Purchase, circulation and fuel taxation

Book Section

PRE-PUBLICATION VERSION

Chapter 2 'Transport Demand Management and Purchase, Circulation and Fuel Taxation' by Stephen Potter.
Pages 13- 27 of Ison, Stephen and Rye, Tom (Eds) (2008): *The Implementation and Effectiveness of Transport Demand Management measures: An International Perspective*, London, Ashgate

Road Transport Taxation and Transport Policy

During the last decade, the UK and many other developed nations have reformed existing forms of road transport taxation to address a number of transport policy goals. This has involved modifying the design of purchase, circulation and fuel taxation to promote:

- More fuel efficient vehicles
- Alternative fuel vehicles
- Cleaner fuels (lower emissions and/or low carbon)
- Modal shift and traffic volume
- Congestion reduction

Of these five groups of objectives, only the last two involve Transport Demand Management (TDM). The first three categories concern policy objectives to influence not the use of vehicles, but their technology, the type of fuel used and fuel economy. The last two objectives do involve TDM, but it is important to specify the aspect of TDM that a tax may influence. Transport demand consists of a group of factors generating the total volume of travel (Potter 2007). These include total number of trips, trip length, mode used and vehicle occupancy. Policies for reducing congestion, as well as considering the total volume of travel also require a consideration of the location and time of trips (although some congestion reduction policies are only about shifting trips rather than affecting the total volume of trips - an issue of network management rather than TDM).

In many cases, TDM has focused upon choice of mode, but this is just one factor in the traffic/congestion generating mix. It is perfectly possible to have effective TDM without modal shift. For example a tax measure may reduce traffic volume by promoting higher car occupancy, trip linking and trip substitution, but no modal shift away from the car. Equally modal shift may be promoted, but if this is in a context of a generally rising volume of traffic, then impacts such as congestion and emissions will continue to worsen.

Overall, when looking at the role of taxation in transport policy it should be recognised that (a) some important tax measures are primarily to influence vehicle technology, the type of fuel used and fuel economy, and (b) a comprehensive approach to TDM is needed covering all aspects making up travel demand.

Positioning of Taxation Measures

In developing the design of taxation measures, a crucial point is to position the measure in the transport system where it will have the most direct impact. This positioning relates to whether the objective of a measure is mainly to manage vehicle choice or use. There are three crucial taxation points which relate to user decisions:

- Tax on the initial purchase of a vehicle;
- 'Circulation' Tax on the ownership of vehicles (annual registration tax and company car taxation), and
- Tax on the use of vehicles (fuel, tolls, roadspace and parking).

Purchase and circulation taxes will have a strong influence on the choice of vehicle and the technology associated with the fuel it uses. Circulation taxes, although distanced from the point of purchase, also largely have an impact upon vehicle choice rather than use. Taxes on various aspects of the use of vehicles (fuel, road user charges and parking) have the strongest impact upon decisions to use a vehicle once purchased. The latter are therefore the main TDM taxes. Consequently, this chapter concentrates upon the use of road fuel duties, with other user taxes and charges covered by other chapters in this book. However, this chapter will first review purchase and circulation taxes as they have some secondary TDM effects.

Purchase Taxation Measures

In addition to VAT, many countries, and most European Union states, have a specific car purchase tax, although the UK and Germany are notable exceptions. The UK did have a 10% Car Purchase Tax, but in 1992 it was replaced by the UK government policy of raising fuel duty.

In a number of EU countries, existing car purchase taxes have been reformed to promote cleaner and low carbon vehicle technologies. For example, as noted in the review of European car taxation by Skinner et al (2006), the Netherlands have introduced a series of reforms to their original 42% car purchase tax that has led, from mid 2006, to the registration taxes being reduced for the most fuel-efficient cars (rated A or B under the national fuel efficiency/CO_2 emissions labelling system[1]). The reductions amount to €1000 for A-labelled cars and €500 for B-labelled cars, while cars in the least efficient bands (D to G) faced an increase in tax of up to €540.

This tax structure is similar to a trail which ran in 2002. An ex post evaluation of the trial (VROM, 2003) found that, compared to 2001, the market share of the A-labelled cars in 2002 increased from 0.3% to 3.2%, while that of B-labelled cars rose from 9.5% to 16.1%. This was a much greater increase than had been anticipated (EEA, 2005). The loss of the incentive in 2003 resulted in a drop in market share for these vehicles, but with a lag effect resulting in their share remaining higher than the pre-incentive year.

