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Title of Paper

Road Cost Recovery in South Australia

Abstract

The paper is concerned with developing a methodology to determine the level of cost recovery from road transport in South Australia. Previous studies were examined and none of these were found to be satisfactory. The method employs a financial contribution analysis, which includes an assessment of public sector costs, congestion costs and environmental costs. Separable and joint costs are discussed.

There is evidence of considerable over recovery by the Commonwealth Government. On the separate cost basis, all vehicle classes generate sufficient revenues to cover costs. Increased taxes and charges by the State without a corresponding reduction in Commonwealth taxes would increase over recovery from the roadsector.

INTRODUCTION

Australia's land transport system is dominated by road transport. In the context of road cost recovery the principle of 'user pays' appears to many people to be both a fair and practical basis to pay for the road transport system. The desire from some quarters to increase road cost recovery is reinforced by notions that specific Australian road users are treated very favourably compared to some overseas countries in terms of what they pay. Road cost recovery has been investigated in Australia, but no consensus has emerged on appropriate objectives, methodologies and strategies, and to date little or no action taken to improve the position (1).

The cost recovery debate revolves around four broad questions:

- what does it cost to provide and service the road system?,
- how much do road users pay toward the cost of providing road facilities and associated services?,
- how much should they pay?, and
- what is the best pricing mechanism for making the payments?

This paper reports on a study which addressed the first two questions (Travers Morgan 1985). The study was initiated in part by discussions at, and papers presented to ATAC up to 1983, concerning cost recovery and road pricing issues. The need for a data base to examine the current situation in South Australia (SA), and the effects of any changes to road user charges then under discussion argued for a detailed examination of road cost recovery.

PREVIOUS STUDIES

In developing the methodology to be used in SA several previous investigations of cost recovery were reviewed. None provided a suitable methodology but they indicated the range of issues to be addressed in methodological design. Only one study (SWATS 1980) included congestion costs and none included environmental costs. An estimate of these costs was thought desirable to gain some insight into their size relative to public sector financial costs.

All studies included road capital costs and maintenance costs. The majority of Australian studies have estimated avoidable costs for trucks only and in such cases

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(1) The latest investigation is contained in the report of the National Road Freight Industry Inquiry (1984). Some measures are in the process of implementation to achieve its recommendations.

common cost elements are not always allocated (see for example CRB (1977), Affleck (1976)). The exception to this was the NSW Road Freight Industry Enquiry (McDonnel 1980). The investigations by Affleck (1976), Starkie (1981) and Blackshaw (1982) distinguished avoidable costs for typical arterial roads. The SWATS (1980) study was the only other Australian study to investigate differences in cost by specific road type or location.

Administration, accident and policing costs are generally excluded from studies investigating specific roads or vehicle classes. They are included in the more comprehensive studies (for example Freeman 1982, US Department of Commerce 1965, UK Department of the Environment 1976). The exceptions are Bland (1972) where none of these costs were included, and the NZ road user charges scheme where accident and policing costs are not included (National Roads Board 1978).

The Bland (1972) inquiry used the incremental method to determine cost responsibility of various vehicle classes. Road design components, e.g. lane width, pavement thickness, are disaggregated into increments which reflect use by different vehicle types, and costs are apportioned accordingly. This method of cost measurement has been subject to some criticism.

The Transport Economics Centre (1981) developed cost functions from a statistical analysis of costs and usage by different road user groups. The costs uniquely attributed to heavy vehicles using this methodology were low relative to avoidable costs measured in other studies.

Several different approaches to allocating non-avoidable costs have been used. Freeman (1982) and Bland (1972) used usage factors to pro rate infrastructure costs to different vehicle classes. In the NZ road user charges scheme, the use of the road system is measured by the space and time that a vehicle occupies (National Roads Board 1978). The differential benefit method allocates cost to user groups on the basis of the benefits gained. This method was used by the US Bureau of Public Roads (Department of Commerce 1965), and its use has been attempted in the UK (Ministry of Transport 1968). Another means of allocating joint cost elements is via elasticities of demand so that the least responsive users bear the greatest cost burden. This method is often referred to as the inverse elasticities or 'willingness to pay' method. (Transport Economics Centre 1981 and McGillwray et al 1978).

