PUBLIC TRANSPORT SUBSIDIES IN ADELAIDE

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ABSTRACT: *The paper discusses the subsidization of public transport services in Adelaide. It is structured around four major arguments advanced for such subsidies. Available evidence is examined in relation to these arguments: economies of scale in the provision of public transport, second-best pricing of public transport when competing road prices are below cost, redistribution of economic welfare and land use impacts. The conclusion drawn from the evidence is that there is some justification for subsidy, on both economic and equity grounds, but not to the extent that now occurs.*

PUBLIC TRANSPORT SUBSIDIES

INTRODUCTION

The subsidy to public transport has increased substantially in all Australian capital cities over the last decade. At the beginning of the 1970s the six major public bus and tram operators came reasonably close to covering at least their working expenses. By the end of the decade they were on average recovering from the fare box less than half of their working expenses. The situation for the five suburban rail systems was significantly worse. (Brogan & Amos 1981)

This trend was a result of a series of policy decisions based on two themes. First, that relatively high levels of public transport service should be maintained. Second, the price at which these service levels would be offered to the public should be insulated from the general rate of price increases in the economy, and more particularly from the cost escalation experienced by the operators themselves.

This was the experience in States which had quite different political histories during the decade. Cheap public transport was (and seems to remain) popular with users. But so would be the public subsidy of many other public goods or services, which never received subsidy, or those which are now having their subsidy levels reduced, e.g. electricity, water and sewerage. In this environment it seems valid to explore some of the philosophical arguments which are raised in support of subsidies to public transport.

The South Australian Government has initiated a number of projects over recent years directed to various aspects of public transport provision, including several which provide, inter alia, evidence against which to assess the question of subsidy. In this paper we draw from several of these projects to provide such an assessment of public transport subsidy in Adelaide.

It should be stressed that this paper is not directly concerned with the specific subsidies to special groups, such as concession fares offered to pensioners, students, the unemployed. In Adelaide, as in some other States, the operator is given a specific reimbursement for these concessions (up to the normal adult fare) which is charged to the appropriate Government programme. The reasons for providing the concessions are obvious and their incidence is specific. It is the remainder and much larger proportion of the subsidy which is less obvious, and which benefits all classes of passengers.

Tables 1 and 2 show the distribution of the subsidy by mode, time period and user group in 1981/82. It is a fully distributed cost summary, with the separable costs for each time period attributed to the specific users in that period. Joint and common costs between particular periods are shared equally between all the passengers in the periods. Capital costs are valued at replacement rather than historic cost. (The derivation of these figures is explained in more detail later in the paper).

The total subsidy is $73.3m, of which specific reimbursements for concession fares account for $12.3m (17%). In this paper we consider four main arguments for the general subsidization of public transport.

First there is the economic argument that under certain conditions, maximum community benefit is obtained when the outputs of public enterprises

TABLE 1

Adelaide Public Transport Subsidies 1981/82
Bus and Tram ($m)

Period	Adults	Children & Students	Pensioners	Unemployed & Others	Total
Peak	7.3	8.6	1.1	1.2	18.2
Interpeak	2.6	1.8	4.9	1.8	11.1
School peak	1.5	4.3	0.8	0.7	7.3
Early morning & Evening	2.7	1.1	0.4	0.6	4.8
Weekends	1.3	1.6	0.9	0.5	4.3
Total	15.4	17.4	8.1	4.8	45.8

TABLE 2

Adelaide Public Transport Subsidies 1981/82
Rail ($m)

Period	Adults	Children & Students	Pensioners	Unemployed & Others	Total
Peak	10.1	2.4	1.3	2.1	15.9
Interpeak	1.6	1.7	0.7	1.0	5.1
School peak	0.8	0.9	0.7	0.7	3.0
Early morning & Evening	1.3	0.1	0.1	0.4	1.9
Weekends	0.8	0.4	0.2	0.3	1.7
Total	14.6	5.4	3.0	4.5	27.5

are priced at marginal cost. If it so happens that there are economies of scale in supply, the marginal cost will be less than average cost and a deficit will result.