In Belgium, tax incentives for the purchase of low CO_2-emitting cars were introduced in January 2005. The tax reduction is equivalent to 15% of the sale price, up to a limit of €4350 for a car emitting less than 105gCO_2/km. For cars emitting between 105 and 115gCO_2/km the tax reduction is 3% of the sale price (up to a limit of €850 and 3%). The tax incentive works by the novel approach of reducing the purchaser's personal taxable income rather than refunding the purchase tax (ACEA, 2006). Hence non-taxpayers are unaffected by this mechanism.

VAT is, of course a purchase tax, and there is no reason why a variable rate of VAT could not be levied. Italy does this; as well as a registration tax, Italians pay two rates of VAT on car purchases. This is the standard 19% on cars with an engine capacity of less than 2 000cc (2 500cc for diesels), and at 38% above this threshold.

'Circulation' Tax Measures

Most developed countries have an annual registration (or 'circulation') tax entitling owners to use the public highway. In many countries this circulation tax is varied by the engine size or power of a car, but some nations have implemented reforms to address fuel efficiency or environmental policy objectives. In Denmark the tax varies with fuel consumption, whereas Germany links tax liability directly to the Euro emission standards, with the least polluting car

[1] This is a relative system. The CO_2 emissions of A-labelled cars are more than 20% below the average CO_2 value of new cars, while emissions of B-labelled cars are between 10% and 20% below the average value, etc.

paying only 20 percent of the rate of the most polluting car, but as the overall tax is so low (about €50 per car), its impact on car choice is negligible.

Britain has had a CO2 emission-based circulation tax (Vehicle Excise Duty) for cars since 2001. Initially the range of charges was small, but this has gradually been refined and widened such that by 2008 it covered a range from no charge at all for low carbon vehicles in band A, up to £400 (€610) for vehicles in the highest emitting band G (Table 2.1). From April 2009, VED will be totally restructured into 13 narrower CO2 bands with a new top band of over 255 g/km and the separate 'Alternative Fuel' bands will be phased out by 2011.

Table 2.1: UK Vehicle Excise Duty Rates (£ per year), 2008-09 (for private vehicles registered from March 2001)

VED Band	CO_2 (g/km)	Petrol and Diesel Cars	Alternative Fuel Cars
A	100 and below	£0	£0
B	101-120	£35	£15
C	121-150	£120	£100
D	151-165	£145	£125
E	166-185	£170	£150
F	186-225	£210	£195
G*	Over 225	£400	£385

*For cars registered on or after 23rd March 2006.
Source: DirectGov, http://www.direct.gov.uk/en/Motoring/ (accessed 12.08.08)

Another type of circulation tax is company car taxation. This can be viewed as a sector-specific circulation tax as this is the annual income tax charge where an employer provides employees with a car that is available for private use. In the UK, a major reform of company car taxation took effect in 2002, when the tax charge was related to a car's value weighted by its CO_2 emissions. The charge rises from a base level of 15 percent of a car's purchase price, for cars emitting 165 grams per kilometre (g/km) of CO_2, in 1 percent steps for every additional 5g/km over 165g/km. The maximum charge is 35 percent of a car's price. Diesel cars not meeting Euro IV emissions standards incur an additional charge of 3 percent, up to the 35 per cent ceiling. There are further reductions for company cars using cleaner fuels and technologies.

An assessment of the impact of this tax change (Inland Revenue, 2004) showed that, in the first year of the new system, average CO_2 emissions of new company cars decreased from 196 g/km in 1999 to 182 g/km in 2002. The number of business miles has reduced by over 300 million miles per year and the overall effect has been to reduce the emissions of carbon from the company car fleet; by around 0.5 percent of *all* CO_2 emissions from road transport in UK. It is notable that this tax measure affected both vehicle choice and vehicle use. The TDM effect on business travel was because the old system had tax discounts for high business mileage, which were abolished under the new system.

