Reducing Greenhouse Gas Emissions in Transport: Some Tax Policy Options

Working Paper

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Bureau of Transport and Communications Economics

WORKING PAPER 3

REDUCING GREENHOUSE GAS EMISSIONS IN TRANSPORT: SOME TAX POLICY OPTIONS

SUBMISSION TO THE TRANSPORT WORKING GROUP
ON ECOLOGICALLY SUSTAINABLE DEVELOPMENT

ISSN 1036-739X
ISBN 0 642 16869 5

This publication is available free of charge from the Manager, Information Services, Bureau of Transport and Communications Economics, GPO Box 501, Canberra, ACT 2601.

Printed by the Department of Transport and Communications, Canberra

FOREWORD

A Transport Working Group, along with eight other working groups, was set up in 1990 by the Prime Minister to consider the implementation of Ecologically Sustainable Development principles in sectors of the Australian economy with major impacts on the environment.

The Bureau of Transport and Communications Economics presented a paper on 'Greenhouse Gas Emissions in Australian Transport' to the Transport Working Group in 1990. Subsequently the Bureau was asked by the Working Group to explore three possible tax policy options for ameliorating greenhouse gas emissions from the transport sector. The Bureau's research on these options is contained in this paper.

The three policy options relate to company cars, vehicle sales tax and vehicle registration charges, and a carbon tax on transport fuels. The Bureau does not itself express a view about the desirability of these measures.

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October 1991

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ABSTRACT

This paper provides an examination of three tax policy options which might reduce greenhouse gas emissions in the transport sector. The options relate to taxation of business cars, vehicle sales tax and registration charges, and a carbon tax on transport fuel.

The discussion on business cars covers the current tax arrangements on government/company cars, a comparison between the Australian and the United Kingdom methods of valuing car benefits, the consequences of provision of fuel by employers, and a consideration of whether the availability of second-hand business cars has biased the aftermarket towards larger and less fuel-efficient cars.

The second tax policy option involves an approximately revenue-neutral system of skewed sales tax and registration charges. The effects of the option on the market shares of different fuel consumption classes are estimated, and the equity implications of the skewed charges, particularly in the used car market, are reviewed.

In the third section of the paper the efficiency and equity effects of a carbon tax on transport fuels are discussed, and the effectiveness of such a tax in achieving a given level of emission reduction by 2005 is considered. Approximate estimates of the expected reduction in fuel consumption in specific transport sectors from a particular level of carbon tax are made, and estimated total fuel consumption in 2005 is derived and compared with a 'business-as-usual' scenario.

SUMMARY

This paper documents the results of some recent research by the Bureau of Transport and Communications Economics into some issues under investigation by the Transport Working Group (TWG) on Ecologically Sustainable Development. The research was conducted at the request of the TWG. The paper relates to three tax policy options with the potential to reduce greenhouse gas emissions in transport. They include possible amendments to the tax policies affecting company cars, introduction of rated fuel economy into the basis for levying vehicle sales tax and vehicle registration charges, and introduction of a carbon tax on transport fuels.

It is emphasised that the appropriate choice of options for reducing greenhouse gas emissions depends on whether Australia's policies are to be unilateral or part of a global strategy. In the absence of a global consensus, policies might best be targeted at the urban environmnent: this could secure local environmental benefits for Australians, while still having some favourable side-effects in terms of greenhouse gas emission reduction.

Chapter 2 provides background material for considering whether the provision of government and company cars and fuel affects the size of the total car fleet, the size and fuel efficiency of cars, and the vehicle kilometres travelled (VKT) in such a way as to increase greenhouse gas emissions from motor vehicles. The ownership and size characteristics of the Australian car fleet are described, and the effects of the current tax system on the costs to the employer of providing a car, as opposed to an equivalent benefit in salary, are analysed.

Amendments to the tax treatment of company cars could be argued to be justifiable in terms of economic efficiency and equity. The current tax arrangements result in a tax advantage to the employer who provides a car rather than an equal benefit (post-

tax) increase in salary. To achieve tax neutrality as between provision of any fringe benefit and a salary increment, through the adjustment of the Fringe Benefits Tax, an increase of 10 percentage points to 57 per cent would be required.

In addition, in Australia, the valuation of car benefits for taxation will often be understated by the existing formula. A comparison between the Australian and United Kingdom formulae for valuing car benefits suggests clearly that the deemed benefit of a company car is lower in Australia than in the United Kingdom; though there are differences in Australian and United Kingdom prices for vehicles, petrol, and maintenance.

Estimates of the value of a company/government car in Australia derived from the cost of running an equivalent car privately, are presented. While the value of the private benefit would vary according to the extent of business use, it appears that the value calculated from the present formula would exceed the actual value derived from the car only when private use is under 40 per cent.

With respect to vehicle kilometres travelled in company or government cars, it is argued that where the driver does not pay the cost of fuel and maintenance, the result will almost certainly be an increase in travel. In addition, employees given a choice of car will be less concerned about the fuel efficiency of their vehicles.

The issue is raised as to whether the flow-on effect of larger than average size business cars in the second-hand market is such as to bias the aftermarket towards larger, less fuel efficient cars than would otherwise be purchased by used car buyers. Some slender evidence is provided which suggests that such an effect may exist, but the deficiencies in the data leading to this conclusion are emphasised.

The second tax option examined involved a consideration of the efficiency, effectiveness, revenue and equity effects of the imposition of a system of skewed sales tax and registration charges linked to the rate of fuel consumption of vehicles. An extreme scenario was devised to allow the maximum conceivable effect from the option to be estimated, leaving the effects of less extreme skewing to be gauged by interpolating from the result. The most fuel-efficient vehicles were freed from all taxes and charges, and vehicles with a rated fuel consumption of over 12 litres per 100km faced a sales tax of 100 per cent and registration charges almost twice as high as at present.

The effects of the skewed system of taxes and charges were simulated from an application of the University of Sydney's Institute of Transport Studies Dynamic Vehicle Type Choice and Use model. They indicated a fall in the new car average rate of fuel consumption of 6.3 per cent. This improvement in the rate of fuel consumption could be expected to have significantly penetrated the fleet by 2005, assuming it were to be introduced immediately.

Basing registration or sales taxes on the rate of fuel consumption, rather than on some proxy such as vehicle size, vehicle weight, engine power, or number of cylinders, would encourage consumers to switch to more fuel efficient vehicles within each size class, as well as to smaller vehicles. This may provide vehicle manufacturers with the incentive to develop more fuel-efficient vehicles rather than simply to downsize or reduce performance. Car manufacturers in Australia might be encouraged by the skewed charges option to expedite the transfer of advanced technology from their overseas parent companies.

The model considers only choices between existing vehicle models. The introduction of new, more fuel efficient types of vehicles, would induce more buyers to switch model types, and could see a stronger effect on fleet average fuel efficiency. This could assist in offsetting any increase in average distance travelled (assumed constant in the model) induced by increased fuel efficiency.

The imposition of increased taxes and charges on fuel-inefficient new cars would not result in serious equity effects as few poor people buy new cars, and large new cars are bought primarily by businesses and government. There would be some equity effects on existing car-owners experiencing one-off gains or losses as a result of a skewed system of charges. The major equity impact, however, would appear to be the regressive effect caused by the imposition of higher registration charges on older, large cars. These cars would rise in price as a result of the sales tax changes, and would be subject to higher registration charges if these were not grandfathered. There may be some offsetting effect, however, to the extent that the liability for future high registration charges on non-grandfathered large cars depressed their price. Grandfathering would of course alleviate the burden of high registration charges, at least for some time, on low-income earners who own grandfathered, high fuel-consumption vehicles.

From an efficiency aspect, a disadvantage of adopting the skewed sales tax/registration option is that it would affect the standing charges (fixed costs) attached to vehicle ownership, rather than marginal usage costs. The effects on local vehicle manufacturers, and on the outcome of the recently introduced motor vehicle industry policy of such a tax option, would need to be addressed in considering its practicability.

The third option reviewed was a tax on the carbon content of transport fuels. The work of the Industry Commission and the Australian Bureau of Agricultural and Resource Economics in determining carbon taxes for Australia with a given impact on greenhouse gas emissions, is briefly discussed.

Attention is drawn to the problems of imposing a carbon tax within the existing system of road user taxes. Revenue implications are also examined.

In the long-run a carbon tax should be uniform across all sectors of the economy to achieve any given level of emission reduction at minimum cost. Also, while a carbon tax can be argued to be allocatively more efficient in achieving emission reductions than a range of ad hoc policies, some justifications are presented for using some ad hoc policies in particular circumstances.

Estimates are made of the effects on liquid fuel energy consumption in road and air transport in 2005, of a carbon tax of 23 cents per litre as discussed in Naughten et al (1991). The estimates are based on ABARE (1991) forecasts of fuel consumption, and elasticities of demand derived by Hensher and Young (1991). The effect of such a carbon tax would be a reduction in fuel consumption in the above categories of 12 per cent, compared with the business-as-usual scenario. Consumption in 2005 would probably still be some 26 per cent above the 1988 level.

In considering the equity effects of a carbon tax, attention is focused on people living in remote areas and those on low incomes. Relative proportions of income spent on transport fuel are given for different income groups. There are some indications that higher transport fuel prices induced by a carbon tax may be regressive, however, the overall effect is limited by the relatively small proportions of average household expenditure devoted to fuel or public transport. Particular households may be much more severely affected than would be indicated by grouped data. The paper points out that it is not possible to draw substantive conclusions about welfare from the data examined.

Similarly it was not possible to determine the effects on rural and remote area dwellers in the absence of adequate data on length, purpose and frequency of trips. Some factors which would influence the outcome are discussed.

CHAPTER 1 INTRODUCTION

The Transport Working Group requested the BTCE to explore the economic implications of three possible policy options for ameliorating greenhouse gas emissions from the transport sector. The three options examined here are:

(i) amending tax policies affecting company cars;

(ii) introducing fuel economy into the basis for levying vehicle sales tax and vehicle registration charges;

(iii) introducing a carbon tax on transport fuels

These are not, of course, the only possible instruments of greenhouse policy being considered by the Working Group. Our assessments should therefore be considered within the framework of a broader set of policy options, and with regard to the provisos:

(i) that the adoption of response measures should not result in adverse effects on the economy in the absence of similar action by major greenhouse contributing countries (Federal Government decision of 11 October 1990 adopting an interim planning target for greenhouse gas emissions); and

(ii) that response strategies should be cost-effective, and preferably be justifiable on broad grounds of efficiency, or offer other economic or environmental benefits besides greenhouse gas reduction (Department of Prime Minister and Cabinet 1990).

Of the three measures examined here, only the first, amending the tax treatment of company cars, could be argued to be justifiable in terms of economic efficiency. It seems likely that the present taxation regime does not achieve vertical equity and horizontal equity. Improving the horizontal equity of the taxation regime would be likely, in the longer term, to foster economic efficiency. However, it is not at all certain that such improvement would make a significant contribution to greenhouse objectives, and in the shorter term it might impose some cost to the economy through disrupting the existing structure of car sales and production.

The arguments for fuel-economy based sales taxes and for a carbon tax on transport fuels look strongest in the context of a multilateral agreement on global greenhouse strategies. First, unilateral actions by Australia would have negligible impact on global greenhouse emissions, and a negligible proportion of the benefit of that impact would be captured by Australian society.

Second, such measures are likely to be more effective if part of a global strategy. The quantitative analysis in this paper is concerned with how Australian decisions about vehicle choice and vehicle use would respond to tax signals, given the vehicle technologies made available in the market by manufacturers and importers. The expected response is not large. The Australian response would be larger if the same policy instruments were applied globally, since then they would influence the design and marketing strategies of vehicle manufacturers in North America, Japan and Europe. This would hopefully expand the range of fuel-efficient vehicles available to Australians and permit them to reduce fuel consumption more in response to the proposed taxes, while forgoing less discretionary travel and sacrificing less in terms of desired vehicle characteristics.

