

## REFORMING TRUCK CHARGES

**Margaret Starrs**

### **ABSTRACT**

In 1991, Governments in Australia agreed to the establishment of the National Road Transport Commission. The introduction of uniform national charges for trucks and buses over 4.5 tonnes gross mass was identified as a high priority task for the Commission.

The paper will report on progress with the development and implementation of the heavy vehicle charges in terms of the objectives they were intended to achieve. Charging principles (objectives) were outlined in the Agreement between Governments to guide the development of the charges. Some of the principles could only be achieved by giving less emphasis to other principles. For example, the principles require that the charges recover the fully distributed costs of road use but also that they achieve efficiency.

The context in which the truck charges have been developed is important to an understanding of the current position and the potential way forward. In particular, the taxes and charges dichotomy, the relative importance of cost recovery and efficiency, the charge mechanisms that may be used, the effects on competing transport modes, and the costs of administering the charging regime.

The method and data to be used for the first determination of heavy vehicle charges were prescribed, but more refined methods and data were to be investigated for later determinations. The costs of road use and the use of roads by trucks are the major inputs to the estimation of charges. Much of these data are deficient, based on engineering judgement or best estimates. The paper will describe the improvements made to date and some planned improvements. There remains considerable uncertainty about road costs and how they vary with road use.

### **Contact Author**

Margaret Starrs  
6 Arthur Street  
South Yarra  
VIC 3141  
Australia  
Phone: +61 3 9826 3742  
Fax: + 61 3 9826 3751



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## **1. INTRODUCTION**

There is likely to be a single set of heavy vehicle charges for the use of roads in Australia by the time this paper is presented. This is no mean feat given the historical, legal, economic and financial debates that have occurred in the last 50 or so years about the costs of road use and the way to recover those costs. Whether it is an improvement is still open.

The debates commenced following WWII when States attempted to impose significant charges on trucks which were competing with railways. Constitutional cases established that only charges which recovered road maintenance costs could be imposed on vehicles carrying freight between States. The road maintenance taxes were abandoned in 1979 because they were easy to avoid and were therefore regarded as inequitable (Moore and Starrs 1993). During the 1980s there were several investigations that led to interstate trucks being subject to charges again, but also suggested that charges generally for heavier trucks should be increased considerably. Some studies suggested charges that were four or more times higher than the then current charges.

Charges varied considerably between States and Territories. For a 6-axle articulated truck (the most common long distance freight vehicle), the lowest charge was about \$500 (Northern Territory) and the highest almost \$6,000 (New South Wales). There was therefore some incentive to register trucks in low charge States or Territories. New South Wales and Victoria also imposed permit fees on trucks that travelled in their States at heavier masses, including trucks that were registered in other locations. These factors provided an impetus for discussion of a national approach to heavy vehicle charges.

## **2. COMMON METHOD**

The Heavy Vehicles Agreement signed by all governments in 1991 contains the brief for the charging work undertaken by the National Road Transport Commission. It is restricted to charges for trucks and buses over 4.5 tonnes gross vehicle mass.

The Agreement defines five Charging Principles which require the Commission to set charges:

1. to fully recover distributed road costs while minimising over-recovery from any vehicle class, thereby achieving full recovery of all road costs;
2. adopting a common methodology;
3. to determine and collect charges in a way that achieves a reasonable balance between administrative simplicity, efficiency and equity in the charging structure;
4. to improve pricing, leading to a better allocation of resources, with investment decisions on equipment and infrastructure being based on more relevant demand signals; and

5. to minimise the incentive for operators to 'shop around' for lower charges and undermine the integrity of the national charging system.

The method specified in the Agreement for calculating costs to be recovered was to:

- (a) use PAYGO (pay-as-you-go) for determining what expenditure is to be recovered until an improved method of cost recovery becomes available. PAYGO requires the use of road expenditure to represent road costs and the average of three years' expenditure to help smooth out annual fluctuations;
- (b) use a common methodology, initially based on the model employed by the Inter-State Commission in its 1990 Report, but enhanced with further research then being undertaken by ARRB Transport Research;
- (c) initially adopt the expenditure allocation template to be endorsed by Austroads in the PAYGO process; and
- (d) make use of the Australian Bureau of Statistics Survey on Motor Vehicle Use (SMVU) road task data (with appropriate upgrading) as the source of this data.

