FREIGHT TRANSPORT SUBSIDIES IN NEW SOUTH WALES

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ABSTRACT: *This paper is mainly concerned with estimating the road system costs attributable to the operation of heavy trucks in New South Wales and cost recovery from the road freight industry. The methodology used for calculating the costs is that used by the Commission of Enquiry into the New South Wales Road Freight Industry. Accepting current Federal Government concepts of road user charges, the "road freight deficit" or hidden road system subsidies for heavy truck operations in New South Wales during 1984-85 is found to be about $408 million.*

In discussing road cost recovery, an examination of charging options is made. These include weight distance taxes that are currently in use in New Zealand and are suggested as being suitable for highly productive units such as road trains, B-Doubles and general freight vehicles taking advantage of any relaxation of weight limits. Consideration is also given to other external costs of the road freight industry such as road congestion, air pollution and road accidents.

The paper briefly examines rail freight deficits and concludes that it would be in the national interest to reduce the total subsidies to land freight transport in New South Wales. As a first step, the New South Wales Government should remedy longstanding and severe transport data deficiencies.

1. INTRODUCTION

There are very few people who are not aware of the fact that in recent years, the New South Wales Government Railways have required considerable subsidies from the taxpayer to help finance the operation of freight and passenger services. A brief analysis of NSW rail deficits is given in Section 5 of this paper after a discussion of large hidden subsidies to road freight operations because of under recovery of road system costs.

The term "road freight deficit" is used in this paper to denote the road system costs that may be attributed to the operators of heavy trucks less the amount of taxes and road user charges that are applied to road works. As such, it represents an estimate of hidden subsidies enjoyed by the road freight industry.

Before any calculations are performed, it is necessary to define what costs may be attributable to the operation on heavy trucks on public roads. It is also necessary to specify what revenues, paid by the operators of heavy trucks to Government, may be regarded as road user charges as opposed to general taxes. Even when the costs and road user charges are defined, there is scope for further difference of opinion as to how to calculate the costs. The actual cost calculations themselves are dependent on estimates of numbers of trucks of various types and the distances travelled.

The methodology used to calculate the attributable costs is based on that developed by McDonell (1980) in his comprehensive Report of the Commission of Enquiry into the NSW Road Freight Industry. The estimates obtained this way are checked against two other calculations; one using current New Zealand Road User Charges and the other using a simple North American model.

Government revenue regarded as road user charges will be limited to the following: for the State Government, all vehicle registration fees and the diesel tax and for the Federal Government, those revenues accepted by the Inter-State Commission (1986) as fuel taxes hypothecated to road works.

Under recovery of attributable road system costs by the operators of heavy trucks has been the subject of much comment over the last few years at both State and Federal levels. Most criticism is made on the grounds of economic efficiency and equity. Heavy truck operations are also a continuing factor in the road toll and have detrimental effects on the urban environment. These factors are discussed in more detail in Section 6 under other external costs. Large hidden subsidies for heavy truck operations also encourages more use of trucks with the side effect of increased road congestion and consumption of liquid fuel.

2. ROAD SYSTEM COSTS

2.1 McDonell's Methodology

A general description of the approach adopted by the Commission of Enquiry into the NSW Road Freight Industry (McDonell, 1980, Vol. IV, Appendix 3.1) was given by the Inter-State Commission (1986, p267).

The approach used by the Commissioner, Mr G. McDonell was a pay-as-you-go one to gain an estimate of the total NSW road system cost for 1977-78. The costs

estimated were those required to maintain the road system and were allocated among four categories of vehicles: light rigid trucks with less than 4.1 tonnes carrying capacity, heavier rigid trucks, articulated trucks and all other vehicles. Costs were identified as separable pavement (trucks), separable other (trucks), separable (non trucks), and common. For heavy vehicles, separable pavement costs were calculated using the Economics of Road Vehicle Limits Study (ERVLS) that was developed by the National Association of Australian State Road Authorities (NAASRA). Other separable costs for trucks such as easier grades, overtaking lanes and stronger bridges were found by using broad estimates provided by the NSW Department of Main Roads; as suggested by the Inter-State Commission, we allocate these other separable costs on the basis of gross vehicle weight kilometres. After making an allocation for separable costs for the various classes of vehicles, all other costs are regarded as common costs, with no distinction being made between joint costs and common costs.

The ERVL study provided estimates of 'unit costs' of the pavement damage resulting when a heavy truck passed over one kilometre of average Australian road These unit costs were given for rigid and articulated trucks by numbers of axles in 1975-76 values (Webber, et al, 1978). The ERVL study also gave estimates of annual average distances travelled by each category of heavy truck which are considered more realistic than those given earlier by the Australian Bureau of Statistics (ABS). The total 1977-78 NSW road system costs attributable to all trucks using ERVLS figures was estimated by McDonell at $261.9 million. The methodology adopted by McDonell has been described by Laird (1983, 1985) in a seven step process. Modified in Step 2 to take into account the observations above of the Inter-State Commission, it is as follows

1. Find the total expenditure T for the given financial year in the State for all Government expenditure on traffic and roads. Find also the combined figure R for road maintenance and construction costs incurred by all levels of Government.

2. Calculate separable pavement costs P due to all trucks operating on State Roads using the unit pavement costs, the numbers of trucks in the various categories, and their respective annual average distances travelled.

3. Find 'other separable costs of trucks' Q for the larger roads, stronger bridges, extra passing lanes plus easier grades to accommodate heavy trucks. Take Q as 15% of R with allocation between the light rigid trucks, the heavy rigid trucks and the articulated trucks on the basis of gross vehicle weight kilometres.

4. Assign separable costs S of all other vehicles as 11% of T.

5. Evaluate the remaining costs as common costs, $C = T - P - Q - S$.

6. Allocate these common costs to small rigid trucks, heavy rigid trucks, articulated trucks and other vehicles on the basis of passenger car unit equivalent kilometres (1 for a car, 2 for rigid truck and 3 for an articulated truck).

7. Calculate the total attributable costs to each class of truck and other vehicles.

Using this methodology and ERVLS figures, the total NSW road system costs attributable to all trucks was calculated as $340 million for 1978-79 (Laird, 1983) and $488 million for 1981-82 (Laird, 1985). It is stressed that these figures, like the ones to follow, are approximations based on limited data.

2.1.1 Data Caveats.

As noted by the Commission of Enquiry into the NSW Road Freight Industry (McDonell, 1980, Vol. IV, p1/3), there are serious data deficiencies affecting the road freight industry. The Commission recommended that steps to improve this situation be given high and early priority, calling for research to remedy data conflicts, "especially in reconciling differences in estimates of the truck population recorded by the various Government agencies".

That recommendation was made in 1980. Whilst the establishment of a NSW Road Freight Industry Council, and the production of some reports by this Council have assisted in making some improvements in data, the fact is that basic data such as the numbers of heavy trucks on the NSW Register of Motor Vehicles by type and number of axles is not readily available from the NSW Department of Motor Transport.