A second argument is that subsidized public transport fares induce a transfer from private car. This results in lower traffic flows than would otherwise be the case. When the (arterial) road system is operating at (or near to) its capacity, a time saving and possibly fuel savings could be gained by the remaining road users.

A third argument, based on concepts of equity is that public transport subsidies help to redistribute resources and economic welfare to the poorer sections of the community, thus helping to alleviate any transport disadvantage suffered.

Finally there is a series of arguments which claim an advantage for cheap public transport through its assistance in the achievement of land-use planning, urban development and environmental objectives.

In the remainder of this paper we address each of these issues in turn, with particular reference to Adelaide. Characteristics of Adelaide, particularly the early planning that ensured a system of arterial roads which operate below capacity, indicate that some of the conclusions drawn in the paper are not necessarily transferable to other cities in Australia.

ECONOMIES OF SCALE IN PUBLIC ENTERPRISES

One of the main economic arguments for the subsidization of an industry is the presence of increasing returns to scale or decreasing unit costs, indicating that over the relevant range of output marginal cost will be less than average cost. This results from the existence of costs which do not vary with the level of output supplied. (We are of course referring here to long run marginal cost pricing as public enterprises are on-going concerns with continuing replacement of assets). If the efficient pricing rule of price equals marginal cost is adopted, a deficit equal to the difference between average and marginal cost at that level of output will result; to meet the efficiency criteria it is suggested that a subsidy should be paid to meet the resulting deficit. In theory, an improvement in efficiency resulting from marginal cost pricing in one industry can only be assured if it occurs in all other (or at least closely related) industries, and if the subsidy can be raised without disturbing the marginal conditions in other sectors. It is unlikely that these two conditions hold. However, if they did and if a marginal cost pricing argument were favoured, would a deficit necessarily result?

The evidence is not conclusive but favours the notion that in the long run costs are close to being constant, that is marginal and average costs are equal over the relevant output range. Therefore the economies of scale argument does not appear to provide justification for the subsidization of public transport (Wabe & Coles 1975, Oram 1979)[1].

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1 The costs considered in these investigations are generally costs to the operator. There is an argument that if marginal social costs i.e. costs to consumers and producers are considered unit costs will be decreasing due to the frequency benefit. This is discussed later in the paper.

The issue has not been specifically addressed in Adelaide since, with one major operator and a (more or less) given scale of operations, it would be difficult to determine the presence or otherwise of economies of scale. A different approach to costing has involved the identification of costs that vary with particular resources used in providing services: crew, vehicles, and vehicle hours and kilometres of operation (Travers Morgan 1978, Travers Morgan 1980a). Using this methodology most costs varied with one of the four resources. Approximately 12% of operating costs were not attributable to operating variables, indicating that if the marginal cost pricing rule were adopted a deficit would result. Table 3 shows the percentage of costs allocated in deriving the marginal cost rates. It can be seen from the table that a larger percentage of costs are allocated to bus and tram services than rail services, possibly resulting in an understatement of rail costs (Bray 1983).

The allocated costs can be regarded as medium run, i.e. those that allow for variation in service levels and the size of the fleet. The costs which are treated as fixed are mainly supervisory and head office staff, general expenses, and building and depot maintenance. The assumption was that any changes in service levels being considered would not result in changes to these items and thus to their costs, although for very large changes in ouput it is likely that some of these costs would vary by some step function. But if we do assume that the costs are strictly fixed they amounted in 1981/82 to $9.7m of the total deficit of $73.3m.

