Transport costs and carbon emissions

Report

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1 Executive summary

Introduction

1.1 Following the publication of *Towards a Sustainable Transport System: Supporting Economic Growth in a Low Carbon World (TASTS)*[1] and the forthcoming report of the Committee on Climate Change, the Government is expected to produce a White Paper setting out specific transport policy measures to address the climate change agenda. This provides an important opportunity to debate the full range of possible policy initiatives that might be applied to secure significant carbon reductions from transport. The Campaign for Better Transport (CBT) is seeking to ensure that this debate takes full account of the potential for changes in the real price of different transport modes to encourage greater use of public transport and fewer journeys by private car.

1.2 Steer Davies Gleave was commissioned by CBT to:

- Assess the extent to which demand for public transport has been suppressed as a result of the level of public transport fares relative to motoring costs;
- Estimate what might be achieved in terms of modal shift and reductions in carbon emissions through changes in the price of using different types of transport; and
- Highlight the policy mechanisms that might be used to influence prices and help secure the carbon reduction targets for the transport sector as a whole.

Pricing and transport demand

1.3 Comparisons of carbon emissions by transport mode, while they must be interpreted with caution, suggest that rail and bus generally result in substantially fewer emissions per passenger-km than either car or air travel. Therefore, as we discuss in Section 4, a transport policy that supported an increase in the modal share of public transport within a given overall level of transport demand could help to deliver significant reductions in emissions.

1.4 In principle, such a policy would include measures designed to ensure that the costs of carbon emissions were properly reflected in the price of each mode, thereby encouraging greater use of public transport in preference to higher emissions alternatives. However, our review of the evidence on the impact of pricing on travel demand, reported in Section 3, demonstrates that, over the last two decades, public transport fares have increased significantly while the overall costs of motoring have been falling. It also indicates that public transport fares in the UK are some 20 per cent above the European average and that, together with the Netherlands; we have the highest modal share for car of all the EU 15 countries.

1.5 These outcomes support the view that, in practice, relative transport prices in the UK have tended to encourage car ownership and use and suppress the demand for public transport. They also suggest that Government does not apply a holistic pricing policy across transport modes. Such a policy is essential if the trends in relative prices experienced in recent years are to be reversed.

1.6 At the same time, the growth of car travel has been moderated and even reversed during periods of high motoring fuel costs, most recently during the first half of 2008 when fuel prices increased sharply. Further, the introduction of concessionary bus fares for the over 60s across the UK appears to be stimulating demand, while growth in some rail markets has been partly achieved by competitive pricing on the part of train operators. This experience highlights the potential for using transport pricing in order to influence travel decisions in general and modal choice in particular, and demonstrate that Government is sometimes willing and able to send strong signals through the price mechanism.

Potential impact of price changes

1.7 In order to test this potential further, we developed a simple Transport Demand and Emissions Model, drawing on the results of research into the price elasticity of demand for different types of travel undertaken in recent years. The model, which is described in Section 5, allowed us to assess the effect of changes in relative transport prices in terms of changes in modal demand and emissions levels from a base case. By way of illustration, our model results suggested that a 20 per cent reduction in public transport fares would increase bus travel by 13 per cent and rail travel by 17 per cent within eight years. Had such reductions been made in 2000, bus and rail travel combined might now be around 120 billion passenger-km, a level of public transport use not achieved since 1960.

1.8 However, the model also demonstrated that changes in motoring costs as well as fare reductions are needed to make a significant impact on carbon emissions. Our results indicated that a package of measures, involving increases in motoring taxation combined with substantial reductions in bus and rail fares, would reduce the share of car travel in overall transport demand from 87 per cent in the base case to around 78 per cent by 2025. They also suggested that the use of aviation taxation to improve the competitiveness of rail in longer distance markets could secure a significant reduction in aviation emissions. We estimate that overall, under a Maximum Impact Scenario, carbon emissions from transport could be reduced by some 16 million tonnes per annum, around 13 per cent of base case emissions, by 2025.

Policy implications

1.9 These results demonstrate the effectiveness of price-based initiatives in supporting any carbon reduction strategy for transport, although they would need to be implemented as part of a broader package of measures including, *inter alia*, land use planning, green travel planning and investment in public transport infrastructure. At the same time, our modelling results also indicate the potential for perverse effects if individual measures are applied in isolation. For example, fare reductions without increases in motoring costs would not ensure sufficient modal switch to secure an overall reduction in carbon emissions.

1.10 Hence, policy needs to achieve a more holistic, rebalancing of prices, recognising the different contribution of each transport mode to carbon emissions. In our view, this re-balancing should have at least four main elements, as discussed in Section 6, to be implemented through specific initiatives at the national, regional and local levels:

- In the case of car travel, fuel duty should be used to ensure steadily increasing motoring fuel prices over the long term, creating an expectation among motorists that car use will become gradually more expensive at the margin and encouraging

the use of other modes and more sustainable land use patterns. In the short term, duty could be used to stabilise the overall fuel price, postponing real increases for the duration of the recession but offsetting the substantial fall in prices that can be expected to accompany an economic downturn. In addition, congestion charging, parking and other policies applied within city regions, possibly supported by taxation of free parking provided by employers, should be used to both manage city centre traffic and provide revenue sources to fund improvements in public transport.

- Bus and light rail subsidies at both the national and local level should be targeted to achieve the maximum possible abstraction from car use and ensure improved service quality. Such measures can be usefully supplemented with the deployment of smartcard and other technology that makes public transport much simpler and more convenient for passengers to use. Policies of this kind can be expected to benefit lower income groups while encouraging those on higher incomes to consider bus and light rail services for local journeys.

- Current policy to increase the share of passenger revenue in overall rail funding should be revisited. Specifically, policy in respect of rail fares should be redefined to ensure that the real level of regulated fares remains at the current level. This would involve replacing the RPI+1 formula currently applied with RPI+0. In addition, DfT should work with train operators to enable them to offer a wider range of discounts to encourage greater rail travel on the part of those groups most willing and able to switch from car.

- In the case of aviation, the impact of the EU Emissions Trading Scheme on the demand for air travel is uncertain, not least because it will only apply to aviation from 2012. However, the introduction of the Aviation Duty in the UK affords a more immediate opportunity to use the price mechanism to reduce carbon emissions from domestic and international flights.

1.11 In addition, any short term measures designed to reduce the effects of recession should be assessed in terms of their potential impacts on the transport sector as a whole, together with any associated effects on carbon emissions and climate change. Hence, reductions in motoring taxation, while they could provide relief for businesses and households, should be avoided if they are likely to undermine the viability of commercial transport operators at a time when demand for public transport is anyway likely to fall. Equally, even temporary measures must take account of the substantial costs of deferring attempts to address climate change, as highlighted by the *Stern Review on the Economics of Climate Change*[2].

1.12 The success of transport pricing policy in both the short and the long term will depend partly on the detailed design of individual measures. However, more critically it will require a clear commitment on the part of Government to set well-defined carbon reduction targets for transport and to demonstrate effectively the link between the targets and the package of initiatives proposed. As is invariably the case with a challenging policy agenda, once the commitment has been set in legislation and the will to act established through political leadership, developing the detailed policy levers will be much more straightforward.

2 Introduction

Background to the study

2.1 Following the publication of *Towards a Sustainable Transport System: Supporting Economic Growth in a Low Carbon World (TASTS)*[1] and the forthcoming report of the Committee on Climate Change, the Government is expected to produce a White Paper setting out specific transport policy measures to address the climate change agenda. Transport is clearly within the scope of the Climate Change Bill, and will therefore need to make an explicit contribution to the five yearly carbon budgets for 2008-12, 2013-17 and 2018-22 to be set by the Committee on Climate Change in late 2008. Hence, the White Paper is expected to include a clearly defined carbon reduction strategy for the transport sector, going well beyond the broad policy framework set out in TASTS in order to secure specific reductions in carbon emissions within each five-year budget period.

2.2 The publication of the White Paper will provide an important opportunity to debate the full range of possible policy initiatives that might be applied to secure significant carbon reductions from transport. The Campaign for Better Transport (CBT) is seeking to ensure that this debate takes full account of the potential for changes in the real price of different transport modes to encourage greater use of public transport and fewer journeys by private car. This focus on real prices recognises the need to identify changes in transport prices relative to changes in the general price level, as measured by the retail prices index and similar indices.

2.3 In principle, pricing measures could include changes in both public transport fares and the costs of private motoring (through changes in motoring taxation). However, the evidence discussed in this report indicates that overall transport policy outcomes in recent years have tended to result in increases in real bus and rail fares while failing to offset significant reductions in motoring costs. The scope for applying price-based mechanisms to influence choices between transport modes therefore remains to be explored.

2.4 Against this background, CBT wishes to establish what evidence is available on the possible impacts of pricing measures of different kinds on modal choice and carbon emissions. It is concerned that the evidence base should draw on relevant experience in other countries while recognising the specific factors affecting travel behaviour in the UK. This will ensure that any debate following publication of the White Paper is informed by a proper understanding of the potential role of pricing in meeting climate change and other key policy objectives.

Study objectives

2.5 Steer Davies Gleave was commissioned by CBT to:

- Assess the extent to which demand for public transport has been suppressed as a result of the level of public transport fares relative to motoring costs;
- Estimate what might be achieved in terms of modal shift and reductions in carbon emissions through changes in the price of using different types of transport; and

- Highlight the policy mechanisms that might be used to influence prices and help secure the carbon reduction targets for the transport sector as a whole.

2.6 The scope of the study encompasses travel by car, bus, rail and domestic aviation. In identifying possible policy measures that might be implemented in the UK, it draws on examples from a number of other countries, although it does not aim to provide a comprehensive review of international experience of transport prices and costs.

Organisation of the report

2.7 The remainder of the report is organised as follows:

- Section 3 discusses trends in travel behaviour and transport costs in the UK, drawing key comparisons with other European countries;
- Section 4 sets out the policy context, summarising recent UK policy in relation to each mode of transport, providing examples of alternative approaches taken in other countries and highlighting the importance of pricing as a means of achieving carbon emissions targets;
- Section 5 describes the Transport Demand and Emissions model that we have constructed to estimate the potential impact of price and tax changes and sets out the results obtained from modelling a number of policy scenarios; and
- Section 6 highlights the main policy implications of the evidence provided in the previous sections.

2.8 All references are provided in Appendix A. Key modelling assumptions and data sources are set out in Appendix B.

3 Trends in travel behaviour and costs

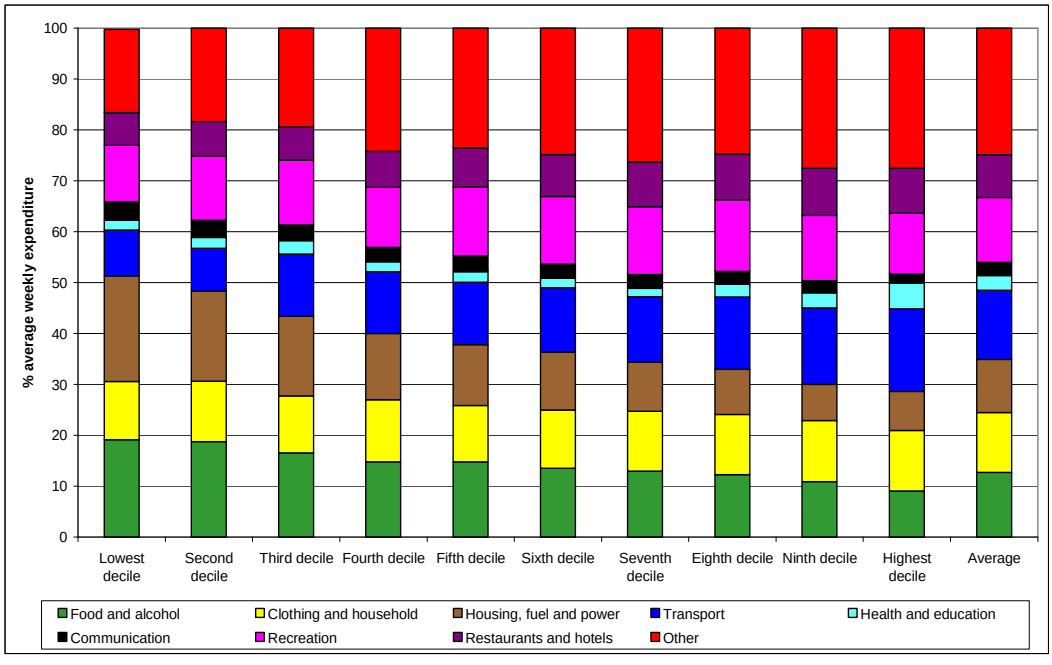
Pricing and travel decisions

3.1 Before assessing the effectiveness of pricing as a policy mechanism for encouraging greater use of public transport, it is important to understand how transport prices and costs affect the travel decisions of individuals and households. In practice, price or cost is only one of a number of factors that will determine whether and how a journey is made, and the importance of price relative to other factors for different types of journey must be established if policy design is to be properly informed.

