

THE CALCULATION AND DELIVERY OF URBAN
TRANSPORT SUBSIDIES IN NEW ZEALAND

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ABSTRACT

The results of Stage One of a study aimed at identifying and evaluating arguments for urban transport subsidies were presented at the 13th ATRF.

Stage Two of the study, aimed at quantifying the results from Stage One, has now been completed.

The main features of the subsidy system proposed are:

- subsidies for producer economies of scale, user economies of scale, and road congestion;*
- a national concession fare system would be introduced;*
- assistance would be provided for alternative transport services designed to meet the needs of transport disadvantaged groups;*
- fares would be set in accordance with marginal costs and the operation of differential fare systems in the main centres;*
- the introduction of performance monitoring; and*
- the use of economic evaluation techniques for all major capital investment proposals.*

The study found that subsidy of \$76 million (1987-88 prices, NZ dollars) was justified in New Zealand, of which \$62m should come from central government with the balance from local government. This compares with current (1987-88) subsidies of \$98.5m, of which \$48.5m is from central government and \$50m is from local government.

This paper summarises the study, with particular emphasis on the calculation of the justified subsidy.

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INTRODUCTION

The Urban Transport Council (UTC) is the organisation responsible for requesting and distributing central government subsidies for urban transport within New Zealand. The UTC also has a small research programme. The major research project carried out in recent years by the UTC has been an investigation aimed at determining the optimal level of subsidies that should be provided for urban transport purposes within New Zealand. The project was carried out for the UTC by Travers Morgan (1988).

This paper looks at the findings of that project.

BACKGROUND TO THE PROJECT

The principal objective of the Subsidisation project was to determine if there were any valid economic and social reasons for subsidising public transport services and, if there were, to determine how much subsidy should be provided.

The project was undertaken in two stages, with each stage having its own terms of reference. Stage One evaluated the arguments for and against public transport subsidies, and the identification of what further research was necessary to determine an optimal level of subsidies. Stage Two was designed to determine the level of subsidies that could be provided on the basis of the findings of the first stage. The results of stage one were presented to the 13th ATRF in Christchurch (Bell and Starrs (1988)).

STAGE ONE

Stage One indicated that there are four specific arguments for subsidising urban public transport on the grounds of economic efficiency and social equity:

- | | |
|---------------------|--|
| Economic Efficiency | 1. Producer economies of scale |
| | 2. User economies of scale |
| | 3. Road congestion benefits |
| Social Equity | 4. Redistribution of income and provision of mobility assistance to the transport disadvantaged. |

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Other arguments for providing public transport subsidies were found to be less sound and likely to be an ineffective means of achieving the goals at which they are aimed. For example, subsidising public transport is likely to be an ineffective means of achieving any fuel conservation policies.

An argument against the provision of subsidies was also given prominence in the first stage. The available evidence indicates that subsidies encourage inefficiency by leading to increased costs. It was concluded that a subsidy system must be designed to ensure that there is control of costs to ensure that the economic efficiency benefits are not lost on technical inefficiency.

Another important finding concerning the social equity argument was that subsidies targetted to specific user groups are more successful at redistributing income and improving the mobility of those who experience some form of transport disadvantage, than are general subsidies. Any subsidy assistance provided for these purposes would therefore need to be carefully designed to ensure that it was effective.

In assessing what further research to undertake on the social equity argument the UTC did not consider that the redistribution of income was an appropriate task for it to be undertaking. The work in Stage Two therefore concentrated on the mobility of the transport disadvantaged.

Stage Two of the study was undertaken to estimate the level of subsidies that could be justified on the basis of the Stage One findings, and to design an appropriate subsidy delivery system. The approach developed is a rational one. Acceptance of the first stage finding leads logically to a system of subsidies provided to achieve certain economic and social goals, and not for other purposes or on other grounds, nor provided in a way that fails to effectively achieve the objectives. Stage Two has therefore built on the Stage One findings.

It is important to note that the subsidy levels determined in the study are based upon the operation of the existing public transport system. No attempt has been made to determine whether the current system is the most cost-effective option. However, the results of the analyses undertaken as part of Stage Two suggest that, in some cases, the appropriateness of the present system should be carefully examined.

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PROPOSED SUBSIDY SYSTEM

(a) Introduction

It is proposed in the Stage Two report that subsidies be provided for producer economies of scale, user economies of scale, road congestion benefits, and for transport disadvantaged groups through concession fares and special services. Each of the subsidy arguments is reviewed below, and the implications of the findings are discussed.