Other countries are starting to follow the UK's example in reforming company car tax. Skinner et al (2006), note that in Belgium, from 2005, employers have been liable for a *'Cotisation de solidarité'* if they allow private use of the car by individuals. This is a tax on employers rather than employees, as, in contrast to the UK, commuting is a tax-deductible expense for employees. This tax is based on CO_2 emissions and fuel type. In France, the 'TVS' tax (*'Tax sur les Véhicules de Société'*) was adjusted from 2006 to take account of CO_2 emissions of the vehicles purchased, to incentivise the purchase and use of lower emission

vehicles. Also from 2006, the amount that companies can set against depreciation for tax purposes has also been related to CO_2 emissions.

The positioning of a circulation tax, being as an annual change on ownership, means that it has a less direct impact on the type of vehicle purchased than does purchase tax. It can, however, be a useful complementary measure to car purchase tax and for countries such as the UK and Germany that have no purchase tax, this second-best, indirect alternative may be the only tax available to influence purchase behaviour.

However, a notable development is the UK government' plan to further reform its VED circulation tax. As well as widening the range of charges (detailed above), from April 2010, a 'first-year' rate of VED is planned. For new cars with emissions under 160 g CO2 /km the first year rate is no different, but it will be higher than the normal rate for new cars with emissions over 160 g CO2 /km. This is effectively a purchase tax, with the maximum additional VED supplement for the most polluting cars of £495 (€750).

The size of the tax is important. Initially the relatively low rates of VED had little discernable effect, but recent changes with a significant annual charge on high CO2 vehicles is generating attention and seems likley, along with the rise in oil prices, to result in some shifts in car purchase behaviour. This is following the pattern set by the strong impact of the reform to company car taxation which, being a major cost to users, its reform to be weighted by CO2 emissions has influenced vehicle choice. A car costing £20,000 (€30,000) used mainly for business purposes under the old system would have cost an employee paying the standard rate of tax about £690 (€1,100) a year. Under the reformed system, it would require a lower level of CO_2 emissions to keep the tax bill the same, and moving to a car with higher CO_2 emissions would result in the tax bill more than doubling to £1,600 (€2,500) per annum.

This substantial tax impact is in contrast to the relatively small tax gains of the VED reforms. The VED reforms before 2007 produced only a saving of about £100 (€65) per annum, which for most purchasers of new cars is too little to influence car choice. Furthermore, the introduction of the new VED structure coincided with the reduction in fuel duties from late 2000 (discussed in the next section), so the small VED reform was counterbalance by the larger tax reduction on fuel. The change to VED in the UK over the past two years, and future proposed changes are now reaching the point where this tax is having an impact on vehicle choice.

Overall, experience indicates that complementary purchase and circulation tax measures can have a significant policy impact on the type of cars purchased. Potter and Parkhurst (2006) note that the combined effect of well-established highly graded purchase and circulation tax systems in Italy and Denmark help explain why their car fleets have a 20% better fuel economy than the UK. The extension and refinement of such tax systems can play an important role in the uptake of cleaner vehicle technologies and low carbon fuels.

Purchase and Circulation Taxes and TDM

Well designed purchase and circulation taxes can stimulate cleaner car technologies and fuels, but their position within the tax system means that they are not an appropriate TDM measure. Some have had an incidental TDM impact, the main example being the UK company car tax reform, because of the business mileage weighting aspect.

There is a more strategic way in which purchase and circulation tax reforms could affect transport demand. The economics of low carbon vehicles are such that they have high capital costs and lower running costs. This becomes more extreme for the more radical technologies

such as hybrids, electric and hydrogen vehicles. In order to stimulate the uptake of such technologies requires strong purchase and circulation tax incentives to reduce fixed costs, while parallel fuel tax concessions take place on cleaner fuels. The net impact is that the fuel-efficient low carbon cars have very low running costs coupled with tax incentives to cut purchase costs. Extending the use of lower cost, good-fuel economy vehicles will cut the cost of motoring and so will produce pressures to increase car use. Historically, the price of motoring has fallen; motoring costs are now 10 percent less than in 1980, while disposable income has risen by 90 percent (Department for Transport 2006). In real-terms, fares for public transport have risen significantly, with a 42 percent rise for bus and coach and 39 percent for rail.

