Freight Flows in Australian Transport Corridors

Occasional Paper

In the past, there have been many occasions when decision makers have wanted to know the likely effects of proposed policies on the different transport industries involved in moving non-bulk freight around Australia. Their decisions have been hampered by a lack of data on the magnitude of, and trends in, non-bulk freight flows between capital cities and almost no usable estimates of the determinants of intercapital freight flows on all modes.

Subject
Series
Date
A to Z
Search
Results
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FREIGHT FLOWS IN AUSTRALIAN TRANSPORT CORRIDORS

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FOREWORD

The lack of reliable estimates on intercity non-bulk freight flows has in the past hampered efforts by the Bureau of Transport and Communications Economics in its efforts to advise Ministers. This was especially so in relation to policies affecting competition between modes in interstate freight traffic.

The current paper was prepared as a result of research undertaken in response to this lack of information. The research was carried out by Dr D. Gargett and Ms L. Aroia.

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Canberra
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CONTENTS

		Page
FOREWORD		iii
SUMMARY		xi
CHAPTER 1	INTRODUCTION	1
CHAPTER 2	OVERVIEW OF CORRIDOR NON-BULK FREIGHT FLOWS	3
	Melbourne-Sydney corridor	5
	Eastern States-Perth corridor	7
	Melbourne-Adelaide corridor	11
	Melbourne-Brisbane corridor	12
	Sydney-Adelaide corridor	18
	Sydney-Brisbane corridor	23
	Summary	24
CHAPTER 3	ESTIMATION OF CORRIDOR MODELS	25
	Form of the models	25
	Road	27
	Rail	28
	Air	28
	Sea	30
	Summary	32
CHAPTER 4	IMPLICATIONS FOR ROAD VERSUS RAIL TRAFFIC SHARES	33
CHAPTER 5	CONCLUDING REMARKS	43
APPENDIX I	DATA AND DATA SOURCES	45
APPENDIX II	MEASUREMENT PROBLEMS OVERCOME	75
APPENDIX III	REGRESSION ANALYSIS RESULTS	95
REFERENCES		103
ABBREVIATIONS		107

TABLES

		Page
2.1	Melbourne-Sydney modal shares of non-bulk freight carried	7
2.2	Eastern States-Perth modal shares of non-bulk freight carried	11
2.3	Melbourne-Adelaide modal shares of non-bulk freight carried	12
2.4	Melbourne-Brisbane modal shares of non-bulk freight carried	17
2.5	Sydney-Adelaide modal shares of non-bulk freight carried	18
2.6	Sydney-Brisbane modal shares of non-bulk freight carried	23
3.1	Road demand elasticities	27
3.2	Rail demand elasticities	29
3.3	Air demand elasticities	30
3.4	Sea demand elasticities	31
4.1	Projected road and rail non-bulk tonnages to 2000	37
I.1	Melbourne-Sydney corridor: freight	46
I.2	Melbourne-Sydney corridor: freight rates and travel times	49
I.3	Eastern States-Perth corridor: freight	50
I.4	Eastern States-Perth corridor: freight rates and travel times	52

		Page
I.5	Sydney-Adelaide corridor: freight	53
I.6	Sydney-Adelaide corridor: freight rates	55
I.7	Sydney-Brisbane corridor: freight	56
I.8	Sydney-Brisbane corridor: freight rates	58
I.9	Melbourne-Adelaide corridor: freight	59
I.10	Melbourne-Adelaide corridor: freight rates	61
I.11	Melbourne-Brisbane corridor: freight	62
I.12	Melbourne-Brisbane corridor: freight rates	64
I.13	Summary of road freight flows	65
I.14	Summary of rail freight flows	66
I.15	Summary of air freight flows	67
I.16	Summary of sea freight flows	68
I.17	Economic indicators	69
II.1	Origin-destination fraction estimates for Melbourne-Sydney rail freight	90
II.2	Rail freight origin-destination fraction estimates for five of the mainland corridors	91
III.1	Melbourne-Sydney demand elasticities	96
III.2	Eastern States-Perth demand elasticities	97
III.3	Melbourne-Adelaide demand elasticities	98
III.4	Melbourne-Brisbane demand elasticities	99
III.5	Sydney-Adelaide demand elasticities	100
III.6	Sydney-Brisbane demand elasticities	101
III.7	Aggregate model demand elasticities	102

FIGURES

		Page
2.1	Non-bulk freight, Melbourne-Sydney corridor	4
2.2	Melbourne-Sydney corridor modal freight share	6
2.3	Non-bulk freight, Eastern States-Perth corridor	9
2.4	Eastern States-Perth corridor modal freight share	10
2.5	Non-bulk freight, Melbourne-Adelaide corridor	13
2.6	Melbourne-Adelaide corridor modal freight share	14
2.7	Non-bulk freight, Melbourne-Brisbane corridor	15
2.8	Melbourne-Brisbane corridor modal freight share	16
2.9	Non-bulk freight, Sydney-Adelaide corridor	19
2.10	Sydney-Adelaide corridor modal freight share	20
2.11	Non-bulk freight, Sydney-Brisbane corridor	21
2.12	Sydney-Brisbane corridor modal freight share	22
4.1	Road and rail freight shares for the six corridors combined, 1971-72 to 1985-86	35
4.2	World trends in rail modal share of total road and rail traffic	36
4.3	Projected rail share of road and rail corridor freight to 2000	39
II.1	Truck counts at Marulan	77
II.2	Share of trucks through Marulan travelling Melbourne-Sydney corridor	78

		Page
II.3	Melbourne-Sydney corridor trucks	79
II.4	Load per truck estimates for Melbourne-Sydney	80
II.5	Melbourne-Sydney road freight estimated by the 'truck count estimation' method	81
II.6	Melbourne-Sydney road freight estimated by the 'ABS survey estimation' method	82
II.7	Melbourne-Sydney road freight estimated by the 'direct estimation' method	85
II.8	Comparison of three methods for estimating Melbourne-Sydney freight	86
II.9	Load per truck estimates for Eastern States-Perth trucks	88

SUMMARY

In the past, lack of information on non-bulk freight flows (especially by road) in the major intercapital corridors has proved to be an important handicap in developing analyses of traffic shares of the various transport modes.

An appropriate methodology has been developed which enables estimates of road freight flows to be derived in the six major mainland corridors (Melbourne-Sydney, Sydney-Brisbane, Sydney-Adelaide, Melbourne-Adelaide, Melbourne-Brisbane and the Eastern States-Perth). Using these estimates, trends in non-bulk freight traffic shares in the various corridors can be examined and the reasons for these shares determined.

In general, the estimates show rail and sea transport as losing freight traffic to road. However, this average result is heavily influenced by the experience on the Melbourne-Sydney corridor. There are quite dissimilar trends on several of the other major corridors. Generally, the overseas phenomenon of a steadily declining rail modal share is being repeated in Australia.

As to the determinants of the trends in modal shares, there are several interesting findings. First, there is very little evidence of an effect on one mode's traffic of price changes in other modes. This is a surprising finding and may simply reflect the tendency of prices of most modes to move in tandem. Second, there is evidence to suggest that national income is the major (if not the only) determinant for the changing trends in traffic.

Road freight flows have been found to be most consistently related to changes in national income, which has a significant positive effect on traffic across most corridors. In fact, in a model of the traffic of all six corridors combined, income alone explains most of the variation in traffic levels over the last 15 years. The relationship to income is such that a 10 per cent increase in national income generates a 19 per cent increase in corridor road freight flows. This

positive link to income leads to road freight trending upwards in all the corridors examined.

In contrast, non-bulk rail freight tonnages have been flat or declining in three of the six corridors examined. For example, the Melbourne-Sydney corridor showed no discernible relationship between rail freight and national income. The Eastern States-Perth and the Sydney-Brisbane corridors are at the other extreme, showing a greater than 1 to 1 positive relationship to national income. Rail freight rates have generally been found to have little effect on rail freight flows in the corridors. The exception is on the long Eastern States-Perth corridor.

Sea freight, in the form of non-bulk coastal shipping, shows a declining modal share on all six corridors, in several cases ceasing totally by the mid 1980s. Air freight, although important in value terms, is not important in terms of weight in the intercapital trade. The tonnages, albeit tiny, have been growing consistently resulting in air's share staying constant or, more generally, rising.

The implications of the findings for future road versus rail modal share are consistent with overseas experience, where rail's traffic share has been consistently declining. Service level rather than price is becoming a much more important factor in transport. Road, with its door-to-door flexible service, suits the new trends in just-in-time manufacturing in a way rail cannot easily match. Also favouring the flexibility of road is the increasing interlinking of the transport network that comes with economic development. Rail's business has thus been increasingly concentrated in those bulk commodities it handles best and in the extremely long haul routes where its cost advantage is maximised and its speed and service disadvantages minimised.

The continued erosion of rail's traffic share is not predetermined: a variety of competitive strategies are available to arrest the decline. However, were past trends to continue, rail's share of road versus rail traffic might be expected to slip, to between 28 and 34 per cent by the year 2000, from 38 per cent in 1984-85.

In summary, then, the problems of lack of information that gave rise to the present research have been solved in such a way as to yield good approximations of corridor non-bulk freight flows (especially road freight flows). The resulting corridor models provide decision makers with a firm base for estimating the effects of policy changes on the transport industries involved in moving freight between Australia's major cities.

CHAPTER 1 INTRODUCTION

In the past, there have been many occasions when decision makers have wanted to know the likely effects of proposed policies on the different transport industries involved in moving non-bulk freight around Australia.

Their decisions have been hampered in two ways. First, there has been a lack of data on the magnitude of, and trends in, non-bulk freight flows between capital cities. This has been especially so for road freight flows. Second, consequent to the lack of data, there have been almost no usable estimates of the determinants of intercapital freight flows on all modes, and thus no firm basis for estimating the effects of changes in policy.

The research reported in this paper was designed to overcome these difficulties. The objectives were threefold.

First, methods were to be developed for estimating the non-bulk freight flows between the major mainland capitals. The freight flows estimated in this study and the resulting estimates of freight share trends in the various corridors are described in chapter 2.

Second, models were to be developed of the determinants of these flows. Models of the determinants of freight flows are presented in chapter 3.

Third, the models developed were to be applied to the analysis of policy questions, principal among these being forecasting for infrastructure planning, with the emphasis on road versus rail competition. Chapter 4 reviews Australian and overseas experience with road versus rail freight share in the light of the findings reported in the previous chapters. Concluding comments are made in chapter 5.

The chapters are supplemented by three appendixes which provide more detail on the data and the data sources used (appendix I), the methods of estimation (appendix II) and the models developed (appendix III).

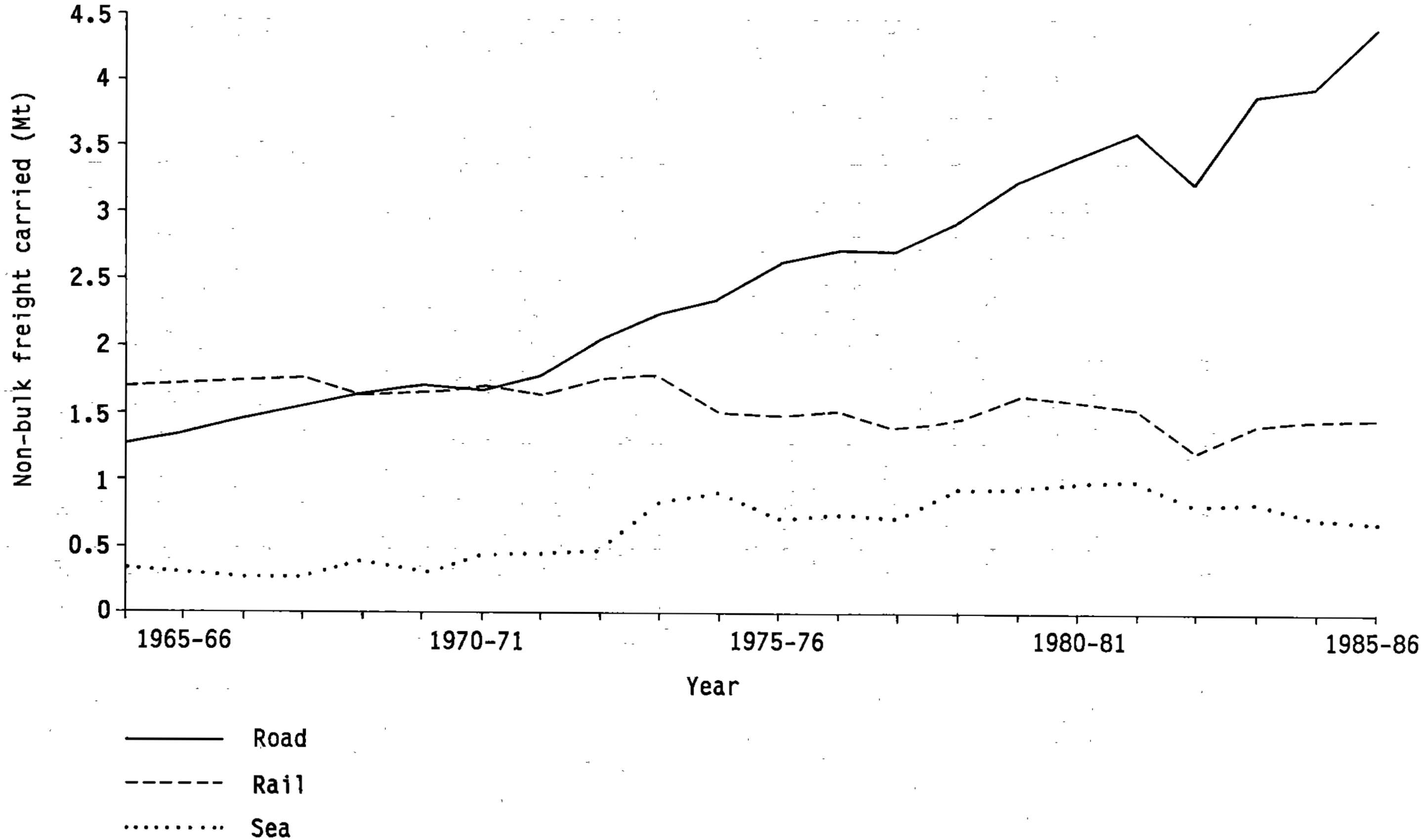
CHAPTER 2 OVERVIEW OF CORRIDOR NON-BULK FREIGHT FLOWS

Historical trends in the demand for non-bulk freight services on the six major mainland corridors can be established using the information provided in appendix I. The six corridors examined are Melbourne-Sydney (where 'Melbourne' includes Geelong and Westernport, and 'Sydney' includes Newcastle and Wollongong), Melbourne-Adelaide, and Sydney-Brisbane (short haul routes), Sydney-Adelaide and Melbourne-Brisbane (medium haul routes), and the Eastern States-Perth (a long haul route). Short, medium and long distances are taken as respectively less than 1000 kilometres, between 1000 and 2000 kilometres and more than 2000 kilometres. These six routes cover the major freight corridors between the State capitals of mainland Australia.

Each of these corridors has been examined in terms of flows of non-bulk road, rail, air and sea freight moving city to city (irrespective of route). Concentration on non-bulk flows was desired from a conceptual standpoint - these were the flows of policy interest with regard to road versus rail competition especially. Bulk commodities were defined to include oil and petroleum products, grain, sugar, minerals, timber, chemicals and any other categorised bulky materials. Non-bulk freight included iron and steel, motor vehicles and parts, steel products, food and beverages, fruit and vegetables and any other non-bulky products.

Demand for non-bulk freight services is quite separate from that for bulk. In addition, quite a lot of the supply infrastructure of rail and sea transport is similarly specialised. Only with sea freight statistics has the data been available to explicitly delineate the non-bulk flows. With the other modes, the assumption has been made that all the intercity (as opposed to interstate) freight is likely to be non-bulk in character. What data is available (for example in BTE 1982 and BTE 1983) supports this assumption.

The 'Eastern States' exclude Tasmania which, being an island state, faces shippers with a more complicated modal choice, trends for which



Source Appendix table I.1.

Figure 2.1 Non-bulk freight, Melbourne-Sydney corridor

might not move similarly to those for the other States. For example, there is still a substantial volume of coastal shipping from Western Australia to Tasmania, even though coastal shipping from Western Australia to the rest of the mainland has been in decline. The necessity of using coastal shipping to reach Tasmania from anywhere else in Australia has offset shipping's increasingly unfavourable cost differentials.

On all corridors, air freight was calculated as being miniscule compared with the other three modes, carrying less than 1 per cent of the traffic; it is thus not discussed in any detail or shown in any of the figures.

MELBOURNE-SYDNEY CORRIDOR

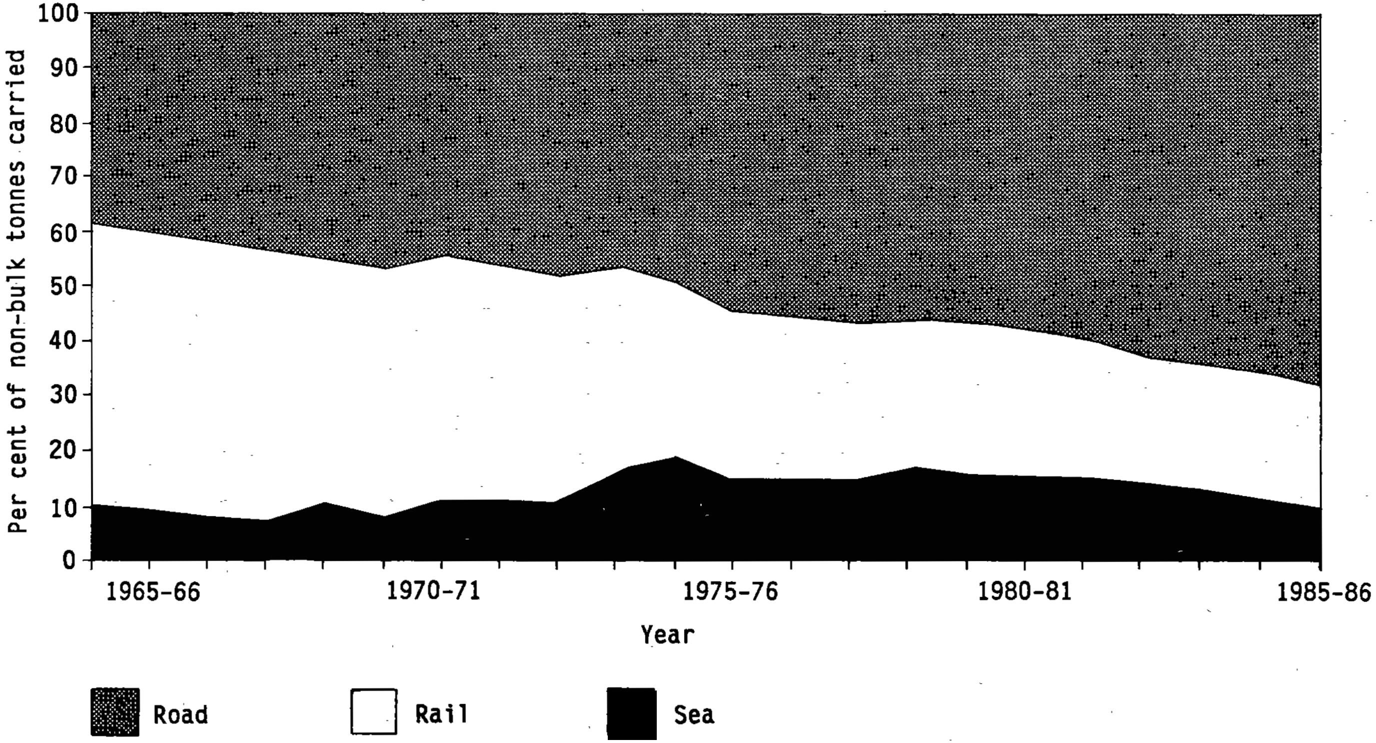
The Melbourne-Sydney corridor is by far the most heavily trafficked route of the six corridors. In 1964-65, a total of 3.34 million tonnes (Mt) of non-bulk freight was carried between the two capitals. By 1985-86, the traffic had increased to 6.46 Mt, representing an annual growth rate of 3 per cent. Of the four modes, road, rail and sea are the major carriers of freight, with air carrying a minimal amount.

Road has had the highest growth rate, with growth at 6 per cent annually. Road tonnages have risen from 1.3 Mt of freight in 1964-65 to an estimated 4.3 Mt in 1985-86. This growth is associated with road's link to the level of economic activity, combined with trends within the road freight industry.

Rail has been the only mode on this corridor to experience a downward trend in its freight flow. Over the time period, intercity rail tonnages gradually fell from 1.7 Mt in 1964-65 to a low in 1982-83 of 1.2 Mt. By 1985-86 rail freight had recovered to 1.4 Mt. However, over the entire period, rail freight has declined by 0.9 per cent annually.

The carriage of non-bulk coastal sea freight is mostly comprised of one-way traffic to Westernport, Victoria, from New South Wales ports. In 1964-65, this totalled 0.3 Mt. By 1985-86 coastal shipping had increased to 0.7 Mt between the two States. The sudden increase in 1973-74 corresponds to an increase in steel production by BHP with a new mill at Port Kembla.

Figure 2.1 illustrates the trends in these three major modes on this corridor, including the traffic-reducing effects of the economic recession of 1982-83. Air has been omitted, due to the minimal tonnages carried.



Source Appendix table I.1.

Figure 2.2 Melbourne-Sydney corridor modal freight share

Figure 2.2 shows the freight modal share of the three modes. Of the total non-bulk freight carried in 1964-65, rail was the predominant freight carrier, carrying 51 per cent of all traffic between the capitals. Road carried 39 per cent and sea 10 per cent. By 1985-86 road had increased its share to 67 per cent. Rail, on the other hand, steadily declined in prominence as a freight carrier (although it is still the second most used transport mode) to carry 22 per cent of non-bulk freight in 1985-86. Sea freight fluctuated around an average of about 10 per cent.

Table 2.1 tabulates, at five-yearly intervals between 1965-66 and 1985-86, the growth and decline in the modal shares of the four modes.

TABLE 2.1 MELBOURNE-SYDNEY MODAL SHARES OF NON-BULK FREIGHT CARRIED

(per cent)

Year	*Road*	*Rail*	*Air*	*Sea*
1965-66	40	51	a	9
1970-71	44	44	a	11
1975-76	54	31	a	15
1980-81	57	26	a	16
1985-86	67	22	a	10

a. Less than 1 per cent (0.6 per cent in 1985-86).

Note Figures may not add to 100 per cent due to rounding.

Source Appendix table I.1.

EASTERN STATES-PERTH CORRIDOR

Traffic on the Eastern States-Perth corridor has grown at an annual rate of 2.4 per cent, from carrying a total of 1.38 Mt in 1964-65 to 2.32 Mt in 1985-86. Road and rail have been the fastest growing modes, the large growth experienced by road being due to the sealing of the Eyre Highway in 1976.

Prior to the completion of the sealing of the Eyre Highway, road freight was growing at 7 per cent annually, that is, from 0.02 Mt in 1964-65 to 0.059 Mt in 1974-75. Four years after the opening of the

Eyre Highway, road freight traffic settled down to a growth rate of 4 per cent, growing from 0.38 Mt in 1979-80 to 0.5 Mt in 1985-86. Much of the traffic is freight travelling to Western Australia from the Eastern States, with the backhaul traffic being about half the outbound traffic.

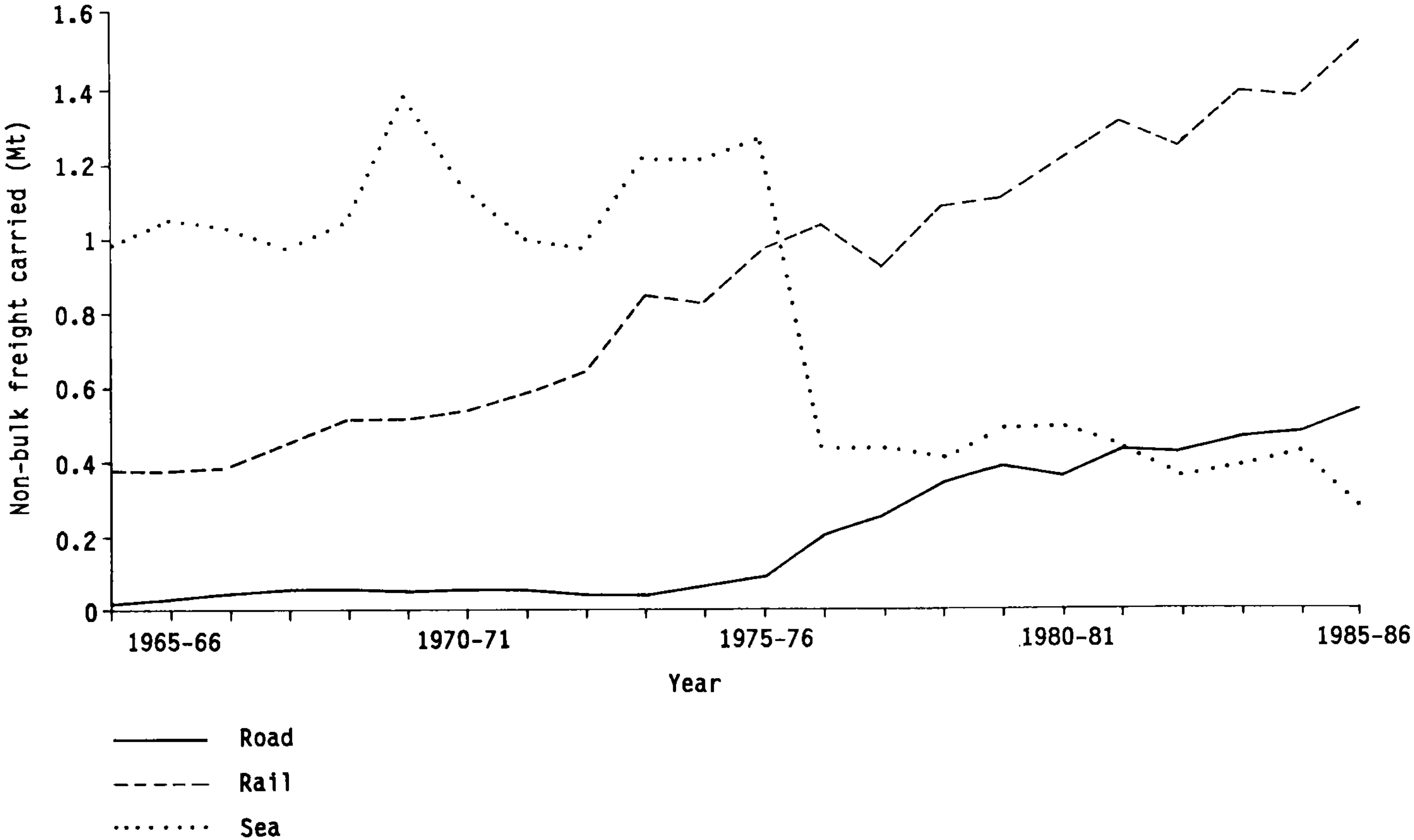
Rail has continued to grow steadily over the period. In 1964-65 rail carried 0.4 Mt of freight. By 1985-86 1.5 Mt was transported between the two coasts, an annual growth rate of 6 per cent. Some of the increase in rail traffic was due to declining sea traffic over the period (Westrail, pers. comm., 1987).