(b) Producer Economies of Scale

Allocative efficiency is achieved when prices are based on marginal costs. In the case of a natural monopoly however, marginal costs are less than average costs and therefore a loss will result. This loss, the difference between the marginal costs and the average costs ie. the fixed costs, will need to be subsidised to achieve the ideal of allocative efficiency. Prices can then be based on marginal costs without the operator incurring a loss. A natural monopoly occurs where large fixed costs exist. A railway is such a case, with large amounts of track required before the railway can operate. Buses, however, do not have the same level of fixed costs (other than trolley buses) and therefore do not qualify for subsidy under this argument.

The amount of subsidy estimated for producer economies set out in Table 1.

TABLE 1 :

SUBSIDIES ESTIMATED FOR PRODUCER ECONOMIES OF SCALE

	NZ\$m (1987/88)	% of Total Costs
Rail - Wellington	3.957	13
- Auckland	0.560	7
- Kapiti	0.500	13
- Wairarapa	0.141	13
	5.158	
Trolley		
Bus - Wellington	0.523	75*
TOTAL	5.681	

* Percentage of the maintenance cost of the overhead structure.

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It is argued in the study that Central Government is responsible for achieving allocative efficiency and therefore this subsidy is the responsibility of Central Government.

The level of fixed cost is stated as a proportion of total costs. To estimate the subsidy in future years all that is required (at least in the short-term) is to apply this percentage to the total costs eg. 13% of the total costs of the Wairarapa line should be subsidised.

In the longer term a full exercise will need to be carried out at regular intervals (say every 5 years) to determine the level of fixed costs. Any major change in the infrastructure cost would also necessitate a recalculation of the subsidy levels.

(c) User Economies of Scale (Frequency Benefits)

The justification for subsidy on the grounds of user economies of scale is based on the argument that, as the number of passengers using a public transport service increases, the service will run more frequently. As a result, the time spent by passengers waiting at stations or bus stops will decrease. This saving of time has been argued to be a justification for subsidy to be provided to scheduled public transport services.

The amount of subsidy which is considered to be justified on the grounds of the user economies of scale argument is estimated by the use of a mathematical model known as a second-best pricing model. This model is also used to determine subsidy justified on the grounds of road congestion, and the two amounts of subsidy are determined together (the model is discussed in more depth later in the paper). User economies of scale were only estimated at peak times in larger cities where a reasonable frequency of service was already provided. The benefit is measured as approximately half the headway, and this would give unrealistic results for low frequency services. No simple method is available to measure the benefits of improved frequency on such services. Therefore no subsidy was considered to be justified at these times or in the smaller centres. The subsidy which is considered to be justified on the grounds of the user economies of scale argument is shown in Table 2.

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TABLE 2 :

SUBSIDIES ESTIMATED FOR USER ECONOMIES OF SCALE

	\$m
Auckland	5.802
Wellington	5.381
Christchurch	1.589
Dunedin	0.846
TOTAL	13.618

The report expresses some doubt over the validity of the user economies of scale argument. This doubt stems largely from the current situation of monopoly operation and regulation of urban public transport systems. For example the consultants believe that, under a more competitive situation, vehicle sizes would vary to optimise the frequency of services (the model assumes constant vehicle capacity). In such a situation user economies of scale would occur but would be at a much lower level than under the present non-competitive environment.

Responsibility for providing subsidy was considered to rest with local government rather than central government. This is argued on the grounds that even though subsidies for user economies of scale would ensure that fare levels are set according to marginal costs and that allocative efficiency is therefore encouraged, the benefits to passengers are considered to be internal to public transport users as a group, experienced at a local level, and related to the way in which local or regional authorities provide public transport services.

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(d) Road Congestion (Second Best Pricing)

Road congestion benefits to motorists of subsidising public transport were measured using a second-best pricing model, first developed by Glaister & Lewis(1978). The model is based on the argument that, in congested conditions, private car users pay less for car use than the marginal social costs they impose as they do not pay for the delay caused to other road users. If this is the case (and if a direct road pricing mechanism to correct it is not available or politically feasible), then there is a potential welfare gain in holding public transport fares down so as to encourage marginal car users to switch to public transport.

The model derives a set of second-best prices for public transport services which involve lowering public transport fares to attract peak users away from car travel, thus lowering congestion and associated efficiency losses in the road sector. The demand relationships are specified by elasticity values. The elasticity values allow demand to be affected by own prices and the prices of competing modes. An optimum situation is reached when the marginal social cost of an extra public transport trip is equal to the marginal social cost of an extra car trip. At this point, the efficiency losses in the road and public transport sectors are minimised.