As will be noted in the next section, fuel price elasticity studies (such as Glaister and Graham 2000, and Goodwin 2002) indicate a short term elasticity of 0.4 (i.e. a 10% drop in price would increase car use by 4%), so a 33% drop in fuel cost (about the amount resulting from policy objectives for low carbon cars) might be expected to increase the volume of car travel by about 13%. To cut transport's environmental impacts we need low carbon vehicles, but if the tax system only addresses the supply side, then it will raise transport demand, counteracting any savings in CO_2 emissions from the low carbon vehicles. In and of themselves, purchase and circulation tax measures will have a negative impact on TDM. Tax (and other policy measures) need to impact upon both vehicle design *and* vehicle use.

Road Fuel Tax

TDM taxation measures need to be positioned to influence not the type of vehicles purchased, but decisions about the amount of travel and mode used. In the UK, and other developed nations, the main tax on the use of vehicles is upon fuel. In the UK there are other taxes and charges affecting use, including a limited number of road and bridge tolls, plus the London and Durham congestion charging zones. In other countries, motorway tolls are more widespread (e.g. in France and the Netherlands). Parking charges are a further significant cost that can be influenced by policy, but are not generally viewed as tax. This chapter concentrates on fuel tax, with further chapters in this book covering other taxes and charges on transport demand.

Fuel tax (or Fuel Excise Duty to use the official term) is a familiar measure that has for long provided a useful and steady income to national and (in some federal countries) regional governments. It is important to distinguish fuel duty from standard sales taxes (such as VAT in the EU). Sales taxes apply to all goods and are levied at a percentage of the price. Fuel duty is in addition to any sales tax. It is charged not as a percentage of the sales price, but at a rate per unit of fuel; per litre (or gallon in the USA) for liquid fuels and per kilogramme for gaseous fuels. The rate may differ according to the type of fuel (diesel, petrol, low-sulphur or LPG), but remains the same whatever fluctuations occur in the base price of the fuel. So, for example, in the UK the current (2008) road fuel excise duty rates are 48.35p per litre for sulphur-free petrol and diesel, 28.35p for biodiesel and bioethanol and 12.21p per kg for liquefied petroleum gas (LPG).

Some countries have component parts for fuel duty (e.g. Belgium has an '*Energy Levy'* as part of its fuel excise duty and the Netherlands also has a carbon and energy levy). In some cases there is also a component to fund fuel stockpiles (e.g. in Finland and the Netherlands). Some Scandinavian countries have a CO_2 levy as well as fuel duty, but this is also at a fixed rate per unit of fuel.

Fuel duty rates vary considerably between countries, affecting the overall retail price. Table 2.2 shows this information for the EU-15 states.

Table 2.2 Tax and retail price of premium unleaded petrol, 2008

	Tax as % of retail price	Retail price (Eurocents per litre)		Tax as % of retail price	Retail price (Eurocents per litre)
Netherlands	64	1.69	**Portugal**	60	1.50
Denmark	62	1.58	**Sweden**	63	1.47
Germany	65	1.57	**Irish Republic**	57	1.34
Finland	64	1.57	**Austria**	56	1.33
Italy	61	1.54	**Luxembourg**	54	1.32
Belgium	61	1.53	**Greece**	47	1.27
France	64	1.51	**Spain**	53	1.23
United Kingdom	67	1.51			

Note: This data covers all tax on petrol (including VAT).
Source of data: www.aaroadwatch.ie/eupetrolprices/ (accessed 12.08.08) and Transport Statistics Great Britain, 2007, Table 10.8.

Fuel Duties and Transport Policy

Fuel Duty was never originally intended to be a transport policy measure. It emerged through the 20th Century to become a steady source of government income that fulfilled a series of important principles of taxation. Firstly, it raises large amounts of predictable and reliable income. Secondly, and unusually for a direct tax measure, fuel tax has some progressive characteristics. A progressive tax is where the tax rate increases with income. Income tax is a clear example where the tax rate rises with income. Fuel duty is a proportional tax (the tax rate remains constant as income rises). However, as the UK *National Travel Survey* shows, there is a strong correlation between income and both car ownership (Department for Transport, 2006a, pp.34–6).., pp.34-36) and the amount of car travel/fuel used/tax paid (See Table 2.3). Consequently this consumption pattern produces an indirect progressive effect, increasing the amount of tax paid by higher income groups, with the top income quintile paying nearly five times more fuel duty than the bottom income quintile.

