The Cost of Community Service Obligations in Roads

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Abstract:

The Community Service Obligation (CSO) concept describes situations where organisations having commercial objectives are required by governments to implement policies which conflict with those objectives. The Bureau of Transport and Communications Economics is currently undertaking a study aimed at extending the concept to roads and estimating the cost of road CSOs in Australia. This paper discusses the conceptual issues associated with road CSOs and the methodology which has been developed for the study. A number of alternative ways to define and measure road CSOs are identified and discussed

The views expressed in this paper are those of the author, and do not necessarily represent those of the Bureau of Transport and Communications Economics.

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Introduction

The Community Service Obligation (CSO) concept describes situations where organisations having commercial objectives are required by governments to undertake activities which conflict with those objectives. The concept has been widely used with reference to loss making telecommunications, postal, railway and urban public transport services. There is little argument that large sections of Australia's road network are constructed to standards which could not be justified on economic grounds and that the revenues collected from users of many roads fail to cover construction and maintenance costs. It would seem, therefore, that the CSO concept should be extendable to the roads area Yet application of the CSO concept to roads is problematic for a variety of reasons, in particular, roads not being supplied by commercial enterprises, lack of a direct road pricing system and data deficiencies

In 1989 the Bureau of Transport and Communications Economics (BTCE) produced a study 'The Cost of Telecom's Community Service Obligations' (BTCE 1989) The Bureau is currently undertaking a study of costs of CSOs in roads This paper discusses some of the conceptual issues associated with road CSOs and the methodology which has been developed for the study.

Defining road CSOs

In its study 'The Cost of Telecom's Community Service Obligations' (BTCE 1989), the BTCE adopted the following definition of a CSO:

> a government requirement to provide products or services to community groups at a price less than the cost of supplying them

From this definition, there are thus two characteristics of services regarded as CSOs: a government requirement and unprofitability

Government requirement

The existence of a government requirement is not always easy to establish. Sometimes the demand is not spelt out clearly in legislation or in explicit directions but is imposed through price controls or informal channels An attempt to distinguish between legitimate CSOs and overinvestment due to other causes such as 'pork barrelling' or poor decision making would be fraught with difficulty and would open any study of road CSOs to a great deal of controversy The only practical approach is to assume that because the road system is built and maintained by governments, the existing system of publicly provided roads and the standards at which such roads are built and maintained, are derived from government requirements

Unprofitability

Unprofitability should be addressed taking a long term perspective as commercial activities are sometimes unprofitable in the short term but have the prospect of long term profitability. There is some disagreement over the treatment of technical inefficiency in assessing costs of CSOs. Technical inefficiency includes bad investment decisions as well as inefficient operating practices. If the aim is to measure the *actual* costs of providing CSOs then the costs of technical inefficiency should be included. In any case, an investigation of the technical efficiency of road authorities' construction and maintenance activities would be a full study in itself.

The BTCE definition quoted above is readily applicable to a commercial organisation selling services to the public (such as Telecom or government railways), whereas use of the roads is not sold directly. In a rudimentary way, road services, the rights to drive over lengths of road, are priced, but only indirectly through taxes and charges such as fuel excise, fuel franchise fees and vehicle registration charges. Thus a measure of the 'profitability' of a given road would be the difference between the cost of providing the road and the revenue accruing to governments from use of the road.

In its study of costs of Telecom's CSOs the BTCE estimated the *avoidable* revenues minus *avoidable* costs of CSOs, that is, the net losses that would be avoided if the services were not provided. Fixed charges such as registration charges and licence fees are of the nature of access charges. Since they are independent of road usage and so cannot be tied to usage of particular roads, they must be excluded from avoidable revenue. This leaves fuel excise and fuel franchise fees as the only revenues which are both road user charges and variable with road usage and thus avoidable.