There is much discussion on the treatment of capital costs in road cost recovery studies. One view is that capital expenditure should be treated as current expenditure (pay as you go approach), and the other that it be treated as an addition to or

replacement of road assets, thus requiring a depreciation and a return on investment calculation on the asset value of roads (public enterprise approach). The latter is the approach adopted by most enterprises, while the former is used in practice by road authorities. The National Road Freight Industry Inquiry (1984: 223) took the view that: "In the case of a relatively mature road network, the two approaches may be expected to lead to similar estimates of annual cost". The cost recovery study by the BTE (1977) used both approaches giving some differences but broadly similar results. The public enterprise approach has the disadvantages that it requires more data, involves much more detailed calculations, and requires somewhat arbitrary assumptions about interest rates and asset replacement values.

Estimates of road user revenues relate to the type of cost allocation. Where avoidable costs are estimated, these costs are usually compared with variable charges for the vehicle types under study, for example fuel tax and road maintenance tax (Affleck 1976, Blackshaw 1982). Where overall cost recovery is the objective, both variable and fixed charges (e.g. motor vehicle registration fees) are included. (BTE 1977, Freeman 1982)

None of the previous studies reviewed provided a framework that was wholly satisfactory. The methodology developed (see below) was comprehensive in its coverage of vehicle types, road classes and levels of government, but also allowed flexibility to use cost components for any of the objectives that could be developed for cost recovery or pricing of roads.

CONCEPTUAL FRAMEWORK

The method adopted was basically a financial contribution analysis, albeit with some refinements. Figure 1 shows the conceptual approach to road cost recovery, with three segments:

A. Public sector costs. These are the costs of infrastructure and services provided by the government to facilitate road use, or which occur as a result of road use;

B. Congestion costs. These are the costs of delay which are imposed by road users on each other; and

C. Environmental costs. These are costs which result from road use, often referred to as externalities, imposed by road users on other groups in the community.

The other major cost segment associated with the use of the road system, private cost, was not considered.