Table 2.3: Car Driver Distance Travelled per Year and Fuel Duty Paid by Income Quintile, 2005

	Lowest income quintile	Second quintile	Third quintile	Fourth quintile	Highest income quintile	Average
Car driver mileage	1,370	2,324	3,405	4,793	6,574	3,684
Fuel Duty paid*	£93	£158	£232	£326	£447	£250

Source of mileage data: Table 5.5 (p.37) Department for Transport, 2006a.
*Fuel duty paid estimated at 6.8p a mile from the 2005 Fuel Duty rate of 47p per litre and an average UK fuel consumption of 9 litres per 100km.

Finally, fuel tax is administratively simple and cheap to gather, it is easily enforced and evasion is difficult. With most petrol and diesel sold for road transport use, the default

position is that it is taxed, with rebates provided for clearly defined other purposes (e.g. exemption may apply for agricultural uses, rail and buses).

In the last 20 years, as well as providing a reliable and equitable source of government income, fuel duties have come to be adapted to address a number of transport policy objectives, as noted in the first section of this chapter. Fuel duties are a very low cost tool for government; the tax has to be gathered and enforced anyway, and any adaptation to address transport policy goals involves a relatively small additional cost in legislation and administration.

Although fuel duty can be used for transport demand management it is important to realise that they can, and are frequently used for other types of transport policy. As well as seeking to manage transport demand, fuel duties are used to promote fuel efficiency and the use of cleaner and low carbon fuels. In this respect, fuel taxation is used for exactly the same purpose as purchase and circulation taxes. The key way to do this is to have differential rates of fuel duty.

Differential rates of fuel duty are not a TDM measure. They are mainly about fuel switching and promoting low carbon vehicles. For example, a differential duty rate on unleaded petrol was used successfully in several countries in the 1990s to promote unleaded petrol and more recently to speed the transition to low sulphur road fuels. In countries with high duties on petrol and diesel, there is considerable scope to promote new low carbon fuels and transport technologies by offering substantial fuel duty concessions. If fuel tax rates are high then tax concessions can go a long way to compensate for the higher capital cost of low carbon vehicles. All this is a valuable part of addressing transport's environmental impacts, but does not affect the volume and modal distribution of travel - which is what TDM is about. Indeed, as noted in the conclusion to the previous section, this will have a negative TDM impact. To address transport demand requires not a differential in fuel duties, but a policy affecting the overall price of fuel.

In the UK, the adoption of fuel tax as a transport demand measure formally took place in 1992 when the Conservative government replaced the UK's ten percent Car Purchase Tax with the *Fuel Duty Escalator*. The principle of the Fuel Duty Escalator was that Road Fuel Duty would be increased annually at above the rate of inflation, initially by 5 percent per annum and, from 1997, 6 percent per annum. This was coupled, for example, with the 1996 policy for regulated rail fares to rise at 1 percent *below* the rate of inflation, thus over time increasing the real cost of travel by car and reducing that of rail. Other European countries have also adopted a policy to raise the overall price of road fuels, in some cases with an increase in public transport subsidies to reduce fares and/or considerable investment in public transport capacity. The Netherlands is a prime example of this.

Fuel duty has thus emerged as a policy instrument to promote modal shift. However, by affecting the price of travel, fuel duty also influences other key determinants of the volume of travel, including:

- Trip length
- Vehicle occupancy
- Trip linking

As was observed earlier in this chapter, TDM is frequently viewed as only being about modal shift. It needs to be more than that. Only a minority of the rise in the volume of car traffic is due to trips shifting from public transport, walking and cycling. Increasing trip

length (rising in the UK by about 0.15km every year), declining car occupancy (dropping in the UK by 0.3% per annum) and a shift in travel towards car-dominated leisure purposes are more important in generating traffic growth. If these elements are not addressed by TDM, then modal shift alone will have little impact on overall transport demand (Kwon and Preston, 2005, Potter 2007). The level of fuel duty will affect all components of transport demand. In addition high fuel duties will also automatically favour cars with a better fuel economy - so fuel duties will have an impact on the type of vehicle purchased as well as the amount of use.

The Impact of Fuel Duty on Travel Demand

Fuel duty has an overall impact on the price of fuel, but it can also be a more targeted measure. As noted above, fuel duty can vary by fuel type, and this kind of targeting works particularly well when differential rates are used to promote fuel quality or a new cleaner fuel, like low-sulphur and low-carbon fuels. This targeting is most effective in promoting the diffusion of a cleaner fuel where the cost of introduction is relatively low (e.g. unleaded and low sulphur fuels and, currently, biofuel blends). Where more radical technologies are involved, like electric vehicles and CNG, which involve a substantial increase in capital cost, then more than a fuel duty concession is needed to effectively promote use, for example a combination of purchase and fuel measures (Potter and Parkhurst 2005).

