairly its monopoly power in some grain growing areas, particularly those which are distant from export ports. The exploitation could, however, be in the form of operating at higher cost levels than would occur in a more efficient, competitive environment, rather than in the form of unfair charges in relation to costs.

Another impediment to technical efficiency could be the effects of inefficient storage and handling practices. For example, an efficient peak load pricing system for transport would need complementary action by storage and handling authorities. Similarly, the existence of State borders and State orientation of grain transport could reduce the scope for technical efficiency.

Efficient port operations are also important, and port infrastructure and operating practices can affect road and rail efficiency. The scope for unconstrained port competition for grain exports is probably limited but there is a need for much better co-ordination of port-related investment decisions.

All these factors highlight the interdependence of each element in the transport, handling and storage chain and the importance of considering the system as a whole.

While the difficulties mentioned might reduce the beneficial effects of any move towards more market-oriented transport arrangements, such a move should, nevertheless, provide for efficiency gains in most areas. It is important, however, that due consideration be given to ensuring that all costs of production are taken into account in the various markets. This means that it might be necessary for specific regulations to remain in some areas. In these instances it is essential that mechanisms be adopted to encourage participants to act as if they were in a competitive market environment.

# APPENDIX I OVERVIEW OF GRAIN TRANSPORT

This appendix provides information about grain production and transport arrangements. The material presented gives a broad perspective on the size of the transport task, the organisations involved in moving grain from farm to domestic or overseas markets and on the transport infrastructure employed. The importance of grain transport costs is also highlighted.

## VALUE OF GRAIN PRODUCTION TO THE ECONOMY

Grain production is widespread and is undertaken in all the mainland States of Australia (see Table I.1). Wheat is by far the most important grain crop, with production levels being three to four times greater than the second largest, barley. Barley production, in turn, is far greater than any of the remaining crops. The main production areas for wheat are New South Wales and Western Australia but all mainland States contribute significantly to total Australian output.

Grain is exported from every mainland State, reflecting the widespread production pattern. Details of export levels of wheat, barley, oats and sorghum for each mainland State in 1985-86 are shown in Table I.2. Wheat is the major grain export, both in weight and in value terms. As was the case with production, New South Wales and Western Australia are the largest exporters.

On average, cereal grain exports represent approximately 72 per cent of the value of cereal grain production (ABS 1986b). Table I.3 indicates that annual cereal grain exports represented around 11 per cent of the total value of all Australian exports over the period 1979-80 to 1984-85. Wheat being the major cereal grain export represented, on average, 8.8 per cent of the total value of all annual exports. Barley is the second largest cereal grain export and in the period 1979-80 to 1984-85 contributed on average about 1.6 per cent of total export earnings. The other cereal grains are relatively small export earners.

TABLE I.1 AUSTRALIAN GRAIN PRODUCTION, BY STATE, 1985-86

| | *New South Wales* | | *Victoria* | | *Queensland* | | *Western Australia* | | *South Australia* | | *Australia*[a] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Grain type* | *('000 tonnes)* | *(per cent)* | *('000 tonnes)* | *(per cent)* | *('000 tonnes)* | *(per cent)* | *('000 tonnes)* | *(per cent)* | *('000 tonnes)* | *(per cent)* | *('000 tonnes)* | *(per cent)* |
| Wheat | 5 911 | 36.7 | 2 225 | 13.8 | 1 730 | 10.7 | 4 377 | 27.1 | 1 879 | 11.7 | 16 127 | 100.0 |
| Barley | 836 | 17.0 | 499 | 10.2 | 822 | 16.7 | 1 024 | 20.8 | 1 704 | 34.7 | 4 913 | 100.0 |
| Oats | 527 | 39.4 | 321 | 24.0 | 27 | 2.0 | 337 | 25.2 | 110 | 8.2 | 1 339 | 100.0 |
| Triticale | 150 | 67.3 | 23 | 10.3 | 18 | 8.1 | 22 | 9.9 | 7 | 3.1 | 223 | 100.0 |
| Sorghum | 245 | 19.1 | 2 | 0.2 | 1 035 | 80.5 | 3 | 0.2 | - | .. | 1 285 | 100.0 |
| Maize | 70 | 30.7 | 5 | 2.2 | 150 | 65.8 | 3 | 1.3 | - | .. | 228 | 100.0 |
| Rice | 674 | 98.0 | - | .. | 14 | 2.0 | - | .. | - | .. | 688 | 100.0 |
| Oilseeds[b] | 213 | 46.3 | 60 | 13.0 | 167 | 36.3 | 4 | 0.9 | 16 | 3.5 | 460 | 100.0 |
| Legumes[c] | 102 | 13.6 | 155 | 20.7 | - | .. | 378 | 50.4 | 112 | 14.9 | 750 | 100.0 |

a. Includes minor production tonnages from other States and Territories. Rows may not add to totals due to rounding.
b. Includes rapeseed, safflowerseed, linseed, legumes and sunflowerseed.
c. Includes lupins, and cow and field peas.
\- Nil or rounded to zero.
.. Not applicable.

*Source* Royal Commission into Grain Storage, Handling and Transport (1986).

TABLE I.2 AUSTRALIAN GRAIN EXPORTS, BY STATE, 1985-86

| Grain type | *New South Wales* ('000 tonnes) | *New South Wales* (per cent) | *Victoria* ('000 tonnes) | *Victoria* (per cent) | *Queensland* ('000 tonnes) | *Queensland* (per cent) | *Western Australia* ('000 tonnes) | *Western Australia* (per cent) | *South Australia* ('000 tonnes) | *South Australia* (per cent) | *Australia*[a] ('000 tonnes) | *Australia*[a] (per cent) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wheat | 4 659.8 | 28.9 | 2 877.2 | 17.8 | 1 642.0 | 10.2 | 5 363.5 | 33.1 | 1 587.2 | 9.8 | 16 129.5 | 100.0 |
| Barley | 281.2 | 6.7 | 254.8 | 6.1 | 801.3 | 19.2 | 927.5 | 22.3 | 1 903.3 | 45.7 | 4 168.1 | 100.0 |
| Oats | 0.1 | 0.1 | 63.7 | 34.4 | 0.0 | 0.0 | 79.6 | 43.0 | 41.6 | 22.4 | 185.0 | 100.0 |
| Sorghum | 0.6 | 0.0 | 0.0 | 0.0 | 1 233.5 | 100.0 | 0.1 | 0.0 | 0.0 | 0.0 | 1 234.2 | 100.0 |

a. Includes minor production tonnages from other States and Territories.

*Source* Australian Bureau of Statistics (1987).

TABLE I.3 SIGNIFICANCE OF CEREAL GRAINS FOR AUSTRALIAN EXPORT EARNINGS, 1979-80 TO 1984-85

| | *Proportion of total value of exports (per cent)* | | | | | *Total value (FOB) of exports ($ million)* | |
|---|---|---|---|---|---|---|---|
| *Year* | *Wheat* | *Barley* | *Sorghum* | *Other*[a] | *Total* | *Cereal grains* | *All exports* |
| 1979-80 | 11.5 | 1.9 | 0.3 | 1.0 | 14.7 | 2 765 | 18 870 |
| 1980-81 | 9.0 | 1.3 | 0.3 | 0.7 | 11.3 | 2 161 | 19 169 |
| 1981-82 | 8.8 | 1.2 | 0.8 | 1.3 | 12.1 | 2 368 | 19 581 |
| 1982-83 | 6.1 | 0.6 | 0.2 | 0.6 | 7.5 | 1 670 | 22 123 |
| 1983-84 | 7.7 | 2.1 | 0.5 | 0.6 | 10.9 | 2 565 | 23 510 |
| 1984-85 | 9.5 | 2.7 | 0.8 | 0.7 | 13.7 | 4 008 | 29 270 |

a. Oats, rice, maize, panicum and millet, canary seed and rye.

*Source* Australian Bureau of Statistics (1986b).

## ORGANISATIONS INVOLVED IN GRAIN TRANSPORT

This section outlines the various organisations involved in the transport of grain from farm to port and some of the relationships that exist between them. The main groups comprise the various public and private marketing authorities, the bulk handling authorities, State road and rail authorities, port authorities, private companies, and employee and employer representatives. Governments also play a major role, both directly through publicly owned authorities and indirectly through general transport-related legislation which impacts on particular elements in the grain transport chain. How these organisations interact and conduct their affairs can have a significant effect on the efficiency with which grain is transported.

### The marketing authorities

The marketing authorities for the various grain types comprise State or national organisations which typically have statutory responsibility for the marketing of particular grains, both internationally and on the domestic market. Typically they employ the grain bulk handling authority in each State to undertake the handling and storage operations, and may use these authorities to arrange domestic transport as well. The level of reimbursement by marketing authorities for bulk handling authority services is generally fixed for periods greater than one year and may be related to such factors as tonnages shipped, performance (for example, throughput over a specified time period) or distance. In times past the level of remuneration has also been the subject of negotiation between Federal and State government ministers. The marketing authorities are also responsible for payments to growers.

The recent White Paper on Reform of Commonwealth Primary Industry Statutory Marketing Authorities (Department of Primary Industry 1986), signalled the intention of the Federal Government to have these organisations commercially orientated, efficient and autonomous. Some evidence of a trend in this direction in the grain industry includes the removal of Australia-wide pooling arrangements for the domestic transport costs of export wheat (each State is now responsible for its own costs) and the payment by bulk handling authorities for storage and ship loading services at port on a performance basis (that is, throughput per hour) rather than a tonnage basis.

The main marketing authorities in the Australian grain industry are outlined in Table I.4.

TABLE I.4 MAIN MARKETING AUTHORITIES IN THE AUSTRALIAN GRAIN INDUSTRY

| *Organisation* | *Relevant legislation* |
|---|---|
| Wheat | |
| Australian Wheat Board[a] | *Wheat Marketing Act 1984*[b] |
| Barley | |
| Barley Marketing Board for the State of New South Wales | Marketing of Primary Products Act, 1983 |
| Queensland Barley Marketing Board | *Primary Producers Organisation and Marketing Act* 1926-1983 |
| Australian Barley Marketing Board (Victoria and South Australia) | *Barley Marketing Act* 1958-1983 (Vic) Barley Marketing Act, 1947-1983 (SA) |
| Grain Pool of WA | *Grain Marketing Act,* 1975-1984 |
| Rice | |
| Ricegrowers' Co-operative Ltd | Co-operation Act, 1923 |
| Rice Marketing Board of NSW | Marketing of Primary Products Act, 1923 |
| Queensland Rice Marketing Board | *Primary Producers Organisation and Marketing Act,* 1926-1983 |
| Sorghum | |
| New South Wales Grain Sorghum Marketing Board | Marketing of Primary Products Act, 1983 |
| Central Queensland Sorghum Marketing Board | *Primary Producers Organisation and Marketing Act* 1926-1983 |
| Elders-Queensland Grain Growers' Association Pty Ltd | .. |

a. The State Wheat Board (Qld) is designated as the Australian Wheat Board representative in Queensland (*Wheat Pool Act,* 1920-83 and *Primary Producers Organisation and Marketing Act,* 1926-83).
b. Commonwealth legislation.
.. Not applicable.

**The bulk handling authorities**

The State bulk handling authorities are responsible for the handling and storage of grain and arranging for (but not paying for) its transport to port to meet export sale requirements (see Table I.5). They do not, however, arrange international shipping services, which are the responsibility of the marketing boards. The bulk handling authorities provide storage facilities at country sites and at seaboard terminals. Most were established initially as grower co-operatives but all now have statutory recognition. Like the marketing authorities they are monopolies protected by government legislation.

**Rail authorities**

Rail authorities provide the track and rolling stock used to transport the major proportion of grain from bulk handling authority silos to port. The Australian National Railways Commission (AN) in South Australia and the State rail authorities in other States carry out this function. These organisations are outlined in Table I.6.

Grain is a significant commodity to most of the State rail authorities, in terms of both total tonnages and freight revenue (see Table I.7). For example, in 1983-84 grain represented 20.8 per cent

TABLE I.5 AUSTRALIAN BULK HANDLING AUTHORITIES

| *Organisation* | *Relevant legislation* |
|---|---|
| Grain Handling Authority of New South Wales | Grain Handling Act, 1954 |
| Grain Elevators Board of Victoria | *Grain Elevators Act* 1958<br>*Wheat Marketing Act 1984*[a] |
| Queensland Grain Handling Authority | *Queensland Grain Handling Act* 1983 |
| South Australian Co-operative Bulk Handling Ltd | Bulk Handling of Grain Act, 1955<br>*Wheat Marketing Act 1984*[a] |
| Co-operative Bulk Handling Ltd of Western Australia | *Western Australian Companies (Co-operative) Act*, 1943-1982 |

a. Commonwealth legislation.

TABLE I.6 RAIL AUTHORITIES

| *State* | *Organisation* | *Relevant legislation* |
|---|---|---|
| New South Wales | State Rail Authority of New South Wales | Transport Authorities Act, 1980 |
| Victoria | State Transport Authority (V/Line) | *Transport Act* 1983 |
| Queensland | Queensland Railways | *Railways Act* 1914-1984 |
| South Australia | Australian National Railways Commission | Australian National Railways Commission Act, 1983[a] |
| Western Australia | Westrail | *Government Railways Act*, 1904-1982 |

a. Commonwealth legislation.

of total freight revenue and 11.6 per cent of total tonnage of the State Rail Authority of New South Wales (SRA NSW).

**Road transport**

The provision of roads in each State is a responsibility shared between the three levels of government. The Federal Government fully finances the National Highway system and provides funds for arterial and local roads. The State governments provide the majority of funds for arterial roads, whilst local governments are mainly responsible for local roads (see section on road funding).

The State road authorities are largely responsible for the setting of road standards and the co-ordination of road investments. The Federal Government is also involved in this, however, mainly through project and program controls on its road funds.