Up to 1975-76 freight flows on the Eastern States-Perth corridor had been dominated by coastal shipping. Sea freight carried more than the other three modes combined. By 1976-77 there was a dramatic loss of 0.776 Mt from coastal shipping. The loss in sea freight was the result of a withdrawal of a shipping company from coastal shipping. Only some of the loss was taken up by rail and road - about 0.18 Mt. There are four alternative explanations about what happened to the rest of the former coastal shipping freight. Firstly, production in Western Australia or the Eastern States could have been scaled back. Secondly, the production could have been redirected to the State of manufacture (either Western Australia or the Eastern States). Thirdly, the production could have been exported overseas (from either Western Australia or the Eastern States). Finally consumption formerly satisfied by interstate trade could have been switched to imported goods (again either in Western Australia or the Eastern States).

Figure 2.3 shows the dominance of coastal shipping up to the mid 1970s and the importance to road freight of the sealing of the Eyre Highway. Figure 2.4 illustrates the modal share dominance of non-bulk coastal shipping in the first half of the period and rail's dominance in the second half.

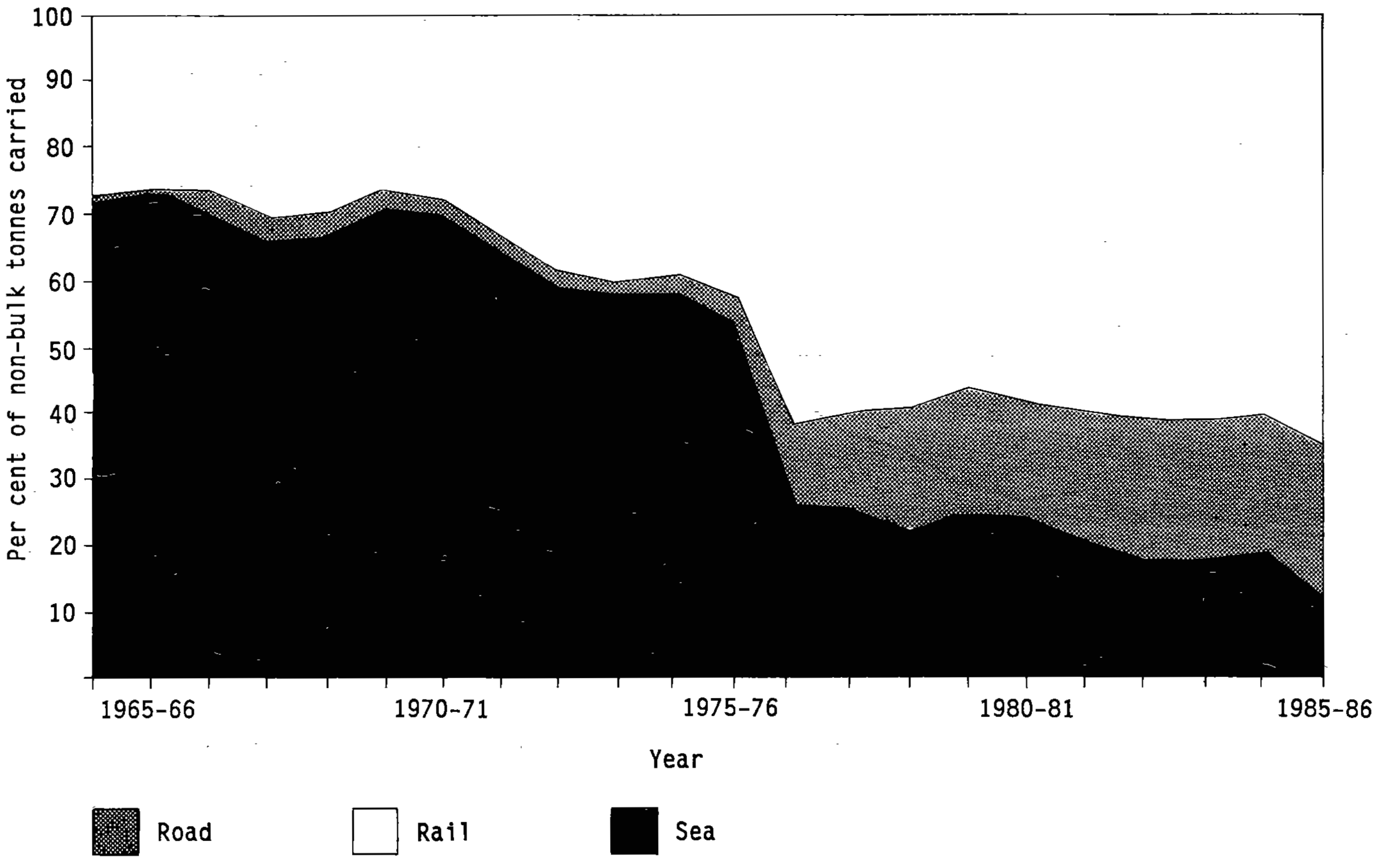
Coastal shipping held a 71 per cent share of the traffic in 1964-65. By 1976-77 this share had dropped to 28 per cent and continued to decline to 12 per cent by 1985-86. The major changes to the road and rail shares came with the sealing of the highway and the drop-off in coastal shipping in 1976-77. By 1985-86 non-bulk freight transport was dominated by rail. Road had slowly increased its share to be the second most used transport mode, replacing sea.

Table 2.2 summarises the modal shares in the corridor, demonstrating the growth in road, rail and air, and the decline in coastal shipping.



Source Appendix table I.3.

Figure 2.3 Non-bulk freight, Eastern States-Perth corridor



Source Appendix table I.3.

Figure 2.4 Eastern States-Perth corridor modal freight share

TABLE 2.2 EASTERN STATES-PERTH MODAL SHARES OF NON-BULK FREIGHT CARRIED
(per cent)

Year	*Road*	*Rail*	*Air*	*Sea*
1965-66	2	26	a	72
1970-71	3	28	a	69
1975-76	4	42	a	54
1980-81	17	59	a	24
1985-86	23	65	a	12

a. Less than 1 per cent (0.5 per cent in 1985-86).

Note Figures may not add to 100 per cent due to rounding.

Source Appendix table I.3.

MELBOURNE-ADELAIDE CORRIDOR

In 1971-72, a total of 1.3 Mt of non-bulk freight was carried between Melbourne and Adelaide. By 1985-86, total freight tonnages had increased to 2.0 Mt, a growth rate of 3 per cent annually. Much of the freight on this corridor is carried by road or rail, with road tending to be the more popular choice.

Road carried 0.78 Mt of freight between Melbourne and Adelaide in 1971-72. By 1985-86 the traffic had increased to 1.3 Mt, a growth rate of 3.7 per cent annually. Besides the 1982-83 downturn due to the economic recession, with a loss of 0.14 Mt, this corridor also experienced a downturn in 1984-85, with a loss of 0.11 Mt.

Rail freight has generally been increasing. In 1964-65, 0.5 Mt was transported between Melbourne and Adelaide. By 1984-85, this had increased to 1.0 Mt, although from 1966-67 to 1968-69 there was a downturn in traffic carried. The trend overall has been for a growth rate of 3 per cent per year.

Sea freight has been mostly comprised of imports into Melbourne from Adelaide. Between 1964-65 and 1982-83, sea freight tonnages fluctuated, reaching a maximum in 1981-82 at 0.2 Mt. By 1983-84 coastal shipping had virtually ceased between the two cities as shipping lines ceased services.

Figure 2.5 shows the freight tonnages for the three modes on the Melbourne-Adelaide corridor. As can be seen, the important competition is between road and rail as the main carriers of freight over this route.

Figure 2.6 shows the modal shares of freight between the two cities, particularly the dominance of road and rail on the corridor. The proportion of freight carried by sea was at best low (compared with the other two major modes), and has recently disappeared. The combined road and rail modal share has remained fairly constant over the period; however, rail has slowly been increasing its modal share.

Table 2.3 summarises the modal shares in the Melbourne-Adelaide corridor. Appendix I has the rail, air and sea series from 1964-65.

TABLE 2.3 MELBOURNE-ADELAIDE MODAL SHARES OF NON-BULK FREIGHT CARRIED
(per cent)

Year	*Road*	*Rail*	*Air*	*Sea*
1971-72	59	41	a	0
1975-76	57	39	a	5
1980-81	55	39	a	13
1985-86	59	41	a	0

a. Less than 1 per cent (0.4 per cent in 1985-86).

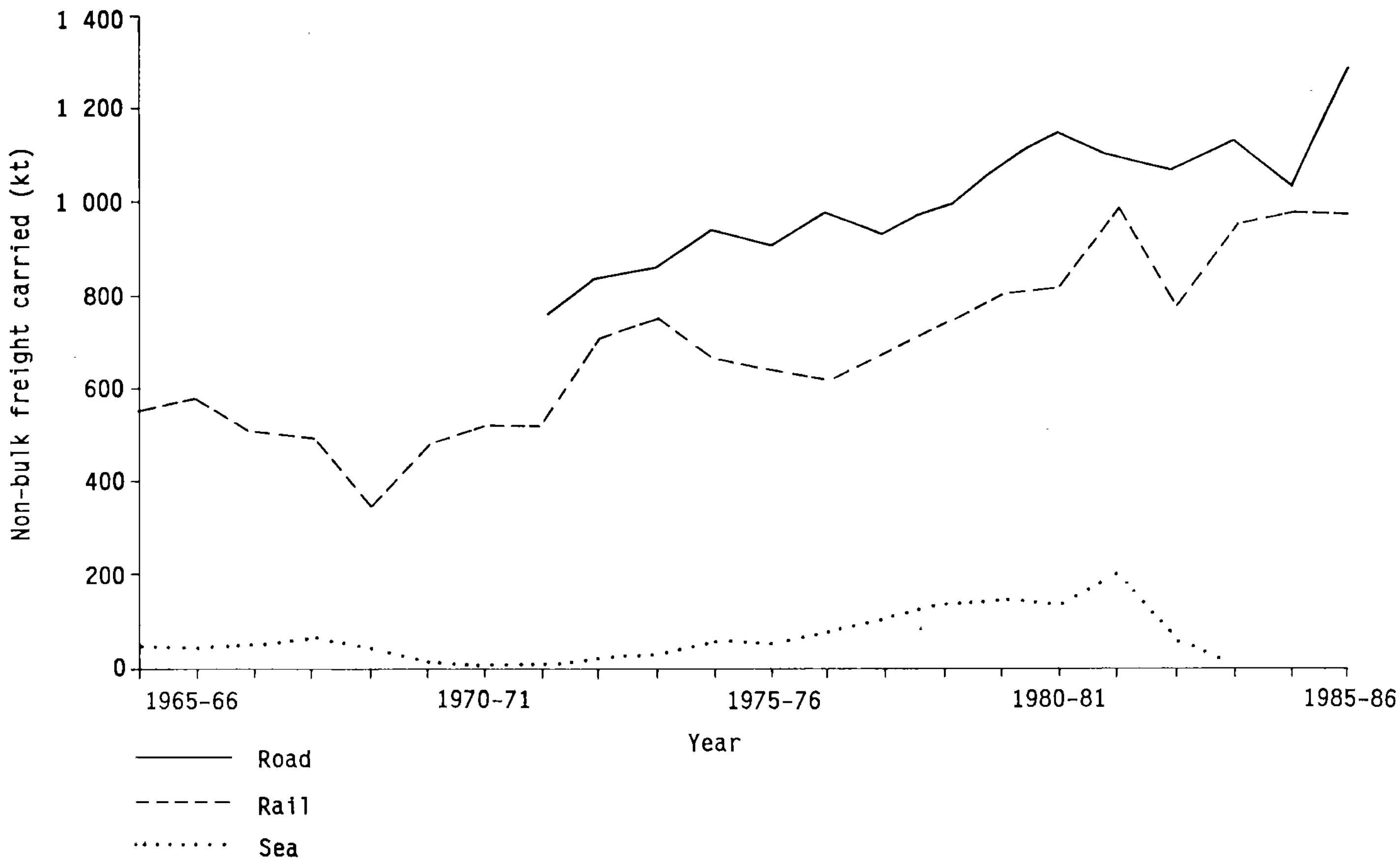
Note Figures may not add to 100 per cent due to rounding.

Source Appendix I table I.9.

MELBOURNE-BRISBANE CORRIDOR

The Melbourne-Brisbane corridor is a relatively small route compared with the others, with regards to total non-bulk freight tonnage carried. This corridor has grown 2 per cent annually over the period, that is from carrying a total of 0.61 Mt in 1971-72 to 1.07 Mt in 1984-85.

According to the available information, road freight has generally been increasing; that is, from carrying 0.38 Mt in 1971-72 to 0.9 Mt in 1985-86. This is a growth rate of 6 per cent annually.



Source Appendix table I.9.

Figure 2.5 Non-bulk freight, Melbourne-Adelaide corridor

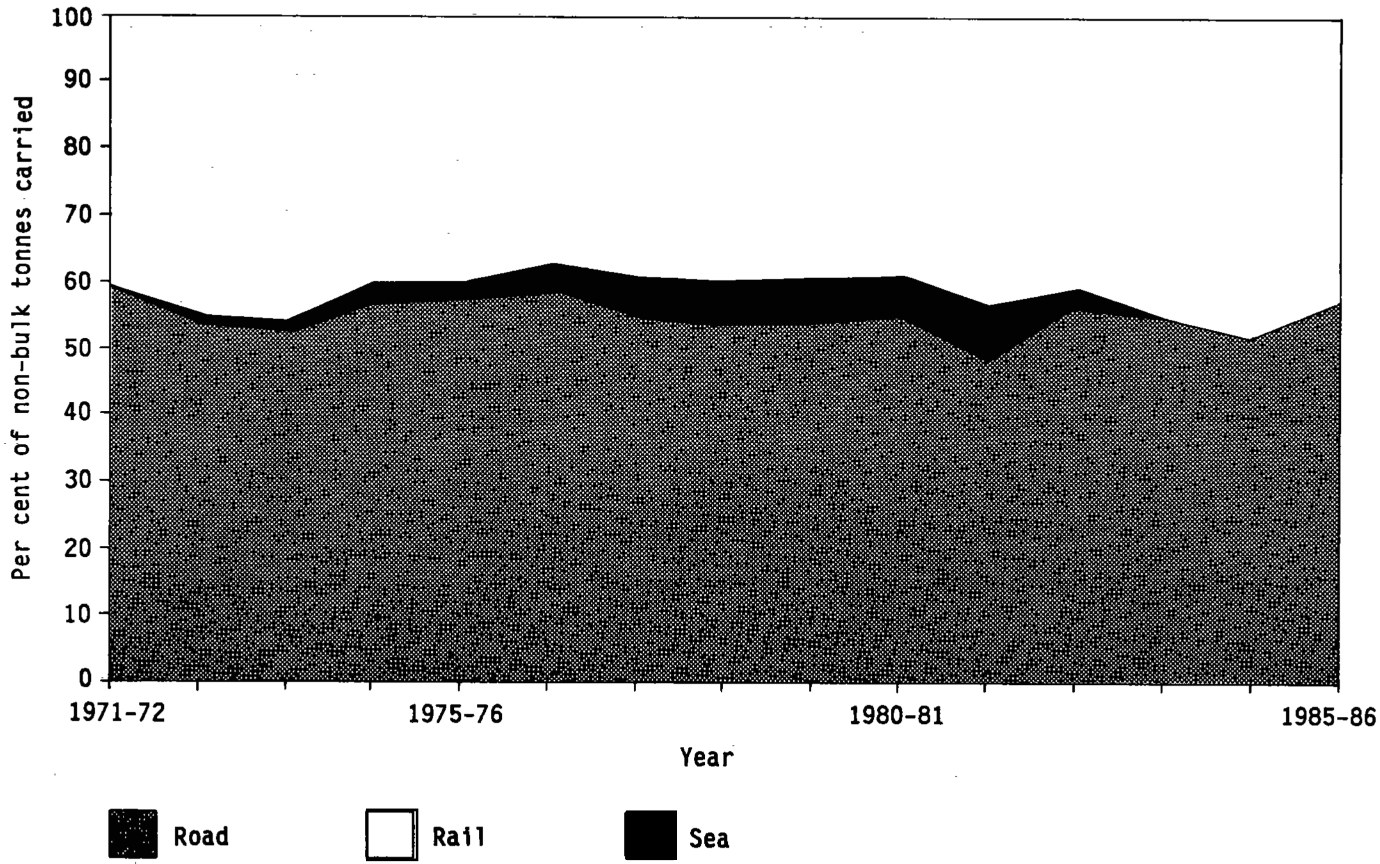


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Figure 2.6 Melbourne-Adelaide corridor modal freight share

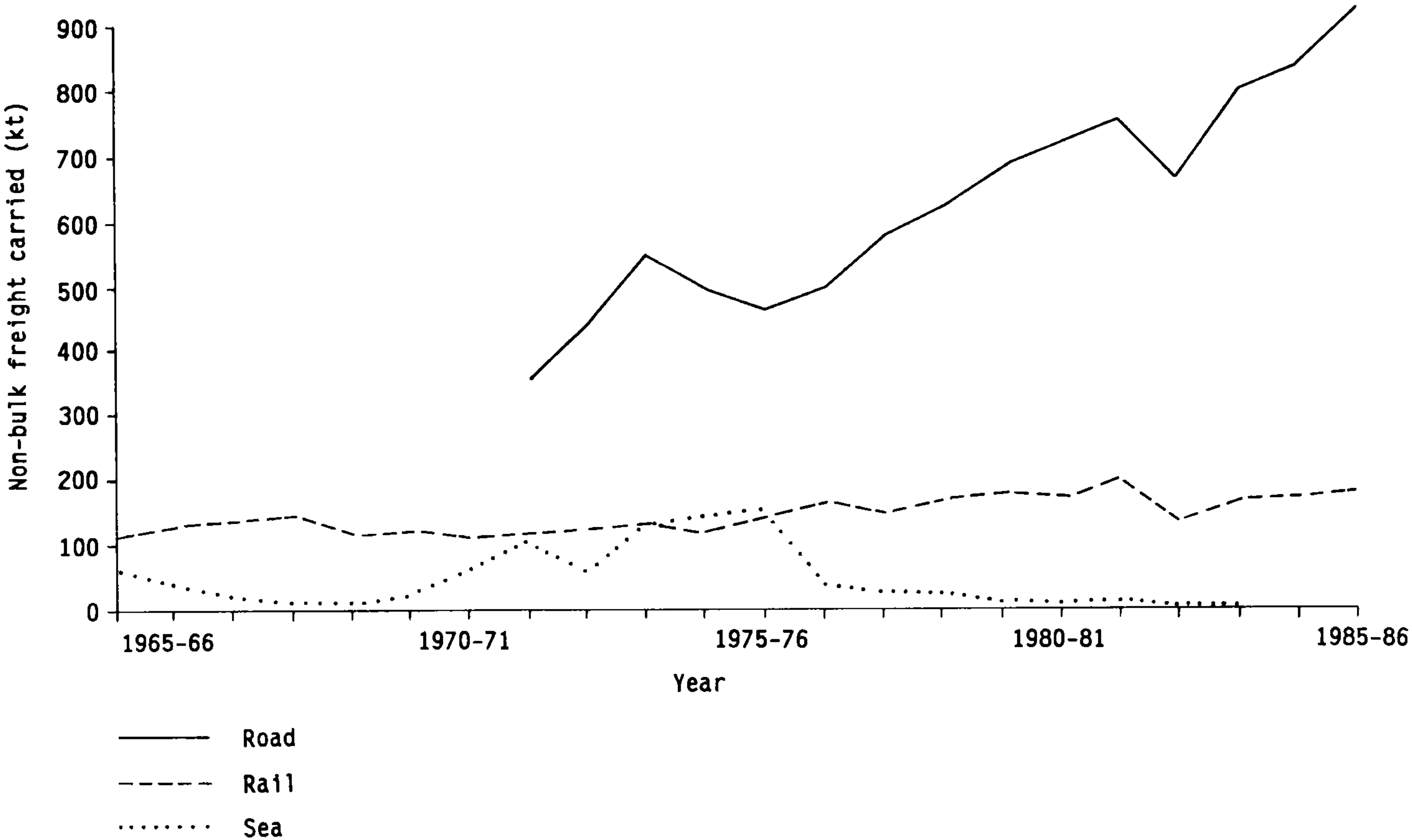

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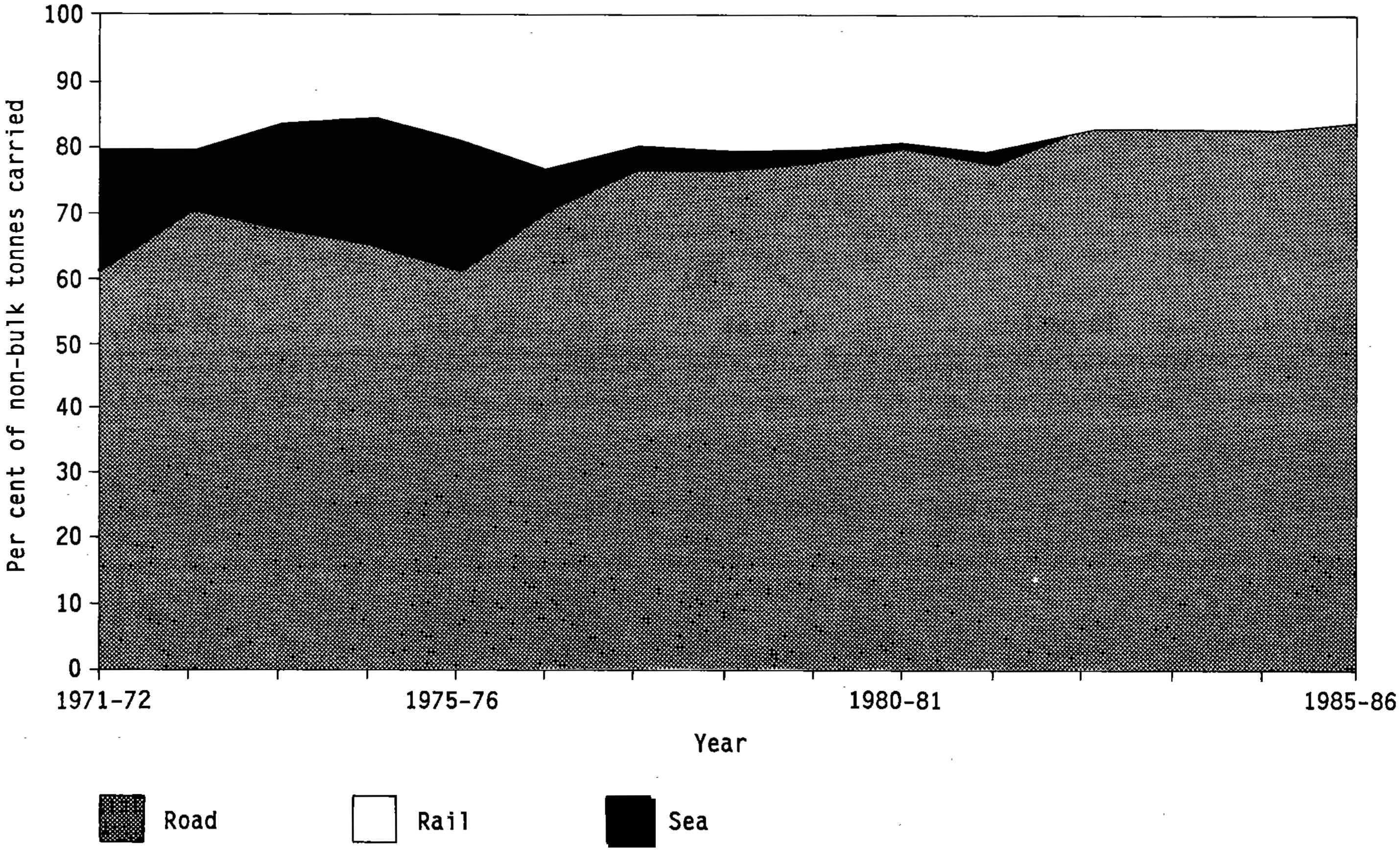
Figure 2.7 Non-bulk freight, Melbourne-Brisbane corridor



Source Appendix table I.11.

Figure 2.8 Melbourne-Brisbane corridor modal freight share

Rail freight between 1964-65 (0.114 Mt) and 1984-85 (0.14 Mt) has been growing at 1 per cent annually with most of the traffic being northbound to Brisbane. The trend has generally been positive, although freight has tended to fluctuate, peaking in 1981-82 at 0.2 Mt.

Coastal shipping between Melbourne and Brisbane comprises mostly exports to Brisbane from Melbourne. Until 1976-77 sea freight had been growing. In that year a 71 per cent decline (0.109 Mt loss) in coastal shipping occurred. Shifts in sourcing of State production and closure of shipping services were the immediate causes. Only some of the traffic was transferred to rail and road - about 0.054 Mt.

Figure 2.7 shows the growth and decline in the three modes on this corridor, especially the decline of coastal shipping.

The most important mode on this corridor, in terms of its modal share, is road. Its share has grown at an annual rate of 2 per cent, whereas rail has tended to lose share over the period. Coastal shipping retained importance until its decline in 1976-77. Figure 2.8 shows the shares of the four modes. The growing importance of road to the corridor is clearly evident, especially since the reduction in coastal shipping. Rail, on the other hand, has shown a gradual decline in modal share.

Table 2.4 presents the figures for modal shares at intervals through the period.

TABLE 2.4 MELBOURNE-BRISBANE MODAL SHARES OF NON-BULK FREIGHT CARRIED
(per cent)

Year	*Road*	*Rail*	*Air*	*Sea*
1971-72	62	20	a	18
1975-76	61	19	a	20
1980-81	80	19	a	1
1985-86	85	15	a	0

a. Less than 1 per cent (0.4 per cent in 1985-86).

Note Figures may not add to 100 per cent due to rounding.

Source Appendix I table I.11.

SYDNEY-ADELAIDE CORRIDOR

In 1975-76, a total of 1.07 Mt of freight was carried over the Sydney-Adelaide corridor. By 1985-86, there had been virtually no change in total freight, which had increased by only 10 000 tonnes to 1.08 Mt. The apparent lack of growth over the period is the result of negative growth for both rail and sea freight cancelling the positive growth in road freight of 7.2 per cent annually. In 1972-73, 0.3 Mt of freight was carried by road, and this had grown to 0.8 Mt by 1985-86.

Rail freight had remained quite static up to 1981-82. From 1983-84, rail freight was recovering from the 1982-83 economic recession, but to levels below what had been carried in the 1970s. Therefore, the overall trend for rail freight has been a decline of 1.6 per cent annually (from carrying 0.33 Mt in 1975-76 to 0.27 Mt in 1985-86).

By 1985-86 coastal shipping had virtually ceased between Sydney and Adelaide. In contrast, in 1964-65, 0.9 Mt had been carried. This decline in sea freight was the result of the gradual decline in BHP shipping iron and steel products to South Australia (BHP, pers. comm., 1987).