The model as originally formulated by Glaister and Lewis contained only the effects of decreasing public transport prices on road congestion levels. For this study the model was re-specified to include two other effects:

- (i) the effect of improved levels of public transport service in peak periods (frequency benefits or user economies of scale); and
- (ii) the congestion costs of more buses on roads. Two components of congestion costs are measured: the contribution of buses to road congestion, and the effect of increased road congestion on the travel time of bus passengers.

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The model is aggregate in nature considering the public transport and road systems as a whole. The aggregate nature of the model requires some averaging of data and requires some care to ensure that the characteristics of the urban transport system are represented fairly.

The model was applied in the four main metropolitan areas in New Zealand (Auckland, Wellington, Christchurch and Dunedin) and to a smaller city (Invercargill, Population 48,000) to test its applicability to smaller centres. The justified subsidy levels from these model applications for road congestion benefits are set out in Table 3.

TABLE 3 :

SUBSIDIES ESTIMATED FOR ROAD CONGESTION BENEFITS

	\$m
Auckland	24.618
Wellington	13.226
Christchurch	3.644
Dunedin	.830
Invercargill	.092
TOTAL	42.410

The model is primarily a pricing model, with the justified subsidy levels being achieved by making changes in price levels. Table 4 shows the suggested changes in fare levels when only road congestion benefits are assessed.

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TABLE 4 :

CHANGES IN FARE LEVELS (Percent)

City	Peak	Interpeak
Auckland		
- bus	+17	-34
- rail	+230	+200
Wellington		
- bus	+10	-45
- rail	-23	-68
Christchurch	+10	+68
Dunedin	+12	no change
Invercargill	+54	-17

A number of sensitivity tests on the input data to the model were undertaken. The model is most sensitive to the parameters used to calculate road congestion benefits, namely the specification of the speed flow curve and the value of time. Other input parameters which can cause relatively large variations in the justified subsidy levels are the own price elasticities and the elasticity of demand for car travel with respect to the price of public transport.

With respect to Invercargill, the Stage Two report concluded that although the application of the second-best pricing model had indicated a subsidy of \$92,000 was justified, the accuracy of the model, and the observation of actual traffic conditions in the city suggested that no subsidy on road congestion grounds was justified. The consultants did, however, consider that the UTC may wish to provide some congestion subsidies to smaller centres as part of a transition period, and suggested a method by which such subsidies could be calculated without the application of a second-best pricing model.

The Stage Two report recommends that central government should subsidise road congestion benefits because central government should have responsibility for subsidies which meets efficiency objectives. Subsidies for road congestion benefits have the purpose of ensuring that marginal social costs are used as the basis for setting fare levels, and this encourages allocative efficiency to be achieved.

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Central Government funding is also supported by current arrangements for road funding. The roads on which the major part of traffic congestion occurs are partly funded by central government, and subsidies may reduce the need for road capacity increases. If changes are made in road funding then this argument would lose its applicability.

The study details the amounts of subsidy considered to be justified on the grounds of road congestion benefits for the 1987/88 financial year, using the second-best pricing model with the latest available data. The consultants state that it is not possible

or practical to calculate the road congestion benefits on an annual basis, and therefore recommend that the model be run every 5 years, or when major new data are available. For the years in between, the subsidy amounts should be updated in line with changes in the Prevailing Weekly Wage Rate Index to reflect changes in the value of travel time savings.

While subsidy amounts for the four main centres are already calculated, there are pricing guidelines which must be adopted by operators to ensure that the objectives of subsidy are met. These guidelines require that fares be set in accordance with marginal costs and that, in the main centres, systems of differential fares operate, as suggested by the model results.

(e) Mobility of the Transport Disadvantaged

Two areas of related research were carried out in the second stage to develop means of targetting subsidies to assist people who are transport disadvantaged. The first area developed criteria for determining transport disadvantage and reviewed the types of services which would best meet the travel need of those who are transport disadvantaged. The second area reviewed the current concession fare practices of operators and developed a proposal for a national concession fare system. This work was undertaken on the basis that a concession fare scheme is a readily available and practical way of directing subsidies to specific groups of people.