An alternative method to determining costs is to consider demand rather than supply units, that is to consider the marginal cost per passenger rather than per service unit (Vickery 1980). This approach provides a marginal cost estimate of virtually zero (the only cost is stopping and starting the vehicle to pick up an extra passenger). Basing a marginal cost pricing policy on this approach would be equivalent to assuming that all costs in public transport provision are fixed, which is patently not the case. The problem appears to arise because of confusion caused by supply units (vehicles in traffic) and demand units (passengers) being different. Using the marginal costs of an individual passenger as the basis of a pricing policy is neither intuitively sensible nor practical economics. For example, it would lead to absurdities such as a result that if a bus had only one passenger he or she should pay the whole costs of operating the bus; whereas if two passengers demanded the service, neither should pay anything. Our preferred approach is to estimate costs in marginal units of supply and apply these costs across the users of that supply.

NON-OPTIMAL PRICING OF ROAD TRAVEL

Another argument in favour of subsidizing public transport is that if road use is priced below cost, competing modes should also be priced below cost to maintain the marginal conditions. This is referred to as a second-best pricing option, the "first-best" being that prices for all modes be set equal to marginal cost. The cost of road travel comprises the money cost associated with travel (petrol, wear and tear on the vehicle and any direct costs such as parking charges), and the time involved in travelling. As the number of vehicles using a road increases the time cost to each vehicle is increased due to the effect of road congestion. This cost increase however is not solely borne by the marginal vehicle but all vehicles in the traffic stream, i.e. there is an external cost imposed by the marginal user. Given the characteristics of

TABLE 3

Percentage of Costs Allocated to Marginal Cost Rates

Category	Allocated		Fixed
	Bus & Tram	Rail	
Traffic			
- Bus & Tram	98	-	2
- Rail	-	97	3
Total Traffic			2
Maintenance			
- Bus & Tram	94	-	6
- Rail	-	93	7
- General	18	0	82
Total Maintenance			14
Fuel			
- Bus & Tram	100	-	0
- Rail	-	100	0
Total Fuel			0
General Expenses	51	8	41
Total	63	25	12

traffic flow the difference between the amount paid by the extra vehicle (average cost) and the cost imposed (marginal social cost) increases as the volume increases.

The extent to which public transport prices should be lowered to account for this non-optimality in road travel prices depends on the amount of congestion and the extent of subsititutability between the two modes. A procedure developed by Glaister and Lewis (1978) has been adapted for use in Adelaide to investigate second-best prices and resulting subsidy levels (Travers Morgan 1981).

The model is formulated in terms of expenditure functions (G), aggregated across all individuals for both the current and proposed situation, and the public transport subsidies (costs - revenues); the expression is maximized and optimal prices and subsidy levels are determined. The model allows for 3 modes (car, bus, rail) and 2 time periods (peak, off-peak) giving six types of transport as follows:

1. peak car
2. off-peak car
3. peak bus
4. off-peak bus
5. peak rail
6. off-peak rail.

Formally the model determines optimal prices (p_3, p_4, p_5, p_6) by maximising:

$$\Big\{ (G\ (a_3, a_4, a_5, a_6, X^1(a_3 \ldots, a_6), X^3(a_3 \ldots, a_6), p, u)$$

$$-G\ (p_3, p_4, p_5, p_6, X^1(p_3 \ldots, p_6), X^3(p_3 \ldots, p_6), p, u)$$

$$-[C^3(X^1, X^3) - p_3X^3] - [C^4(X^4) - p_4X^4]$$

$$-[C^5(X^5) - p_5X^5] - [C^6(X^6) - p_6X^6] \Big\}$$

where G is the expenditure function
p_3, p_4, p_5, p_6, are the variable public transport prices
p is the vector of all other (fixed) prices including p_1 and p_2
u is a vector of constant utility levels
$a_3 \ldots, a_6$ are a set of base prices for modes 3...,6.
$C^3 \ldots, C^6$ are the costs of operating modes 3...,6.

The difference between the expenditure function evaluated at the base prices (a's) and the optimal prices (p's) is the compensating variation, i.e. the amount of money required to compensate for an increase in prices from $p_3, \ldots p_6$ to $a_3, \ldots a_6$. The volumes of peak car travel (X^1) and peak bus travel (X^3) are included in the top two lines of the expenditure function because of the congestion effects of these two modes. The last four terms in the expression are the public transport subsidies.