Figure 2.9 shows the freight trends in the three main modes on this corridor and figure 2.10 shows the freight trends in terms of modal shares.

Rail's share has shown a gradual decline over the period, whereas, road has significantly increased its share to dominate the corridor and carry more than twice the amount of rail. This is evident in figure 2.10 and table 2.5. Coastal shipping tended to fluctuate, but

TABLE 2.5 SYDNEY-ADELAIDE MODAL SHARES OF NON-BULK FREIGHT CARRIED
(per cent)

Year	*Road*	*Rail*	*Air*	*Sea*
1975-76	45	30	a	25
1980-81	57	28	a	15
1985-86	75	25	a	0

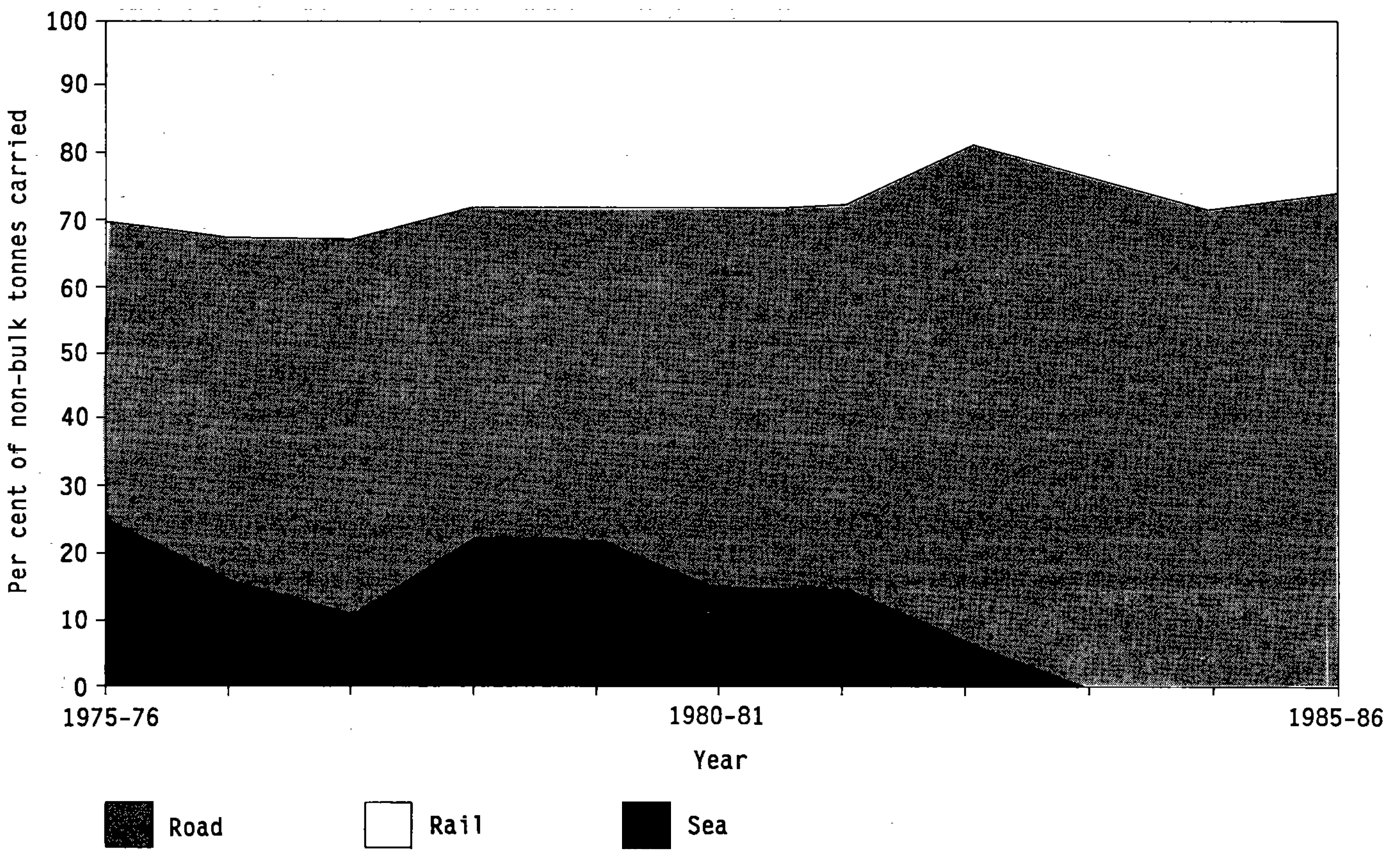
a. Less than 1 per cent (0.6 per cent in 1985-86).

Note Figures may not add to 100 per cent due to rounding.

Source Appendix table 1.5.

Source Appendix table I.5.

Figure 2.9 Non-bulk freight, Sydney-Adelaide corridor

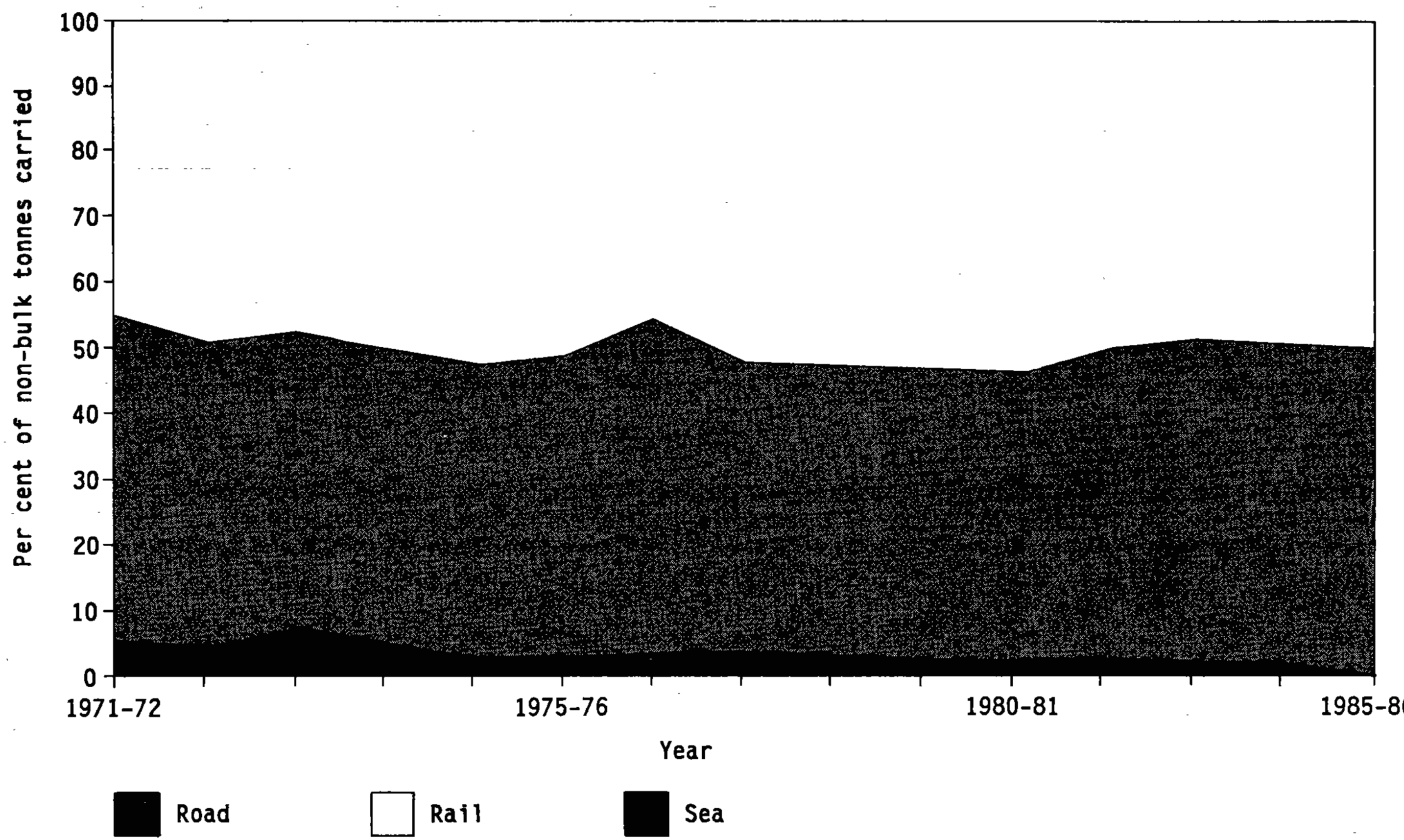


Source Appendix table I.5.

Figure 2.10 Sydney-Adelaide corridor modal freight share

Source Appendix table I.7.

Figure 2.11 Non-bulk freight, Sydney-Brisbane corridor



Source Appendix table I.7.

Figure 2.12 Sydney-Brisbane corridor modal freight share

the final result has been the elimination of non-bulk coastal shipping on this corridor.

Table 2.5 shows the dominance of road on the corridor; road and air freight were the only two modes to gain in their modal shares of the freight corridor, road freight gaining 4.7 per cent and air freight 3 per cent, annually. Coastal shipping was the only mode to experience a substantial loss in its modal share.

SYDNEY-BRISBANE CORRIDOR

Total non-bulk freight traffic on the Sydney-Brisbane corridor, for the three major modes, has grown at 3.2 per cent annually, that is, from carrying 1.8 Mt in 1971-72 to 2.8 Mt in 1985-86. Much of the freight carried by these modes is one-way traffic destined for Brisbane.

Road, rail and air have all experienced growth over the period. However, road and rail experienced severe declines during the recession of 1982-83, especially rail. Road freight between 1971-72 (0.8 Mt) and 1985-86 (1.6 Mt) has grown at an annual rate of 3.4 per cent. Rail freight between 1964-65 (0.4 Mt) and 1985-86 (1.4 Mt) has grown at 5 per cent annually.

Of the three major modes used to carry freight on this corridor, coastal shipping has been the only one to experience a negative growth, dramatically declining 15 per cent annually over the period. In 1964-65, coastal shippers carried 0.23 Mt of freight. By 1985-86 only 6000 tonnes was carried.

TABLE 2.6 SYDNEY-BRISBANE MODAL SHARES OF NON-BULK FREIGHT CARRIED

(per cent)

Year	*Road*	*Rail*	*Air*	*Sea*
1972-73	47	48	1	4
1975-76	45	52	1	3
1980-81	45	52	1	3
1985-86	50	49	1	0

Note Figures may not add to 100 per cent due to rounding.

Source Appendix table 1.7.

Figure 2.11 shows the almost equal growth of road and rail since the 1970s, and the decline of the sea mode.

Figure 2.12 shows the modal shares of the three modes. Road and rail are the only two major freight carriers on this corridor, having almost equal shares. Sea freight has slowly declined in its share of the freight corridor.

Table 2.6 documents the modal shares at intervals through the period.

SUMMARY

Several patterns can be seen in the results from the six corridors.

First, non-bulk coastal shipping has continued its postwar decline to the point where services have been virtually suspended on several routes (Melbourne-Adelaide, Melbourne-Brisbane, Sydney-Adelaide and Sydney-Brisbane). Only where distance (Eastern States-Perth) or specialised cargo (steel from Sydney to Melbourne) makes coastal shipping still competitive has it survived.

Second, with regard to competition between road and rail there seem to be three types of corridor. The first type is where rail is losing modal share to road. This includes by far the largest corridor, the Melbourne-Sydney corridor, as well as the two smallest corridors (Melbourne-Brisbane and Sydney-Adelaide). The second type is where rail is gaining modal share. The Eastern States-Perth corridor is the sole example here, where rail is gaining modal share as coastal shipping services are withdrawn. The final type is where rail is holding modal share. This includes the Melbourne-Adelaide and Sydney-Brisbane corridors.

Finally, the modal share of air, although tiny in tonnage terms (less than 1 per cent of the task in any corridor), is being maintained or expanded in all the corridors. In addition, it should be remembered that in value terms air is an important freight mode (BTCE 1987).

CHAPTER 3 ESTIMATION OF CORRIDOR MODELS

The descriptions presented so far have illustrated the varying trends in freight traffic shares between modes on the various corridors. Using the available information, freight flow models have been developed for the six mainland corridors examined in chapter 2, namely Melbourne-Sydney, Sydney-Brisbane, Sydney-Adelaide, Melbourne-Brisbane, Melbourne-Adelaide and Eastern States-Perth. The results of the empirical estimation of these models follow, examining the effects of income and freight rates on the tonnage of freight consigned between the city pairs.

FORM OF THE MODELS

All freight flows are estimated as being a double-log function of various explanatory factors. These factors include the modal freight rate, the alternative freight rate, income and dummy variables (where appropriate). Income is measured as gross domestic product, unless otherwise specified. All explanatory factors are expressed in real terms. The deflator for freight rates is the consumer price index and that for income is the non-farm GDP deflator. The rationale for using general price deflators is that interstate transport is a substitute for other production possibilities in the economy (for example, intrastate production).

Thus the models are of the general form:

$$\ln(FF_i) = c + a_1*\ln(FR_i) + a_2*\ln(FR_{alt}) + a_3*\ln(Y)$$

where FF_i (freight $flow_i$) is weight (in units as given in tables I.1 to I.12) moving by mode i; FR_i (freight $rate_i$) is real freight rate for mode i; FR_{alt} (freight $rate_{alt}$) is real freight rate(s) for alternative mode(s); and Y (income) is real seasonally adjusted gross national product in 1979-80 dollars.

As there are four modes (i = 1 to 4), there are thus four models per corridor. The four equations are not regarded as forming a separable demand system. As was mentioned in the earlier discussion of trends in the Eastern States-Perth corridor, there are four alternatives to intercity trade: closure of production capacity, intrastate trade, importing and exporting. This being the case, no restrictions are put on the estimated price elasticities.

It was expected that the modal price elasticities (a_1) would be negative and the cross-price elasticities of demand (a_2) would be positive. For example, freight tonnages by road would fall when road freight rates rose and would rise when rail freight rates rose. In the simple version of the models estimated, no lag structure on price is specified. There is usually substantial free capacity in a transport network that is available to respond quickly to demand. The only mode where there might be substantial lags in supply response is rail. However, rail intercity traffic has been either static or slowly expanding. Any large jumps have been in a downward direction. In general, the demand response of shippers to price changes has been immediate (within the year), and these changes in demand have been accommodated by the transport systems.

It was expected that income would positively influence freight tonnages (a_3 positive). Caution is, however, advisable in the interpretation of the income elasticities, as income might well be capturing the effects of some of the variables that could not be measured - for example, service levels. In addition, in some of the road models traffic has grown from very small bases, or the route has been associated with a fast growing State on one end of the corridor. In all these cases, the simple models fitted here using national gross domestic product might overstate the true income elasticities. Further work on more sophisticated models is warranted, including possibly the separation of income per person from population, or the use of corridor-specific (State) income and population data.

The time period used for the estimation of the Melbourne-Sydney and Eastern States-Perth corridors is from 1964-65 to 1985-86. For the Adelaide and Brisbane corridors the time period is between 1971-72 (or 1972-73) and 1985-86. Aggregate models of all six corridors combined are estimated for each mode over the period 1971-72 (or 1972-73) to 1985-86.

Details on all regression equations and on all independent variables, including the dummy variables, can be found in appendix III, where regression coefficients are reported to four decimal places. This is necessary for accuracy when dealing in logarithms. Route-specific dummy variables are not discussed in this chapter, unless they are of major explanatory significance to the regression equations. Rather, the discussion is of a general nature, covering the main findings of the modelling. Details of the econometric results and data used are left to the three appendixes.

ROAD

Road freight demand models are generally influenced by two independent variables - road freight rate and income (both expressed in real terms). Estimates of the elasticities for the six corridors are shown in table 3.1, with t-statistics in brackets.

What is evident from the results of the regression analyses is that price and income have different effects and levels of significance as explanatory variables, according to distance. For the long haul route

TABLE 3.1 ROAD DEMAND ELASTICITIES

Corridor	*Real road freight rate*	*Real income*	*D76*[a]
Melbourne-Sydney	-0.70 (-5.06)	1.04 (9.48)	..
Eastern States-Perth	-3.17 (-2.94)	1.30 (1.57)	0.35 (1.27)
Melbourne-Adelaide	..	1.13 (8.33)	..
Melbourne-Brisbane	..	2.02 (11.45)	..
Sydney-Adelaide	..	1.97 (15.38)	..
Sydney-Brisbane	..	1.09 (6.09)	..
Aggregate of six corridors	..	1.93 (25.32)	..

a. Dummy variable for the sealing of the Eyre Highway in 1976.
.. Not applicable.

Note t-statistics are in brackets.

Source Appendix tables III.1 to III.7.

(Eastern States-Perth) there is a high price elasticity on the demand for road freight. On the short to medium haul routes income is unitary, becoming elastic as distance increases. The Melbourne-Sydney corridor is also influenced by the price for road freight.

Income is the only variable included in the equations for the Adelaide and Brisbane corridors. The freight rates are of the correct sign, but are multi-collinear, with income as an important explanatory variable. The freight rate variable is, therefore, excluded from the estimations.

The aggregate model results in 98 per cent of the variance in road freight tonnages being explained by using income alone. The income elasticity in the aggregate is 1.9, meaning that with every 10 per cent increase in real national income, road freight flows between Australian cities increases about 19 per cent. Again, caution is advisable in taking this result too literally, as the income variable might be picking up the effects of, for example, unmeasured changes in service levels over time.

RAIL

Demand relationships for rail freight are estimated as a function of three variables - rail freight rate, alternative freight rate (sea, road) and income (all expressed in real terms). Dummy variables tend to be route-specific. A summary of variable elasticities is presented in table 3.2. All rail rates are from the Railways of Australia *Goods Rate Book* (1986) (unless otherwise specified), applying to a general 'class C' rate.

The rail models show that, apart from the eastern States-Perth corridor, rail tonnages have a consistently low elasticity to the rail freight rate. The models also indicate that tonnages have a variable but positive relationship to income, the outstanding exception being the negative coefficient on the Melbourne-Sydney corridor (-0.12). For the Melbourne-Sydney and Eastern States-Perth corridors, rail freight demand has been somewhat influenced by the competing road and sea freight rates. The aggregate model confirms the low responsiveness of intercity rail freight to freight rate and income changes.

AIR

Air freight demand models are influenced by income, and for some corridors the air freight rate also (both expressed in real terms). Demand elasticities for air are shown in table 3.3.

TABLE 3.2 RAIL DEMAND ELASTICITIES

Corridor	Real rail freight rate	Real income	Real alternative rate
Melbourne-Sydney	-0.25	-0.12	0.12[a]
	(-1.02)	(-0.66)	(0.86)
Eastern States-Perth	-0.92	1.29	0.23[b]
	(-1.83)	(4.19)	(1.22)
Melbourne-Adelaide	-0.09	0.69	..
	(-0.16)	(0.36)	
Melbourne-Brisbane	-0.12	1.10[c]	..
	(-1.20)	(7.41)	
Sydney-Adelaide	-0.46	1.53	..
	(-1.60)	(1.67)	
Sydney-Brisbane	-0.11	1.33	..
	(-1.63)	(22.81)	
Aggregate of six corridors	-0.10	0.59	..
	(-0.46)	(3.79)	

a. Road.
b. Sea.
c. Average of GDP and non-bulk Queensland interstate trade.
.. Not applicable.

Note t-statistics are in brackets.

Source Appendix tables III.1 to III.7.

The demand elasticitites for air show that for all the corridors, income is an important and statistically significant explanatory variable. Air freight flows are generally elastic with respect to income, especially in the longer distance corridors. Air freight flows proved inelastic with respect to air freight rates. This is consistent with the picture of air freight as a 'luxury good' which will show high growth with increasing national income, and whose usage will be generally price-insensitive. This is also supported in the aggregate model, where income alone explains 95 per cent of the movement in air freight tonnages.

TABLE 3.3 AIR DEMAND ELASTICITIES

Corridor	*Real air freight rate*	*Real income*
Melbourne-Sydney	..	0.91 (8.54)
Eastern States-Perth	..	3.16 (12.70)
Melbourne-Adelaide	-0.19 (-2.12)	0.87 (7.48)
Melbourne-Brisbane	-0.68 (-1.75)	6.83 (15.16)
Sydney-Adelaide	-0.26 (-3.08)	1.92 (19.31)
Sydney-Brisbane	..	1.25 (20.42)
Aggregate of six corridors	..	1.22 (18.63)

Note t-statistics are in brackets.

Source Appendix tables III.1 to III.7.

SEA

The sea freight rate, alternative freight rates (rail, road) and income were the main independent variables that were found to influence the demand for non-bulk intercity coastal shipping. Dummy variables were route-specific. All estimated elasticities are presented in table 3.4. Sea rates were proxied by rates on Tasmanian-based routes and were made available by the Australian National Line (see appendix II for further details).

Generally, the alternative rate(s) proved to be more statistically significant than the real sea rate, which indicates that the alternative mode or modes are important competitors to the sea mode.

The demand models for sea freight have shown that for the short haul routes (Melbourne-Sydney, Melbourne-Adelaide and Sydney-Brisbane)

TABLE 3.4 SEA DEMAND ELASTICITIES

Corridor	*Real sea freight rate*	*Real income*	*Real alternative rate*
Melbourne-Sydney	-0.13 (-0.59)	1.26 (1.86)	1.41[a] (1.24)
Eastern States-Perth	-1.11 (-1.65)	0.72 (0.86)	2.29[a] 1.51[b] (1.73) (2.10)
Melbourne-Adelaide	..	1.40 (2.16)	..
Sydney-Adelaide	-1.68 (-3.81)	0.26 (0.33)	..
Sydney-Brisbane	-0.37 (-0.79)	-1.58 (-1.77)	..
Aggregate of six corridors	-0.83 (6.13)	0.64 (2.58)	

a. Rail.
b. Road.
.. Not applicable.

Note t-statistics are in brackets.

Source Appendix tables III.1 to III.7.

income is an important variable, whereas the sea freight rate has only slight effect on traffic. On the Sydney-Brisbane route, however, income negatively influences sea freight demand, but is still a statistically significant variable. For the medium haul route (Sydney-Adelaide), the sea freight rate assumes importance. The other medium haul route, Melbourne-Brisbane, did not prove amenable to modelling, probably because of discrete supply changes on this route. On the long haul route (Eastern States-Perth), the sea and alternative freight rates as well as income are important determinants of non-bulk sea freight tonnages.

The aggregate model shows sea freight has been inelastic with respect to income (0.64), but less so with respect to its own freight rate

(-0.83). Indeed, the aggregate model includes a dummy variable to catch the effect of increasing closures of shipping services in recent years, which may well be related to relative freight rates.

SUMMARY

Road freight flows were found generally to be very responsive to changes in national income. The range was between a 1 to 1 response and a 2 to 1 response, with the aggregate of the corridors towards the upper end of the range.

Rail was much less responsive to income, especially in the major Melbourne-Sydney corridor. The aggregate model for rail showed a 0.6 to 1 response to income.

Air freight was even more responsive with income elasticities varying between 1 and 7. Elasticities of the latter magnitude usually indicate that the markets are as yet at a very immature stage of development, with rapid growth the norm.

The response of coastal shipping to income was similar to rail's, with one negative and an aggregate elasticity of 0.6. However, for coastal shipping the main point of interest is perhaps not so much the income elasticities as the virtual collapse of shipping on several routes.

It should be noted that with all the income elasticities there is the possibility of coefficient overestimation on some corridors, especially where one or both of the cities involved is faster growing than Australia as a whole.

Responsiveness of freight flows to rate changes (either of the mode or for alternate modes) varied, both across modes and across corridors. Generally the longer the route, the more responsive the flows to price changes. In general, there was little discernible effect of one mode's prices on another mode's traffic.

CHAPTER 4 IMPLICATIONS FOR ROAD VERSUS RAIL TRAFFIC SHARES

The primary benefit of analysing past trends of freight flows in interstate trade lies in applying the knowledge so gained to an evaluation of the likely future - that is projecting likely traffic. Projections are important not so much in their own right as in the guide they give to the likely patronage over the life of a particular piece of transport infrastructure. Patronage is in turn a guide to appropriate capacity, likely revenues and maintenance costs. An adequate assessment of these factors comprises a necessary part in the rational assessment of the benefits versus the costs of a particular investment by government or by private organisations.

Attention has therefore been given to analysing what is known of past trends, specifically in road versus rail traffic shares, and to projecting a likely outcome for Australian interstate road versus rail traffic shares by the turn of the century.

Past experience with road versus rail traffic shares

For the aggregate of the six main Australian corridors, the experience over the last 15 years has been a fairly steady erosion in rail's share of the intercity traffic to the benefit of road (see figure 4.1).

This is backed up by the aggregate models for road and rail from chapter 3, which show that the responsiveness of road freight to a real change in gross domestic product (income elasticity) was 1.93 while rail's income elasticity was only 0.59. Use of these elasticities is subject to the caution that the income coefficients may have captured the effects of service changes. However, if one assumes only partial bias in the coefficients from this cause, and further assumes that the effects of service changes or other variables are likely to be the same in the future as they have in the past, the the income elasticities provide a rough guide to the likely growth trend in traffic levels.

Thus, for a 1 per cent change in real gross domestic product one can expect intercity road freight to grow almost 2 per cent while rail freight can be expected to grow only 0.6 per cent. Similar elasticities (2.3 for road and 0.6 for rail) were found by Morton (1969) for a similar period (1945-1968) in the history of transport in the United States. Given this measured disparity in rail's responsiveness to income vis-a-vis road, it is no wonder that although absolute tonnages hauled by rail are increasing, rail's share of intercity freight traffic is declining.

Indeed Australian experience in this regard has not been unique. As shown in figure 4.2, the common experience in the developed Western economies surveyed by the European Conference of Ministers of Transport (1985) has been for an erosion in market share over time. The phenomenon is also repeated in the developing world. The World Bank (1979) has developed a standardised methodology for forecasting rail traffic for developing country loan applications which specifies 'a decrease in railway modal shares of no less than 2.5 per cent per year over the first ten years of the project'.