An issue that arises at this point is whether all revenue collected from fuel levies should be taken into account when defining and costing road CSOs or only the proportion passed on to road authorities, with the remainder viewed as a tax. Docwra and Kolsen (1978) provided a convenient resolution to the problem: 'One important distinction between a price and a tax is that the former is paid for some specific good or service, while the latter is paid without the state providing any specific counterpart for each specific tax payment'. Their suggestion for defining a charge is 'the price which would have been charged in a more or less competitive market in the absence of any government intervention *specific to that industry*' (emphasis in original). Thus the road charge would be the amount at which road costs were fully covered. This would vary from road to road. Where the amount actually paid in fuel levies exceeds the costs of the road, this excess would be regarded as a tax. Where fuel levies failed to cover costs, the deficiency would be a 'negative tax' or subsidy. Thus the proportion of road user payments regarded as tax would differ between roads and would be negative for CSO roads. The subsidies for CSO roads would be counted as the cost of the CSOs.

The requirement that the government intervention in an industry be specific to the industry for an impost to be regarded as a charge, means that, unless the rates of such taxes were especially high for the road transport industry, sales taxes, stamp duty and customs duties on vehicles, parts and tyres, cannot be regarded as specific road user charges because they apply to a range of goods and services.

There remains a major difficulty with applying an unprofitability criterion to individual roads. Under a road pricing system that does not differentiate between different roads, economically efficient investment behaviour will mean that some roads will underrecover and others overrecover. For an individual road, whether avoidable revenues exceed costs at the optimal level of investment will depend on the level of taxes, the elasticity of demand for road use and the extent to which additional road investment produces savings in users' costs. The presence of indivisibilities in road investment, for example numbers of lanes, introduces another reason why it would be purely coincidental if the economically efficient level of investment in a road resulted in full recovery of costs. There will be a negative relationship between over-investment in an economic sense and cost recovery but the relationship is expected to be a loose one.

Even if it were feasible to charge different rates for different roads, Walters (1968) has argued that optimum road usage charges are unlikely to raise sufficient revenue to cover costs for most non-urban roads. Indeed, Walters suggests that 'insistence on a budgetary equilibrium for a particular road may lead to quite appalling results'. Leaving aside the complications raised by the theory of second-best, economically efficient pricing requires that prices, at any instant in time after the asset has been created, equal short-run marginal costs. Congestion costs would be one element of short-run marginal costs. In urban areas, revenue raised from congestion charges would contribute significantly to capacity costs. On rural roads, the level of congestion will usually be inadequate for a congestion related charge to permit costs to be recovered. This is not to say that investment in uncongested roads will never be warranted. Investments in improving the quality of such roads can be justified on the grounds of the savings in vehicle operating costs, time and accident costs. Thus, even with optimal pricing, unprofitability of a road is not an indicator of whether there is overinvestment from an economic efficiency viewpoint.

In order to obtain an economically efficient allocation of road funds, road investments should be assessed in terms of social costs and benefits. It might therefore be considered appropriate to define road CSOs in terms of social costs and benefits. A road would be classed as a CSO if it was built or maintained to a standard above that at which net economic benefits are at a maximum. A recent discussion paper by the New South Wales Roads and Traffic Authority (RTA 1992) suggested a similar approach.

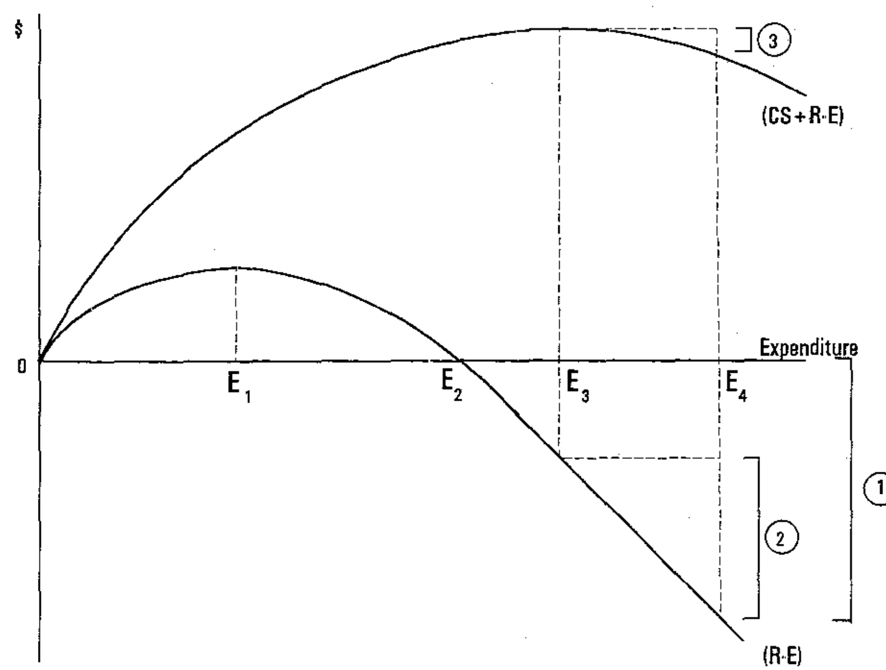
> 'Road quality CSOs could be identified and valued where there is a minimum road service standard that must be met (an obligation), yet the costs of meeting the standard outweigh the community benefits. In other words, a CSO exists where the RTA is required to provide a quality beyond the economically optimum level.'