(i) Transport Disadvantaged Criteria

The work on developing criteria to determine transport disadvantage identified five factors which are indicators of transport disadvantage: vehicle ownership, location, life cycle, financial situation, and attitudes to available modes of travel. The interaction of these factors influences the degree of travel difficulty that is experienced. For example, the combination of low income, young family, no vehicle access, and residential location in a State housing area is likely to result in extreme transport difficulties.

Although the work has not provided any quantitative data on the extent and degree of transport disadvantaged, it does provide valuable qualitative information. This will allow parameters to be set for more in depth research and/or for experimental projects to be undertaken.

The main proposal from the work is the funding of innovative services to provide transport to people who have difficulty in using public transport or who do not have access to suitable public transport. The proposal is designed to assist people in situations where there are no suitable public transport services or who are unable to use public transport due to disability. The Total Mobility Scheme (the use of taxis by disabled persons at subsidised fares) is a good example of this type of service which is currently funded by the UTC. Contract taxi services and community transport services are suggested in the report as worthy of further consideration.

The funding of off-peak services (ie. evenings and weekends) is discussed in the study report under this section but no specific recommendations are made. The issue is of importance as these services are probably of most benefit to people who are likely to be considered transport disadvantaged. Subsidies for off-peak periods are not included in the second-best pricing model as no road congestion benefits or user economies of scale are considered likely to occur at these times.

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The study estimated the amounts of subsidy which would need to be provided to allow current evening and weekend services to continue to operate. The estimates indicate that \$16 million would be needed to subsidise existing off-peak services in Auckland, Wellington, Christchurch, Dunedin, and Invercargill if peak fares were to be charged, and \$20 million if interpeak fares were to be charged. The study concluded that subsidies of these amounts are difficult to justify on the grounds of administrative simplicity or improved mobility and that alternative service types as discussed above should be considered. The estimated subsidy levels included in the project report therefore did not include subsidies for off-peak services.

(ii) Concession Fares

The proposed concession fare scheme aims to improve the mobility of certain transport disadvantaged groups, for whom the cost of public transport is a factor in preventing them from making trips to essential services or amenities. The consultants have proposed six concession fare groups, who would be able to travel on public transport at 50 percent of the adult fare. Public transport operators would be reimbursed for lost revenue due to providing this concession. The proposed concession fare groups are:

1. children for all travel
2. school students, for travel to and from school
3. the elderly) These four groups
4. beneficiaries) restricted to
5. disabled persons) off-peak in large
6. persons on low income) centres as lower fares would be charged in inter-peak.

The estimated subsidy level for funding concession fares for the above groups is \$14.7 million.

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Concession fares are a 'second-best' means of providing support to persons who experience transport disadvantage on the grounds of the cost of travel. An income support scheme to achieve the desired income distribution is preferred. But until such a scheme is in place fare concessions will continue to be used by governments as redistribute tools, despite their ineffectiveness in this regard.

Concession fares should be funded by central government for social equity reasons. Without central government funding people in some areas might receive no or less support than people in other areas. This is considered by the consultants to be inequitable and is supported by evidence from the Total Mobility scheme. This scheme requires matching subsidy from local government and has resulted in different levels of assistance in different parts of New Zealand. If it is to be national objective to provide transport assistance by way of concession fares, then they should be funded by central government.

A related question is which agency should pay for the cost of concession fares for school transport. This cost would be a major component of the subsidy required for fare concessions and can be argued to be the responsibility of educational rather than transport authorities. Acceptance of funding responsibility for school transport by education authorities may reduce costs.

THE SUBSIDY SYSTEM IN TOTAL

The total subsidies justified on the basis of the four arguments analysed in the previous section are set out in Table 5.

TABLE 5 : TOTAL JUSTIFIED SUBSIDIES

	1987/88 (\$m)
Producer Economies of Scale	5.681
User Economies of Scale	13.618
Road Congestion Benefits	42.318
Concession Fares	14.700
	<hr/>
	76.317

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The table shows that a total amount of subsidy of \$76 million is considered to be justified. This compares with total subsidy for all sources for the 1988/89 year of approximately \$105 million. Neither of these amounts include subsidies currently provided for paratransit, planning and administration, demonstration and transport improvement projects, and UTC administration and research expenses for which total funding of \$12.6 million has been provided for 1988/89. The justified subsidy level also does not include funding for alternative services for the transport disadvantaged. The amounts would depend on the services provided by public transport operators.

The funding implications of the justified subsidy levels are shown in Table 6. The reductions shown are derived strictly from the justified subsidy levels. They do not take account of the cost of providing off-peak services, whether they be new types of services or the current conventional services. The reductions are most severe in the "Other Regions", but are also significant for the main centres, particularly Christchurch and Dunedin.