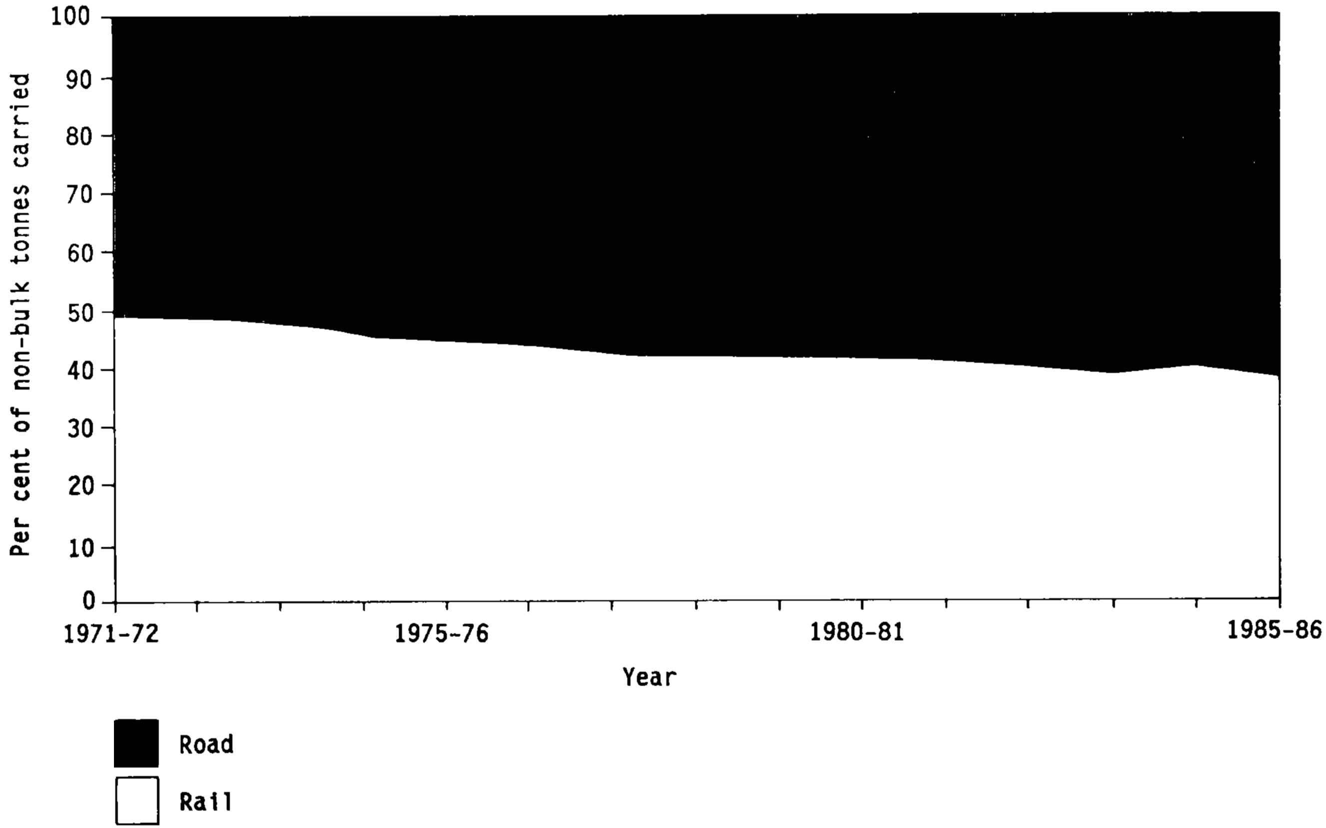
The worldwide trend towards a declining rail traffic share basically reflects two underlying factors. First, the commodities traditionally carried by rail are not those supplying the growth areas of national economies. Second, service level rather than price is, over time, becoming a much more important factor in transport (Seidenfus 1985).

Road, with its door-to-door flexible service, suits the new trends in just-in-time manufacturing in a way rail cannot easily match. Also favouring the flexibility of road is the increasing interlinking of the transport network that comes with economic development. Rail has been holding its modal share, though, in the extremely long haul routes where its cost advantage is maximised and its speed and service disadvantages minimised.

Projections of road versus rail freight shares

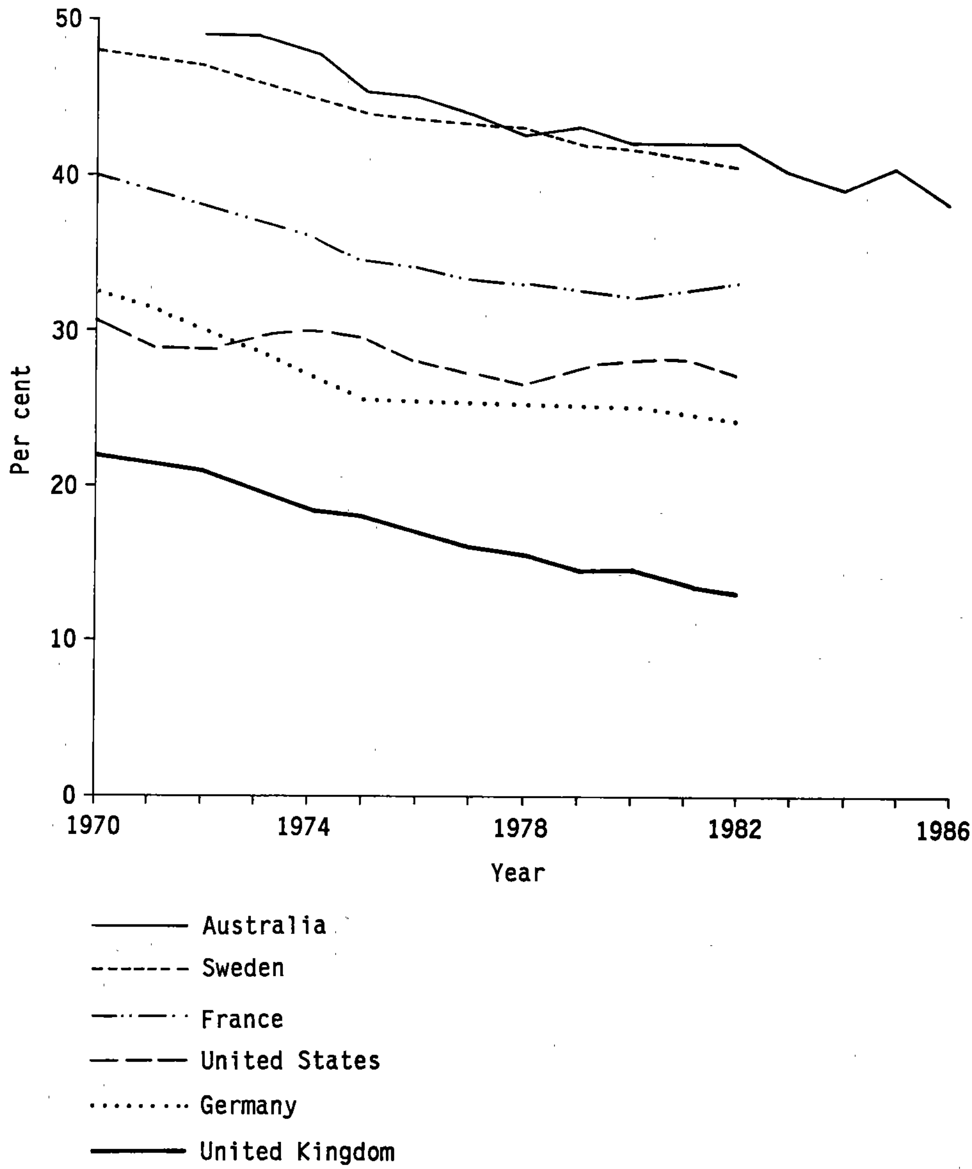
The continued erosion of rail's traffic share is not predetermined: a variety of competitive strategies is available to arrest the decline. However, before examining these, the likely future in Australia for rail's freight share, if it is assumed that past patterns continue unaffected, is considered.

The first and most important assumption used in making the projections that follow is that there will be no fundamental change in past patterns. Two additional assumptions are necessary to use the models of chapter 3 to derive likely road versus rail freight shares by the



Sources Appendix tables I.13 and I.14.

Figure 4.1 Road and rail freight shares for the six corridors combined, 1971-72 to 1985-86



Sources European Conference of Ministers of Transport (1985); BTCE estimates.

Figure 4.2 World trends in rail modal share of total road and rail traffic

year 2000. Firstly, it is assumed that real gross domestic product in Australia will grow on average by 2.5 per cent annually to the end of the century. Secondly, it is assumed that real freight rates will remain constant over the period.

Using these three assumptions, the projected road and rail tonnages of table 4.1 are derived. The projected rates of growth for the two modes vary across the corridors. However, for five of the six corridors, road freight growth rates are above those for rail freight. Road growth rates are roughly in the range of 3 to 6 per cent per year. Rail growth rates range from 2 to 4 per cent per year, except for the Melbourne-Sydney corridor which is forecast to experience almost no growth.

TABLE 4.1 PROJECTED ROAD AND RAIL NON-BULK TONNAGES TO 2000

Corridor	*1985-86 (Mt)*	*1999-2000 (Mt)*	*Growth rate (annual percentage changes)*
Road			
Melbourne-Sydney	4.35	6.47	2.9
Eastern States-Perth	0.65	1.09	3.8
Melbourne-Adelaide	1.32	2.06	3.2
Melbourne-Brisbane	0.92	2.05	5.9
Sydney-Adelaide	0.84	1.83	5.7
Sydney-Brisbane	1.30	2.25	4.0
Weighted total	9.38	15.75	3.8
Aggregate model	9.38	18.08	4.8
Rail			
Melbourne-Sydney	1.44	1.37	-0.4
Eastern States-Perth	1.52	2.53	3.7
Melbourne-Adelaide	0.99	1.29	1.9
Melbourne-Brisbane	0.18	0.25	2.4
Sydney-Adelaide	0.27	0.49	4.4
Sydney-Brisbane	1.37	2.32	3.8
Weighted total	5.77	8.25	2.6
Aggregate model	5.77	7.11	1.5

Figures for the growth rate by each mode for the total of the six corridors can be derived in two ways. First the forecasts from models for each corridor can be added up and a weighted growth rate obtained for the *total* freight projected for all six corridors. The second alternative is to construct an *aggregate model* of the six corridors and use it in forecasting. The results of these two methods for both road and rail are also shown in table 4.1.

Using the *aggregate model*, the projected growth rate for road is 4.8 per cent per year while that for rail is 1.5 per cent. Adding the individual projections to form a *total* projection results in a road growth rate of 3.8 per cent and a rail growth rate of 2.6 per cent.

The difference between the aggregate model and the weighted total from the disaggregate models can be attributed to several sources. Two of these seem the more important. In the disaggregate Melbourne-Sydney road model, the declining real freight rate (table 3.2) seems to share some of the effect allocated in the aggregate model solely to income. This results in a lower disaggregated road freight projection (given that the road freight rate is held constant).

In the rail case, the aggregation of some of the fast-growing individual corridors with slow-growing corridors results in a low aggregate growth rate. This does not compound the growth as much as when growth is localised and left to compound.

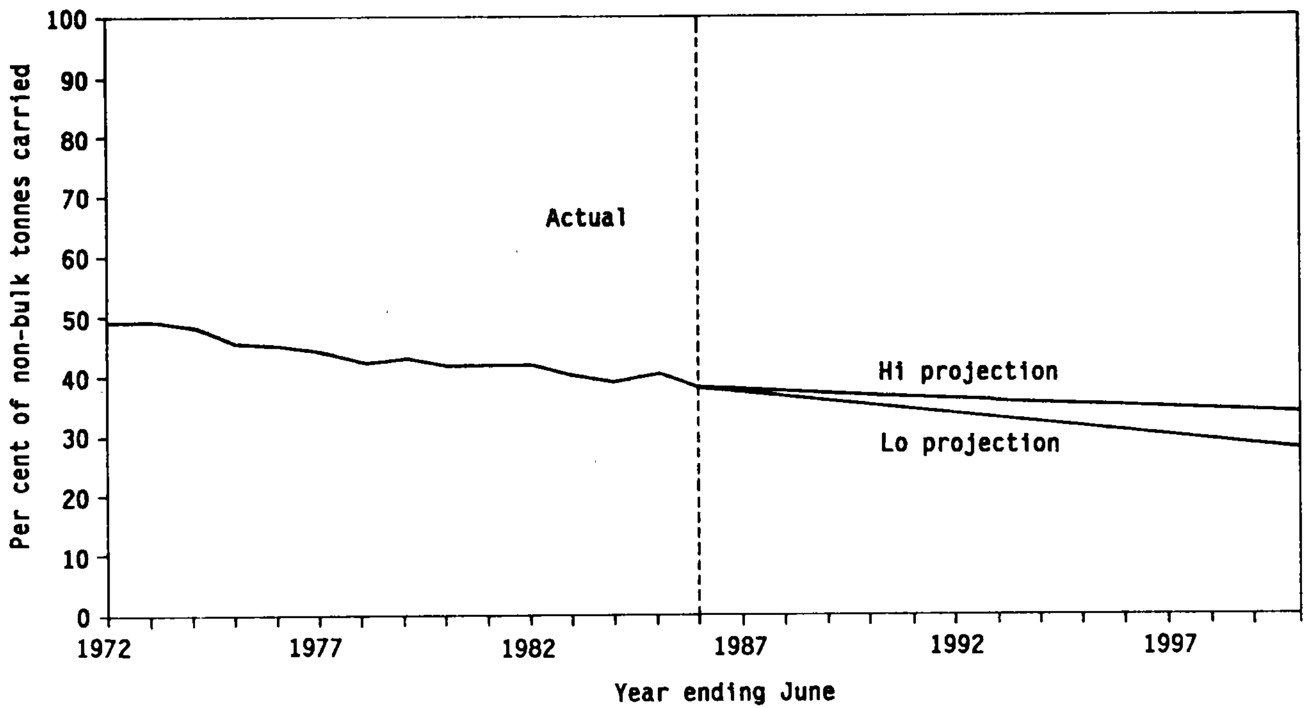
This reasoning suggests that a mix of methods might be more appropriate, with the 'total' projection for rail being preferable, and the 'aggregate' projection for road. These two figures give a projected rail modal share of 31 per cent by the year 2000.

By 2000 rail's share relative to road on the interstate corridors is projected to be between 28 (aggregate) and 34 (total) per cent, down from 38 per cent in 1984-85 (figure 4.3).

Future road versus rail competition

Several factors may cause the future to be different from the base case projections. For a start, the railways may not be content to shrink their business towards non-corridor bulk traffic, but may move to adopt strategies for maintaining or even winning back their intercity freight traffic share.

Such a development has been taking place in the Federal Republic of Germany where the railways have been attempting to adjust to meet client requirements through services such as Inter-city-Cargo, terminal services, and batch freight (Seidenfus 1985).



Sources Appendix tables I.13, I.14 and BTCE estimates.

Figure 4.3 Projected rail share of road and rail corridor freight to 2000

Here in Australia, V/Line and the SRA have been making a similar effort, with the introduction of 'superfreighters' on the Melbourne-Sydney run. The concept is to have a dedicated container line-haul train leaving each city at the same time each day. Containers are loaded from flat-bed trucks onto specially constructed rail cars. At the other end of the journey the containers are available for pick-up by truck again. Rail concentrates on an efficient line-haul task, and efficient interfacing with urban trucks.

Such a strategy can also be adopted by road operators. In Australia, plans have been mooted for road terminals outside Melbourne and Sydney. The strategy would be the same as for the superfreighters. An efficient fleet of highway vehicles would undertake the line-haul and would efficiently interface with urban trucks for delivery.

In the United States railways are developing a system of stacking two containers on top of each other on a special low-slung rail wagon. A limitation to operation is bridge heights along the track. The aim is to increase the amount of freight carried per train, but road operators are attempting the same strategy. The introduction of B-doubles (double trailer road vehicles) in all mainland jurisdictions of Australia is indicative of the approaches available to road operators.

In general, in order to offer better services, the railways will have to combine efforts to reduce costs with a pricing policy which better equates rates with costs. The result will be less general rate cross-subsidisation in their operations. In order to do this, loss making services will either have to be curtailed, or if they relate to so-called community service obligations, losses will have to be compensated for in an agreed manner with governments. This will be especially crucial as the need develops to replace existing rail infrastructure and expand capacity at strategic points.

Such actions by the railways have as their goal the establishment of a more profitable organisation that is then able to offer a wider choice of economic services with a correspondingly more flexible pricing policy to match (see Heaver & Nelson 1977). Shippers should increasingly be able to negotiate the design and pricing of rail services tailored to their needs (for Canadian and Australian examples see BTCE 1988).

Other possible factors tending to modify the base case projections would be radical changes from past competitive conditions. These could be in association with possible 'threshold' effects or with possible changes in government policy. Threshold effects arise where changes (for example, reductions in travel time) are made to a mode, but no change in traffic is observed until the effect (travel time) falls above or below a limit. For example, anecdotal evidence from the road freight industry suggests that if rail is going to compete effectively with road on the Melbourne-Sydney link, line-haul travel times would have to come down from the present 18 hours to about 12 hours (representing an 'overnight' delivery). The potential for such threshold effects is greater for rail than road, given rail's current delivery times.

Possible future government policy changes would also seem likely on balance to favour rail over road. The cost recovery levels from road freight vehicles currently are low relative to the road damage incurred (see Luck & Martin 1988). Increases in road cost recovery levels from road would allow rail to recover more of its costs while still competing effectively.

The development of such competitive strategies will be an ongoing task for the railways if they are to hold modal share during the 1990s. The emphasis in all such strategies must be on adapting rail's service rather than on any particular technology. Rail must adapt to the increasing importance that clients are putting on punctuality, security and additional customer services.

Summary

Using the models derived in earlier chapters, fairly simple projections indicate a decline in rail's share of road and rail corridor traffic from the current 38 per cent to between 28 and 34 per cent by the year 2000. However, the adoption of competitive strategies by rail, possible threshold effects of service changes, and any changes to government policy on road cost recovery could all alter the balance back somewhat in favour of rail.

CHAPTER 5 CONCLUDING REMARKS

Methods for estimating non-bulk freight flows between Australia's major cities have been developed. In particular, the problem of estimating road freight flows has been solved in such a way as to provide adequate time series for modelling purposes. Certainly there exists the possibility of measurement error in the resulting models, given the severity of the measurement problems faced in deriving the data. However, a variety of corridor models have been fitted and the degree of consistency in the results lends credence to the measurement methods developed.

All of the corridors examined have experienced an increase in the total volume of freight traffic over the last 15 to 20 years, except for the Sydney-Adelaide route following the elimination of coastal shipping.

In spite of the generally increasing total tonnage of freight, there have been pronounced shifts in the traffic shares of the various modes. The overall pattern is of a gradual shift from rail to road, a decline and sometimes eclipse of coastal shipping and a steady increase in the very tiny air freight share. The patterns in the individual corridors are sometimes different from this generalisation, however, with the rail to road shift being least apparent on the long haul Eastern States-Perth route.

The modelling suggests that road and air freight are likely to continue to grow rapidly in the future due to their strong links to national income. Growth in rail and coastal shipping traffic, on the other hand, is likely to continue to be somewhat slower. This is consistent with the evidence, for both Australia and for overseas, that rail's share of intercity freight traffic has been declining from the mid 1960s to the mid 1980s. A variety of reasons have been adduced to explain this, the most prominent of which is the increasing importance being placed by shippers on service aspects of the transport task. If the declining share of rail is to be arrested, rail operators will have to meet or better the services provided by road hauliers.

Finally, the modelling has been used to conclude that there is little discernible effect of one mode's prices on another mode's traffic.

In summary, work is warranted especially in regard to the possibility of using State-specific income data. However, analysts and decision makers now have available a firm measurement base for estimating the effects of policy changes on the different transport industries involved in moving freight between Australia's major cities.

APPENDIX I DATA AND DATA SOURCES

Tables I.1 to I.12 show non-bulk freight flows and freight rates for the six corridors, Melbourne-Sydney, Eastern States-Perth, Sydney-Adelaide, Sydney-Brisbane, Melbourne-Adelaide, and Melbourne-Brisbane. 'Melbourne' is defined to include Geelong and Westernport, and 'Sydney' includes Newcastle and Wollongong. Travel times are also given for Melbourne-Sydney (table I.2) and Eastern States-Perth (table I.4). Tables I.13 to I.16 give summaries of freight flows for each transport mode.

The sources for the information and estimates provided in tables I.1 to I.12 are provided at the end of the appendix. The methods and assumptions used in producing the estimates are explained in appendix II.

Economic indicators used in the modelling are in table I.17. The sources for these are also identified at the end of the appendix.

In general the time series presented in tables I.1 to I.17 cover the period 1964-65 to 1985-86.

TABLE I.1 MELBOURNE-SYDNEY CORRIDOR: FREIGHT[a]

Year	*Trucks through Marulan (both ways)*	*Origin-destination fraction for road*	*Melbourne-Sydney trucks*	*Load per truck Sydney-Melbourne*	*Road freight Melbourne-Sydney*
	1	*2*	*3*	*4*	*5*
	number	*fraction*	*number*	*t*	*Mt*
1964-65	199 356	0.552	110 044	11.65	1.286
1965-66	196 630	0.533	104 804	12.80	1.342
1966-67	201 413	0.514	103 526	14.00	1.450
1967-68	215 930	0.495	106 886	14.50	1.550
1968-69	237 821	0.476	113 202	14.58	1.650
1969-70	254 461	0.457	116 288	14.68	1.708
1970-71	258 977	0.438	113 432	14.77	1.676
1971-72	283 384	0.419	118 738	14.86	1.764
1972-73	339 856	0.400	135 942	14.94	2.030
1973-74	388 362	0.380	147 578	15.03	2.218
1974-75	404 622	0.380	153 756	15.12	2.324
1975-76	447 299	0.380	169 974	15.21	2.586
1976-77	460 711	0.380	175 070	15.30	2.678
1977-78	457 692	0.380	173 922	15.39	2.676
1978-79	491 852	0.380	186 904	15.48	2.894
1979-80	541 879	0.380	205 914	15.57	3.206
1980-81	570 679	0.380	216 858	15.66	3.396
1981-82	597 451	0.380	227 032	15.74	3.574
1982-83	530 303	0.380	201 516	15.83	3.190
1983-84	635 346	0.380	241 432	15.92	3.844
1984-85	642 906	0.380	244 304	16.01	3.912
1985-86	710 000	0.380	269 800	16.10	4.344

TABLE I.1 (Cont.) MELBOURNE-SYDNEY CORRIDOR: FREIGHT[a]

Year	Rail freight NSW-Vic.	Grain NSW-Vic.	Rail freight less grain NSW-Vic.	Rail freight Vic.-NSW	Origin-destination fraction for rail	Rail freight Sydney-Melbourne	Rail freight Melbourne-Sydney
	6	7	8	9	10	11	12
	Mt	Mt	Mt	Mt	fraction	Mt	Mt
1964-65	1.288	0.037	1.251	0.740	0.850	1.063	0.629
1965-66	1.216	0.034	1.182	0.837	0.850	1.005	0.711
1966-67	1.371	0.042	1.329	0.704	0.850	1.130	0.598
1967-68	1.460	0.036	1.424	0.637	0.850	1.210	0.541
1968-69	1.304	0.013	1.297	0.609	0.850	1.097	0.518
1969-70	1.296	0.002	1.294	0.624	0.850	1.100	0.530
1970-71	1.318	0.004	1.314	0.669	0.850	1.117	0.569
1971-72	1.269	0.021	1.248	0.650	0.850	1.061	0.553
1972-73	1.354	0.011	1.343	0.686	0.850	1.142	0.583
1973-74	1.334	0.005	1.329	0.746	0.850	1.130	0.634
1974-75	1.121	0.082	1.039	0.712	0.850	0.883	0.605
1975-76	1.117	0.025	1.092	0.624	0.850	0.928	0.530
1976-77	1.236	0.142	1.094	0.664	0.850	0.930	0.564
1977-78	1.088	0.094	0.994	0.613	0.850	0.845	0.521
1978-79	1.013	0.028	0.985	0.694	0.850	0.837	0.590
1979-80	1.524	0.446	1.078	0.804	0.850	0.916	0.683
1980-81	1.237	0.263	0.974	0.867	0.850	0.828	0.737
1981-82	1.089	0.129	0.960	0.807	0.850	0.816	0.686
1982-83	0.782	0.037	0.745	0.655	0.850	0.633	0.557
1983-84	0.961	0.016	0.945	0.679	0.850	0.803	0.577
1984-85	1.027	0.085	0.942	0.728	0.850	0.801	0.619
1985-86	1.052	0.058	0.994	0.693	0.850	0.845	0.589

TABLE I.1 (Cont.) MELBOURNE-SYDNEY CORRIDOR: FREIGHT[a]

Year	*Air freight Sydney-Melbourne*	*Air freight Melbourne-Sydney*[b]	*Non-bulk shipping Sydney-Melbourne*	*Non-bulk shipping Melbourne-Sydney*
	13	*14*	*15*	*16*
	t	*t*	*Mt*	*Mt*
1964-65	8 227	8 227	0.342	0.002
1965-66	8 829	8 829	0.309	0.001
1966-67	9 841	9 841	0.259	0.011
1967-68	10 698	10 698	0.249	0.006
1968-69	11 438	11 438	0.357	0.003
1969-70	12 905	12 905	0.295	0.012
1970-71	11 412	11 412	0.399	0.027
1971-72	11 284	11 284	0.389	0.049
1972-73	11 869	11 869	0.410	0.053
1973-74	13 804	13 804	0.776	0.045
1974-75	12 695	12 695	0.813	0.082
1975-76	12 431	12 431	0.662	0.035
1976-77	12 372	12 372	0.684	0.030
1977-78	14 088	14 088	0.659	0.042
1978-79	14 823	14 823	0.850	0.068
1979-80	16 199	14 246	0.875	0.042
1980-81	15 023	14 299	0.941	0.011
1981-82	16 630	16 481	0.940	0.021
1982-83	16 566	17 139	0.757	0.012
1983-84	16 032	18 752	0.783	0.021
1984-85	15 846	21 729	0.683	0.011
1985-86	16 939	20 764	0.656	0.003

a. 'Sydney' includes Newcastle and Wollongong. 'Melbourne' includes Geelong and Westernport.
b. Data on separate direction available only since 1980; before 1980 traffic assumed equidirectional.

TABLE I.2 MELBOURNE-SYDNEY CORRIDOR: FREIGHT RATES AND TRAVEL TIMES

Year	*Truck rates Sydney-Melbourne*	*Truck rates Melbourne-Sydney*	*Rail freight rates*[a]	*Air freight rates*	*Sea freight rates*[b]	*Truck times*	*Rail times*[c]	*Air times*[d]	*Sea times*[b]
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
	$/t	*$/t*	*$/t*	*$/kg*	*$/t*	*hours*	*hours*	*hours*	*hours*
1964-65	16.00	18.20	9.00	0.200	8.45	15.50	48.00	1.12	36.00
1965-66	16.10	18.30	9.00	0.205	8.82	15.37	48.00	1.12	36.00
1966-67	16.70	18.80	9.00	0.209	9.70	15.24	47.70	1.12	36.00
1967-68	17.40	19.50	9.00	0.209	10.19	15.11	47.30	1.12	36.00
1968-69	18.20	19.90	9.00	0.209	10.45	14.97	47.00	1.12	36.00
1969-70	18.60	20.30	9.45	0.209	11.26	14.84	46.70	1.12	36.00
1970-71	19.70	21.50	9.45	0.230	12.39	14.71	46.30	1.12	36.00
1971-72	20.70	22.90	9.86	0.240	13.50	14.58	46.00	1.12	36.00
1972-73	22.20	24.60	9.95	0.240	16.86	14.45	21.00[f]	1.12	36.00
1973-74	24.30	27.40	10.37	0.270	16.86	14.32	20.75	1.12	36.00
1974-75	27.40	30.80	12.14	0.300	20.36	14.18	20.50	1.12	36.00
1975-76	29.90	34.90	12.80	0.370	28.07	14.05	20.25	1.12	36.00
1976-77	32.20	37.70	14.40	0.370	51.14	13.92	20.00	1.12	36.00
1977-78	33.80	39.10	15.09	0.390	59.43	13.79	19.75	1.12	36.00
1978-79	35.40	40.80	15.85	0.450	60.64	13.66	19.50	1.12	36.00
1979-80	35.80	41.60	17.60	0.550	69.43	13.53	19.25	1.12	36.00
1980-81	36.90	42.70	21.35	0.790	78.14	13.39	19.00	1.12	36.00
1981-82	39.10	45.20	24.04	1.150	89.64	13.26	18.75	1.12	36.00
1982-83	41.70	47.40	26.95	1.450	100.36	13.13	18.50	1.12	36.00
1983-84	42.60	48.60	24.77	1.760	101.93	12.38	18.25	1.12	36.00
1984-85	44.20	51.60	22.87	2.220	101.93	12.19	18.00	1.12	36.00
1985-86	46.40	55.50	24.69	2.590	103.14	12.00	18.00	1.12	36.00

a. The rail rate applies to forwarding agent rates.
b. Tasmania-Sydney. Constancy is based on advice from Australian National Line that sea times had not significantly altered.
c. Rail time includes the shunting, terminal and running times. Variations in scheduled times were so minor that constancy was assumed.
d. The direct route between Sydney and Melbourne; actual variations were negligible.
f. Drops in rail time attributable to the opening of new freight forwarders terminals.