The method of defining and measuring CSOs is bound up with the objective of the exercise. If the intention is to focus on the economic costs of CSOs then the social benefit-cost approach would be appropriate. If the emphasis was on cross-subsidies, the revenue-cost approach should be adopted.

The method used to *define* CSOs need not be the same as that used to *measure* them. It is possible to define CSOs in benefit-cost terms and measure them in revenues and costs. A road would still be classed as a CSO if it was providing a service quality standard above the economic optimum, but instead of measuring the cost of the CSO as the economic cost of this overprovision, the cost would be assessed as the net effect on government revenue of the overprovision Thus the CSO measure would be the avoidable loss at the existing standard minus the avoidable loss at the economically optimal standard. This approach would be followed if the objective was to make transparent the funding and geographical cross-subsidy aspects of uneconomic road spending.

Figure 1 provides a diagrammatic exposition of the relationships between the methods of CSO definition and measurement suggested so far in the paper. Government revenues minus expenditures (the R-E curve) and net social benefits (the CS+R-E curve) are plotted against road expenditure which serves as a proxy for road standard. It is assumed that road standards are perfectly divisible and that the tax is levied on fuel consumed. The R-E curve rises initially as more vehicles are attracted to a higher standard road and reaches a maximum early because, at lower standards, fuel consumption is highest Tax revenue falls off gradually after reaching a maximum because, even though vehicle numbers are increasing, fuel consumption per vehicle is falling, and the effects on vehicle operating costs from successive improvements in the road standard are diminishing. Eventually the stage will be reached where there are no further gains in revenue from increased spending The increased spending without any compensating revenue increase pulls the R-E curve down into the negative area The profit maximising level of spending for the government is at E_1. Revenues equal costs at E_2.

Figure 1



The net social benefit curve is the R-E curve with the area of the consumer surplus triangle under the demand curve added on. It reaches a maximum and begins to fall due to diminishing returns in user cost savings from increased spending on the road. The optimum level of expenditure from the point of view of society is at E_3. In the diagram it lies to the right of the zero profit level E_2, but this will not always be the case.

Letting E_4 represent the level of expenditure corresponding to the existing standard, three CSO measures are shown:

1 The revenue-cost approach: CSO defined as occurring at standards above the zero profit standard (E_2) and measured as total revenue minus total cost, ie. ① in the diagram;

2 The mixed approach: CSO defined as occurring at standards above the economic optimum (E_3) and measured as the difference between revenue minus cost at the existing and optimal standards ②; and

3 The social benefit-cost approach: CSO defined as occurring at standards above the economic optimum (E_3) and measured as the difference between net social benefits at the optimal and existing standards ③.

The CSO measure under method 3 is less than that under method 2 by the amount of the increased consumer's surplus.

Justifying CSOs in Roads

Justifications for subsidisation and/or overinvestment in some roads can be divided into economic and non-economic. For a CSO to be economically justified it must improve the efficiency of resource allocation. It might be questioned whether a government requirement which would improve resource allocation should be called a CSO. However, neither the BTCE's Telecom definition nor those suggested above for roads mention the reason for the government requirement. As already noted, optimal pricing will lead to underrecovery on roads where there is little or no congestion. A subsidy would be necessary to make up the deficit. Under the existing charging system, a commercial road authority would need to finance not only government requirements to invest beyond the economic optimum, where these were unprofitable, but also requirements to invest at the economic optimum level where this exceeded the zero profit level of investment. Thus there would be CSOs which improve resource allocation under a revenue-cost CSO definition.