The method outlined in the Heavy Vehicles Agreement was developed by the Inter-State Commission (ISC 1990) and is similar to methods in use in New Zealand, the United Kingdom and the United States of America (Jones and Nix 1995).

The cost allocation component of the method takes as its basis existing road expenditure in various categories, referred to as the expenditure template. Where possible, the various categories of road expenditure are then attributed to vehicle classes on the basis of their road use expressed in different ways (eg kilometres travelled, vehicle weight). Cost attribution is based on engineering relationships or judgement about how specific expenditures vary with the road use parameters. Expenditures that can be attributed in this way are referred to as separable costs.

Expenditures which are invariant with road use (ie cannot be attributed to specific road use parameters) are referred to as non-separable costs. In other words, there is some base level of expenditure required no matter what use is made of the road. These non-separable costs are nevertheless attributed to vehicle classes to obtain fully distributed costs of road use.

The results of the cost allocation process are allocated costs by vehicle class which are then used as the basis for determining charges for road use by heavy vehicles

The main instruments that are specified in the Agreement as charges to recover allocated costs are:

- (i) road use charge (diesel fuel excise);
- (ii) access charge; and
- (iii) mass-distance charge

The access charge and mass-distance charge were combined by the Commission into a fixed annual charge in the national heavy vehicle charges. They are imposed by States and Territories in conjunction with vehicle registration. The road use charge is

notional only; it is that part of the diesel fuel excise imposed by the Federal government on fuel sales that was assessed as a charge as opposed to a tax. Unlike the fixed annual charges, the revenues from which are generally spent on roads, the revenues from the road use charge are not. The revenues are collected by the Federal government and are not related to the level of Federal road expenditure.

### 3. DEFICIENCIES IN THE METHOD

While based as closely as possible on known relationships between road use and costs, the relationships are not well defined and the cost allocation process is necessarily subjective. Examples below show some of the assumptions used and how results can be affected by fairly minor changes in the process.

#### **Pavement Maintenance Costs**

In the Inter-State Commission (ISC) and National Road Transport Commission work, 60 per cent of (routine) pavement maintenance costs were attributed on the basis of equivalent standard axles (ESA-km). The use of ESAs to describe pavement deterioration is based on the 1950s ASSHO Road Test in which different vehicles with different loads were driven over pavement sections for up to two years. The Test did not include chip-sealed granular pavements or triaxle trailers, and it assumed that single axles with single tyres did no damage to pavements. These factors mean that the Test may not be very relevant to Australian (or New Zealand) conditions.

The analyses of the Test results also left something to be desired according to Potter (1995, p6):

“... the pavements (and subgrades) froze in winter and, hence, were “solid as a rock” and practically unaffected by traffic loads during this period. In the following spring, as the pavements “thawed out”, they were saturated with water and, hence, were exceedingly weak and deteriorated rapidly under traffic loading. In the subsequent analysis, it was necessary to “weight” the vehicle passes according to the season in which they occurred (eg one pass in spring = 100 passes in winter) arriving at the smooth curves for condition vs traffic which we all wave around.”

Nevertheless, the relationships continue to be used (with some amendment). Subsequent research in Australia and other places has tended to confirm the general relationship between axle mass and pavement deterioration (the fourth power relationship) but little work has been done on how this affects costs.

Prior to the establishment of the Commission and at the request of the ISC, ARRB Transport Research commenced work on investigating an improved cost allocation process. Two methods were used to examine the relationship between road use and maintenance expenditure for a sample of roads (Martin 1994)

The statistical approach involved estimating relationships between maintenance expenditure and road use. The direct measurement approach involved estimating relationships between road condition and road use. Road condition was measured using the profilometer and falling weight deflectometer. The direct measurement approach was preferred to the statistical approach because the latter is data intensive and data were generally insufficient to have much confidence in the results. The direct measurement approach is, on the other hand, likely to underestimate road-related wear because it is based on a structural assessment of road wear.

Both approaches suffered from lack of data on cumulative ESAs since the last major treatment. Only annual ESAs were available, and they were rough estimates based on average annual daily travel and the proportion of heavy vehicle use on the roads in the sample. Routine and periodic maintenance expenditure were combined as no statistical difference in the effect of road use on them could be discerned. Put another way, the combination was necessary to get any relationship (which was a reflection of the poor data).