TABLE I.3 EASTERN STATES-PERTH CORRIDOR: FREIGHT

Year	*Trucks through Ceduna (westbound)*	*Trucks through Ceduna (eastbound)*	*Load per truck ES-Perth*	*Load per truck Perth-ES*	*Road freight ES-Perth*	*Road freight Perth-ES*
	1	*2*	*3*	*4*	*5*	*6*
	number	*number*	*t*	*t*	*Mt*	*Mt*
1964-65	978	1 106	13.28	6.76	0.013	0.007
1965-66	1 409	1 593	14.59	7.42	0.021	0.012
1966-67	1 828	2 050	15.96	8.12	0.029	0.017
1967-68	2 324	2 433	16.53	8.41	0.038	0.020
1968-69	2 164	2 496	16.62	8.46	0.036	0.021
1969-70	1 791	2 348	16.74	8.51	0.030	0.020
1970-71	1 737	1 895	16.84	8.57	0.029	0.016
1971-72	1 929	2 151	16.94	8.62	0.033	0.019
1972-73	1 456	1 513	17.03	8.67	0.025	0.013
1973-74	1 234	1 551	17.13	8.72	0.021	0.014
1974-75	2 201	2 411	17.24	8.76	0.038	0.021
1975-76	3 237	3 237	17.34	8.82	0.056	0.029
1976-77	7 585	6 959	17.44	8.87	0.132[b]	0.062[b]
1977-78	9 629	8 834	17.54	8.93	0.169	0.079
1978-79	12 991	11 903	17.65	8.98	0.229	0.107
1979-80	14 599	13 343	17.75	9.03	0.259	0.120
1980-81	13 354	12 700	17.85	9.08	0.238	0.115
1981-82	15 792	15 257	17.94	9.13	0.283	0.139
1982-83	15 384	14 982	18.05	9.18	0.278	0.138
1983-84	16 702	16 689	18.15	9.23	0.303	0.154
1984-85	17 190	16 929	18.25	9.29	0.314	0.157
1985-86	19 304	19 012	18.35	9.34	0.354	0.178

TABLE I.3 (Cont.) EASTERN STATES-PERTH CORRIDOR: FREIGHT

Year	*Rail freight ES-Perth*	*Rail freight Perth-ES*	*Air freight ES-Perth*	*Air freight Perth-ES*	*Non-bulk shipping ES-Western Australia*[a]	*Non-bulk shipping Western Australia-ES*[a]
	7	*8*	*9*	*10*	*11*	*12*
	Mt	*Mt*	*Mt*	*Mt*	*Mt*	*Mt*
1964-65	0.223	0.155	0.0006	0.0004	0.646	0.333
1965-66	0.249	0.126	0.0007	0.0004	0.736	0.316
1966-67	0.269	0.118	0.0006	0.0004	0.697	0.329
1967-68	0.317	0.134	0.0007	0.0004	0.661	0.311
1968-69	0.376	0.137	0.0009	0.0006	0.664	0.477
1969-70	0.408	0.106	0.0011	0.0007	0.698	0.685
1970-71	0.431	0.106	0.0014	0.0009	0.734	0.600
1971-72	0.447	0.134	0.0014	0.0009	0.687	0.415
1972-73	0.451	0.190	0.0020	0.0013	0.615	0.353
1973-74	0.592	0.248	0.0026	0.0017	0.695	0.514
1974-75	0.609	0.212	0.0025	0.0017	0.740	0.472
1975-76	0.735	0.226	0.0029	0.0019	0.451	0.755
1976-77	0.764	0.265	0.0025	0.0016	0.285[c]	0.145[c]
1977-78	0.794	0.223	0.0032	0.0021	0.302	0.124
1978-79	0.787	0.289	0.0031	0.0021	0.261	0.139
1979-80	0.829	0.281	0.0030	0.0020	0.332	0.149
1980-81	0.879	0.323	0.0033	0.0022	0.399	0.088
1981-82	1.004	0.301	0.0041	0.0027	0.320	0.112
1982-83	0.822	0.417	0.0057	0.0038	0.259	0.094
1983-84	1.031	0.297	0.0076	0.0050	0.283	0.098
1984-85	0.979	0.380	0.0066	0.0044	0.346	0.072
1985-86	1.074	0.431	0.0071	0.0050	0.202	0.064

a. To or from Fremantle.
b. Jump in road freight due to the opening of the sealed Eyre Highway.
c. When the sealed Eyre Highway opened, a shipping company withdrew from coastal shipping.

Note Eastern States abbreviated as ES.

TABLE I.4 EASTERN STATES-PERTH CORRIDOR: FREIGHT RATES AND TRAVEL TIMES[a]

Year	*Truck freight rates*[b]	*Rail freight rates*[b]	*Air freight rates*[c]	*Sea freight rates*[d]	*Truck times*[f]	*Rail times*[b]	*Air times*[f]	*Sea times*[c]
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
	$/t	*$/t*	*$/kg*	*$/t*	*hours*	*hours*	*hours*	*hours*
1964-65	16.00	13.16	0.73	25.52	53.49	216.0	3.00	168.0
1965-66	16.10	13.16	0.75	25.69	53.49	216.0	3.00	168.0
1966-67	16.70	13.16	0.79	26.02	53.49	216.0	3.00	168.0
1967-68	17.40	13.16	0.79	26.38	53.03	216.0	2.50	168.0
1968-69	18.20	13.19	0.79	26.57	52.57	168.0	2.50	168.0
1969-70	18.60	13.82	0.79	27.93	52.11	168.0	2.50	168.0
1970-71	19.70	13.82	0.86	29.29	51.66	168.0	2.50	168.0
1971-72	20.70	14.23	0.90	26.24	51.20	168.0	2.50	168.0
1972-73	22.20	14.56	0.90	25.64	50.74	168.0	2.50	168.0
1973-74	24.30	15.00	1.01	27.71	50.29	168.0	2.50	168.0
1974-75	27.40	17.24	1.13	33.50	49.82	168.0	2.50	168.0
1975-76	29.90	19.18	1.39	42.57	49.37	168.0	2.50	168.0
1976-77	32.20	21.52	1.39	49.07	49.37	168.0	2.50	168.0
1977-78	33.80	23.25	1.50	65.14	49.37	168.0	2.50	168.0
1978-79	35.40	24.89	1.76	70.00	49.37	168.0	2.50	168.0
1979-80	35.80	27.34	2.00	81.07	49.37	168.0	2.50	168.0
1981-82	39.10	35.40	3.27	96.36	48.92	86.0	2.50	168.0
1982-83	41.70	39.54	4.18	110.86	48.69	86.0	2.50	168.0
1983-84	42.60	38.27	5.03	113.36	48.45	86.0	2.50	168.0
1984-85	44.20	37.46	6.32	113.36	48.23	86.0	2.50	168.0
1985-86	46.40	39.92	7.37	114.64	48.00	86.0	2.50	168.0

a. Rates apply to general cargo.
b. Melbourne-Perth; the jumps in time have to do with the opening of sections of standard gauge track.
c. Sydney-Perth.
d. Tasmania-Fremantle.
f. Adelaide-Perth; constancy is based on advice from Australian National Line that sea times have not noticeaoly changed over the period.

TABLE I.5 SYDNEY-ADELAIDE CORRIDOR: FREIGHT[a]

Year	Non-bulk shipping Sydney-Adelaide[b]	Non-bulk shipping Adelaide-Sydney[b]	Air freight Sydney-Adelaide	Air freight Adelaide-Sydney	Road freight Sydney-Adelaide	Road freight Adelaide-Sydney
	1	2	3	4	5	6
	kt	kt	kt	kt	kt	kt
1964-65	514.0	386.0	1.145	0.544	na	na
1965-66	466.0	349.0	1.292	0.614	na	na
1966-67	367.0	281.0	1.378	0.654	na	na
1967-68	440.0	319.0	1.392	0.661	na	na
1968-69	444.0	280.0	1.566	0.734	na	na
1969-70	421.0	283.0	1.785	0.848	na	na
1970-71	409.0	385.0	2.147	1.020	na	na
1971-72	444.0	273.0	2.227	1.057	148.7	158.6
1972-73	495.0	93.0	2.327	1.095	213.4	160.8
1973-74	390.0	91.0	2.766	1.314	264.1	196.0
1974-75	277.0	17.0	3.126	1.485	246.8	225.2
1975-76	247.0	19.0	2.446	1.162	257.7	218.8
1976-77	152.0	10.0	3.336	1.584	290.8	237.8
1977-78	94.0	15.0	3.972	1.887	296.8	266.3
1978-79	120.0	133.0	3.985	1.893	273.8	279.5
1979-80	144.0	128.0	4.113	1.875	302.3	308.4
1980-81	122.0	47.0	4.170	1.817	318.4	325.0
1981-82	97.0	78.0	3.617	1.979	334.3	341.3
1982-83	39.0	16.0	3.583	1.587	295.8	301.9
1983-84	3.0	0.0	3.493	1.712	354.4	361.7
1984-85	10.0	3.0	4.051	1.976	331.5	359.7
1985-86	0.0	0.0	na	na	380.8	426.6

TABLE I.5 (Cont.) SYDNEY-ADELAIDE CORRIDOR: FREIGHT[a]

Year	*Rail freight NSW-SA*	*Rail freight SA-NSW*	*Origin-destination fraction for rail (westward)*	*Origin-destination fraction for rail (eastward)*	*Rail freight Sydney-Adelaide*	*Rail freight Adelaide-Sydney*
	7	*8*	*9*	*10*	*11*	*12*
	kt	*kt*	*fraction*	*fraction*	*kt*	*kt*
1964-65	na	na	0.251	0.112	..	..
1965-66	na	na	0.251	0.112	..	..
1966-67	na	na	0.251	0.112	..	..
1967-68	na	na	0.251	0.112	..	..
1968-69	na	na	0.251	0.112	..	..
1969-70	na	na	0.251	0.112	..	..
1970-71	na	na	0.251	0.112	..	..
1971-72	na	na	0.251	0.112	..	..
1972-73	na	na	0.251	0.112	..	..
1973-74	na	na	0.251	0.112	..	..
1974-75	na	na	0.251	0.112	..	..
1975-76	1 137.9	355.1	0.251	0.112	285.6	39.8
1976-77	1 174.5	366.9	0.251	0.112	294.8	41.1
1977-78	1 145.3	365.7	0.251	0.112	287.5	41.0
1978-79	1 078.9	390.6	0.251	0.112	270.8	43.7
1979-80	1 184 3	411.8	0.251	0.112	297.3	46.1
1980-81	1 072.5	413.8	0.251	0.112	269.2	46.3
1981-82	1 113.9	387.8	0.251	0.112	279.6	43.4
1982-83	na	na	0.251	0.112	..	..
1983-84	761.3	269.3	0.251	0.112	191.1	33.2
1984-85	935.7	313.4	0.251	0.112	234.9	35.1
1985-86	949.1	312.9	0.251	0.112	238.2	35.0

a. 'Sydney' includes Newcastle and Wollongong.
b. Large shifts have to do with the withdrawal of shipping companies from the route.
na Not available.
.. Not applicable.

TABLE I.6 SYDNEY-ADELAIDE CORRIDOR: FREIGHT RATES

Year	*Truck freight rates Sydney-Adelaide*	*Truck freight rates Adelaide-Sydney*	*Rail freight rates*	*Air freight rates*	*Sea freight rates*[a]
	1	*2*	*3*	*4*	*5*
	$/t	*$/t*	*$/t*	*$/kg*	*$/t*
1964-65	28.40	19.40	33.25	0.302	10.00
1965-66	28.67	19.58	33.25	0.331	10.30
1966-67	29.76	20.38	33.25	0.342	10.30
1967-68	31.07	21.36	33.25	0.364	10.65
1968-69	32.30	21.93	33.34	0.364	12.00
1969-70	33.66	22.43	34.94	0.364	13.40
1970-71	35.64	23.77	34.94	0.397	16.20
1971-72	37.20	24.89	35.42	0.400	17.50
1972-73	39.65	26.58	35.75	0.400	21.93
1973-74	41.54	29.90	37.25	0.450	21.93
1974-75	50.16	33.81	41.70	0.510	26.45
1975-76	55.00	37.00	45.70	0.640	37.38
1976-77	58.78	40.29	57.46	0.640	59.05
1977-78	61.03	42.85	63.83	0.690	66.60
1978-79	64.24	46.25	72.41	0.800	70.04
1979-80	65.59	47.70	84.49	0.950	80.15
1980-81	67.29	48.83	116.78	1.260	90.17
1981-82	71.70	51.91	142.17	1.750	103.45
1982-83	75.49	55.99	157.35	2.190	115.85
1983-84	74.19	56.68	178.35	2.690	117.64
1984-85	78.87	58.75	195.40	3.410	117.64
1985-86	79.38	56.97	213.48	4.080	119.00

a. Tasmania-Brisbane.

TABLE I.7 SYDNEY-BRISBANE CORRIDOR: FREIGHT[a]

Year	*Non-bulk shipping Sydney-Brisbane*	*Non-bulk shipping Brisbane-Sydney*	*Air freight Sydney-Brisbane*	*Air freight Brisbane-Sydney*	*Road freight Sydney-Brisbane*	*Road freight Brisbane-Sydney*
	1	*2*	*3*	*4*	*5*	*6*
	kt	*kt*	*kt*	*kt*	*kt*	*kt*
1964-65	210.0	16.0	5.802	2.790	na	na
1965-66	189.0	14.0	6.023	2.897	na	na
1966-67	219.0	43.0	6.760	3.251	na	na
1967-68	134.0	3.0	7.131	3.430	na	na
1968-69	175.0	1.0	7.122	3.425	na	na
1969-70	150.0	1.0	7.884	3.792	na	na
1970-71	162.0	2.0	8.228	3.957	na	na
1971-72	89.0	4.0	8.556	4.115	632.8	247.8
1972-73	83.0	3.0	8.894	4.277	637.2	281.8
1973-74	153.0	5.0	11.660	5.608	681.6	311.2
1974-75	85.0	15.0	11.365	5.466	673.3	261.5
1975-76	41.0	5.0	10.615	5.105	659.2	237.8
1976-77	62.0	2.0	9.999	4.809	714.5	265.3
1977-78	54.0	8.0	11.868	5.708	807.2	325.7
1978-79	70.0	8.0	12.780	6.014	577.5	329.6
1979-80	50.0	7.0	12.399	5.814	637.3	363.8
1980-81	57.0	1.0	12.405	5.967	671.5	383.3
1981-82	43.0	3.0	13.881	5.860	705.1	402.5
1982-83	52.0	2.0	13.531	6.029	623.8	356.1
1983-84	54.0	3.0	14.219	6.666	747.4	426.6
1984-85	37.0	0.0	14.612	7.475	786.8	446.8
1985-86	5.0	1.0	na	na	959.3	483.8

TABLE I.7 (Cont.) SYDNEY-BRISBANE CORRIDOR: FREIGHT[a]

Year	*Rail freight NSW-Qld*	*Rail freight Qld-NSW*	*Origin-destination fraction for rail (northbound)*	*Origin-destination fraction for rail (southbound)*	*Rail freight Sydney-Brisbane*	*Rail freight Brisbane-Sydney*
	7	*8*	*9*	*10*	*11*	*12*
	kt	*kt*	*fraction*	*fraction*	*kt*	*kt*
1964-65	491.7	228.8	0.689	0.597	338.7	136.6
1965-66	506.8	245.2	0.689	0.597	349.2	146.4
1966-67	564.3	264.0	0.689	0.597	388.8	157.6
1967-68	612.5	277.9	0.689	0.597	422.0	165.9
1968-69	660.7	327.4	0.689	0.597	455.2	195.5
1969-70	776.9	293.5	0.689	0.597	535.3	175.2
1970-71	841.3	339.1	0.689	0.597	579.6	202.5
1971-72	838.6	351.6	0.689	0.597	577.8	209.9
1972-73	1 037.6	389.0	0.689	0.597	714.9	232.2
1973-74	1 145.8	374.3	0.689	0.597	789.5	223.5
1974-75	1 080.9	426.2	0.689	0.597	744.8	254.4
1975-76	1 093.4	402.0	0.689	0.597	753.3	240.0
1976-77	1 163.5	423.7	0.689	0.597	801.7	253.0
1977-78	1 051.6	383.4	0.689	0.597	724.5	228.9
1978-79	1 175.6	442.6	0.689	0.597	810.0	264.2
1979-80	1 317.5	473.2	0.689	0.597	907.8	282.5
1980-81	1 418.4	428.5	0.689	0.597	977.3	255.8
1981-82	1 575.9	481.5	0.689	0.597	1 085.8	287.4
1982-83	1 141.9	437.1	0.689	0.597	786.7	260.9
1983-84	1 270.0	456.0	0.689	0.597	875.0	272.2
1984-85	1 329.2	532.5	0.689	0.597	915.8	317.9
1985-86	1 470.2	687.7	0.689	0.597	1 013.0	410.5

a. 'Sydney' includes Newcastle and Wollongong.
na Not available.
.. Not applicable.

TABLE I.8 SYDNEY-BRISBANE CORRIDOR: FREIGHT RATES

Year	*Truck freight rates Sydney-Brisbane*	*Truck freight rates Brisbane-Sydney*	*Rail freight rates*	*Air freight rates*	*Sea freight rates*[a]
	1	*2*	*3*	*4*	*5*
	\$/t	*\$/t*	*\$/t*	*\$/kg*	*\$/t*
1964-65	21.42	13.42	23.80	0.192	7.66
1965-66	21.62	13.54	23.80	0.198	8.08
1966-67	22.45	14.10	23.80	0.205	9.00
1967-68	23.43	14.78	23.80	0.209	9.78
1968-69	24.36	15.17	23.86	0.209	10.27
1969-70	25.39	15.52	25.00	0.209	11.26
1970-71	26.88	16.44	25.00	0.231	12.39
1971-72	28.06	17.21	25.36	0.240	13.50
1972-73	29.90	18.38	25.39	0.240	16.86
1973-74	31.33	20.69	26.66	0.270	16.86
1974-75	37.83	23.38	28.80	0.300	20.36
1975-76	41.48	25.62	31.97	0.370	28.07
1976-77	44.33	28.26	40.80	0.370	51.14
1977-78	46.00	29.69	45.80	0.390	59.43
1978-79	47.43	30.52	55.13	0.450	60.64
1979-80	48.15	30.90	61.52	0.550	69.43
1980-81	49.10	31.73	84.53	0.800	78.14
1981-82	51.78	33.84	101.75	1.170	89.64
1982-83	54.53	33.66	112.35	1.540	100.36
1983-84	55.48	32.67	126.55	1.770	101.93
1984-85	58.98	32.86	139.70	2.240	101.93
1985-86	59.36	32.83	152.80	2.610	103.14

a. Tasmania-Sydney rate was used as a proxy rate. The distance between Sydney and Brisbane is approximately equivalent.

TABLE I.9 MELBOURNE-ADELAIDE CORRIDOR: FREIGHT

Year	Non-bulk shipping Melbourne-Adelaide	Non-bulk shipping Adelaide-Melbourne	Air freight Melbourne-Adelaide	Air freight Adelaide-Melbourne	Road freight Melbourne-Adelaide	Road freight Adelaide-Melbourne
	1	2	3	4	5	6
	kt	kt	kt	kt	kt	kt
1964-65	2.1	40.4	3.316	1.394	na	na
1965-66	1.7	39.9	3.797	1.596	na	na
1966-67	1.0	44.4	4.190	1.762	na	na
1967-68	2.7	59.3	5.107	2.148	na	na
1968-69	2.7	35.9	5.415	2.277	na	na
1969-70	0.0	7.1	5.894	2.478	na	na
1970-71	0.0	0.0	5.307	2.231	na	na
1971-72	0.0	0.0	5.485	2.306	467.9	314.8
1972-73	0.0	18.5	5.037	2.118	510.6	365.5
1973-74	0.0	2.3	6.723	2.827	460.5	457.6
1974-75	0.0	56.3	5.616	2.361	578.6	399.6
1975-76	1.5	45.9	5.433	2.284	582.0	363.6
1976-77	5.2	61.0	6.207	2.610	653.0	367.3
1977-78	0.0	102.1	6.394	2.688	615.8	389.4
1978-79	0.0	132.9	7.614	3.201	585.6	396.1
1979-80	0.0	145.5	7.986	2.916	646.2	437.1
1980-81	0.0	127.7	7.443	2.449	680.9	460.6
1981-82	1.2	199.0	6.490	2.607	714.9	483.6
1982-83	0.0	59.0	5.217	2.297	632.5	427.9
1983-84	0.0	0.0	5.833	3.139	757.8	512.6
1984-85	0.0	0.0	7.116	3.321	705.4	453.3
1985-86	0.0	0.0	na	na	910.4	534.6

TABLE I.9 (Cont.) MELBOURNE-ADELAIDE CORRIDOR: FREIGHT

Year	*Rail freight Vic.-SA*	*Rail freight SA-Vic.*	*Origin-destination fraction for rail (westward)*	*Origin-destination fraction for rail (eastward)*	*Rail freight Melbourne-Adelaide*	*Rail freight Adelaide-Melbourne*
	7	*8*	*9*	*10*	*11*	*12*
	kt	*kt*	*fraction*	*fraction*	*kt*	*kt*
1964-65	449.1	404.4	0.693	0.572	311.2	231.3
1965-66	402.6	518.4	0.693	0.572	279.0	296.5
1966-67	395.9	411.8	0.693	0.572	274.3	235.5
1967-68	406.2	364.2	0.693	0.572	281.5	208.3
1968-69	240.9	295.7	0.693	0.572	166.9	169.2
1969-70	342.7	413.0	0.693	0.572	237.5	236.2
1970-71	347.3	482.5	0.693	0.572	240.7	276.0
1971-72	338.7	492.2	0.693	0.572	234.7	281.5
1972-73	431.1	707.0	0.693	0.572	298.8	404.4
1973-74	534.5	667.3	0.693	0.572	370.4	381.7
1974-75	467.9	590.4	0.693	0.572	324.3	337.7
1975-76	436.3	580.7	0.693	0.572	302.3	332.2
1976-77	431.3	555.0	0.693	0.572	298.9	317.5
1977-78	456.1	621.7	0.693	0.572	316.1	355.6
1978-79	474.4	710.7	0.693	0.572	328.8	406.5
1979-80	507.3	646.7	0.693	0.572	351.6	369.9
1980-81	536.4	768.0	0.693	0.572	371.7	439.3
1981-82	699.6	879.8	0.693	0.572	484.8	503.2
1982-83	535.7	707.6	0.693	0.572	371.2	404.7
1983-84	655.3	844.2	0.693	0.572	454.1	482.9
1984-85	700.3	847.3	0.693	0.572	485.3	484.7
1985-86	na	na	0.693	0.572	..	..

na Not available.
.. Not applicable.

TABLE I.10 MELBOURNE-ADELAIDE CORRIDOR: FREIGHT RATES

Year	Truck *freight rates Melbourne-Adelaide*	Truck *freight rates Adelaide-Melbourne*	*Rail freight rates*	*Air freight rates*	*Sea freight rates*[a]
	1	*2*	*3*	*4*	*5*
	$/t	*$/t*	*$/t*	*$/kg*	*$/t*
1964-65	15.65	10.90	18.60	0.192	10.85
1965-66	15.80	11.00	18.60	0.198	11.00
1966-67	16.40	11.45	18.60	0.205	11.13
1967-68	17.12	12.00	18.60	0.209	11.48
1968-69	17.80	12.32	18.64	0.209	11.58
1969-70	18.55	12.60	19.53	0.209	12.50
1970-71	19.64	13.35	19.53	0.231	13.14
1971-72	20.50	13.98	19.80	0.240	14.21
1972-73	21.85	14.93	19.97	0.240	14.21
1973-74	22.89	16.80	20.82	0.270	17.79
1974-75	27.64	18.99	24.37	0.300	21.57
1975-76	30.31	20.80	27.84	0.370	30.50
1976-77	32.39	22.95	36.83	0.370	38.93
1977-78	33.63	24.00	40.95	0.380	43.93
1978-79	35.40	25.69	46.68	0.450	46.21
1979-80	36.14	26.80	53.39	0.520	52.86
1980-81	37.08	27.43	76.69	0.740	59.50
1981-82	39.51	29.16	105.76	1.130	68.29
1982-83	41.60	31.45	107.97	1.440	76.43
1983-84	40.88	31.84	113.52	1.670	77.57
1984-85	43.46	33.00	125.66	2.110	78.50
1985-86	43.74	32.00	137.52	2.500	83.07

a. Tasmania-Adelaide.

