Draft

Setting Efficient Public Transport Fares when Roads are Under-Priced

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1. Introduction

This note discusses how to estimate efficient public transport fares (for bus or rail trips) when private road use is under-priced.

It is well established in the economics literature that resources are allocated efficiently when prices (P) equal the marginal social cost (MSC) of service delivery inclusive of any environmental costs (Abelson, 2012). If P > MSC, people who are willing to pay for the service are being inefficiently denied the service. If P < MSC, resources are being allocated inefficiently to a service that is not valued as highly as other uses of the resources.

Accordingly, if the MSC > P for private road use, road use is excessive and there are benefits from discouraging marginal road users. The most efficient way to do this is to charge road users the MSC of road use. If this is not possible for some technical or political reason, another strategy is to lower the prices of substitutes such as bus and rail travel below the MSC of service provision. However under-priced bus and rail trips encourage excessive bus and rail use and so also have costs. Therefore in setting public transport fares below their MSCs, we need to trade-off the benefits of lower private road use against any costs of increased use of public transport.

To put the discussion in a policy context, price regulators typically set prices for a 2-3 year or longer period. Accordingly, the prices should equal the social costs that vary with usage over this time. For buses this is likely to be most costs associated with bus use including depreciation of buses. For rail this would likely include at least some rolling stock costs but not major track or station infrastructure costs. Thus efficient prices should be set to equal long-run social marginal cost (LRSMC) where the long-run refers to the policy decision period.

Sections 2 and 3 below discuss the net benefits of lower private road use and the costs associated with below-cost pricing for bus trips respectively. Similar arguments apply to below-cost pricing for rail trips. Section 4 provides a hypothetical benefit–cost exercise to illustrate how to estimate an efficient public transport fare. In Section 5, I discuss some critical empirical issues that would affect the outcome including assumptions and price setting by the NSW Independent Pricing and Regulatory Tribunal (IPART). The final section provides some conclusions.

2. Benefits from Reduced Private Use of Roads

The benefits from reduced road use are illustrated in Figure 1, which shows a market for private users of roads.

There are two demand curves for private road use. D_1 shows the demand for motor vehicle (M) trips with bus prices = LRMSC. Lower bus prices reduce the demand for private road use and so shift the demand curve to the left. Thus D_2 is the demand with lower bus prices. As per the transport economics literature, these demand curves are likely to be quite vertical (price inelastic). Note also that the demand curves represent what motorists are willing to pay for road use (or alternatively their marginal benefit from road use).

The LRMSC schedule for private road use includes resource costs associated with road use and third party costs. These costs include: marginal vehicle operating costs, accident costs, road maintenance and repair, marginal parking costs, third party congestion costs, carbon emission costs, air quality and noise costs, and any other cost associated with road use. In practice the LRMSC schedule tends to rise with more MV trips as congestion rises. For simplicity the schedule is drawn horizontal in Figure 1. This does not affect presentation of the issues.

The internalised price for the motor vehicle driver is the sum of the costs borne by the motor vehicle driver. These costs include marginal vehicle operating costs, accident costs and road user charges (fuel excise tax, road tolls and parking charges).[1]