Under a social benefit-cost CSO definition, if all costs and benefits were correctly measured and taken into account and there was perfect certainty about the future, there could be no such thing as 'overinvestment' to improve resource allocation. The CSO concept could nevertheless be used to cover cases of *seeming* overinvestment where there are benefits which have been omitted from the analysis because they are too difficult to quantify, or undervalued because of the partial equilibrium nature of the analysis.

The main economic justifications for CSOs are based on the notion that roads produce external economies and diseconomies It has been pointed out that roads provide a variety of supplementary benefits such as serving as fire-breaks and stock routes. However, it is doubtful that these benefits would be of sufficient size to warrant serious consideration (Docwra, G E 1981).

There are other situations where benefits may be excluded or undervalued. The computer models used by road authorities for evaluating road investments do not allow for generated demand. This could provide an economic efficiency rationale for seeming overinvestment in roads expected to promote economic development. Little research has been undertaken into the value of time for freight transport and the costs of damage to freight as a result of road roughness and these are usually ignored in cost-benefit analyses of road projects The value of reducing the time during which roads are closed due to flooding is another example of a benefit not normally quantified

The economic efficiency justifications discussed so far are scarcely adequate to explain the pattern of road expenditures, in particular, the vast numbers of CSOs which are likely to exist in local roads, mostly in rural areas, used for access purposes Doubtless the real explanations for road investment patterns lie in historical, political, and institutional factors. Historically, roads have been constructed to open up new areas to development, to directly create employment, to improve communications and thereby strengthen political control and unity, to further the reach of law and order, to encourage trade and industry, to promote decentralisation of population and economic activity, and for military reasons Many of these considerations continue to influence decisions on road expenditures in Australia today.

More often than not, the arguments for CSOs are couched in terms of equity and rights. All citizens regardless of where they live are entitled, as of right, to certain standards of services at similar prices. For transport and communications activities it is a question of equity of access. These services have a social role of reducing isolation As ARRDO (1981) expressed it, one of the reasons transport services are subsidised is 'To achieve social objectives - that is, where some minimum level of mobility for all is considered socially desirable, irrespective of financial capacity'.

If CSOs were defined in revenue-cost terms, many roads would be CSOs simply because of the difficulties associated with charging different prices for use of different roads. A social benefit-cost definition avoids this. Where the CSO improves resource allocation, a benefit-cost CSO definition can highlight the gap between the real optimal road standard and that suggested by the particular cost-benefit analysis technique in use, but measuring the CSO in benefit-cost terms makes no sense When using a benefit-cost CSO measure it is necessary to assume that the CSOs are solely for non-economic reasons

Practical Issues Facing a Road CSO Study

Level of analysis

The measured CSO cost will vary with the level of disaggregation with which the analysis is undertaken. The cost of road quality CSOs is obtained by adding together the losses in either net government revenues or net economic benefits for loss making sections of road. Sections of road generating surpluses are ignored. If a loss making section was broken down into subsections, it may be found that some of the subsections, in fact, generate surpluses. After excluding these non-CSO subsections, the total CSO cost for the section would be higher. For example, a road that follows fairly flat terrain might not be a CSO except where it cuts through a hill where costs are much higher. It could be that the section of road over the hill should be of a lower standard than that over flat terrain to maximise the net benefits of the hill section. Thus the further the system is broken down the larger the CSO cost estimate is likely to become. Fortunately, the links in road authority databases are usually quite small and when they are long, it is usually because the section of road is fairly homogeneous.

Network effects

Road links will nearly always be complements in demand for other links and will sometimes be substitutes. Two links are complementary if downgrading (upgrading) the standard of one reduces (increases) the traffic along the other. Links along the same road are the obvious example. Where downgrading (upgrading) a link raises (reduces) traffic along another link, the two would be substitutes. Links on roads which are alternative routes are likely to be substitutes. The difficulties these create for a study of road CSOs is that hypothetical downgrading of one link to the point where it ceases to be a CSO can alter the CSO status of other links. In these circumstances, adding together CSO costs for links estimated under a *ceteris paribus* assumption can produce a meaningless result.