**National transport bodies**

Several Federal organisations exist to review policy, to furnish the Federal Minister for Transport with advice on national transport

TABLE I.7 GRAIN TONNAGE AND REVENUE OF GRAIN TRAFFIC, BY RAIL AUTHORITY, 1983-84

| | *Rail authority* | | | | |
|---|---|---|---|---|---|
| *Item* | *SRA NSW* | *V/Line* | *Queensland Railways* | *Australian National* | *Westrail* |
| Grain tonnage ('000 tonnes) | 5 340 | 3 081 | 2 240 | 1 725 | 3 600 |
| Percentage of total freight tonnage | 11.6 | 29.3 | 4.2 | 26.2 | 17.7 |
| Grain revenue ($ million) | 116.5[a] | 53.1 | 30.6 | 18.4 | na |
| Percentage of total freight revenue | 20.8 | 33.0 | 4.4 | 9.7 | na |

a. Assuming freight rate for all grains is $21.80 per tonne. This was derived by dividing wheat revenue ($104.7m) by amount of wheat carried (4.8m tonnes).
na Not available.

*Sources* Australian National Railways Commission (1984). Queensland Railways (1984). State Rail Authority of NSW (1985). State Transport Authority (V/Line) (1984). Westrail (1985).

issues, and to facilitate the co-ordination of State transport services. These organisations include:

- the *Australian Transport Advisory Council* (ATAC), comprising State and Federal Ministers responsible for transport, road and marine matters;
- the *Transport Industries Advisory Council* (TIAC), comprising representatives from industry, unions, user groups and transport authorities;
- the *Australian Road Freight Transport Advisory Committee* (ARTAC), comprising senior representatives of the road freight industry; and
- the *Railway Industry Council* (RIC), comprising representatives from each State department of transport (except Queensland) and relevant unions.

### Unions

Union coverage in the grain transport chain changes along its length. Although the production and rural storage stages are largely non-unionised, the remainder of the chain is heavily unionised. State awards predominate in the grain handling and storage phase, and Federal awards assume the major role in the transport, port and shipping phase. Conciliation committees between unions and management have been set up in a few areas to investigate and resolve industrial disputes. Some of these committees involve unions in a range of management strategies (for example, Westrail Participative Planning Consultative Committee), whilst others exist only to discuss occupational health and safety matters.

The New South Wales Grain Handling Inquiry (1981) strongly recommended formal employee consultative groups to meet management of the New South Wales Grain Handling Authority on a regular basis. However, this recommendation was not put into effect.

### Employer groups

Three main groups of employers exist in the transport of grain from regional silo to port, with the State rail authorities being the main employer groups. The other two groups are the bulk handling authorities, who employ the labour used to load and unload the rail trucks, and the road contractors, who often are owner-drivers.

In the port and shipment phase the associations of employers (apart from the grain handling authorities) are:

- Association of Employers of Waterside Labour;
- Association of Australian Port and Marine Authorities;
- Australian Chamber of Shipping;
- Australian Shippers' Council;
- Associated Chambers of Commerce of Australia;
- Mechanical Harvesters' Association of Australia; and
- Brisbane Chamber of Commerce (Grain and Seed Exporters Section).

## TRANSPORT OF GRAIN FROM FARM TO LOCAL SILO

The transport of grain from farm gate to the bulk handling receival depot is primarily undertaken by the grower, using his own trucks, or by a road transport contractor. The grower arranges this transport and pays all direct costs associated with it.

**Vehicles used**

According to CANAC Consultants (1984), three truck types are typically involved in the movement of grain from farm to silo:

- a six-axle articulated vehicle, with a 38.5 tonne gross mass[1];
- a three-axle rigid vehicle, with a 20.4 tonne gross mass; and
- a two-axle rigid vehicle, with a 14.6 tonne gross mass.

Generally, the larger vehicles are used over longer distances while the smaller vehicles, owned by farmers, are used for short hauls.

**Distances travelled**

In most States the average distance from farm gate to receival silo is less than 20 kilometres (see Table I.8). The shortness of this distance is the product of a number of historical factors, such as the early development of rail lines to serve wheat growing districts, the relative economics of rail and road transport of grain given previous levels of technological and infrastructure development, and the economics of silo size.

TABLE I.8 TRANSPORT OF GRAIN IN AUSTRALIA: AVERAGE DISTANCE, BY STATE
*(kilometres)*

| *Movement* | *NSW* | *Vic* | *Qld* | *SA* | *WA* | *Aust* |
|---|---|---|---|---|---|---|
| Farm to silo | 15 | 8 | 48 | 13 | 21 | 17 |
| Silo to export terminal | 500 | 330 | 380 | 150 | 270 | 360 |

*Source* Hussey (1986).

As these factors have changed over time so have the economics of the proximity of farms and receival silos. For example, the study of the Victorian situation by CANAC Consultants (1984) found that total transport, handling and storage costs of grain could be reduced if grain was moved over longer distances from the farm to larger silos served by main rail lines.

1. This is 0.5 tonnes over the legal limit in eastern States which, apparently, represents generally accepted practice among contractors.

**Roads used**

The roads currently used by trucks transporting grain from farms to local silos are primarily what the National Association of Australian State Road Authorities (NAASRA) terms 'Rural Local Roads'. These roads are defined by NAASRA as roads which provide access to properties for agricultural activities, household supplies and cultural activities. Rural areas are defined as those areas which lie outside towns with populations greater than 1000 people (NAASRA 1984b).

These roads most commonly are unsealed with a gravel pavement. Only 20 per cent of rural local roads were sealed in 1981 (the most recent year for which data are available). Issues associated with the standard of rural roads are discussed in more detail in Appendix IV.

**Funding of roads used**

The main source of finance for the construction and maintenance of rural local roads is rural local government. As shown in Table I.9, in 1984-85 local government contributed, from its own resources, 51.9 per cent of total expenditure on rural local roads. The State governments contributed 23.6 per cent and the Federal Government 24.5 per cent in that year.

Expenditure on rural local roads in 1983-84 represented 24.8 per cent of total expenditure on roads, the largest share of any of the road categories. It represented 17.8 per cent of total Commonwealth road expenditure, 15.9 per cent of State government road expenditure and 43.6 per cent of all money spent on roads by local government (Independent Committee of Inquiry into Federal Road Funding Arrangements 1986).

TABLE I.9 EXPENDITURE ON RURAL LOCAL ROADS, BY LEVEL OF GOVERNMENT, 1983-84 AND 1984-85[a] (1983-84 PRICES)

| | *Commonwealth* | | *State* | | *Local* | | *Total* | |
|---|---|---|---|---|---|---|---|---|
| *Year* | *($m)* | *(per cent)* | *($m)* | *(per cent)* | *($m)* | *(per cent)* | *($m)* | *(per cent)* |
| 1983-84 | 213.4 | 26.3 | 175.1 | 21.6 | 422.0 | 52.1 | 810.5 | 100.0 |
| 1984-85 | 202.3 | 24.5 | 195.4 | 23.6 | 429.7 | 51.9 | 827.4 | 100.0 |

*Sources* BTE (1986a, forthcoming).

There are, therefore, significant public finance issues involved in the transport of grain over local roads. Appendix III outlines road funding arangements in greater detail.

### Peaks in road usage

The transport of grain from farm to silo occurs primarily within a peak period between November and January. This is mainly due to seasonal factors governing the growing season of grain, but is also influenced by the pricing and remuneration practices of some grain marketing and bulk handling authorities. The net result is often congestion at silos and on roads, as well as the associated problems with the provision and pricing of storage and transport capacity.

As noted earlier, wheat is the predominant grain and thus it largely determines the demands placed on grain transport and storage capacity. Only oil seeds and coarse grains are harvested in the off-season. Barley and oats are harvested in the same season as wheat.

The peak load problem is exacerbated by limited provision of on-farm storage facilities, by such factors as: the method of payment for grain where growers receive payment only after the grain has been received by the bulk handling authority; and by the pricing practices of some authorities which penalise growers who deliver outside the main delivery period. Some action, however, has been taken on this problem. The Victorian Grain Elevators Board offers incentives for delayed deliveries and the Australian Wheat Board also adjusts its payments for delayed deliveries.

## TRANSPORT FROM LOCAL SILO TO PORT

The transport of grain from silo to port also suffers from peaks and troughs in demand because of the seasonal nature of grain harvesting and arrival pattern of bulk grain vessels. The majority of grain is transported directly from country storages by rail to a port within the same State. However, there are significant variations to this process, including:

- the movement of grain from country storages to sub-terminals or central receival points;
- the movement of grain to port by road; and
- road or rail transport across State borders to port.

### Co-ordination of transport services

The organisation of the movement of grain from silo to port requires a high degree of co-ordination between the bulk handling authorities, marketing authorities and rail authorities. The bulk handling authorities are nominally responsible for organising transport services, but they must integrate with the export schedule of the marketing authorities and with rolling stock availability. For this purpose a variety of co-ordinating mechanisms (both formal and informal) have been established in each State. The New South Wales system, outlined below, indicates the general form of this co-ordination:

- day-to-day working parties, drawn from the operational staff of each organisation, to arrange daily grain movements;
- co-ordinating committees, drawn from the 'middle level' staff of each organisation, to co-ordinate action relating to the movement of grain (for example, the deployment of rolling stock, ship movements and grain terminal receivals and dispatches); and
- joint operations committees, comprising senior staff, who discuss broader operational policy matters.

At another level, consultations take place between these organisations and grower organisations. The purpose of these discussions is to improve communications, for example, by resolving particular problems growers may have with the transport system.

Freight rates are typically a matter for discussion between the marketing authorities and the rail authorities. Rail freight agreements exist in several States and in some cases specify formulae for determining freight rate increases over a certain period (typically 3-5 years). Some agreements also include a loyalty clause guaranteeing that the marketing authority ships a certain proportion of its grain by rail.

In cases where road haulage is required the bulk handling authorities are usually responsible for the tendering process and allocation of contracts. Discussion or negotiation of freight rates is therefore typically between the bulk handling authorities and road contractors.

### Country storage sites

The data in Table I.10 show the number and capacity of country storage sites by State in 1985-86. The size, number and location of these sites and the quality of loading equipment provided largely determine the nature of the grain transport task and the efficiency with which it can be conducted.

One feature of the present country storage system which is particularly important to the level of grain transport costs is the number of small, dispersed country storage sites. Such sites are typically associated with high transport costs for a number of reasons:

- Small dispersed country storage sites usually imply lightly trafficked branch lines, whilst economies in railway operations are significantly related to the density of traffic over rail lines (that is, average costs tend to decrease as the amount of traffic over a route increases).
- Small storage sites typically have short rail sidings and less investment in modern loading equipment, which militate against the use of such cost efficient railway technology as long 'block' (that is, grain only) trains and large wagons.
- A large number of small storage sites increases the number of loading operations which the rail operator has to engage in to transport a given quantity of grain. Each loading operation involves additional time-related costs such as labour and reduces the utilisation of rolling stock.

The Central Receival Point (CRP) system was initiated in Victoria in the 1982-83 and 1983-84 seasons largely in response to these costs. The system involves consolidating grain from various smaller silos into a small number of large storages. By the end of the 1985-86 season 23 CRPs were either existing or proposed for the end of that year. A further 18 are planned.

Another factor associated with the country storage system which affects the cost efficiency of grain transport is the need for double handling caused by the use of these larger sub-terminals in addition to local silos (State Rail Authority of New South Wales 1986). Australian Railway Research Development Organisation (1982) estimated that 46 per cent of New South Wales wheat for export went via these sub-terminals in 1980-81. However, these sub-terminals may have a role in rationalising the provision of rail services by allowing the use of road transport or small capacity trains on the low traffic routes, leaving the movement from sub-terminals to port to the larger and more efficient trains and wagons.

**Modal split**

The general modal split of grain transport from country silo to port in each of the States is shown in Table I.11. The factors influencing this split, apart from the economics of the two modes in the carriage of grain, include the availability of road receival facilities at port

TABLE I.10 CAPACITY OF COUNTRY STORAGE SITES, BY STATE, 1985-86 SEASON

| *Item* | *NSW* | *Vic* | *Qld* | *WA* | *SA* |
|---|---|---|---|---|---|
| Number of permanent sites | 264 | 260 | 86 | 189 | 111 |
| Permanent storage capacity (million tonnes) | 6.21 | 4.27 | 1.85 | 7.49 | 4.20 |
| Average permanent storage site capacity ('000 tonnes) | 23.5 | 16.4 | 21.5 | 39.6 | 37.8 |
| Number of temporary sites | 71 | 34 | 32 | 38 | .. |
| Temporary storage capacity (million tonnes) | 6.07 | 1.67 | 1.47 | 1.42 | .. |
| Average temporary storage site capacity ('000 tonnes) | 85.5 | 49.1 | 45.9 | 37.4 | 0 |

.. Not applicable.

*Source* Australian Wheat Board, (pers. comm., 1987).

and regulations governing the intrastate road transport of grain. These factors are also outlined in Table I.11 and discussed in a later section.

**Distances travelled**

The estimated average distance by rail from country storage to port is given in Table I.8 in the previous section. The longest distances involved are in New South Wales, where some grain is transported over 800 kilometres. South Australia, by virtue of the penetration of the Spencer and St Vincent Gulfs into the major wheat growing areas, has relatively small distances between ports and local silos.

TABLE I.11 INTRASTATE GRAIN TRANSPORT ARRANGEMENTS: COUNTRY SILO TO PORT

| *Item* | *NSW* | *Vic* | *Qld* | *WA* | *SA* |
|---|---|---|---|---|---|
| Approximate proportion of grains carried by road[a] | 0 | 30 | 8-15 | 20 | 50 |
| Availability of road receival facilities for grain at port | None, but facilities planned for Port Kembla and Newcastle | Yes | Yes | Yes, but not at Kwinana | Yes |
| State regulation limiting road haulage of grain | Nil | Carriage restricted to rail beyond 60 km<br><br>Farmers can use their own truck for prescribed grains (wheat, barley, oats) | Carriage restricted to rail beyond 120 km<br><br>Permits are issued to road contractors to supplement rail capacity in peak season | Carriers regulated to nearest facilities outside port area<br><br>Farmers can use own trucks to any destination | Nil |

TABLE I.11 (Cont.) INTRASTATE GRAIN TRANSPORT ARRANGEMENTS: COUNTRY SILO TO PORT

| *Item* | *NSW* | *Vic* | *Qld* | *WA* | *SA* |
|---|---|---|---|---|---|
| | | V/Line also uses road for line haul movements, 'closed lines' and consolid-ation movements | | | |
| Legislation | None | *Transport Act* 1983 | *Transport Act* 1960-1981 | *Transport Act*, 1966-1982 | None |

a. Figures relate to 1985-86, except for Queensland where the data are the average of the three-year period to 1985-86.