TABLE I.11 MELBOURNE-BRISBANE CORRIDOR: FREIGHT

Year	*Non-bulk shipping Melbourne-Brisbane*	*Non-bulk shipping Brisbane-Melbourne*	*Air freight Melbourne-Brisbane*	*Air freight Brisbane-Melbourne*	*Road freight Melbourne-Brisbane*	*Road freight Brisbane-Melbourne*
	1	*2*	*3*	*4*	*5*	*6*
	kt	*kt*	*kt*	*kt*	*kt*	*kt*
1964-65	38.9	21.8	0.032	0.010	na	na
1965-66	27.7	12.5	0.107	0.033	na	na
1966-67	11.4	9.4	0.024	0.007	na	na
1967-68	2.9	8.1	0.041	0.013	na	na
1968-69	9.0	0.2	0.151	0.046	na	na
1969-70	25.4	2.6	0.188	0.058	na	na
1970-71	48.5	12.5	0.524	0.167	na	na
1971-72	94.6	10.8	0.593	0.182	293.7	90.3
1972-73	55.5	2.9	0.839	0.258	351.5	107.2
1973-74	132.3	2.8	1.467	0.451	448.3	133.8
1974-75	142.7	2.6	1.332	0.409	390.7	127.4
1975-76	150.7	1.6	1.457	0.448	363.9	119.0
1976-77	42.4	1.2	1.577	0.484	390.2	126.3
1977-78	26.4	1.7	1.193	0.588	449.1	150.3
1978-79	24.7	0.0	2.228	0.684	424.4	193.9
1979-80	1.0	11.7	1.900	0.456	468.3	214.0
1980-81	7.5	0.9	2.174	0.658	493.5	225.5
1981-82	12.6	1.8	2.698	0.927	518.2	236.8
1982-83	2.2	0.0	3.005	0.900	458.5	209.5
1983-84	0.0	0.0	3.164	1.018	549.3	251.0
1984-85	1.3	0.0	3.253	1.122	654.1	272.3
1985-86	0.0	0.0	na	na	642.8	282.0

TABLE I.11 (Cont.) MELBOURNE-BRISBANE CORRIDOR: FREIGHT

Year	Rail freight Vic.-Qld	Rail freight Qld-Vic.	Origin-destination fraction for rail (northbound)	Origin-destination fraction for rail (southbound)	Rail freight Melbourne-Brisbane	Rail freight Brisbane-Melbourne
	7	8	9	10	11	12
	kt	kt	fraction	fraction	kt	kt
1964-65	50.6	118.2	0.661	0.720	36.4	78.1
1965-66	57.5	132.2	0.661	0.720	41.4	87.4
1966-67	63.5	138.6	0.661	0.720	45.8	91.6
1967-68	65.2	147.8	0.661	0.720	47.0	97.7
1968-69	57.7	116.5	0.661	0.720	41.6	77.0
1969-70	60.7	123.0	0.661	0.720	43.7	81.3
1970-71	53.5	114.3	0.661	0.720	38.5	75.6
1971-72	41.9	132.9	0.661	0.720	30.2	87.9
1972-73	45.8	142.5	0.661	0.720	33.0	94.2
1973-74	40.6	158.8	0.661	0.720	29.2	105.0
1974-75	35.6	141.4	0.661	0.720	25.6	93.5
1975-76	37.5	174.7	0.661	0.720	27.0	115.5
1976-77	37.7	210.4	0.661	0.720	27.2	139.1
1977-78	40.1	182.5	0.661	0.720	28.9	120.6
1978-79	37.7	210.9	0.661	0.720	27.1	139.4
1979-80	44.6	222.5	0.661	0.720	32.1	147.1
1980-81	39.4	219.6	0.661	0.720	28.3	145.2
1981-82	52.6	252.3	0.661	0.720	37.9	166.7
1982-83	44.1	158.9	0.661	0.720	32.2	105.0
1983-84	66.4	180.3	0.661	0.720	48.7	119.2
1984-85	79.5	176.7	0.661	0.720	27.3	116.8
1985-86	na	na	0.661	0.720	..	..

na Not available.
.. Not applicable.

TABLE I.12 MELBOURNE-BRISBANE CORRIDOR: FREIGHT RATES

Year	Truck *freight rates Melbourne-Brisbane*	Truck *freight rates Brisbane-Melbourne*	*Rail freight rates*	*Air freight rates*	*Sea freight rates*[a]
	1	*2*	*3*	*4*	*5*
	$/t	*$/t*	*$/t*	*$/kg*	*$/t*
1964-65	20.85	16.00	38.90	0.311	10.60
1965-66	21.00	16.15	38.90	0.341	10.60
1966-67	21.85	16.80	38.90	0.353	10.60
1967-68	22.80	17.62	38.90	0.375	10.60
1968-69	23.71	18.10	39.00	0.375	12.00
1969-70	24.71	18.50	40.87	0.375	13.40
1970-71	26.17	19.60	40.87	0.409	16.20
1971-72	27.32	20.52	41.44	0.410	17.50
1972-73	29.10	21.92	41.82	0.410	21.93
1973-74	30.50	24.67	43.58	0.460	21.93
1974-75	36.82	27.88	51.00	0.530	26.45
1975-76	40.38	30.55	55.88	0.660	37.38
1976-77	43.15	33.70	69.98	0.660	59.05
1977-78	44.78	35.40	77.31	0.710	66.60
1978-79	46.17	36.40	87.24	0.830	70.04
1979-80	46.87	36.84	101.53	0.970	80.15
1980-81	47.80	37.84	134.55	1.280	90.17
1981-82	50.40	40.35	165.27	1.640	103.45
1982-83	53.08	40.14	199.28	2.230	115.85
1983-84	54.00	38.95	207.61	2.810	117.64
1984-85	57.41	39.18	228.69	3.580	117.64
1985-86	57.48	39.15	249.73	4.280	119.00

a. Tasmania-Brisbane.

TABLE I.13 SUMMARY OF ROAD FREIGHT FLOWS

(Mt)

Year	*Melbourne-Sydney*	*Eastern States-Perth*	*Sydney-Brisbane*	*Sydney-Adelaide*	*Melbourne-Adelaide*	*Melbourne-Brisbane*	*Total*
1964-65	1.29	0.02	na	na	na	na	na
1965-66	1.34	0.03	na	na	na	na	na
1966-67	1.45	0.05	na	na	na	na	na
1967-68	1.55	0.06	na	na	na	na	na
1968-69	1.65	0.06	na	na	na	na	na
1969-70	1.71	0.05	na	na	na	na	na
1970-71	1.69	0.05	na	na	na	na	na
1971-72	1.76	0.05	0.85	0.31	0.75	0.37	4.09
1972-73	2.03	0.04	0.90	0.37	0.88	0.44	4.66
1973-74	2.22	0.04	0.97	0.46	0.93	0.55	5.17
1974-75	2.32	0.06	0.90	0.47	0.98	0.50	5.23
1975-76	2.59	0.09	0.86	0.48	0.94	0.46	5.42
1976-77	2.68	0.19	0.94	0.53	1.02	0.50	5.86
1977-78	2.68	0.25	1.10	0.56	1.00	0.58	6.17
1978-79	2.89	0.34	0.91	0.55	0.98	0.62	6.29
1979-80	3.21	0.38	1.00	0.61	1.08	0.68	6.96
1980-81	3.40	0.35	1.06	0.64	1.14	0.72	7.31
1981-82	3.57	0.42	1.11	0.68	1.20	0.76	7.74
1982-83	3.19	0.42	0.98	0.60	1.06	0.67	6.92
1983-84	3.84	0.46	1.17	0.72	1.27	0.80	8.26
1984-85	3.91	0.47	1.23	0.69	1.16	0.84	8.30
1985-86	4.34	0.53	1.43	0.81	1.44	0.93	9.48

TABLE I.14 SUMMARY OF RAIL FREIGHT FLOWS

(Mt)

Year	*Melbourne-Sydney*	*Eastern States-Perth*	*Sydney-Brisbane*	*Sydney-Adelaide*	*Melbourne-Adelaide*	*Melbourne-Brisbane*	*Total*
1964-65	1.69	0.38	0.48	(0.33)	0.54	0.12	3.54
1965-66	1.72	0.38	0.50	(0.33)	0.58	0.13	3.64
1966-67	1.73	0.39	0.55	(0.33)	0.51	0.14	3.65
1967-68	1.75	0.45	0.59	(0.33)	0.49	0.15	3.76
1968-69	1.62	0.51	0.65	(0.33)	0.34	0.12	3.57
1969-70	1.63	0.51	0.71	(0.33)	0.47	0.13	3.78
1970-71	1.69	0.54	0.78	(0.33)	0.52	0.11	3.97
1971-72	1.61	0.58	0.79	(0.33)	0.52	0.12	3.95
1972-73	1.73	0.64	0.95	(0.33)	0.70	0.13	4.48
1973-74	1.76	0.84	1.01	(0.33)	0.75	0.13	4.82
1974-75	1.49	0.82	1.00	(0.33)	0.66	0.12	4.42
1975-76	1.46	0.96	0.99	0.33	0.64	0.14	4.52
1976-77	1.49	1.03	1.06	0.34	0.62	0.17	4.71
1977-78	1.37	1.02	0.95	0.33	0.67	0.15	4.49
1978-79	1.43	1.08	1.07	0.31	0.74	0.17	4.80
1979-80	1.60	1.11	1.19	0.34	0.80	0.18	5.22
1980-81	1.57	1.20	1.23	0.32	0.81	0.17	5.30
1981-82	1.50	1.31	1.37	0.32	0.99	0.21	5.70
1982-83	1.19	1.24	1.05	0.23	0.78	0.14	4.63
1983-84	1.38	1.33	1.15	0.23	0.94	0.17	5.20
1984-85	1.42	1.36	1.23	0.27	0.97	0.17	5.42
1985-86	1.43	1.51	1.42	0.27	(1.00)	(0.17)	5.80

Note Figures in parentheses are estimates.

TABLE I.15 SUMMARY OF AIR FREIGHT FLOWS

(Mt)

Year	*Melbourne-Sydney*	*Eastern States-Perth*	*Sydney-Brisbane*	*Sydney-Adelaide*	*Melbourne-Adelaide*	*Melbourne-Brisbane*	*Total*
1964-65	0.016	0.001	0.008	0.002	0.005	0.000	0.032
1965-66	0.014	0.001	0.009	0.002	0.005	0.001	0.032
1966-67	0.020	0.001	0.010	0.002	0.006	0.000	0.039
1967-68	0.021	0.001	0.011	0.002	0.007	0.000	0.042
1968-69	0.023	0.001	0.011	0.002	0.008	0.000	0.045
1969-70	0.026	0.002	0.012	0.003	0.008	0.000	0.051
1970-71	0.023	0.002	0.012	0.003	0.008	0.001	0.049
1971-72	0.023	0.002	0.013	0.003	0.008	0.001	0.050
1972-73	0.024	0.003	0.013	0.003	0.007	0.001	0.051
1973-74	0.028	0.004	0.017	0.004	0.010	0.002	0.065
1974-75	0.025	0.004	0.017	0.005	0.008	0.002	0.061
1975-76	0.025	0.005	0.016	0.004	0.008	0.002	0.060
1976-77	0.025	0.004	0.015	0.005	0.009	0.002	0.060
1977-78	0.028	0.005	0.018	0.006	0.009	0.002	0.068
1978-79	0.030	0.005	0.019	0.006	0.011	0.003	0.074
1979-80	0.030	0.005	0.018	0.006	0.011	0.002	0.072
1980-81	0.029	0.006	0.018	0.006	0.010	0.003	0.072
1981-82	0.033	0.007	0.020	0.006	0.009	0.004	0.079
1982-83	0.034	0.009	0.020	0.005	0.008	0.004	0.080
1983-84	0.035	0.013	0.021	0.005	0.009	0.004	0.087
1984-85	0.038	0.011	0.022	0.006	0.010	0.004	0.091
1985-86	0.038	0.012	na	na	na	na	na

TABLE I.16 SUMMARY OF SEA FREIGHT FLOWS

(Mt)

Year	*Melbourne-Sydney*	*Eastern States-Perth*	*Sydney-Brisbane*	*Sydney-Adelaide*	*Melbourne-Adelaide*	*Melbourne-Brisbane*	*Total*
1964-65	0.34	0.98	0.23	0.90	0.04	0.06	2.55
1965-66	0.31	1.05	0.20	0.82	0.04	0.02	2.44
1966-67	0.27	1.03	0.26	0.65	0.05	0.02	2.28
1967-68	0.26	0.97	0.14	0.76	0.06	0.01	2.20
1968-69	0.39	1.14	0.18	0.72	0.04	0.01	2.48
1969-70	0.31	1.38	0.15	0.70	0.01	0.03	2.58
1970-71	0.43	1.33	0.16	0.79	0.00	0.06	2.77
1971-72	0.44	1.10	0.09	0.72	0.00	0.11	2.46
1972-73	0.46	0.97	0.09	0.59	0.02	0.06	2.19
1973-74	0.82	1.21	0.16	0.48	0.02	0.14	2.83
1974-75	0.90	1.21	0.10	0.29	0.06	0.15	2.71
1975-76	0.70	1.21	0.05	0.27	0.05	0.15	2.43
1976-77	0.71	0.43	0.06	0.16	0.08	0.04	1.48
1977-78	0.70	0.43	0.06	0.11	0.10	0.03	1.43
1978-79	0.92	0.40	0.08	0.25	0.13	0.03	1.81
1979-80	0.92	0.48	0.06	0.27	0.15	0.01	1.89
1980-81	0.95	0.49	0.06	0.17	0.13	0.01	1.81
1981-82	0.96	0.43	0.05	0.18	0.20	0.01	1.83
1982-83	0.77	0.35	0.05	0.06	0.06	0.00	1.29
1983-84	0.80	0.38	0.06	0.00	0.00	0.00	1.24
1984-85	0.69	0.42	0.04	0.00	0.00	0.00	1.15
1985-86	0.66	0.27	0.01	0.00	0.00	0.00	0.94

TABLE I.17 ECONOMIC INDICATORS

Year	Consumer price index[a]	Private motoring cost[b]	Automotive fuel index[b]	Non-farm GDP[c]	Non-farm GDP deflator[d]	Farm GDP	Farm GDP deflator[d]
	1	2	3	4	5	6	7
	index	index	index	$m	index	$m	index
1964-65	29.9	29.6	24.6	17 908	30.8	2 170	45.9
1965-66	31.0	30.7	25.3	19 207	32.0	1 891	44.5
1966-67	31.8	31.5	26.0	20 933	32.9	2 326	43.2
1967-68	32.9	32.3	27.1	23 059	34.1	1 769	40.4
1968-69	33.7	34.1	26.9	25 671	35.5	2 355	39.0
1969-70	34.8	35.0	27.1	28 904	36.7	2 137	37.1
1970-71	36.5	36.7	29.5	32 323	38.6	1 943	34.3
1971-72	39.0	38.9	30.3	36 150	41.2	2 217	35.6
1972-73	41.3	40.5	30.6	40 632	43.8	3 085	57.4
1973-74	46.7	43.8	34.3	48 225	50.0	4 185	71.4
1974-75	54.5	52.8	39.6	59 509	60.9	3 679	57.6
1975-76	61.5	62.4	45.4	70 886	70.8	3 756	54.5
1976-77	70.1	68.7	47.4	81 120	78.9	4 150	58.4
1977-78	76.7	74.5	51.7	88 804	85.4	3 913	55.9
1978-79	83.0	81.7	63.5	98 934	91.2	6 359	77.0
1979-80	91.4	92.2	85.3	111 449	100.0	7 369	100.7
1980-81	100.0	100.0	100.0	128 142	110.6	7 071	107.5
1981-82	110.4	109.7	107.9	145 157	123.3	7 342	96.2
1982-83	123.1	123.4	125.0	161 244	136.8	5 582	90.9
1983-84	131.6	133.6	137.7	180 072	147.3	9 038	107.3
1984-85	137.2	142.1	148.0	200 487	156.8	9 053	105.0
1985-86	148.7	154.3	156.6	223 345	168.2	8 632	102.5

a. Index 1980-81 = 100 (eight capital cities).
b. This is a consumer price index subgroup. Index 1980-81 = 100 (eight capital cities).
c. Gross domestic product.
d. Index 1979-80 = 100.

DATA SOURCES

Column no.	*Source*
TABLE I.1	
1	DMR NSW (1987).
2	BTE (1977, 1982); CTER (1965); NSW Ministry of Transport (pers. comm., 1986); Rimmer (1970); see appendix II.
3	Column 1 multiplied by column 2.
4	ABS (1963, 1982); BTE (1982); CTER (1965); DMR NSW (1986); Joy (1975); Commission of Inquiry into the NSW Road Freight Industry (1980); MRD WA (1980); NAASRA (1985); Truck and Bus Transportation (1981).
5	Column 3 multiplied by column 4, divided by one million.
6	STA (1986).
7	GHA NSW (1986).
8	Column 6 minus column 7.
9	STA (1986).
10	BTE (1976, 1979, 1983); BTCE estimates; see appendix II for explanation of assumed constancy.
11	Column 8 multiplied by column 10, divided by one million.
12	Column 9 multiplied by column 10, divided by one million.
13,14	DofA (1986).
15,16	MSB NSW (1986).
TABLE I.2	
1,2	Henderson Consultants (1987).
3	State Transport Authority, Victoria (pers. comm., 1987).
4	ABS (1978); BTE (1986).
5	ABS (1972); ANL (pers. comm., 1987). These fares represent the Tasmania-Sydney route.
6	The 1985-86 travel time was given by the Long Distance Road Transport Association (pers. comm., 1987). This figure was then extrapolated by using bus times as a proxy (from Tasmanian Tourist Bureau 1981).
7	State Transport Authority, Victoria (pers. comm., 1987).
8	DofA (pers. comm., 1987). This is the direct route time between Melbourne-Sydney.
9	ABS (1972); ANL (pers. comm., 1987). These times refer to the Tasmania-Sydney route as a proxy.
TABLE I.3	
1,2	Highways Department, South Australia (1987); Western Australia Tourist Commission (1986).
3,4	ABS (1987a); ISC (1987).

5	Column 1 multiplied by column 3, divided by one million.
6	Column 2 multiplied by column 4, divided by one million.
7,8	ANRC (1981) ANRC (pers. comm., 1987).
9,10	DofA (1986).
11,12	Fremantle Port Authority (1986).

TABLE I.4

1	Henderson Consultants (1987). No rates were available for this corridor. Therefore the Melbourne-Sydney rates were used as estimates of the going rate for the service.
2	ROA (1986); STA (pers. comm., 1987). These rates represent the Melbourne-Perth route. ROA supplied data for between 1974 and 1986. Prior to that the Melbourne-Sydney rates were used as approximations to the rate changes.
3	ABS (1978); BTE (1986).
4	ABS (1972); ANL (pers. comm. 1987). These fares represent the Tasmania-Fremantle route, assuming an average weight of 14 tonnes per container.
5	1985-86 travel time was given by the Long-Distance Road Transport Association (pers. comm., 1987). This figure was then extrapolated by using the bus times for the Eastern States-Perth as a proxy (from Tasmanian Tourist Bureau 1981).
6	State Transport Authority, Victoria (pers. comm., 1987). These times refer to the Melbourne-Perth route.
7	DofA (pers. comm., 1987). These times refer to the Adelaide-Perth route.
8	ANL (pers. comm., 1987); State Ships (pers. comm., 1987). These times are based on the transit time (time at sea) for Sydney-Perth.

TABLE I.5

1,2	MSB NSW (1986).
3,4	DofA (1986).
5,6	ABS (1982, 1987a). There is no data available prior to the 1970-71 ABS survey. 1980-81 census data was used as the base year. Pre-1980 and post-1981 data from ABS was adjusted using traffic counts at Marulan as a measure of the 'actual' flow to and from Adelaide.
7,8	ANRC (pers. comm., 1987).
9,10	BTCE estimates; see appendix II for explanation of assumed constancy.
11	Column 7 multiplied by column 9.
12	Column 8 multiplied by column 10.

TABLE I.6

1,2	BTE (1986); Henderson Consultants (1987). An initial rate was given by the numerical series from BTE (1986). The Sydney-Melbourne rates were used as approximations for the changes in the rates.
3	ROA (1986).
4	ABS (1978); BTE (1986).
5	ANL (pers. comm., 1987). These rates refer to the Tasmania-Brisbane voyage. Sydney-Adelaide (by sea) is approximately the same distance as Tasmania-Brisbane; therefore the Tasmanian-Brisbane rate was used to represent the cost for freight carried along the Sydney-Adelaide route.

TABLE I.7

1,2	MSB NSW (1986).
3,4	DofA (1986).
5,6	ABS (1982, 1987a). 1980-81 was used as the base year. Pre- and post-1980-81 data was adjusted using traffic counts at Marulan as an indicator of the flow of traffic to and from Brisbane.
7,8	Queensland Railways (pers. comm., 1987).
9,10	BTCE estimates; see appendix II for explanation of assumed constancy.
11	Column 7 multiplied by column 9.
12	Column 8 multiplied by column 10.

TABLE I.8

1,2	Henderson Consultants (1984). The Sydney-Melbourne rates were used as a basis for determining rates of change between the years, prior to 1976 and after 1984.
3	ROA (1986).
4	ABS (1978); BTE (1986).
5	ANL (pers. comm., 1987). These rates represent the Tasmania-Sydney route.

TABLE I.9

1,2	Port of Melbourne Authority (1986).
3,4	DofA (1986).
5,6	ABS (1982, 1987a). 1980-81 census data was used as the base year. Pre- and post-1980-81 data was adjusted using traffic counts at Marulan as an indicator of the traffic flow to and from Adelaide.
7,8	STA (1986).
9,10	BTCE estimates; see appendix II for explanation of assumed constancy.

11	Column 7 multiplied by column 9.
12	Column 8 multiplied by column 10.

TABLE I.10

1,2	Henderson Consultants (1987).
3	ROA (1986).
4	ABS (1978); BTE (1986).
5	ANL (pers. comm., 1987). These rates refer to the Tasmania-Adelaide route.

TABLE I.11

1,2	Port of Melbourne Authority (1986).
3,4	DofA (1986).
5,6	ABS (1982, 1987a). 1980-81 census data was used as the base year. Pre- and post-1980-81 data was adjusted using traffic counts at Marulan as a measure of the traffic flow to and from Brisbane.
7,8	STA (1986)
9,10	BTCE estimates; see appendix II for explanation of assumed constancy.
11	Column 7 multiplied by column 9.
12	Column 8 multiplied by column 10.

TABLE I.12

1,2	BTE (1986); Henderson Consultants (1987). An initial rate was given by the numerical series in BTE (1986). The Sydney-Melbourne rate was used to determine the rate changes.
3	ROA (1986).
4	ABS (1978); BTE (1986).
5	ANL (pers. comm., 1987). These rates refer to the Tasmania-Brisbane route.

TABLE I.17

1-3	ABS (1986).
4-7	ABS (1987b).

APPENDIX II MEASUREMENT PROBLEMS OVERCOME

Time series models have been extensively used for modelling individual modes in transport. For example, the Bureau of Transport and Communications Economics has developed models for domestic and international air freight, liner shipping (imports), bulk shipping (exports) and intercity rail traffic. In modelling these three modes - air, sea and rail - time series models are possible because data on the basic flows is available over a sufficiently long period. For intercity road freight flows, however, the data firstly offers only partial coverage, secondly is available over only limited periods and thirdly lacks standardisation. Lacking adequate ways around this measurement problem for road freight flows between cities has meant that corridor modal share models have not previously been estimated for Australia.

A method of estimating road freight flows has now been developed. In addition, other measurement problems that were encountered in estimating data for the study have been addressed. These problems are discussed below.

ROAD

Freight flows

In looking at the problem of estimating corridor road freight flows in Australia, initially the Melbourne-Sydney[1] corridor was concentrated on, since four sets of information were available:

(1) truck counts at Marulan, 1964-65 to 1985-86;

(2) ABS survey estimates of partial road freight flows 1972-73 to 1978-79 and 1982-83 to 1985-86;

(3) ABS census estimates of freight flow 1980-81; and

---

1. 'Sydney' includes Newcastle and Wollongong. 'Melbourne' includes Geelong and Westernport.

(4) BTCE survey estimates of corridor road freight flows, 1972-73 to 1977-78.

From these four sets of information, three independent estimates were made of the freight flows, using:

- for (1) the 'truck counts estimation' method;
- for (2) and (3) the 'ABS survey estimation' method; and
- for (3) and (4) the 'direct estimation' method.

As will be seen, the three estimates agreed quite closely. This meant two things. Firstly, a degree of confidence in the estimates was established. Secondly, having validated the three methods against one another, it was possible to use any of these methods for other corridors with the same degree of confidence.

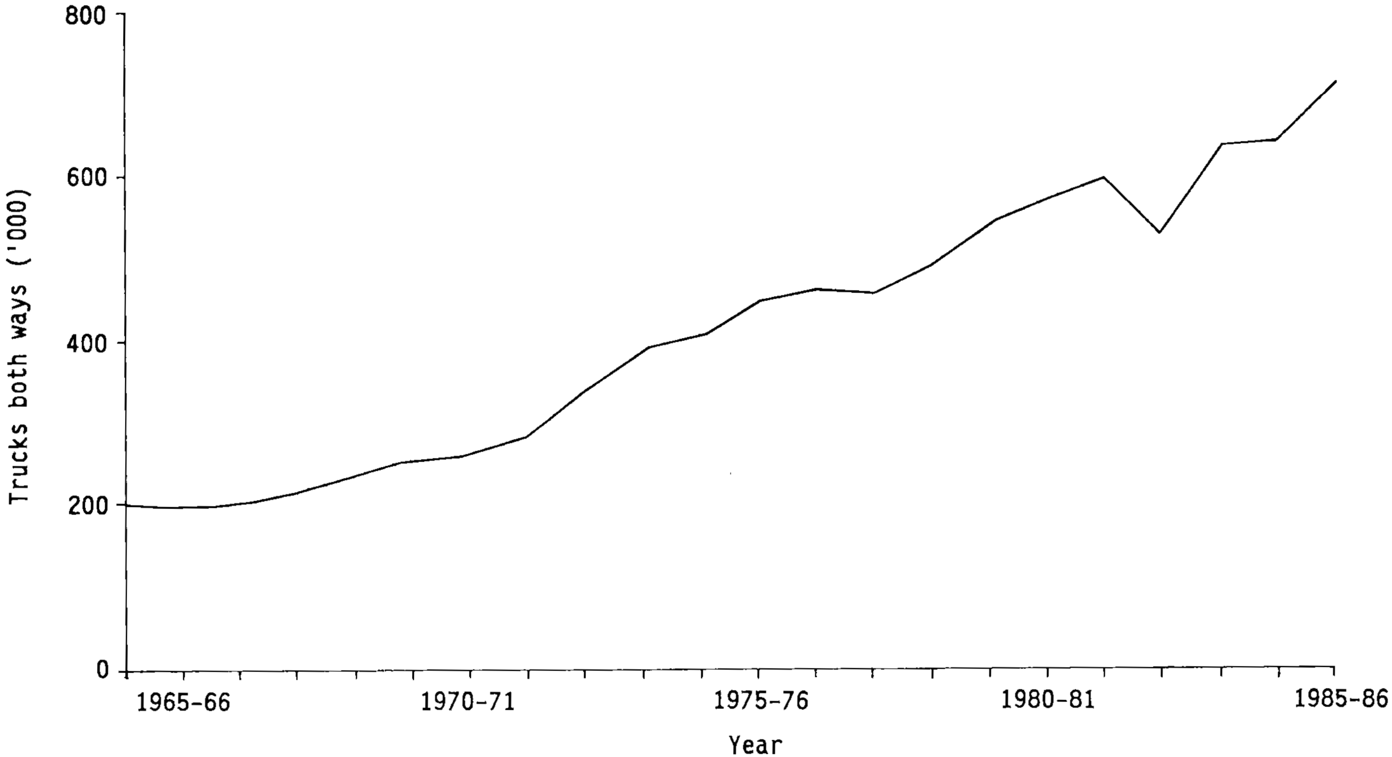
Melbourne-Sydney corridor

The first method of estimation was based on *truck counts* at Marulan. Figure II.1 shows the growth in truck numbers passing through the weigh station. Truck count data includes both 'local' and 'through' traffic. The 'through traffic count', which isolates end-to-end corridor flows, used an estimated fraction of trucks passing through Marulan whose origin-destination was Melbourne-Sydney or vice versa. Any traffic that moved beyond the corridor, for example Melbourne-Brisbane via Sydney, was excluded in the estimation of this origin-destination fraction. Figure II.2 presents the data drawn upon in estimating the origin-destination fraction, which has remained remarkably stable during the last 15 years at about 0.4. (Note this fraction is *not* a modal share, but rather the share of traffic between a certain origin-destination pair in the total traffic passing a counting point, or flow measurement point.)