Costing road CSOs for even a small region and fully taking into account the network effects would be a major undertaking. For a study of the size being undertaken by the BTCE it is not feasible to consider demand relationships between road links. However, this is not expected to be a very serious limitation on the study because the effects of downgrading road links would usually be quite limited geographically.

Optimal road standards

With a revenue-cost approach it would not be necessary to identify the road standard where revenues equalled costs (E_2 in figure 1). It is simply a matter of subtracting total costs from total revenues. Identification of the optimal standard (E_3 in figure 1) would be necessary under the benefit-cost approach. Road standards can be assessed in terms of roughness, number of lanes, width and alignment (curvature and gradient).

It is envisaged that a series of discrete optimal road standards could be specified for ranges of AADT (average annual daily traffic) levels. The capacity standards might be as follows: unsealed, single lane sealed, narrow two lane sealed, wide two lane sealed, three lane and four lane. For each standard and range of traffic volumes, an optimal level of 'terminal roughness' would be estimated at which the road should be treated. The AADT range limits might have to be varied for different states or regions within states reflecting differences in average construction costs and multiple tables would be needed for varying traffic compositions (percentage of commercial vehicles).

Costs of pavement construction and maintenance could be obtained using the BTCE's Pavement Life Cycle Cost (LCC) model (BTCE 1990). This model estimates the costs of future maintenance and pavement reconstruction expenditures given details of pavement characteristics, AADT levels, vehicle compositions and traffic growth rates. It can be set up to assume pavements are treated whenever they reach a specified terminal roughness level or to determine the economically optimal level of terminal roughness.

Obviously a large number of assumptions would have to be made in deriving optimal standards including the distribution of hourly volumes, the elasticity of demand, alignment, pavement construction and maintenance costs, average bridging cost per kilometre, vehicle operating costs, the value of time and so on. Pavement thickness would be set according to the standard practices of the road authorities since it is not intended to investigate the economic warrant of the pavement thickness/maintenance cost trade-offs chosen by road authorities.

For any actual length of road there will be a wide range of factors which will cause the optimal standard to differ from that determined for a hypothetical road of the same traffic volume and traffic composition. The available databases usually supply information on only a limited number of relevant factors. Alignment data are not available from some road authority data bases and on more curved roads a wider pavement would be justified. Where this is not available it will be necessary to assume an average curvature. Separating the traffic volume ranges associated with the various optimal standards, bands could be determined where the optimal standard is deemed to be indeterminate as between the two adjacent standards. The width of these bands could be set on the basis of sensitivity tests.

The results would be compared with data from road authority databases. The data would be obtained in the form of total lengths of roads by region at each capacity standard, for specified ranges of AADT, vehicle composition and roughness. For those capacity standard-AADT-vehicle composition road groups which have above optimal capacity or roughness standards, the revenue, benefit and cost implications of changing to the lower optimal standard would have to be estimated.

Roughness standards must be handled differently from capacity standards because a road may be fairly smooth, not because there is a policy of treating the pavement too often, but because it has been resealed or reconstructed recently. Terminal roughness levels for the capacity-AADT-vehicle composition road groups can be inferred by assuming that the average roughness level in a region is maintained constant, and distributing the upgrading work among the different road groups in a manner consistent the actual roughness levels in groups. Some smoothing could be carried out to ensure that the implied terminal roughness levels consistently fall with AADT level, removing the effects of irregularities in the data arising from a preponderance of roads with high or low sealing ages in particular groups. The terminal roughness levels so derived could be used in the LCC model to estimate costs of roads in the CSO groups.

The BTCE study will confine itself to rural roads which are the responsibility of state and federal governments. Urban roads will be omitted because the economics of these are different and much more complex. Roads which are the responsibility of local governments will be omitted because there is very little data available, particularly on traffic levels. It is noted, however, that local governments accounted for 38 percent of total road spending in Australia in 1988-90 (BTCE 1992) and it is probable that the bulk of road CSOs are to be found in local roads.