Similar data limitations were noted by this writer (Laird, 1983) and are reflected by the absence of heavy truck numbers by type in the comprehensive submission of the NSW Government to the National Road Freight Industry in January 1984. It can only appear that the NSW Department of Motor Transport does not know how many articulated trucks and heavy rigid trucks are running around on NSW roads; moreover, it does not care. The fact that the Australian Bureau of Statistics is prepared to supply this data every three years following surveys of motor vehicle usage should not relieve the NSW Government from this responsibility.

Another major data deficiency is that of the average distances travelled by heavy trucks. Once again, the NSW Government, with the exception of the NSW Department of Main Roads, appears to have done little recently to remedy this situation. In a submission to the Inter-State Commission (1985), the DMR makes the useful distinction between trucks involved in short haul and long haul work, and gives estimates of annual average distances for each type of truck on a short or long haul basis.

The following are some estimates for the average annual distances travelled by a six axle articulated truck.

DMR Short Haul	20,000
ABS 1970's (McDonell)	80,500
ABS SMVS 1985	88,400
ERVLS	100,000
DMR Long Haul	120,000
Inter-State Commission	128,000
Federal Dept. of Transport IS estimate	160,000

It may also be noted that surveys conducted for the NSW Road Freight Industry Council show that 50% of owner drivers cover more than 140,000 km per year. The above range of estimates for articulated trucks shows a need for more research by NSW authorities in the distances heavy trucks are driven, as well as, the numbers of heavy trucks on NSW roads.

2.1.2 Application to NSW data for 1984-85

From the 1985 Annual Report for the Commissioner of Main Roads, a total of $769.6 million was applied to construction and maintenance of NSW roads, and total other expenses including interest, administration and research was about $150.1 million. Local Government expenditure (ABS Cat.No. 5502.1) on NSW roads for construction and maintenance amounted in 1984 to $554.7 million with the DMR Annual Report noting payments to Councils of $187 million. The figure R is then taken as $1137 million. Local Government in NSW also spent an extra $88 million on debt charges associated with road works. The assessed cost of police control of traffic and Department of Motor Transport Administration was $169.9 million with a further $49.7 million for the provision of traffic facilities (Auditor General, 1985). Accordingly, the extra road system costs (T - R) is $458 million and so T is taken as $1595 million for 1984-85.

The NSW Department of Main Roads in its submission to the Inter-State Commission (1986, p. 287) gives estimates for the pavement damage (resealing, rehabilitation and reconstruction of damaged pavement, but excluding pavement widening, overtaking lanes and deviations) for various classes of trucks by numbers of axles. These figures are given in Table 1 as 1984/85 figures adjusted by the DMR cost rise indices. (The DMR estimates pavement damage for a six axle semitrailer at 12.5 cents per vehicle kilometre and for all heavy trucks at about 1 cent per tonne kilometre). Truck numbers, and estimates for annual average distances travelled by the Economics of Road Vehicle Limits Study (ERVLS), for rigid and articulated trucks by numbers of axles is also given in Table 1. Using the data in Table 1 and the ABS estimate of 2.873 million other vehicles travelling an average of 15,900 kilometres each year, other separable costs and common costs are allocated for each class of vehicle. The attributable costs for heavy trucks are $604.1 million, (articulated trucks $368.6 million and heavy rigid trucks $235.5 million) with an extra $61.8 million for light rigid trucks.

For six axle articulated trucks, attributable road system costs are calculated at about $25,900 per vehicle per year or 25.9 cents per truck kilometre. These estimates, like the assumption of an average annual distance of 100,000 kilometres per year for a large semitrailer, are considered conservative.

2.2 Other estimates of costs.

2.2.1 Application of New Zealand Road User Charges to NSW Data.

A further estimate of NSW road system costs attributable to the operations of heavy trucks may be found by the application of New Zealand Road User Charges. Some details of these charges are given by the Bureau Of Transport Economics (1985), the Inter-State Commission (1986) and in Section 5.3 of this paper. The charges in force during most of 1985 for various classes of heavy trucks are given in Table 1. Using this data along with estimates of the vehicle kilometres travelled by the various types of trucks, it is found that if heavy trucks operating in NSW were charged New Zealand Road User Charges, they would have paid a total of $NZ904.14 million for 1984-85. Taking an exchange rate of $A=$NZ1.3, the total charge is about $A695 million for all heavy trucks operating in 1984-85 on NSW roads. Taking into account the fact that NZ Road User Charges were increased by an average of 46% on 1 February 1985, this estimate is a high one.

TABLE 1

DATA USED FOR SEPARABLE COSTS 1984-85

	Max Weight	Truck Nos.	Annual Ave. distance	Unit Pavement costs	New Zealand road user charge
	tonnes	000	000 km	cents/km	$NZ/1000 km
LIGHT RIGID					
2 axle	-	88.2	15.3		
HEAVY RIGID					
2 axle	13.9	44.14	30	4.79	201
3 axle	20.4	11.81	40	5.01	228
4 axle or more	24	4.37	50	9.69	208
ARTICULATED					
3 axle	22.4				308
4 axle	28.9				355
3 or 4 axle		4.97	60	12.6	331.5
5 axle	35.4	3.15	90	16.93	382
6 axle	38.4	8.42	100	13.92	324
more than 6		0.15			

Sources: Maximum truck weights, ISC, p218; Truck numbers, ABS Survey of Motor Vehicle Usage Supplement; Annual Average Truck Distances from Economics of Road Vehicle Limits Study (ERVLS) as quoted by McDonell; Unit Pavement Costs are DMR estimates for 1982-83 (submission to ISC and ISC report, p287) inflated by 11.4% based on cost rise indices of 7% for 83-84 and 4.1% for 84-85.

Note that a light rigid truck is one under 3 tonnes tare weight, and for calculating other separable costs is assumed to have a maximum gross weight of 7 tonnes ABS figure do not differentiate between 3 and 4 axle articulated trucks; hence the assumption about weights and unit pavement charges for "3 or 4 axle" articulated trucks.

For calculating common costs, ABS figures give 2.873 million cars, each travelling an average of 15,900 kilometres throughout 1984-85.

2.2.2 A North American Model.

One way of estimating total road system costs attributable to truck operations developed as a North American model (Bunting,1983) is to assign 40% of the road construction and maintenance costs plus 30% of the remaining road system costs. Application of this simple model to the above 1984-85 data above gives attributable NSW road system costs of $592 million.

2.2.3 Discussion of costs.

The estimate of $604 million for NSW road system costs attributable to the operations of heavy trucks in 1984-85 obtained by the application of McDonell's methodology is effectively supported by both estimates using New Zealand Road User Charges and the North American model.