The ARRB Transport Research recommendation is that 50 per cent of maintenance expenditure should be attributed to the gross mass of a vehicle (AGM-km) rather than 60 per cent on the basis of ESA-km. This recommendation results in little change to the share of expenditure allocated to heavy vehicles (both just under 25 per cent). It has more effect on the distribution of allocated costs by vehicle class, with costs per vehicle decreasing by about \$600 for a 6-axle articulated truck, and increasing by about \$70 for a 2-axle rigid truck.

### **Pavement Construction Costs**

In the ISC template, 60 per cent of pavement construction costs were attributed to ESA-km. For the national charges, 60 per cent were attributed to AGM-km, following a review of practice in States and Territories (NRTC 1992). In addition, even though pavements are designed for a certain number of passes of an equivalent standard axle, it has been argued that this is not an appropriate attribution parameter because there are economies of scale in pavement construction costs. Although the pavement design parameter is a power function, the relationship between pavement depth and pavement costs is not (NSW Taskforce 1990).

Later work by ARRB Transport Research suggests that ESA-km is the appropriate attribution parameter but that a lower share of pavement construction costs (45 per cent) are separable (Martin 1994). The use of ESA-km preserves the non-linear relationship between cost and road use (measured as cumulative loads).

### **Non-Separable Costs**

Non-separable costs are allocated using vehicle kilometres of travel (VKT), following the ISC (1990). VKT is a measure of the utilisation of the road system; its use reflects the fact that all vehicle classes contribute to the basic need for roads and the joint cost

components which arise from those collective needs. However, in an earlier study, the Inter-State Commission argued against the use of VKT to estimate fully distributed costs because "distance related parameters should not be associated with common (fixed) cost because by definition they cannot be unambiguously related to vehicle travel" (ISC 1987, p69). The New Zealand approach uses vehicle-related parameters (although four of them, rather than the number of vehicles alone) and was then considered by the ISC to be more logical because only costs related to road use (separable costs) should be allocated on the basis of road use.

The use of VKT as the non-separable cost parameter significantly affects the expenditure allocated to heavy vehicles, and to specific vehicle classes. Compared to using vehicle numbers, the former increases from about 22 per cent to 25 per cent of total expenditure on roads, with costs per vehicle increasing by over \$2,000 for a 6-axle articulated truck, and by over \$100 for a 2-axle rigid truck. The proportionate increase is greater for the heavier truck (about 12 per cent) compared to the lighter truck (about 8 per cent).

### **Local Roads**

Total road expenditure by local governments is only reported in government financing statistics (generally two to three years after the event) and not in the detailed categories required for the cost allocation process. The procedure used to estimate the cost of local road use is to apply the arterial road unit cost rates by parameter to the equivalent parameters on the use of local roads. For example, the arterial road unit cost rate (cents per ESA-km) is multiplied by the number of ESA-kms on local road to obtain the local road expenditure due to ESA-km. Other parameters are treated similarly so that a total local road expenditure can be estimated.

This method gave a local road expenditure estimate of \$1,300 million compared to expenditure of about \$1,800 million in 1992-93 (BTCE 1996). The difference may be explained by arterial unit cost rates being lower than for local roads. This would be true if local roads are built to a lower standard than arterial roads, which they probably are in general. Work undertaken for the Commission on a limited sample of local roads indicated that the share of maintenance costs attributable to heavy vehicles was similar to that for arterial roads, but as their use of local roads is low unit cost rates are high (Martin 1993).

There are other explanations. Not all local road expenditure is use related. This could be because there is a certain basic level of access or road design standard that is desired no matter what the use of a road. If that is the case, then allocation on a cost-occasioned or use-related basis is arguably inappropriate. The distribution of expenditure between construction and maintenance also differs for arterial and local roads. Local governments spend about half their roads budgets on maintenance while about one third of arterial road expenditure is on maintenance. Finally, estimates of local road use by heavy vehicles are subject to much uncertainty (NRTC 1995).

#### **4. DISCUSSION**

The national heavy vehicle charges have been subject to some criticism. It is claimed that they:

- fail to fully recover costs;
- do not promote economic efficiency; and
- concentrate too much on administrative simplicity and equity.