Third, it might be argued that in the absence of a global strategy on greenhouse emissions Australia should consider giving priority to urban development strategies, traffic demand management and road pricing. Such measures are likely to have favourable side-effects on transport energy consumption and on greenhouse emissions. However, more directly they would be targeted at the urban environment and at delivering environmental benefits for Australians.

The Bureau therefore suggested that the report of the Working Group might attempt to distinguish two sets of policy priorities: one appropriate within the framework of an effective global greenhouse agreement, and the other appropriate to unilateral policies pending such an agreement.

All these possible measures are capable of interacting with one another - sometimes positively, in that one measure would reinforce another. (For instance, the cashing out of company cars would probably raise the demand elasticity for fuel, and thus augment the response to a carbon tax). Equally they might interact negatively, in that one measure would achieve an impact which would reduce the scope for alternative measures to contribute to greenhouse amelioration.

CHAPTER 2 COMPANY CARS

This chapter provides background material for considering whether the provision of government and company cars and fuel affects the size of the total car fleet, the size and fuel efficiency of cars, and the vehicle kilometres travelled (VKT) in such a way as to increase greenhouse gas emissions from motor vehicles.

FLEET CHARACTERISTICS

In this discussion vehicles are categorised as business (government, company, unincorporated business) and private. Business vehicles make up almost half of *new* vehicle registrations.

Data from a 1985 sample of Sydney households indicate that of the 45 per cent of business cars in *new* car registrations, 9 per cent were government, 11 percent were company and 25 percent were household business (Hensher, personal communication, 1991).

Australia-wide data for 1990 (table 2.1) show that 'other business' (company and unincorporated business) vehicles comprised 37 percent and government vehicles 9 per cent of *new* vehicle registrations. New private vehicle registrations made up the remaining 54 per cent (PAXUS 1990).

Private new vehicle registrations (54 per cent) include some vehicles which may be used partly for business purposes, but the extent of these registrations is unknown. There are some reasons why it could be expected to be small. It is up to the car-owner to choose whether to register the car as business or private.

In 1990 medium and large cars made up 81 per cent of new government and business registrations and only 54 per cent of new private registrations. However the present mix of new private car

TABLE 2.1 NEW VEHICLE REGISTRATIONS BY SIZE CLASS AND CATEGORY, 1990

Engine size	Government	Other Business	Private
Small	6 378	33 297	117 134
(%)	15	20	46
Medium	14 976	41 083	61 506
(%)	34	24	24
Large	21 105	71 292	50 734
(%)	49	42	20
Luxury	840	24 378	24 050
(%)	2	14	10
Total	43 299	170 770	253 424
(%)	9	37	54

Source Paxus, Report on the State of the Automotive Industry, 1990.

registrations does not offer any indication of the choices likely to be made by the present users of management cars provided by employers in the hypothetical case that these were cashed out. Management car users are likely to fall within a higher income range and may have chosen large cars anyway. Also large management cars are often complementary to small private cars in two-car households. Within the category of company cars there are management cars and field cars. Field cars are likely to be essential for conducting company business, and decision makers would tend to be influenced by costs, and choose cars suitable for the field purpose. Management cars, on the other hand, may be chosen for status or perk reasons (Schou 1981).

Schou (1981) estimated that 41 per cent of business vehicles were management cars and 59 per cent were field cars and that while few management cars (1 per cent) were of a small size, around 7 per cent of field cars were small. However any conclusions drawn from Schou's analysis must be treated with caution as this was a survey of business vehicles before the introduction of the fringe benefits tax (FBT).

Schou (1981) found that 70 per cent of company management cars and 95 per cent of field cars travelled further than the national average of vehicle kilometres travelled annually.

The average replacement cycle for company cars is based on time or vehicle kilometres travelled and was found to be 3.5 years or approximately 91 000 kilometres, whichever came first (Cullen Egan Dell, 1990). The replacement cycle tends to be shorter for field vehicles than for management vehicles because of the greater mileage per year.

TAXATION OF FRINGE BENEFITS

The total annual costs involved in providing a company car are tax deductible at the corporate tax rate. In 1986 the federal government introduced the Fringe Benefits Tax (FBT) which increases the cost of providing a benefit of any kind to employees. The FBT payment is not tax deductible.

At present tax rates there is evidence of a tax advantage for the employer of approximately 9.2 per cent from providing a fringe benefit in place of an equal benefit salary increase (see table 2.2). The example can be generalised by using the following formulae (see appendix I for derivation).

Cost to employer of providing a fringe benefit (C_b)
$$= 1.08x$$

Cost to employer of providing an equivalent post-tax salary increase (C_s)
$$= 1.179x$$
(where x = value of benefit)

With the increase of the FBT in April 1992 to 48.25 per cent, the tax advantage of a fringe benefit will then be approximately 7.8 per cent.

To achieve tax neutrality by increasing the rate of FBT an increase to approximately 57 per cent would be required (see appendix I). That is a 10 percentage point increase from the current FBT rate of 47 per cent.

For tax-exempt employers (including governments) there is a greater tax advantage to the employer from providing a benefit rather than the equivalent post-tax salary. Evidence of this can be illustrated using appendix I. By inserting $t_c = 0$ in the practical example in appendix I, the following can be calculated:

$$\text{Cost of fringe benefit} = 1.47x$$
$$\text{Cost of salary increase} = 1.93x$$

TABLE 2.2 TOTAL COSTS OF A HYPOTHETICAL ANNUAL FRINGE BENEFIT OF $10 000

	Fringe Benefit ($)	Equivalent Salary ($)
Direct cost to employer	10 000	19 324 [a]
Liability FBT @ 47%	4 700	0
Less company tax saved @39%	3 900	7 536
Net cost to employer	10 800	11 788

a. to provide a post-tax value of $10 000 to an employee on a marginal tax rate of 48.25 percent.

Source BTCE estimate.

VALUING THE DEEMED BENEFIT OF MANAGEMENT CARS

The value of car benefits for FBT in Australia can be assessed by the statutory formula method or the operating cost (logbook) method. An employer can select either method to calculate the taxable value of the benefit. The advantage of providing such a formula is that it results in a considerable saving in administrative and compliance costs. The relevant question then is whether the formula is pitched at such a level that the savings in administrative and compliance costs are sufficient to justify any loss of efficiency. A comparison between the Australian and United Kingdom formulae suggests that there is some reason to believe that the Australian formula may in fact be generous to employers.

Comparative figures on the deemed benefits in Australia from the statutory formula, and the UK scale benefits, are shown in table 2.3 for selected Australian vehicles, and for comparable cars in the UK. Substantial increases in the UK valuation formula have increased the scale benefits almost four-fold in nominal terms since 1987-88, when the Chancellor of the Exchequer observed that the private use of a company car was substantially undertaxed.

In the United Kingdom, the holder of a company/government car is deemed to derive a scale benefit determined by engine size, age of vehicle and business kilometres driven. In addition, if provided with fuel, the employee is deemed to derive a further scale benefit determined by the same factors.

The statutory formula used in Australia is:

$$\frac{ABC}{D} - E = \text{Value of benefit}$$

A = the purchase price of the car when new
B = statutory fraction based on kilometres travelled
C = the number of days a car benefit applied
D = the number of days in the year
E = contribution by the employee to cost of vehicle

The Statutory fraction (B) varies with 'annualised number of whole kilometres', decreasing as these increase. 'Annualised kilometres' are derived by imputing an annual rate of car use in cases where a car is not used for a full year.

In the case of small vehicles, travelling around 20 000 kilometres, the Australian formula values the benefit at 49 per cent of that resulting from the United Kingdom formula for 1991-92. However for the same small vehicle travelling more than 40 000 kilometres, the Australian deemed benefit is around one third of that in the United Kingdom.

TABLE 2.3 DEEMED BENEFIT OF COMPANY CARS IN AUSTRALIA AND THE UNITED KINGDOM in 1991-92

AUSTRALIA[a] $A	UK[b] English pounds	
CASE 1: Small vehicle - Holden Barina, value $ 15 200, 1 300 cc's, travelling an annualised 20 000 kilometres.		
$\frac{15\ 200 \times 0.18 \times 365}{365} - 0$	Scale benefit	2 050
	Fuel benefit	480
= $2 736	Total benefit	2 530
	=	$A5 566[c]
CASE 2: Same vehicle travelling more than an annualised 40 000 kilometres		
$\frac{15\ 200 \times .06 \times 365}{365} - 0$	Scale benefit	1 025
	Fuel benefit	240
= $912	Total benefit	1 265
	=	$A 2 783
CASE 3: Large vehicle - Commodore Executive, value $25 000, travelling an annualised 20 000 kilometres engine size > 2 000 cc's		
$\frac{25\ 000 \times 0.18 \times 365}{365} - 0$	Scale benefit (>2 000 cc, <4 years old)	4 250
= $ 4 500	Fuel benefit	900
	Total benefit	5 150
	=	$A 11 330
CASE 4: Same vehicle travelling more than an annualised 40 000 kilometres		
$\frac{25\ 000 \times 0.06 \times 365}{365} - 0$	Scale benefit	2 125
	Fuel benefit	450
= $A 1 500	Total benefit	2 575
	=	$A 5 665

a. based on the assumption that the car is held by the employer for the whole fringe benefits tax year and is available for private use every day during that year and the employee's contribution to the cost of the car is zero.
b. the deemed benefits are for a car with a business mileage between 2 500 and 18 000 per year.
c. exchange rate based on $A2.2/pound.

For a large vehicle travelling 20 000 kilometres, the Australian formula gives a valuation of only 40 per cent of the United Kingdom deemed benefit. The same vehicle travelling more than 40 000 kilometres has a benefit value of only 26 per cent of that for the United Kingdom.

These estimates suggest clearly that the deemed benefit of a company car calculated using the Australian formula is lower than the United Kingdom scale benefit. It may be however, that the United Kingdom formula overestimates company car benefits. Because of differences between Australian and United Kingdom prices of vehicles, petrol, maintenance etc., this comparison does not claim to be more than illustrative.

An estimate of the value of a car in Australia could be made from the cost of running an equivalent car privately. This includes depreciation, interest, registration and insurance, fuel, tyres and maintenance. Table 2.4 shows the total annual costs in Australia of cars similar to those in Table 2.3, assuming an annual mileage of 20 000 kilometres.

The value of the private benefit would, of course, vary according to the extent of business use. From table 2.4, it would appear that private use of the car would have to be less than approximately 40 per cent (in the case of both the large and small car travelling an annualised 20 000 kilometres) before the taxpayer would choose not to use the formula. That is, the private value of the car calculated by the formula would exceed the actual value derived from the car only when private use is under 40 per cent.

TABLE 2.4 RUNNING COSTS OF A PRIVATE CAR IN AUSTRALIA [a]

	Kilometres	Costs
Small 1300 cc Charade	20 000	$ 6 998
Large 3800 cc Commodore	20 000	$11 034

a. based on ownership period for private motoring of new to three years.

Source NRMA (1991).

IMPLICATIONS OF THE TAX ADVANTAGE FOR THE VEHICLE MIX

If a tax neutral environment existed where costs to the employer of providing a benefit or an equal benefit increase in salary were equivalent, employers would be indifferent to the choice between the two.

Company cars which have a high level of business use and thus form part of the business's resources, would be retained. How many management vehicles would be cashed out in a tax neutral environment is uncertain. One might speculate that provision of management cars is institutionalised in some sectors of the economy, and in these sectors tax neutrality alone would not suffice to lead to cashing out.

If policies to promote cashing out of company cars could be devised, the employee would have a number of alternatives. The employee might purchase a new or used car. The employee might choose a large car, reflecting the complementarity of small and large cars in high income households, or simply the taste of the employee as a consumer. Alternatively he could purchase a small car with greater fuel efficiency. To the extent that some employees chose used large cars, this would prompt a rise in second-hand prices of large cars, and go some way to restoring the attractiveness of first-hand purchases of large cars.

VEHICLE KILOMETRES TRAVELLED

Cullen Egan Dell (1990) report that only 5 per cent of companies limit petrol payment for company cars. In this situation the driver of a management car does not pay the full marginal cost of driving. His decision as to how much to drive will then be distorted, and the result will almost certainly be an increase in VKT. In addition employees will be less concerned about the fuel efficiency of their vehicles in considering their choice of car.