This 1984-85 estimate of $604 million for NSW is high in comparison with a 1981-82 estimate of $552 by the National Road Freight Industry Inquiry (May,1984 and ISC, 1986) of Australian arterial road costs apportioned to heavy trucks. Whilst the May report recognised local road costs were excluded, it was noted by consultants to the National Inquiry (Clark,1984, p6) that "A narrow definition of road cost was nominated by the inquiry". The amount allocated by the National Inquiry as total Australian road expenditure for 1981-82 has been questioned by Moriarty and Beed (1986) who contend that it was some $510 million too low. The use by the National Inquiry of inverse elasticities for allocating joint road costs is also open to question, as are very low annual road cost allocations of only $1400 to each heavy rigid truck and $9500 to articulated trucks.

3. REVENUES FROM TRUCKS.

3.1 Road User charges and general taxes.

The National Road Freight Industry Inquiry proposed a classification of Government receipts from all road users into the two categories of general taxes and road user charges. General taxes include all sales taxes, custom duties and some fuel taxes. For New South Wales, road user charges include annual registration fees and weight taxes paid to the Department of Motor Transport and fuel taxes as levied by the Federal and State Governments that are hypothecated to road works.

It should be noted that whilst there are other taxes levied on fuel, including fuel excise, these are regarded by the Federal Government as general taxes. Although these taxes are substantial, they do not form part of road cost recovery from heavy vehicles. In determining relevant Federal road user charges, the Inter-State Commission (1986, p1) is constrained only to accept Australian Land Transport Program (ALTP) and Australian Bicentennial Road Development (ARBD) revenues.

In addition, the Industries Assistance Commission (1986, page 7) in its draft report has recommended "that general revenue be adopted as the sole rationale for taxation of petroleum products ..... " and draws attention to the importance of introducing alternative measures for paying for roads.

3.2 NSW Road User payments for 1984-85.

The Department of Motor Transport annual fees for heavy vehicles are weight taxes, registration fees (that include a Heavy Vehicle Inspection Scheme fee) and a tax levy. These fees depend on the tare weight of the vehicle. There is also a third party insurance fee. For a semitrailer with a prime mover weighing 8.1 tonnes and one trailer weighing 7.5 tonnes unladen, the Department of Motor Transport full annual fees as of 1 February, 1986 would be $2,753. (ISC, 1986, p. 218). Using the truck numbers as given in Table 1, less the numbers of trucks of each type with Interstate Plates and the estimates of NSW registration fees for each vehicle type (rigid or articulated by number of axles) as noted by the Inter-State Commission (1986, pages 336 and 218), a total of about $100 million was paid by heavy trucks in 1984-85. Since a number of trucks such as those used for agricultural purposes are allowed to pay reduced fees, this figure of $100 million for annual fees for heavy trucks is a maximum. A further maximum of $44 million was paid for light rigid trucks.

The fuel taxes collected by Government that are directly applied to road works are listed in the Report of the Inter-State Commission (pages 527-528), and are currently 2 cents per litre for the Federal ABRD levy, 3.6 cents for the Federal ALTP levy, and 3.57 cents per litre as a diesel tax levied by the State Government. This gives a total of 9.17 cents per litre of diesel as road user charges. Using the fact that in 1984-85 the NSW diesel fuel levy amounted to $37,535,000 (DMR 1985 Annual Report) at the above rate of 3.57 cents per litre, about 1051 million litres of diesel fuel was used by motor vehicles. The ARBD and ALTP levies on this amount of fuel are $58,878,000. Accordingly, NSW road user charges in the form of fuel taxes as above for 1984-85 were $96.4 million. The total NSW road user charges for heavy trucks for 1984-85 are therefore estimated at a maximum of $196 million.

It is noted that a six axle semitrailer with a fuel efficiency of say 55 litres per 100 kilometres (ABS, 1986) driven 100,000 kilometres a year, would use 55,000 litres a year and pay about $5034 each year in road user charges from fuel taxes. The road revenue from a six axle semitrailer on NSW charges as above and excluding third party insurance is then about $7900 a year. Assuming fuel efficiency as above and it is driven 100,000 kilometres a year, this is about 8 cents per vehicle kilometre.

4. ROAD FREIGHT DEFICITS.

Just as rail freight deficits can be quoted when they occur for a given financial year, it is also possible to have a road freight deficit. In this paper, the road freight deficit is defined as the road system costs attributable to the operation of heavy trucks, less the road user charges paid. It should be noted that this road freight deficit does not include other external costs imposed by the road freight industry such as involvement in road accidents, road congestion, and pollution. These external costs are discussed further in Section 6.

Using McDonell's methodology for costing, the NSW road freight deficit for 1984-85 is about $408 million.

The under-recovery of road system costs for six axle semitrailers driven 100,000 kilometres a year is calculated at about $18,000 per vehicle or about 18 cents per truck kilometre. This estimate is considered conservative.

5. RAIL FREIGHT DEFICITS

In its 1981 Report on Rail, the Australian Railway Research and Development Organisation noted that large rail deficits at the end of the seventies resulted from passenger operations, short haul low volume general freight services, Government contraints on passenger fares and freight rates, intrastate freight deregulation whilst maintaining a large rail work force that had received large wage and salary increases, and a need to undertake maintenance deferred from the sixties. The ARRDO 1981 Report on Rail noted the NSW Government rail deficit for 1979-80 as $328 million, an amount that includes debt servicing charges. Of this (PTC Annual Report for 1980), some $106.8 million was due to freight services, including $47.7million for interest.

As outlined in the reports of the Commission of Enquiry into the NSW Road Freight Industry (McDonell,1980), the National Road Freight Industry Inquiry (May,1984) and consultants on cost recovery to the National Inquiry (Clark,1984), there are considerable shortcomings in the published accounts of the NSW Government Railways. In addition, there are data deficiencies and questions of how to allocate joint and common costs between freight and passenger operations. The May Report took the view that it was unreasonable to allocate any track costs to the operation of country passenger services, so the cost of maintaining track (outside the metropolitan area) was allocated to freight operating costs. With this adjustment, the May Report considered the published NSW rail freight deficit of $113 million for 1981-82 should have been increased to $139 million. The May Report also noted further outlays for leasing, debt servicing and capital works, and taking this into account, quoted a "true" rail freight deficit of at least $160 million for 1981-82. With a freight task of 10 7 Billion tonne km that year, this gives an average NSW rail freight deficit of about 1.5 cents per tonne km.

5.1 NSW Rail freight deficits for 1984-85.

The 1984-85 rail freight revenue supplement was published by the NSW State Rail Authority in their 1985 Annual Report as $41.8 million. Other revenue supplements were $167 million for metropolitan trains and $156.2 million for country trains. This report also noted $126.8 million paid for leasing charges, $103.7 million for debt servicing and $16.5 million for superannuation. There was also a capital works program for NSW rail of $420 million, plus freight rebates of nearly $60 million from consolidated revenue for coal, wheat and other items.