##### **Cost Recovery**

The charges more than fully recover costs of road use from heavy vehicles as a group. The allocated costs were about \$1,000 million, while the fixed annual charges were estimated to raise about \$370 million and the road use charge about \$810 million (set at 18 cents per litre on diesel fuel).

The diesel fuel excise was 26 cents per litre in 1992; if all of the diesel fuel excise was counted as revenues from road use then the cost recovery ratio would be even higher than the 1.18 obtained when using 18 cents per litre as the road use charge component of the diesel excise.

When individual vehicle classes are considered there are variations in cost recovery. At average distance travelled, there is over recovery from all rigid trucks, articulated trucks with 3, 4 or 5 axles and 2-axle buses, and under recovery from trucks with 6 or more axles and 3-axle buses. Charging Principle 1 required that over recovery from any vehicle class be minimised, which gave some recognition to the difficulty of designing a set of charges perfectly correlated with allocated costs or road use by vehicle class.

There are also variations within vehicle classes because costs and charges are based on the average vehicle in the class. Vehicles which operate over the average gross mass, but more particularly, travelling more than the average distance will incur more costs than they pay in charges. Indeed, a fuel charge of about 25 cents per litre (and no fixed annual charges) was estimated to provide a better overall match of costs and revenues than the combination of fuel and fixed charges in the national heavy vehicle charges (NRTC 1993).

##### **Economic Efficiency**

The process used to estimate charges is only loosely related to economic efficiency. The method uses expenditure (not costs) and allocates all expenditure to achieve full recovery. Its main objective is achieving a fair distribution of total expenditure between all vehicle classes, based on their use of the road system. It does not lead to charges based on marginal costs of road use. This is quite apart from questions about whether externality costs are included, or whether/how capital improvement costs are

included. Indeed, if these costs are added they are likely to result in more distortion than the method used for road authority costs.

Charging on the basis of marginal cost would be preferred if the existing charges result in a different use of vehicles or cause more freight to be carried on road vehicles than other modes relative to the optimal achieved by marginal cost pricing. The first question to be considered though is how we define marginal costs. The cost of one vehicle using a road cannot be determined so other methods, using some form of averaging, are generally used. The following shows the range of the estimates that have been made:

- One approach is the marginal cost method in the 1982 US cost allocation study. It estimated costs to restore pavements (represented by resurfacing) to their original condition and divided them by the estimated cumulative loads (ESAs) to which the restored pavements are subject over their lives. This resulted in costs per ESA-mile (\$US 1981) ranging from 9 cents for rural interstate highways to 80 cents for urban local roads (US DoT 1982, pE-25).
- The Bureau of Transport and Communications Economics (BTCE) adapted the US method and estimated marginal costs as 47 per cent of all road expenditure, on the basis that proportion best represented pavement restoration expenditure (Luck and Martin 1988). No estimates were available of cumulative loads on the treated pavements so ESA-kms in one year were used, giving an estimate of marginal costs of 14.6 cents per ESA-km (\$A 1986-87). Depending on the state of the road system, ESAs on all roads in one year may or may not be a reasonable representation of cumulative (lifetime) ESAs on the pavements restored in one year.
- In work undertaken for the Commission, marginal costs were estimated as the separable components of expenditure from the cost allocation process (Meyrick & Associates 1992). They are equivalent to about 11 cents per ESA-km (but there are several road use parameters used so the cost effects by vehicle class are different).
- A further variation on the estimation of the marginal costs of road use is the approach being used in the current review of mass limits for heavy vehicles (Austroads 1996). They are estimated as the load-related component (60 per cent) of pavement rehabilitation costs. The costs were estimated from pavement areas, reconstruction rates and the proportion of cost attributable to loading, as provided by road authorities. The estimated rehabilitation costs are \$770 million in total or 1.6 cents per ESA-km for arterial roads and 25.3 cents per ESA-km for local roads.

Estimates of marginal costs therefore vary considerably depending on the method used. They also vary considerably with the type of road: roads constructed to a high standard have lower marginal costs and vehicles that use them may be paying charges which cover those costs.



Now we turn to the question of the effects of charges on behaviour and whether it is likely to lead to an improvement in efficiency.