Transport costs and household expenditure

3.2 It is clear that households are concerned with the overall cost of transport, since it typically represents a significant proportion of the annual household budget. The most recent *Expenditure and Food Survey* (EFS), undertaken in 2006, indicates that transport accounts for some 14 per cent of average household expenditure, the highest of any single category of expenditure[1]. The EFS also demonstrates that the proportion is significant regardless of income level, as shown in Figure 3.1. This suggests that many households will be particularly aware of transport costs and hence sensitive to the impact that changes in such costs have on their overall expenditure. Moreover, in the light of recent increases in commodity and fuel prices and with a significant economic slowdown in prospect, many households are likely to become more focused on finding opportunities for savings in transport expenditure.

FIGURE 3.1 HOUSEHOLD EXPENDITURE BY INCOME DECILE GROUP 2006

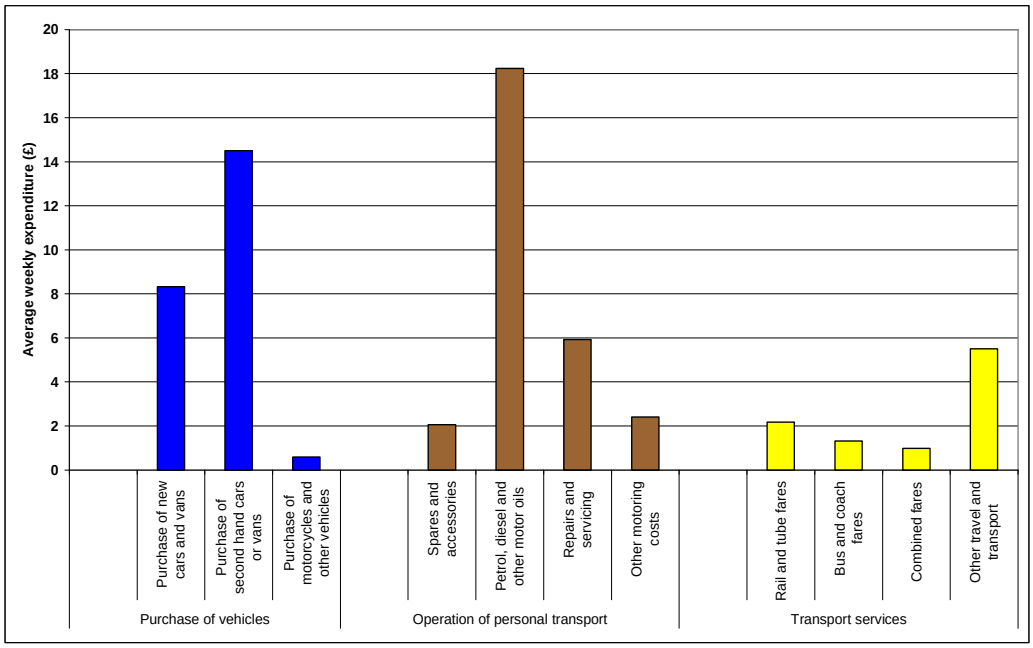


3.3 Savings may arise from reductions in the overall level of travel, particularly in the case of discretionary journeys such as leisure trips but, more importantly in the context of this study, households may also look for cheaper ways of making regular, non-discretionary journeys such as those to work or for shopping. Hence, a significant

increase in the costs of motoring relative to the costs of using public transport can encourage greater use of bus and rail services, and there is already some evidence of a switch from car to bus and rail in the wake of recent substantial increases in the price of motor fuel, as discussed further below. However, the extent and sustainability of any switch of this kind will depend critically on the extent of the price change and whether the price competitiveness of public transport is maintained over time.

3.4 It is also important to recognise that households may only be able to reduce a proportion of their overall transport costs by using alternative modes, at least in the short term. This is because many motoring costs, which typically account for a relatively high proportion of expenditure on transport, are fixed in the short run. A more detailed examination of the EFS, the results of which are shown in Figure 3.2, suggests that the purchase price of vehicles accounted for some 38 per cent of total household transport costs in 2006. While this is expressed as an average weekly sum for the purposes of the EFS, in practice it is a fixed outlay, either made as a single payment at the time a vehicle is purchased or committed in the form of a series of payments under a loan or credit agreement for a defined period.

FIGURE 3.2 BREAKDOWN OF AVERAGE WEEKLY EXPENDITURE ON TRANSPORT 2006



3.5 Further, at least a proportion of the EFS expenditure category "operation of personal transport" will also be fixed in the short term. For example, while repair and servicing costs will be partly related to vehicle use, most car owners expect to pay a standard charge when a car is serviced professionally, and some parts will deteriorate with time as well as with mileage. Within this category of expenditure on vehicle operation, only petrol, diesel and motor oils can be said to be largely, if not entirely, variable.

3.6 It follows that a substantial proportion of motoring costs are effectively fixed once the decision to purchase a vehicle has been taken. By contrast, expenditure on public transport, currently a relatively small proportion of total household transport costs, tends to be variable in the sense that fares can usually be avoided if the associated journeys are not made or are made using other means. Season ticket purchases, which may involve a significant one-off payment for unlimited travel, are an important exception since they reduce the marginal cost of travel by the mode in question to

zero. However, a proportion of the purchase price is often refundable when a passenger no longer requires the ticket before the expiry date. Moreover, the increasing deployment of smart-card technology, supporting "pay-as-you-go" journey purchasing options, will tend to increase the proportion of household expenditure on public transport that is variable in the short term.

3.7 This difference in the short term variability of motoring and public transport costs is an important consideration when making comparisons between them and in understanding the likely efficacy of pricing as a means of achieving transport policy objectives. Its implications are considered in more detail below in the context of the discussion of pricing trends.

Other factors affecting travel decisions

3.8 As noted above, for any given journey an individual will take account of a range of factors other than price in deciding which mode of transport to use. These will include:

- The scheduled or expected journey time;
- The reliability of the mode in question;
- Relative levels of comfort and convenience; and
- Flexibility of travel arrangements.

3.9 Depending on the journey, these factors may well favour the use of a private car in preference to public transport. For relatively short trips, a journey by car is often shorter as the route is more direct and journey time is not dependent on a fixed service schedule. In the case of longer trips, rail services tend to offer a shorter journey time than the car, particularly where a journey is made at peak times when roads are congested, although UK experience over the last ten years demonstrates that rail passengers can encounter poor performance and substantial overcrowding at times. Rail can also afford the opportunity to work, read, eat and sleep, none of which is possible for a car driver. Arguably, longer distance bus and coach services have little advantage over the car since they may also be delayed by congestion and scheduled journey times, while broadly comparable with journey times by car, are likely to be extended by the need to make connections in order to reach the final destination.

3.10 In addition, all forms of public transport offer considerably less flexibility in terms of the route taken, the potential for breaking a journey and the scope for making additional, local journeys once the main destination has been reached. This latter consideration can be particularly important where those travelling expect to remain at the destination for an extended period, for example because they are taking a holiday or visiting friends or relations. In these circumstances, the availability of a private car will generally increase their ability to make additional, possibly unplanned trips in the local area, particularly where local transport services are limited or unfamiliar to them. Journeys within London are, of course, an exception, since it is generally much easier to travel around the city by public transport.

3.11 Results from the *British Social Attitudes Survey*[2], while in some cases relatively dated, provide clear evidence that factors such as convenience and flexibility as well as cost are important determinants of mode choice. Table 3.1 summarises the responses to a number of relevant questions included in the survey at different times over the last 15 years. These highlight a particular reluctance to use public transport for short journeys

and a perception that bus services, while they often provide connections to local destinations, are not sufficiently frequent and do not offer good value for money. They also suggest that car users are generally not willing to sacrifice convenience in response to environmental concerns, although this particular response was obtained in 2003 and attitudes may have changed with the greater emphasis on climate change and broader environmental issues in more recent years.

TABLE 3.1 ATTITUDES TO PUBLIC TRANSPORT AS AN ALTERNATIVE TO THE PRIVATE CAR

Survey question/statement	Year	% agreeing or strongly agreeing	% disagreeing or strongly disagreeing
Many of the short journeys I make by car I could just as easily make by bus	2006	28.25	54.36
Driving one's own car is too convenient to give up for the sake of the environment	2003	44.12	25.51
Buses do not run often enough	2001	41.13	32.5
Buses cost too much	2001	42.03	29.96
Buses will generally take you where you mostly need to go	2001	54.57	21.16
A visitor to the countryside these days really needs a car to get around	1995	71.04	15.06

3.12 For long distance journeys, journey time is clearly an important consideration, particularly in the case of travellers with a high value of time. Hence, for the longest journeys within the UK, such as between London and destinations in Scotland, business travellers will tend to choose air transport over both rail and car. Leisure travellers taking short breaks and wishing to reach such destinations as quickly as possible are also likely to regard air as the preferred option. Rail operators have therefore found it difficult to penetrate these markets simply through competitive fare offers.

3.13 However, a recent report by the UK Civil Aviation Authority (CAA) on *Recent trends in growth of UK air passenger demand* suggests that rail services have become increasingly competitive on routes with a rail journey time of around three hours or less[3]. Routes on which competition appears to have been effective include London to Manchester and London to Leeds and possibly Edinburgh to Manchester, although the journey time for the latter is some four hours. While the flight time between these cities is considerably less than 3 hours, the requirement to arrive at the airport at least one hour before departure, together with the lengthy pre-flight security procedures currently in place, means that the overall journey time by air is comparable with that by train. Moreover, business passengers who value unbroken journey time, during which they can work more effectively, will see significant advantages in choosing the rail option.

3.14 This discussion highlights the difficulty of drawing simple conclusions from comparison of prices and costs for different modes of transport. A given travel decision may be the outcome of quite complex trade-offs, with the result that one mode may be chosen over another even where it is demonstrably more expensive. Hence, the greater convenience and flexibility provided by the private car may mean that it remains the preferred choice for many individuals and households even where the public transport alternative enables them to realise significant monetary savings. Similarly, while the benefits of a relatively unbroken journey may provide rail with some advantages over air transport, the substantial overall journey time savings currently provided by air on some routes are likely to be difficult to offset through price alone.

3.15 The existence of these trade-offs does not, in itself, mean that pricing policy is of limited value in understanding recent and future travel behaviour. However, it is important to distinguish between price and cost changes and other factors influencing the choice of transport mode. Hence, while the remainder of this section seeks to draw broad conclusions from an examination of recent trends in costs, prices and demand, these must be qualified by recognition of the range of factors affecting travel patterns over time. In Section 5, we discuss a more detailed approach to estimating the effect of price and cost changes on travel decisions.