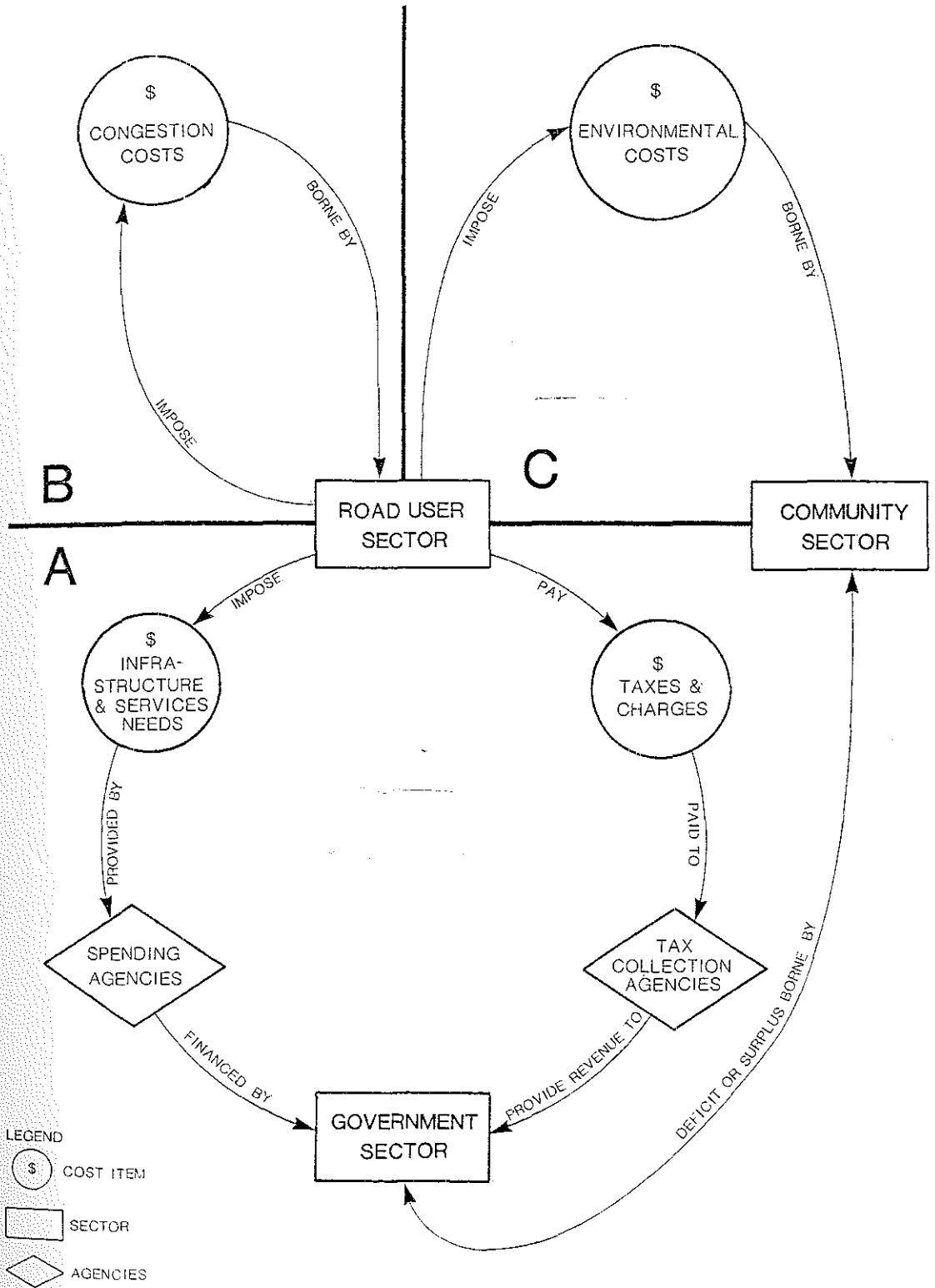

Figure 1 Cost Recovery Study – Conceptual Framework

Public Sector Cost Recovery

The road user sector creates demands for road infrastructure and services (shown in the upper half of Segment A in Figure 1), that are normally met by intermediate or spending agencies, which are in turn financed by government funds. The source of these funds (shown in the lower half of Segment A in Figure 1) are taxes and charges on the road user sector. Any surplus or deficit to the government sector as a result of these transactions is a credit or debit to the community as a whole.

The public sector road user costs included in the analysis were:

- Highways Department road construction, maintenance and associated costs;
- Local Authority road construction, maintenance and associated costs;
- The cost of policing roads and traffic (net of fines for traffic infringements);
- The public sector proportion of medical costs associated with road accidents;
- Administrative costs; and
- The net cost of compulsory third party insurance operated by the State Government Insurance Commission.

The public sector road user revenues included in the analysis were:

- Motor vehicle registration fees;
- Driver licence fees;
- Stamp duty on motor vehicle registration and compulsory third party insurance;
- Fuel taxes which include four components: Commonwealth Crude Oil Levy, Commonwealth excise, ABRD levy, and the State Business Franchise;
- Indirect taxes on vehicles (and parts) to the extent that rates of tax exceed the national average. There are two taxes included: import duties on new imported vehicles, and sales tax on new vehicles.

Congestion Costs

Congestion costs are external to individual road users, but internal to the group as a whole, as Figure 1 shows. In one sense they have little relevance to the conventional 'financial' concerns for cost recovery as such. On the other hand they are often claimed to be a significant cost, and are of relevance to road pricing. In the longer term congestion costs can lead to increased capacity and therefore transfer the cost to the public sector segment.

The analysis of congestion costs was confined to peak periods and to urban arterial roads in Adelaide. It is considered that it is only within these boundaries that any significant amount of road congestion occurs in SA on a regular basis.

Environmental Costs

Environmental costs are external costs generated by road users and borne by the community at large, as shown in Figure 1. They include such things as traffic noise and air quality impact. As in Segment B, environmental costs can be transferred to the public sector segment in the longer term, by ameliorative action taken by the government. Alternatively ameliorative action may be taken by individual private households and others, in essence leaving the costs to be borne by the community at large.

The analysis undertaken in Segment C was to review the literature and make estimates of environmental costs in SA, based on overseas research. Specific local estimates of environmental costs would be required to produce reliable data for SA.

PUBLIC SECTOR COST RECOVERY

Cost recovery from road users within the public sector forms the major component of the analysis. The methodology adopted is therefore described in more detail.