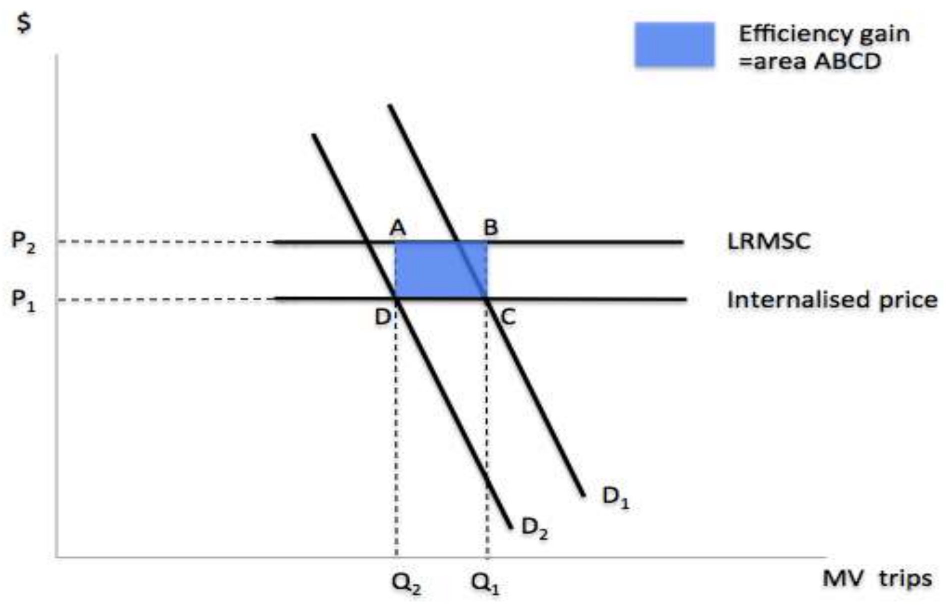

Figure 1 Market for private road use: efficiency gains from low bus fares

[1] The private time cost of trips could be included in both the LRMSC and the internalised price of travel. However this does not affect the critical difference between the LRMSC and the internalised price. Of course, the same is true of marginal vehicle operating costs which I have included in both schedules.

In this figure it is assumed that LRMSC exceeds the internalised price. This is an empirical matter and may not apply in all places and times. Some components of the internalised price, for example parking charges or fuel excise, may reflect charges greater than the associated resource or environmental cost (i.e. they include economic rents for the revenue collecting entity). This issue is discussed further in Section 5.

The quantity of motor vehicle trips (per period) is given by the intersection of the demand curves and the internalised costs, i.e. Q_1 and Q_2 for the D_1 and D_2 demand schedules respectively.

The benefit (the efficiency gain) from lower bus prices is given by the shaded area ABCD. This area is a product of the change in the quantity of motor vehicle trips ($Q_1 - Q_2$) as a result of lower bus fares and the difference between the LRMSC of motor vehicle trips and the internalised price of motor vehicle trips.

It should be noted that this benefit is not equal simply to the saving in environmental externality costs. It is the difference between the marginal social cost of the trips and the marginal gross value to the trip maker. Of course the net value to the trip maker is lower because of road user costs. In so far as these road user costs exceed the marginal cost of road use, there is a loss of economic rents to entities collecting road user costs. As IPART (2014) recognised, this loss should be offset against the environmental costs. This is reflected implicitly in describing area ABCD as the efficiency gain or social benefit of lower road use.

3. Net Cost of Lower Bus Prices

The net costs of lower bus prices are illustrated in Figure 2 showing the market for bus trips. In this case there is just one demand curve. For convenience, and as is common, this is drawn as a linear schedule.

The LRMC schedule includes a similar set of costs for buses as for motor vehicles and so may include some external congestion and environmental costs. For simplicity the LRMC schedule is again shown as horizontal. The regulated price line reflecting the lower prices sits below the LRMC schedule.

With price set at P_1= LRMSC, there are Q_1 bus trips. At a regulated lower price, bus trips increase to Q_2. The increased patronage includes motorists (and their passengers) who have switched to bus travel, users of other modes including walkers who have switched to bus travel, trip makers making more trips and others who previously did not travel.

Some of these new users would make a bus trip with a small decline in price below P_1. Other would do so only when price falls close to P_2. Thus, on average and with a linear demand curve, the generated bus users gain a benefit of 0.5 ($P_1 - P_2$). And the total benefit to these beneficiaries is 0.5 ($Q_2 - Q_1$)($P_1 - P_2$). Thus the TOTAL benefit to the generated users equals area ACD.