Targeting by fuel type to promote fuel switching is, however, not TDM. The type of targeting needed for TDM involves varying price by geographical area (e.g. in city centres where congestion is greatest or where new development is taking place), by parts of the road network (e.g. particularly congested roads), by journey types (e.g. work and school trips) and by time (e.g. congested peak hours). In some cases it is also required to target TDM measures by institutional factors (e.g. Travel Plans for a particular employment site or leisure facility). Fuel duties simply cannot be targeted in any of these ways. At best, in federal countries where individual states can set fuel duties, there can be a crude geographical variation, but differentials can produce border effects, with motorists travelling quite some distance to exploit lower fuel prices in adjacent states. This certainly happens in the USA and similar border effects occur in the European Union and elsewhere. In Singapore (where fuel duties are high), border controls check motorists driving into Malaysia, who are legally required to have a nearly full tank in order to stop them border hopping to fill up on cheap fuel.

One way that fuel duties can have a targeted TDM impact is for them to vary by type of user. By having a lower rate of duty or an exemption for public transport vehicles, then this will lower operator costs, which could result in lower fares and enhanced services - so promoting modal shift. The impact in this case is indirect and the danger is that a simple rebate or exemption will be absorbed within the cost structure of operators, with little or no TDM policy benefit. As such the design of the rebate/exemption is crucial. This can be illustrated by the case of the rebate mechanism in the UK, where the fuel duty rebate takes the form of the 'Bus Service Operators Grant' (BSOG) where bus operators receive a grant according to how much fuel each operator uses. This design of subsidy has been subject to criticism because it rewards fuel use regardless of patronage. The UK Commission for Integrated Transport (CfIT) has supported research to explore rebate designs that would link more directly to TDM policies. Their studies produced recommendations for a payment per passenger to replace BSOG in order to incentivise operators to grow patronage (CfIT 2002). One CfIT study indicated that if BSOG funding were reallocated to this redesigned system, demand could increase by 4.7%, with 20% to 40% of the newly generated passenger trips transferring from cars (FaberMaunsell, 2002). Bristow et al (2007) notes that an even more targeted approach is possible if some funds from the fuel duty rebate is allocated to support service enhancements specified to achieve TDM impacts, as has happened with the UK 'Kickstart' programme to support bus service enhancements. This targeted investment has

produced a growth in patronage averaging over 20% in the first year of operation (Bristow et al 2007), considerably higher than the 4.7% estimated by the less targeted design in the CfIT study. Such a programme could include targeting by geographical area and other TDM variables.

Overall, therefore, fuel duty is a general measure applicable at a national level that promotes TDM by raising the level of fuel costs for motorists. It is not really possible to target the TDM impacts of collecting fuel duty, but more targeted rebates to promote TDM policies are possible. In practice most countries that have a rebate for public transport do not target this in any way. Targeting fuel duty rebates according to TDM principles can be important and is a neglected policy area.

The effectiveness of the imposition of fuel duty as a general pricing mechanism will depend on the context in which it is applied. As noted above, some counties have combined a policy to increase fuel duties with subsidies to reduce public transport fares (or the rate of fare rises). So, the TDM impact of fuel duties will very much depend of the overall pricing context. Fuel Duties would be expected to have a stronger TDM impact if there were complementary policies to reduce public transport fares (and also increase public transport coverage) than if such complementary measures were absent.