When the expenditure function is differentiated with respect to $p_3, \ldots p_6$, and converted to elasticity form, a linear system of equations is obtained:

$$\begin{bmatrix} e_3{}^3 & e_3{}^4 & e_3{}^5 & e_3{}^6 \\ e_4{}^3 & e_4{}^4 & e_4{}^5 & e_4{}^6 \\ e_5{}^3 & e_5{}^4 & e_5{}^5 & e_5{}^6 \\ e_6{}^3 & e_6{}^4 & e_6{}^5 & e_6{}^6 \end{bmatrix} \begin{bmatrix} (p_3 - S_3)X^3 \\ (p^4 - C_4{}^4)X^4 \\ (p_5 - C_5{}^5)X^5 \\ (p_6 - C_6{}^6)X^6 \end{bmatrix} \frac{1}{S_1X_1} = \begin{bmatrix} e_3{}^1 \\ e_4{}^1 \\ e_5{}^1 \\ e_6{}^1 \end{bmatrix}$$

where e are income compensated elasticities, and $e_4{}^3$ is the elasticity of demand for mode 3 with respect to the price of mode 4.
S_1 and S_3 are the marginal social costs of peak car and bus traffic respectively where:

$$S_1 = \frac{dG}{dX^1} + \frac{dC^3}{dX^1} \text{ and } S_3 = \frac{dG}{dX^3} + \frac{dC^3}{dX^3}$$

Glaister & Lewis interpret the system of equations as follows:

"...both peak and off-peak prices will be below respective marginal social costs by an amount proportional to marginal social costs of car use, both because of the possibilities of attracting peak car users directly (through $e_3{}^1$ and $e_4{}^1$) and reallocating demand between periods (through $e_3{}^4$ and $e_4{}^3$) so as to allow further adjustment to car traffic" (page 346).

For the application in Adelaide the marginal social cost of car travel is measured via a speed flow curve developed by Davidson (1966) and modified by Akcelik (1978), and a value of time. Public transport operating cost data are derived from the cost studies described above. Existing public transport and road demand data are derived from traffic assignments, and passenger and vehicle counts. Elasticities represent our best estimates: the degree of confidence decreases from high for the own-price elasticies, to medium for the mode-switching and time-switching elasticies, to low for the simultaneous time and mode switching elasticities(1). As the elasticities in which we have least confidence are low, they do not have a large effect on the model results. The input data is given in Table 4.

The application of the model in Adelaide is restricted to two modes, bus and rail, and two time periods, weekday peak and interpeak. Both are simplifications; tram accounts for only 3% of STA patronage, and early morning, evening and weekend services account for 19% (Crouch 1983). The latter accounts for 17% of the fully distributed subsidy (see Tables 1&2). With these omissions (and the fixed costs) a subsidy of $39.5m currently occurs.

The results of the model application, given in Table 5, indicate that the optimal level of subsidy to public transport services resulting from the sub-optimal pricing of urban road travel in Adelaide is $13.8m. Most of the subsidy then accrues to peak hour bus users whose fares should be set at 74% of the marginal cost. Peak rail fares should be set at 84% of marginal cost. This is the reverse of what actually occurs in Adelaide where existing bus fares are a relatively higher percentage of marginal cost than rail fares (39% compared to 21%). The 1982 level of bus and rail fares are 52% and 25% respectively of the optimum level indicated by the model.

Off peak fares are closer to the optimum levels, but once again rail fares are further from the optimum; existing bus fares are higher than the optimum. This results from the zone fare system on STA services which charges the same fares to bus and rail passengers (even though costs are different), and, more important, to the fact that rail journeys are longer than bus journeys.

The elasticity values used in the model only represent best estimates. The model is sensitive to the elasticity values used particularly the car-cross elasticities. Some sensitivity testing of the values was carried out and the results are reported in Table 6. In the first case (A) car-cross elasticities are set to zero implying car and public transport are not competitive; the result is that marginal cost is charged and no subsidy occurs as a result of the price of road travel being less than marginal cost. The marginal cost pricing does, however,result in changes in demand with bus demand decreasing in the peak and increasing in the interpeak, and rail demand decreasing in both time periods.