Trends in motoring costs and fares

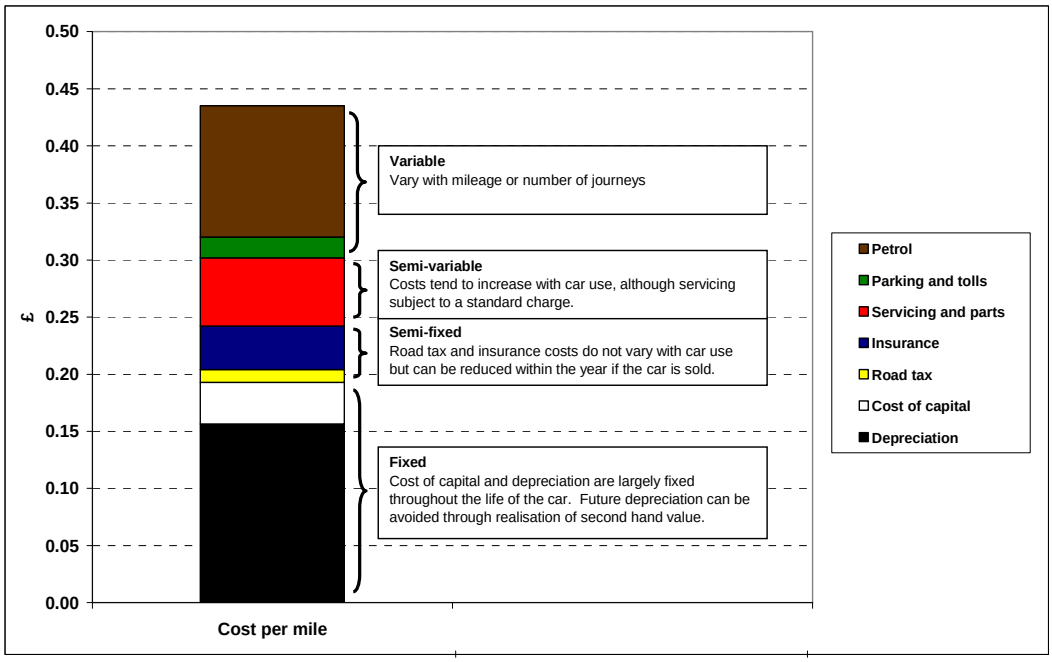
The components of motoring costs

3.16 We have already noted that a significant proportion of motoring expenditure does not vary with car use and that this is an important consideration when investigating the impact of changes in motoring costs. More specifically, it is essential to understand how an individual motorist can be expected to react to changes in the different components of overall motoring costs before seeking to interpret broad trends in costs and travel behaviour. Figure 3.3 provides a breakdown of the average cost per mile for a vehicle with a purchase price of between £13,000 and £20,000 travelling 15,000 miles per year, based on information published by the Automobile Association[4].

3.17 The figure demonstrates that for cars in this price range, at least 56% of the average cost per mile does not vary with mileage. Changes in such costs, while they will influence decisions about whether to purchase a vehicle, will not have an immediate effect on the number of vehicle-km travelled. Over time, changes in purchasing decisions, for example whether to renew a vehicle or acquire a second or third, will affect the overall level of car usage. However, in general the relationship between these costs and measured vehicle-km will be relatively complex, depending on the average age and evolution of the vehicle stock as well as the level of usage at any point in time.

3.18 By contrast, changes in costs that vary directly with mileage will tend to have a more immediate impact on distance travelled by car. Faced with a sharp increase in petrol prices for example, motorists can react relatively quickly, possibly switching to public transport in order to make journeys that have already been planned. In principle, changes in variable costs might also influence longer term decisions concerning car purchase, although such an effect would be particularly difficult to identify because of the lag between the cost change and any associated change in purchasing behaviour as well as the inherent variability of motoring fuel prices.

FIGURE 3.3 COMPONENTS OF MOTORING COSTS 2007



3.19 It is also worth noting that, over the long term, changes in fuel prices can result in responses from the motor industry that are designed to offset, or at least mitigate, the impact on overall motoring costs. Hence, substantial and sustained increases in petrol prices during the 1970s encouraged the development of more fuel efficient engines that have greatly moderated fuel costs per mile, resulting in greater car use than might otherwise have been the case. Steer Davies Gleave has examined dynamic impacts of this kind using a UK car ownership model designed for the purpose, to be discussed further in Section 5.

Recent trends in UK transport costs

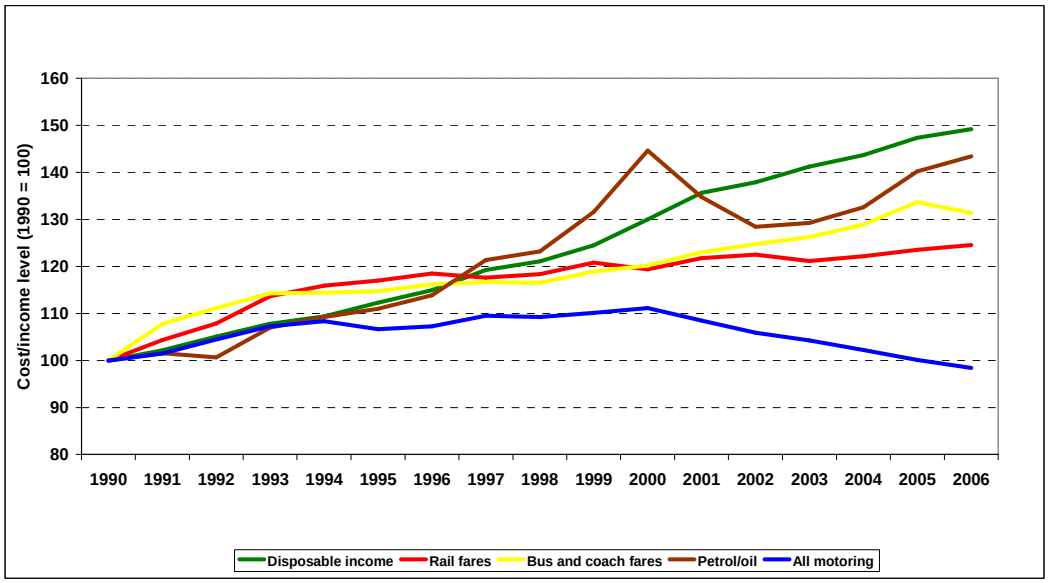
3.20 Against this background, changes in real transport costs and disposable income between 1990 and 2006, based on data published in the Department for Transport's (DfT's) *Transport Trends Edition 2007*, are presented in Figure 3.4[5]. This shows that overall motoring costs, having risen by some ten per cent during the 1990s, have actually declined since 2000 with the result that by 2006 they were around their 1990 level. However, petrol and oil prices, which are a reasonable proxy for the short run costs of motoring, have increased significantly over the period, although they have also fluctuated more than other transport costs. Bus and rail fares have also increased significantly in real terms and by 2006 were between 25 and 30 per cent above their 1990 levels.

3.21 Note that rail fares have increased over much of the period since 1996, when railway operations were privatised, despite the regulation of some fares through regulatory mechanisms included in the franchise agreements with rail operators. *Rail Industry Monitor 2007*[6] suggests a real increase in average fares of 9.3 per cent between 1995 and 2006 despite a reduction in regulated fares, which account for some 42 per cent of total fare revenue, of three per cent over the same period. As discussed in Section 4, regulated fares have been allowed to increase in real terms since 2003.

3.22 The overall trends illustrated in Figure 3.4 suggest that, while car ownership has been encouraged over the period as a whole, the increasing cost of motoring fuel has

probably suppressed the demand for car usage to some degree. Bus and rail travel will also have been lower relative to the level that would have prevailed if real price increases had been more moderate, although both public transport modes may have benefited from a modal switch from car during periods when petrol prices were increasing rapidly.

FIGURE 3.4 TRENDS IN TRANSPORT COSTS 1990 - 2006

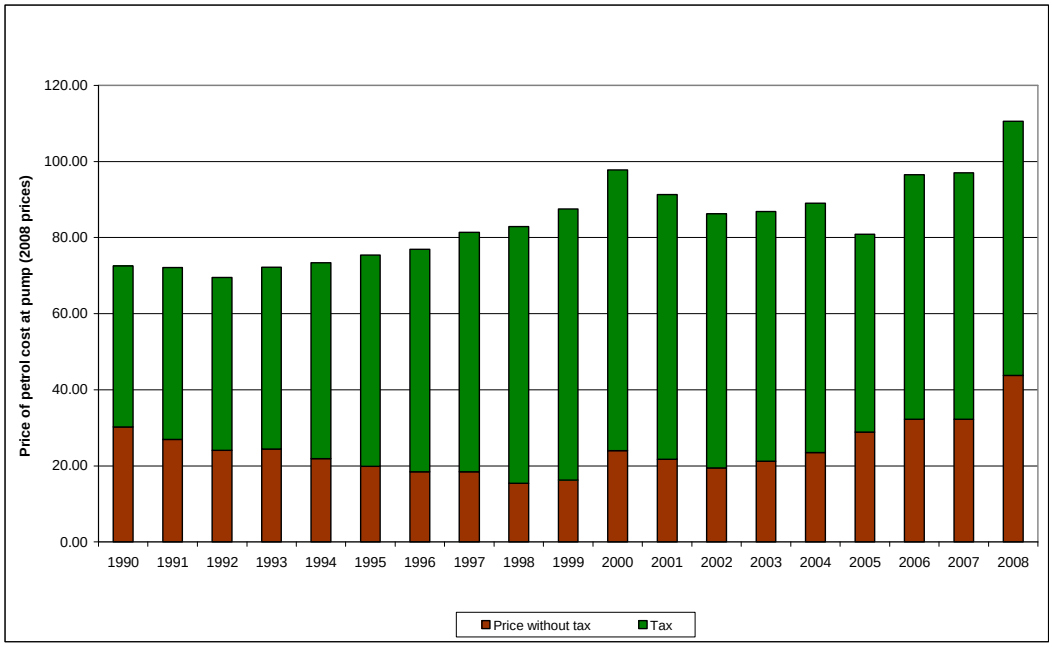


3.23 At the same time, it is far from clear that households have faced strong and increasing incentives to consider the public transport alternative to car use. Moreover, the steady increase in real public transport fares over the last 20 years does not point to a policy of encouraging greater use of public transport modes. Specifically, we note that:

- The parallel growth in real disposable income has exceeded the growth of transport costs, making all forms of transport more affordable;
- Given the importance of factors such as convenience and flexibility as drivers of many mode-choice decisions, it is not clear that the general rise in motoring fuel costs relative to public transport fares has been sufficient to materially affect such decisions; and
- At least since 2000, this relative rise in fuel costs has been driven largely by underlying increases in the price of fuel rather than by policy mechanisms designed to discourage car use at the margin.

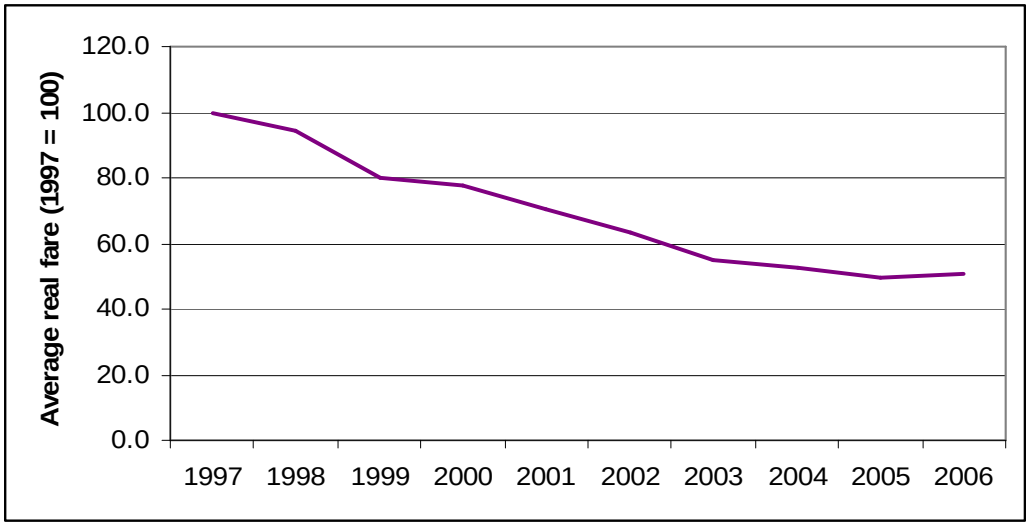
3.24 This last point is illustrated in Figure 3.5, which shows the impact of taxation on real UK petrol prices since 1990, with data sourced from the Department of Business Enterprise and Regulatory Reform (BERR)[7]. While the underlying real price of petrol fell steadily between 1990 and 2000, the price at the pump grew from 1992 as a result of the Fuel Duty Escalator (FDE), a mechanism that provided for automatic increases in fuel duty ahead of the rate of inflation. As discussed in Section 4, this was abolished in response to the protests over the price of petrol in 2000 and, since then, pump price increases have tended to reflect underlying increases in the cost of fuel more closely. In 2008, taxation as a whole (including fuel duty and VAT) represented some 67 per cent of the pump price as compared with 74 per cent in 2000.

FIGURE 3.5 UK PETROL PRICES 1990 - 2008



3.25 Regarding the domestic aviation market, it is difficult to obtain data on air fares allowing an analysis of trends over time, mainly because the large variety of fares with different conditions attached and the operation of airline yield management systems make the collection of comparable data problematic. Nevertheless, recent data compiled by DfT in response to a Parliamentary Question and presented in Figure 3.6, while they relate to both domestic and international flights, serve to illustrate the substantial reduction in fares on many routes in recent years[8]. Reductions of this magnitude undoubtedly stimulated a significant increase the demand for domestic as well as international air travel.