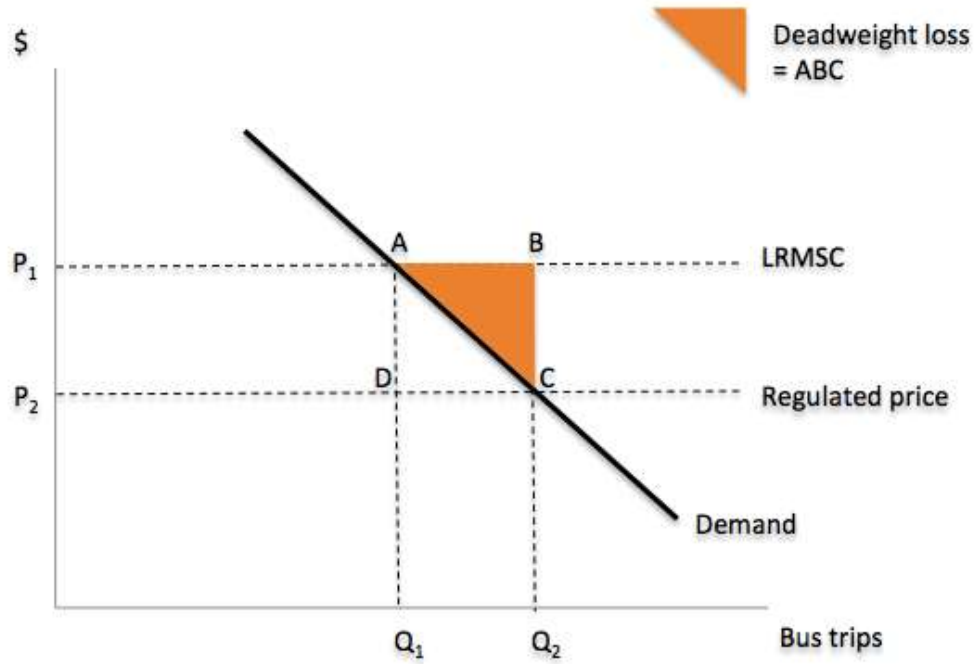

Figure 2 Market for bus trips: the cost of lower bus fares

It should be stressed that this standard transport economics methodology picks up all the private benefits for new bus trips including the benefits of those diverting from roads.[2] This is a more accurate method of estimating the net benefits of modal switching than estimating savings of travel time and vehicle operating costs for road users who transfer to buses which appears to be the method used by IPART (2014). It would of course be double counting to include private time savings or any other private benefits in addition to area ACD.

On the other hand, the total cost of these extra trips (including bus trip costs, congestion and external costs) is given by area ABCD.

Thus the **net cost** (efficiency loss) to the public of the extra trips is given by area ABC. This is sometimes described as a deadweight loss (because there is no offsetting gain).

By contrast the lower fares for existing bus users (Q_1) represents a transfer of revenue from taxpayers to existing bus users. By convention such transfers are not counted as a net welfare gain or loss in an analysis of efficient pricing.

[2] This assumes that trip makers understand the private benefits and costs of the alternative travel modes. As this is a regular routine choice, this is a reasonable assumption.

However there may be an additional deadweight loss associated with raising taxes to pay for the transport subsidy for both new **and** existing bus trips. The deadweight cost of taxation arises because taxation nearly always distorts either efficient labour supply or consumption. As IPART (2014) notes, even a relatively efficient tax has a deadweight cost of around 20%, meaning that a subsidy of $100 has a deadweight loss of $20.

4. Hypothetical Cost-Benefit Example for Metropolitan Sydney Bus Fares

Drawing on the above analysis, the following is an example of how the benefits and costs of lower bus fares for metropolitan Sydney could be evaluated. The numbers are averages based on actual figures for Sydney. Of course, practice would vary by time and location. All calculations are based on an average day. The results are sensitive to the assumptions uses and some of these are discussed further in the following section.

Base case:
550,000 bus trips a day
LRMC = $5 per bus passenger trip. This is the approximate financial cost of supply of metropolitan bus trips and does not include any external costs.

Proposed regulated fare = $4 per bus passenger trip
Price elasticity of bus trips = 0.4 (based on IPART, 2014)
Additional bus trips = 10% (25% fall in fare × 0.4) = 55,000 trips per day
Number of car drivers changing to bus trips = 27,500 trips per day (author’s assumption)
Other persons changing to, or taking more, bus trips = 27,500 trips per day
Net benefit of fewer road trips = $1.5 per road trip avoided (see discussion in Section 5).

Cost to taxpayers of subsidy for all trips = $1.0 per trip = $605,000 for all trips
Deadweight cost of taxation = 20% of total subsidy

Benefits per day of proposed fare reduction (excluding transfer payments):

Car drivers who change to bus	27,500 × $0.50	=	$13,750
Other new bus trips	27,500 × $0.50	=	$13,750
External benefits of less road use	27,500 × $1.50	=	$41,250
Total benefits per day		=	$68,750

Costs per day of proposed fare reduction

Net (taxpayer) costs for new trips	55,000 × $1.00	=	$ 55,000
Deadweight cost of taxation	605,000 × $1.00 × 0.2	=	$240,000
Total costs per day		=	$295,000

On these assumptions, the cost of a $1.0 fare reduction below the assumed efficient LRMSC of $5.0 per bus trip exceeds the benefit by over $200,000 per day and would not be economically efficient. However this is very sensitive to the deadweight cost of taxation and indeed to several other assumptions discussed below.