*Sources* National Road Freight Industry Inquiry (1984, 267). Royal Commission into Grain Storage, Handling and Transport (1986).

**Railway track and rolling stock**

The condition of railway track and rolling stock (wagons, locomotives and brakevans), as well as the standard of signalling equipment and the provision of crossing loops, are important factors in the efficiency of grain transport (see Chapter 6). Aspects of these factors which appear to be particularly significant in terms of cost savings and productivity gains include:

- the use of block or unit trains;
- the use of high capacity wagons;
- the use of bottom-discharging wagons (as opposed to those which require the grain to be raked out by hand); and
- the provision of long crossing loops at the grain terminals.

All these factors are, however, inter-related. For example, the size of wagon and the speed it can travel is determined by both the standard of track and the capacity of available locomotives. Therefore Table I.12, which presents information on the characteristics of each rail system's grain wagons, should only be taken as a broad indicator of the condition of rolling stock.

**Road vehicles and infrastructure**

Where road transport is used to carry grain to port it is usually by six-axle articulated trucks with a mass between 38 and 42 tonnes and on rural arterial roads and National Highways. South Australia is the only State where road contractors are able to compete freely for grain freight. In New South Wales road haulage of export grain is precluded by the non-availability of road receival facilities at port. In the other States regulations restrict the distance over which grain can be transported, restrict road cartage of grain to growers only and/or require permits for the road transport of grain (see Table I.10).

One reason for the regulation of intrastate road transport of grain is the substantial road damage which can be caused by heavy trucks and the present lack of efficient mechanisms to recover the cost of this damage. Appendix II provides a discussion of this issue of road cost recovery. Concern over the economic viability of railway systems is another reason for regulation of road competition.

In South Australia, and in States such as Queensland (where permits are issued to road contractors to supplement rail capacity in the peak season), road contractors are hired by the bulk handling authority. The South Australian experience with road contracting shows that,

TABLE I.12 CHARACTERISTICS OF RAIL WAGONS USED TO TRANSPORT GRAIN, BY RAIL AUTHORITY, 1986[a]

| *Rail authority* | *No. of wagons* | *Total capacity (tonnes)* | *Average capacity (tonnes)* | *Highest capacity (tonnes)* | *Proportion of capacity with bottom discharge (per cent)* |
|---|---|---|---|---|---|
| SRA NSW | 1 562 | 82 606 | 52.9 | 58.0 | 100.0 |
| V/Line | 1 400 | 52 547 | 37.5 | 55.0 | 100.0 |
| Westrail | 1 387 | 63 247 | 45.6 | 75.0 | 67.3 |
| Australian National | 590 | 27 440 | 46.5 | 66.0 | 78.8 |
| Queensland Railways | 1 536 | 54 981 | 35.8 | 55.8 | 90.5 |

a. Most recent inventory of grain wagons, which generally was taken in 1986.

*Source* Rail authorities, (pers. comm., 1987).

because truck operators are required who can provide a large amount of capacity and who have proven reliability, a few trucking companies tend to dominate the industry State-wide and a single operator may dominate a particular region. There is, apparently, little inter-regional competition. However, the large trucking companies may employ sub-contractors and this part of the industry is usually competitive.

In all States, vehicles used to transport grain must comply with Australian Design Standards. Individual State regulations also control the mass and dimensions of road vehicles for such purposes as safety and restricting road damage. Current vehicle requirements include:

- Vehicle design and construction - regulatory controls exist on the mechanical conditions of the vehicles, braking, trailer couplings, tyre type and pressure and suspension systems.
- Mass limits - restrictions on mass limits vary. In New South Wales and Victoria the maximum weight is 38 tonnes, in Queensland

it is 41 tonnes and in Western Australia and South Australia it is 42.5 tonnes. New South Wales and Victoria have indicated that they might be prepared to review their vehicle limits after further analysis of cost recovery of heavy trucks.

- Dimension limits - there is a large degree of uniformity existing between the States. Vehicles up to 2.5 metres wide and 4.3 metres in height are permitted in all States except Victoria, where the regulation height is 4.0 metres (National Association of Australian State Road Authorities 1985).
- Conditions of loading and driving - drivers are limited in the number of hours that they may work continuously.

In 1984-85 total expenditure on rural arterial roads amounted to $717.9 million and to $545.4 million on National Highways. The Federal Government financed 96 per cent of the National Highway program and 25 per cent of the rural arterial roads program. The State governments met the remaining expenditure (Table I.13). Appendix III describes the pattern of funding of these roads in greater detail.

**Interstate movements**

Only about 3.9 per cent of grain exported from Australia in 1985 travelled to port from an interstate location (Table I.14). The border areas of southern and northern New South Wales and western Victoria account for the majority of interstate grain movements. Wheat, barley and rice are the major grains moved interstate and road transport accounts for a relatively high proportion of this traffic. For example, almost 70 per cent of export rice shipped from southern New South Wales to Victoria in 1985-86 was transported by road (Ricegrowers' Co-operative Ltd, pers. comm., 1987).

These features of the interstate transport of grain reflect, in part, the tendency of State governments to attempt to retain the highest possible proportion of their States' production for their own rail, port and grain handling systems. In some instances, however, agreements have been developed between State governments or rail and grain authorities which allow the movement by rail of grain across State borders. Most of these agreements relate to border areas and are in response to grower pressures to allow grain to move in the least-cost direction. An alternative response to this pressure is to provide handling and freight concessions to growers in border regions.

TABLE I.13 FUNDING OF RURAL ARTERIAL ROADS AND NATIONAL HIGHWAYS, BY LEVEL OF GOVERNMENT, 1983-84 AND 1984-85 (1983-84 PRICES)
*($ million)*

| | *Level of government* | | | | | |
|---|---|---|---|---|---|---|
| | *Commonwealth* | | *State* | | *Total* | |
| *Road category* | *1983-84* | *1984-85* | *1983-84* | *1984-85* | *1983-84* | *1984-85* |
| National highways | 509.6 | 520.9 | 28.3 | 24.5 | 537.9 | 545.4 |
| Rural arterial roads | 202.2 | 181.9 | 475.6 | 536.0 | 677.8 | 717.9 |
| Total | 711.8 | 702.8 | 503.9 | 560.5 | 1 215.7 | 1 263.3 |

*Sources* BTE (1986a, forthcoming).

A number of agreements have been made to allow the shipment of southern New South Wales grain through Victorian ports. The Border Railways Act, 1922 permitted Victorian Railways to construct and operate a broad gauge rail line into southern New South Wales and the Victorian bulk handling authority to operate silos on these lines. Between 1978-79 and 1981-82 a buffer zone was created in southern New South Wales which extended the area from which interstate grain shipments could be made. The New South Wales bulk handling authority was reimbursed by Victorian authorities for the services it provided in the zone. Although this zone lapsed in 1982-83 (replaced by handling and freight concessions for intrastate delivery), the Australian Wheat Board the Grain Handling Authority of New South Wales negotiated an agreement in 1985 for the movement of large quantities of New South Wales wheat through Victorian ports.

The grain and rail authorities in South Australia and Victoria have also negotiated an agreement for the movement of grain by rail across their border. The agreement allows grain to move from north-western Victoria to Port Adelaide and from southern areas in South Australia to Portland. There is, however, a restriction: the amount of revenue lost by each rail authority as a result of the transfer must be offset by revenue gains from the transfer. This means, effectively, that a large proportion of grain that would 'naturally' flow from South

Australia to Portland is prevented from moving in this direction by the smaller size of grain shipments from north-western Victoria to Port Adelaide.

Interstate road transport is unrestricted, apart from regulations on vehicle mass and dimension. Interstate transport of grain by road is, in fact, encouraged to some extent because the restrictions which apply to intrastate road based grain transport do not apply to interstate grain shipments by road.

The potential for expanded interstate shipments of grain by rail from southern New South Wales to Victoria was investigated by the BTE in the early 1980s (BTE 1984b). This analysis showed that grain could be shipped from a larger New South Wales area, and more grain would be moved by rail, if another standard gauge connection existed between the two States. It also predicted cost savings due to reduced requirements for bogie exchange and rail-rail transhipments. These benefits, however, were not justified by the projected costs of constructing and maintaining the standard gauge line.

**Receival of grain at port**

The rate at which grain can be received into port storages (that is, the intake rate), the size of these storages and the availability of road receival facilities all affect the efficiency and capacity of the grain transport system. These factors are described for each Australian grain port in Table I.15 and discussed below.

The rate at which grain can be received into port storages largely determines the number of trains or trucks that can be turned around in a day. The New South Wales terminals, for example, can receive seven to eight trains per day. Slow intake rates may cause bottlenecks or delays to trains and trucks. This will add to transport costs directly by causing extra time-related expenditures (for example, wage and running costs) and indirectly by reducing the potential utilisation of rolling stock.

The size of port storage facilities also influences the number of trains or trucks (and ships) which can be received at port within a certain time period and therefore has the potential to cause bottlenecks and transport delays. In some cases inadequate port storage capacity also requires the use of supplementary storage facilities in the port hinterland region and, by thus requiring an additional stage of unloading and loading into and out of storage, adds significantly to transport costs.

TABLE I.14 INTERSTATE GRAIN MOVEMENTS, 1985-86

| *Origin* | *Destination* | *Tonnes* |
|---|---|---|
| New South Wales | Victoria[a] | 492 000 |
| | Queensland[b] | 246 000 |
| | South Australia[b] | 2 000 |
| Victoria | South Australia[b] | 63 500 |
| South Australia | Victoria[a] | 35 000 |
| Interstate movements as a proportion of total grain exports (per cent)[c] | | 4 |

a. Figures based on three-year average to 1985-86.
b. Figures based on 1985-86 season.
c. Figures based on 1985-86 data.

*Sources* BTE estimates. Royal Commission into Grain Storage, Handling and Transport (1986, 22).

As noted in the previous section the availability of road receival facilities at port is a major determinant of the presence of road-rail competition. The capacity of road receival facilities is, however, also important to this equation. For example, currently planned road receival facilities for Port Kembla and Newcastle, by having a maximum intake rate of only 1000 tonnes per day, will limit road deliveries of grain to less than 10 per cent of the total New South Wales harvest (see Appendix V).

## GRAIN EXPORTS, PORT CHARACTERISTICS AND SHIPPING SERVICES

This section deals with the port characteristics which affect the size and type of ships used to transport Australian grains, the efficiency of ship loading operations and the markets for shipping services.

### Grain exports

A summary of grain exports from Australian ports in 1984-85 is provided in Table I.16. It shows the large proportion of grain shipped through a few major ports (Sydney, Newcastle, Geelong, Brisbane and Fremantle). It also shows the different distribution of exports by grain type among the various ports. These relativities between the ports will vary from year to year, however, with changes in climatic conditions.

TABLE I.15 CHARACTERISTICS OF AUSTRALIAN SEABOARD GRAIN TERMINALS, 1984-85

| *Port* | *Receival facilities* | *Storage capacity ('000 tonnes)* | *Intake rate (tonnes per hour)* |
|---|---|---|---|
| New South Wales | | | |
| Port Jackson | Rail | 245 | 3 200 |
| Newcastle | Rail | 200 | 4 000 |
| Port Kembla[a] | Road and rail | 260 | 3 600 |
| Victoria | | | |
| Geelong | Road and rail | 845 | 2 000 |
| Portland | Road and rail | 165 | 1 500 |
| Queensland | | | |
| Brisbane | Road and rail | 60 | 2 200 |
| Gladstone | Road and rail | 80 | 1 200 |
| Mackay | Road and rail | 37 | 1 000 |
| South Australia | | | |
| Adelaide | Road and rail | 404 | 4 400 |
| Ardrossan | Road | 283 | 3 800 |
| Port Giles | Road | 239 | 2 400 |
| Port Lincoln | Road and rail | 397 | 4 200 |
| Port Pirie | Road and rail | 212 | 2 200 |
| Thevenard | Road and rail | 208 | 1 950 |
| Wallaroo | Road and rail | 233 | 2 300 |
| Western Australia | | | |
| Fremantle | Rail | 308 | 1 600 |
| Albany | Road and rail | 313 | 2 400 |
| Bunbury | Road and rail | 27 | 300 |
| Esperance | Road and rail | 144 | 1 000 |
| Geraldton | Road and rail | 556 | 3 000 |

a. Not yet completed.

*Sources* Bulk handling authorities in South Australia and Western Australia, (pers. comm., 1987). Various port and harbour authorities' Annual Reports.

TABLE I.16 EXPORTS OF GRAIN, BY PORT, 1984-85
*('000 tonnes)*

| | *Grain* | | | |
|---|---|---|---|---|
| *Port* | *Wheat* | *Barley* | *Other* | *Total* |
| New South Wales | | | | |
| Port Jackson | 2 189.1 | 114.6 | 0.0 | 2 403.7 |
| Newcastle | 2 152.8 | 0.0 | 0.0 | 2 152.8 |
| Victoria | | | | |
| Geelong[a] | 2 228.1 | 525.2 | 266.8 | 3 030.1 |
| Portland | 1 232.5 | 273.2 | 21.2 | 1 526.9 |
| Melbourne | na | na | na | 131.2 |
| Queensland | | | | |
| Brisbane | 878.4 | 647.2 | 785.9 | 2 311.5 |
| Gladstone | 150.1 | 4.8 | 609.5 | 764.4 |
| Mackay | na | na | na | 90.1 |
| South Australia | | | | |
| Adelaide | 454.7 | 272.6 | 8.5 | 735.8 |
| Ardrossan | 74.4 | 256.1 | 0.0 | 330.5 |
| Port Giles | 9.1 | 217.8 | 0.0 | 226.9 |
| Port Lincoln | 484.0 | 263.9 | 6.2 | 754.1 |
| Port Pirie | 282.4 | 206.5 | 0.0 | 488.9 |
| Thevenard | 178.2 | 45.7 | 18.4 | 242.3 |
| Wallaroo | 196.8 | 178.6 | 7.2 | 382.6 |
| Western Australia | | | | |
| Fremantle | 1 837.1 | 160.4 | 192.1 | 2 189.6 |
| Albany | 900.3 | 478.8 | 34.3 | 1 413.4 |
| Bunbury | 69.8 | 0.0 | 27.2 | 97.0 |
| Esperance | 464.4 | 339.9 | 0.0 | 804.3 |
| Geraldton | 999.3 | 188.7 | 215.8 | 2 208.1 |

a. 31 December 1984.
na Not available.