The published accounts of State Rail do not give sufficient information to even guess at a reasonable figure for a rail freight deficit, and thus represent yet another example of a severe NSW Government transport data deficiency. The quoted rail freight revenue supplement is far too low a figure for a rail freight deficit. Whilst not conceeding all track maintenance costs and capital works should be a charge against rail freight operations, one rough estimate for a rail freight deficit is to take the above deficit rate of 1.5 cents per tonne km, and the 1984-85 freight task of 12.3 Billion tonne km to get a NSW rail freight deficit of about $184 million.

There are three factors, additional to those noted above, contributing to a rail freight deficit in 1984-85. In October 1984, coal freight rates were further lowered. There were also 49 days of major strike action within State Rail during 1984-85. During that year, State Rail paid Federal tax on diesel fuel of about $9.6 million hypothecated to road works.

5 2 Prospects for reduction in rail freight deficits.

The removal of brake vans and two man crewing, with heavier coal and wheat trains, has improved bulk rail freight productivity. General rail freight operations have been improved with new freight terminals and scheduled container train services, along with the purchase of eighty new 81 Class diesel electric locomotives and electrification to Newcastle and Port Kembla. Closure of an outmoded small freight facility at Darling Harbour and openning of a new terminal at Chullora may also help reduce rail freight deficits.

A large number of internal problems with management and labor relations as identified by the Hon. Justice Macken (1980) still persist, including a "railway ethos" of malaise pervading some levels of railway service. The NSW Parliament's Public Accounts Committee found in 1985 unacceptably high levels of absenteeism in State Rail. In late 1986, the Government agreed to continue promotion by seniority rather than merit in some areas of State Rail. The former Chief Executive, Mr. D. Hill was credited in stopping the rail deficit rising a further $300 million a year by improved work practices (Fin. Review, 2/10/86) and his successor, Mr. P. Johnson was reported (The Australian 26/3/87) that he would establish a unit to review " inefficient and costly" work practices without any retrenchments from State Rail's 40,000 workforce to save "many millions of dollars"

In recent years, each of Australian National, Westrail and Queensland Railways have demonstrated notable improvements in rail operations and financial health Following its formation in 1975, new infrastructure including a new link to Alice Springs and standard gauge to Adelaide, plus two federal Parliamentary inquiries, Australian National with bipartisan support has halved its deficit in real terms. With the support of the Western Australian Government, Westrail has moved to more commercial operations and has reduced its deficit, despite the recent loss of some bulk traffic Queensland Railways retained management consultants in the early eighties; with subsequent reorganisation assisted by a large coal haulage task, QR has returned operating profits of over $100 million a year for 1984-86. If State Rail in New South Wales would match the performance of these three other Government rail systems, then there would be a substantial reduction in the rail freight deficit. However, in order to achieve fully efficient freight operations, State Rail will also require improvements to track alignment and clearances of NSW mainlines, similar to those that have taken place or are now underway in the other three rail systems.

6. OTHER EXTERNAL COSTS

The road freight industry in Australia, whilst generally regarded as efficient and reliable, imposes considerable external costs on the wider community in additional to the road freight deficits discussed above. Rail freight also has some external costs that are discussed in Section 6.6. The Inter-State Commission (1986, p. 136) recognised three common types of external costs of freight transport.

1. Road accidents, to the extent to which they are not covered by insurance payments;

2. Noise and pollution;

3 Congestion that affects non-road users or other classes of road users.

The Inter-State Commission notes that these external costs are important and clearly so in the case of road accident costs. It also notes that these costs are met from general taxation revenues, and road transport through fuel taxation not hypothecated to road works is a significant contributor to general taxation

Other additional external costs of road freight include extra road damage from overloading of heavy trucks, and the occupational health and safety of truck drivers.

6.1 Road accidents.

The costs of road accidents involving heavy trucks is difficult to quantify. A discussion and an estimate of $38 million for road accidents in NSW involving heavy trucks for 1977-78 was given by McDonell (1980, Vol V, AN9))

Although heavy trucks form a small fraction of all motor vehicle registrations, their involvement in fatal road accidents is high. The National Road Freight Industry Inquiry (May, 1984) noted that for Australia, articulated trucks in 1983 had an overall accident rate of 7.4 fatalities per 100 million vehicle-km, and that this rate was over three times that for cars and station wagons. The National Inquiry also recommended a number of safety measures for truck vehicles and driver behaviour. However, the Inquiry's recommendation to remove speed limit differentials between cars and trucks is open to question, as is a decision by Government taken in December 1986 to increase speed limits for heavy vehicles to 90 km/hour outside built-up areas.

The Federal Office of Road Safety estimated the total cost of all road accidents in Australia in 1983 was $2700, with "much of the amount was obtained from insurance premiums paid by road users" (ISC, 1986, p137) and the Federal Government bearing $160 million and the State and Territory Governments bearing $135 million in 1983 as costs "directly associated with road accidents". For 1985, the Federal Office of Road Safety (1986) estimates each fatality costs $300,000 and each serious injury costs $52,000. Making an allowance for the cost of minor injuries and property damage, it is estimated that road crashes cost the Australian community some $3 Billion each year From such figures, the NSW Department of Motor Transport and the Traffic Authority of NSW (1986) calculates "a total annual heavy vehicle crash cost to NSW of more than $130,000,000".

The Australian Bureau of Statistics (ABS) in its Survey of Motor Vehicle Usage estimates that in the twelve months ending 30 September 1985, NSW registered articulated trucks were driven in total of some 1,223 million kilometres. The Traffic Authority of NSW advises that articulated trucks were involved in 146 road fatalities in the 12 months ending 30 June 1985. This suggests NSW semitrailers were involved at a high rate of about 12 road fatalities per 100 million kilometres of travel during 1984-85.

Road accidents involving heavy trucks may result in costs to Government agencies in clearing a road. These costs can be significant when spillage occurs from a truck carting hazardous chemicals. Where closure of a road, or part of a road occurs, following an accident involving a heavy truck, costs are incurred by other road users.

Research conducted with British data by Gregg (1983) concludes that on a tonne-kilometre basis, freight transport by road causes 18 times more fatalities than by rail with the death rate per tonne-km by road increasing for the heavier trucks.

6.2 Noise and air pollution.

A recent 'Road Cost Recovery Study' undertaken by Travers Morgan for South Australia cites an OECD range of costs for air and noise pollution from 0 26c to 0.64 c per vehicle km (Amos, et al, 1986). Based on this range, heavy truck operations in NSW for 1984-85 with an estimated 3754 million vehicle kilometres gave rise to an external cost of $9.8 million to $24 million for air and noise pollution.

One unpleasant side effect from the operation of certain poorly maintained heavy trucks is the excessive emissions of black exhaust fumes. In NSW, control (not always effective) of motor vehicle emissions is the responsibility of the State Pollution Control Commission (SPCC). Research (Taylor,et al, 1984) suggests more attention should be paid to emissions of nitrogen oxides from heavy duty diesel motor vehicles. As recognised by the National Inquiry (May,1984), the costs of air and noise pollution are highest in urban areas, and may justify reservation of certain freight to rail, or the imposition of special charges.