5. Some Key Empirical Assumptions

Clearly there are many material assumptions. The major ones are highlighted and discussed here.

The benefits of lower bus fares are driven by the product of (i) the number of car drivers that switch to bus trips and (ii) the difference between the LRMSC of road trips and the internalised private cost of road use. The costs are driven by product of (iii) the number of new bus users and the difference between (iv) the LRMSC of bus trips and the regulated fare. They also depend on (v) the deadweight loss per $ of subsidy.

We discuss these five factors briefly in turn. It is not intended to provide detailed empirical suggestions.

The number of car drivers that switch to bus trips Based on sources quoted in IPART (2014), the overall price elasticity of bus trips is in the order of -0.3 to -0.4. However, this elasticity applies to all sources of new bus trips, including diversion from other modes and increased trip making. IPART (2014) does not clarify how the increased trips are broken down by source. It is questionable how many car drivers who pay over $20 per trip, or even over $10, in road tolls and car parking charges are likely to change to bus trips on the basis of a $1 reduction in fare. Trip behaviour is more likely to be influenced by bus proximity and frequency but that is a separate issue.

The LRMSC of road trips and the internalised private cost of road use In Section 2**,** we noted the major components of LRMSC of road trips and the private cost of road use and observed that in some cases the private cost could be greater than LRMSC. This would occur when road user charges in excess of resource costs exceed the third party costs of road trips (mainly third party congestion and environmental costs). These costs are not readily elicited from IPART (2014) which does not distinguish clearly between external and private costs. It also estimates a surprisingly low level of road user charges in excess of marginal resource use of $0.33 per trip per driver who switches to bus trips (Table 8.1). This includes only Harbour Bridge and Tunnel tolls and allows for no rents from parking other than the parking levy. Adoption of the method of analysis outlined in this paper could help to clarify the LRMSC and private cost of road use and therefore the difference between them.

The number of new bus users This issue is included for completeness, but can simply be a function of an agreed price elasticity, given service levels. However the various sources of new bus users may have some minor implications for related costs or benefits (e.g. loss of economic surplus for railways).

LRMSC of bus trips In this paper, the LRMSC is assumed to be broadly equal to the long-run average financial costs of bus trips. On the other hand IPART (2014) has assumed to-date that the marginal social cost of extra bus trips is zero. Under this extreme assumption, the only cost of extra bus trips (and lower fares) would be the deadweight cost of taxation. Actually a zero marginal cost assumes not only that there would be no extra bus operations and related resource costs but also that there would be no additional boarding and de-boarding times and no additional crowding or standing in the buses. None of this seems realistic to this writer (and user of buses) and IPART (2014) recognises this. The LRMSC of bus trips requires an evidence base. It cannot be determined by assumption.

The deadweight loss per $ of subsidy This paper agrees with IPART (2014) that it is appropriate to include the deadweight loss of taxation as a consideration in cost-benefit analysis and by extension in setting efficient prices where there are significant marginal impacts on taxation requirements. In order not to unduly discriminate against subsidies, it may be appropriate to assume that government will raise the extra revenue efficiently, but the deadweight loss is unlikely to be less than 10 cents in the dollar of taxation raised.

6. Conclusions

The first best solution to efficient road use would be to price roads equal to LRMSC. This would avoid second best solutions such as lower public transport fares with the associated efficiency costs identified in this paper.

In the absence of efficient road pricing and assuming that road use is under-priced, setting public transport fares below LRMSC may be efficient (produce a net social benefit). This occurs so long as the benefit of lower fares is greater than the costs outlined in this paper. This is not assured especially if road users make up only a small proportion of the additional public transport users as a result of the lower fares.

The outcome is an empirical (cost-benefit) matter in which various critical variables need to be estimated. These include the likely diversion of road users and other trip-makers to public transport, the LRMSC of road use and of public transport trips, the implicit value of road travel embodied in the internalised price of road trips, and the deadweight cost of raising taxation.

An additional challenge is that the magnitudes of these variables will vary with location and time of day.

Of course, government may wish to subsidise public transport for social reasons. But this raises different options and questions which are outside the scope of this paper.

References

Abelson, P. 2012, *Public Economics, Principles and Practice*, 3E, McGraw-Hill, Sydney.

IPART, 2014 (December), *Review of External Benefits of Public Transport – Draft Report*.