Cases B & C show only small changes indicating the importance of the car-cross elasticities, as one would expect. The options in Case D indicate the synergistic effects of the elasticities: the percentage

1 The model requires income compensated elasticities; this adjustment has not been made. The effect however is small. (Glaister & Lewis 1978)

TABLE 4

Input Data for Second Best Pricing Model

	Bus		Rail		Car
	Peak	Off-Peak	Peak	Off-Peak	Peak
Fares (c/pass km)	8.4	6.0	5.0	3.6	n.a.
Marginal Cost (c/km)	21.8	5.1	23.8	5.1	n.a
Demand (pass '000 km/hr)	140.6	87.6	69.2	31.0	1,430.8
Elasticities (with respect to price of)					
Bus-peak	-0.15	0.01	0.02	0.005	0.027
Bus-off-peak	0.01	-0.45	0.005	0.02	0.009
Rail-peak	0.02	0.005	-0.2	0.01	0.006
Rail-off-peak	0.005	0.02	0.01	-0.57	0.002

TABLE 5

Results of the Model Application

	Fares (c/pass km)	Demand ('000 pass km/hr)	Annual Deficit ($'000)
Bus Peak	16.05	130.77	9,396
Bus Off-Peak	4.15	105.11	1,505
Rail Peak	20.05	53.05	2,485
Rail Off-Peak	4.15	28.91	414
Car Peak	n.a.	1463.76	n.a.
Total			13,800

TABLE 6

Sensitivity Testing of Elasticities used in the Model

Items Varied	Subsidy	
	Amount ($m)	% Change from Base
A. Car-cross elasticities set to zero	0	n.a.
B. Public transport elasticities set to zero	12.3	-11
C. Public transport time elasticities set to zero	13.2	-4
D. Car, public transport and time cross elasticities		
- set to zero	0	n.a.
- increased 100%	31.2	+126
- decreased 50%	6.1	-56
E. All elasticites increased 100%	15.1	-9

change in the subsidy level being greater than the percentage change in the elasticity values. Case E shows that if own-price elasticities increase along with the cross elasticities the increase in the subsidy level is reduced significantly.

In the case most favourable to public transport, i.e. our cross elasticity values are 100% below best estimates, the optimal subsidy of $31.2m is still below the existing subsidy level of $39.5m for peak and interpeak services.

This second best pricing model is formulated in terms of price only, while service quality and levels are other, usually more important, determinants of demand. The marginal costs of the public transport modes used are internal, i.e. costs to the operator only are considered, while the marginal social cost of car travel is used. According to Turvey and Mohring (1975) "The right approach is to escape the notion that the only costs which are relevant to optimization are those of the bus operator. The time costs of the passengers must also be included too, and fares must be equated with marginal social costs" (page 280). It is difficult to assess what the effect of this omission is, although we would expect it to lead to a higher subsidy. An attempt has recently been made to extend the model to incorporate both producer and consumer costs in the U.K., but by so doing the fundamental basis of the model has been changed: it no longer assesses the "correct" level of subsidy but whether the marginal $ of subsidy is better spent on lower fares or higher service levels (Department of Transport 1982).

DISTRIBUTIONAL IMPACT

There is a desire on the part of many governments to ensure a reasonable level of mobility for the poorer sections of the community. Such a desire underpins the provision of concession fares to pensioners and the unemployed. But can it justify the much larger blanket subsidy of all fares? At the time of writing a study is being carried out in Adelaide on the incidence of the public transport deficit which enables some comment to be made on this issue (Travers Morgan 1984).

The incidence analysis has allocated, to users in each time period, those costs which are uniquely attributable to that time period. Costs which are joint between time periods are attributed in equal proportions to all the passengers in the corresponding time periods. The total costs by different user groups are then compared with the total revenue earned from each. This revenue included any specific reimbursements paid on behalf of that group by the government. The resulting subsidy estimates therefore exclude these reimbursements.