However, it does not necessarily follow that this widespread failure of companies to control fuel consumption by employees results from a tax advantage given to company cars. More probably it reflects low fuel prices, and more companies would take steps to charge managers at the margin if fuel prices were higher.

FLOW-ON EFFECTS OF COMPANY/GOVERNMENT CAR PURCHASES

If the market distortions considered above result in purchases of management cars which are larger than would otherwise be bought by employees, there would be a flow-on effect in the second-hand market.

It is therefore important to know whether the company and government cars entering the used car market are the preferred choice of buyers, or whether consumers are induced to take them up by the high rates of depreciation on such cars at first resale, which would result from an oversupply.

Using Glass's Guide to used passenger vehicles, and arbitrarily choosing the month of September from 1988 to 1991, selected vehicles' average annual depreciation rate over the three years can be calculated. The impact of inflation, of real relative price changes in each category, and of exchange rate changes over the 3 years on each size category have not been taken into account in the analysis. The calculations are nominal depreciation rates only.

Table 2.5 indicates that the nominal annual rate of depreciation of large vehicles was approximately 3 percent greater than for small vehicles. If this reflects the true situation, then a possible explanation is that the aftermarket has been biased towards larger, less fuel efficient cars by the discounting of such vehicles at first resale. In the hypothetical situation that (i) policy changes could induce cashing out of many company cars, and (ii) a substantial number of 'cashed-out managers' opted for smaller new cars, this aftermarket effect might be reduced.

TABLE 2.5 DEPRECIATION RATES BY SIZE CLASS OF VEHICLE

Vehicle Class	Average annual depreciation [a]
Small	8.0
Medium	8.6
Large	11.0
Luxury	13.5

a. Average annual depreciation of selected vehicles in each class size over 3 years from September 1988-91.

Source Glass's Guide, September 1988-91.

CHAPTER 3 VEHICLE SALES TAX AND REGISTRATION CHARGES

One policy option under consideration by the ESD Transport Working Group (TWG) is to make sales taxes and/or annual registration charges 'skewed' (or more heavily skewed) towards higher charges on the owners and buyers of cars with a high rate of fuel consumption. To minimise problems at the boundary of vehicles subject to such a tax regime, it would be desirable to include vehicles which are close substitutes for cars and stationwagons in the skewed tax regime, for example, some light commercial vehicles (LCVs) and forward control passenger vehicles (FCPVs).

Sales tax is currently 20 per cent on new cars priced up to $30 505 wholesale, and 30 per cent on vehicles above this wholesale price. [A luxury tax on a sliding scale of from 30 per cent up to 50 per cent, on vehicles exceeding a wholesale price of $30 233, was announced in March 1990, to become operational in May 1990. This tax, now removed, caused many buyers to bring forward their purchases of vehicles to be affected by the tax, thus distorting the market (AIA 1991)].

Five states impose a graduated weight tax as part of registration charges (IEA 1991,60). However the annual cost of registration and Third Party Insurance (TPI) forms a greater proportion of the cost of a small car (2.5 per cent of purchase price for a base model Laser in 1987) than for a large car (2.05 per cent of purchase price for a base model Commodore in 1987, based on data in AIC 1988).

A skewed sales tax/registration charges strategy could be implemented, in a revenue-neutral way, by reducing charges on vehicles with rated fuel consumption below some benchmark, and increasing charges on vehicles with fuel consumption above this benchmark.

Effectiveness in encouraging fuel economy would be best pursued by basing the rate of sales tax or registration charge directly on the rated fuel economy of the vehicle rather than upon some measure of the size of the vehicle. Such a tax regime would encourage consumers to switch towards more fuel efficient vehicles within each size class, as well as encourage some movement towards smaller vehicles.

It is assumed in the following analysis that the hypothetical skewed registration charge regime would be grandfathered. That is, it would apply only to vehicles manufactured after the introduction of the new regime. It is also assumed that vehicle suppliers would not adjust their prices so as to appropriate or absorb the changes in on-road vehicle prices arising from the changes in sales taxes and registration charges.

VEHICLE MIX

Professor David Hensher, of the Institute of Transport Studies, University of Sydney, was approached by the BTCE to see whether his Dynamic Vehicle Type Choice and Use (DVTCU) models could give estimates of the impact of skewing sales and registration charges.

The DVTCU model, using Hensher's 1985 Sydney household panel data and his 1988 vehicle database applied to the 1985 vehicle mix, was adapted to apply to 7 classes of vehicles based directly on the rate of fuel consumption of particular vehicles. An extreme degree of skewing in the tax regime was examined to allow the maximum conceivable effect from the option to be estimated. The effects of less extreme skewing might be gauged by interpolating from the result arrived at.

A scenario was devised which would exempt the most fuel efficient vehicles from charges and give some benefit to owners of vehicles rated at less than average litres per 100 kilometres. In an attempt to approximate revenue neutrality after market shifts induced by the tax and registration changes, an increasingly high scale of charges was set for vehicles rated at above average litres per 100 kilometres.

Table 3.1 shows the basis of the sales tax/registration scenario investigated. The bottom line price changes or 'price shock' fed into the DVTCU model can be regarded as representing alternative combinations of changes to sales tax and registration (including Third Party Insurance) charges.

Registration charges (including Third Party Insurance premiums) over the life of the vehicle have been capitalised, so that they could be treated additively with the sales tax changes, using a real discount rate of 20 per cent per year. The same interest rate has been used to capitalise registration charges for all vehicles, including cars bought by companies and governments.

Research on the appropriate level of the discount rate to adopt for car buyers has resulted in a wide range of values, particularly among different income groups. Greene (1983) considered that rates varying from 39 per cent for a 1977 household income of US$10 000, to 4 per cent for a 1977 household income of $50 000, were most appropriate. The rate of 20 per cent may be high for private new car buyers where these are in high income categories, but it is, in effect, a conservative assumption. The effect of decreasing the discount rate would be to increase the 'price shock' in table 3.1, giving a stronger effect on fuel consumption. With a discount rate of 10 per cent real, the same price shock as in table 3.1 could be obtained with a lower level of skewed registration charges (shown in table 3.2).

TABLE 3.1 EXISTING AND PROPOSED SKEWED SALES TAX AND CAPITALISED REGISTRATION CHARGES: 20% DISCOUNT RATE

	Low fuel consumption				High fuel consumption		
Class	1	2	3	4	5	6	7
L/100km	<6	6-8	8-9	9-10	10-11	11-12	>12
Proposed (as percentages of wholesale price):							
Sales Tax	0	15	25	35	50	80	100
Reg'n pa	0	1	1.27	1.77	2.27	4.1	6.95
NPV Reg'n	0	5	6.35	8.85	11.35	20.5	34.75
Total	0	20	31.35	43.85	61.35	100.5	134.75
Existing (as percentages of wholesale price):							
Sales Tax	20	20	20	20	20	30	30
Reg'n pa	3.45	3.45	3.45	3	3	2.25	1
NPV Reg'n	17.3	17.3	17.3	15	15	11.3	5
Total	37.3	37.3	37.3	35	35	41.3	35
'Price Shock':							
Changes in sales tax and NPV registration (as percentages of retail price):							
Increase (Decrease)	(24.5)	(11.5)	(3.9)	5.9	17.6	37.0	62.3

Note NPV calculated using 20% real discount rate.
30% dealer margin assumed.
Registration includes compulsory Third Party Insurance premium

TABLE 3.2 EXISTING AND PROPOSED SKEWED SALES TAX AND CAPITALISED REGISTRATION CHARGES: 10% DISCOUNT RATE

	Low fuel consumption				High fuel consumption		
Class	1	2	3	4	5	6	7
L/100km	<6	6-8	8-9	9-10	10-11	11-12	>12
Proposed (as percentages of wholesale price):							
Sales Tax	0	15	25	35	50	80	100
Reg'n pa	1.75	2.2	2.4	2.4	2.65	3.2	4.0
NPV Reg'n	17.5	22.2	6.24	24	26.5	32	40
Total	17.5	37.2	49	59	76.5	112	140
Existing (as percentages of wholesale price):							
Sales Tax	20	20	20	20	20	30	30
Reg'n pa	3.45	3.45	3.45	3	3	2.25	1
NPV Reg'n	34.5	34.5	34.5	30	30	22.5	10
Total	54.5	54.5	54.5	50	50	52.5	40
'Price shock':							
Changes in sales tax and npv registration (as percentages of retail price):							
Increase (Decrease)	(24.5)	(11.5)	(3.9)	5.9	17.6	37.0	62.3

Note NPV calculated using 10% real discount rate.
30% dealer margin assumed.
Registration includes compulsory Third Party Insurance premium

The model estimated that imposing the extreme degree of skewness indicated in table 3.1 (through both sales taxes and registration charges) would cause the new car average rate of fuel consumption to drop by 6.3 per cent, from 9.77 to 9.16 litres per 100 kilometres (table 3.3). These average consumption rates for new cars are based on the 1985 fleet model mix, are on-road consumption (increased by 2 to 7 per cent from test results, depending on class), and are based on a 70 per cent city / 30 per cent country drive cycle, rather than the Australian Standard 55 per cent city / 45 per cent country cycle. A commensurately smaller improvement might be expected from a less extreme, more practicable degree of skewing. The model assumed VKT per vehicle remained constant, and did not include LCVs.

TABLE 3.3 EFFECTS OF SKEWED CHARGES BASED ON FUEL CONSUMPTION CLASSES ON NEW CAR CHOICE, NEW CAR AVERAGE FUEL CONSUMPTION, AND REVENUE

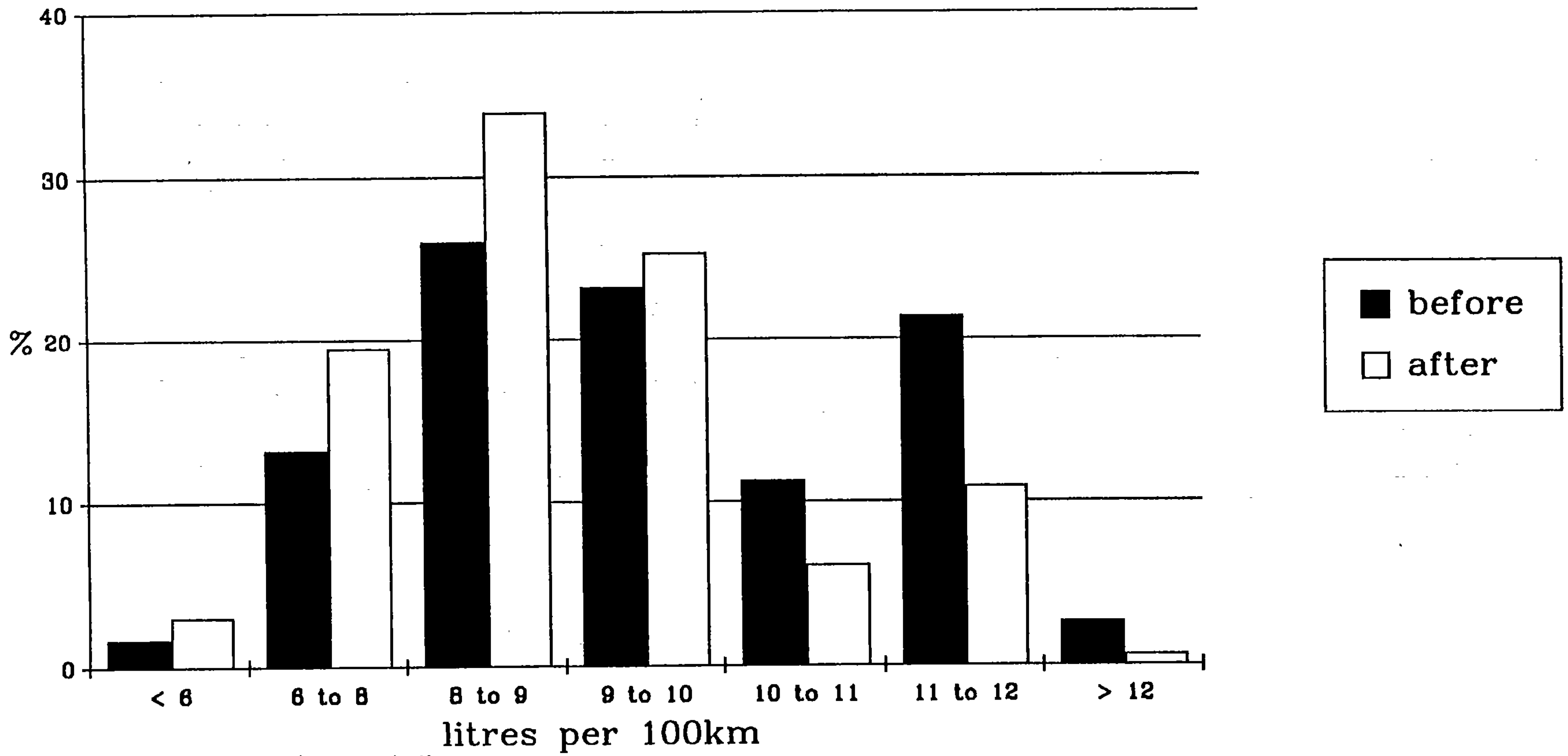
CLASS	MARKET SHARE (BEFORE)	TAX CHANGE (% RETAIL PRICE)	MARKET SHARE (AFTER)
<6 L/100KM	1.81	-24.5	3.15
6 to 8	13.21	-11.5	19.54
8 to 9	26.10	-3.9	33.98
9 to 10	23.29	5.9	25.40
10 to 11	11.31	17.6	6.21
11 to 12	21.49	37.0	10.99
> 12 L/100KM	2.80	62.3	0.73
	BEFORE		AFTER
1988 New Car Average Litres/100km	9.77		9.16
1988 Sales Tax/ Regn.Revenue[a] ($m)	2 171		1 888
1988 Fuel Tax[b] ($m)	168		158