Alignment and gradient standards

Alignment and gradient standards involve the creation of 'non-renewable and specific' assets. By non-renewable assets is meant expenditures to create assets which, having once been undertaken, need not be incurred again so long as capacity does not have to be increased beyond the level for which the expenditures were made (Kolsen 1968). Costs of acquisition and preparation of land, excavation of cuttings and building of embankments would be examples. Non-renewability is of little importance unless it is associated with specificity, that is, they have no alternative use in their present form. Land can be sold but the costs of constructing the alignment can never be recovered. The initial cost of constructing the pavement does not come into this category because the pavement wears out and the cost of reconstruction is almost as great as that for the initial construction.

The existence of non-renewable and specific assets means that the cost curve for expansion differs from that for contraction. The cost of constructing the alignment would feature in the expansion cost curve (upgrading the road to higher standards) but not in the contraction cost curve (downgrading the road). Along the contraction cost curve, the main costs would be those of maintaining the road on the existing alignment but at lower standards until the point was reached where the road ceased to be a road and the land sold

If the study aimed to look backwards in time and estimate the costs imposed by CSOs in the past, the expansion curve would be relevant. This is not practical because the necessary information on road alignments and expenditures in the past is usually not available and, given that 'bygones are bygones', it is of questionable value. The contraction option, which ignores alignment and gradient standards, is feasible and is in keeping with the avoidability approach to costing CSOs It would provide an estimate of the savings to be had from eliminating CSOs.

Land costs

The total avoidable cost of a road includes the opportunity cost of land It may be possible to obtain some guidance from state road authorities as to the average values of land surrounding major roads. More often than not, however, this avoidable cost will be zero as the land with at least a minimum standard road would be required for access purposes. A further reason why the opportunity cost of land will often be zero is that, in most cases, the value of land to farmers would be less than the cost of breaking up the road (Munby 1960). Where a CSO is defined in social benefit-cost terms, there is no need to estimate opportunity costs of land except where the optimal road standard is no road at all. The optimal standard is located by analysing costs and benefits from incremental changes to standards.

Transition between standards

For comparing costs and benefits at one road standard with those at a lower standard, there are two alternative approaches. One is to estimate the costs of construction of a new pavement, future maintenance costs and future benefits or revenues, at each standard and simply take the difference. This is equivalent to assuming that instantaneous and costless transition from one standard to another is possible. The alternative is to recognise that the overdesigned road already exists and to estimate the cost savings and losses in benefits/revenues from allowing the pavement to deteriorate to the lower optimal standard.

The instantaneous and costless transition option would be easier to implement. For the downgrading option it would not only be necessary to identify optimal standards for ranges of traffic levels in the long-run, but also to estimate the benefits and costs of *actually* downgrading overdesigned roads to the optimal level. Generally it will not be worthwhile to reduce the capacity of a road until it becomes due for reconstruction. From data on roughness, AADT, vehicle composition and traffic growth rates, the LCC model is able to indicate when reconstruction will become due. For some grossly overdesigned roads downgrading may be warranted at the time of resealing.

Annualisation of costs

It was noted above that unprofitability should be addressed taking a long-run perspective. While revenues are normally fairly constant from year to year, costs will vary greatly. Road pavements are reconstructed when they wear out and may undergo several major maintenance treatments in the intervening years. Costs have to be made comparable with revenues. If avoidable future costs of existing roads were expressed as present values and then converted to annuities at the chosen discount rate, they would vary considerably depending on the stage of the road in the cycle of reconstruction and deterioration. Old roads due for reconstruction in the near future will be greatly disadvantaged relative to new roads and this disadvantage will be greater the higher the discount rate.

For the purposes of *determining* the optimal standards at which to construct hypothetical roads, the correct approach is to compare discounted present values of costs and benefits for construction of a new road. However, for the purposes of *measuring* the costs of CSOs of actual roads, if one assumes instantaneous and costless transition from a higher to a lower standard, it would be consistent to argue that the stage a road is at in its life cycle should be irrelevant. Taking costs over a period of one life cycle and averaging these over time (equivalent to using a zero discount rate) would put all roads on the same basis regardless of their current stage in the life cycle. This suggestion is consistent with the paygo approach used for road pricing. The resultant estimate of the cost of road CSOs could be interpreted as the long-run value of the average annual saving to governments (revenue-cost approach) or to society (benefit-cost approach) from elimination of existing CSOs. This long-run would only be reached when all roads in the system had been downgraded.