Table 7 shows the distribution of the total 'non-specific' subsidy of $61m by user group. It distinguishes the periods of weekday peak hours (including school peak) from all other periods.

Table 7 shows that about half of the non-specific subsidy is spent on adult 'full' fare paying passengers, two thirds of which is attributed to the peak commuting hours(1). In addition to their concession fares, children and students account for a further 29.1% of the non-specific subsidy. The pensioners, unemployed and others on whose behalf the mobility argument is most strongly supported, in fact account for only 21.8% of the non-specific subsidy. Interestingly, the non-specific subsidy to these groups is actually larger than the specific subsidy they receive ($7.2m).

For rail in particular, the subsidies favour the non-concession traveller, with 57% of the non-specific subsidy going to adult passengers, three quarters of them peak period commuters.

Comparisons made of the household incomes of the public transport subsidy recipients is also instructive. Using data obtained from a home interview survey (Pak-Poy et.al. 1978) we derived the comparisons of subsidy distribution shown in Table 8.

As a way of redistributing economic welfare to the less well off, Adelaide's public transport subsidies are inefficient. On average about 55% of the total public transport deficit is spent on higher than average income households although these represent only 43% of all households. For rail, only 41% of the subsidy is directed to travellers in the 57% of households with less than average incomes.

Since this distribution includes the concession fares the distributive efficiency of the non-specific subsidy alone is likely to be even less. It is clear therefore that the distributional effects cannot justify the present scale, and certainly not the structure of subsidies. In principle, if the total public transport subsidy were able to be allocated to those most in need, the subsidy received by the poorest 20% of households could be increased by a factor of over 6 times its present level.

1 This allocation of the subsidy to "workers" is supported in Adelaide by the public transport unions.

TABLE 7

Adelaide Public Transport Subsidies 1981/82
Proportions of Subsidy (%)*

	Bus		Rail		Total
	Weekday Peaks	Other	Weekday Peaks	Other	
Adults	14.4	10.8	17.9	6.1	49.2
Children & Students	15.7	5.5	4.6	3.3	29.1
Pensioners	1.9	5.1	2.7	1.2	10.9
Unemployed & Others	2.0	2.6	3.9	2.4	10.9
Total	34.0	24.0	29.1	13.0	100.0

* Excluding specific reimbursements for concession fares

TABLE 8

Distribution of Total Public Transport Subsidies*
by Household Income of Recipients (%)

	Households with Income	
	Less than Average	More than Average
Adelaide households	57	43
Proportion of public transport subsidies	45	55
Proportion of rail subsidies	41	59
Proportion of bus subsidies	47	53

* Includes both specific reimbursements for concession fares and non-specific subsidies

URBAN LAND-USE POLICIES

There are various strands to these arguments of which we consider three in particular

i) the viability of central city areas

ii) urban consolidation

iii) environmental amenity of urban areas.

Viability of City Areas

It is held by many people, in Adelaide as elsewhere, that it is important to sustain activity levels in the central city and to retain its role as a focus of retailing, commercial and recreational activity. (It is a vociferous call in Australia because of the structure of local governments). This argument implies maintaining a high level of transport accessibility including cheap, "affordable" public transport.

We do not comment on the substantive issue of whether the central city should be protected from socio-economic trends adverse to it, but we observe that the subsidy of public services is rarely extended to other services, which if made cheaper for the central city area, would also assist with viability, e.g. subsidized electricity or water supply. Indeed, in a close parallel, it could be argued that a policy of subsidized car parking would be an equally (if not more) effective way of preserving the role of the central city. In Adelaide the situation is that the Adelaide City Council, which has most to gain from the preservation of the central city, earns a surplus on the car parking facilities it controls (Travers Morgan 1980b). Increases in public transport fares are often followed by increases in parking charges.