a 'Revenue' is combination of sales tax and NPV of registration charges.

b Tax on fuel used by new cars in 1988; the $10 million loss would grow year- by year until all cars came within the ambit of the skewed sales taxes and registration charges regime.

Source Hensher (1991 personal communication)

Figure 3.1 shows before and after market shares. The 1988 market share of cars using up to 10 litres per 100km increased by about one-quarter, from 64 per cent to 82 per cent. The market share of the class freed from sales taxes and registration fees (less than 6 l/100km) increased by almost three-quarters to 3.14 per cent. (Appendix II shows the changes which occurred in New Zealand following variations to the sales tax regime in 1974).



Source Hensher 1991 personal communication

FIGURE 3.1 NEW CARS: CHANGE IN 1988 MARKET SHARES DUE TO SKEWED SALES TAXES AND REGISTRATION CHARGES

Based on the ratio of new car sales (410 473 in 1988: AIA 1991) to the Australian stock of cars (7 375 610 in 1988: SMVU), and considering the current high average age of the fleet, the estimated degree of improvement could be expected to have made significant inroads into the fleet by 2005, assuming it was introduced immediately. Thus, in terms of the target for 2005 there would seem to be little to be gained by applying the skewed registration scheme retrospectively to existing vehicles.

The skewed sales tax/registration charges option could be expected to deliver a reduction of approximately 6 per cent in carbon dioxide emissions from cars and station wagons by 2005 or shortly thereafter. This would represent about 3 per cent of total transport emissions, based on the 1988 emissions pattern.

If manufacturers responded to the increasing market shares for low fuel consumption vehicles by increasing their design and marketing efforts for these vehicles, then consumers could be presented with a superior bundle of car characteristics for such vehicles when making a new car purchase decision. There could also be 'bandwagon' effects influencing buyers towards fuel efficient vehicles as their market share improves. Under these conditions, the DVTCU model could understate long run market share changes and fleet average economy improvements.

Overall 'revenue' for 1988 from sales tax and NPV of registration was estimated to decrease by some 13 per cent. Revenue from fuel excise was estimated to fall by $10 million in 1988 due to the effect on new vehicle market shares of the skewed charges. This effect would be cumulative, until the total fleet fell within the ambit of the new scheme, when the total excise from petrol used by all cars could, other things being equal, be expected to have fallen by 6.3 per cent (which would have equated to about $221 million in 1988 terms) from what it would otherwise have been.

The effect on states' registration revenues would be gradual, as revenues from registration charges on cars under the existing regime were phased out over approximately 20 years, and as the revenues from cars under the new regime were phased in. The net present value of revenue to the states (expressed in NPV terms) would not be the same as that calculated for car buyers, as the states would have a much lower discount rate than would the average individual car buyer. Under the scenario in table 3.1, registration revenue would drop considerably, but a different mix of sales tax and registration charges, which gave the same 'price shock', might be devised to balance the impacts on the revenues of different levels of government.

These changes in sales taxes and registration charges could be expected to influence the prices of secondhand vehicles in the future in opposite directions. A skewed sales tax would to some extent increase the prices of second-hand high fuel consumption vehicles relative to those of used low fuel consumption vehicles.

Skewed registration charges would reduce the resale prices of (non-grandfathered) high fuel consumption vehicles, since second-hand buyers would take into account their future liability to high registration charges, but would act to increase the price of second-hand cars subject to grandfathering relative to non-grandfathered cars.

Third party insurance premiums

It is open to question whether the inclusion of Third Party Insurance charges in the skewing process is appropriate If Third Party Insurance charges are excluded from the skewing process, then a different scenario would be required to achieve the retail price changes fed into the DVTCU model. Table 3.4 shows a scenario which achieves approximately the same 'price shock'. A negative sales tax or rebate of 12.5 per cent would be required for the most fuel-efficient class (under 6 litres per 100km) to achieve the price reduction of 24.5 per cent which was used in the model.

EQUITY EFFECTS

The major equity effects of serious concern will not be on the buyers of new cars, as few poor people buy new cars. While some low income households may purchase new vehicles, it seems likely that these people would not be asset-poor as well. Farmers in a bad season and others with fluctuating income levels, students from comparatively wealthy families living away from home, and

TABLE 3.4 EXISTING AND PROPOSED SKEWED SALES TAX AND CAPITALISED REGISTRATION CHARGES (EXCLUDING THIRD PARTY INSURANCE PREMIUM)

	Low fuel consumption				High fuel consumption		
CLASS	1	2	3	4	5	6	7
L/100KM	<6	6-8	8-9	9-10	10-11	11-12	>12
Proposed (% age of wholesale price):							
Sales Tax	-12.5	5.5	15	27.5	40	75	100
Reg'n pa	0	0.27	0.65	1.08	2.15	3.7	6.75
Existing (% age of wholesale price):							
Sales Tax	20	20	20	20	20	30	30
Reg'n pa	0.83	0.83	0.81	0.81	0.87	0.85	0.8
Changes in sales tax and npv registration (as percentages of retail price):							
Increase (Decrease)	(24.5)	(11.5)	(3.9)	5.9	17.6	37.0	62.3

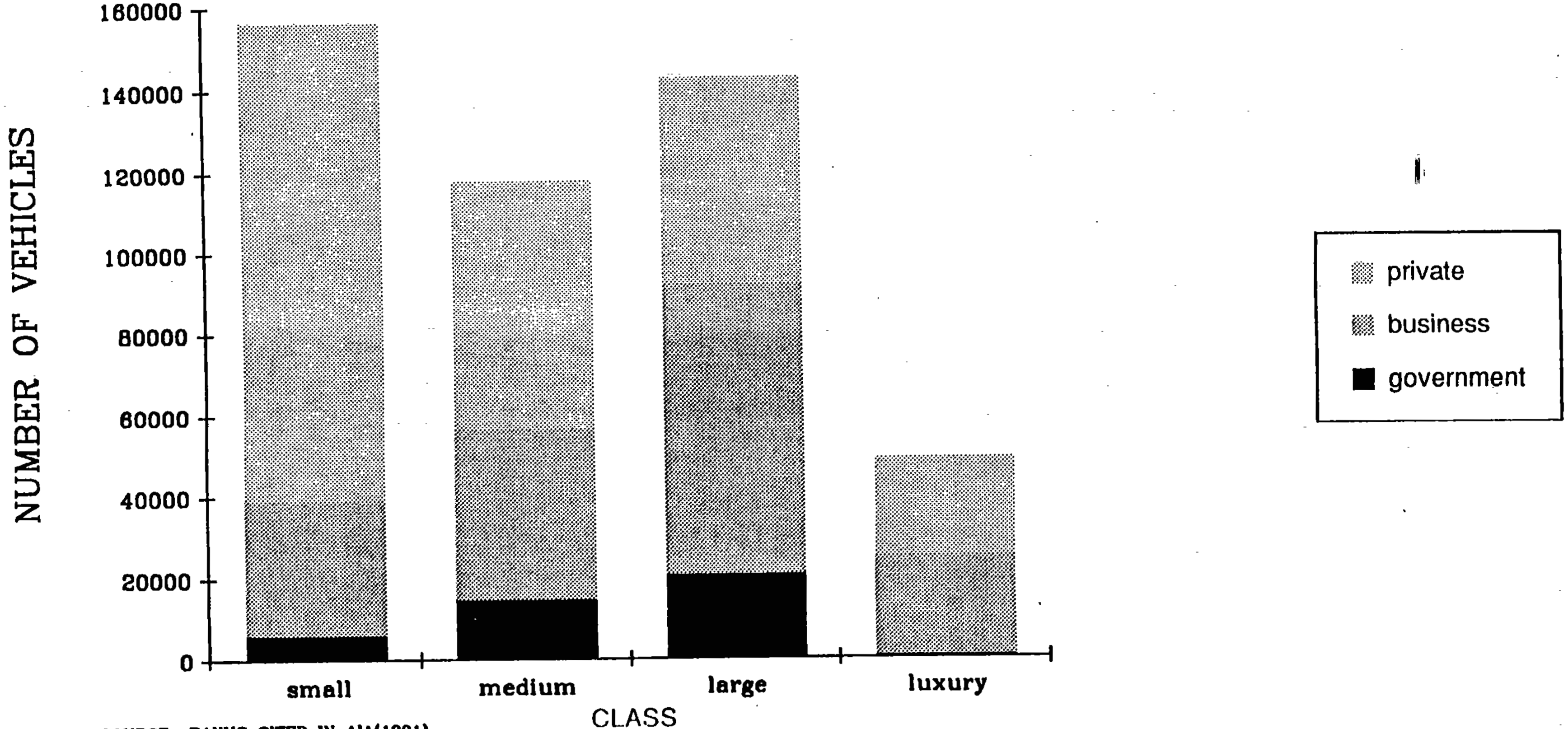
Note NPV calculated using 20% real discount rate.
30% dealer margin assumed.

recent superannuees might be new car purchasers with low income levels. The equity effects of concern seem likely to arise in conjunction with the effects on secondhand car prices (windfall capital gains and losses) and the on-going effects of registration charges on non-grandfathered secondhand cars.