In estimating the *actual* savings to the government or to society from eliminating existing road CSOs, the fact that roads are at different stages of their life cycles is a very relevant consideration. The result of an exercise to estimate actual cost savings would be best expressed as a discounted present value. This could be converted to an annuity if an equivalent annual cost was required.

Growth in demand

As already indicated, for the purpose of identifying and measuring road CSOs under a benefit-cost approach, it is proposed to specify a number of discrete capacity standards and threshold AADT levels at which upgrading from one standard to the next is warranted. Previous studies have identified such threshold AADT levels and have shown that they fall as the traffic growth rate increases (BTE 1984, Kerali, H R *et al* 1992). However, these studies assume that the choice is between upgrading immediately or never. Where there is the alternative of delaying implementation, an optimal time could be determined. With benefits growing over time, the optimal time occurs where the condition $B(t) = rC$ is satisfied, where $B(t)$ is benefits as a function of time, r is the discount rate and C the cost of the upgrade. Thus the optimal time is the year where the benefit in that year from upgrading equals the cost of bringing forward the upgrade in time by one year. As long as changes in the growth rate do not alter the relationship between AADT and benefits, with optimal timing of upgrading, the threshold AADT level between one standard and the next will be independent of the growth rate. A higher growth rate will bring forward the optimal time but it does not change the threshold AADT level. The threshold AADT levels which apply regardless of growth can be derived by assuming immediate implementation and zero growth.

Despite this fortuitous result, there are likely to be cases of mistaking optimal behaviour for overinvestment where the timing of upgrading has been influenced by the stage of the road in the cycle of pavement maintenance treatments and reconstructions. Obviously there would be cost savings in undertaking both upgrading and maintenance or reconstruction concurrently.

Opportunity cost of road funds

At the optimal road standard, the benefit from an additional dollar of expenditure will be one dollar. It could be said that the marginal benefit-cost ratio is unity. For this to be the optimum in a general equilibrium sense, it is necessary to assume that the marginal dollar spent on the road in question would earn one dollar in its alternative use. However, capital rationing of road funds will often mean that projects with benefit-cost ratios above one are not implemented. For example, the New South Wales Roads and Traffic Authority has a target benefit-cost ratio of two. If the road budget was assumed to be a fixed amount, the opportunity cost of expenditure on a CSO road would be the benefits foregone by not spending the funds on non-CSO roads. The issue is whether there is warrant for treating the road budget as a fixed amount. Funds saved by eliminating road CSOs might not be used on other roads but could be redirected to any area of government or returned to taxpayers through tax reductions. The reality is likely to be somewhere in between, with some funds retained by the roads sector and the rest diverted elsewhere. To the extent that funds would be diverted to other road projects with benefit-cost ratios above unity, a road CSO study based on a marginal benefit-cost ratio of one will underestimate the real opportunity cost of CSOs.

Under the assumption that the road budget is a fixed amount, a 'total system approach' to estimating the cost of CSOs could be employed taking account of the opportunities forgone. A search for road CSOs will inevitably find many roads which are 'negative CSOs', that is, under a revenue-cost CSO definition, they earn more for the government than the amounts spent on them or, under a benefit-cost definition, there is underinvestment from an economic viewpoint.

Once the analysis identifying CSOs had been carried out it would not be too difficult a task to reallocate the road budget by progressively taking funds from the most costly CSOs and reallocating them to the most lucrative 'negative CSOs'. This would continue until the point was reached where no more gains could be made. The resultant cost of CSOs, that is, the gain from reallocating the road budget would still underestimate the true cost of CSOs because the 'negative CSOs' have only been upgraded along a contraction path. Possible investments which involve new road alignments (eg. town bypasses, straightening curves, reducing gradients) would not have been considered. The result would also be an underestimate because, with the lack of data on local roads, only reallocation to roads in state road authority databases could be considered.

Conclusion

Summary of the different approaches

A range of alternative approaches to defining and measuring road CSOs has been discussed. The alternatives can be summarised as follows:

Revenue-cost approaches

- A CSO exists where avoidable revenue for a road link is less than total avoidable cost and this difference would be the measure of the CSO. Costs of CSOs would be assessed as a simple average per year over one cycle of reconstruction and reseals.