Multiplying the time series for trucks through Marulan by the Melbourne-Sydney origin-destination fraction gave a time series for trucks travelling Melbourne-Sydney (both ways), as shown in figure II.3.

Data on the average load of trucks using the Melbourne-Sydney corridor was also estimated from previous studies, and is shown in figure II.4.

Deriving a final time series for road freight flows in the corridor was a matter of multiplying the Melbourne-Sydney truck numbers in figure II.3 by the load per truck estimates of figure II.4. Figure



Source DMR NSW (1987).

Figure II.1 Truck counts at Marulan

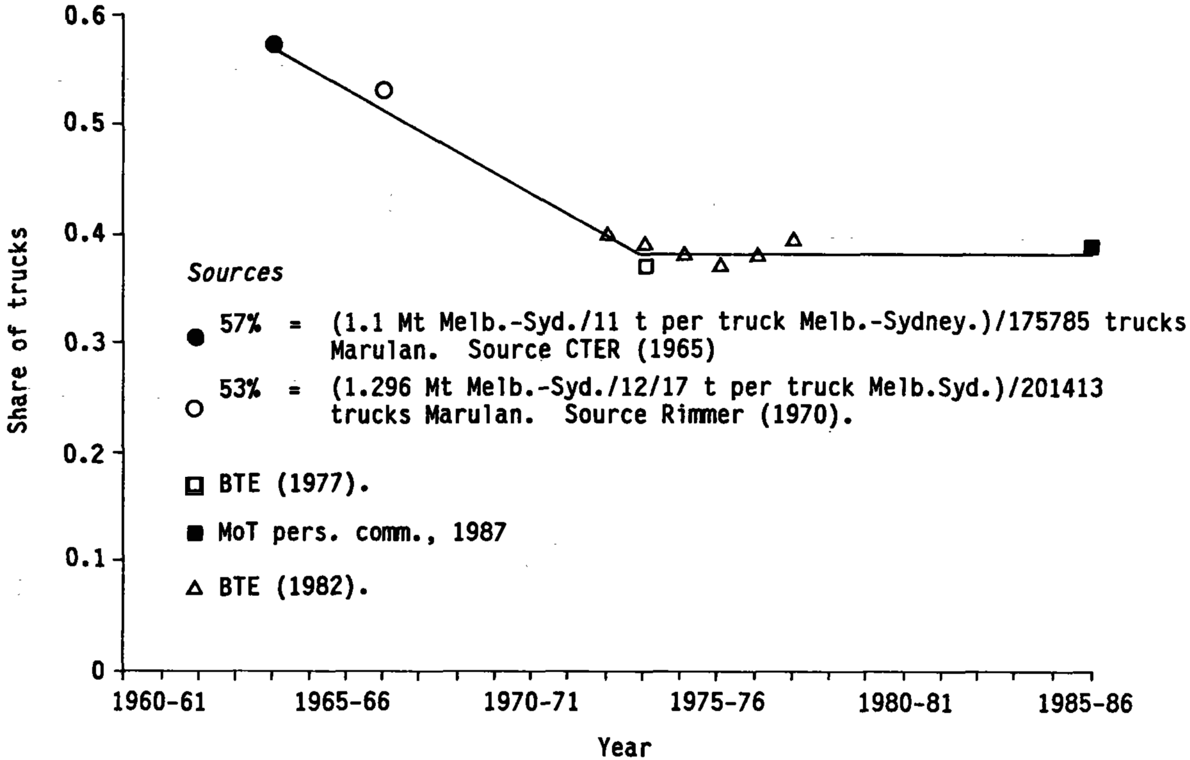
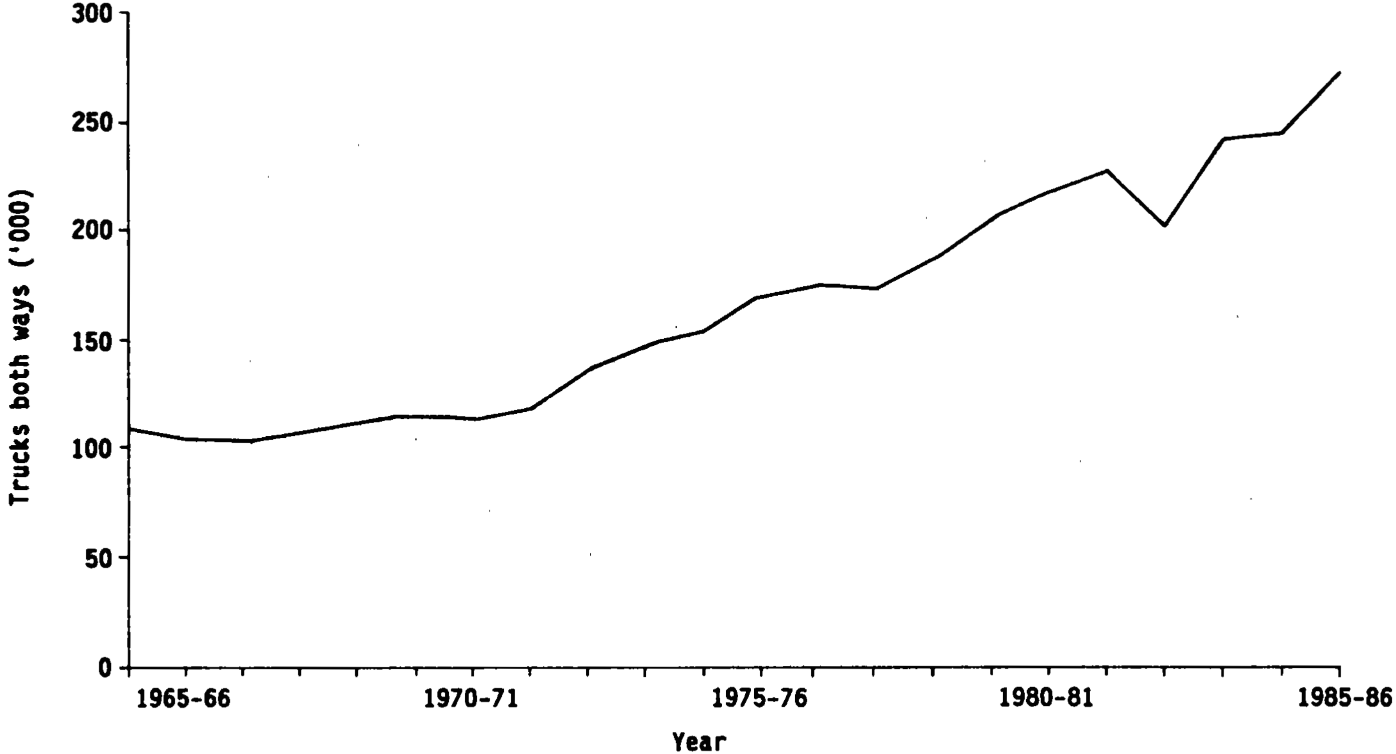


Figure II.2 Share of trucks through Marulan travelling Melbourne-Sydney corridor



Source Appendix table I.1.

Figure II.3 Melbourne-Sydney corridor trucks

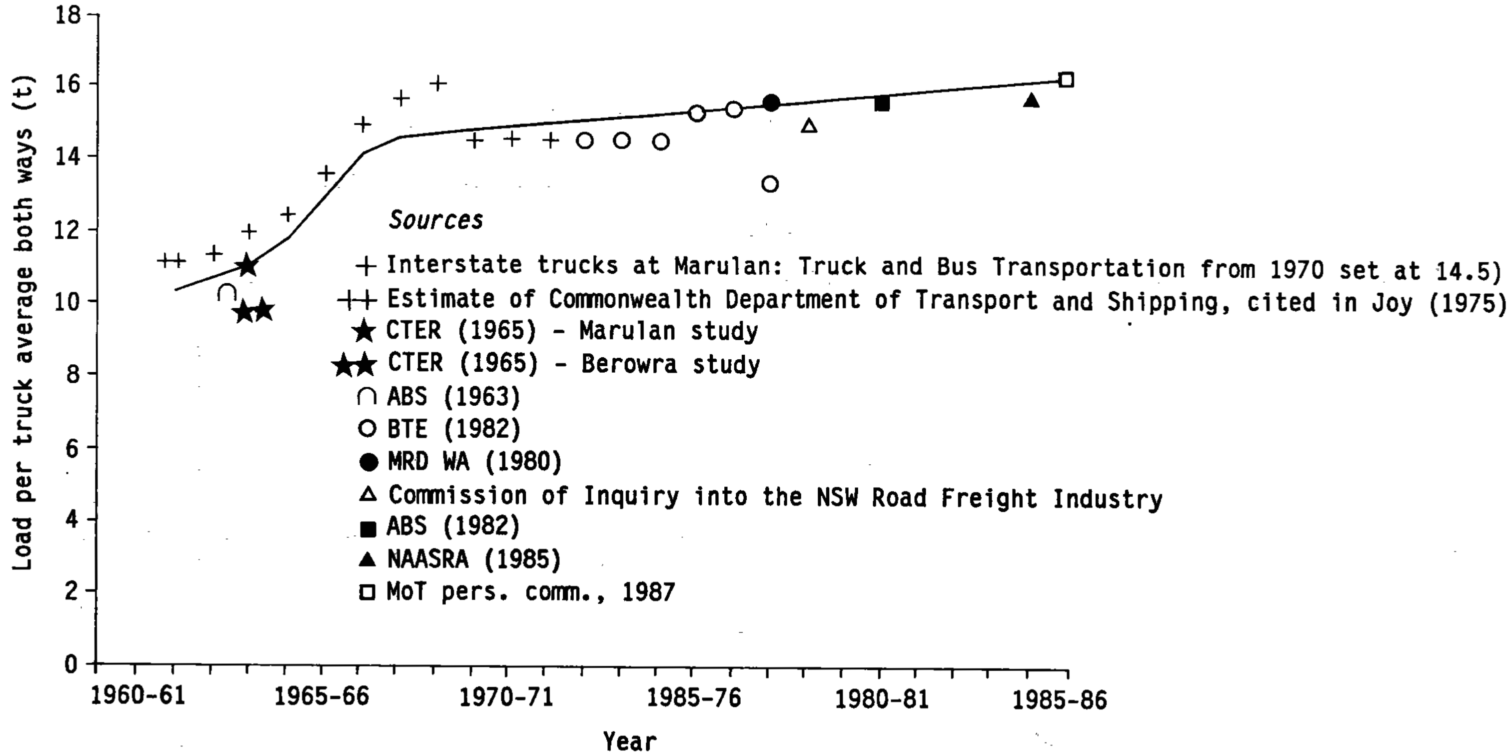
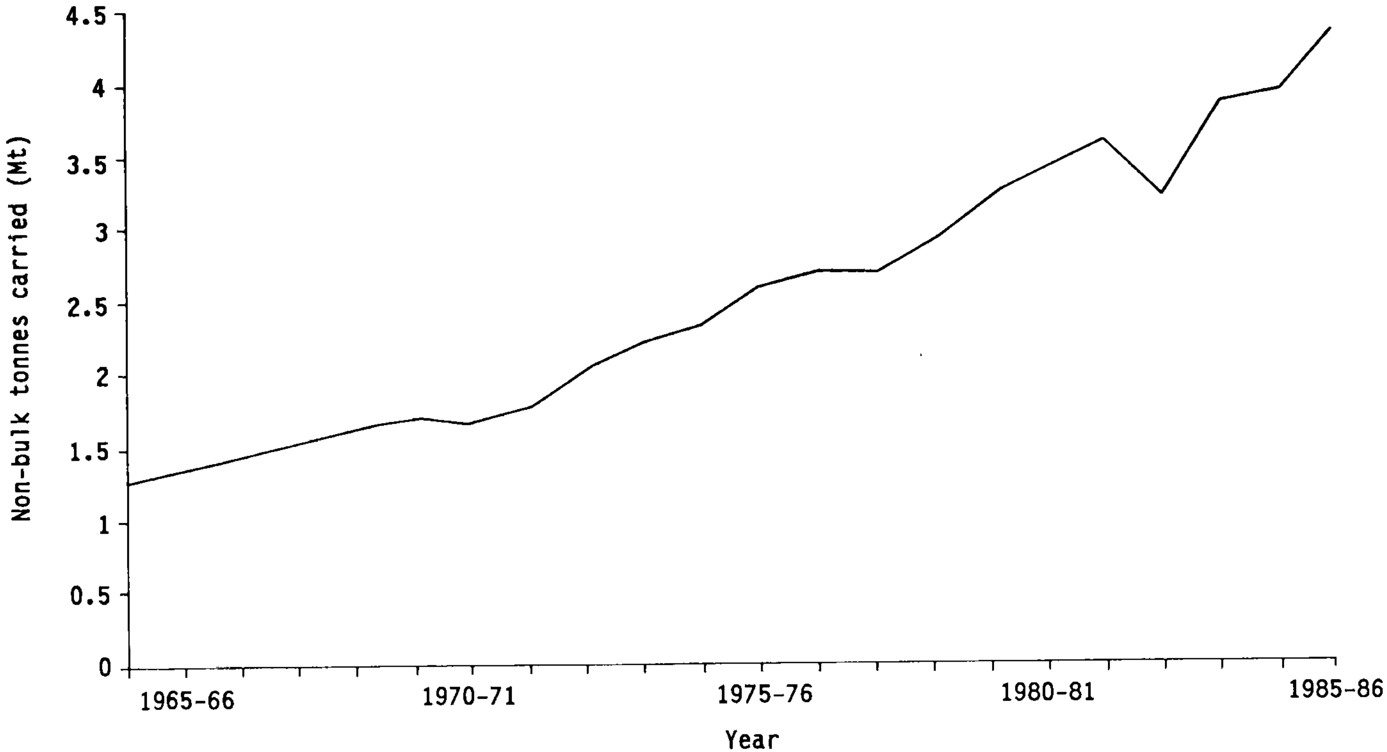
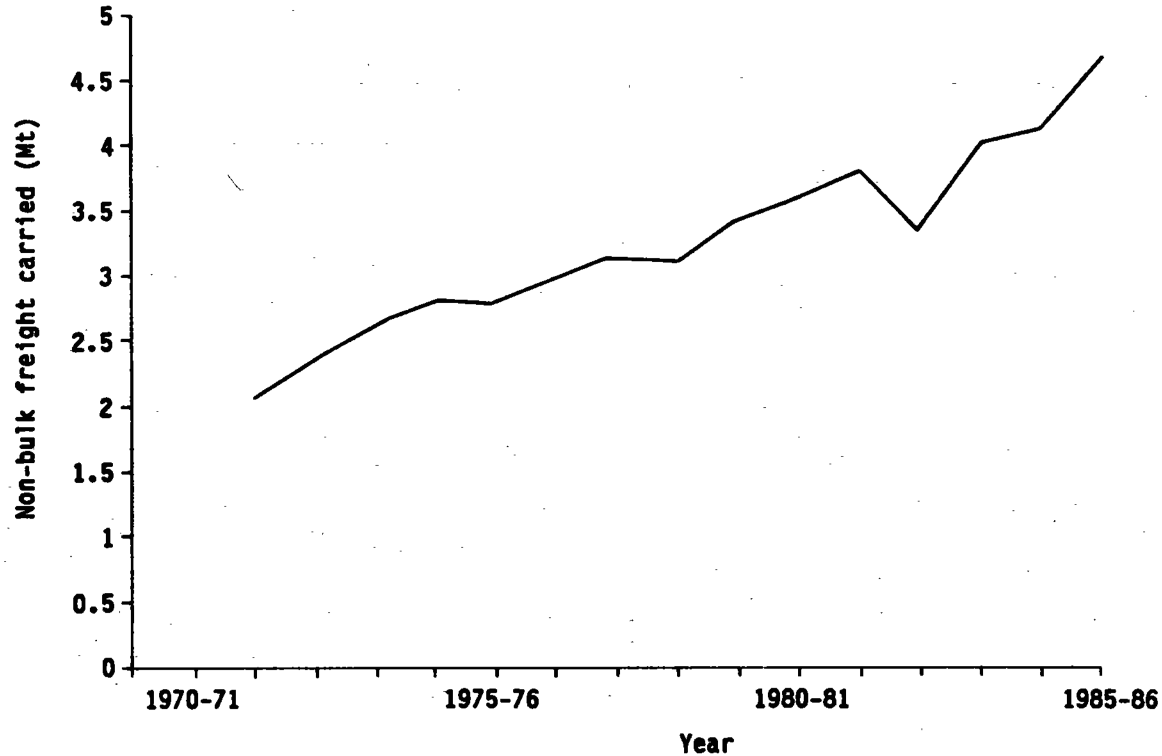


Figure II.4 Load per truck estimates for Melbourne-Sydney



Source Appendix table I.1.

Figure II.5 Melbourne-Sydney road freight estimated by the 'truck count estimation' method



Source BTCE estimates.

Figure II.6 Melbourne-Sydney road freight estimated by the 'ABS survey estimation' method

II.5 presents the time series for road freight flows Melbourne-Sydney, as derived from the 'truck count estimation' method.

The second estimation method used was the *ABS survey estimation.* Reliable data from an ABS survey of freight forwarders was available for the periods 1972-73 to 1978-79 and 1983-84 to 1985-86. However, in addition to the freight forwarders, independent owner-drivers carry significant amounts of freight. Thus the data from the ABS surveys could only be regarded as providing a partial coverage of the total road freight flows on the routes. However, the 1980-81 ABS census estimates of freight flows were as good an attempt at complete coverage as would be made. The census was sent to all truck owners, thereby assuring a (theoretically) complete coverage.

Therefore, to estimate total road freight flows from the ABS freight forwarders survey data, two assumptions were made:

- the fraction of freight moved by freight forwarders remained constant from 1972-73 to 1978-79 and again from 1982-83 to 1985-86; and
- the percentage change in total road freight movements between 1978-79 and 1980-81 and 1980-81 and 1983-84 could be approximated by the percentage change in truck movements at Marulan.

Applying the second assumption to the ABS 1980-81 census data gave estimates of total road freight flows from 1978-79 to 1983-84. Comparing the estimates of total freight for 1978-79 and 1983-84 with the freight forwarders survey estimates for the same years gave a fraction for each year. Dividing the survey estimates for 1972-73 to 1978-79 by the fraction for 1978-79 (as per the first assumption), gave an estimate of total freight flows Melbourne-Sydney for 1972-73 to 1978-79. The same procedure was followed for the 1983-84 to 1985-86 period. The process of putting together the series was thus like building a 'balancing scale'. The ABS census point estimate was the balancing point. The truck series, extrapolated either side, formed the two arms. Finally the two survey series stretching below and beyond that were raised to be placed on top of the 'truck series' arms. The result was an estimate of road freight flows for the years 1972-73 to 1985-86 in the Melbourne-Sydney corridor by the ABS survey estimation method. This is shown in figure II.6.

The third method used was the *direct estimation* method. Estimates were available for the period 1972-73 to 1977-78 from highway surveys conducted by the Bureau of Transport Economics (see BTE 1982) and from the 1980-81 ABS census (see ABS 1982). These are shown in figure II.7.

Figure II.8 compares the results of the three methods of estimation. There is a surprising degree of agreement between the three series on the level of and the trend in road freight movements in the Melbourne-Sydney corridor. The constant distance between the 'ABS survey' estimates and the 'truck count' estimates really only reflects the difference between the two series, at one point - the 1980-81 balancing point in the 'scale' analogy, and is not evidence of a consistently higher estimate over the time series. While the estimates do differ, there is enough agreement as to level, trend and short term variation to make modelling possible.

Taking this as a validation of the measurement methods, road freight flows in the other five major mainland intercity corridors were estimated.

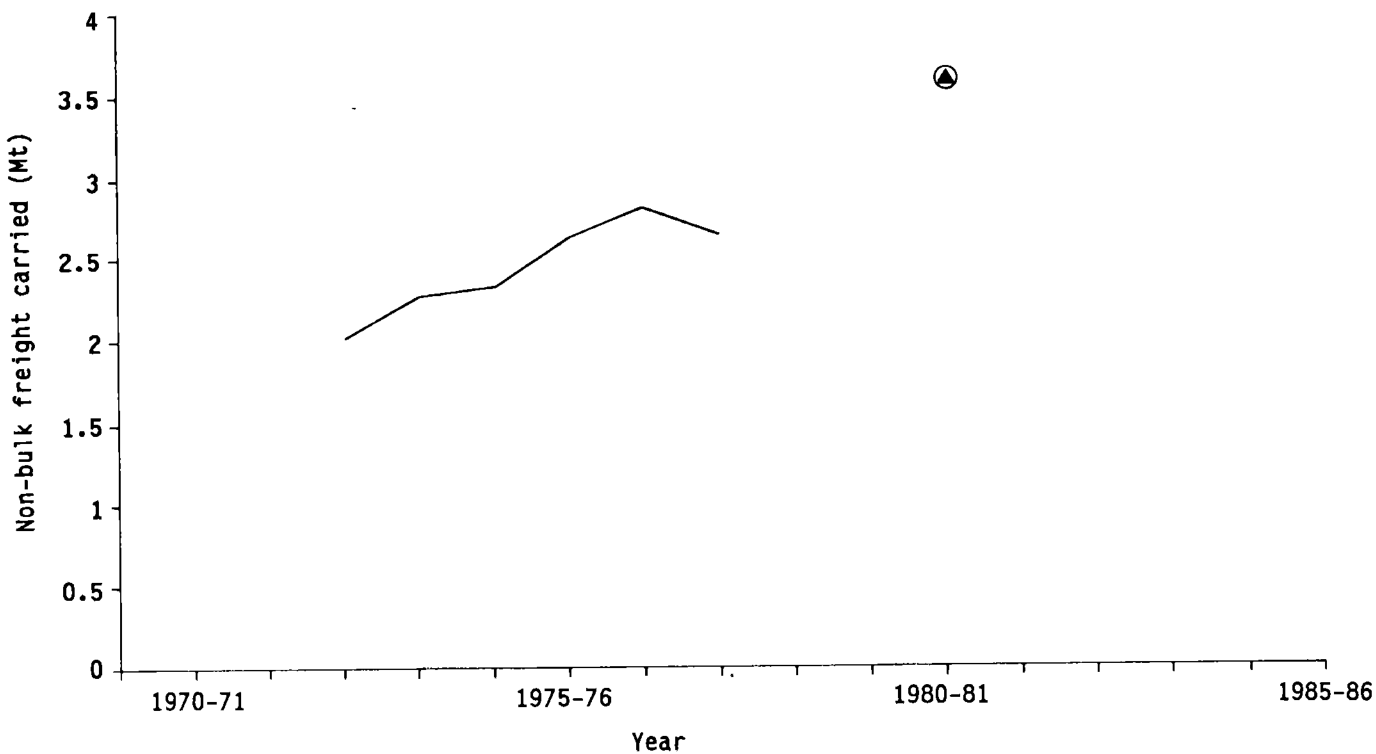
Eastern States-Perth corridor
The truck count estimation method was used for the Eastern States-Perth corridor, using truck counts at Ceduna. For this corridor, the method of freight flow estimated involved a similar procedure to that used for the Melbourne-Sydney corridor. However, there were differences in the data methodology between the two corridors. They were:

- the load per truck is directional;
- truck counts are directional; and
- no origin-destination fraction was necessary.

Truck count data involved counts of trucks and semitrailers. These counts are the number of trucks passing through the Ceduna Fruit Fly Block in South Australia. The truck counts are directional, that is, counts were taken for east and west bound traffic. No fraction was used for these truck counts because it was assumed trucks travelling westward after Ceduna could only be bound for Western Australia (and vice versa).

The load per truck series initially was difficult to determine, particularly in determining the backhaul load. According to various literature sources the average backhaul load was half the outhaul load. To construct the series involved using the following references:

- ABS census (ABS 1982); and
- Inter-State Commission survey (ISC 1987).



Sources ABS (1982); BTE (1982).

Figure II.7 Melbourne-Sydney road freight estimated by the 'direct estimation' method

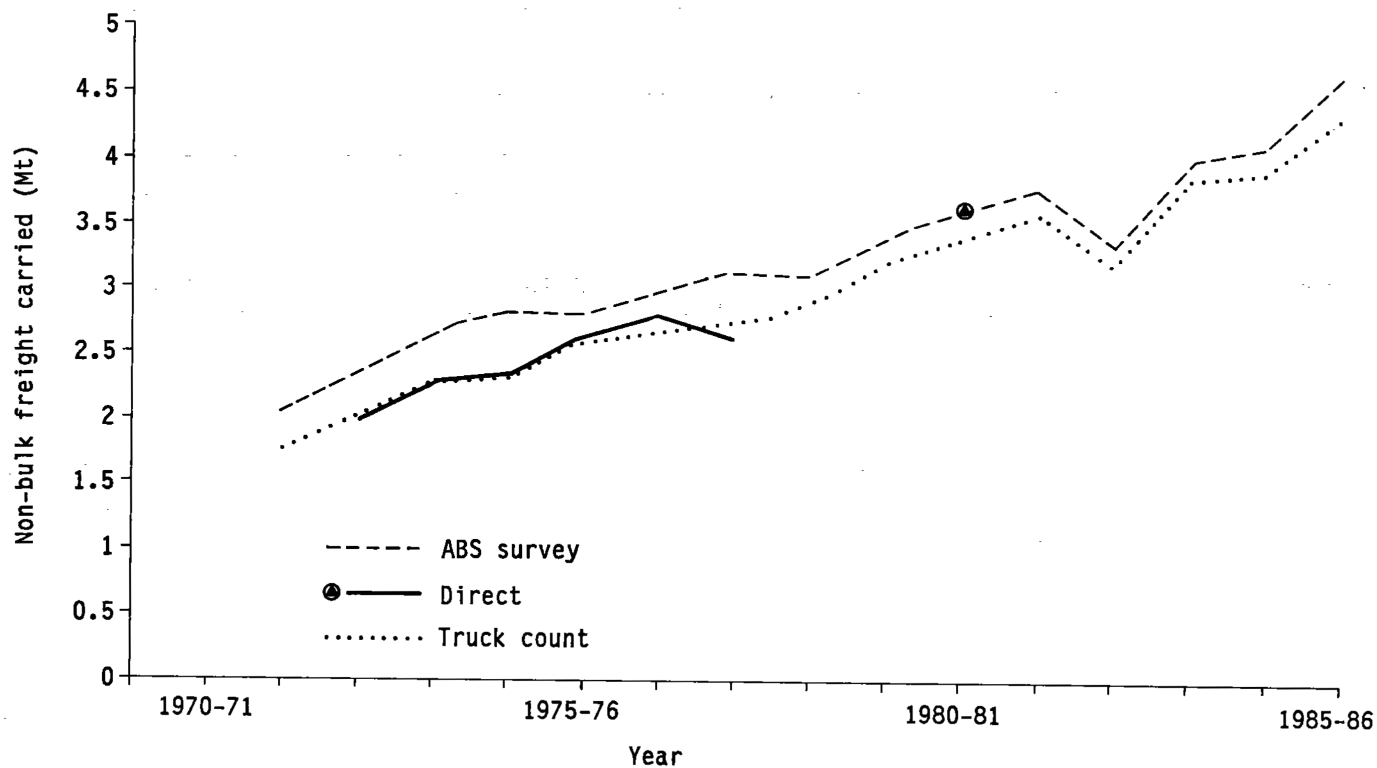


Figure II.8 Comparison of three methods for estimating Melbourne-Sydney freight

Both sources gave the same results. Firstly, westbound trucks caried 1.14 times the Melbourne-Sydney corridor load per truck. Secondly, eastbound trucks carried 0.58 times the Melbourne-Sydney corridor load per truck. Figure II.9 summarises the evidence drawn on in estimating east to west truck loads.