FIGURE 3.6 UK ONE WAY AIR FARES 1997-2006



3.26 However, there is evidence that the general increase in domestic air travel during the 1990s, partly the result of greater competition from low cost carriers, has been arrested in recent years. The CAA report on *Recent trends in growth of UK air*

passenger demand, cited above, highlights two main pricing impacts affecting demand since 2004:

- The increase in the price of oil, which resulted in jet fuel prices rising from $320 per tonne in January 2004 to $900 in November 2007 and airline fuel costs (after taking account of price hedging) increasing by 70 per cent; and
- A doubling of Air Passenger Duty from February 2007, from £5 to £10 in the case of domestic air travellers, an increase that appears to have been passed on to passengers by both low cost carriers and full service airlines.

3.27 The CAA also presents evidence that, at least on some routes, rail fares compare favourably with air fares and that where tickets are not purchased a month or more in advance, average rail fares tend to be cheaper. Table 3.2 reproduces the summary of results obtained from the CAA's investigation of minimum (off-peak, non-flexible) fares offered through *the trainline.com* and *skyscanner.net* during November 2007. This suggests that passengers not able to plan their journeys well in advance can make substantial savings by using the rail option, although it may also indicate that rail operators do not offer the same discounts for advance purchase as their airline competitors. However, as the analysis was based on a comparison of off-peak fares it is difficult to draw conclusions about the price-competitiveness of rail in the broader market. In addition, the results varied considerably by route, with air undercutting rail in some 15 of the 26 routes investigated.

TABLE 3.2 AVERAGE MINIMUM AIR AND RAIL FARES FOR DOMESTIC ROUTES

	Ticket purchased		
	3 days before travel	**10 days before travel**	**45 days before travel**
Average air fare	£126	£93	£56
Average rail fare	£88	£82	£56
Air fare as % of rail fare	144	113	101

3.28 Overall, the position in relation to domestic aviation in the UK appears similar to that for the broader transport sector in that pricing trends, while they may have encouraged a switch to rail at certain times and in certain markets, have been determined primarily by economic factors rather than active policy intervention. Notably, the CAA was unable to identify the specific impact of the increase in Air Passenger Duty but concluded that it "seems unlikely to have been a key driver in the slowdown of demand growth" as compared with the impact of the rising price of aviation fuel. The latter is clearly unconstrained by policy, at least directly, since aviation fuel is not currently subject to any form of duty. The development of aviation taxation, including the recently proposed changes involving a levy on each flight rather than on each passenger, are discussed in more detail in Section 4.

Transport costs in other European countries

3.29 The UK's overall experience in relation to transport costs contrasts in a number of ways with that in other European countries. In particular, research by the Commission for

Integrated Transport (CfIT) in 2001, recently updated, has highlighted specific differences in the pricing of public relative to private transport in the UK as compared with several major European economies[9]. These differences, while not the only explanation, are an important element in any understanding of how travel behaviour in the UK differs from that in much of Continental Europe.

3.30 In terms of motoring taxation, the UK is broadly in line with a number of the most developed European countries. Figure 3.7, which is based on Eurostat data for July 2008, shows that the current price of unleaded petrol exceeds €1.3 per litre in nine of the EU 15 group of countries, although the UK is clearly towards the top end of the range with a price of just under €1.4 per litre[10]. In 2001, CfIT reported similar conclusions in respect of overall motoring taxation, with the annual level of taxation in the UK in line with that in Denmark, Finland, France, Ireland and Italy and some 25 per cent lower than in the Netherlands. In Germany, however, taxation was around 20 per cent lower than in the UK, more comparable to the levels in Sweden and Spain.

3.31 At the same time, the UK has experienced significantly higher public transport fares than other European countries. CfIT's 2001 research included a comparison of fares for an average journey using survey results obtained by UITP on behalf of Millenium Cities. This suggested that fares in the UK were higher than in all major European countries except Denmark and Sweden and more than 20 per cent above the EU average. More recent work undertaken on behalf of CfIT by Atkins has demonstrated that bus operators in the UK continue to be considerably more dependent on fare revenue than their counterparts elsewhere in Europe, as shown in Figure 3.8[11].

FIGURE 3.7 PETROL PRICES AND TAXATION IN THE EU 15 2008

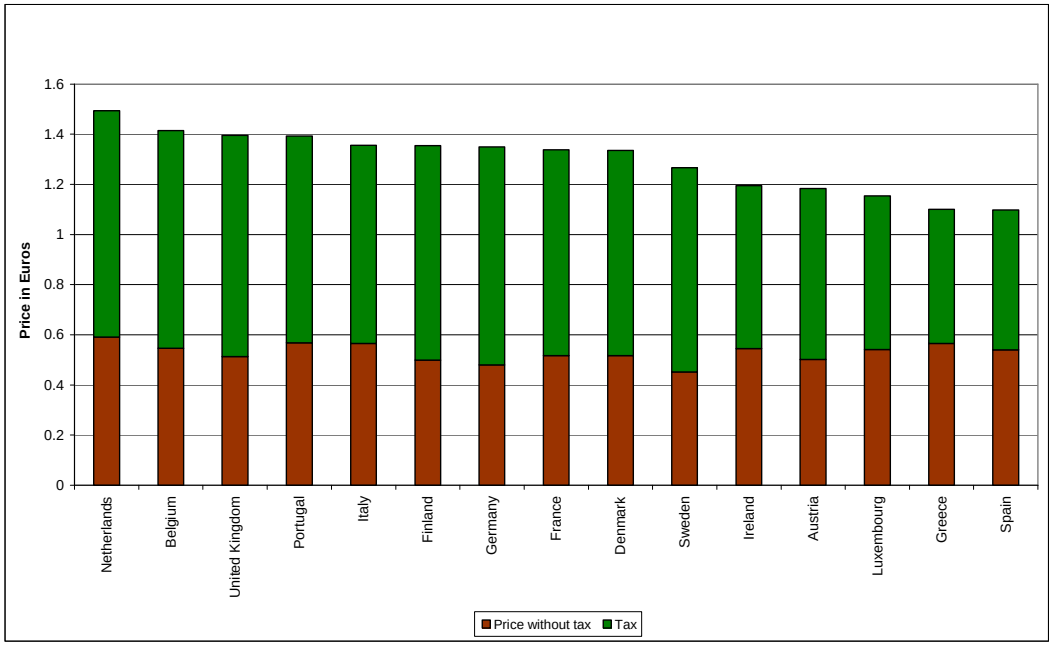
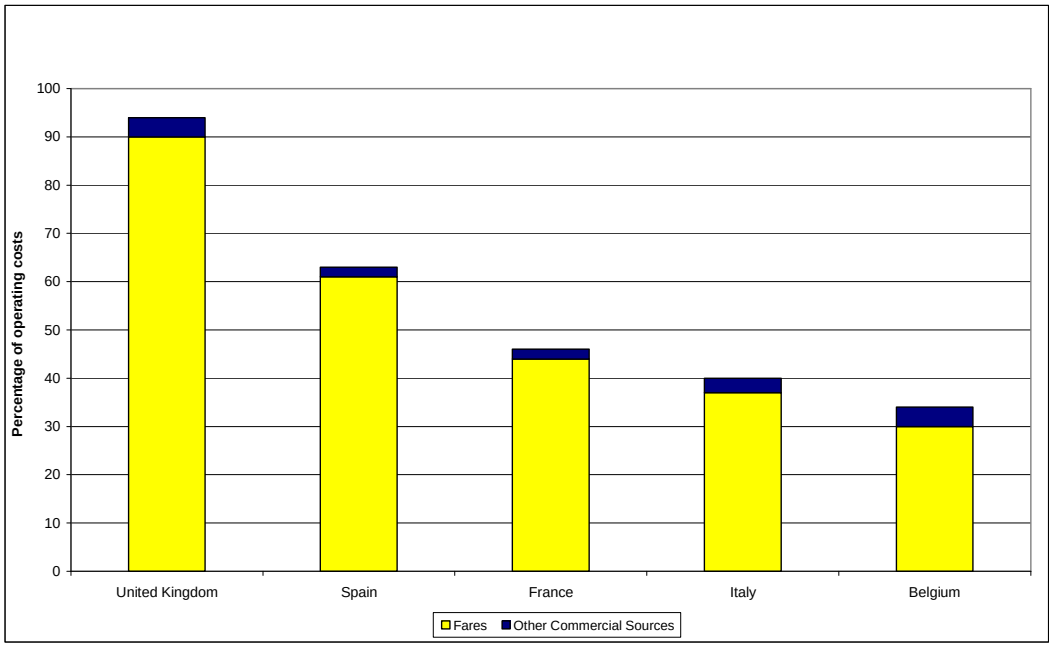


FIGURE 3.8 BUS INDUSTRY DEPENDENCE ON COMMERCIAL REVENUE IN EUROPE 2005



3.32 It is more difficult to compare the relative contribution of fares to cost recovery across the European rail sector, not least because of need to consider investment and operating expenditure separately and the considerable variability in the subsidy to the UK industry from one year to the next. However, the UK Government's most recent *Rail White Paper* indicates that, although fares accounted for some 49 per cent of funding requirements in 2005/06, including both capital and operating expenditure, their share is expected to increase to around 70 per cent by 2013/14, the end of the next Network Rail Control Period[12]. While not directly comparable, this can be set against the findings of the Atkins study cited above, which suggest that public transport as a whole receives an operating subsidy covering 50 per cent or more of operating costs in many leading European countries.

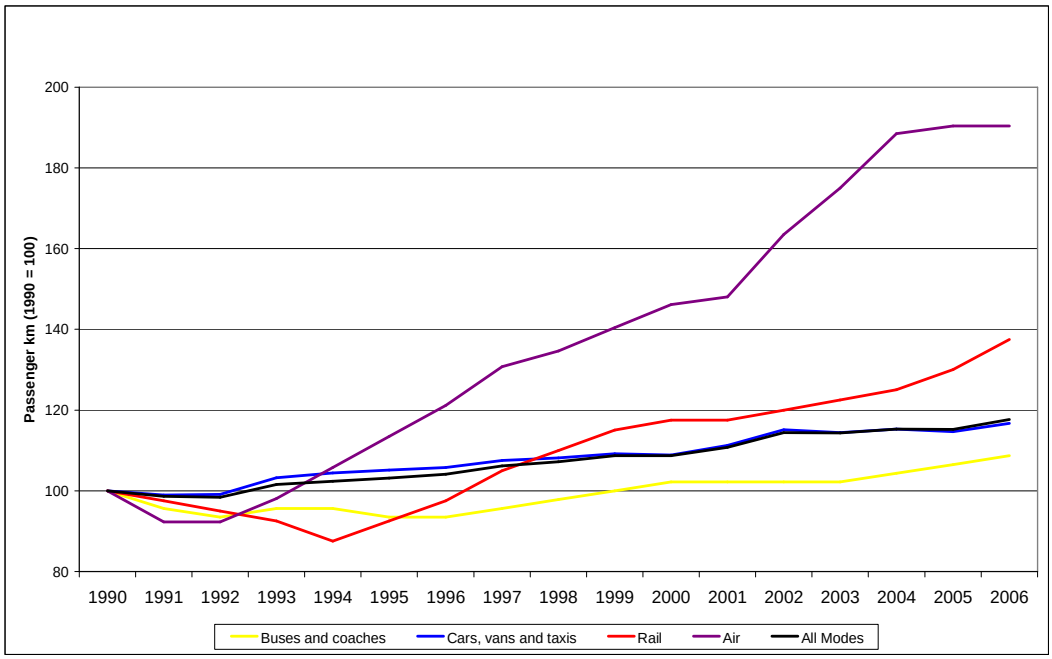
Trends in modal choice

Trends in demand and modal shares

3.33 These pricing trends go some way to explain travel behaviour and mode choice in the UK in recent years, although care is needed in drawing conclusions about the relationship between demand for a particular mode and its price.