Heavy truck operations can also be accompanied by pollution generating activities. A particular case in point is the operation of the Port Kembla Coal Loader with road receival of export coal peaking in 1985 at 6 million tonnes per annum. Direct dumping of coal on satellite stockpiles by heavy trucks, and reclamation afterwards by front end loaders dumping into trucks has been found by the SPCC (1986) to be a major source of dust pollution in Wollongong.

6.3 Road and port congestion.

The operation of heavy trucks on various roads at certain times can lead to road congestion and hence delays to other road users. Whilst it is difficult to quantify such external costs of trucking operations, it is worth noting that savings in "travel time" costs are often used to justify expensive road works.

A further form of congestion involving heavy trucks may be found at various large container ports. Problems with truck queues at, and near, ports such as Port Botany have been known for some years and have been the subject of reports commissioned by the NSW Road Freight Industry Council. These truck congestion problems at container ports were also raised at a Shore Based Shipping Costs seminar held in 1984 and again in the final report of the Industry Task Force on Shore-Based Shipping Costs in 1986. This report notes a less than adequate level of communication between the container terminals and the road transport system, and suggests that there is "considerable scope for more self-discipline by road operators in their approach to the queuing problem outside terminal and depot gates". Heavy truck congestion is also a problem on roads leading to the Port Kembla Coal Loader. More details of truck problems at ports, and the results to date of efforts by the NSW Government to reserve certain container and coal traffic to rail are given by this writer (Laird,1986) elsewhere.

6 4 Truck overloading.

Additional costs are imposed on the road system by overloaded trucks, with the NSW Department of Main Roads estimating the cost to the taxpayer of extra maintenance of NSW roads due to overloading being $32 million in 1981-82 (NSWDMR, 1985). The 1985 Annual Report of this Department notes that during 1984-85, a record 12,185 vehicles were reported as overloaded.

6.5 Occupational health and safety in trucking

The May Report (1984) dealt with truck safety issues in general, rather than give special attention to occupational health and safety of truck drivers. The May Report recommended that the most stringent blood alcohol concentration limits be applied , and that there be considerably better enforcement of driving hours by truck drivers. To this end, the May Report recommended the early adoption of tachographs throughout Australia for heavy trucks.

Turning to the involvement of all heavy trucks in NSW road accidents, the Traffic Authority notes that the total number of heavy truck drivers killed in 1985 was 33. This must make truck driving one of the most dangerous occupations in NSW. The ABS publication "Employment Injuries, NSW", 1982-85 gives different figures for loss of lives of truck drivers, and notes that in 1984-85, there were 69 lives lost in the workplace and 31 lives lost at work in road traffic injuries. With regard to non-fatal injuries, the Traffic Authority notes a total of 511 truck drivers injured in 1985. The Australian Bureau of Statistics states "The highest incidence of road traffic accidents involves workers in the road transport industry, where there were around 9 per thousand in each of the years 82-83 to 84-85".

6.6 Other external costs of rail freight.

Rail freight has external costs, including those noted by the Inter-State Commission and listed above. Level crossings are often a source of problems, and can be the scene of serious accidents involving road users. Level crossings can also be a source of delay to road users, and in some cases contribute to road congestion. Freight trains, as well as being noisy, can also cause vibration in nearby buildings. Pollution can be a problem from diesel locomotives, particularly with heavy trains being hauled up steep gradients. Some areas of rail operations have occupational health and safety problems. As in the case of road freight, external costs for rail freight are hard to quantify. However, it is clear that with the present road and rail freight operations in Australia, overall, road freight imposes considerably higher external costs than rail freight.

7. OTHER EFFECTS OF SUBSIDIES.

The hidden subsidies in the form of road freight deficits and other external costs, coupled with inefficiencies in competing land transport modes, have assisted the rapid growth of the road freight industry in Australia. In turn, this has increased Australia's dependence on liquid fuels. The effect of under-recovery of costs from the road freight industry leading to more demand for imported trucks, etc , and the effect on the balance of overseas payments is also relevant.

7.1 The growth of the road freight industry.

The Bureau of Transport Economics (1984) notes that on a tonne kilometre basis, road freight more than doubled between 1970-71 and 1981-82, and that during these 11 years, road freight increased its share of the Australian domestic freight task from 20% to 27%. Analysis of ABS data shows that in the fourteen year period from

1970-71 to 1984-85, the freight task for NSW articulated trucks more than tripled from 5.4 to 17 Billion tonne kilometres (BTKM) whereas the NSW Government rail freight task showed restrained growth from 9.1 to 12.3 BTKM. Whilst certain coal and grain traffic is reserved to rail in NSW, other freight was effectively deregulated in the early seventies. Deregulation, coupled with under recovery of road system costs from heavy truck operators plus readily available finance (and for a time investment allowances) has fuelled the growth of the road freight industry.

During 1984-85, some 7.44 BTKM of road freight was carried in NSW by interstate plated vehicles. This far exceeds the NSW interstate rail freight task, which the Inter-State Commission (1986, p99) noted as 3.78 BTKM. Figures given in the ISC report on cost recovery for interstate transport show that in South Australia and Western Australia combined, the rail to road modal split on a tonne kilometre basis was 64% to 36%. To obtain this modal split in NSW, on 1984-85 figures, there would need to be a 3.4 BTKM freight task transfer from road to rail.

As noted by Forsyth (1985), most vehicles, including freight vehicles, use congested urban roads and congested intercity highways, which account for most of the spending on roads. It is well known that a large proportion of Federal road funding is directed to intercity and national highways for work including four lane highways or overtaking lanes. How much of this intercity road upgrading could be reasonably deferred if there was less interstate trucking remains a question. Meanwhile, as noted by the Federal Treasury (1985) in its submission to the Inter-State Commission, *"underpricing of transport services will result in user demand and future investment in transport infrastructure being increased beyond their socially optimal levels"*

7.2 Energy considerations.

An Australian Transport Advisory Council report (1979) noted that rail is about four times more energy efficient compared with road for long distance freight. Moreover, rail has oil substitute options such as electrification. Further discussion of energy usage in transport is given in a Bureau of Transport Economics report (1981) and by Gentle (1983). The National Energy Conservation Programme in 1983 addressed the need to conserve diesel fuel, noting that whilst diesel was 13% of all petroleum fuel demand in 1970-71, it had risen to 20% by 1980-81 and was expected to further increase.

In the longer term, more attention will need to be paid in Australia in conserving liquid fuel as its self sufficiency in oil declines. As recognised by the Federal Department of Energy and Resources (Energy 2000, 1986) transfer of certain freight to rail and sea does have potential for energy savings. Moreover, *"such a modal shift would be more likely if measures were introduced to ensure that road haulers paid their real share of road maintenance costs ..."*

There is also an effect on balance of payments. Whilst the dependence of the road freight industry on overseas funds for trucks and parts may decrease in time, this could well be more than offset by the need to import more oil to offset declining Australian self sufficiency in oil. It was claimed by an oil industry spokesman (The Australian 24 March 1987) that by 1992-93, Australia will be needing to import some 270,000 to 360,000 barrels of oil a year which at current prices would cost $A3.2 Billion annually.