In the UK, the general context has been one where, compared to other European countries, both fuel duties and public transport fares are high. Even the 1996 policy to limit the increase in (already high) regulated rail fares was reversed in 2002 to increase fares at 1% above inflation (coupled with a funding decision to also raise London bus and Underground fares above inflation in order to help finance service improvements) So the UK context is one where the modal shift impact of high fuel duties will to be muted, but where other price-related TDM impacts (on the amount of travel, journey length, trip linking and vehicle occupancy) might be expected to be stronger. An examination of changes in traffic growth before and after the introduction of the Fuel Duty Escalator policy indicates that this policy did have a general impact. UK road traffic grew by 18 percent in the six years from 1987 to 1993 (before the Fuel Duty Escalator) and by 13 percent in the six years between 1993 and 1999 when the Fuel Duty Escalator was in operation (Department for Transport, 2004: Table 7.1). Of course many factors affect traffic growth, particularly the strength of the economy, however detailed fuel demand elasticity studies (e.g. Glaister and Graham, 2000; Goodwin, 2002) suggest that the tax increases resulted in 10 percent less demand for fuel in 2000 than if the duty rates had only increased at the same rate as inflation. The UK Government (cited in Marsden, 2002) estimated that the TDM effects of the fuel duty escalator saved between 1 and 2.5 million tonnes of carbon emissions.

The UK Fuel Duty Escalator was abandoned in 2000. In September of that year, farmers and truck drivers mounted a blockade of oil refineries to protest, ostensibly, at the increase in road fuel duty. The protest exploited a strategic weakness in the fuel distribution system. With all fuel deliveries originating from a few refineries, a relatively small number of people and vehicles were able to blockade the refinery gates. Coupled with panic buying, within days fuel shortages were causing transport chaos. The government capitulated, cut fuel duties and abandoned the fuel duty escalator. From 2000-2007 there have been only two inflation-rate rises in UK fuel duty, meaning that the escalator has been reversed. In the first two years alone, Road Fuel Tax revenue dropped by 13% (Department for Transport, 2003) and by 2005 all road tax revenues had dropped by over £2 billion (Potter and Parkhurst, 2005). The politics behind the 2000 fuel protest were complex. High fuel duties were a catalyst for two groups from whom, paradoxically, the level of fuel duty was in reality a peripheral issue. Farmers in the UK had grievances over a number of agricultural policy issues, but actually benefited

from a substantial fuel duty rebate; for truck drivers, overcapacity in the industry and not the price of diesel fuel was their main problem. Both groups, however, found the fuel protest to be an effective way to air wider grievances (Parkhurst 2002). Despite this, the UK fuel duty protests did highlight a weakness in a policy for high increases in fuel duty. It is certainly difficult for any one individual country (or state in a federal system) to have a large difference in fuel duty rates - and fuel prices are an issue amenable to popular political dissent.

As shown in Table 2.1, the UK no longer has the highest fuel price (indeed it is in the middle of the range of EU petrol prices). The more gradual escalators used in some other EU states have faced lesser difficulties that the UK experienced. However, in the context of rapidly rising oil prices it is now becoming politically difficult to raise fuel duties any further and there have been protests in a number of European nations and calls for road fuel tax to be cut. If the oil price remains high, it seems that the further use of fuel duty as a policy instrument will be severely curtailed.

Lessons on Fuel Duty for TDM

As a TDM measure, fuel duty has an impact at the national level and its influence is upon the overall pricing context. A policy for high fuel duties provides a foundation upon which other, more targeted, TDM measures can be placed - be they fiscal, regulatory, organisational or infrastructure. Fuels duties have a particular strength in that they exert a broad positive impact upon the full range of traffic generating factors. These include not just modal choice, but also the other structural components determining travel volume, such as trip length, vehicle occupancy and trip linking. However, fuel duties are not a rapid TDM measure. As the 'escalator' experience shows, they need to be applied consistently and with political sensitivity. Their effects build up slowly and their effectiveness will also depend on the pricing context - particularly relative costs to public transport and other travel alternatives. If constantly applied over time, a regime of high fuel duties can result in this becoming a part of user expectations and understanding. High fuel costs become part of the everyday transport landscape, and so people adjust long term behaviour and expectations accordingly.

Targeting the collection of fuel tax is possible for policies to promote fuel switching and the adoption of low carbon vehicles (ideally as part of a mix with other policy measures). Targeting of the collection of fuel duty is not really possible to serve TDM objectives. A rise in fuel duty will affect some trip types more than others, affecting discretionary trips more and those where mode shifting and trip avoidance is most viable. These may, or may not, be the sort of trips that are desirable TDM policies. The area where some targeting is possible is in rebates to public transport and other users. The careful design of rebates can address TDM goals, but has not tended to take place. This neglected aspect could be a valuable TDM tool.