Registration charges are a relatively small component of operating costs of most heavy vehicles. BTCE (1992) estimated that vehicle operating costs could increase by over 2 per cent in the Northern Territory and Tasmania as a result of the national heavy vehicle charges, and less than 1 per cent in other places. (The then existing charges in the Northern Territory and Tasmania were considerably lower than elsewhere.) Work for the Commission indicates that for large vehicles, purchase decisions are not driven by registration charges but by the type of work expected to be performed by a vehicle (AGB McNair 1993). Regulation of axle mass and gross vehicle mass are arguably more likely to affect truck choice than charges. For example, the penetration of triaxle trailers was fast and extensive when their allowable axle mass was increased to 1.5 tonnes more than for tandem axles in the late 1970s.

The main study of the economic effects of a marginal cost pricing system was undertaken for the US road system and estimated significant benefits (Small et al 1989). A large share of the benefits of the marginal cost pricing system were estimated to result from changes in the types of trucks used (in contrast to the AGB McNair study). The changes were estimated from a logit model which used aggregate data on truck usage by vehicle classes as dependent variables in the selection of a vehicle class. The use of aggregate data may affect the results. Other factors which may mean that the results are not transferable from the US are its relatively low charges compared to costs, and the different axle and gross mass limits, truck operations and types, and road pavements in the US.

The benefits were also large because the model varied the marginal costs (and prices) by road type. A pricing system of this complexity may not be feasible, and if it were it would involve relatively high collection costs.

By comparison, the economic benefits of charges which reflected the mass of vehicles were estimated as part of the evaluation of the national heavy vehicle charges (Meyrick and Associates 1992). The benefits (relative to the existing State-based charges) were estimated at \$2.5 million per annum. The difference from the US study mainly relates to assuming no change in vehicle use as a result of the charges (see above), but also using lower estimates of the level of marginal costs. A further comparison of relative efficiency of different charging regimes is the effect of the over recovery implied by the rate of diesel fuel excise. As it is passed on to consumers and export industries, it is an inefficient means of raising taxation. If the tax components of diesel fuel excise (and State franchise fees) were removed and replaced with income taxes, Swan Consultants (1994) estimated that economic output (GDP) would increase by \$600 million per annum. Clearly, if efficiency improvement were the objective, then imposts on the road freight industry should be decreased.

The question of whether there is full cost recovery from one mode is irrelevant to the efficient use of different modes of transport. The choice of mode will be distorted if each is not charging marginal costs for the services they provide, eg carrying a

container between point A and point B. The issue is raised because it is often argued that if there is not full recovery of the costs of the road system from trucks, then railways should be treated in the same manner with respect to its track costs. But what is the cost of road use is not a settled issue (see above). The costs of a particular trip are most unlikely to be the same as the cost estimated from the cost allocation process, as the process applies to expenditure and to averages over the whole road system.

Studies in Australia have examined the marginal and fully distributed costs of road and rail where they are in competition and generally concluded that road is more cost efficient than rail. Blackshaw (1982, p11) noted that while studies of aggregate cost recovery by mode provide some use "any assessment of whether prices charged by individual modes are consistent with economic efficiency needs to be made at a considerably less aggregate level, and related to avoidable cost concepts".

Blackshaw's analysis of road and rail costs and revenues in the Adelaide-Melbourne corridor indicated that road covered its short run avoidable costs while neither road nor rail covered their long run costs. Road was however closer to doing so than rail. This result was confirmed by ISC (1986) when it examined interstate freight services where road and rail were competitive, but not by ISC (1987) because only truck registration charges were included in the revenue recovery analysis. As discussed above, the marginal costs of high standard roads are lower than the average for all roads. The interstate road/rail results (ie road user charges in excess of costs) probably reflect the fact that where road and rail are in competition, high standard roads are used by trucks.

Another measure of the relative efficiency of modes is the level of input tax to which they are subject. The road transport industry pays a significantly higher rate of tax than rail transport and the average for all other industries combined (SCOT 1995).

Finally, even if marginal costs are significantly higher than fully distributed costs (as implied by the US Department of Transport (1982) study), then the efficiency benefits to rail of road marginal cost pricing can be expected to be low. Small et al (1989) found that they would be about 0.5 per cent of the total estimated benefits. Although small in absolute terms, the benefits may of course be significant in specific corridors or markets.