8. TOWARDS BETTER ROAD COST RECOVERY

There is no doubt that both rail and road freight operations in NSW have considerable scope for improved cost recovery. The scope for improved cost recovery from rail freight has been discussed in Section 5.2 and in the ARRDO 1981 Report on Rail that also notes "better cost recovery from heavy commercial road vehicles is an important part of a strategy to obtain improved cost recovery by rail from general freight". The Federal Treasury (1985) observes that both road and rail should be brought closer to full cost recovery and that *"Under-recovery and subsidisation of the costs of rail serices do not reduce the need to pursue full cost recovery in the road sector"*.

8.1 Various schemes for road user charges

The general principles for designing an economically efficient system of road user charges (as distinct from general taxes) have been discussed in the May Report (1984, Section 9.9, pages 226 to 247). The May report (1984, Figure 9.3, p. 234-5) lists the desirable properties and disadvantages of fuel taxes, annual vehicle registration fees, drivers' licence fees, vehicle - km charges and road tolls as "actual and potential instruments for road user charges".

A discussion of road user charges and their operation in the United States and New Zealand has been given by the Bureau of Transport Economics (1985) and the Inter-State Commission (1986, Chapter 11 which also includes cost recovery policies in the United Kingdom).

A standard American classification of road user charges for all vehicles is (AASHTO, 1984, p.38).

First structure (or level)	Registration and annual weight taxes.
Second structure	Fuel taxes.
Third structure	Weight distance taxes.

Problems with NSW road user charges for heavy trucks as seen by the National Inquiry (May,1984), AASHTO (1984, p.5) and others include the following: Registration and weight taxes are not equitable between the low mileage and high mileage vehicles, also they are more in the nature of "an entrance fee" rather than a "use tax". The diesel fuel tax for heavy trucks also has economic efficiency problems, because fuel cost per kilometre does not vary proportionately with the weights of vehicles. The road damage caused by a vehicle is generally accepted as proportional to the fourth power of the axle loadings.

The third structure road user charges include the vehicle - km charge recognised by the National Inquiry and now available as an option under the new Federal Interstate road user charges. Third structure taxes are also known as weight distance-taxes. They are generally reserved for heavy trucks, and usually imposed in addition to the first and second structure taxes. The modern third structure tax is one that takes into account the maximum gross vehicle mass along with the number and spacing of axles, and numbers of tyres, in contrast to the older style "ton-mile" tax like the former Australian road maintenance tax.

8 2 Advantages of a weight-distance tax.

The National Inquiry recognised the advantages of a weight-distance tax, noting (May, 1984, p. 237) "the principles behind such charges are excellent in terms of both equity and economic efficiency", although as a practical measure, each heavy truck requires the installation of distance-measuring equipment "to ensure that there is no significant degree of evasion of the charges".

The Australian Automobile Association has a policy that states;

> *"AAA believes charges levied for road construction and maintenance should be equitable to each class of road user. AAA therefore supports the philosophy of special taxes for heavy commercial vehicles on the grounds of technical evidence that such vehicles impose disproportionately higher road construction and maintenance costs than lighter vehicles and urges adjustment of commercial vehicle user fees to give appropriate consideration to weight and distance factors".*

The American Association of State Highway and Transportation Officials (AASHTO; formerly AASHO) is the American equivalent of NAASRA. AASHTO (1984, p.6) "believes that a state administered federal weight-distance tax is the only tax" that has:

(1) equity among all taxpayers,
(2) a minimum of evasion,
(3) low cost-effective administration.

The American Automobile Association "has had a national policy favoring the imposition of weight-distance taxes on commercial vehicles for many years" and notes "motorists have been confronted with a consistent pattern of fuel tax and registration fee increases to support burgeoning fiscal requirements of maintaining the nation's huge capital investment in highways" (AASHTO, 1984, p. 17). These fiscal requirements go further than minimal road pavement maintanence, and as per the 1982 United States Federal Highway Cost Allocation Study, include road "resurfacing, restoration, rehabilitation and reconstruction" costs, i.e. the 4R Program (AASHTO, 1984, p. 4).

The Association of American Railroads notes (AASHTO, 1984, p. 32) that ten states now use weight distances taxes, and "railroads have a compelling interest in promoting more equitable highway user charges". This Association quotes a 1984 study showing that the cost of administering third structure weight distance taxes in the ten states averages 4.6% of the revenue collected. This modest cost also "provides for effective collection and enforcement"

The AASHTO Quarterly (1984, p. 38) also quotes a survey of world experience with truck weight-distance systems. This survey notes that the Australian schemes were 'based on voluntary reporting" with payment after the truck journey and were rescinded "due to widespread abuses and trucker protests". It is also noted that the New Zealand scheme of road user charges has been in successful operation since 1978, and involves a prepaid truck distance. Sweden has a scheme similar to that of New Zealand whilst in Portugal, trucks and intercity buses are subject to a tax based on average carrying capacity and the distance travelled. Austria, Finland, France and Britain also have weight-distance taxes. The survey concludes 'that interest in, and use of, weight-distance based methods for truck taxation around the world is significant"

8.3 New Zealand Road User Charges.

As noted above, these involve a weight-distance or vehicle - km charge for all heavy trucks. The Road Users Charges Act 1977 requires that all vehicles with a manufacturer's gross laden weight of more than 3.5 tonnes, with certain exceptions (eg. bulldozers and front-end loaders) must display a prepaid distance licence. All distance licences are issued at Post Offices, and record the vehicle type, registration plate number, distance recorded number and readings. Distance licences are normally sold in multiples of 1000km, with the rate depending on the number and configuration of axles and tyres, and the gross vehicle weight.

The net receipts to the New Zealand National Roads Board (Report, 1986) from road user charges for heavy trucks was about $210 million for 1985-86.

Further details of the New Zealand system of road user charges are given in the May Report (p. 451) that notes the system is intended "to match the payment made on behalf of an individual vehicle to the cost of road pavement occasioned by that vehicle's use of the road network". The May Report (p. 453) also noted that "the New Zealand Road Transport Association is opposed to this system of road user charges" and "seeks to have the charges replaced by a combination of fuel and tyre taxes, together with an annual registration fee". These views also appear in the 1984 Review of Road User Charges. The New Zealand Ministry of Transport (1985) notes that the Government subsequently decided to continue with the hubodometer based charges and to increase these by an average of 46 per cent as of 1 February 1985.

The Review of Road User Charges (1984, p. 3) notes the original objectives for Road User Charges included in a taxation system based on "user pays" principles and to provide an assured source of income to meet expenditure on roads. The road costs comprise "driver" (traffic control services costs), "space" (costs of providing road space for traffic) and "strength" (costs relating to pavement strength maintenance allocated according to the "fourth power rule"). The Review notes (1984, p. 16) that heavy vehicles are also subject to general taxes and "these other taxes meet costs associated with externalities of road use such as costs relating to accidents, policing or environmental effects". Thus, New Zealand Road User Charges exclude the above externalities.