The public sector costs and revenues allow cost recovery calculations at four levels:

- for all roads;
- by road user group or vehicle type: cars, light commercial vehicles, heavy rigid trucks and heavy articulated trucks;
- by road class: National Highways, rural arterials, urban arterials, rural locals and urban locals. Expenditure on local roads was only included to ensure comprehensiveness. There was no attempt to attribute local road costs to individual vehicle classes; and
- by level of government: Commonwealth, State and Local. As local governments do not levy any taxes or charges directly on road users, only two levels of government occur for attribution of road user revenues.

The financial contribution of a particular road use sector is the revenue that the sector provides through taxes and charges less the costs that can be attributed to that sector.

Capital costs are calculated on the 'pay as you go' principle, the amount actually expended in a particular year [2].

There are two cost bases used:

- separable and common cost and;
- fully distributed cost.

In the former, the costs attributed to a particular sector are those costs which would be avoided if that sector did not use the road system, plus a share of common costs. Separable costs are uniquely attributable to a user group, while common costs are attributable to more than one user group but nonetheless vary with use. Common costs are attributed on the basis of measures of traffic flow.

The fully distributed cost basis includes the separable and common cost elements, plus an allocation of the costs which are joint between user groups. Joint costs are those which do not vary with increases or decreases in use by individual user groups. The joint costs are distributed on the basis of number of vehicle kms travelled by each vehicle class.

The proportion of costs which can be 'separated' or uniquely attributed depends on the degree to which road user segments are disaggregated. For example, costs which are joint between vehicle classes using a particular road type are avoidable (and so separable) if that road type as a whole is considered. A hierarchy of costs was therefore identified which corresponded to a hierarchy of sectors, built up from vehicle types, to road types, to urban/rural roads, to the total road sector. In principle all costs can be separated by road class, so no costs were treated as joint between road classes.

The view of cost separability taken is long run. Although most costs associated with provisions for road traffic would not vary immediately with changes in road use, in the long run the costs should respond (even if institutional factors tend to reduce responsiveness in practice). As an example, policing and administrative costs of road use are treated as variable with traffic levels; although the activities of any one member of the police force or any one administrator are common between road user groups, the totality of policing and administration is variable with the number of roads and the amount of road use. It was considered that if a less 'strict' approach was adopted, it would frustrate any rational allocation of road costs to user groups.

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(2) The annual capital value of urban arterial roads was estimated using the public enterprise approach to determine if the amounts were similar to current capital expenditure. At a rate of return of 3% the public enterprise approach resulted in costs 11% higher than using the pay as you go approach.

Table 1 shows the attribution of the major cost categories to vehicle classes for rural arterial roads (including National Highways). All separable costs are attributed to heavy vehicles (rigid or articulated); in South Australian conditions no costs could be specifically attributed to light commercials or cars.

The separable construction costs were identified by examining a sample of recent projects and varying the design life equivalent standard axles (esa's) to determine the change in construction costs. The analysis indicated that 7.5% of earthworks costs could be saved (principally through narrower road widths) and 20% of pavement costs could be saved if roads were designed at minimum sealed pavement thickness for light vehicles only. These are relatively small amounts attributed to heavy vehicles when compared with some other investigations of the cost incidence of heavy vehicles. The sample of projects was fairly small (8 rural arterial or National Highway projects) and could affect the results. It is more likely the results are a reflection of SA topography and soil conditions.

The principal determinant of pavement maintenance costs was taken to be axle loadings, as is the usual procedure. It was assumed that 20% of costs were due to climate and weathering, and the remaining 80% were attributed in accordance with current e.s.a.'s by heavy rigid and heavy articulated vehicles. Maintenance costs of bridges and culverts are relatively invariant with traffic loads in SA. The 10% of costs thought to vary are allocated between heavy rigid and heavy articulated vehicles on the basis of vehicle kms undertaken (3).

Revenues collected from road users are generally collected on the basis of vehicle ownership rather than usage, except for the four fuel taxes. These revenues were allocated to road classes on the basis of vehicle kms of travel on each road class by each of the four vehicle types.

The Road Cost Allocation Model

A mathematical model, RCAM (Road Cost Allocation Model) was developed to carry out the numerous calculations required, and to allow easy updating from year to year. It also allows changes to cost and revenue relationships if improved data on the incidence of costs and revenues become available.