New cars

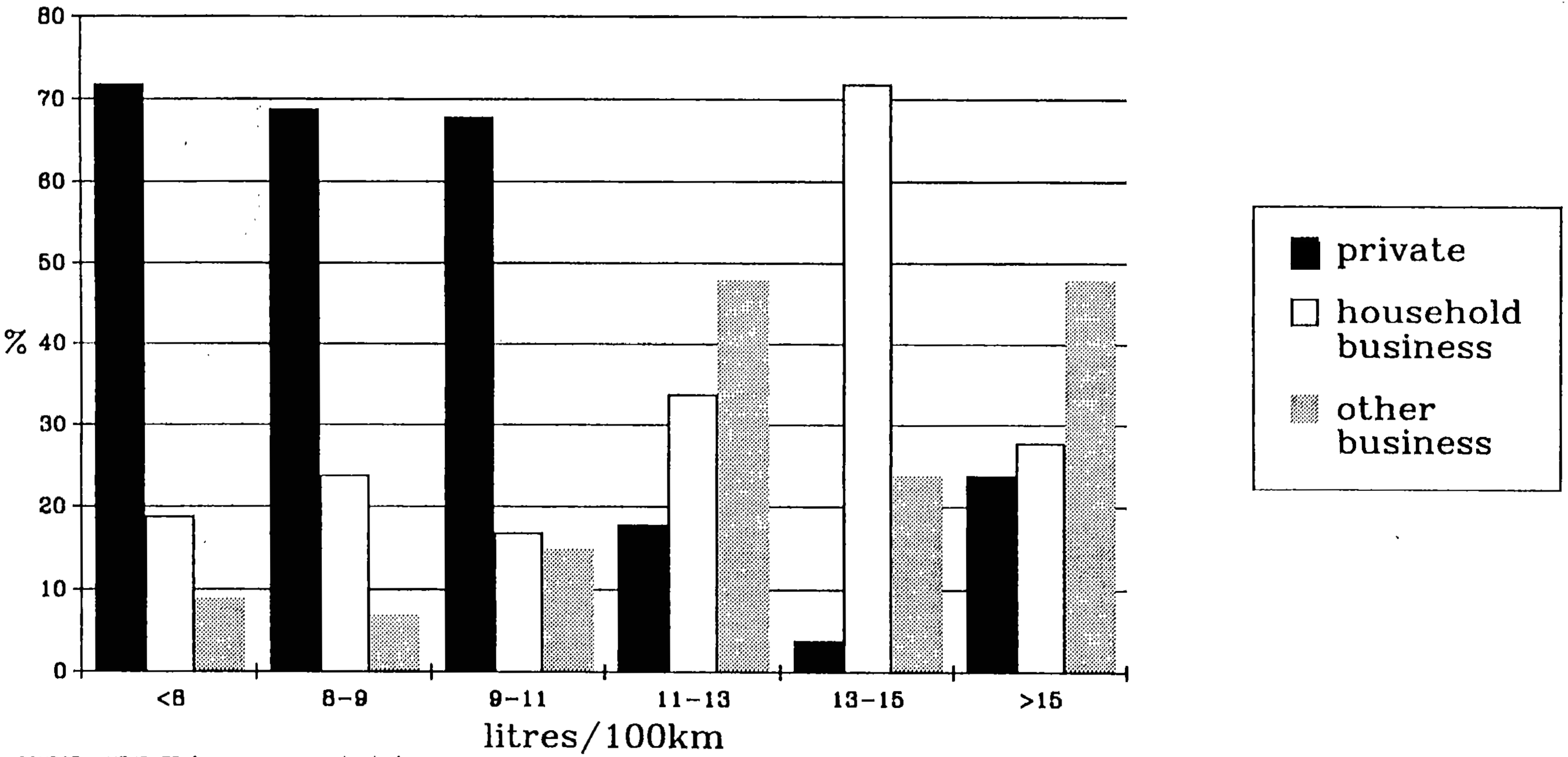
Paxus data for 1990 Australian new car sales by type of purchaser by vehicle size class (see figure 3.2) shows that a large proportion of small vehicles, and about half of the smaller number of medium-sized vehicles, are purchased by private individuals rather than businesses or governments (AIA 1991). Larger new cars are bought primarily by businesses and government. Buyers of new low fuel consumption cars will not be adversely affected by the new regime.

Figure 3.3 displays rates of fuel consumption by type of registration for new cars, derived from 1985 panel data for Sydney (Hensher 1991 personal communication). A large proportion of new vehicles with low and moderate fuel consumption were



SOURCE PAXUS CITED IN AIA(1991)

FIGURE 3.2 NEW VEHICLE SIZE v TYPE OF PURCHASER: AUSTRALIA 1990



SOURCE HENSHER (personal communication)

FIGURE 3.3 NEW CARS: 1985 SYDNEY - REGISTRATION TYPE v FUEL EFFICIENCY privately registered, but only a small proportion of high fuel consumption vehicles. This distribution would tend to ameliorate any horizontal equity effects which could arise if high fuel consumption vehicles operated with a higher occupancy than more fuel-efficient vehicles.

Figure 3.4 displays the distribution of new car fuel consumption rates by both average household income and average personal income, based on Hensher's 1985 panel data for Sydney. Based on average household income, there does not appear to be a clear relationship between income and new car fuel consumption rate.

Used cars covered by the skewed charges system

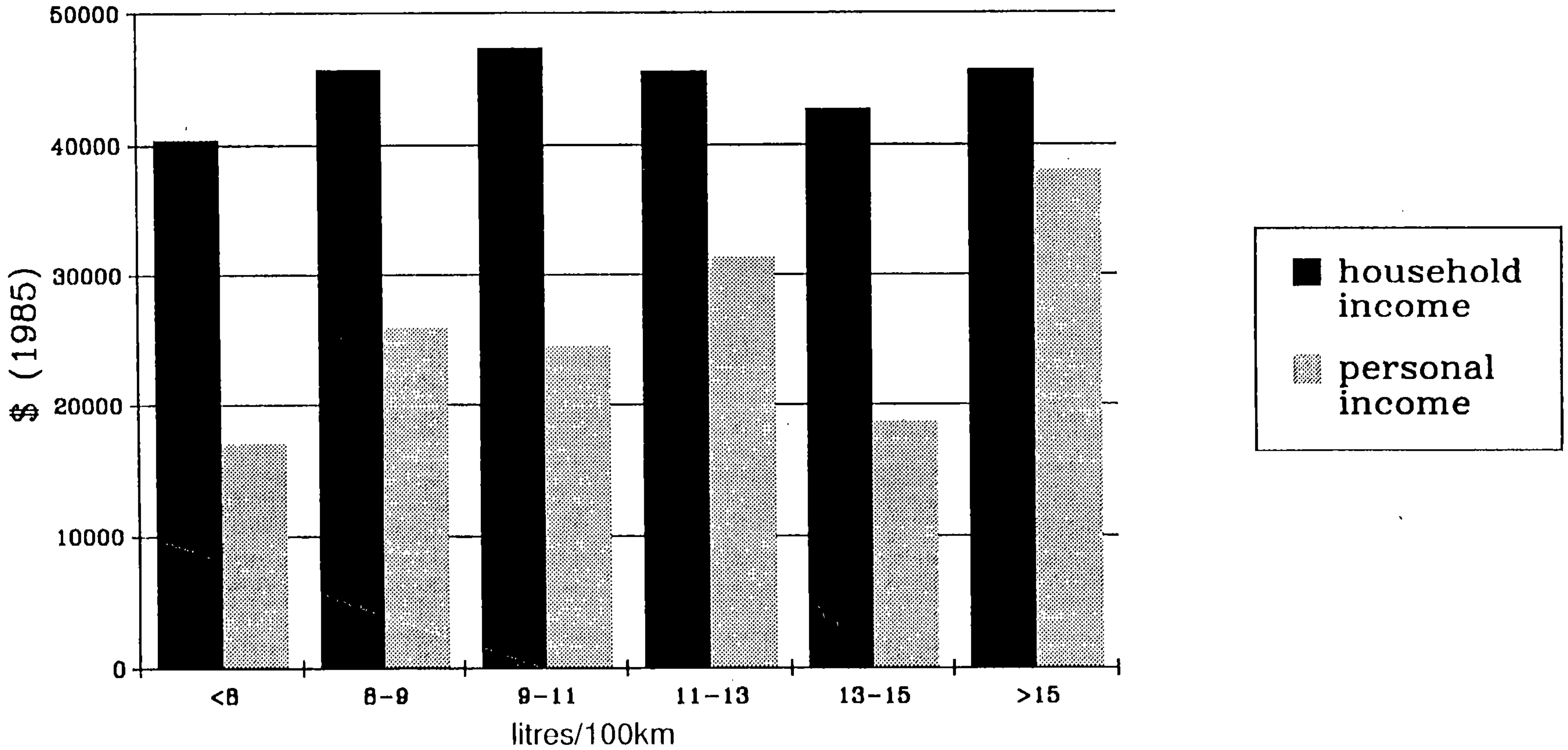
Skewed sales taxes should tend to raise the prices of large/ high fuel consumption used cars. This price rise could be expected to be smaller than for new cars in this category. On the other hand, skewed registration charges could be expected to exert a downward influence on used car prices for high fuel consumption vehicles, as prospective buyers weighed up the impact of future registration imposts on these vehicles. This effect could partially offset the welfare impact of skewed sales taxes on future buyers of used high fuel consumption cars who remain in the market. Others would ameliorate their welfare losses from the increased registration charges by switching into the market for smaller cars.

Used cars covered by the existing system

Sales tax effects

The changes in the prices of new cars could also be expected to generate windfall capital gains and losses to owners of existing cars not falling within the ambit of a skewed sales tax scheme. The owner of a high fuel consumption car covered by the existing system, who bought prior to the sales tax change, would experience a capital gain. The reverse would be the case for fuel efficient vehicles.

It would appear that equity problems could arise in the case of low-income owners of fuel-efficient vehicles who realised a capital loss where their vehicles were sold without being



Source Hensher (1991 personal communication)

FIGURE 3.4 NEW CARS: SYDNEY 1985 PANEL SAMPLE - FUEL EFFICIENCY v INCOME replaced. Owners of existing high fuel consumption vehicles which were traded-in for similar cars would be partially compensated for the higher sales tax through a higher trade-in value.

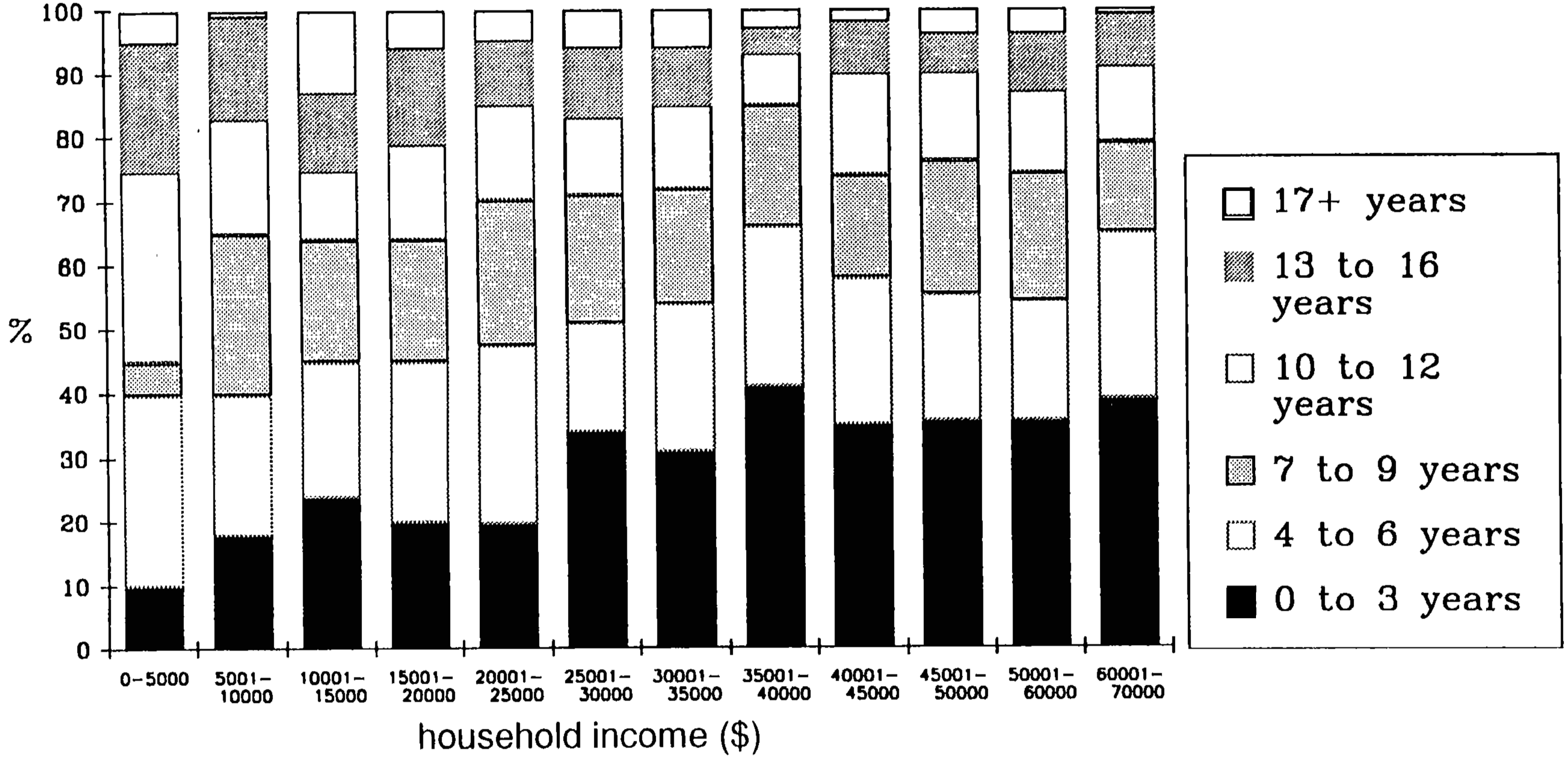
Greene and Liu (1988), in their study of the effects on consumers' surplus of fuel economy improvements due to the introduction of Corporate Average Fuel Economy (CAFE) standards in the USA, chose to ignore the effects on the prices of used cars. They considered that the effects were sometimes positive, sometimes negative, but overall about zero. Their paper asserted that buyers and sellers of used cars are, in aggregate, the same people. However, there may be 'winners' and 'losers' within this group.