The Inter-State Commission (1986, p230 and p498-499) gives details of the New Zealand Road User Charges and their 1985-86 rates. These charges were further increased as of 1 December 1986. The current rate for a six axle articulated truck, with the purchase of separate distance licences for the prime mover and trailer, is $NZ375.64 per 1000km if the gross weight is 38 tonnes, and $NZ438.95 per 1000km if the gross weight is 41 tonnes.

8.4 A weight distance tax for NSW.

The former NSW road maintenance tax was introduced in 1958 under the Road Maintenance (Contribution) Act, 1958, at a rate of one third of a penny per ton mile based on the tare weight of the vehicle plus 40% of its load capacity (ISC, 1986, p. 121). This tax had a life of some 21 years until it was abolished following truck blockades of national highways throughout Australia in April 1979. During these years, the tax was never indexed for inflation, and was increasingly widely evaded with maximum annual receipts for NSW peaking during 1974-75 at about $21 million.

A major problem with the former road maintenance tax was that it relied on the owner of the truck having to declare truck distances travelled with compulsory tamper proof distance recording devices. In turn, the tax became to be regarded by some heavy truck operators as one that could be avoided, and by other truck drivers as unfair. Since the tax was abolished in Australia during 1979, the New Zealand scheme as outlined above along with other weight distance taxes in ten States in America have been shown to be workable.

A second problem was the old tax did not pay regard to the number of axles, and hence did not reflect the actual road system costs as accurately as the modern weight distance taxes do.

These problems are minor when compared with the institutional barriers that favour a continual reliance on annual registration fees and fuel taxes (and hence low road cost recovery levels from heavy trucks at the present levels of charges). Faced with the insistent view of the road freight industry that they are more than paying their share of road costs, Governments can easily share the view of the Inter-State Commission (1986, p 18) that in view of the many unresolved issues in road cost recovery studies, etc., *" . there is a need to exercise considerable care in the drawing of policy conclusions regarding road cost recovery"*.

Given the favourable overseas experience with weight-distance taxes, and the fact that these taxes are now a recognised charging mechanism under the Federal Interstate Road Transport Charge Act, 1985, it is difficult to accept general arguments advanced against such taxes by the NSW Department of Main Roads in its 1985 submission to the Inter-State Commission (p. 3.1).

"A variable tonne-km scheme would be administratively unwieldly and costly, with administrative costs likely to absorb the majority of the funds raised".

"The use of distance-measuring equipment could give rise to similar policing problems to those encountered by the previous Road Maintenance (Contribution) Act".

As noted above, the American Association of State Highway and Transportation Officials favour weight distance taxes. However, NAASRA as the Australian counterpart to AASHTO does not, if its mid 1986 notes on cost recovery implications on RORVLS are any guide.

The recent Inquiry into the distribution of Federal roads grants (Cameron,1986) has recommended that certain road funds be allocated on a basis that of indicators of axle loading, road occupancy, and requirements for restorative and upgrading works.

Public debate in Australia has now reached a point that there is general agreement that road as well as rail should be required to meet their costs for freight transport. This debate may be expected to sharpen as Governments seek to balance budgets in harder times and meet demands for better roads. Proposals for heavier trucks and B-Doubles also invite attention to the suitability of weight distance taxes for the road freight industry

8 5 Road trains and B-Doubles

Road trains have been permitted by the NSW Department of Motor Transport to operate in NSW in an area of the State west of a line taken taken from the Queensland border at Mungindi through Walgett, Byrock, Cobar, and Ivanhoe to the Victorian border at Wentworth since July 1985. Some 150 permits have been issued to date for NSW road trains to carry any goods in vehicles of 35 metres maximum length. In NSW a large road train would total about 70 tonnes. Apart from a one off Department of Motor Transport permit fee of $50, standard annual registration fees based on the tare weight of the prime mover and trailers apply. This Department in a submission on heavy vehicle safety (1986, p 33) to the NSW Parliamentary STAYSAFE Road Safety Committee states: *If road trains can operate successfully within the current framework, it will not be appropriate to withold extension of their length to 50m or to restrict them from further eastward movement from the current area, on safety grounds*

B- Doubles are another class of combination vehicle that comprise a prime mover and two trailers. They are also known as Canadian B-Trains or twin articulated vehicles, and have been in use for some years in some States of America and Provinces of Canada. The use of these vehicles is strongly favoured by the road freight industry as a way of increasing productivity (Close, 1985) and permission to use B-Doubles has been sought from the NSW Government. The NSW Road Freight Industry Council (1985) notes that initial Government reaction was negative; however, Council "was instrumental in drawing together relevant parties to ensure that the issue of B- Double operation was reconsidered". Two B-Doubles are under trial until late 1987 between south-western Sydney and Canberra.

Road trains and B-Doubles are examples of highly productive commercial freight vehicles that should already be fitted with tachographs for road safety reasons and paying vehicle kilometre road user charges on road cost recovery grounds. Yet, no mention is made of weight distance charges for Road Trains or B- Doubles in the above mentioned submission of the NSW Department of Motor Transport. Based on 1985-86 New Zealand Road User Charges, operators of B-Doubles (if and where permitted to operate) should be paying about 30 cents (Australian) per vehicle kilometre in addition to current NSW annual registration fees and fuel taxes.

8.6 Proposals for Heavier Trucks.

As part of a recent Review of Road Vehicle Limits (RORVL), the National Association of State Road Authorities (NAASRA, 1985,1986) has proposed that the maximum gross weight of a standard 6 axle articulated truck be raised from 38 tonnes to 41 tonnes (Option A) or higher (including 42.5 tonnes (Option C) as is currently the case in Western Australia).

Whilst a relaxation in truck weights is strongly advocated by the trucking industry, proposals to move to heavier weights received some adverse editorial comment throughout 1986 (e.g. The Sun Herald on 13 May 1986 and The Illawarra Mercury on 31 May and 1 December 1986) with opposition from The Local Government Association of NSW, the National Roads and Motorists Association (NRMA) , Australian Federation of Consumer Organisations and others. At the December 1986 meeting of the Australian Transport Advisory Council (ATAC comprising State and Federal Transport Ministers), NSW and Victoria retained the present truck weight limits. However, these limits could be reviewed "in the light of further analysis and consultation with the road freight industry on the matter of cost recovery".

Based on current New Zealand Road User Charges (Section 5.3) and the above quoted exchange rate of $A1=$NZ1.30, the incremental cost for a 6 axle semitrailer of moving from 38 tonnes to 41 tonnes maximum weight is 5 cents per vehicle kilometre. The cost quoted is an incremental one to reflect the extra road system costs of moving to heavier trucks, and is a fraction of the actual road user charges currently applying in New Zealand. Using the ABS figure of NSW articulated trucks travelling in sum a total of 890 million laden kilometres, this indicates an increased road system bill of $44.5 million from articulated trucks alone if Option A is adopted.