Therefore, while there is little evidence against which to test the relationship of subsidized public transport with central area viability, it seems to us that it is not in any event an argument for public transport subsidies in particular. It certainly does not seem equitable that the taxpayers of the State as a whole should provide the wherewithal for preserving the turnover of businesses located in one particular area of it.

Urban Consolidation

A further argument is that land use and transport policies should be integrated to sustain a policy of high density development and urban consolidation based on strong public transport links. Support for such a policy has been based on a desire to make maximum use of existing urban infrastructure, to prevent urban sprawl, and to produce more energy efficient cities.

Again we offer no comments on the substantive issue. However if such a policy is favoured we do not see public transport subsidies as a necessary component. Other things being equal, urban consolidation would probably help to reduce the public transport deficit by improving average loadings. Indeed, subsidized public transport in many ways acts against such a policy. As with cheap petrol, cheap public transport fares and high service levels increase the viability of living in outer areas.

Environmental Amenity

If public transport subsidies do induce a transfer from private car, then in principle, the adverse enviromental impacts of road traffic may be reduced. However, in practice three factors tend to mitigate against the significance of this impact.

First, the elasticities of public transport demand with respect to fares is itself fairly low. In Adelaide estimates made of aggregate bus and rail demand elasticities yielded estimates (much of the same order as found elsewhere) of -0.37 for bus and -0.40 for rail (Travers Morgan 1980b).

Secondly, the contribution of modal transfer to these relatively low elasticities is itself quite low. Although there is no Adelaide-specific evidence, research carried out in the USA and U.K. (Lewis 1977, Chan 1979) indicates that when public transport patronage responds to a reduction in fares the greater part of the increase consists of existing public transport users making more or longer trips, and of new trips. The modal transfer effect, and hence the effect on traffic volumes is relatively small.

Thirdly, many of the major environmental impacts of road traffic, such as noise, visual intrusion, severence, and air pollution require very large changes in traffic flow to produce perceptible changes in impact. Whilst further research would be desirable for a conclusive result, the expectation is strongly that in Adelaide the environmental case for the existing level of public transport subsidy would not be particularly telling. (There may be an environmental argument for public transport in terms of infrastructure provision in particular corridors (Wayte & Starrs 1983)).

The difficulty of improving environmental amenity through public transport subsidies can be partially demonstrated by the application of the second best public tranpsort model described earlier. Although the optimum position requires peak fares to increase substantially (90% for bus and 300% for rail) the model indicates that this would only result in a 2% increase in peak car traffic. By contrast much larger percentage changes in demand occur for the public transport modes. Thus for a substantial change in fare levels the change in road traffic levels would be marginal.

CONCLUSIONS

In this paper we have considered four arguments often used to justify the subsidization of public transport and we presented evidence relating to Adelaide. In summary the evidence can be used to support some subsidization of public transport, but considerably less than the $73.3m which occurred in 1981/82. Quantified elements of subsidy which would be justified on various criteria are $12.3m for concessions (which is taken as given), $9.7m for fixed costs, and $13.8m for road congestion benefits. This leaves $37.5m of the deficit for which the arguments addressed do not appear to offer justification.

This amount includes subsidies for tram services, and for early morning, evening and weekend services which were not separately addressed in the paper. The mobility argument could be used to justify subsidizing the latter services, and this is an area where further research could be undertaken.

Evidence was also presented on the incidence of the public transport subsidy, as it is often claimed that it benefits the less well off members of society. Our conclusion is that as a way of redistributing economic welfare to lower income households, the present system of fares subsidy is inefficient. For every $1 of subsidy which the system does direct to households with less than average income, it provides $1.23 to households with higher than average incomes. It should be emphasised that we are not arguing against distributional objectives, but are concerned with the mechanisms for achieving those objectives.

Arguments were presented about the efficiency of using public transport subsidies to achieve urban development and environmental objectives. The evidence is scant, but tends to indicate that at the present relative levels of road traffic and public transport usage, even substantial changes to levels of subsidy would have only marginal effects on urban development and the quality of the environment.

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