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(3) Maintenance of bridges may not be greatly affected by normal traffic loads, but the effect of overloads by heavy vehicles is less clear.

TABLE 1: ATTRIBUTION OF COSTS TO VEHICLE CLASSES (%)

Cost Component	Cost Classification		
	Separable	Common	Joint
Construction (1)			
Earthworks	7.5	4.6	87.9
Pavement	20.0	4.0	76.0
Other Roadworks	-	-	100.0
Bridges & Drainage	-	5.0	95.0
Signals	-	100.0	-
Miscellaneous	-	-	100.0
Land	-	100.0	-
Maintenance			
Pavement/Surface	80.0	-	20.0
Bridges Culverts	10.0	-	90.0
Signals	-	100.0	-
Miscellaneous	-	-	100.0
Highways Department			
Administration & Road Safety	-	-	100.0
Local Government	-	-	100.0
Policing	-	-	100.0
Medical	100.0	-	-
Department of Transport			
Administration	-	96.1	3.9
Compulsory 3rd Party Insurance	100.0	-	-

Notes:

(1) Attribution for rural arterials.

RCAM calculates the avoidable cost and revenue associated with a given segment of the road system. These segments are defined in terms of one or more vehicle types using one or more road classes. The model user allocates each individual cost/revenue item across one or more contributory variables. These variables include the number of registered vehicles of each type, the length of road of each class, the vehicle kilometres of usage of each vehicle type on each road type, and others as determined appropriate. The model determines the effect on each cost/revenue item of removing the selected vehicle/road type combinations. The model user also defines the agencies which are responsible for each cost item and which collect each revenue item. Thus the avoidable costs and revenues of each vehicle/road type can be attributed between agencies and levels of government.

COST RECOVERY LEVELS

Public Sector Cost Recovery

Table 2 lists the costs and revenues included in the model. In 1982/83 total costs were $260.9m and total revenues $481.8m. The major cost items are road construction and maintenance, although significant amounts are expended on administration and policing of roads. The major revenue items are the crude oil levy and excise on fuel. Sales tax on vehicles and parts is also a significant revenue item.

Some of the major results of the study are now presented to give an indication of the ways in which the data base can be used for alternative purposes. Results are given with the inclusion and exclusion of the Commonwealth Crude Oil Levy (COL) as this particular tax represents 38% of total revenues from road users, and there is extensive debate about whether it is a road user charge or not.

The overall level of cost recovery from road users in SA was 185% in 1982/83 if the COL is included and 114% if it is excluded. There are large differences in cost recovery by level of government (see Table 3). The large over-recovery by the Commonwealth government is evident, even when the COL is excluded. The figures in Table 3 are total costs and revenues to each level of government, ie there are no joint road costs between levels of government.

TABLE 2: ROAD COSTS AND REVENUES, SOUTH AUSTRALIA 1982/83

Costs		Revenues	
Item	Amount ($'000)	Item	Amount ($'000)
Highways Department		**Vehicle Charges**	
Construction	83,095	Registration	50,992
Maintenance	42,080	Stamp duty on registration	25,422
Administration	10,405		
Road traffic safety	1,868	Stamp duty on CTPI	2,024
Local Government		**Drivers' Licence Fees**	7,617
Construction	29,593		
Maintenance	32,045		
Police Department	31,546	**Fuel Taxes**	
		Crude oil levy	183,783
		Excise	78,392
		ABRD	15,072
		State franchise fee	25,726
Department of Transport			
Planning	550		
Motor Registration	10,369		
Road Safety	1,873		
Health Commission	6,671	**Indirect Taxes**	
		Import duties	20,323
		Sales Tax	72,421
Compulsory Third Party Insurance	10,856		
Total	**260,951**		**481,774**

TABLE 3: SA ROAD COST RECOVERY, CONTRIBUTION RATIOS, 1982/83[1]

	Including COL	Excluding COL
Commonwealth Government	4.62	2.33
State Government	0.94	0.94
State Total [2]	0.62	0.62
OVERALL	1.85	1.14

Notes:

(1) Contribution ratio = revenues/costs.

(2) Includes State Government revenues and costs, and local government costs. Local governments receive no revenue directly from road users.