Few people would question that more funds are needed for road works in NSW. Acceptance of the option of a vehicle kilometre tax for certain heavy trucks by the road freight industry should be required by the NSW Government before any further consideration is given to heavier trucks.

9. CONCLUSIONS

There are still severe rail and road freight data deficiencies in NSW, despite the strong recommendations made in 1980 by the McDonell Commission of Enquiry into the NSW Road Freight Industry. The NSW Government should act now to remedy these deficiencies and at least require the Department of Motor Transport to keep better records of truck numbers and State Rail to improve the quality of financial data presented in its Annual Reports.

Whilst the NSW Government has made a considerable investment in rail freight operations, State Rail continues to have a substantial rail freight deficit, which is far in excess of the published rail freight revenue supplement. This NSW rail freight would be nearly eliminated if State Rail were to adopt management and work practices similar to those found with Australian National, Westrail and Queensland Railways.

The strong growth of the NSW road freight industry over recent years has been accompanied by increasing road freight deficits or hidden subsidies to operators of heavy trucks for roads maintained at public expense. The NSW road freight deficit for 1984-85 was found to be about $408 million, with under-recovery of road system costs by operators of six axle articulated trucks conservatively estimated to be $18,000 per truck or 18 cents per truck kilometre.

In the interests of economic efficiency, it is recommended that the NSW Government, with the assistance of other State Governments and/or the Federal Government as need be, now improves the levels of both rail freight cost recovery and of road cost recovery from operators of heavy trucks. Vehicle kilometre charges or weight distance taxes should be considered for all heavy rigid and articulated trucks, and at least be required for all road trains and B-Doubles. In the event of any substantial increase in annual registration fees for heavy truck operators, they should have the option of paying on the distance travelled by the vehicle in a manner similar to the new Federal Interstate registration scheme.

Other high external costs of trucking operations in NSW such as road accidents, road congestion and air pollution also warrants the attention of the State Government. These external costs would in some cases justify the reservation to rail of certain freight traffic.

REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS, AASHTO Quarterly, July 1984, Washington.

AMOS P., HILL T., AND STARRS, M. (1986), "Road cost recovery in South Australia", 11th Australian Transport Research Forum, Vol 1, p21-40., Northern Territory Dept. of Transport and Works, Darwin.

AUSTRALIAN TRANSPORT ADVISORY COUNCIL (1979), Transport and Energy Overview, AGPS, Canberra.

AUSTRALIAN BUREAU OF STATISTICS (1986), Survey of Motor Vehicle Use 1984-85, 9208.0

AUSTRALIAN RAILWAY RESEARCH AND DEVELOPMENT ORGANISATION, 1981 Report on Rail.

BUREAU OF TRANSPORT ECONOMICS (1981), Freight Transport Energy Consumption, AGPS, Canberra.

BUREAU OF TRANSPORT ECONOMICS (1984), Overview of the Australian Road Freight Industry, AGPS, Canberra.

BUREAU OF TRANSPORT ECONOMICS (1985), Review of Road Pricing in Australia and Overseas, AGPS, Canberra.

CAMERON, R.J. (1986), Report of the Inquiry into the distribution of Federal road grants, Canberra.

CLARK, N. AND ASSOCIATES (1984), Assessment of cost recovery levels, Sydney.

CLOSE, H. (1985), Misinformation kills better road safety and productivity, Australian Transport, August 1985, p. 7.

DEPARTMENT OF RESOURCES AND ENERGY(1986), 'Energy 2000', A National Energy Policy Review, Paper No 9, Energy Conservation.

FEDERAL OFFICE OF ROAD SAFETY (1986), Road crash Accident Statistics

FORSYTH, P. (1985), Road user charges, cost recovery and road-rail competition, Centre for Economic Policy Research, ANU, Canberra.

GENTLE, N.F.(1983), Energy Use-Transport, Position paper for Energy '83 Conference, Canberra,The Institution of Engineers, Australia, Proceedings, p298-315.

GREGG, S.J. (1983), as quoted, RAILS, August 1983, New Zealand.

INDUSTRIES ASSISTANCE COMMISSION (1986), Draft Report on Certain Petroleum Products, Canberra

INTER-STATE COMMISSION (1986), Cost recovery arrangements for Interstate land transport, AGPS, Canberra.

LAIRD, P.G. (1983), The assessment of New South Wales road freight deficits, Eighth Australian Transport Research Forum, Proceedings, Vol1, p 287-303, AGPS, Canberra.

LAIRD, P.G. (1985), Road Freight Deficits, Transport '85 Conference, The Institution of Engineers, Australia, Proceedings, p26-30.

LAIRD, P.G. (1986), A tale of two ports, Current Affairs Bulletin, Vol63, No3, August, p24-31

MORIARTY,P. AND BEED, C.(1986), Subsidies to Australian Road and Rail Freight, Australian Road Research, 16(3), p175-183.

McDONELL, G. (1980), Report of the Commission of Enquiry into the NSW Road Freight Industry, Volume IV, Government Printer, Sydney.

MACKEN, HON.J. (1980), Report of the Commission of Inquiry into Industrial Relations in the Public Transport Commission of NSW, NSW Parliamentary Paper No.78

MAY, T., MILLS, G. AND SCULLY, J. (1984), National Road Freight Industry Inquiry Report, AGPS, Canberra.

NATIONAL ASSOCIATION OF AUSTRALIAN STATE ROAD AUTHORITIES (1985), Review of Road Vehicle Limits:(1986), Cost Recovery Implications of RORVL.

NEW SOUTH WALES DEPARTMENT OF MAIN ROADS (1985), Submission to the Inter-State Commission.

NEW SOUTH WALES DEPARTMENT OF MAIN ROADS (1985), Annual Report, 1984-85

NEW SOUTH WALES DEPARTMENT OF MOTOR TRANSPORT (1986), Heavy Vehicle Safety, Submission to STAYSAFE Parliamentary Committee on Road Safety.

NEW ZEALAND MINISTRY OF WORKS AND DEVELOPMENT (1984), Review of Road User Charges, Final report of the Working Party.

NEW ZEALAND MINISTRY OF WORKS AND DEVELOPMENT (1985 and 1986), Road User Charges, Government Printer, Wellington.

NEW ZEALAND NATIONAL ROADS BOARD (1986), Annual Report, Wellington

TAYLOR, J.A., JAKEMAN, A.J. AND SIMPSON, R.W. (1984), Nitrogen Oxides from Motor Vehicles in Australia, Search, ANZAAS, Vol 15, 202-207

WEBBER, J.H.E., BOTH G.J. AND KER, I.R.(1978), Commercial Vehicle Costs and charges: a study of separable pavement costs, Australian Road Research Board Proceedings, Vol. 9, Part 6, p301-311.