Therefore constructing the Eastern States-Perth corridor road freight data series involved the following items and procedures:

(1) truck counts, eastbound;

(2) truck counts, westbound;

(3) load per truck, eastbound;

(4) an estimate of eastbound road freight tonnages - (1) multiplied by (3);

(5) load per truck, westbound;

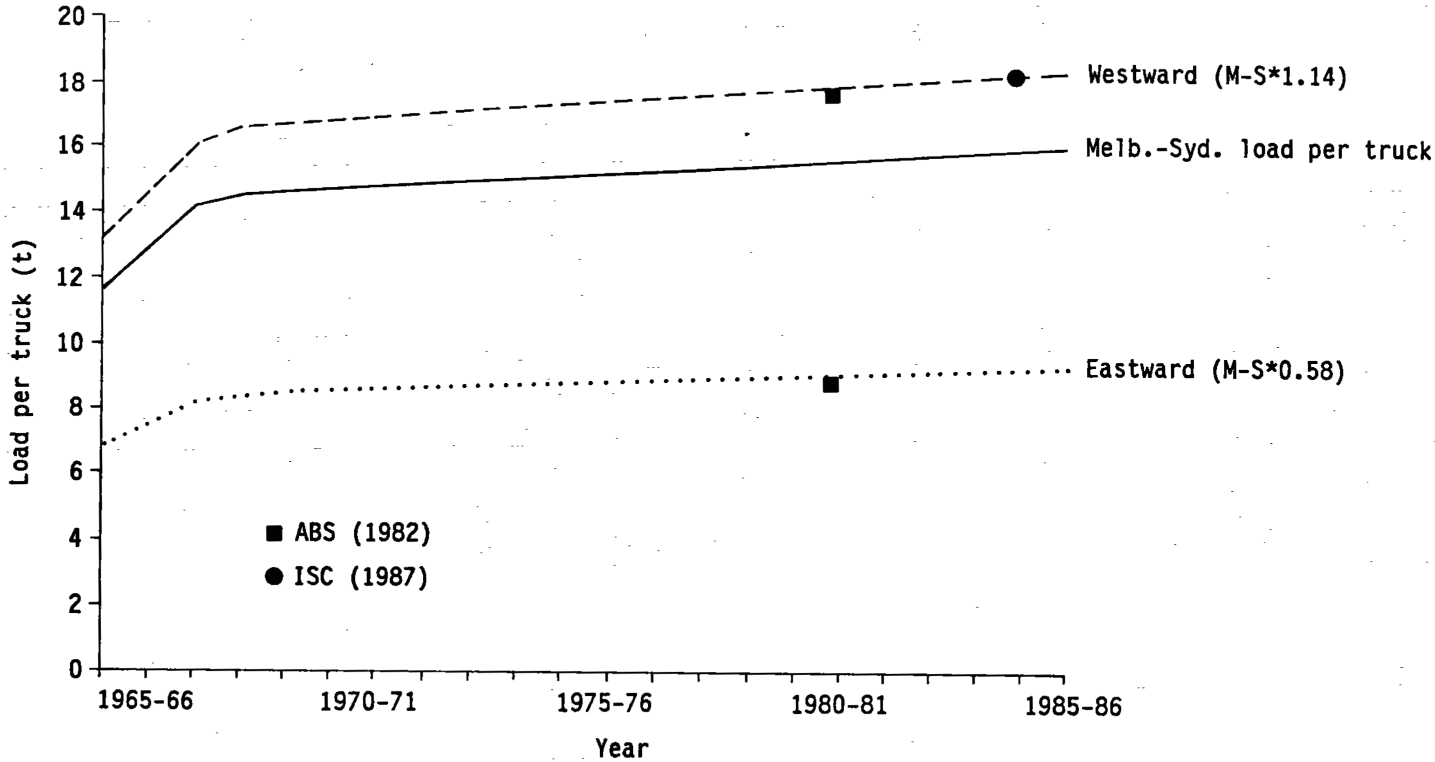
(6) an estimate of westbound road freight tonnages - (2) multiplied by (5).

Adelaide and Brisbane corridors

The ABS survey estimation method was used for the remainder of the corridors (Melbourne-Adelaide, Melbourne-Brisbane, Sydney-Adelaide and Sydney-Brisbane).

On the corridors leading to Adelaide and Brisbane there were three pieces of information available. Firstly, a 1980-81 census was undertaken by the (ABS 1982). Secondly, two partial road freight surveys were also undertaken by the ABS (ABS 1986), the first over the period 1971-72 to 1978-79, the second since 1982-83. The census data was used as a base year for freight flows along the four corridors. The census, being a complete coverage of flows, was used to 'calibrate' the partial survey data.

The calibration involved using the third source of information (truck counts at Marulan) to link the end points of the two surveys with the 1980-81 base of the census. It was assumed that the percentage movements in the truck counts could, over a short period, indicate likely movements in road freight. Thus, for example, the last partial survey figure of 1978-79 was increased by the same percentage as the increase in Marulan truck movements between 1978-79 and 1980-81, to give an estimate of what the partial survey figure would have been in 1980-81. Comparing this with the census figure gave an estimate of the fractional coverage of the partial survey. Dividing the partial survey estimate by this fraction gave a time series of estimated total freight movements in the corridors.



Sources ABS (1982); Highways Department of SA (1987); ISC (1987).

Figure II.9 Load per truck estimates for Eastern States-Perth trucks

Freight rates

Road freight rates were constructed from two main sources. The first source was a BTCE contract with a private consultancy firm (Henderson Consultants 1987) and the second was contractor rates from the Long Distance Road Transport Association (available in BTE 1986). A single rate is assumed to apply for each direction on the corridor. While this is demonstrably not the case in reality, use of this assumption simplifies the modelling and should make no difference to the estimated coefficients as long as the outhaul and backhaul rates move in the same manner. All road rates are in dollars per tonne. Rates for some corridors were not available for the entire time series.

Melbourne-Sydney and Melbourne-Adelaide rates are the only two rates that cover the complete time series period. The data available represented only an approximate calendar year rate, effective 1 April of the respective year. A weighted average was hence used to adjust the series to a financial year rate.

There were no rates available for the Eastern States-Perth corridor. Melbourne-Sydney road rates were provisionally substituted as a proxy for variation in the going rate for the service. Most of the other corridors lacked a consistent time series. The data that was available was extrapolated by using the Melbourne-Sydney rate as a guide to the rate of change between the years. For example, Sydney-Adelaide and Melbourne-Brisbane had an initial rate available in 1976-77. Sydney-Brisbane had a series available between 1976-77 and 1983-84. Beyond this period the Melbourne-Sydney rate was used to extrapolate rate changes.

RAIL

Freight flows

Intersystem rail freight data, provided by the State rail authorities, refers to State-to-State freight tonnages. Origin-destination fractions were required to determine the intercapital freight flow on all corridors except Eastern States-Perth, where it was desired to measure all trans-Nullarbor freight flows. The Adelaide and Brisbane corridors have an origin-destination fraction that applies for each direction of freight.

Rail freight on the Melbourne-Sydney corridor was initially difficult to estimate. Grain shipments over the border to Victorian ports disrupted the data series, particularly for southbound traffic. Once the amount of grain crossing the border by rail was eliminated from the time series, general freight between the two capitals could be assessed.

An origin-destination fraction for the Melbourne-Sydney corridor was determined using three studies. Table II.1 gives details of the studies and the fractions derived for the Melbourne-Sydney corridor. As no trend over time was apparent in the figures, information from all three studies was used in ariving at a final judgment of the origin-destination fractions.

TABLE II.1 ORIGIN-DESTINATION FRACTION ESTIMATES FOR MELBOURNE-SYDNEY RAIL FREIGHT

Source	*Year*	*Melbourne-Sydney*[a] *(kt)*	*Total NSW-Vic. (kt)*	*Total without wheat (kt)*	*Fraction*[b]
BTE (1976)	1971-72	1 761	2 097	2 076	0.85
BTE (1979)	1975-76	1 428	1 765	1 740	0.82
BTE (1983)	1979-80	1 774[c]	2 356	1 910	0.93

a. 'Melbourne' includes Melbourne, Westernport and Geelong. 'Sydney' includes Sydney, Newcastle and Wollongong.
b. Equals Melbourne-Sydney tonnages divided by 'total without wheat' tonnages.
c. Intercity traffic levels were overestimated as this figure refers to Sydney, Newcastle and Wollongong to Victoria, and Melbourne Westernport and Geelong to NSW. Therefore the origin-destination fraction is also overestimated.

Table II.2 shows the origin-destination fractions for rail freight flows for five of the corridors. No origin-destination fraction was necessary for the Eastern States-Perth corridor as the aim was to measure all trans-Nullarbor freight flows. The final estimates of origin-destination fractions adopted for each corridor are presented in the data tables of appendix I. These were arrived at by combining information from table II.2 with information derived from discussions with the individual State rail systems.

TABLE II.2 RAIL FREIGHT ORIGIN-DESTINATION FRACTION ESTIMATES FOR FIVE OF THE MAINLAND CORRIDORS

	Year		
Corridor	*1971-72*	*1975-76*	*1979-80*
Melbourne-Sydney	0.85	0.82	0.93[a]
Melbourne-Brisbane			
Northbound	0.91	0.76	0.78[a]
Southbound	0.77	0.70	na
Melbourne-Adelaide			
Eastward	0.87	0.79	0.82[a]
Westward	0.62	0.61	0.68
Sydney-Brisbane			
Northbound	0.74	0.70	0.96[a]
Southbound	0.74	0.39	na
Sydney-Adelaide			
Eastward	0.14	0.15	0.94[a]
Westward	0.12	0.17	0.27

a. Based on city to system statistics: overestimates origin-destination fraction; for example, Adelaide-NSW includes substantial traffic to Broken Hill.
na Not available.

Sources BTE (1976, 1979, 1983); BTCE estimates.

Freight rates

Rail rates were derived from the *Goods Rate Book* (ROA 1986), with the exception of the Melbourne-Sydney rate which refers to a forwarding agent's rate. The rates apply for both directions of traffic, and are in dollars per tonne.

Rates from the *Goods Rate Book* refer to a general freight rate. According to this book, freight and its respective rates are divided into classes. In the analyses, the general rate or 'class C' rate was used.

Railways of Australia data applied from 1974-75 to 1985-86. Prior to this period a Melbourne-Sydney rate was used to extrapolate other corridors' rate changes. Melbourne-Perth was used to represent the Eastern States-Perth corridor.

AIR

Freight flows

Prior to 1979-80, the air freight data refers to the two major airline carriers - Ansett and Australian Airlines (previously Trans Australian Airlines). From 1979-80, the data was directional and refers to uplifts and discharges within flight, that is uplifts and final destination of freight tonnages within a particular flight number.[2]

Due to the lack of origin-destination estimates for air freight corridor flows, no fractions were used to adjust the data for the effects of any possible indirect feeders into each corridor.

Freight rates

Freight rates for air refer to a dollars per kilogram rate for a 20 kilogram package. The rate applies for both directions of flight.

An initial series from 1964-65 to 1977-78 was available from published ABS air freight rates (ABS 1978), appling to all Sydney-bound corridors (including Sydney-Perth as the Eastern States-Perth rate). To extend the series to 1985-86 involved using Ansett and Australian Airline rates published in BTE 1986.

Rates for all Melbourne-bound corridors (excluding Melbourne-Sydney) for the period 1978-79 to 1985-86 were derived from Ansett and Australian Airlines rates published in BTE (1986). To continue the series back from 1978-79 to 1964-65 involved substituting another route that linked the series, as an approximate estimate of the movement of rates on that service.

SEA

Freight flows

The time series data for sea freight refers to non-bulk freight, which was calculated by eliminating bulk freight from the total sea freight

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2. As defined by DofA (1986), 'uplifts and discharges within flight' detail by direction the initial point of uplifts and the final destination of revenue traffic within a particular flight number, that is, the movement between two airports not necessarily directly connected but within the same flight number series.

data provided by the State port authorities, according to imports and exports from the respective interstate port.

Bulk freight included oil and petroleum products, grain, sugar, minerals, timber, chemicals and any other categorised bulky material. Non-bulk freight hence included iron and steel, motor vehicles and parts, steel products, food and beverages, fruit and vegetables and any other non-bulky products.

As the freight tonnages destined for cities beyond the corridor could not be assessed, State-to-State sea freight was used as an approximate estimate for freight consigned between the two cities determining a particular corridor. Therefore no corridor origin-destination fractions were applied to sea freight. This assumption was believed to be realistic. In addition, as corridor origin-destination fractions are very slow to change (see the discussion of rail origin-destination fractions above), it was felt that the assumption would not bias the elasticities estimated in the sea freight models.

Freight rates

Obtaining data on sea freight rates presented problems. Prior to 1972-73 the ABS had published rates on all corridors (ABS 1972). Where data was missing in any one year it was interpolated. This gave a freight rate series on each of the corridors from 1964-65 to 1971-72.

However, after 1971-72, the only data publicly available was data from the Australian National Line on routes out of Tasmania.

The solution adopted to derive a set of complete sea freight rate series was to assume that a Tasmania-to-the-mainland route of approximately equal distance would be used as a proxy for each intercapital route. The rates that were paired in this way were:

- Melbourne-Sydney = Tasmania-Sydney;
- Melbourne-Brisbane = Tasmania-Brisbane;
- Melbourne-Adelaide = Tasmania-Adelaide;
- Sydney-Brisbane = Tasmania-Sydney;
- Sydney-Adelaide = Tasmania-Brisbane;
- Eastern States-Perth = Tasmania-Fremantle.

These ANL series from 1971-72 to 1985-86 were then compared with the rates published in ABS (1972); the agreement was judged adequate. Each ANL series was therefore extrapolated backwards using the percentage changes in the relevant ABS series.

Before this could be done, however, there was a major difference in the two data series to be resolved. ANL data referred to a dollars per container rate whereas ABS data referred to a dollars per tonne of general cargo rate. Compatability between the two series was achieved by dividing the container rates by an average container weight of 14 tonnes.

CONCLUSIONS REGARDING DATA MEASUREMENT

There are several conclusions that can be made about data measurement for the present study.

First, the problem of constructing road freight flows has been solved in such a way as to provide adequate time series. This applies to both the level and trend of the series. Second, other data problems have been resolved in such a way as to yield good approximations for the data derived. Third, it should be borne in mind that the art of fitting equations to time series is always beset with difficulties. There exists the possibility of measurement error in the equations presented, given the severe measurement problems faced in deriving the data. However, a variety of corridor models have been fitted, using data derived by a variety of methods (appendix III). The degree of consistency in the results (discussed in chapter 3) lends credence to the measurement methods developed, as does the validation of the road freight measurements described above.

APPENDIX III REGRESSION ANALYSIS RESULTS

Log linear regressions of the form described in chapter 3 were estimated for the various corridors and modes.

The details of the models for the six corridor and aggregate flows are provided in tables III.1 to III.7 respectively for Melbourne-Sydney, Eastern States-Perth, Melbourne-Brisbane, Sydney-Adelaide, Melbourne-Adelaide, Sydney-Brisbane, and the aggregate corridors.

Variables not (statistically) significantly different from zero were left in the equations if their presence was felt to convey some theoretical information. Thus, for example, the slight negative elasticity on income in the rail freight equation for the Melbourne-Sydney corridor was left in to highlight the fact that rail in this important corridor (in contrast to road) does not seem to be participating in the benefits of economic growth (see table III.1). Similarly, the coefficient on the rail freight rate variables in all but the Eastern States-Perth corridor tended to be relatively small. This indicates a consistent trend toward inelastic response to freight rate increases, a fact that would not be highlighted if the freight rate variables were dropped when they were not statistically different from zero.

TABLE III.1 MELBOURNE-SYDNEY DEMAND ELASTICITIES

	Real freight rates							*Dummy variables*		
Mode	*Road*	*Rail*	*Air*	*Sea*	*Real income*	$\bar{R}^2$	*DW*[a]	*D83*[b]	*D75*[c]	*D74*[d]
Road	-0.7030	..	..	..	1.0363	0.99	1.42	-0.1173	..	..
	(-5.06)				(9.48)			(-3.67)		
Rail	0.1243	-0.2536[f]	..	..	-0.1219	0.63	1.90	..	-0.1477	..
	(0.86)	(-1.02)			(-0.66)				(-2.57)	
Air	..	..	..	..	0.9129	0.92	1.82	..	..	..
					(8.54)					
Sea	..	1.4093	..	-0.1267	1.2584	0.88	1.99	..	..	0.7516
		(1.24)		(-0.59)	(1.86)					(4.03)

a. Durban-Watson statistic.
b. Equals 1 for the economic recession in 1982-83; 0 otherwise.
c. Equals 1 to account for the structural adjustment in rail freight after 1974-75; 0 otherwise.
d. Increased shipment of steel; equals 0 to 1972-73; 1 otherwise.
f. Rail forwarding agents rate.
.. Not applicable.

Note t-statistics are in parentheses; a t-statistic greater than 2.1 indicates that the coefficient is significantly different from zero (at the 0.05 level of significance).

TABLE III.2 EASTERN STATES-PERTH DEMAND ELASTICITIES

	Real freight rates							Dummy variables	
Mode	*Road*	*Rail*	*Air*	*Sea*	*Real income*	$\bar{R}^2$	*DW*[a]	*D83*[b]	*D76*[c]
Road	-3.1695	..	..	..	1.3007	0.95	1.57	..	0.3500
	(-2.94)				(1.57)				(1.27)
Rail	..	-0.9155	..	0.2306	1.2875	0.98	1.66	0.0247	..
		(-1.83)		(1.22)	(4.19)			(0.39)	
Air	..	..	..	..	3.1572	0.96	1.72		
					(12.70)				
Sea	1.5149	2.2945	..	-1.1073	0.7233	0.81	1.87	..	..
	(2.10)	(1.73)	(-1.65)	(0.86)					

a. Durbin-Watson statistic.
b. Equals 1 for the economic recession in 1982-83; 0 otherwise.
c. The Eyre Highway was sealed in 1976; equals 0 before 1975-76; 1 otherwise.
.. Not applicable.

Note t-statistics are in parentheses; a t-statistic greater than 2.1 indicates that the coefficient is significantly greater than zero (at the 0.05 level of significance).

TABLE III.3 MELBOURNE-ADELAIDE DEMAND ELASTICITIES

	Real freight rates							*Dummy variables*		
Mode	*Road*	*Rail*	*Air*	*Sea*	*Real income*	$\bar{R}^2$	*DW*[a]	*D83*[b]	*D69*[c]	*SeaD*[d]
Road	..	..	..	..	1.1309	0.84	2.88	..	..	..
					(8.33)					
Rail	..	-0.0880[f]	..	..	0.6855	0.84	1.48	-0.1781	-0.3735	..
		(-0.16)			(0.36)			(-1.89)	(-4.22)	
Air	..	..	-0.1909	..	0.8743	0.74	1.29	..	..	..
			(-2.12)		(7.48)					
Sea	..	..	..	..	1.3961	0.98	1.51	..	..	-11.1780
					(2.16)					(-30.20)

a. Durbin-Watson statistic.
b. Equals 1 for the economic recession in 1982-83; 0 otherwise.
c. Equals 1 to account for the low rail freight in 1968-69; 0 otherwise.
d. Equals 1 in 1983-84 to 1985-86 to account for the downturn in sea trade with Melbourne; 0 otherwise.
f. Rail forwarding agent rate.
.. Not applicable.

Note t-statistics are in parentheses; a t-statistic greater than a certain value indicates that the coefficient is significantly different from zero (at the 0.05 level of significance). These values are 2.1 for air, rail and shipping and 2.2 for road.

TABLE III.4 MELBOURNE-BRISBANE DEMAND ELASTICITIES

	Real freight rates							*Dummy variables*		
Mode	*Road*	*Rail*	*Air*	*Sea*	*Real income*	$\bar{R}^2$	*DW*[a]	*D83*[b]	*D695*[c]	*SeaD*[d]
Road	..	..	..	..	2.0249 (11.45)	0.91	1.68	..	..	..
Rail	..	-0.1228 (-1.20)	..	..	1.0987[f] (7.41)	0.86	1.70	-0.1694 (-2.34)	-0.3150 (-8.78)	..
Air	..	..	-0.6791 (-1.75)	..	6.8345 (15.16)	0.93	2.12	..	..	..

a. Durbin-Watson statistic.
b. Equals 1 for the economic recession in 1982-83; 0 otherwise.
c. Equals 1 to account for the slump in rail freight between 1968-69 and 1974-75; 0 otherwise.
d. Equals 1 to account for the downturn in sea trade with Melbourne in 1983-84 and 1985-86; 0 otherwise.
f. Average of gross domestic product and non-bulk Queensland interstate trade.
.. Not applicable.

Note t-statistics are in parentheses; a t-statistic greater than a certain value indicates that the coefficient is significantly different from zero (at the 0.05 level of significance). These values are 2.1 for air, rail and shipping and 2.2 for road.

TABLE III.5 SYDNEY-ADELAIDE DEMAND ELASTICITIES

	Real freight rates						*Dummy variables*			
Mode	*Road*	*Rail*	*Air*	*Sea*	*Real income*	$\bar{R}^2$	*DW*[a]	*D83*[b]	*D85*[c]	*D84*[d]
Road	..	..	..	..	1.9725	0.95	1.96	-0.0843	-0.1285	..
					(15.38)			(-1.73)	(-2.44)	
Rail	..	-0.4601	..	..	1.5282	0.80	2.52	..	..	-0.3069
		(-1.60)			(1.64)					(-4.05)
Air	..	..	-0.2623	..	1.9178	0.95	1.46	..	..	..
			(-3.08)		(19.31)					
Sea	..	..	..	-1.6789	0.2646	0.97	1.27	-1.1027	..	-4.1524
				(-3.81)	(0.33)			(-3.55)		(-17.15)

a. Durbin-Watson statistic.
b. Equals 1 for the economic recession in 1982-83; 0 otherwise.
c. Equals 1 in 1984-85 to account for a downturn; 0 otherwise.
d. Acccounts for the downturn in sea trade with Sydney; equals 1 in 1983-84 to 1985-86; 0 otherwise.
.. Not applicable.

Note t-statistics are in parentheses; a t-statistic greater than a certain value indicates that the coefficient is significantly different from zero (at the 0.05 level of significance). These values are 2.1 for air and shipping, 2.2 for road and 2.3 for rail.

TABLE III.6 SYDNEY-BRISBANE DEMAND ELASTICITIES

	Real freight rates							*Dummy variables*	
Mode	*Road*	*Rail*	*Air*	*Sea*	*Real income*	$\bar{R}^2$	*DW*[a]	*D83*[b]	*SeaD*[c]
Road	..	..	..	..	1.0880	0.74	1.79	-0.1231	..
					(6.50)			(-1.57)	
Rail	..	-0.1130	..	..	1.3263	0.96	1.74	..	..
		(-1.63)			(22.81)				
Air	..	..	..	..	1.2503	0.95	1.61	..	..
					(20.42)				
Sea	..	..	..	-0.3658	-1.5830	0.79	2.35	..	-1.1536
				(-0.79)	(-1.77)				(-3.54)

a. Durbin-Watson statistic.
b. Equals 1 for the economic recession in 1982-83; 0 otherwise.
c. Equals 1 to account for the downturn in sea trade with Sydney in 1984-85 and 1985-86; 0 otherwise.
.. Not applicable.

Note t-statistics are in parentheses; a t-statistic greater than a certain value indicates that the coefficient is significantly different from zero (at the 0.05 level of significance). These values are 2.1 for air, shipping and rail, and 2.2 for road.

TABLE III.7 AGGREGATE DEMAND ELASTICITIES

	Real freight rates							
Mode	Road	Rail	Air	Sea	Real income	R^2	DW[a]	D85[b]
Road	..	..	..	..	1.93 (25.32)	0.98	2.6	..
Rail	..	-0.10 (-0.46)	..	..	0.59 (3.79)	0.87	1.5	..
Air	..	..	..	..	1.22 (18.63)	0.95	1.4	..
Sea	..	..	..	-0.83 (-6.13)	0.64 (2.58)	0.87	1.2	-0.75 (-6.06)

a. Durbin-Watson statistic.
b. Equals 1 to account for the closure of shipping services in 1984-85 and 1985-86; 0 otherwise.

Note t-statistics are in parentheses; a t-statistic greater than a certain value indicates that the coefficient is significantly different from zero (at the 0.05 level of significance). These values are 2.2 for road and 2.1 for air, rail and coastal shipping (values for the Sydney-Adelaide rail corridor being roughly estimated for the aggregate model for missing years).

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ABS	Australian Bureau of Statistics
ANRC	Australian National Railways Commission
BTCE	Bureau of Transport and Communications Economics
BTE	Bureau of Transport Economics
CTER	Committee on Transport Economic Research
DofA	Department of Aviation
DMR NSW	Department of Main Roads, New South Wales
GHA NSW	Grain Handling Authority of New South Wales
ISC	Inter-State Commission
MRD WA	Main Roads Department, Western Australia
MSB NSW	Maritime Service Board of New South Wales
NAASRA	National Association of Australian State Road Authorities
ROA	Railways of Australia
STA	State Transport Authority, Victoria

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
ANL	Australian National Line
ANRC	Australian National Railways Commission
BTCE	Bureau of Transport and Communications Economics
BTE	Bureau of Transport Economics
CTER	Committee on Transport Economic Research
DofA	Department of Aviation
DMR NSW	Department of Main Roads, New South Wales
GDP	Gross domestic product
GHA NSW	Grain Handling Authority of New South Wales
ISC	Inter-State Commission
kt	kilotonnes (thousand tonnes)
MoT	Ministry of Transport, New South Wales
MRD WA	Main Roads Department, Western Australia
MSB NSW	Maritime Services Board of New South Wales
Mt	Megatonnes (million tonnes)
NAASRA	National Association of Australian State Road Authorities
QR	Queensland Railways
ROA	Railways of Australia
SRA	State Rail Authority of New South Wales
STA	State Transport Authority Victoria, (V/Line)
TAA	Trans Australian Airlines
t	tonnes
..	not applicable