Results by road class are shown in Table 4. Once again total costs and revenues are shown, as in principle, there are no joint costs between road classes as discussed above. When the COL is included all roads (except perhaps rural locals) generate revenues sufficient to cover their costs. When the COL is excluded National Highways, rural locals and urban locals generate less revenues than their costs. The highest contribution is earned by urban arterials due to the much higher level of utilisation (to which revenues are related). The State Government earns positive net contributions from National Highways and local roads; its share of funding is relatively low for these road classes.

TABLE 4: ROAD COST RECOVERY BY ROAD CLASS, CONTRIBUTION RATIOS, 1982/83 (1)

	Commonwealth Government	State Government	State Total	Total
Including COL				
National Highways	1.30	1.29	1.29	1.30
Rural Arterials	9.73	0.66	0.64	2.21
Urban Arterials	7.13	0.99	0.93	2.85
Rural Locals	3.30	1.11	0.31	0.99
Urban Locals	10.68	1.15	0.30	1.21
All Roads	4.62	0.94	0.62	1.85
Excluding COL				
National Highways	0.68	1.29	1.29	0.83
Rural Arterials	5.10	0.66	0.64	1.41
Urban Arterials	3.49	0.99	0.93	1.72
Rural Locals	1.68	1.11	0.31	0.62
Urban Locals	5.22	1.15	0.30	0.73
All Roads	2.33	0.94	0.62	1.14

Notes:

(1) See notes to Table 2.

Table 5 summarises cost recovery results by vehicle class on arterial roads. Results are given with and without the COL, and also on the two cost bases: separable costs and fully distributed costs. Separable costs are 52% and joint costs 48% of total costs.

TABLE 5: ROAD COST RECOVERY BY VEHICLE CLASS, CONTRIBUTION RATIOS, 1982/83 ARTERIAL ROADS(1)

	Commonwealth Government	State Government	State Total	Total
Separable Cost Analysis				
Including COL				
Cars	21.76	1.63	1.60	5.43
Light Commercials	16.87	1.55	1.50	5.63
Heavy Rigid	7.92	1.25	1.17	2.97
Heavy Articulated	4.78	0.39	0.37	1.84
Excluding COL				
Cars	11.08	1.63	1.60	3.40
Light Commercials	8.05	1.55	1.50	3.26
Heavy Rigid	3.72	1.25	1.17	1.85
Heavy Articulated	2.64	0.39	0.37	1.13
Fully Distributed Cost Analysis				
Including COL				
Cars	4.80	0.97	0.93	2.40
Light Commercials	3.89	0.80	0.76	2.16
Heavy Rigid	4.12	1.05	0.98	2.15
Heavy Articulated	3.68	0.36	0.34	1.59
Excluding COL				
Cars	2.44	0.97	0.93	1.50
Light Commercials	1.86	0.80	0.76	1.25
Heavy Rigid	1.94	1.05	0.98	1.34
Heavy Articulated	2.03	0.36	0.34	0.97

Notes:

(1) See notes to Table 2.

On the separable cost basis all vehicle classes generate sufficient revenues to cover costs. Recovery from cars and light commercials is significantly higher than from heavy rigid and articulated vehicles. When only State Government costs and revenues are considered heavy articulated vehicles contribute revenues which are only 39% of their costs. This probably reflects two factors: the level of use of SA roads by vehicles not registered in the State, and which do not purchase fuel within SA; and the nominal registration fee for vehicles engaged in interstate trade. Legislation was recently passed in the Commonwealth Parliament to charge registration fees to interstate vehicles.

On the fully distributed cost basis all recovery levels fall and the disparities are less. The allocation of joint costs is technically arbitrary, and this should be borne in mind when examining the results. Heavy articulated vehicles are the only vehicle class not to make a positive contribution (if the COL is excluded). The State Government results indicate that all vehicle classes, except heavy rigid vehicles, contribute revenues less than costs, with the recovery rate for heavy articulated vehicles falling to 36%.

As discussed above, there is no general agreement on which costs and revenues should be included in a cost recovery analysis. The main results presented include all costs and revenues; the sensitivity of the contribution ratios for articulated vehicles to the exclusion of some cost or revenue items is shown in Table 6. In the first option, only road construction and maintenance costs are included, and revenues that can be regarded as road user charges (i.e. sales tax, import duties and stamp duties are excluded). There is a decrease in the contribution ratio as the revenues excluded exceed the costs excluded.