Grandfathering registration charges

The equity implications of a skewed annual registration charge regime depend critically on whether or not it would be grandfathered. That is, the new charging could be applied only to vehicles manufactured after introduction of the skewed regime, and not to those already on the road.

Grandfathering would delay regressive vertical equity effects, where there is a tendency for lower income groups to own proportionately more older high fuel consumption vehicles. Figure 3.5 displays 1985 data supplied by Hensher (1991 personal communication). The proportion of cars over 10 years old was about 55 per cent for the lowest household income category, and about 21 per cent for the highest household income category. If the lowest and highest income classes are ignored, the percentages are about 36 and around 25 per cent.

Grandfathering could have adverse horizontal equity effects. For example, the owner of an existing low fuel consumption car would have to pay higher registration fees than the owner of a low fuel consumption car which fell within the ambit of the new scheme. This could be overcome, at a cost in state revenues, by allowing the owners of existing low fuel consumption vehicles to enjoy the benefits of skewed registration charges.



Source Hensher (1991 personal communication)

FIGURE 3.5 SYDNEY PANEL DATA 1985: VEHICLE AGE v HOUSEHOLD INCOME

If grandfathering were not adopted, then the improvement in fleet average fuel consumption could be expedited due to the possible resulting increase in the scrappage rate of fuel-inefficient cars. However, this latter course could have equity implications for low-income groups with high-fuel-consumption cars, whose vehicles, being older on average, would be more likely to be affected.

Registration charges based on rated fuel consumption would presumably have to be based on the rated fuel consumption of the vehicle when new, to avoid the administrative costs of testing the fuel consumption of all vehicles annually. This would soften the impact on lower income owners of older cars, the fuel economy of which had deteriorated in use.

IMPLEMENTATION ISSUES

Basing skewed registration or sales taxes directly on the rate of fuel consumption gives a greater improvement than when the skewed charges are based on Paxus vehicle size classes. A run of the DVTCU model using 7 vehicle-size classes (derived from 6 Paxus classes by dividing the Paxus small class into mini and small classes) yielded only half the effect (a 3.3 per cent improvement in average new car fuel economy) following the same sales tax and registration changes as yielded a 6.3 per cent improvement when based on fuel consumption classes.

Basing registration or sales taxes on the rate of fuel consumption, rather than on some proxy such as vehicle size, vehicle weight, engine power, or number of cylinders, means that there would be an option/incentive for vehicle manufacturers to develop more fuel-efficient vehicles rather than merely downsizing or reducing performance. If sales taxes were to be skewed about a published series of targets for the fleet average year-by-year (which will hopefully be improving) then this incentive would be ongoing. Depending on their assessment of the Australian market's receptivity to new technology and its sensitivity to price changes, car manufacturers in Australia might be encouraged by the skewed charges option to expedite the transfer of advanced technology from their overseas parent companies.

The DVTCU model used here considers only choices between existing vehicle models. The introduction of new, more fuel efficient types of vehicles by manufacturers could see a stronger effect on fleet average fuel efficiency, and would induce more buyers to switch model types. Such an effect could assist in offsetting any increase in average VKT (assumed constant in the model) induced by increased fuel efficiency, which might in any case largely be sterilised by increased fuel taxes.

For revenue neutrality, a skewed sales tax/registration charges strategy requires reduced charges on vehicles with rated fuel consumption below some benchmark, and increased charges on vehicles with fuel consumption rates above this benchmark. The benchmark might be static or might be related to target values for the fleet or new car average fuel consumption rate for various years in the future. In the latter case, it might be desirable to fix a fuel-efficient vehicle's registration class when it is new, by the relationship of its fuel consumption rate to the benchmark of that time. This would give an ongoing benefit to those who chose a fuel-efficient vehicle when purchasing.

Action might be needed to prevent a 'lock-in' effect, whereby owners of existing low tax, high fuel consumption vehicles retain these vehicles longer than they otherwise would have done, slowing the penetration of fuel efficiency improvements. This could be achieved by announcing, at the inception of a skewed charging scheme, that all vehicles would fall within the ambit of the scheme as from some future date, say 1 January 2001. Alternatively, exhaust emissions regulations could be progressively tightened and made applicable to existing vehicles.

It would be desirable for the skewed charges to apply to LCVs and FCPVs as well as cars and station wagons, if the market were not to be distorted, and the effect on fuel consumption damped, by buyers switching to LCVs and FCPVs. Including LCVs and FCPVs in such a charging scheme would increase by about 16 per cent the number of vehicles from which emissions reductions could be expected as a result of a move to more fuel-efficient vehicles, and the effect of including them would be boosted by the higher average kilometres travelled by LCVs - about 18 per cent more than cars (1988 SMVU). On the other hand, use of LCVs and FCPVs by those relying on their special characteristics, such as farmers, schools or health service operators, may warrant continuance of, or provision for, special tax status for these vehicles.

The reliance on the rate of fuel consumption as the basis for sales taxes and registration charges would seem to require vehicles to be labelled for tested fuel consumption rate and registration category, as part of the ADR process.

Such a sales tax strategy implemented for environmental reasons would need to be insulated from any political decision to replace existing wholesale sales taxes with a flat-rate Goods and Services tax. For high fuel consumption vehicles, this could be handled by converting the skewed sales tax to an excise (over and above the prospective rate of GST). For fuel-efficient vehicles, a rebate scheme might be devised.

The implementation of a skewed registration charging scheme could be affected if registration fees for light vehicles, including cars, were to be replaced by road user charges recovered via fuel excise. This option is currently being examined by a Commonwealth working group which will report to the November Special Premiers' Conference.

Unlike a carbon tax, a disadvantage of adopting the skewed sales tax/registration option is that it would affect the standing charges (fixed costs) attached to vehicle ownership, rather than marginal usage costs. The Federal Chamber of Automotive Industries (FCAI), in its submission to the TWG, preferred measures which increased fuel costs to those which increased standing costs, as would the skewed sales tax or registration charges option (FCAI 1991). The effects on local vehicle manufacturers, and on the outcome of the recently introduced motor vehicle industry policy, of changes in size-class market shares from adopting the skewed sales tax or registration charges option, will need to be addressed.

CHAPTER 4 CARBON TAXES

Due to the difficulty in measuring carbon dioxide emissions from transport fuels, the carbon content of fuel may be used as a convenient proxy. A tax on the carbon content can then be employed as a means of reducing the level of carbon dioxide emissions. Fuels containing relatively high levels of carbon would attract commensurately higher levels of tax per unit of measure.

Carbon taxes rely on the incentive caused by the shift in fuel prices, to encourage more energy efficient technologies, to reduce the transport task, and to promote a shift toward fuels with either lower, or no carbon content.

The extent of any tax-induced decrease in carbon dioxide emissions would depend on how responsive the particular uses of fuel are to changes in fuel price.

ESTABLISHING A RATE OF CARBON TAX

The most efficient level for a carbon tax would be such as would equate the marginal social cost of damage done by the carbon dioxide (or carbon based) emission with the marginal social cost of emission reduction. At such a level, the social cost of further reduction in emissions would be greater than the damage caused by the emissions. Unfortunately, determining the level of damage done by greenhouse gas emissions is highly speculative, given the uncertainty surrounding the consequences of an enhanced greenhouse effect.

The only practical solution to determining an appropriate rate of carbon tax is to find a rate which would result in a given acceptable level of emissions, or target level of emission reduction. The rate and timing of the introduction of the tax would be based on estimates of how demand for various carbon fuels would change after an increase in prices, and the time taken for those reductions to be achieved. The induced price change needs to occur sufficiently long enough before a reduction in emissions is required, to give fuel users the time to adjust capital and other structural factors which affect fuel use. Prior announcement of the intended level of tax in the longer term is also desirable. Instantaneous adjustments will be small.

In the long run, the rate of carbon tax should be uniform across all sectors of the economy and for all fossil fuels in order to achieve a national greenhouse target with minimum cost.

In the short run, however, a rapid move to a uniform carbon tax might impose large adjustment costs on some sectors of the economy. Also, in a dynamic context, it has been argued that non-uniformity may be justified in order to stimulate the introduction of alternative (fossil) fuels likely to be more benign in terms of their environmental effect. For example, the AGA has asked for an explicit fixed-term moratorium on the imposition of excise on compressed natural gas for vehicles, and the same arguments could be deployed to seek a delay in the imposition of a carbon tax on compressed natural gas. In the longer term there will be a tendency for any relatively low-taxed fuels to be over consumed.

Recent attempts at determining a carbon tax rate applicable in Australia have been undertaken by ABARE and the Industry Commission (IC).

An ABARE paper by Naughten, Zhaoyang, Jones, Stocks and Belcher (1991) concluded,

> *In order for the base case level of demand for energy services to be satisfied while meeting the Toronto target, a tax of $143 a tonne of carbon would need to be imposed from 2000, and $337/t from 2005. .....progressively higher rates of carbon tax [to contain growth in demand] are required in subsequent years.*

For the transport sector, this is equivalent to a carbon tax in 2000 of about $0.10 per litre (1991 dollars) for motor spirit. On the same basis, a tax of about $0.23 per litre would be required in 2005. A scenario of lower growth in energy services demand than the ABARE base case forecast would imply a lower carbon tax. Depending on different views about energy demand elasticities, the required rates of tax could be considerably lower or higher. ABARE is preparing estimates of possible carbon tax rates for the Energy Use Working Group and Energy Production Working Group of ESD. These would be expected to be of the order of the above estimates. As it would seem appropriate that the various working groups consider similar policies, the analysis later in this section is based on these ABARE estimates.

The IC draft report 'Costs and benefits of reducing greenhouse gas emissions' described an analysis of carbon tax rates using the Wedge model. The Commission estimated that for Australia to reach the 'Toronto target' by 2005, in the context of an international agreement supported by OECD and some other countries, the required tax would be about US$ 56 per tonne of carbon dioxide. This would be equivalent to $A 263 per tonne of carbon or about $0.18 cents per litre of petrol - a similar order of magnitude to the ABARE estimates.

Results from simulations on the OECD GREEN model, reported in IC(1991) produced substantially different results from the above. The GREEN model proposed wide disparity in world regional carbon taxes[1].

Presumably, if other energy demand management measures and enforced improvement in energy efficiency were instituted, the carbon tax required to meet the same target would be lower than proposed above, disparity in rates aside.

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1. Based on a scenario slightly less onerous than the Toronto target for greenhouse gas reductions (and with a global consensus on reductions among mainly OECD countries only) the world wide tax estimated with the GREEN model in 2010 was $123 per tonne of carbon (1985 $US) rising to $215 (1985 $US) by 2020. In terms of petrol, this is equivalent to $US 0.0838 per litre, rising to $US 0.1466 per litre. The carbon tax required in the Pacific region, ie Japan Australia and New Zealand) would be considerably higher at $US 955 per tonne of carbon, or $US 0.651 (1985 $US) per litre of fuel, but this is irrelevant to Australia, since it relates to the aggregate of economies with very different energy structures.