3.34 Figure 3.9 shows the overall trends in passenger-km for each of the main UK transport modes since 1990, based on data from *Transport Statistics Great Britain 2007*[13]. This demonstrates that the demand for car travel has continued to grow steadily, although relatively slowly, throughout the period. Travel by both bus and rail actually fell during the first half of the 1990s, with bus travel remaining broadly flat thereafter and rail demand growing more rapidly than car travel after 1994. Domestic air travel grew substantially with the entry into the market of low cost carriers from the mid 1990s, although a significant slowdown in growth since 2004 is clearly visible.

FIGURE 3.9 TRENDS IN PASSENGER-KM BY MODE 1990 - 2006



3.35 Set against the relative changes in prices and costs discussed above, these trends suggest that:

- The private car continues to be the primary mode of transport for most households and individuals, the demand for car travel having grown in line with total passenger-km, encouraged to some degree by flat or declining motoring costs albeit moderated at times by substantial increases in the price of motor fuel;
- Bus travel appears to have been suppressed by significant real fare increases and is now barely above its level in 1990;
- The demand for rail travel, while it has grown relatively rapidly since the mid 1990s and possibly benefited at times from sharp rises in motor fuel costs, has also been suppressed to some degree, with the result that it has failed to secure a significant increase in modal share; and
- Domestic air transport, having grown rapidly for much of the last twenty years from a low base, is now levelling off as a result of major increases in aviation fuel prices, passed on in passenger fares, and possibly some competition from rail.

3.36 The immediate impact of sudden and significant increases in the price of motor fuel can be seen more readily from recent road traffic data reported by DfT. These indicate that car traffic in the second quarter of 2008 was two per cent lower than in the same quarter in 2007, suggesting that the fuel price rises in early 2008 had a marked effect on car use[14]. The longer term impact of these changes is unclear, however, and it is possible that more recent reductions in petrol and diesel prices will stimulate car traffic, subject to the impact of the economic contraction now being experienced. Against this, there is some evidence from the United States that unprecedented fuel price levels can fundamentally change behaviour such that reductions in car use are sustained even after prices have fallen[15].

3.37 Notwithstanding this uncertainty, the overall picture since 1990 is one of relative stability in terms of modal shares, as shown in Figure 3.10, although the impact of rapid increases in the volume of rail travel were beginning to have a limited impact by 2006[16]. This tends to reinforce the contention that, taken as a whole, UK transport pricing policy has done little to materially encourage greater use of public transport in preference to the car.

FIGURE 3.10 MODAL SHARES OF PASSENGER-KM IN SELECTED YEARS

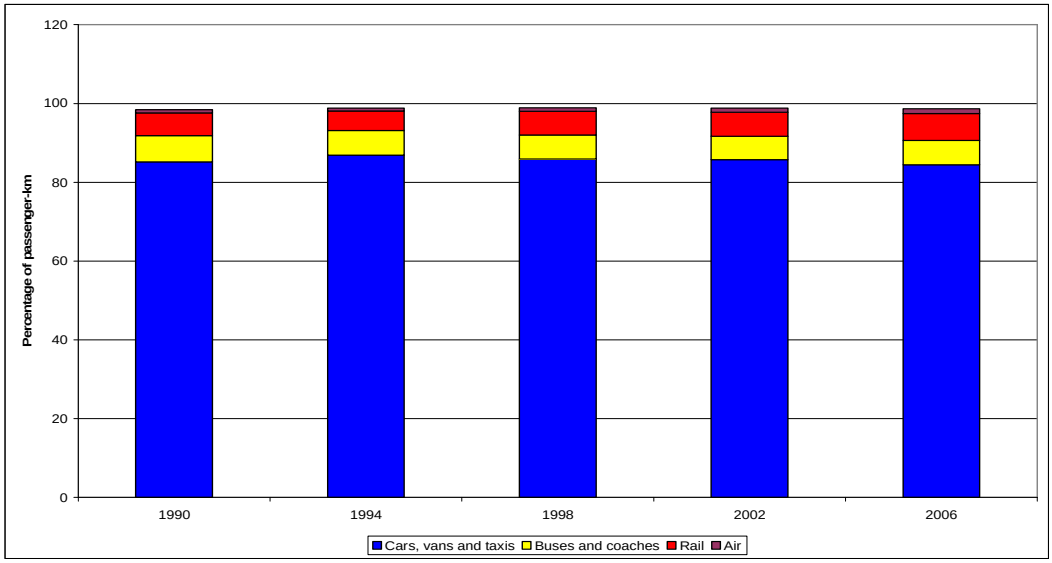
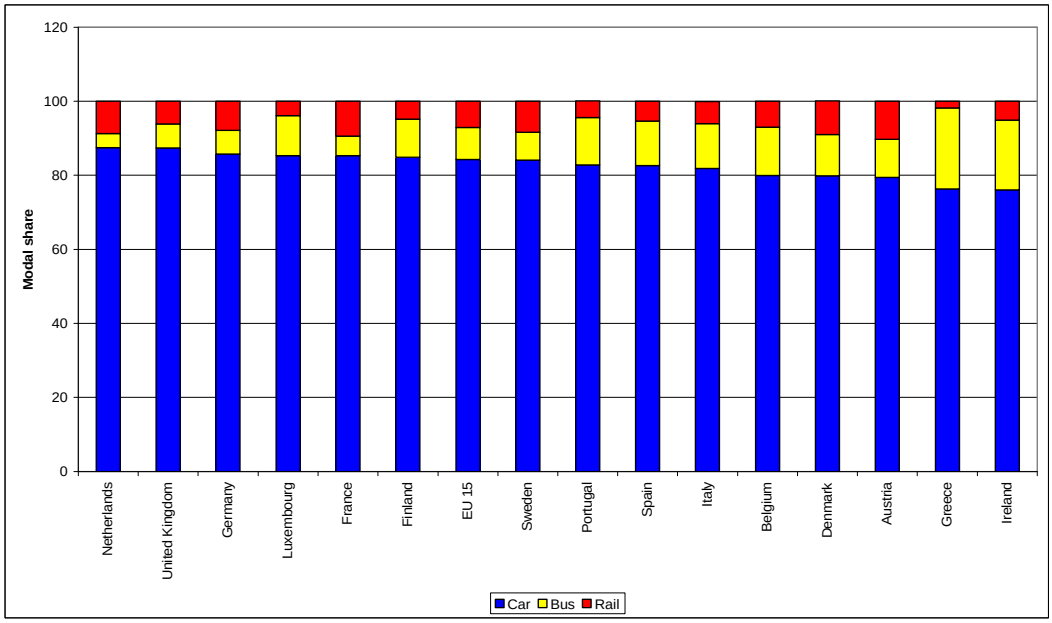


FIGURE 3.11 MODAL SHARES FOR THE EU 15 2006



3.38 Again, this outcome is in contrast to experience in other European countries, many of which have secured a much higher modal share for public transport. The shares in Figure 3.11 are sourced from Eurostat and are not directly comparable with those in Figure 3.10, but they do demonstrate that the UK, together with the Netherlands, has the highest modal share for car, substantially above that for countries such as Austria, Belgium, Denmark and Ireland[17]. These countries, which are comparable with the UK

in terms of their level of development and average incomes, serve to illustrate what can be achieved through different applications of motoring taxation and public transport fares policy implemented within a wider transport policy framework.

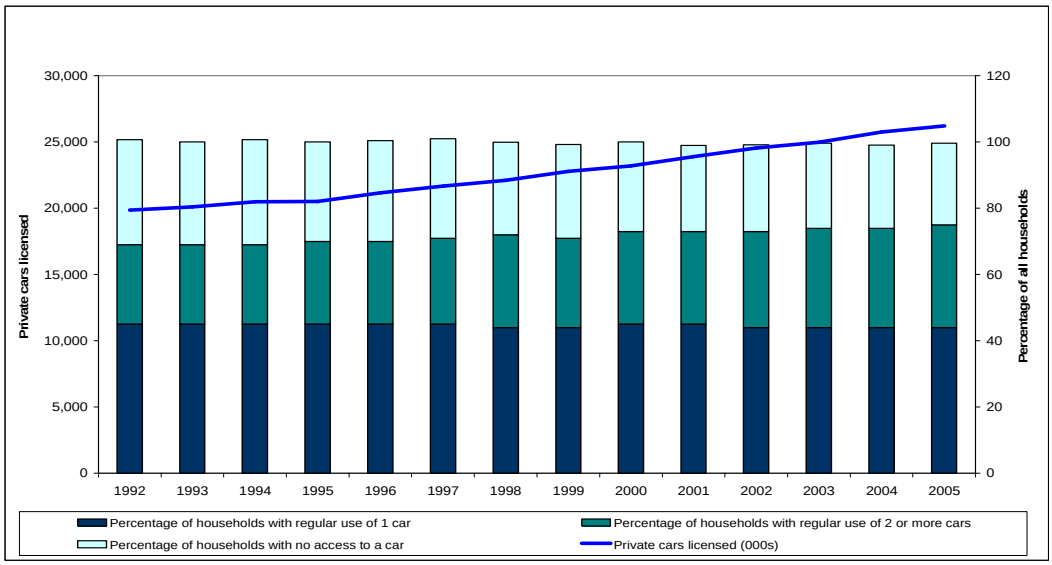
Trends by income, sector and location

3.39 Figure 3.12 shows both the increase in UK registered car ownership and changes in household access to a car between 1992 and 2005, sourced from the *Transport Trends 2007 Edition* cited above. The increase in registered ownership, which exceeded 25 per cent over the whole period, was clearly substantial but the increase in car access is perhaps equally striking. In particular, the percentage of households without access to a car has declined significantly, from around 32 per cent in 1992 to less than 25 percent in 2005.

3.40 This suggests that many households unable to afford a car at the beginning of the 1990s are now able to do so. It seems likely that this trend has been driven by the general decline in motoring costs already observed, although the overall increase in real disposable income will also have increased the ability of households at the lower end of the income range to keep and operate a car. In any event, this rise in ownership will have changed the dynamics of price impacts to some degree, with the price of petrol rather than the overall cost of motoring now representing the relevant basis for comparison in the travel decisions of many more households.

3.41 This is supported by Figure 3.13, based on a comparison of *National Travel Survey* results for 1999/2001 and 2006, which provides clear evidence of a much greater propensity to travel by car among lower income groups[18]. While rail travel also appears to have increased significantly among these households, it is at least open to question how much greater use of all public transport modes, including both bus and rail, they might have made had motoring costs not declined.

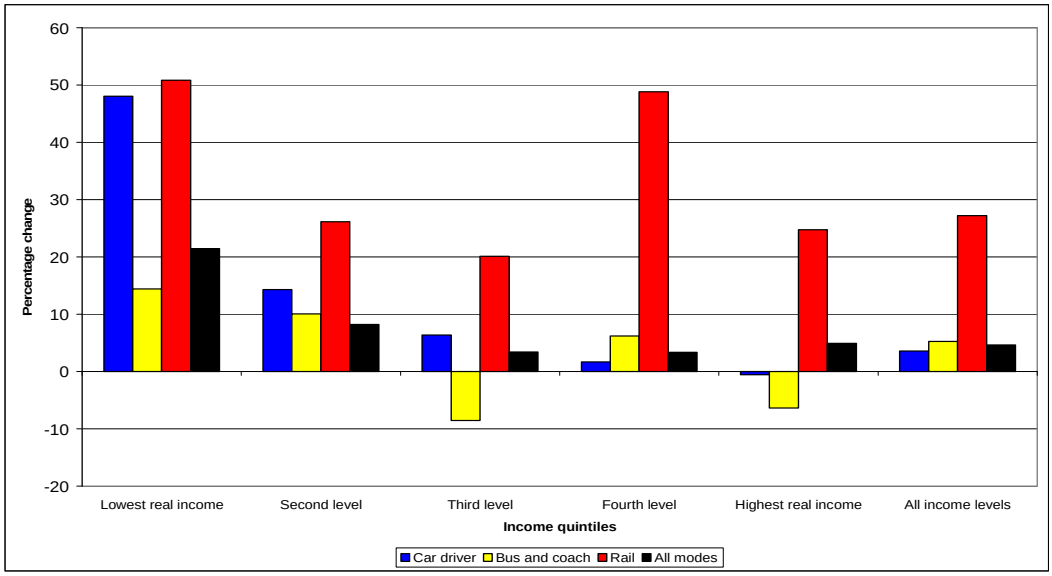
FIGURE 3.12 CHANGES IN CAR OWNERSHIP AND ACCESS 1992 - 2005



3.42 The changes among higher income groups are also instructive in that they suggest a much greater tendency on the part of these households to travel by rail rather than car. Higher earners may have been more influenced by the price of motoring fuel (the relevant marginal cost for households already owning a car) which was returning to its 2000 level by 2006. The observed changes are consistent with more, longer distance,