Since the time of the Australian costings, the institutional environment, costs and charges for both modes have changed so the results should be treated with some caution. Nevertheless, the main point remains that whether there is full recovery of the costs of road use is irrelevant to the question of the efficient use of competing modes of transport. Indeed, full recovery may lead to a reduction in efficiency if the costs relate to the whole road system and not to the trips/roads where trucks and railways are in competition.

## Administration and Equity

Charging Principle 3 requires a reasonable balance between administrative simplicity, efficiency and equity in the national heavy vehicle charges. The selection of fixed annual charges rather than charges which varied with operating mass or with mass and distance was in the interests of administrative simplicity. It involved minimal changes to registration systems and so collection costs.

It arguably improved efficiency and equity to some extent as charges were more closely aligned to the fully distributed costs of road use by vehicle class. For example, in most States the relativity between charges for rigid trucks and articulated trucks will now more closely reflect allocated costs. There are many more rigid trucks than articulated trucks and it appears that this was a factor in State decisions on charge levels because of the consequent effects on revenues. (A small increase in rigid truck charges in absolute terms will result in a large amount of additional revenue.)

On the other hand, efficiency may be lower because costs of road use vary by State and Territory and that variation is not reflected in a national set of charges. Equity is also reduced because the charges are for the average vehicle in a vehicle class. Trucks which carry volume freight or travel less than the average distance pay relatively more than trucks which are loaded to maximum mass or travel more than the average distance. The distance effect is countered to some extent by the fact that the road use charge (diesel fuel excise) recovers two thirds of the costs allocated to heavy vehicles. Administration (collection and enforcement) costs of a more refined set of charges would be higher than for fixed annual charges. The costs can range from 2 to 20 per cent of revenues raised for charges which vary with mass and distance, depending on the complexity of the regime (Nix and Jones 1995). The lower proportions also occur where the mass-distance charges raise all or most revenues from truck operators (as occurs in New Zealand). The cost in Australia may be around \$40 million (4 per cent of \$1,000 million). This assumes that the cost of administration is not affected by the level of charges but only the method of collection. There are likely to be costs of a similar order of magnitude for truck operators to pay the charges. (Typically the operator cost of obtaining permits is more than the cost of issue by authorities.)

It would be difficult to justify costs of the order of \$80 million to collect revenues of \$370 million. The picture may change if there were no road use charge (diesel fuel excise) and all costs were collected by way of mass-distance charges (as occurs in New Zealand). This is unlikely in Australia as the diesel fuel excise is a major source of revenue for the Federal government. Indeed, when the national heavy vehicle charges were set (1992), the diesel excise was 26 cents per litre (of which 18 cents was the Road Use Charge), and it is now 34 cents per litre as a result of indexation in line with the Consumer Price Index. The road use charge component has been subject to indexation without consequent adjustment of the fixed annual charges.

## 5. CONCLUSION

The paper has attempted to show that knowledge about the relationships between road use and road wear, and road use and costs leave many unanswered questions or questions with more than one plausible answer. When that is the case, it is difficult to justify large increases in truck charges. The available information does suggest great variability in costs with road standard and road use. In these circumstances increasing charges, which are based on averages across the road network, may reduce rather than increase efficiency.

It is difficult to conclude that the national heavy vehicle charges are a significant improvement over the State and Territory charges. The level of cost recovery has not changed overall, but there has probably been a better matching of costs and revenues by vehicle class taking a national perspective. (This is of course dependent on what is a fairly subjective method of cost allocation.) It is not possible to conclude on whether efficiency has improved when we cannot even estimate the marginal cost of road use. The cost of administering heavy vehicle charges is likely to have reduced somewhat by the fixed annual charges which replaced a range of State-based systems with varying degrees of complexity.

Despite the cautious conclusion on improvement, the national heavy vehicle charges were well received by States and Territories, and even more so by the road freight transport industry. The fact that a long debate has been closed seems to be a contributing factor. Perhaps more important from the road transport industry point of view is the level of the charges. For the long distance freight industry workhorse (the 6-axle articulated truck) the fixed annual charge is \$4,000 compared to charges over \$20,000 which were being proposed in the 1980s.

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