However, there already exists a type of carbon tax on fuel used by cars, ships and rail in the form of the current fuel excise. At the extreme, it could be argued that the part of the fuel excise which is not hypothecated to road cost recovery (the majority of the excise collected from the use of petrol in cars) should be regarded as a pre-existing carbon tax. On the other hand, it may be plausible to regard the non-hypothecated portion of the excise to be roughly justified as a deterrent to urban air pollution and traffic congestion or as a revenue tax on final consumption. On this view, a carbon tax directed at a greenhouse target should be additional to fuel excise.

The case is unambiguous for heavy road vehicles, where currently road track damage costs are believed to be under recovered through diesel fuel excise. Aviation, which does not pay fuel excise but pays only landing charges to airport owners and air navigation charges, is also likely to be paying no more than the marginal social cost excluding greenhouse considerations. For aviation and for heavy road vehicles it is clear that any carbon tax should be additional to existing charges.

REVENUE IMPLICATIONS FROM A CARBON TAX

The revenue generated by a carbon tax, assuming it is additional to the current pricing structure, is difficult to estimate accurately given the uncertainty of the demand response. However, the results of the ABARE MARKAL-MENSA model simulations (Naughten et al 1991) indicate liquid fuels consumption for transport in 2000 under the envisaged carbon tax would be actually 5.2 per cent higher than 1990 levels. Transport liquid fuels consumption in 2005 would be about 8.1 per cent higher than in 1990. This level of consumption would imply revenue of about $ 7.2 billion (1991 dollars) from a carbon tax of $0.23 per litre on liquid transport fuels in 2004-05. Other transport fuels, natural gas and electricity, would provide a relatively small amount of additional revenue. This should only be regarded as a rough estimate.

Whether the carbon tax rate considered by ABARE would be sufficient to reduce emissions to the level proposed in the Government's interim planning target is not clear. The BTCE view is that it would be difficult to achieve reductions in transport fuels anywhere near the Toronto target level, from the imposition of taxes of around \$0.10 rising to \$0.23 per litre for automotive gasoline, as suggested by ABARE. However, it would be unnecessary to achieve a 20 per cent reduction in the transport sector if proportionately greater reductions were achieved in other sectors of the economy.

EFFICIENCY IMPLICATIONS FROM THE IMPOSITION OF A CARBON TAX

A carbon tax is one way of internalising the costs of the greenhouse related consequences of consuming transport fuel. Perhaps more immediately identifiable external effects of transport fuel consumption are traffic congestion, and air and noise pollution in the urban environments. A spin-off of any pricing measure to address a perceived over-consumption of transport fuel will be a reduction in these other negative externalities. Adoption of a carbon/greenhouse tax will undoubtedly reduce local pollution factors if the carbon tax has the effect of reducing transport activity.

Equally, policy initiatives targeted explicitly at alleviating other external social costs from transport, such as congestion, urban air pollution and noise would be likely to induce spin-offs in lower fuel consumption and lower carbon dioxide emissions. The benefits of reducing these non-greenhouse externalities would accrue directly to Australians. Therefore it could be argued, pending an effective and comprehensive international greenhouse convention, priority should be given to measures targeted at local externalities, eg through traffic demand management, road pricing and urban land-use strategies.

However increased prices for transport fuels could help overcome barriers to efficient management of the variety of environmental problems associated with vehicle use, particularly in urban areas. In the context of a global agreement on greenhouse policy, it is difficult to consider how sustaining emissions below an acceptable level could be maintained efficiently where prices fail to provide an adequate signal to transport fuel users that there is social damage associated with their activities. A carbon tax would be a useful reinforcement for programs which seek to change behaviour and attitudes.

EFFECTIVENESS OF A CARBON TAX IN REDUCING CONSUMPTION OF TRANSPORT FUELS

The consumption of road transport fuels is determined by three factors. These are:

1) the size of the transport fleet;
2) the average fleet fuel economy; and
3) the number of vehicle kilometres travelled.

The effectiveness of a carbon tax as a measure for reducing emissions relates directly to the relationship between changes in the price of fuel and each of these three factors.

Cars

A carbon tax might affect the size of the fleet by either delaying or reducing the purchase of new cars and by encouraging the early scrapping of the older and relatively less fuel efficient vehicles. The time period for bringing about a change in the fleet size would be quite long, involving a change in lifestyle for some people. Hensher and Young (1991) estimated the five year elasticity of demand for changes in the size of the Australian car fleet with respect to automotive gasoline price at -0.31. That is, a $0.23 per litre increase in petrol prices in 2005, as proposed by Naughten et al (1991), might reduce the size of the car fleet, over the long term[2], by around 6.5 per cent[3] from what it would otherwise have been. It is important to note that these changes do not refer to the current size of the fleet, but the future size of the fleet, allowing for future growth.

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2. ABARE (1991, 16) forecasts assume petrol prices and real product taxes will increase at 2.3% p.a. from 1991-92 on. Pump price in 1991 assumed at $0.70 per litre. Price level in 2000 assumed at $0.859 (1991 dollars). A $0.10 per litre carbon tax introduced in 2000, implies an 11.64% increase in the real price. A $0.23 carbon tax in 2005 would imply a 12% increase in real price from the 2000 price level. This is 23.9% above the underlying price in the absence of a carbon tax.
3. Elasticity calculations are based on an assumption of constant own-price elasticity of demand.

As with the size of the transport fleet, the time required to bring about a major shift in the average fuel economy of the fleet can be quite long. This is particularly so if the scrappage rate remains at its low current level. A carbon tax would encourage purchasers of new vehicles to buy more fuel efficient cars than they might otherwise buy. The size of this effect may however be small where fuel costs represent only a small proportion of the total costs associated with car ownership. The Hensher and Young estimate of the size of the likely effect, after five years, on the Australian car fleet average fuel economy with respect to a change in the price of fuel, was very small, at around -0.09. Based on this estimated elasticity, the $0.23 carbon tax proposed for 2005 might improve fleet average fuel economy, in the long-run, by almost 2 per cent, compared with what it would otherwise be. There would be a further effect, also in the long-term, as higher fuel prices induced vehicle manufacturers to expedite the introduction of more fuel efficient technologies. In isolation, the impact of a relatively modest fuel price increase on the rate of technology change would be small.

The final way a carbon tax might affect the consumption of fuel is through the kilometres travelled per car. This is the most immediate factor to change in response to changes in the price of fuel since it is not fixed in the short-term. There are reasons to speculate that the long-term effect might be smaller than the short-term effect. In the short-term, car owners would forego discretionary travel or substitute public transport for private travel, where this were possible. Hensher and Young's estimate of the elasticity over five years of car kilometres travelled per vehicle with respect to a change in fuel price was -0.26. A carbon tax of $0.23 per litre in 2005, might reduce average kilometres travelled per car by just under 5.5 per cent from what it would otherwise be.

The total effect on fleet fuel consumption of a carbon tax of 23 cents per litre would, over the long term, be a reduction of around 13.5[4] per cent from the 'business as usual' level.

4 Effects of price changes are calculated on the basis of constant price elasticities.

Road freight

In the case of road freight, the increased costs induced by a carbon tax are likely to be passed forward to industry and consumers. However this is not likely to provide a strong incentive for users to switch from road to the more energy efficient modes, given the need for major reforms in transit times and service quality in rail, and the fact that substitution possibilities are likely to be limited to the interstate segment of the non-bulk task, where there is some scope for rail to increase its share.

The effectiveness of a carbon tax in encouraging reductions in emissions *within* the road freight industry is difficult to estimate. The Hensher and Young estimate of the five-year own-price elasticity of demand for automotive diesel oil was -0.55. This low elasticity would tend to indicate a weak price-induced effect on overall diesel consumption, in the absence of very significant increases in price. The ability to pass forward costs and the relatively small proportion of the final cost of goods represented by transport, mean that the road transport task need not be affected significantly by a carbon tax. On the other hand, competition within the industry could ensure that any avenues for saving fuel are quickly taken up.

Given the relatively higher carbon content per litre of diesel oil compared to automotive gasoline, the carbon taxes consistent with the ABARE scenario above would be around $0.12 per litre in 2000 and around $0.27 cents per litre in 2005[5]. Overall, the introduction of a carbon tax at these levels, additional to current excises and road charges, might reduce diesel consumption from the forecast levels by about 6.5 per cent following the 2000 impost, and slightly over 12 per cent following the 2005 tax. The post carbon tax levels of consumption of automotive diesel oil in trucks would still be well above the 1988 levels of ADO consumption.

5. Similar growth and fuel price assumptions as applied to the estimates made for a carbon tax that might apply to automotive gasoline for cars were used for ADO.

Air transport

The effect of a carbon tax on the demand for air travel depends on the extent to which airfares rise after a carbon tax is imposed on fuel and how sensitive the demand for air travel is to changes in airfares.

BTCE (1989) describes cost structures for aircraft in the current Australian domestic fleet[6]. This has been used to assess the effect a carbon tax might have on overall flight costs. Based on the Australian aircraft fleet as it was at 30 December 1990 and the mean stage distances of aircraft in the major airline fleets[7] increases in avtur price of 10 and 23 cents per litre, would increase average flight costs for the fleet by around 4.3 and 9.8 per cent respectively.

Costs per kilometre flown vary highly depending on the type of aircraft. For example, based on current costs and other things remaining equal, a 23 cents per litre increase in the cost of avtur was estimated to increase overall flight costs by as much as 13.27 per cent for the Boeing 727-200. (The smallest estimated increase in overall costs was 3.6 per cent for the Fokker 50).

BTCE estimates of the one-year price elasticities of demand for travel by Australian residents to overseas destinations (BTCE 1988) showed the three most popular destinations for leisure travellers, Europe, Asia and New Zealand, all have similar price elasticities of demand for leisure travel (-0.86, -1.08 and -1.09 respectively). An elasticity of -1 would result in a decrease in travel of around 12 per cent for a price increase of $0.23 per litre of avtur, assuming jets flying overseas have a similar cost structure to domestic jets. Estimates of the price elasticity of demand for business travel to overseas destinations were considerably lower[8]. Using the elasticity for business travel to Europe, a $0.23 per litre increase in avtur price could be expected to result in a decrease in travel of

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6. BTCE Aerocost model of aircraft operating costs, 1989.
7. Includes Compass, Ansett, Ansett Express, Ansett WA, Australian and East-West Airlines.
8. The own price elasticity for Europe was -0.23. Estimates of elasticity for Asia and New Zealand were not statistically significant.

almost 3 per cent, again assuming fuel costs for domestic and overseas jets constitute similar proportions of total costs.

For domestic aviation, Hensher and Young (1991) have estimated a one-year price elasticity of demand for aviation turbine fuel. The Hensher and Young work attempted to separate out endogenous factors such as overall demand for travel, and general health of the economy, from overall demand. Their estimate for avtur price elasticity of demand for domestic aviation was -0.18, which is very low. Using this estimated elasticity, a 23 cents per litre carbon tax impost in 2005[9], might reduce forecast avtur consumption by slightly less than 9 per cent from what it would otherwise be.

Total transport energy consumption

On the assumption that the carbon tax is imposed in sufficient time for the full effects to flow through by 2005, liquid fuel energy consumption in 2005 for air, car and road freight, based on the estimated reductions described above,[10] would be 1072 petajoules compared to the 'business as usual' scenario estimate of 1221 petajoules. This represents a reduction of 12 per cent. Actual energy consumption in 1987-88 was 850 petajoules for the same transport categories (ABARE 1991).