TABLE 6 :

JUSTIFIED SUBSIDY LEVELS COMPARED TO
TOTAL CURRENT SUBSIDIES
(1987/88 prices, \$m)

	<u>Justified</u>	<u>Current</u>	<u>Difference</u>
Auckland	36.860	44.880	-8.020
Wellington	29,177	32,510	-3.333
Christchurch	6.480	11.102	-4.622
Dunedin	2.370	3.271	-0.901
Other Regions			
- Municipal buses	.513	3.531	-3.018
- Private buses	.894	3.183	-2.289

The implied subsidy reductions are however tempered by the recommendations in the report that central government fund most of the justified subsidies, and by the suggestion that local and regional and regional authorities may continue to provide subsidies if they wish. Local Authorities will

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however, in the light of the study findings, need to question whether there is any sound basis for doing so. They will also have to ensure that the provision of additional subsidy will not interfere with the efficiency and equity objectives of central government subsidy.

Of the \$76 million in subsidies that are justified, the report recommends central government should fund \$63.4 million, 83% of the total. This is an increase on the current level of central government funding. The major part of the benefits of subsidies accrue to the four main centres, especially Auckland and Wellington. Implementation of the proposed subsidies would therefore re-distribute funds from smaller centres to the larger cities in New Zealand.

ACHIEVING THE OBJECTIVES

The proposed subsidy system is based on the provision of subsidies to meet efficiency and social objectives. Three mechanisms are proposed in the study to ensure that the subsidies are used to achieve these objectives: pricing guidelines, investment guidelines, and performance monitoring. In addition, it is proposed that ad hoc efficiency studies be undertaken to improve efficiency and effectiveness.

(a) Pricing Guidelines

Pricing guidelines have been prepared to reflect the specific objectives for which subsidies are provided and are based on marginal cost pricing. Operators would be required to price in accordance with the guidelines if they wish to receive subsidy funds. The guidelines were developed for two cases : cities with a peak demand period, and cities with more even demand throughout the day.

Implementation of the guidelines will result in:

- differential fare systems in the main centres, with lower fares in the interpeak period;
- fares being based on cost. This implies that a common fare structure for all modes cannot apply unless the cost of each mode is the same;
- the adjustment of fare levels to reflect producer economies of scale and road congestion benefits where applicable;
- the provision of concession fares to approved concession recipients.

The pricing guidelines are the principal mechanism for implementing the subsidy policies developed in the report.

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(b) Investment Guidelines

An economic evaluation manual has been prepared for use where major investment decisions are required. A major decision is defined as one that costs the equivalent of a new bus or more. The UTC currently has a policy on funding replacement buses if the buses to be replaced are 15 years or more old. The policy would remain and obviate the need to meet the investment guidelines for bus replacement in such circumstances. This course of action will assist smaller operators who may not have the capability to undertake economic evaluations.

The manual in effect provides for a cost/benefit analysis to be conducted for all major investment proposals. The guidelines are relatively straightforward, although one aspect which may prove difficult to implement is the reduction in subsidy required where an investment fails to meet the guidelines, but an operator proceeds with the investment.

(c) Performance Monitoring

A system of performance monitoring is proposed to ensure that subsidies do not lead to higher costs (as tends to be the case). The system essentially provides for the publication of selected indicators for operators, supplemented by ad hoc efficiency and effectiveness studies. The consultants also suggest the use of tendering to ensure cost control.

IMPLEMENTATION OF THE PROPOSED SYSTEM

Before the UTC had a chance to implement the recommendations of the subsidisation project, the NZ Government announced its intention to deregulate the passenger transport sector along similar lines to that which had occurred in the UK. The system proposed by the consultants is not readily compatible with the deregulated environment currently in place in the UK. However until details of what deregulation will mean to New Zealand are known, the study results remain on hold and have not been implemented. The results have however been accepted "in principle" by the UTC.

CONCLUSION

The objective of the study was to develop a subsidy system which has a sound theoretical and practical basis and this has been achieved. However, the subsidy proposals have severe funding implications for the smaller centres, and for off-peak services in the main centres. The result might be major adjustments to service levels and the types of services provided. Significant changes could therefore be expected if the study proposals are implemented.

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However before implementation of the proposals was even contemplated, proposals to change the operating environment were announced by the NZ Government. This has resulted in consideration of the project being deferred until details of the new environment became known.

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