*Sources* Various port authorities' Annual Reports.

## Australian port characteristics

Facilities for ships, such as pilots and lights, and provision of berths and the harbour itself, are generally the responsibility of the port authority in each port. The port authority may also provide the ship loading equipment, although at some ports the bulk handling authority has responsibility for this equipment.

Of the above facilities, the 'draught' (depth of water in the channels at the berth) and the loading rate of grain onto ships are the main concern of grain exporters. Table I.17 summarises the position of Australian grain ports with regard to these factors. They are discussed in greater detail below.

*Port loading rates*

The loading rate figures shown in Table I.17 refer to the rate at which grain can be moved from port storage to ship. All ships loading wheat from Australia must complete loading within a certain time, otherwise a monetary penalty (demurrage) becomes payable by the marketing authority or charterer to the shipowner. If, however, the ship is loaded in less than the time allowed a bonus payment, termed 'dispatch', is paid by the shipowner to the charterer. Demurrage rates are generally twice those of dispatch (Department of Transport, Western Australia 1986, 13).

The loading rates required for wheat from Australian ports are set out in the Austwheat 1983 Charter Party (see Table I.18). In past years the demurrage-dispatch result has generally been in favour of the Australian Wheat Board (Department of Transport, Western Australia 1986, 14). Factors crucial to this result are industrial relations and shipping congestion at port.

Agreement between bulk handling authorities and the Australian Wheat Board regarding remuneration for handling wheat now requires that the authorities 'meet a shiploading capacity of 9000 tonnes per day on a 30 000 tonne shipment' (Australian Wheat Board 1985b).

*Port draught and ship size*

Draught is of major importance because it largely determines the size of ship which can be loaded at each port. Ship size, in turn, influences sea freight rates, as can be seen in Table I.19. Port restrictions on ship size thus add to the landed price, including freight, of Australian grain and affect its international competitiveness. As Table I.20 shows, Australia has a relatively high proportion of 'small' ships involved in its grain trade. Although this may be due to restrictions in Australian export markets as much as Australian ports, it does indicate a transport cost disadvantage. However, as Table I.20 also indicates, a significant trend towards employing larger ships is evident in the Australian grain trade.

TABLE I.17 CHARACTERISTICS OF AUSTRALIAN PORTS

| *Port* | *Draught restriction (max. fully laden ship)*[a] | *Loading rate*[b] *(tonnes per hour)* |
|---|---|---|
| New South Wales | | |
| Port Jackson | 55 000 | 3 200 |
| Newcastle | 55 000 | 4 000 |
| Victoria | | |
| Geelong | 40 000 | 1 600 |
| Portland | 55 000 | 1 000[d] |
| Queensland | | |
| Brisbane[c] | 60 000 | 2 200 |
| Gladstone | 50 000 | 1 600 |
| Mackay | 40 000 | 200 |
| South Australia | | |
| Adelaide | 40 000 | 1 000 |
| Ardrossan | 10-15 000 | 800 |
| Port Giles | 60 000 | 800 |
| Port Lincoln | 90 000 | 1 600 |
| Port Pirie | 10-15 000 | 800 |
| Thevenard | 10-15 000 | 800 |
| Wallaroo | 10-15 000 | 800 |
| Western Australia | | |
| Fremantle | 60-65 000 | 5 000 |
| Albany | 45 000 | 1 600 |
| Bunbury | 14 000 | 250 |
| Esperance | 20-30 000 | 600 |
| Geraldton | 14 000 | 1 000 |

a. The Australian Wheat Board emphasises that these figures should be used as a guide only.
b. BTE estimates.
c. Fisherman Island.
d. From Grain Elevators Board (1985).

*Sources* Australian Wheat Board, (pers. comm., 1987). BTE estimates.

TABLE I.18 LOADING PERIOD ALLOWED UNDER AUSTWHEAT 1983 CHARTER PARTY

| *Mean cargo load (tonnes)* | *Time allowed (fair weather days)* |
|---|---|
| 5 000-8 000 | 6 |
| 8 000-15 000 | 7 |
| 15 000-25 000 | 8 |
| 25 000-40 000 | 9 |
| 40 000-60 000 | 10 |
| In excess of 60 000 | 11 |

*Source* Australian Wheat Board (cited in Department of Transport, Western Australia 1986, 14).

Another cost associated with draught restrictions is that of two-port loading, where a large ship is unable to load to its full capacity at one port and is required to visit another port to 'top-up' before leaving Australian waters. This can lead to additional port and shipping costs. As shown in Table I.21, a significant number of South Australian and Western Australian ports in particular have a draught restriction such that ships are required to two-port load. Separate data for Fremantle (Kwinana) show that 54 per cent of all grain ships loading at this port between October 1984 and August 1985 were engaged in two-port loading (Department of Transport, Western Australia 1986). In 1986, shipowners were charging more than $1.20 per tonne for the additional cost of two-port loading in Western Australia (Department of Transport, Western Australia 1986).

**Ports of destination**

The capacity of ports in importing countries to receive large ships is another major factor influencing the size distribution of ships carrying Australian grain and, therefore, Autralian port infrastructure requirements. Until recently investment to improve ports in the major importing countries had been slow, reflecting in part the irregular nature of the grain trade (where importing country requirements vary greatly from year to year). However, expansion in port size is now occurring in some of these countries, as demonstrated in Table I.22.

The significance of port size in importing countries lies largely in the fact that these countries often own their own bulk shipping fleets

TABLE I.19 SINGLE VOYAGE RATES FOR DRY BULK CARRIERS, BY SHIP SIZE, 1983-86

| | *Single voyage rates ($ per tonne of cargo)* | | |
|---|---|---|---|
| *Year* | *30 000 DWT* | *55 000 DWT* | *120 000 DWT* |
| 1983 | 18.9 | 13.6 | 5.0 |
| 1984 | 18.1 | 12.6 | 6.0 |
| 1985 | 15.8 | 11.7 | 5.1 |
| 1986[a] | 11.8 | 8.1 | 3.6 |
| Percentage change 1983-86 | -37.6 | -40.4 | -28.0 |

a. Average of nine months to September 1986.

*Source* Lloyds Shipping Economist (1987, 37).

TABLE I.20 SIZE DISTRIBUTION OF GRAIN-TRADING SHIPS, 1981 AND 1984 *(per cent of cargo tonnes)*

| | *1981* | | *1984* | |
|---|---|---|---|---|
| *Size* | *Australia* | *Total world exports* | *Australia* | *Total world exports* |
| Less than 40 000 DWT | 83.3 | 49.8 | 71.4 | 42.2 |
| 40-100 000 DWT | 16.7 | 42.0 | 28.6 | 51.5 |
| Greater than 100 000 DWT | 0.0 | 8.2 | 0.0 | 6.3 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

*Source* Drewry Shipping Consultants (1986).

TABLE I.21 PORTS FROM WHICH VESSELS FREQUENTLY REQUIRE FURTHER LOADING AT ANOTHER PORT[a]

| *Port* | *Average annual shipments* | *Average number of annual shipments requiring two-port loading* | *Percentage* |
|---|---|---|---|
| Western Australia | | | |
| Albany | 41 | 13 | 32 |
| Bunbury | 3 | 2.7 | 90 |
| Esperance | 18 | 12 | 67 |
| Geraldton | 53 | 36 | 68 |
| South Australia | | | |
| Adelaide | 33 | 15 | 45 |
| Ardrossan | 4 | 1 | 25 |
| Port Giles | 1 | 1 | 100 |
| Port Pirie | 33 | 24 | 73 |
| Thevenard | 19 | 7 | 37 |
| Wallaroo | 11 | 9 | 82 |
| Victoria | | | |
| Geelong | 79 | 27 | 34 |
| Queensland | | | |
| Brisbane | 64 | 6 | 9 |
| Mackay | 1 | 0.3 | 33 |

a. Three-year averages using figures for 1983-84, 1984-85 and 1985-86.

*Source* Royal Commission into Grain Storage, Handling and Transport (1986, 25).

and therefore take into account the ability to use their own ships when making a decision to purchase grain. The upgrading of port size in importing countries reflects the trend towards larger ships in the bulk fleets of these countries.

Like Australia, the other major exporting nations (that is, the United States, Canada and Argentina) have only a limited number of ports capable of serving ships sized 60 000 DWT and over. There are two in the USA and three in Canada, while in Argentina the single grain port can handle ships only up to 45 000 DWT). The Panama Canal also limits most ships using that route to below the 60-70 000 DWT size.

TABLE I.22 CHARACTERISTICS OF PORTS IN GRAIN-IMPORTING COUNTRIES

| *Country* | *Port characteristics* |
|---|---|
| Western Europe | Small ports and limited storage capacity favours ships in the 20-40 000 DWT range |
| Indonesia | Port facilities generally limit ship size to 14-20 000 DWT |
| China and USSR | Until recently ports could only handle ships up to 35-40 000 DWT. USSR has upgraded its port facilities in the Black Sea and these ports are now capable of handling bulk ships of around 100 000 DWT |
| Japan | Port facilities recently upgraded such that they can now handle ships in the 'Panamax' (60-70 000 DWT) size |
| South Korea | Upgrading currently taking place and it is expected that this country will be capable of accepting 60-70 000 DWT grain ship shortly |
| Egypt | Good port facilities for ships up to 50 000 DWT |
| Iraq | Up to 70 000 DWT |

*Source* Department of Transport, Western Australia (1986).

**Shipping characteristics**

As noted in the previous section, ships involved in the world grain trades are becoming increasingly large and are often owned by the importing country.

The majority of Australian grain is sold on an free on board (FOB) basis, which means that the buyer is responsible for the selection of the ship and the payment of freight rates. The ships are nominated to the Australian Wheat Board for its approval of ship size and loading port location. Freight rates are seldom disclosed to the Australian Wheat Board. Although most shipments of grain from Australia are made on an FOB basis with the purchaser bearing the direct costs, the charged freight rates affect the competitiveness of Australian suppliers.

Australian involvement in the transport chain of an FOB shipment continues until a certificate is issued by the appropriate State agency of the Federal Department of Primary Industry certifying that the ship to be loaded with grain is 'clean'. If a ship is not deemed clean then work is required to bring the ship up to standard. In Western Australia 70 per cent of ships typically pass the Department of Primary Industry test on first survey, 28 per cent require a few days work, and 1-2 per cent require more than a week's work (Department of Transport, Western Australia 1986, 30).

The present state of world bulk shipping markets is very competitive, with an oversupply of tonnage caused by factors such as the subsidised provision of shipbuilding facilities and operation of shipping fleets, and the decline in world grain trade. The level of oversupply in the dry bulk carrier market is shown in Table I.23.

This competitive situation has favoured charterers. Australia, however, is always at some disadvantage because of the distance from major trading routes and lack of bulk cargo for the voyage to Australia. Bulk carriers typically have to come to Australia in ballast because only a small amount of bulk materials is imported.

The most likely future scenario of continuing subsidisation of shipping tonnage and depressed world bulk trade, however, should assure a continuing advantage to charterers over shipowners. Despite this general situation problems may occur in certain segments of the market, such as the chartering of small bulk ships.

TABLE I.23 OVERSUPPLY IN DRY BULK CARRIER MARKET: SURPLUS CAPACITY AS A PROPORTION OF TOTAL DEMAND, JUNE 1986

| | *Ship size* | | | |
|---|---|---|---|---|
| *Measure* | *10 000 to 39 999 DWT* | *40 000 to 79 999 DWT* | *80 000 DWT plus* | *Total* |
| Surplus to demand (per cent) | 25 | 32 | 20 | 25 |

*Source* Lloyds Shipping Economist (1986, 23).

## IMPORTANCE OF GRAIN TRANSPORT COSTS

The importance of transport costs for grain is discussed in the following sections.

### Transport costs for all grains

The Australian Bureau of Statistics (ABS) input-output data allow the calculation of the proportion of the value of output of cereal grains accounted for by transport costs. Table I.24 gives the proportion of total domestic transport costs to the value of output for selected commodities. Although this information is based on the 1978-79 input-output tables, comparisons of these proportions are useful. For example, the proportion of cereal grain domestic transport costs to the value of cereal grains output is 12.5 per cent. This is the second largest proportion for all farm commodity groups. It reflects the low value-to-weight ratio of wheat compared with other farm commodities.

This last point is shown by the high proportion of transport costs in the value of bulk mineral output. For example, transport costs represent 33.3 per cent and 17.3 per cent of the value of the ferrous metal ores and coal, oil and gas groups respectively.

Rail transport costs represent 6.9 per cent of the total value of cereal grains output (see Table I.24). Table I.25 provides an indication of how this proportion for rail has changed since 1979-80. In more recent years the proportion of rail transport costs to the value of wheat output has fluctuated around an average of 8 per cent.

### Transport costs for wheat

Given the significance of wheat as Australia's major cereal grain export, additional figures are presented in Table I.26 that indicate the share of transport costs for wheat in total wheat production costs, by State. The data in the table are based on the assumption that the main pattern of delivery is road from farm to local silo followed by rail from silo to port. In 1983-84 the land transport costs for wheat represented 15.7 per cent of total wheat production costs (including handling and storage charges), while rail transport alone represented 12.7 per cent. This compares with 10.7 per cent for handling and storage. There is significant variation across the States and this reflects the variations in average freight rates plus differences in farm costs.

### Trends in costs and prices

Table I.27 presents information about changes in farm costs, rail freight and prices for wheat and barley from 1979-80 to 1984-85. It is clear from the relative movements in farm costs and prices received for wheat and barley that growers are facing increasing financial pressure. However, it is also apparent that total farm costs have been growing more quickly than rail freight charges. Overall, rail freight charges have moved at about the same rate as the CPI, whereas farm costs have been increasing relatively quickly because of factors such as rising equipment and interest costs.