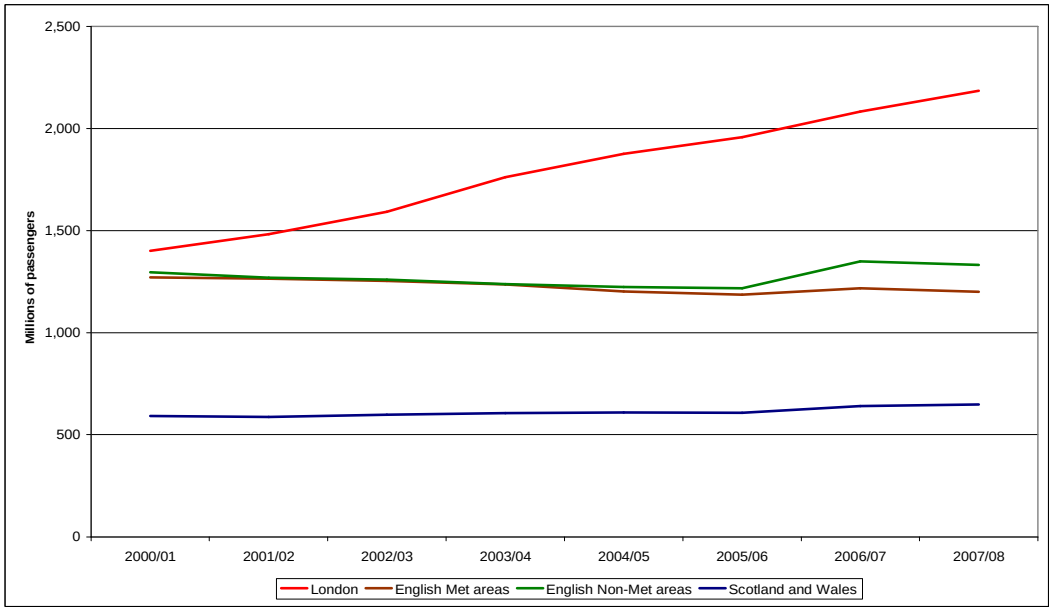
discretionary travel by rail in preference to car, although they could also be at least partly explained by strong economic growth and rising real incomes over the same period.

FIGURE 3.13 PERCENTAGE CHANGE IN INDIVIDUAL TRAVEL BY MODE 1999/2001 - 2006



3.43 Figure 3.13 also suggests that increases in travel by bus have been largely confined to lower income households. This is consistent with the view that the bus still represents the most cost effective form of transport for many households in this group, notwithstanding the significant increase in car access noted above. Nevertheless, it is likely that bus travel among both lower and higher income households would have grown more rapidly if real fare increases had been more moderate.

FIGURE 3.14 BUS AND LIGHT RAIL PATRONAGE BY REGION 2000/01 - 2007/08



3.44 The potential for increasing bus patronage can be assessed by examining the growth in bus passengers in London as compared with the rest of the UK. Over the last ten years, London has benefited from higher service levels, supported by subsidy, than other parts of the country. In addition, Transport for London and its predecessor have exercised

more direct control over bus service provision than other regional and local transport planning authorities and made much greater progress in implementing smartcard technology. The result is illustrated in Figure 3.14, based on data from the DfT's regular *Bulletin of Bus and Light Rail Statistics*, which highlights the contrast between the strong growth in bus use in the capital and the flat or declining patronage experienced elsewhere[19].

3.45 It is important to recognise that London's relative success in promoting bus use is the result of a range of factors, including high levels of service frequency, the convenience of the Oyster card and the impact of the congestion charge, rather than fares policy in isolation. Indeed, London bus fares have been increased significantly on occasions in order to fund service improvements. At the same time, fares data published by the DfT indicate that while London experienced an 11 per cent increase in real fares between 1996/97 and 2007/08[20], the corresponding increase across English PTE areas was 20 per cent and the average for outside London 14 per cent. This indicates that policy in London has at least moderated increases as compared with the more substantial, commercially driven rises observed elsewhere, encouraging higher levels of patronage than would otherwise have been achieved.

3.46 There is also some evidence of a more recent demand response to price outside London following recent changes in concessionary fare entitlements providing people aged 60 or over with free access to buses anywhere in the country. Survey results reported by DfT indicate that the proportion of concessionary fare pass holders using their pass at least once increased by nine percentage points between autumn 2007 and May/June 2008. The results are based on relatively small survey samples and it is too early to draw firm conclusions on the specific impact of free travel, but it is likely that the new scheme has increased the attractiveness of bus relative to car travel for journeys outside individual pass holders' local area.

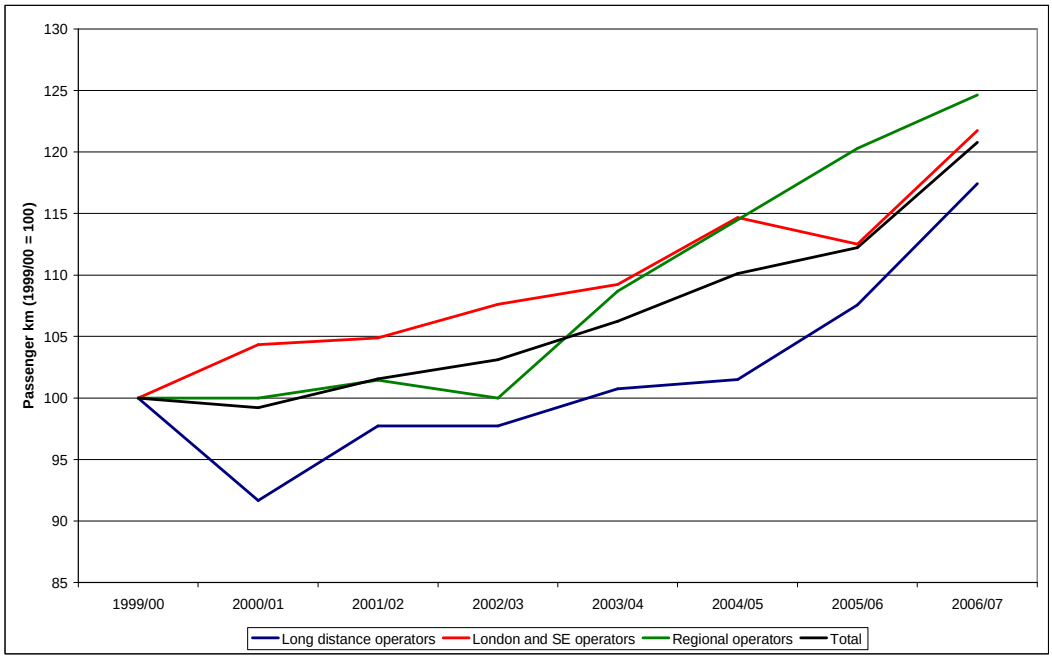
3.47 The growth in rail demand has also varied significantly between regions and types of service, although for rail it is more difficult to draw firm conclusions about the impact of price changes based simply on an investigation of the differences. These are nevertheless shown in Figure 3.15, which presents the growth in passenger-km for each of the main rail sectors reported in *National Rail Trends*[21].

3.48 Demand in London and the South East, which accounted for some 48 per cent of total demand in 2006/07 and is heavily affected by commuting to and from London, has been growing rapidly over much of the period since 1999/2000. This growth has reflected increases in GDP and Central London Employment and it is likely that the parallel real growth in rail fares has had only a limited impact in terms of suppressing rail usage in this sector.

3.49 However, demand for long distance services, which often compete more directly with the private car, does appear to have been declining or flat until 2004/05. This was partly the result of the deterioration in service quality in the wake of the Hatfield disaster, which undoubtedly caused a major decline in rail travel in 2000/01, and extended periods of disruption on the West Coast Mainline also contributed to the slow return to 1999/2000 traffic levels thereafter. Nevertheless, *Rail Industry Monitor 2007* indicates that standard unregulated long distance fares increased by 26.6 per cent and first class fares by 49.5 per cent in real terms between 1995 and 2006, and increases of this magnitude almost certainly led to suppression of demand. Since 2004/05, demand within this sector has been growing more rapidly, possibly influenced to some degree

by increases in motoring fuel prices, a factor that may also have contributed to the strong growth of regional services since 2003/04.

FIGURE 3.15 RAIL DEMAND BY SECTOR 1999/2000 - 2006/07



Summary of findings

3.50 While we would continue to emphasise the need for caution in interpreting recent trends in transport costs, prices and demand, this review of evidence in the UK and from across Europe suggests a number of conclusions. These are summarised below.

- Transport represents a significant proportion of average UK household expenditure and households are likely to be sensitive to changes in transport costs. While the steady growth in real disposable income since 1990 has made transport more affordable, the significant economic slowdown currently in prospect is likely to encourage households to search for savings in the weekly transport budget.
- The overall costs of motoring have been flat or declining for much of the period since 1990. This has led to an increase in car ownership, notably among households that previously did not have access to a car. In parallel, there has been a marked increase in the propensity of lower income groups to travel by car.
- At the same time, the growth in overall car use appears to have been moderated, at least during periods characterised by sharp increases in the price of motoring fuel. Before 2000 such increases were driven partly by taxation, in particular the operation of the FDE, but more recent increases have been more directly related to changes in the underlying cost of both petrol and diesel. However, given the greater convenience and flexibility of the private car, particularly for making short journeys, users are often unwilling to use alternative modes except where the associated monetary savings are significant.

- Real bus fares have increased significantly since 1990 and it is likely that this has contributed to flat or declining bus patronage across the UK. However, experience in London, where service levels are higher and more heavily subsidised and demand has been growing, has demonstrated the scope for building patronage. Recent, country-wide changes to concessionary fare entitlements for passengers of 60 and over now appear to be encouraging greater use of bus services in other areas, providing further, albeit limited, evidence of the potential demand response to major reductions in fare levels.

- Rail fares have also increased substantially over much of the last 20 years, although regulated fares actually fell in real terms between privatisation in 1996 and 2003. Increases are unlikely to have had a significant impact on commuter journeys to and from London, a major driver of demand for London and South Eastern services, which account for almost half of rail passenger-km travelled. However, they have probably suppressed demand in other sectors. Long distance services were particularly slow to recover from the effects of the Hatfield accident and the level of rail fares may provide part of the explanation. The increase in demand for both long distance and regional services since 2004/05 may have been partly driven by the rise in the cost of motoring fuel over the same period.

- Demand for domestic air travel, which grew substantially from a low base at the beginning of the 1990s, has flattened off over the last three years. This appears to have been largely due to increases in the cost of aviation fuel reflecting underlying rises in the price of oil since 2004. However, there is also some evidence of price competition with rail services on shorter routes.

- Notwithstanding the strong growth of rail demand, the share of total passenger-km accounted for by car has remained broadly constant since 1990 at around 85 per cent. Moreover, based on a comparison of Eurostat modal share data for the EU 15, it is clear that the UK is more car-dependent than almost all other developed European countries. While there is no evidence that motoring taxation in the UK is lower than elsewhere, UK public transport services tend to be more dependent on commercial revenues and consequently characterised by fare levels that are higher than the average for the EU.

3.51 These conclusions support the broad view that the rise in public transport fares relative to motoring costs has tended to discourage greater use of bus and rail services in preference to car travel. They also highlight the potential for using transport costs and prices as policy levers to influence mode choice decisions, although they provide little guidance on the precise change in price that would be needed to effect a given change in the demand for a particular mode. Before estimating the potential impact of price-based policy interventions in Section 5, we first review UK transport policy over the last 15 years, assessing its impact on the trends in travel behaviour already discussed and identifying key differences with the policy stance in other countries. We also consider how UK policy might change in response to the climate change agenda and the generally recognised need to reduce the transport sector's carbon emissions.

4 The policy context

Overview of UK transport pricing policy

4.1 Following the *Stern Review on the Economics of Climate Change*[1] and the *Eddington Report on Transport and the Economy*[2], recent Government national policy documents have stressed the need to 'get the prices right to cover the environmental and congestion costs of transport, to encourage technological innovation, to promote behaviour change, and to be smart with our investment decisions'[3].