- A CSO exists where the government as road provider would gain from allowing the road to deteriorate to a lower standard and the CSO cost would be measured as the amount the government would save by allowing the road to deteriorate to the point where avoidable revenue equals avoidable cost Costs of CSOs would be assessed as a discounted present value

The main difference between these two approaches lies in the distinction discussed previously, between assuming that there is instantaneous and costless transition between capacity standards or undertaking the analysis recognising that the overdesigned road already exists.

Social benefit-cost approaches

- A CSO exists where the net benefits to society would be greater if the road had initially been constructed at a lower standard and/or was maintained at a lower standard, and the CSO measure would be the difference between net benefits at the existing standard and the net benefits at the lower optimal standard. Costs of CSOs would be assessed as a simple average per year over one cycle of reconstruction and reseals.

- A CSO exists were there are positive net benefits to society from allowing a road to deteriorate to a lower standard, and the CSO measure would be the net benefits gained from allowing the road to deteriorate to the level at which the road ceased to be a CSO. Costs of CSOs would be assessed as a discounted present value.

There are again two alternatives reflecting the two alternative assumptions about transition between standards.

Mixed approach

The definitions of CSOs under the benefit-cost approaches would be combined with the CSO measures under the revenue-cost approaches. Either of the two alternative assumptions concerning transition between standards could be made.

Total system approach

Assuming that the road budget is a fixed amount, the road budget would be reallocated to maximise either net government revenues or net economic benefits, and the cost of CSOs measured as either the gain to the government or the net economic gain to society from the reallocation The total system approach is not an alternative to the previous three approaches. It is an extension which can be made to any of them. Either of the two alternative assumptions concerning transition between standards could be made

The BTCE Study

The present paper, which looks at the conceptual issues of road CSOs and suggests a methodology for costing them, summarises the results of the first stage of the BTCE's road CSO study. The second stage, which aims to derive some broad estimates of the costs of road CSOs in Australia, is now under way. The study should also be able to indicate how the costs and benefits of road CSOs vary between states and regions within states and between commercial and other vehicles. The approach being followed is to estimate the saving from eliminating existing CSOs under the benefit-cost and mixed approaches. Having obtained a result for one it is not much additional work to do the other. It should also be fairly straightforward to derive an estimate under the revenue-cost approach but omitting land costs. A benefit-cost approach involves considerably more work and involves a much greater number of assumptions but the results would be more useful. Road funds are not spent according to commercial criteria and there is no question that they should be. Furthermore, under the revenue-cost approach, the CSOs identified will be as much due to the method of road pricing currently employed as to legitimate reasons for the existence of road CSOs such as encouraging social intercourse. This is illustrated by the result that a change in the level of fuel excise will alter the number and cost of CSOs under a revenue-cost approach. The 'total system approach' is not being followed on the grounds that it is doubtful whether the fixed road budget assumption is realistic. However, by assuming that the opportunity cost of a dollar of spending on a CSO road is a dollar, the study will be adopting a conservative stance which is likely to understate the costs of CSOs. Estimates under both assumptions of costless and instantaneous transition between standards and actual downgrading of roads will be derived.

A study at this level will of necessity be highly aggregated and based on some strong assumptions. For example, it must be assumed that the economic benefits of road standards are fully taken into account and correctly valued so there are no CSOs resulting from 'seeming overinvestment' in roads as discussed above. The elasticity of demand and the value of time are quantities that will have a significant effect on the outcome but on which there are no agreed values provided in the literature. Plausible values will have to be chosen and applied across the board. It may be possible to undertake sensitivity tests on some of these assumptions. It will be necessary to stress therefore that the quantitative results from the study will be orders of magnitude only.

Some of the methods and concepts developed will be applicable in efforts by others to measure CSO costs at greater levels of detail, for example, at a regional or individual project level. It may then be possible to take greater account of the specific circumstances of the case at hand instead of relying on some of the assumptions made in the national study. The discussion of how the CSO concept can be applied to roads and the methodology developed may well be as significant as the actual quantitative results of the study.

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