### Ocean freight rates for grain

Previous tables have shown domestic transport charges for grain. Table I.28 presents ocean freight rates for grain from Australia and the US Gulf region to selected overseas ports. The figures show that Australia's sea freight rate advantage is in the Asian markets.

TABLE I.24 TRANSPORT COSTS AS A SHARE OF THE VALUE OF SELECTED COMMODITY OUTPUTS[a]

*(per cent)*

| *Commodity* | *Road* | *Rail* | *Sea[b] and air* | *Total* |
|---|---|---|---|---|
| Cereal grains | 4.9 | 6.9 | 0.7 | 12.5 |
| Sheep | 4.0 | 2.3 | 0.3 | 6.6 |
| Meat cattle | 11.0 | 2.0 | 0.3 | 13.3 |
| Milk cattle and pigs | 6.8 | 0.6 | 0.3 | 7.7 |
| Meat products | 5.8 | 0.8 | 0.1 | 6.7 |
| Milk products | 5.8 | 0.9 | 0.2 | 6.9 |
| Ferrous metal ores | 2.6 | 13.9 | 16.8 | 33.3 |
| Non-ferrous metal ores | 2.4 | 6.3 | 2.5 | 11.2 |
| Coal, oil and gas | 4.2 | 9.9 | 3.2 | 17.3 |
| Basic iron and steel | 3.8 | 2.7 | 3.2 | 9.7 |

a. Based on 1978-79 input-output tables.
b. Coastal shipping.

*Sources* Australian Bureau of Statistics (1984a and magnetic tape).

A large oversupply of bulk shipping has led to depressed sea freight rates for grain. This is reflected in data for the East Coast Australia-Middle East trade which show a decline in the nominal ocean freight rate for wheat of 36 per cent over the period 1979 to 1986 (see Table I.29).

Table I.30 combines the information on domestic transport costs for wheat with the ocean freight rate data to give an indication of the percentage of transport charges for each mode in the CIF export price for wheat to the Middle East. The total transport charge as a percentage of the CIF export price in 1984-85 was around 21 per cent. Sea freight represented 11 per cent, rail freight 8 per cent and road freight 2 per cent.

TABLE I.25 CHANGES IN THE PROPORTION OF RAIL FREIGHT CHARGES TO THE VALUE OF WHEAT OUTPUT, 1979-80 TO 1984-85

| *Year* | *Rail freight charges ($m)* | *Value of wheat production ($m)* | *Rail freight charges as proportion of wheat output value (per cent)* |
|---|---|---|---|
| 1979-80 | 179 | 2 478 | 7.2 |
| 1980-81 | 117 | 1 684 | 6.9 |
| 1981-82 | 230 | 2 600 | 8.8 |
| 1982-83 | 110 | 1 566 | 7.0 |
| 1983-84 | 370 | 3 606 | 10.3 |
| 1984-85 | 305 | 3 330 | 9.2 |

*Sources* Australian Wheat Board (1985a). Bureau of Agricultural Economics (1986b).

TABLE I.26 WHEAT LAND TRANSPORT, HANDLING AND STORAGE COSTS, 1983-84

| State | Road costs from farm to local silo ($ per farm) | Rail costs from local silo to port ($ per farm) | Handling[a] and storage costs ($ per farm) | Wheat production costs[b] ($ per farm) | Share of cost item in production costs (per cent) Road | Rail | Total land transport | Handling and storage | Total transport handling and storage |
|---|---|---|---|---|---|---|---|---|---|
| New South Wales | 3 431 | 19 735 | 14 768 | 114 734 | 3.0 | 17.2 | 20.2 | 12.9 | 33.1 |
| Victoria | 1 691 | 12 727 | 8 249 | 79 314 | 2.1 | 16.0 | 18.1 | 10.4 | 28.5 |
| Queensland | 4 140 | 7 613 | 10 752 | 95 788 | 4.3 | 7.9 | 12.2 | 11.2 | 23.4 |
| Western Australia | 4 082 | 14 549 | 14 498 | 165 188 | 2.5 | 8.8 | 11.3 | 8.8 | 20.1 |
| South Australia[c] | 1 968 | 5 590 | 7 362 | 60 309 | 3.3 | 9.3 | 12.6 | 12.2 | 24.8 |
| Australia[d] | 3 125 | 13 135 | 11 018 | 103 155 | 3.0 | 12.7 | 15.7 | 10.7 | 26.4 |

a. Includes tolls of $0.74 per tonne and $1.84 per tonne imposed by the bulk handling authorities of South Australia and Western Australia respectively.
b. Production costs are handling, storage and transport costs plus farm cash costs associated with wheat and other crops; non-wheat cash costs are excluded.
c. Represents cost pattern for 45 per cent of movements. This probably results in an over-estimate of land transport costs.
d. Figure provided only for comparative purposes.

*Sources* Australian Wheat Board (1985a). BTE estimates. Bureau of Agricultural Economics (1986a). Industries Assistance Commission (1983a).

TABLE I.27 COMPARISON OF GRAIN RAIL FREIGHT CHARGES, FARM COSTS AND GRAIN PRICES, 1979-80 TO 1985-86

| *Year* | *Index of farm costs* | *CPI* | *Index of rail charges* | *Index of gross unit value* | |
|---|---|---|---|---|---|
| | | | | *Wheat* | *Barley* |
| 1979-80 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1980-81 | 111.4 | 109.4 | 99.6 | 101.3 | 117.4 |
| 1981-82 | 132.3 | 120.8 | 126.8 | 103.9 | 110.7 |
| 1982-83 | 144.5 | 134.7 | 118.5 | 116.3 | 124.0 |
| 1983-84 | 156.6 | 143.8 | 150.5 | 107.2 | 124.0 |
| 1984-85 | 165.1 | 150.0 | 149.0 | 119.0 | 119.8 |
| 1985-86 | 176.6 | na | na | 115.7 | 105.8 |

na Not available.

*Sources* Australian Wheat Board (1985a). Bureau of Agricultural Economics (1986b). BTE (1986b).

TABLE I.28 OCEAN FREIGHT RATES FOR GRAIN ON SELECTED ROUTES, END OF JUNE 1986

| *Wheat, sorghum*[a] | | | |
|---|---|---|---|
| *To* | *From* | *Ship size (DWT)* | *US$ per tonne* |
| USSR (Black Sea) | US Gulf | 20-40 000 | 17.05 |
| | Australia (East Coast) | 20-40 000 | 22.00 |
| Egypt | US Gulf | over 50 000 | 10.75 |
| | Australia (East Coast) | 30-50 000 | 19.50 |
| China | US Gulf | 20-30 000 | 27.00 |
| | Australia (East Coast) | 20-30 000 | 12.50 |
| Japan (wheat only) | US Gulf | 15-19 999 | 24.50 |
| | Australia (East Coast) | 15-19 999 | 16.25 |
| Jakarta | Australia (East Coast) | 23 000 | 10.50 |
| | Australia (West Coast) | 23 000 | 9.00 |
| Jordan (barley in bulk)[b] | Australia | na | 15.00 |

a. Heavy grain.
b. Light grain.
na Not available.

*Source* International Wheat Council (1986).

TABLE I.29 OCEAN FREIGHT RATES FOR WHEAT FROM EAST COAST AUSTRALIA TO MIDDLE EAST[a], 1979 TO 1986

| *Year*[b] | *US$ per tonne* |
|---|---|
| 1979[c] | 29.50 |
| 1980[d] | 30.35 |
| 1981 | 41.00 |
| 1982 | 29.00 |
| 1983 | 22.00 |
| 1984 | 22.00 |
| 1985 | 24.00 |
| 1986 | 19.00 |

a. Spot charter rates, handy-sized vessels.
b. June of the year specified.
c. April.
d. October.

*Source* International Wheat Council (1986).

TABLE I.30 RELATIVE IMPORTANCE OF TRANSPORT CHARGES IN THE MOVEMENT OF WHEAT FROM AUSTRALIAN FARMS TO MIDDLE EAST PORTS, 1984-85

| *Item* | *$ per tonne* | *Proportion of export price (per cent)* |
|---|---|---|
| Road freight from farm to local silo | 4.18 | 2.0 |
| Rail freight from local silo to port | 17.39 | 8.2 |
| Sea freight | 24.00 | 11.3 |
| Total transport charge | 45.57 | 21.5 |
| Export price (CIF) | 211.73 | .. |

.. Not applicable.

*Sources* Australian Wheat Board (1985a). BTE estimates. International Wheat Council (1986).

# APPENDIX II RECOVERY OF ROAD COSTS

'Road cost/expenditure recovery calculations are in essence an arithmetical, ex-post comparison of the revenues obtained from road user charges with the costs/expenditures incurred in the provision and use of the road system' (BTE 1985a, 5). The calculations are typically used as a guide to the efficient (in a user pays sense) level of road provision and/or the pricing of road use.

In recent times there has been a large number of inquiries which have addressed the matter of road cost recovery. These have included the Commission of Inquiry into the New South Wales Road Freight Industry (1980), the National Road Freight Industry Inquiry (1984), the Inter-State Commission's (1986) *An Investigation of Cost Recovery Arrangements for Interstate Land Transport* and the National Association of Australian State Road Authorities's (1985) *Review of Road Vehicle Limits*. The subject has also attracted significant debate within the transport research community.

One aspect of these investigations that has particular relevance to the transport of grain is the recovery of costs associated with the use of roads by vehicles with heavy axle loads. The level of cost recovery achieved from these vehicles is a major determinant of the efficiency of any modal split that would occur if the transport of grain was less constrained by regulations. It also has implications for the financial position of each level of government in a less regulated environment.

This appendix examines cost recovery methodology and the implications the results of previous investigations have for promoting the efficient transport of grain and for intergovernment finance. The cost recovery methodology and the conclusions of previous studies are outlined more fully in BTE (1985a) and Inter-State Commission (1986). The presentation below is a summary of these works.

## METHODOLOGY OF COST RECOVERY

The basic methodology of cost recovery assessment comprises three main steps:

- identification of the various cost elements in maintaining and upgrading the road system;
- apportionment of these costs among the various user groups; and
- estimation of the revenue collected from each user group.

The recent ISC study adopted the 'pay-as-you-go' approach to cost recovery. Under such an approach, the annual cost of maintaining, renewing and upgrading the road system is typically defined as the sum of all the expenses incurred in supplying and maintaining the stock of road space. Another approach is available (known as the public enterprise approach) which involves estimating the costs of operating the road system over the period under consideration, measurement of the capital value of the stock and the calculation of an economic return on the asset (Inter-State Commission 1986, 225).

Cost recovery studies have, therefore, typically only been concerned with financial costs. Economic costs, such as opportunities forgone, and the various externalities, such as air and noise pollution, most often are not included.

Of the financial costs associated with the road system, three main categories can be identified:

- *Avoidable costs,* which are costs which may vary in the short run and which can be attributed to different user groups. Such costs include those associated with wear and tear of road and bridge pavements.
- *Common costs,* which are costs which may vary in the long run and which, over this time period, may be attributed to different user groups. Such costs include those associated with increasing the capacity of a road system due to changes in the composition of traffic.
- *Joint costs,* which are those costs which cannot be apportioned to separate user groups. These costs include initial planning costs and road maintenance expenditure arising from the deterioration of road pavements over time.

There is some debate over what costs should be included in each of the cost categories. For example, in the avoidable cost category, the Commission of Inquiry into the New South Wales Road Freight Industry

(1980) included the additional construction costs caused by having heavy vehicles in the traffic mix, whilst most other studies have excluded this factor. Similarly, the Webber, Both and Ker (1978) study excluded bridge costs, whereas these costs are typically included in assessments of avoidable cost.

Once it has been decided what costs should be included in the analysis, the apportionment of these costs between the road user groups can proceed. This apportionment is typically done in two stages:

- estimation of avoidable costs on the basis of engineering studies which show that pavement damage is generally related to traffic levels, the fourth power of the axle load and the distance travelled; and
- allocation of costs above avoidable costs, which is typically done using either Ramsey pricing or according to some other criterion such as average annual distance travelled.

This apportionment procedure has also caused some debate over the estimation of demand elasticities for road use and over the prudence of Ramsey pricing given that it neglects dynamic and equity considerations (see BTE 1985a and Winston 1985, 81).

Ignoring these problems for the moment and assuming that a 'reasonable' allocation of costs has been made, it remains to estimate the revenue contributions made by each user group. These contributions are typically taken to include excise on motor spirit and diesel, petrol franchise licensing fees, registration fees, drivers' licence fees and road transport and associated miscellaneous taxes. However, some studies have also included sales taxes and custom duties on motor vehicles and associated products (see discussion in BTE 1985a, 9-10).

**RESULTS OF STUDIES INTO COST RECOVERY**

Despite the variety of approaches taken in estimating levels of cost recovery from different road user groups, a common conclusion of all studies has been that there is an under-recovery of costs from the heavy vehicle group. A comparison of the results obtained from the various Australian studies of road cost recovery is presented in Inter-State Commission (1986, Table 12.16, 308-309). The BTE (1985a, 60) study, for example, estimated that in 1981-82 about 40 per cent of the avoidable road costs caused by six-axle trucks were recovered from the operators of these vehicles. Recent estimates by the BTE suggest this proportion may have increased in more recent years (Luck & Martin 1987).

In the case of heavy grain trucks, these results may still over-estimate the levels of cost recovery achieved. This is because the estimates are made on the basis of arterial road standards, whilst heavy grain trucks, especially those transporting grain from the farm, will make significant use of local roads. As the Commission of Inquiry into the New South Wales Road Freight Industry (1980, 3/3) noted, pavement strength is a major determinant of the damage caused to roads by heavy vehicles, and for weaker pavements the exponents of axle load 'may be considerably greater than four, or there may be no simple exponential relationship, or the pavements may fail entirely'. If this is the case then the under-recovery of costs from heavy vehicles will have particular impact on rural local governments as they are the main financiers of local roads in rural areas.