4.2 However, the Government has not set out what this means for the pricing strategies and structures for individual modes in precise terms. Nor has it described out how it will seek to achieve the 'right price' for each mode. It has discussed 'getting the prices right' in conceptual terms, drawing on notions of rational economic pricing to cover external costs discussed further below. Nevertheless, in general prices for air, bus and rail travel, as well as for road use, are often very different from the economic ideal and pricing policy rarely forms a major part of policy documents. Moreover, with the exception of road pricing, there is relatively little political debate surrounding the pricing of transport.

4.3 At the same time, there is considerable controversy surrounding changes in transport prices, in relation both to UK transport prices relative to those elsewhere and the change in absolute prices for a given mode over time. In practice, Government has limited ability to directly influence price without making radical changes to the way in which the transport industry is operated and regulated, at least for some modes, and when it has sought to influence prices it has often faced strong opposition. This is best illustrated by reviewing policy in relation to each mode in turn.

Car travel

4.4 Government has three principal levers for influencing the costs of motoring – VED, fuel duty, and the direct pricing of road space. The most significant policy instrument applied in recent years was the fuel duty escalator (FDE), which operated from 1993 to 2000, controlled by HM Treasury and presented as an 'environmental' tax on motoring. As noted in Section 3, it was abandoned following sharp increases in fuel prices and subsequent protests from UK road hauliers and others concerned about the impact on their businesses.

4.5 Current policy, as stated in the Government's recent *Pre-Budget Report (PBR)* is to increase rates of duty "each year at least in line with inflation as the UK seeks to reduce polluting emissions", but this falls someway short of using fuel duty to actively reduce the demand for car travel[4]. The immediate changes affecting fuel prices announced in the PBR (a reduction of 2.5 per cent in the rate of VAT and a 2 pence per litre increase in duty) are intended to offset one another, while the planned longer term increases in duty (1.84 pence per litre from April 2009 and 0.5 pence per litre per year above indexation from April 2010) are unlikely to have a significant effect on car use.

4.6 VED, although a much lower tax, has been more successfully employed as an incentive to purchase lower-carbon vehicles, as has the income tax payable on company cars. Recent reforms to VED included the introduction of further rate bands designed to

reinforce incentives to purchase vehicles offering greater fuel efficiency and reduced emissions, although following the PBR the impact of these changes is to be temporarily moderated in response to the recession.

4.7 In any event, as already discussed, neither VED nor company car tax are likely to play a significant role in the perceived price the car driver faces when deciding whether or not to make a trip by car. In this respect, a further important mechanism potentially providing for economically efficient pricing of car use, as distinct from car ownership, is congestion charging, possibly coupled with the work place parking levy or taxation of free parking in line with other benefits provided by employers. A simple congestion charging scheme has been introduced in London with considerable early success in reducing congestion levels.

4.8 However, as a policy, congestion charging is highly controversial. A scheme in Edinburgh was rejected after consultation, while in 2007 the Government's Number 10 website attracted 1.8 million signatures for a petition against national road pricing. Perhaps for this reason, the Government's strategy has been to support congestion charging where local authorities wish to pursue it, providing an incentive in terms of funding of large scale additional investment through the Congestion 'Transport Innovation Fund'. The success of this policy remains uncertain, despite some expectation that schemes in Greater Manchester, Bristol and Cambridge will be implemented, not least because, in the view of many commentators, the Government has failed to provide the necessary leadership in demonstrating the benefits of road pricing. Certainly road pricing on the national road network is not yet in prospect, although the Government is piloting schemes to test the available technologies.

4.9 In any event, congestion charging is a less useful mechanism for reducing carbon emissions because, while it undoubtedly brings some environmental benefits, it clearly does nothing to discourage car travel on uncongested roads. Fuel duty is generally considered to be more effective, as carbon emissions are directly related to vehicle fuel consumption and discouraging consumption through fuel pricing is therefore a more direct means of achieving the desired policy outcome. At the same time, as has been demonstrated in the past, the use of fuel duty to progressively increase the costs of motoring over time through mechanisms such as the FDE is equally controversial. The reintroduction of such a mechanism in its original form at a time when the economy is entering a recession would be challenging.

4.10 Perhaps the most important conclusion to draw from this brief review of policy relating to car travel is that there has been no consistent management of the relative costs of car use and public transport, although Government has recognised the divergence between motoring costs and fares at least since the *10 Year Plan*[5].

Rail travel

4.11 With the privatisation of the rail industry following the 1993 Railways Act, the then Government introduced a relatively complex economic regulatory framework, governing fares as well as other prices and costs faced by the train operators themselves. While this has been modified to some degree by the current administration, the fundamental mechanisms for regulating fares through the franchise agreements between Government and the train operators are still in place. Hence, while there is no Government control over unregulated fares that are specific to individual operators, Season Tickets and standard class Saver Tickets (now called "off

peak" tickets) continue to be subject to the RPI-X style regulation initially applied to the privatised utilities.

4.12 However, while the basic mechanism for regulating these fares has not been changed, the level at which real fares have been allowed to grow was modified considerably following a review of rail fares in 2003. Faced with substantial increases in the costs of maintaining, renewing and enhancing the rail network, and seeking to change the balance of funding away from the taxpayer towards the passenger, the Government replaced the RPI-1 formula applied since privatisation with RPI+1. Hence, rail fares are now permitted to rise year-on-year by one per cent more than inflation. Moreover, more recently franchises have been let on the basis of even higher regulated fare rises. This happened first on the South Eastern franchise, where a RPI+3% per annum rise was set by Government to help defray the costs of introducing the new high-speed commuter services in Kent. It has also been applied to other franchises where there is no equivalent investment planned, for instance on the East Midlands franchise let in 2007.

4.13 At the same time, the impact of competition on fare levels has been mixed. Notwithstanding the fragmentation of the railway at the time of privatisation, competition between train operators remains muted, often limited to changes in service timings with a view to benefiting from the automatic allocation of revenue from interchangeable tickets. In the case of unregulated fares, the main constraints on fare increases are competition from the private car and, to some degree, from bus and coach operators on short to medium distance routes and from air for longer journeys. Against this background, it is interesting to note that a number of franchised train operators have introduced innovative unregulated fares seeking to encourage greater off-peak travel. Southwest Trains' introduction of low Megatrain fares, based on the Megabus concept introduced by its sister bus company, is a notable example.

Bus travel

4.14 In the case of bus services, the Government is arguably more constrained in its ability to influence fares, at least in the absence of legislative change. Since the 1985 Transport Act, which deregulated bus services outside London, fares in the rest of the country are largely determined by operators. Government has some influence through recent legislative provisions that permit authorities to specify maximum fares as part of partnership arrangements. There is a further route through the introduction of quality contracts, which, like quality partnerships, were provided for in the Transport Act 2000. However, such contracts are generally regarded as difficult to implement since they would potentially displace established commercial operations, although the Local Transport Bill currently in Parliament has sought to facilitate their introduction.

4.15 Within the existing framework, the Government's main policy instrument for supporting reduced fares, at least outside London, is the Bus Service Operator's Grant (BSOG), formerly the Fuel Duty Rebate paid to operators to offset duty on fuel consumed. The Department for Transport has recognised that this is poorly targeted on environmental outcomes, tending to encourage the operation of bus mileage rather than increased patronage, and has recently consulted on other options. Nevertheless, the introduction of a per-passenger payment, although identified as a worthwhile aspiration for the long term, is not among the preferred options put forward for more immediate implementation. The short term aim appears to be to encourage fuel

efficiency rather than to support significant fare reductions in order to increase the modal share of bus travel.

4.16 Subsidies provided by local authorities and, in the case of London, by Transport for London, have also helped to moderate fare increases but budgets for bus service provision are coming under increasing pressure. In recent years, bus operating costs have been increasing above the rate of inflation and, while efficiency improvements will no doubt continue to be made, these are unlikely to be sufficient to offset the ongoing rise in the cost base. A recent report from CfIT on *Cost Issues in Public Transport Operation* suggests that costs per kilometre run could increase by between 30 per cent and 100 per cent over the next 25 years[6]. *In* addition, although the introduction of free bus travel for pensioners, reported in Section 3, will have made bus services more attractive for this group, operators can be expected to look for further fare rises elsewhere in order to cover any emerging gap between costs and revenues.

Air travel

4.17 Government policy in respect of the price of air travel has been based on encouraging competition, with policy levers necessarily constrained by the international regulations governing the industry. The main policy instrument is Airport Passenger Duty, levied on each individual passenger and transparently passed on by the airlines through the air fare.

4.18 There is no tax on aviation fuel. Efforts to impose such a tax in order to cover, say, environmental externalities are complex due to the international treaties and regulations that cover aviation. The more immediate mechanism is the inclusion of aviation within the European Union Emissions Trading Scheme from 2012, as discussed in Section 6.

Summary

4.19 In summary, Government policy on transport pricing can be regarded as pragmatic, modally specific and designed to meet a variety of policy and financial objectives. However, it should be remembered that the level of Government involvement in the determination of transport costs and prices has been determined through policy choice, and the impact of policy is as much the result of inactivity as it is proactivity. Moreover, while the policy stance often reflects the differing remit of the regulators or Government departments involved, in general there is little evidence that Government has explicitly considered the relative prices of different modes or their impact on demand, modal shares and carbon emissions in the round.

Transport pricing in other countries

4.20 This experience contrasts with that in a number of other European countries, some of which have been considerably more successful in encouraging greater use of public transport, as discussed in Section 3. In many cases they have employed a wide range of measures, including investment in public transport, effective co-ordination of transport and land use planning, full integration of bus and rail services and traffic reduction initiatives of various kinds as well as price-based measures. The latter are therefore typically applied as part of a much broader policy framework rather than as separate initiatives. For this reason, it is often difficult to assess the impact of price alone on modal choice, although it is clear that both motoring taxation and public transport

fares have been used to support a modal shift away from car in a number of countries, cities and regions.

Motoring taxation and other costs

4.21 The research undertaken by CfIT previously cited identified a number of examples of the successful use of motoring taxation and other mechanisms for influencing motoring costs in order to discourage car use. The following examples, while taken from the original research conducted in 2001, illustrate the range of experience:

- Denmark has particularly low levels of car ownership by European standards, with some 343 cars per thousand of the population reported in 2000 compared with over 400 in the UK and over 500 in Germany. This has partly been achieved through high levels of taxation on the purchase of new vehicles, the minimum rate of 105 per cent rising to 180 per cent depending on the sales price.

- The Netherlands also imposes high levels of motoring taxation, through both taxes on the purchase price of new cars and duty on fuel. Like Denmark, it has one of the lowest levels of car ownership in Europe, with 376 cars per thousand of the population reported in 2000, although the feasibility and popularity of cycle use across the country also encourages lower car dependency. Nevertheless, in terms of its share of overall passenger-km, the Netherlands has the highest level of car dependency among the EU 15, demonstrating that high levels of motoring taxation are not necessarily sufficient to discourage car use.

- Individual cities have also achieved significant reductions in the modal share taken by car through city centre parking strategies based on limited parking spaces and high charges. CfIT's study of Munich, one of the main city case studies included in its research, highlighted its success in reducing city centre car traffic by limiting the number of parking spaces to 6,000 and introducing a charge of £1.50 per hour. This was balanced by substantial investment in park-and-ride sites encouraging the use of rail services for city centre trips. Similar policies have been followed in Stuttgart.

4.22 CfIT's research also included studies of transport policies applied in cities outside Europe and highlighted a number of more innovative applications of the price mechanism to discourage motoring. Notably, Singapore's Vehicle Quota System limits the growth in vehicles to three per cent per annum, with potential owners bidding for Certificates of Entitlement issued in line with this constraint. This supplements the city state's congestion charging scheme, which discourages driving in areas and at times when congestion is greatest.

4.23 At the same time, the research suggests that some countries have successfully controlled car usage without recourse to high levels of motoring taxation. Germany, for example, imposes a relatively low level of taxation on new car purchases and reported a relatively high level of car ownership in 2000. In addition, as illustrated in Figure 3.7, taxation on motoring fuel is currently similar to that in the UK. Nevertheless, Germany has been more successful in moderating the growth of car use. While this experience has been partly due to parking and other restrictions of the kind applied in Munich, it also highlights the need to examine measures to encourage travel by public transport as distinct from initiatives that discourage travel by private car.

Public transport fares

4.24 It is difficult to draw broad conclusions concerning national policy in respect of public transport fares since fare structures and levels are typically set, and services often funded, at the regional or local level. Hence, we have undertaken a limited review of fares policies applied in individual cities and regions in order to determine the range of experience.