If a more severe definition of road revenues is used so that only hypothecated taxes and charges are treated as revenue, the recovery rate from articulated vehicles reduces to well below one. The major taxes on road users (notably the crude oil levy and fuel excise) are not hypothecated for road expenditure. (Part of the fuel excise has recently been hypothecated by the Commonwealth Government).

If all pavement construction costs are attributed to heavy vehicles on the basis of esa's then the contribution ratio for articulated vehicles falls but remains above one. In the main results only 20% of pavement construction costs were considered separable by vehicle class (see Table 1).

Congestion Costs

Congestion costs were estimated using a speed flow curve (Davidson 1966) and a composite value of time representing the mix of traffic using Adelaide's urban arterial roads. They represent at most $16.2 m which compares with public sector road costs of $260.9 m for the whole road system in SA, and $75.2 m for urban arterial roads in Adelaide.

TABLE 6: EFFECT ON CONTRIBUTION RATIOS FOR ARTICULATED VEHICLES OF ALTERNATIVE REVENUES AND COSTS, SEPARABLE COST ANALYSIS

Costs	Revenues	Contribution Ratios
All	All	4.78
Road Construction Road Maintenance	Registration fees Driver licence fees Fuel taxes	3.24
All	Hypothecated taxes and charges	0.17
Pavement construction costs distributed on the basis of ESA's	All	1.46

Environmental Costs

A reliable estimate of environmental costs could only be made by reference to specific local studies. Using inference from estimates in other countries assumes that Australia's travel environment and social welfare functions are similar to those for which the costs were developed. There is some consistency in estimates presented in a recent OECD review of European and US data, so these values were used. The costs for noise and air pollution ranged from 0.26c to 0.64c per vehicle km, giving a SA cost in the range of $26 m to $67 m in 1982/83.

CONCLUDING COMMENTS

The analysis demonstrates that almost 30% of road user costs are not for road construction and maintenance, but for other costs associated with road use, eg policing, administration, medical costs. Whether these costs should be included in the set of costs upon which any road user charging system is based might be subject to dispute. For example, policing of crime is charged neither to the criminals apprehended, nor to the victims benefiting from police services. Perhaps more definitely, annual losses on compulsory third party insurance could be excluded, since over time these are likely to be recovered either from users in other years, or from other classes of insurance.

Road users are a very fruitful source of net tax revenues to the public sector as a whole. One of the most striking results, however, is the imbalance between levels of Government in terms of tax revenues collected and the costs borne. In SA there does not seem to be a problem of road cost recovery per se; rather there is a particular funding problem faced by the State. It may become necessary for budgetary reasons for the State to impose higher taxes and charges to recover its expenditures. This has little to do with arguments for increasing cost recovery to improve economic efficiency or equity. Indeed to the extent that efficiency and equity are promoted by a policy of 'user pays', increased taxes and charges by the State, without any corresponding reduction in Commonwealth taxes, would simply compound the existing over-recovery.

Road user revenues are related, either directly or indirectly, to road use; the greater the use of a particular road type, the higher the attributable revenue. Recovery rates vary markedly between road types as average cost per vehicle varies while average revenue per kilometre is similar, with total revenue by road class proportional to its utilisation. Road classes which have the lowest contribution ratios are those with levels of investment and servicing disproportionate to their utilisation. If market conditions prevailed in the roads sector, one of the principal indicators of where to concentrate resources would be the relative profitability of different road types. In SA the results indicate there is over-investment/servicing of:

- local roads compared to arterial roads;
- rural roads compared to urban roads; and
- rural National Highways compared to rural arterial roads.

These distortions in road investment have been acknowledged in roads reports over the years, including the latest (BTE 1984). These results indicate that there may be more merit in treating cost recovery as an investment issue rather than a pricing issue (Starkie 1982).

The net contribution of road users is higher than the estimated congestion and environmental costs. The effect of charges to recover these costs would be to change resource allocation and the structure of prices, not cost recovery per se. The current financial contribution seems to indicate that the benefits of private and commercial road transport are such that road users as a whole are willing to pay for all internal and external costs attributable to them.

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