Naughten et al (1991) using MARKAL-MENSA and a somewhat different 'business as usual' scenario, estimated that if a carbon tax of 10 cents per litre were imposed in 2000, and 23 cents per litre in 2005, Australian liquid fuel consumption in 2005 would be 1115 petajoules (ABARE 1991, 87-88), or around 1030 petajoules for the three categories included above. While the estimated levels of consumption of liquid fuels in 2005 following imposition of the carbon tax are similar in both scenarios, the Naughten et al result represented a 3 per cent reduction from their unconstrained base case scenario, compared with the 12 per cent reduction based on the Hensher elasticities

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9. Details on fuel prices paid by domestic airlines are confidential and are likely to vary between major airlines depending on the ability to negotiate a lower price. For this example, a 25 cents per litre current price, growing at 2.3% per year until 2005 is assumed.
10. Assuming all transport gasoline is consumed by cars and all ADO is used by road freight. Using disaggregation provided in ABARE (1991, 87).

and the ABARE (1991) 'business as usual' scenario discussed above.

INCOME AND EQUITY EFFECTS - DISTRIBUTIONAL IMPLICATIONS

The two specific groups likely to be most affected by the introduction of a carbon tax are those on low incomes and people living in isolated or remote areas.

There are two alternative ways to examine the impact of tax increases across specific groups in a society. These approaches focus on the primary and secondary effects of the tax. A complete examination would cover both.

The primary effect of a tax would be the direct price increase in goods or services bought for final consumption, such as petroleum in the case of a tax on carbon-based fuels. The secondary effect would be manifested in the price of those goods and services which use transport fuels attracting a potential carbon tax as an intermediate input. Examples of goods which are likely to have some strong secondary effect from the imposition of a carbon tax might include public transport and goods that are transported long distances before final consumption.

In order to examine the secondary effect of the introduction of a carbon tax it would be necessary to construct a complete input/output model of the economy to determine what component of each sector's output was comprised directly of a carbon fuel input. Then it would be a matter of considering to what extent the range of prices and output across output sectors would vary depending on changed prices in the carbon fuel source sectors. If consumption for each sector could also be disaggregated according to the type of specific equity groups which were to be examined, the full impact of price changes could be understood. The task is obviously substantial and beyond the current resource limitations of the Bureau. This approach is being adopted in a study by Mr Mick Common and Ms Umay Salma, being funded currently by the ERDC. However problems with data availability and the need to 'gross up' certain sectors to create a tractable problem, will necessarily attach some limitations to their results.

Nonetheless, the BTCE is of the view that when considering the total effects of the imposition of a carbon tax on *transport* fuels the primary effects will outweigh heavily the secondary effects. Moreover, the primary effects will provide sufficient approximation of the overall effect to provide at least a moderate degree of assistance in determining equity effects.

Equity effects on income groups

To examine the primary effect of a carbon tax on income groups, the BTCE reviewed the Australian Bureau of Statistics 'Household Expenditure Survey, Australia 1988-89 - Detailed expenditure items' (ABS 1990), the HES. The HES includes details of expenditure by household income quintile groupings (table 4.1).

TABLE 4.1 EFFECTS OF CARBON TAXES BASED ON 1988-89 HES

	Quintile income groups				
	1	2	3	4	5
Average weekly income	$143.48	$324.74	$539.72	$795.29	$1,371.60
Av h/hold expenditure	$258.46	$411.86	$615.66	$816.11	$1,261.08
Av com/serv expenditure	$234.51	$345.67	$476.47	$608.60	$845.60
Av petrol purchases	$7.99	$14.94	$19.94	$26.50	$31.93
Rail & bus fares	$1.31	$1.80	$2.19	$2.88	$4.18
Petrol/AHE[a] (%)	3.09%	3.63%	3.24%	3.25%	2.53%
Petrol/ACSE[b] (%)	3.41%	4.32%	4.18%	4.35%	3.78%
Rail & bus/AHE[a] (%)	0.51%	0.44%	0.36%	0.35%	0.33%
Av no. adults per h/hold	1.36	1.79	1.91	2.19	2.53
65 years and older	0.61	0.46	0.13	0.08	0.09
Under 18 years	0.30	0.71	1.06	1.07	0.97
Carbon tax (10% increase in petrol price)					
Petrol purchases					
(incl 10% tax)	$8.79	$16.43	$21.93	$29.15	$35.12
Petrol (incl 10% tax)/AHE[a]	3.40%	3.99%	3.56%	3.57%	2.79%

a. Average weekly household expenditure
b. Average weekly household commodity and service expenditure

Source Australian Bureau of Statistics (1990)

If a carbon tax were imposed at a flat rate per litre of petrol, there are some indications the effect would be regressive. The proportion of household expenditure devoted to petrol by the highest income group is relatively low. Any flat rate tax could be regressive if the revenue were used to reduce progressivity in the income tax. The highly aggregated nature of the HES makes any definite judgment difficult; some households in the lower income groups will be much more adversely affected than others. Also, the survey is not a good indicator of average expenditure of households where relatively few households in the quintile group purchase the item in question. For example, in the lowest income group, many households may not make petrol purchases; the effect of a carbon tax on petrol purchasing low income households could therefore be much more severe than the survey averages would suggest. In addition, the HES data does not take into account household wealth. It is quite possible for many households to be income poor yet asset rich.

One possibly important secondary price effect which could be examined fairly simply using the HES, is the cost of public transport. According to the HES data, combined rail and bus fares as a proportion of the average household expenditure were greatest for the lowest income quintile at 0.51 per cent of household expenditure. Again, the proportion for households **using** public transport could be somewhat higher. The proportion decreased steadily as the average household income rose. The highest income quintile spent only 0.33 per cent of average household expenditure on combined train and bus fares. The effect of a carbon tax on public transport fares would be proportionately smaller than the effect of the tax on petrol prices. There may be a small adverse effect on low income earners in so far as public transport costs are concerned but it is likely to be very small.

While the different proportions of household expenditure devoted to transport fuel by different income groups mean that higher energy prices would affect some groups more than others, they do not provide a good indication of how economic welfare would be affected. This will depend on transport substitution possibilities, and substitutability between transport and other goods. It may be that those who are most well off have more choice and substitution possibilities than the less well off.

Rural and remote areas

People in rural and remote areas, and possibly those in outer suburbs with poor urban public transport, could suffer adverse equity effects if they rely more heavily on automobile kilometres than do urban city dwellers. This will be true if rural and remote dwellers have a need to travel generally longer distances more frequently. For remote areas the average trip length may be longer, but whether the frequency of trips or total distance travelled is greater is not known.

In 1991 the BTCE undertook an examination of some of the consequences that might flow through to residents of Darwin, from adopting the Inter-State Commission (ISC) recommendations on land transport reform (Ockwell 1991). The examination was limited to first round effects. Even with the substantial ISC recommended charges, the effect in Darwin was estimated to be unlikely to exceed more than a $1 per week increase in household expenditure.

The relatively proximate location of many services in rural towns, tends to indicate a relatively small welfare effect from a carbon tax compared to what might arise in larger cities. It should be recognised that in cities and the related conurbations, services and employment tend to be much more widely scattered than in rural towns.

There are indications that higher transport fuel prices induced by a carbon tax would be regressive. The tax would be paid at the same rate by all income groups, and in the highest income group a relatively lower proportion of household expenditure is allocated to fuel. Also, as noted above, any flat rate tax could be regressive to the extent that the revenue raised is used to reduce progressivity in the income tax. However, the relatively low proportions of income and expenditure devoted to petrol <u>on average</u>, for all groups, limit the extent of any regressive effect.

APPENDIX I COSTS TO EMPLOYERS OF PROVISION OF A BENEFIT OR AN EQUIVALENT POST-TAX SALARY

Where C_b = costs to employer of provision of a benefit, C_s = costs to employer of provision of an equivalent post-tax salary, t_c = company tax rate, t_f = fringe benefits tax rate, and t_p = personal income tax rate, the costs can be derived by the following:

$$C_b = (1 + t_f - t_c)x$$

$$C_s = \left(\frac{1 - t_c}{1 - t_p}\right) x$$

and the advantage to the employer can be derived:

$$\frac{C_b}{C_s} = (1 + t_f - t_c)\,\frac{1 - t_p}{1 - t_c}$$

For example, in the current tax environment, where $t_c = 0.39$, $t_p = 0.4825$ and $t_f = 0.47$, and x is the value of the fringe benefit, then:

$$C_b = (1 + 0.47 - 0.39)x$$

$$= 1.08x$$

and,

$$C_s = \left(\frac{1 - 0.39}{1 - 0.4825}\right) x$$

$$= 1.179x$$

the tax advantage, can thus be derived:

$$\frac{C_b}{C_s} = \frac{1.08}{1.179}$$

$$= 0.92$$

An algebraic solution calculating a neutral rate of FBT where t_f^* = neutral rate of FBT, can be derived by the following:

$$t_f^* = \frac{1 - t_c}{1 - t_p} - (1 - t_c)$$

$$= \frac{(1 - t_c)t_p}{1 - t_p}$$

In the current tax environment where $t_c = 0.39$ and $t_p = 0.4825$, then:

$$t_f^* = \frac{0.61 \times 0.4825}{0.5175}$$

$$= 0.569$$

APPENDIX II NEW ZEALAND'S 1974 CHANGE TO SKEWED SALES TAX REGIME

It may be of interest to note the effects in New Zealand of a change in 1974 in the sales tax regime, from a flat 40 per cent to a skewed structure, with rates of 30 per cent on cars with engine displacements under 1.35 litres, 37.5 per cent on cars between 1.35 and 2 litres, 50 per cent on cars between 2 and 2.7 litres, and 60 per cent on cars with engine displacements above 2.7 litres.

TABLE II.1 CUMULATIVE CHANGE IN NEW ZEALAND NEW CAR MARKET SHARES, 1975-78

	Due to sales tax change	Due to fuel price rise
< 1.05 Litre		
1975	0.89%	-2.63%
1976	0.58%	-4.11%
1977	0.74%	-3.47%
1978	1.12%	-3.00%
1.05 Litre to < 2 Litre		
1975	2.98%	11.12%
1976	3.77%	17.41%
1977	3.53%	14.69%
1978	3.44%	12.72%
2 Litre to 2.7 Litre		
1975	-2.54%	9.40%
1976	-2.47%	14.71%
1977	-2.23%	12.41%
1978	-2.39%	10.75%
> 2.7 Litre		
1975	-1.32%	-4.37%
1976	-1.87%	-17.89%
1977	-2.04%	-28.01%
1978	-2.16%	-20.46%

Source Falvey and Rogers (1986)

Changes in market share due to the skewed sales tax, rather than to the rise in fuel prices which occurred at much the same time, have been estimated by Falvey and Rogers (1986), and are shown in table II.1. The size of the lagged effects is evident: from 1975 to 1978 the size of the change in the market share of the smallest class increased by 26 per cent and by 15 per cent for the next class. While the 2.0 to 2.7 litre class regained some of its market share, the lagged effect was strongest for the over 2.7 litre class: the decline in its market share increased in size by 64 per cent from 1975 to 1978.

Falvey and Rogers (1986,58) commented that 'the effects of the tax rate changes are surprisingly small'. It appeared that the dominant influence had been the fuel price rise.

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Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
AIA	Automotive Industry Authority
AIC	Automotive Industry Council
BTCE	Bureau of Transport and Communications Economics
FCAI	Federal Chamber of Automotive Industries
IC	Industry Commission
IEA	International Energy Agency
OECD	Organisation for Economic Co-operation and Development
NRMA	National Roads and Motorists' Association

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ABBREVIATIONS

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ADR	Australian Design Rule
AIA	Automotive Industry Authority
AIC	Automotive Industry Council of Australia
BTCE	Bureau of Transport and Communications Economics
DVTCU	Dynamic Vehicle Type Choice and Use
ERDC	Energy Research Development Corporation
ESD	Economically Sustainable Development
FCAI	Federal Chamber of Automotive Industries
FCPV	Forward Control Passenger Vehicle
GST	Goods and Services Tax
IEA	International Energy Agency
ISC	Inter-state Commission
LCV	Light Commercial Vehicle
VKT	Vehicle Kilometres Travelled
NRMA	National Roads and Motorists' Association
OECD	Organisation for Economic Co-operation and Development
SMVU	Survey of Motor Vehicle Usage
TWG	Transport Working Group