Fuel Duty in a Road User Charging World

Over the next decade the road transport taxation landscape is possibly set to change in a dramatic manner. Road user charges appear to be set to become a major part of the taxation system, both in the UK and a number of other countries. As well as the UK, several other nations and states are exploring or implementing national road user charges. Schemes for freight transport have been implemented first (notably in New Zealand, Germany, Switzerland and Austria), but in Britain, the Netherlands, and in Oregon, USA, schemes for country-wide car road user charges are progressing. There are a variety of reasons for road user charges rising up the political agenda, which are explored elsewhere in this book. Among them is the point made in this chapter that, unlike fuel duty, road user charges can be targeted on the places and times congestion occurs and other key TDM factors. An additional point is that the increasing diversity of transport fuels produces administrative difficulties and raises equity issues. How does one justify and enforce the taxation of gas or electricity at one rate for domestic use and at a much higher rate

for road transport use? In the longer term this will be even more of an issue were hydrogen to become a major transport fuel.

The emergence of a new road transport taxation regime centred upon road user charging rather than fuel duties therefore raises the question as to what role fuel duties have, if any, in this new transport taxation landscape. Should road user charges replace fuel duties? Should they be in addition to fuel duties - or some blend of the two? The freight road user charge schemes have replaced previous annual registration taxes either fully or in part. In the Oregon and Dutch proposals for private motorists, road user charges replace fuel duty (with the Dutch proposal advocating the replacement of car purchase tax as well); in the UK this has yet to be decided. For existing city road user charging schemes, such as in London, Oslo and Singapore, the charges are in addition to fuel duties, circulation and purchase taxes.

There are two key points in considering whether any new road user charges should replace or be in addition to fuel duties and other taxes. Firstly there is the point made at the beginning of this chapter that road duties serve important transport and environmental policy objectives other than TDM. If fuel and vehicle excise duties were entirely removed then this would sweep away the existing incentives for fuel efficiency and the promotion of low carbon fuels. Fuel duty inherently promotes fuel efficient vehicles, and a lower tax on cleaner fuels has proved to be a potent and cost-effective policy instrument. A shift to a purchase tax, graded by vehicle fuel efficiency and fuel type could form a replacement measure, but, as noted earlier in this chapter, the top rate charges would need to be high to seriously affect purchasing behaviour. Rebates on road user charges could also form an alternative to retaining fuel duty, similarly graded by fuel efficiency and fuel type. However, retaining fuel duty which can target these factors well, or a combination of fuel and purchase tax measures, would seem a more appropriate approach.

A second point is that studies modelling the impacts of a national road user charge in the UK have suggested that replacing fuel duties with road user charging in a revenue neutral package would fail as a TDM measure because it would result in motoring costs falling in less congested areas where traffic growth is already rising rapidly (e.g. rural areas and city fringes). It would also lead to activity patterns redistributing to low charge areas (Wenban-Smith, 2006). As detailed in Foley and Fergusson (2003) their modelling work indicates that such a revenue neutral charge (with the road user charge replacing fuel duty) would help to redistribute traffic and ease pressure on congestion hot spots, but would not necessarily lead to an overall decrease in traffic levels or CO_2 emissions. In the context of eliminating fuel duties, and with the real costs of motoring continuing to fall, a revenue neutral road user charge would worsen overall traffic levels and CO_2 emissions.

Conclusions

Purchase, circulation and fuel taxation can be used to promote a variety of transport and environmental policy goals. In exploring the use of these tax measures it is important to distinguish between policy measures to influence vehicle characteristics (technology, the type of fuel used and fuel economy) as opposed to vehicle use. Well designed purchase and circulation taxes can stimulate cleaner car technologies and fuels, but their position within the tax system means that they are not an appropriate TDM measure. Indeed, if successful, of themselves, they will have negative TDM effects.

Road fuel duties are an appropriate and effective TDM measure and one that can be targeted to serve other sustainable transport policy goals. Within this broad context it is appropriate to introduce more targeted measures. These include targeting fuel duty rebates, which is a neglected area of opportunity, and the introduction of complementary TDM

measures, such as road user charges. Rather than replacing fuel duties, evidence is mounting that to manage transport demand as well as effectively address other sustainable transport policy goals, any new fiscal measure needs to complement and not replace fuel and vehicle excise duties. This may be a politically inconvenient truth and the real challenge is now managing the transition towards an effective new transport taxation regime.

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