## HEAVY VEHICLES, COST RECOVERY AND RURAL LOCAL GOVERNMENT

As noted above, most studies into the impact of heavy vehicles on roads have measured only the effects on the arterial road system. Analysis of the impacts of heavy vehicles on local roads has been hindered by lack of data on the mix of traffic using local roads, the pavement strength of the local roads used by heavy vehicles, and the relationship between pavement strength and damage caused by axle loads. Despite this lack of data, the evidence indicates that: trucks do cause damage to local roads; a large proportion of the resulting road costs are not recovered from the vehicle owners; and the costs which are recovered are not recovered directly by local governments, which are the bodies responsible for the majority of local road expenditure. All these factors are important to the efficiency of the transport of grain.

The 1985 NAASRA Review of Road Vehicle Limits (National Association of Australian State Road Authorities 1985), as part of its investigations, undertook a survey of 460 local government authorities to ascertain their attitudes to heavy vehicles and their views on the impacts of these vehicles. The results of this survey are summarised below:

- Ninety-five per cent of the local government authorities (LGAs) consider that heavy vehicles significantly affect local road expenditure.
- The most significant concern of the majority of LGAs was the pavement damage caused by heavy vehicles. Ninety-five per cent of rural LGAs (66 per cent of urban LGAs) gave pavement damage as the major problem.

- The second most significant problem associated with heavy vehicles noted by rural LGAs was dust.
- One of the most significant types of truck operations in rural areas is grain transport. Twenty-nine per cent of all rural LGAs noted grain transport as the major type of truck operation.
- Fifty per cent of rural LGAs indicated that more than half of their road network is affected by major truck operations. Thirty-seven per cent of rural LGAs indicated that between 10 and 50 per cent of their road network is affected.
- Ninety-four per cent of rural LGAs consider that damage caused by heavy vehicles significantly affects maintenance expenditure on their local road systems.

As noted in the previous section, the various costs caused through the use of roads by vehicles with heavy axle loads are not fully recovered from their operators. Costs which are recovered assist the financial performance of the Commonwealth and State governments but not local governments directly. The only mechanism currently available for local governments to obtain compensation from heavy vehicle operators for the use of local roads is via State and Commonwealth road grants. Given that these grants are presently distributed between local government areas primarily on the basis of population and road length, it would be impossible under current arrangements to match any road damage costs caused by particular road users with road grants to local governments.

The general conclusion, therefore, is that heavy trucks cause significant damage to the rural local road system but that the existing pricing and road grant distribution mechanisms would not allow local governments to be accurately compensated for damage caused by a significant increase in truck movements. The cost of increased local road maintenance expenditure caused by an increased number of trucks, under existing road funding arrangements, would be borne primarily by ratepayers and, to a lesser extent, by the road-using community or taxpaying community in general. This lack of targeting would, according to the logic of the the user-pays principle, result in both efficiency and welfare losses. It also confronts the problem of the shortage of rural local government financial resources, which implies that any increased rate of road pavement deterioration will either require a diversion of funds from other areas of expenditure or a reduction in the standard of roads.

## APPENDIX III FINANCING OF RURAL ROADS

This appendix examines the level and pattern of expenditure on rural roads in Australia over the five-year period 1980-81 to 1984-85, the latest year for which data are available. The objective of the analysis is to show the significance of road expenditure to each level of government and thereby indicate some of the possible financial implications of the need for increased road expenditure on those roads likely to be subjected to increased grain traffic under less regulated transport arrangements.

Rural roads comprise three road categories: national roads, which mainly consist of the major links between capital cities; rural arterial roads, which facilitate travel between a capital city or major regions and key towns; and rural local roads, which give access to and from national roads and arterial roads and provide access to property.[1]

The responsibility for funding rural roads is divided among the three levels of government. The Federal Government has undertaken full financial responsibility for National Highways and provides a share of funding for other roads. The individual State governments have constitutional responsibilities for all roads but finance mainly arterial roads. Local government authorities are mainly responsible for local roads.

There are basically two types of road expenditure: construction and maintenance. According to the technical definition, construction includes reconstruction and all works of a major nature while maintenance covers works of a routine nature (Independent Committee of Inquiry into Federal Road Funding Arrangements 1986, 141-142). More generally, construction refers to work concerned with improving or

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1. Rural local roads are effectively the roads remaining after the declaration of national and arterial roads. For further functional classifications of roads and their respective definitions refer to Commonwealth Bureau of Roads (1975, 28).

upgrading the level of service of a road (that is, improvements in road carrying capacity). Maintenance, on the other hand, refers to work aimed at restoring a road to its original condition when it has deteriorated physically due to traffic. Increased grain traffic on roads will therefore most likely result in increased road maintenance, rather than construction, expenditures.

## PATTERN OF EXPENDITURE ON RURAL ROADS

### Expenditure by level of government

Table III.1 contains data on rural road expenditure by level of government and road category for the period 1980-81 to 1984-85. In 1984-85 the Commonwealth Government contributed around 43 per cent of total expenditure on rural roads, the State governments 36 per cent and local governments 21 per cent. Around 57 per cent of the Commonwealth contribution is dedicated to the National Highway system. Over the five-year period, 1980-81 to 1984-85, Commonwealth Government expenditure on rural roads increased by 33.7 per cent, State government expenditure increased by 8.6 per cent and local government expenditure increased by 4.0 per cent.

Table III.2 shows the distribution of these expenditures between the grain growing States. It shows a similar trend to that of total Australian expenditure, in that the Commonwealth Government has been the main source of real increases in rural road expenditure. There are, however, significant State differences in government road funding patterns.

### Expenditure on construction and maintenance

The data presented in Table III.3 show that construction works accounted for 66.6 per cent of total rural road expenditure in 1984-85, and maintenance works for 33.4 per cent. Over the period 1980-81 to 1984-85, construction expenditure increased 22.0 per cent and maintenance 8.2 per cent. Maintenance expenditure has been more significant in the local roads category, comprising 40 per cent of total rural local road expenditure, compared to 36 per cent of rural arterial expenditure and 18 per cent of the National Highway expenditure in 1984-85.

The data in Table III.4 show that maintenance expenditure is also more significant to local government than to the State and Commonwealth governments. In 1984-85, for example, maintenance expenditure represented 53 per cent of local government expenditure on roads, compared to 44 per cent of State road expenditure and 16 per cent of Commonwealth road expenditure. The changes in maintenance expenditure

TABLE III.1 RURAL ROAD EXPENDITURE, BY LEVEL OF GOVERNMENT, 1980-81 TO 1984-85 (1983-84 PRICES)
*($ million)*

| *Level of government* | *1980-81* | *1981-82* | *1982-83* | *1983-84* | *1984-85* |
|---|---|---|---|---|---|
| Commonwealth | | | | | |
| National roads | 377.6 | 358.7 | 382.4 | 509.6 | 520.9 |
| Rural arterial roads | 126.4 | 112.5 | 145.0 | 202.2 | 181.9 |
| Rural local roads | 172.8 | 168.8 | 164.6 | 213.4 | 202.3 |
| Total | 676.8 | 640.0 | 692.0 | 925.2 | 905.1 |
| State | | | | | |
| National roads | 48.6 | 34.5 | 27.3 | 28.3 | 24.5 |
| Rural arterial roads | 466.1 | 475.8 | 457.7 | 475.6 | 536.0 |
| Rural local roads | 181.3 | 186.4 | 168.5 | 175.1 | 195.4 |
| Total | 696.0 | 696.7 | 653.5 | 679.0 | 755.9 |
| Local | | | | | |
| National roads | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rural arterial roads | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 |
| Rural local roads | 413.2 | 424.6 | 448.6 | 422.0 | 429.7 |
| Total | 413.9 | 424.6 | 448.6 | 422.0 | 429.7 |
| Total | 1 786.7 | 1 761.3 | 1 794.1 | 2 026.2 | 2 090.7 |

*Sources* BTE (1986a, forthcoming).

by level of government over the period 1980-81 to 1984-85 are shown in Table III.5. This indicates that the proportion of Commonwealth rural road expenditure spent on maintenance increased from 15 per cent to 20 per cent. Expenditure on maintenance as a proportion of total rural road expenditure by the States remained relatively constant, whilst the share of local government rural road expenditure spent on maintenance decreased from 37 per cent to 33 per cent.

TABLE III.2 RURAL ROAD EXPENDITURE, BY GRAIN-GROWING STATE AND LEVEL OF GOVERNMENT 1984-85[a], AND PERCENTAGE CHANGE 1980-81 TO 1984-85

*($ million)*

| | *Level of government* | | |
|---|---|---|---|
| *State* | *Commonwealth* | *State* | *Local* |
| New South Wales | 277.8 | 240.5 | 161.4 |
| | (35.6) | (-11.3) | (10.2) |
| Victoria | 155.6 | 130.5 | 82.6 |
| | (29.4) | (12.0) | (-22.9) |
| Queensland | 207.0 | 192.5 | 105.2 |
| | (34.9) | (38.1) | (15.6) |
| Western Australia | 105.8 | 74.5 | 37.2 |
| | (28.6) | (-8.6) | (36.8) |
| South Australia | 75.1 | 47.0 | 31.3 |
| | (29.9) | (22.7) | (16.3) |
| Total | 821.3 | 685.0 | 417.7 |
| | (32.8) | (5.9) | (4.8) |

a. Constant 1983-84 prices.

*Note* Percentage change shown in parentheses.

*Sources* BTE (1986, forthcoming).

**IMPORTANCE OF EXPENDITURE ON RURAL ROADS TO EACH LEVEL OF GOVERNMENT**

Whilst data are not available to show specifically rural road expenditure in terms of total expenditure by each level of government, some indication of the relative impacts on total budgets of changes in road costs is provided in Table III.6. This shows that the Commonwealth Government spent 2 per cent of its total budget on roads in 1984-85. The State governments spent 5.5 per cent of their total budgets on roads, whereas road expenditure accounted for 32.3 per cent of local government expenditure. There has been little variation in these proportions over the period 1980-81 to 1984-85.

Table III.7 shows the differences between the various local government categories with respect to their expenditure on roads. Although the data are not directly comparable to the data used in Table III.6, they can be used to illustrate the importance of road expenditure to rural local governments relative to urban local governments. It is apparent from the two tables that road expenditure is a major item of expenditure for all local governments but that, in terms of total budgetary impacts, any increased road expenditure commitments will be of most concern to rural local government.

**FINANCIAL RESOURCES OF RURAL LOCAL GOVERNMENT**

A survey of non-metropolitan local government authorities by Perlgut et al. (1986) provides a useful insight into the capacity of rural local government to finance increased road expenditure. Responses which relate to grain transport issues were given by 384 councils. These are summarised below.

- Sixty-two per cent of councils in the Wheat-Sheep Zone[2] indicated that their financial position had either remained the same or deteriorated over the previous five-year period (p.19).
- Eighty-six per cent of councils in the Wheat-Sheep Zone predicted that their financial position would either remain the same or deteriorate over the next five years (p.19).
- The main factor affecting the financial position of local governments is their rate income and this is, in turn, affected by the inflation rate, major capital works and the level of local farm income. Forty-two per cent of all councils indicated that farm income had an 'extremely' important effect on their rates (p.37). Seventy-nine per cent of all councils indicated that they had a 'less than moderate' ability to increase their rate income (p.33).

Consequently, local government authorities in rural areas may have a limited ability to raise additional finance for road works. This implies that there will be a reduction in either the standard of local roads or in other local government services should significant additional damage occur to rural local roads without those costs being met by other levels of government.

**KEY ASPECTS OF RURAL ROAD FINANCING**

This outline of the pattern of rural road expenditure highlights a

2. Bureau of Agricultural Economics classification of agricultural zones.

TABLE III.3 TOTAL EXPENDITURE ON RURAL ROADS, 1980-81 TO 1984-85 (1983-84 PRICES)

*($ million)*

| *Categories* | *1980-81* | *1981-82* | *1982-83* | *1983-84* | *1984-85* |
|---|---|---|---|---|---|
| Construction | | | | | |
| National roads | 355.1 | 319.7 | 328.5 | 440.4 | 443.9 |
| Rural arterial roads | 362.0 | 355.5 | 366.5 | 423.9 | 455.0 |
| Rural local roads | 423.6 | 470.3 | 459.9 | 465.3 | 493.0 |
| Total | 1 140.7 | 1 145.5 | 1 154.9 | 1 329.6 | 1 391.9 |
| Maintenance | | | | | |
| National roads | 71.0 | 73.5 | 81.1 | 97.5 | 101.4 |
| Rural arterial roads | 231.0 | 232.8 | 236.3 | 253.8 | 263.0 |
| Rural local roads | 344.0 | 309.5 | 321.9 | 345.2 | 334.4 |
| Total | 646.0 | 615.8 | 639.3 | 696.5 | 698.8 |
| Total | 1 786.7 | 1 761.3 | 1 794.2 | 2 026.1 | 2 090.7 |

*Sources* BTE (1986a, forthcoming).

number of factors which are relevant to the transport of grain. These are:

- the size of expenditure on rural roads is large, averaging $1 890 million per annum over the period 1980-81 to 1984-85 (in 1983-84 prices);
- rural local roads account for the major share of this expenditure, representing 35 per cent of construction and 48 per cent of maintenance expenditure in 1984-85;
- the Commonwealth Government provides the largest share of rural road funds (43.3 per cent in 1984-85) but rural local governments are responsible for the majority of rural local road expenditure (54 per cent in 1984-85);
- maintenance expenditure is mainly borne by State and local governments (81 per cent in 1984-85). It accounts for the

TABLE III.4 EXPENDITURE ON RURAL ROAD CONSTRUCTION AND MAINTENANCE, BY LEVEL OF GOVERNMENT, 1984-85 (1983-84 PRICES)

| | *Level of government* | | | | | |
|---|---|---|---|---|---|---|
| | *Commonwealth* | | *State* | | *Local* | |
| *Category* | *($m)* | *(per cent)* | *($m)* | *(per cent)* | *($m)* | *(per cent)* |
| Construction | 763.7 | 84.4 | 426.3 | 56.4 | 201.9 | 47.0 |
| Maintenance | 141.4 | 15.6 | 329.6 | 43.6 | 227.8 | 53.0 |
| Total expenditure | 905.1 | 100.0 | 755.9 | 100.0 | 429.7 | 100.0 |

*Sources* BTE (1986a, forthcoming).

TABLE III.5 EXPENDITURE ON RURAL ROAD MAINTENANCE, BY LEVEL OF GOVERNMENT 1980-81 AND 1984-85[a], AND PERCENTAGE CHANGE 1980-81 TO 1984-85

| | *1980-81* | | *1984-85* | | *1980-81 to 1984-85* |
|---|---|---|---|---|---|
| *Level of government* | *($m)* | *(per cent)* | *($m)* | *(per cent)* | *(percentage change)* |
| Commonwealth | 96.6 | 14.9 | 141.4 | 20.2 | 46.4 |
| State | 309.6 | 47.9 | 329.6 | 47.2 | 6.4 |
| Local | 240.0 | 37.1 | 227.8 | 32.6 | -5.1 |
| Total | 646.2 | 100.0 | 698.8 | 100.0 | 8.1 |

a. 1983-84 prices.

*Sources* BTE (1986a, forthcoming).

majority of local governments' rural local road costs (52 per cent in 1984-85);

- rural local governments spend a much larger proportion of their total budgets on roads than either the State and Commonwealth governments or urban local governments; and

- the financial resources currently available to rural local governments to enable them to meet increased road costs are limited.

The overall conclusion, therefore, is that an increase in rural road maintenance expenditure (especially local road expenditure) resulting from a significant increase in grain traffic, will have the greatest impact on rural local governments, but will also have budgetary implications nation-wide.

TABLE III.6 COMMONWEALTH, STATE AND LOCAL GOVERNMENT OUTLAYS ON ROADS AS A PROPORTION OF TOTAL OUTLAYS[a], 1980-81 TO 1984-85
*(per cent)*

| | *Level of government* | | |
|---|---|---|---|
| *Year* | *Commonwealth* | *State* | *Local* |
| 1980-81 | 1.9 | 5.9 | 31.0 |
| 1981-82 | 1.8 | 5.5 | 29.7 |
| 1982-83 | 1.8 | 5.2 | 30.4 |
| 1983-84 | 2.2 | 5.3 | 31.6 |
| 1984-85 | 2.0 | 5.5 | 32.3 |

a. Calculations provided to the Committee of Inquiry into Federal Road Funding by ABS. Outlays are those by the general government sector. Outlays on roads are:

- for the Commonwealth, current and capital expenditure, plus grants to the States and local authorities;
- for the States, current and capital expenditure, plus grants to local authorities, minus grants from the Commonwealth;
- for local authorities, current and capital expenditure, minus grants from the Commonwealth and States; whereas
- total outlays are current and capital expenditure, plus grants and advances to other levels of government, minus receipts from all specific purpose grants.

*Source* Independent Committee of Inquiry into Federal Road Funding Arrangements (1986, 109).

TABLE III.7 LOCAL GOVERNMENT ROAD EXPENDITURE FROM UNTIED REVENUE AS A PERCENTAGE OF LOCAL GOVERNMENT TOTAL EXPENDITURE FROM UNTIED SOURCES, BY STATE, BY LOCAL GOVERNMENT CATEGORY[a], 1983-84

*(per cent)*

| | *Urban* | | | | *Rural* | | | |
|---|---|---|---|---|---|---|---|---|
| *State* | *Metro-politan* | *Large city* | *Medium city* | *Small city* | *Large town* | *Medium town* | *Small town* | *Country* |
| New South Wales | 22.8 | 25.0 | 26.2 | 26.0 | 25.6 | 26.6 | 28.2 | 31.9 |
| Victoria | 15.3 | 16.9 | 20.5 | 15.5 | 16.3 | 18.4 | 20.1 | 23.9 |
| Queensland | 8.3 | 6.2 | 8.7 | 13.2 | 11.9 | 11.5 | 12.4 | 12.1 |
| Western Australia | 17.3 | .. | .. | 14.9 | 13.9 | 21.2 | 18.9 | 18.6 |
| South Australia | 20.4 | .. | 25.7 | 21.6 | 17.9 | 10.4 | 27.8 | 27.4 |

a. Harris classification.
.. Not applicable

*Source* Australian Bureau of Statistics (1985).

## APPENDIX IV STANDARD OF RURAL ROADS

Roads in Australia are currently the subject of a major study by the BTE and a report on the findings will be available later in 1987. The report will continue the series of assessments of the Australian road system which have been made by the Bureau (and previously the Commonwealth Bureau of Roads) since the late 1960s.

The most recent published report in this series is the *Assessment of the Australian Road System: 1984* (BTE 1984a). This report provides a comprehensive overview of the development of the road system, its physical performance and financing arrangements. This appendix draws on the information on the standard of rural roads provided in that study and the NAASRA Roads Studies (National Association of Australian State Road Authorities 1984a, 1984b, 1984c).

The standard of a road refers to its physical condition (surface, alignment, roughness, and other characteristics) relative to the amount of traffic or function it serves. Each of the rural road categories - National Highways, rural arterial and rural local roads - performs different functions and thus is constructed and maintained to a different physical condition.

Within each road category the physical condition of a road is (ideally) related to the level and composition of traffic it serves. The physical condition of a road is therefore typically judged within its category definition and with reference to the amount of traffic it serves. The composite indicator developed by NAASRA for this purpose is known as the level of service indicator.

A 1984 NAASRA study (National Association of Australian State Road Authorities 1984b, 16-17) developed criteria for deciding whether travel on rural arterial roads was regarded as being under 'good', 'fair' or 'poor' conditions. The criteria took account of:

- road type
- surface

- horizontal and vertical alignment
- roughness
- bridge strength and width
- daily traffic volume.

These level of service indicators are available for National Highways and rural arterial roads, but not for local roads. The main reason for the omission of local roads was because they comprise a much larger and more diverse road group and, hence, were much more difficult to model.

The results of the application of the criteria to a NAASRA survey of National Highways and rural arterial roads in 1981 are shown in Tables IV.1 and IV.2. The survey results indicate that the majority of roads in these categories are in good condition: nation-wide, 72 per cent of National Highways and 76 per cent of rural arterial roads were assessed as being in good condition. However, there were State-to-State variations. Western Australia had the highest proportion of both types of roads in good condition (the Territories being excluded).

It should be noted that under the Australian Bicentennial Road Development (ABRD) program in particular, significant investments have been made in the National Highway system since 1981. As a result this road category is now likely to be at a substantially higher standard than it was in 1981.

As mentioned above, level of service indicators are not available for local roads. NAASRA did, however, include estimates of length of rural local roads by road surface (stereotype) and by average daily traffic volume (see Tables IV.3 and IV.4) (National Association of Australian State Road Authorities 1984a). These figures show, first, that the most common rural local road surface is unsealed but paved, with 43.6 per cent of all rural local roads having a gravel surface. Second, they show that sealing of rural local roads is generally related to the level of traffic it carries, but there were, in 1981 at least, some roads carrying more than 100 vehicles per day which were still unsealed. These higher volume unsealed roads may be providing a relatively low level of service, although roughness, width, alignment and so on are also important considerations. The BTE's 1987 assessment of the current Australian road system is indicating that the capacity of the rural local road system is generally adequate and its performance improving.

TABLE IV.1 LEVEL OF SERVICE PROVIDED BY NATIONAL HIGHWAYS, BY STATE, 1981

*(per cent)*

| *Quality of traffic service* | *NSW* | *Vic* | *Qld* | *SA* | *WA* | *Tas* | *ACT and NT* | *Total* |
|---|---|---|---|---|---|---|---|---|
| Good | 60.3 | 67.7 | 60.6 | 58.6 | 76.3 | 62.6 | 99.9 | 71.7 |
| Fair | 28.2 | 29.1 | 30.0 | 6.1 | 10.8 | 19.7 | 0.1 | 15.2 |
| Poor | 11.5 | 3.2 | 9.4 | 35.3 | 12.9 | 17.7 | 0.0 | 13.1 |
| Total[a] | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | (1 301) | (685) | (3 880) | (2 604) | (4 654) | (310) | (2 680) | (16 114) |

a. Total length (kilometres) shown in parentheses.

*Source* National Association of Australian State Road Authorities (1984c, 326).

TABLE IV.2 LEVEL OF SERVICE PROVIDED BY RURAL ARTERIAL ROADS, BY STATE, 1981

*(per cent)*

| *Quality of traffic service* | *NSW* | *Vic* | *Qld* | *SA* | *WA* | *Tas* | *ACT and NT* | *Total* |
|---|---|---|---|---|---|---|---|---|
| Good | 70.5 | 82.1 | 63.5 | 80.9 | 89.9 | 66.9 | 97.2 | 76.3 |
| Fair | 18.5 | 14.0 | 23.9 | 12.5 | 8.7 | 26.7 | 2.6 | 16.2 |
| Poor | 11.0 | 4.0 | 12.6 | 6.6 | 1.4 | 6.4 | 0.2 | 7.5 |
| Total[a] | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | (29 904) | (15 600) | (19 221) | (10 364) | (17 403) | (2 621) | (3 229) | (98 342) |

a. Total length (kilometres) shown in parentheses.

*Source* National Association of Australian State Road Authorities (1984c, 327).

TABLE IV.3 RURAL LOCAL ROAD LENGTHS BY ROAD STEREOTYPE, 1981

*(kilometres)*

| | *Road stereotype* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *Sealed* | | | | *Unsealed* | | | |
| *Category* | *10.5 metre width* | *7.5 metre width* | *6 metre width* | *4 metre width* | *Paved* | *Formed* | *Unformed* | *Total* |
| Length | 800 | 6 500 | 44 300 | 34 100 | 187 100 | 90 700 | 66 100 | 429 600 |
| (per cent) | (0.2) | (1.5) | (10.3) | (7.9) | (43.6) | (21.1) | (15.4) | (100) |

*Source* National Association of Australian State Road Authorities (1984a, 47).

TABLE IV.4 RURAL LOCAL ROAD LENGTH, BY TRAFFIC VOLUME, 1981
*(kilometres)*

| *Road type* | *Average annual daily traffic range* | | | |
|---|---|---|---|---|
| | *Under 10-49* | *50-99* | *Over 99* | *Total* |
| Sealed | 17 760 | 23 570 | 44 270 | 85 600 |
| | (11) | (42) | (79) | (20) |
| Unsealed | | | | |
| Paved | 142 700 | 32 600 | 11 800 | 187 100 |
| | (89) | (58) | (21) | (44) |
| Formed | a | a | a | 90 700 |
| | | | | (21) |
| Unformed | a | a | a | 66 100 |
| | | | | (15) |
| Total[b] | 160 460 | 56 170 | 56 070 | 429 500 |
| | (100) | (100) | (100) | (100) |

a. Not disaggregated by traffic volume.

*Note* Percentages shown in parentheses.

*Source* National Association of Australian State Road Authorities (1984a, 47).

In summary, the previous studies on the standards of rural roads highlight a number of features. These are:

- National Highways and rural arterial roads are generally in good condition;
- the most common rural local road stereotype is the unsealed gravel-paved road, which comprises 44 per cent of rural local road length;
- the capacity of the rural local road system is generally adequate for existing traffic levels and axle loads; and
- continuation of current road funding levels should result in a gradual improvement in the local road system.

## APPENDIX V URBAN IMPACTS OF THE TRANSPORT OF GRAIN BY ROAD

> The main community concern [with deregulation of grain traffic] would be the possibility of concentrations of heavy vehicle flows on particular urban roads. This could detract from community amenity and, in some cases, add to traffic congestion. A more specific concern is public safety and the increased risk of serious accidents arising out of additional commercial vehicle flows.... (PA Australia et al. 1983, 115).

This report, by PA Australia to the Queensland Minister for Transport on regulation of railway traffic, highlights the urban impacts of additional truck movements which could result from the relaxation of State government restrictions on road grain traffic (including the development of road receival facilities for grain at ports).

The main types of impact of heavy vehicles in urban areas are:

- access (trucks may hinder access to urban amenities and services);
- noise and air pollution;
- congestion on roads;
- risk of accidents; and
- reduced parking space.

By far the major concern of urban local councils with heavy vehicle movements is road pavement damage. Seventy-six per cent of the urban local government authorities surveyed by NAASRA in 1985 to ascertain their attitude to heavy vehicles listed this as their major concern. Other main concerns are noise, vibration and parking (National Association of Australian State Road Authorities 1985, 87).

The extent of impacts caused by particular heavy vehicle movements, such as grain traffic to ports, depends on the number of truck movements, the types of urban areas they move through (residential, commercial and/or industrial) and the standard of road that they move over (width, pavement strength).

Removal of economic regulations on the road transport of grain, if it were accompanied by development of adequate road receival facilities at port, would have the potential to generate a large number of additional truck movements. Tables V.1 and V.2 present estimates of the number of additional one-way truck movements which could result from 15 per cent of current export grain traffic moving to major ports by road.[1]

It is doubtful that road transport of grain could be expanded to the levels indicated in the tables, at least in the short to medium term. As Table V.2 shows, the road receival facilities at the terminals would need an intake rate, in most cases, of around 2000 tonnes per day (tpd) if grain flowed to port evenly over the year; and a receival rate in excess of 3000 tpd if a peak flow occurred. Facilities with such capabilities do not appear to be available at the ports at present (although there might be scope at some seaboard grain terminals to modify current rail delivery facilities so that they can also handle road receivals). The road receival facilities planned for Newcastle and Port Kembla, for example, have a road receival rate of only 1000 tonnes per day, which effectively limits the number of trucks to a maximum of 40 per day (Macdonald Wagner 1984 and 1986). This physical constraint on road transport of grain means, for example, that less than 10 per cent of grain currently flowing through the Newcastle port could be delivered by road.

It is difficult to generalise between ports as to the types of urban areas affected by increased truck movements. Council restrictions may limit the trucks to arterial roads to minimise their impacts on residences, but the use of these roads by local residents for access purposes and the proximity of residences to the roads will vary between cities. The impacts of noise, safety hazard, access and congestion appear to depend on such inter-urban land use variations (Macdonald Wagner 1984, 1986).

If the roads used are arterial roads, the standard of construction should be suitable for heavy vehicles but, as has been noted in a previous appendix, maintenance costs will increase with increased road usage by heavy vehicles. Expansion in road capacity may also be

1. Lloyd (1986, 104) estimated that V/Line would lose 10 to 20 per cent of its traffic after deregulation.

TABLE V.1 ESTIMATED NUMBER OF ANNUAL GRAIN VEHICLE TRIPS TO VARIOUS EXPORT PORTS ASSUMING THAT 15 PER CENT OF CURRENT GRAIN EXPORTS ARE DELIVERED BY ROAD

| *Port* | *Total grain exports (tonnes)*[a] | *15 per cent by truck (tonnes)* | *Assumed truck capacity (tonnes)* | *Number of vehicle trips (one-way)* |
|---|---|---|---|---|
| Sydney | 2 742 340 | 411 351 | 24.0 | 17 140 |
| Newcastle | 2 130 729 | 319 609 | 24.0 | 13 317 |
| Geelong | 2 448 901 | 367 335 | 24.0 | 15 306 |
| Brisbane | 2 474 300 | 371 145 | 27.0 | 13 746 |
| Fremantle | 3 388 981 | 508 347 | 28.5 | 17 837 |

a. Figures relate to 1985-86 except for Geelong, where data relate to year ended December 1985.

*Sources* Annual Reports of various State port authorities.

TABLE V.2 ESTIMATED NUMBER OF DAILY GRAIN VEHICLE TRIPS TO VARIOUS EXPORT PORTS AND REQUIRED ROAD RECEIVAL RATES TO HANDLE 15 PER CENT OF CURRENT GRAIN EXPORTS

| | *Assumed even annual flow*[a] | | | *Assumed peak flow*[b] | | |
|---|---|---|---|---|---|---|
| *Port* | *Daily trips (one-way)* | *Trips per hour*[c] | *Required receival rate (tpd)* | *Daily trips (one-way)* | *Trips per hour*[c] | *Required receival rate (tpd)* |
| Sydney | 86 | 11 | 2 064 | 172 | 22 | 4 128 |
| Newcastle | 67 | 8 | 1 608 | 134 | 16 | 3 216 |
| Geelong | 77 | 10 | 1 848 | 154 | 20 | 3 696 |
| Brisbane | 67 | 8 | 1 809 | 144 | 16 | 3 618 |
| Fremantle | 89 | 11 | 2 537 | 178 | 22 | 5 074 |

a. Assuming a 200-day working year with no peak flow.
b. Assuming 50 per cent of total traffic is delivered within a three-month (50 working day) period.
c. Assuming a single, 8-hour shift (Macdonald Wagner 1984, 1986).

*Source* Table V.1.

necessary; this would depend on current traffic levels and future increases in traffic flow.

The removal of restrictions on road grain traffic, if accompanied by development of adequate road receival facilities at port, therefore has the potential to generate a large number of new truck movements in urban areas. The extent of actual road movement of grain, the type of urban areas affected and the roads used by the trucks will determine the size of impacts in each area. However, it appears that even if only a small proportion of export grain were to move by road, the impacts on urban residents could be serious enough to cause community concern.

## APPENDIX VI PAST STUDIES OF GRAIN TRANSPORT

There have been a number of studies that have examined marketing, handling, storage and transport of grain in Australia. Most have concentrated on Australia's major cereal grain export, wheat. A selection of studies that have focussed on transport issues are discussed in this appendix. They are presented in chronological order.

### BTE Study 1978

BTE (1978) examined transport of the wheat harvest using data from the early 1970s. It covered issues such as variations in road and rail haulage costs and discussed ways to reduce total transport costs.

Some of the major findings for road haulage of wheat were:

- While most growers transported their grain to the local silo, road haulage rates charged by commercial contractors from the farm to the local or regional bulk handling authority silo were based on vehicle marginal operating cost, and the rates reflected the degree of excess capacity then available in commercial trucking. Consequently, small fluctuations in tonnages did not affect freight rates.
- A sudden large increase in demand for road haulage from the local or regional silo to port could lead to a rise in freight rates. This would be due to the increases in specialised trucking capacity required to move large quantities of wheat over long distances, that is, there would not be enough short-run capacity in existing road transport. This does not imply that capacity could not be developed in the long run.

For rail transport:

- Freight rates were found to recover short-term avoidable costs and some fixed costs such as depreciation and interest on wheat wagons and locomotives. They did not always recover fixed overhead costs, which are difficult to allocate to particular commodities.

- Seasonal variations were found to have no major effect on rail freight rates.
- Interstate movements were seen as a way of reducing national wheat transport costs but such movements could have adverse affects on the deficits of some rail authorities. For example, there could be an increase in the State Rail Authority of New South Wales' deficit because of grain moving to Queensland and Victoria.

A number of the study's recommendations for reducing rail costs have either been adopted or proposed by some rail authorities. For example, recommendations included:

- replacement of old, inefficient rolling stock;
- increasing train size;
- reductions in crew size from three to two; and
- introduction of cost-based freight rates to reflect the relative cost differences between main line and branch line operations.

**New South Wales Grain Handling Inquiry 1981**

The New South Wales Grain Handling Inquiry (1981) found many inefficiencies in the New South Wales grain handling and transport system. For example:

- Handling and storage facilities had at times been built to fulfil elected grower member promises to their grower electorates rather than to minimise costs.
- Some country storage facilities were built because of the inability of seaboard terminals to accept the complete grain harvest being transported from country areas. This increased double handling and therefore costs. On-farm storage was suggested as a way to overcome silo receival rate problems and this would then reduce the peak demand on transport.
- The small quantities of wheat transported on the domestic market at any one time were found to place a burden on rail transport.

The Inquiry argued that in an ideal system there would be a co-ordinated national rail and handling network but concluded that interstate rivalry prevented this outcome.

**IAC Wheat Study 1983**

The Industries Assistance Commission (1983) wheat study looked in detail at marketing arrangements for wheat. The report was produced to help formulate future arrangements for the wheat industry.

Transport problems identified included:

- branch or small volume rail lines have high maintenance costs and limited capacity; and
- because rail charges are based on distance, growers who deliver to silos on efficient rail lines subsidise those growers who deliver to silos on small volume rail lines.

It was argued in the report that more rational economic decisions would be made if the mode of delivery was based on actual cost of transport.

Some areas of transport cost savings identified in the report were:

- increased use of road transport for short hauls;
- use of single origin-destination trains rather than multiple stop trains; and
- use of central receival storage rather than numerous small silos.

**CANAC Consultants Report 1984**

CANAC Consultants of Canada undertook a detailed analysis of the Victorian grain handling system in the early 1980s (CANAC Consultants 1984).

Problems identified included:

- An excessive number of silos and rail lines connecting those silos.
- A large proportion of the grain crop that moved between the farm and the country silo travelled only a short distance, thereby minimising the growers' direct costs. However, this practice results in high rail costs due to the large number of low volume country silos.
- A peak load problem was created by the short delivery period over which grain is moved to the silo and by the method of payment where growers only receive payment for wheat when it has been received by the bulk handling authority. (This is now partly alleviated by incentives offered by the Victorian Grain Elevators Board for delayed deliveries. The Australian Wheat Board also adjusts its payment system for delayed deliveries.) On-farm storage was examined as a way of reducing the peak load problem but the Consultants found that the operating cost savings did not offset the disadvantages such as the increased cost of pest control.

The CANAC study team also looked at the cost of a Central Receival Points (CRP) system for grain storage and transport. A CRP system allows considerable rail cost savings through the use of block trains with a smaller number of loading points.

The Consultants examined the diversion of tonnages from rail to road for the total haul to port and found that there were no significant cost advantages over the CRP system.

**ARRB Road Transport Costs Study 1984**

In 1984 the Australian Road Research Board (ARRB) undertook an analysis of the impact of increased movements of grain by truck as a result of the introduction of the Central Receival Points system in Victoria (Australian Road Research Board 1984).

The study examined the substitution of road for rail transport of grain from silos located on selected rail lines. The impact of additional grain trucks on the road network was measured by the increase in the present value of roadwork costs. Roadwork costs included capital costs of reconstruction, maintenance and resealing.

Increases in the present value of roadwork costs arose from three sources:

- reconstruction work must be brought forward due to the more rapid deterioration of the pavement caused by extra truck movements;
- pavement thickness must be increased to allow for additional trucks; and
- additional routine maintenance is required due to the increase in truck numbers.

Over long distances the standard truck type assumed was a six-axle articulated truck while over short hauls the three-axle rigid truck was assumed. Only truck numbers were varied on the short and long haul routes, not truck type.

The results showed an increase in roadwork costs resulting from more grain truck movements ranging from 1 to 16 per cent of current expenditure. In 1983-84 prices this is equivalent to a range of $1 000 per kilometre to $13 000 per kilometre. This wide variation in results was due to different road conditions and the different base traffic levels on particular routes. It is thus very difficult to use generalised results to show the impact of additional grain trucks on an individual road route.

**Jeffery Study 1985**

Jeffery (1985) undertook a comparative study of overseas and Australian grain storage, handling, transport and marketing. The study found that grain transport costs in Australia were relatively high because:

- The entire grain crop is delivered to bulk handling authorities over a short period. To accommodate this peak load requires more rolling stock than if the volume were delivered more evenly.
- There is a lack of road competition.
- A shorter distance for main line rail hauls is involved.

**ISC Wheat Freight Subsidy Study 1985**

A subsidy on wheat transport between the mainland and Tasmania allows Tasmanians to pay the same price for wheat as that paid on the mainland. The subsidy is funded by a levy on all wheat sold in Australia. The ISC undertook an evaluation of the subsidy and recommended its continuation (Inter-State Commission 1985).

The rationale for the subsidy relies on an equity concept of uniform Australia-wide prices for staple goods. The ISC argued that the entire wheat marketing system had to be examined to determine the optimal changes to the Tasmanian wheat freight subsidy.

The ISC did note that increased wheat production in Tasmania is being prevented by the subsidy. However, even without the subsidy there would be little prospect of Tasmania supplying all its own wheat requirements.

**Hussey Report 1986**

Hussey (1986) prepared an overview of grain marketing in Australia. The study highlighted the degree of statutory monopoly control of the industry.

Some of the transport problems highlighted in the report were:

- political interference in rail freight rate setting;
- monopoly control of grain transport;
- the lack of cost-based rail freight rates; and
- disputes at ports.

It was argued in the report using economic theory that competition in the transport of grain would lead to lower costs. It was also argued that controls over ports should be relaxed so that the private sector could build new facilities or operate existing facilities under contract.

**Victorian Rural Economics Study 1986**

This was a broad study of the problems facing Victorian agriculture. The report examined the efficiency of the grain transport system, the impact of government regulation on growers' choice of transport mode, the level of cost recovery of road and rail transport and the current and potential pricing methods of transport operators (Lloyd 1986).

It was concluded that:

- The main feature of Victorian grain transport is the statutory monopoly position of V/Line.
- The efficiency of the system suffers because of the lack of contestability in the transport market. This allowed some factor inputs to gain some of the rents available as a result of the monopoly. It also allowed price averaging to take place so that the price of services did not always reflect the cost of providing those services.
- While rail transport has a large fixed cost to avoidable cost ratio, road transport is the reverse. By reducing prices to avoidable costs on many routes rail transport could afford to undercut road transport. The cost of road transport would depend on the availability of backloads. The possible backloads include fertiliser which, like grain, is reserved to V/Line by statute.
- Though V/Line possibly has a natural monopoly on long hauls, the break-even distance between road and rail transport is not known with any certainty.

The report recommended that complete deregulation take place so that road transport could compete freely with V/Line. As an interim measure V/Line should set grain transport prices no higher than the cost of road transport and cross-subsidisation between lines should cease. The report also found that there is a need for better co-ordination of transport, handling and storage facilities.

**State Rail Authority of New South Wales 1986**

In August 1986 the State Rail Authority of New South Wales organised a conference where it announced plans for reductions in wheat freight rates (State Rail Authority of New South Wales 1986). The new freight rates were to be based on the cost of serving particular areas rather than the distance of areas from New South Wales ports. The result would be higher freight rates for grain delivered to silos on branch lines and reductions in freight rates for grain delivered to silos on main lines. Unpublished research work by the New South Wales State Transport Study Group was the basis for the new approach to match wheat freight rates with the costs of the services. Other work presented at the conference included a comparative study of the State Rail Authority of New South Wales and North American railways and a summary of wheat transport cost recovery.

Two significant findings relating to wheat transport cost recovery were:

- wheat hauled between local silos and sub-terminals recovers only 16 per cent of the total cost; and
- the entire rail transport system for wheat recovers 67 per cent of its total costs. (Although wheat does not recover its total rail costs it is covering avoidable cost plus a significant level of fixed cost. Thus it is an important traffic for the SRA.)

Factors identified as affecting the cost efficiency of wheat transport by rail included:

- the use of low volume track where track maintenance costs per tonne were high;
- an excessive number of wagons was required because of inefficiencies in loading and unloading;
- the inability to run optimum sized trains due to siding restrictions at silos, loading rates and track capacity;
- double handling by rail due to two separate movements from receival silo to sub-terminal and from sub-terminal to port; and
- an excessive number of loading points, many only being able to handle small numbers of wagons at low loading rates.

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### Abbreviations

| | |
|---|---|
| AGPS | Australian Government Publishing Service |
| BTE | Federal Bureau of Transport Economics |


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## ABBREVIATIONS

| | |
|---|---|
| ABRD | Australian Bicentennial Road Development Program |
| ABS | Australian Bureau of Statistics |
| AN | Australian National |
| ARRB | Australian Road Research Board |
| BHA | Bulk Handling Authority |
| BTE | Federal Bureau of Transport Economics |
| CBH | Co-operative Bulk Handling |
| CGC | Commonwealth Grants Commission |
| CIF | Cost, insurance and freight |
| CPI | Consumer Price Index |
| CRP | Central Receival Point |
| DWT | Deadweight tonne |
| ESAL | Equivalent Standard Axle Load |
| FOB | Free on board |
| GHA | Grain Handling Authority |
| GT | Gross tonne |
| GTK | Gross tonne-kilometre |
| hp | horsepower |
| IAC | Industries Assistance Commission |
| ISC | Inter-State Commission |
| LGA | Local Government Authority |
| NAASRA | National Association of Australian State Road Authorities |
| NTK | Net tonne-kilometre |
| SRA NSW | State Rail Authority of New South Wales |
| tpd | tonnes per day |
| TTK | Trailing tonne-kilometre |