4.25 The *World Cities Research* undertaken on behalf of CfIT, the results of which were published in 2005, highlighted considerably lower average fare levels in Paris, Tokyo, Madrid, Barcelona and Singapore than in London, notwithstanding the subsidies provided by Transport for London alluded to above[7]. Interestingly, transport operators in all these cities, with the exception of Paris, rely at least as heavily on the farebox as a source of revenue as operators in London. They have nevertheless been able to secure real fare reductions, with evidence of significant results in terms of increased patronage:

- In Barcelona the average price of a journey fell by 4.2 per cent between 2000 and 2003. Revenue increased by some ten per cent per annum over the same period, although this was also driven by the extension of the rail and metro systems serving the city and the introduction of new tickets allowing free interchange between the public transport modes.
- Madrid's public transport fares were simplified and reduced as early as 1987 with the introduction of a common fare within the city and travel passes allowing easy interchange between the modes. Patronage increased by 61 per cent between 1986 and 2002, reversing an earlier trend decline in public transport use.
- In Paris the introduction of the Carte Orange monthly ticket, again allowing access to a number of modes, has significantly reduced the cost of commuting, not least because employers pay half of the cost of tickets purchased by their employees. Employers also provide direct support to public transport through the "Versement transport", a tax levied on public and private sector organisations located in cities throughout France, with rates varying according to city size and salaries paid. Public transport has maintained a modal share of some 20 per cent of trips, although the share taken by car has been rising at the expense of walking and cycling.

4.26 There is also case study evidence of the effectiveness of fare reductions in supporting modal switch away from the private car in the smaller cities investigated by CfIT. Munich provides an example of the complementary use of fare levels and parking restrictions as well as other measures to increase public transport's modal share. In addition to offering low fares for single trips and competitively priced travelcards, Munich Planning and Tariff has introduced more innovative pricing strategies, for example job tickets giving large employers discounts of up to 50 per cent on season tickets for their staff.

4.27 Other German cities have achieved results through effective targeting of concessionary fares, in particular to encourage children and students to use public transport. In Stuttgart, the ending of state funding of child concessions initially resulted in a 20 per cent increase in fares and child patronage fell by some ten per cent as a result. However, the Stuttgart Transport and Tariff Association subsequently introduced a flat rate child ticket, allowing travel to school and to other destinations after midday,

increasing the share of pupils using public transport to make the daily school trip to 40 per cent.

4.28 Further research undertaken on behalf of the Transport 2000 Trust, The Countryside Agency and the Citizens Advice Bureau, as documented in *Rural Transport Futures*, has also demonstrated the scope for using fares policy to increase use of public transport within wider regional areas and particularly in rural districts[8]. This is an important issue in the UK, where the level of service in rural areas tends to be limited and car dependency correspondingly greater. By way of illustration, in the Greater Copenhagen Region in Denmark, transport fares are both lower and more flexible than is typically the case in similar rural districts in the UK. Again, substantial discounts for children and students within the region have also helped to encourage greater use of public transport for regular school trips.

4.29 The effects of fares policies of this kind can also be reinforced through the tax system. For example, in the Republic of Ireland bus passes provided by employers are exempt from tax, providing an incentive to use public transport in preference to car. Similar tax-based mechanisms have also been applied in the United States.

4.30 While this review of experience outside the UK is far from comprehensive, it does serve to highlight a more pro-active use of fares policies in other countries. In many cases low fares have been targeted in order to encourage certain types of traveller to use public transport, as in the case of employer discounts for employee season tickets and concessionary fares for school children. In addition, the benefits of low fares have often been supplemented by the advantages of integrated ticketing and fare flexibility. The perceived value of this flexibility is also demonstrated by experience in London, where bus patronage appears to have increased partly in response to the introduction of Oyster cards, notwithstanding some significant fare rises to help cover the costs of investment in services.

4.31 We also note that many cities and regions in Europe often enjoy greater autonomy in developing fares strategies than their counterparts in the UK. Both CfIT and the *Rural Transport Futures* report conclude that this is typically the result of a greater emphasis on local funding of public transport in many European countries. Consideration of the broader financial and institutional arrangements governing public transport provision are beyond the scope of this report, but we suggest that greater availability of locally generated funds will tend to improve the ability of local transport authorities to target price-based initiatives more effectively.

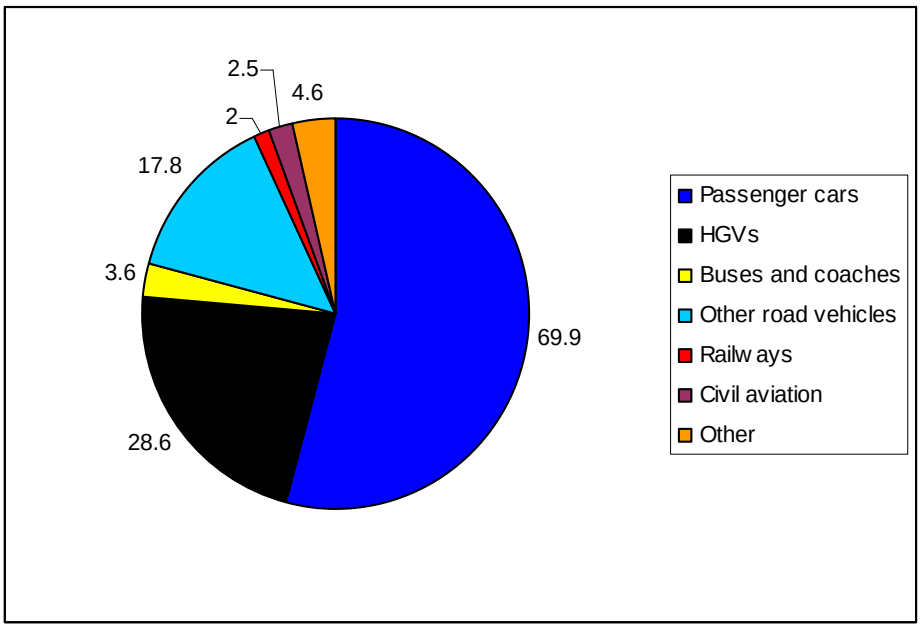
Transport pricing in the context of climate change

4.32 Figure 4.1 shows the relative contributions of the main transport modes by IPCC source category, sourced from *Transport Statistics Great Britain 2007*[9]. Note that transport's contribution is even higher if measured by reference to end user category.

4.33 Hence, notwithstanding the conclusions of *The Stern Review of the Economics of Climate Change*, which indicated that other sectors are better placed to achieve the largest reductions in emissions, it seems likely that transport will need to make a substantive contribution to achieving any reduction target. The level of the contribution and the means of achieving it will clearly need careful consideration in the light of the recommendations of the Committee on Climate Change (CCC) on overall emissions targets for the UK, expected in December 2008. The Department for Transport has announced that, while it is already developing a carbon reduction

strategy for the sector, long term goals will be set in early 2009 in order to reflect the timescales in the government's Climate Change Bill.

FIGURE 4.1 UK TRANSPORT CARBON DIOXIDE EMISSIONS 2005 (MILLION TONNES)



4.34 According to economic theory, any strategy to achieve a reduction in carbon emissions in the most efficient way must involve an effective use of the price mechanism in order to change behaviour. Specifically, the theory advocates setting prices equivalent to long run marginal social cost, such that individuals choose an economically efficient level of consumption. In the case of transport, this would require the price of each mode to be set to reflect the total long run marginal cost, including climate change impacts and other external costs, of using it. In effect, this involves pricing the damage created by carbon together with the other environmental impacts of transport, leaving the forces of supply and demand to determine the optimal level of travel by mode.

4.35 However, while this approach is based on a strong theoretical foundation and underpins the preferred policy stance of a number of organisations advising on transport issues, notably CBT itself and CfIT, applying it in practice is problematic. One important reason for this is the lack of consensus on the appropriate price of an additional tonne of carbon dioxide, which depends, *inter alia*, on:

- The estimated physical impact over a long time horizon, based on the best understanding of the science of climate change at a given time;
- The long term target for concentration of carbon in the atmosphere, which can only be determined through global agreement; and
- The economic value placed on future damage resulting from carbon emissions relative to the current benefits of travel and other activities causing them.

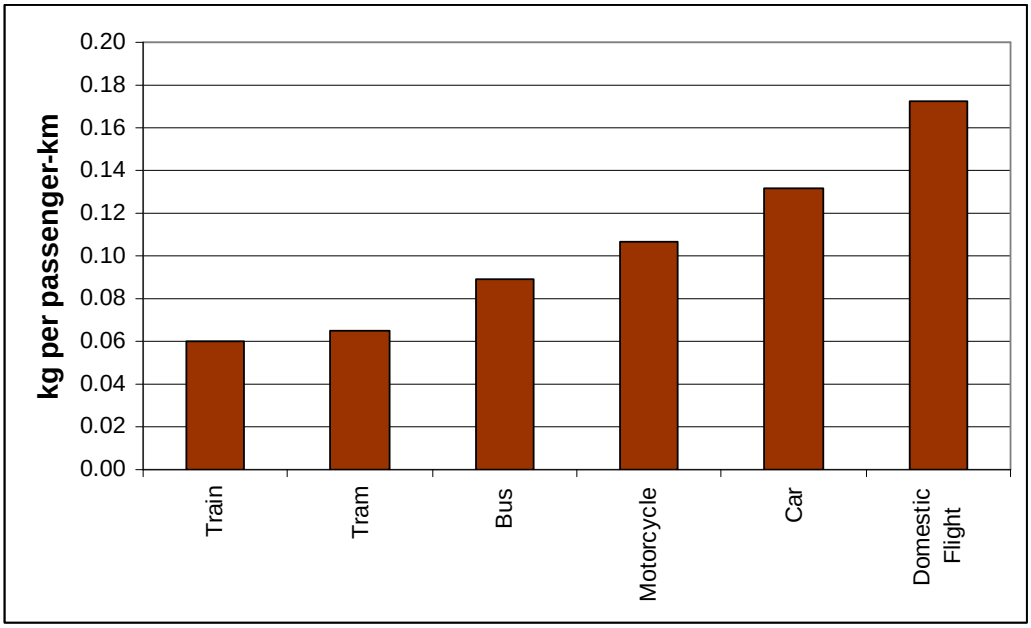
4.36 These are complex issues and it is perhaps not surprising that recent guidance on the shadow price of carbon, produced by the Department for the Environment, Farming and Rural Affairs (DEFRA)[10], has been subject to criticism from various quarters[11]. Further, in view of the ongoing debate on how carbon should be valued, seeking to reflect

carbon costs in the price of different transport modes using DEFRA's current recommended value of £26 per tonne of carbon dioxide appears premature.

4.37 It is perhaps for this reason that the CCC has been asked to consider a different approach, involving setting carbon reduction targets for the UK economy and identifying appropriate contributions from each sector, taking account of both the supply-side and demand-side measures available. In the case of transport, the CCC has commissioned research to identify the full range of measures, including incentive mechanisms to encourage greater use of low carbon modes, green travel planning, local authority investment to encourage walking and cycling and technologies for reducing vehicle emissions. These are to be ranked in terms of their costs of implementation in order to generate marginal abatement cost curves defining the most cost effective path to achieving any given target.

4.38 Figure 4.1 indicates that car use makes one of the greatest relative contributions in terms of carbon dioxide emitted per passenger-km travelled. Figure 4.2 shows emissions for each mode, based on the *Guidelines to DEFRA's Greenhouse Gas Conversion Factors for Company Reporting*[12].

FIGURE 4.2 CARBON DIOXIDE EMISSIONS BY TRANSPORT MODE



4.39 Estimates of emissions per passenger-km can vary, depending on the underlying assumptions about occupancy rates for each mode, and it is not therefore possible to conclude, on the basis of these figures alone, that one mode is preferable to another in all circumstances. However, the figure does demonstrate that significant reductions in carbon dioxide might be secured if public transport were to take a greater share of a given overall level of travel demand. By way of illustration, if the modal share of car in the UK were to fall from around 85 per cent to 80 per cent, the level achieved by a number of European countries, and the resulting change in passenger-km for this mode were distributed between bus and rail in proportion to their current shares, total carbon emissions from transport would fall by some two million tonnes or 1.5 per cent. Set alongside other measures applied across the economy, this could represent a significant contribution to meeting the CCC's overall carbon budgets.

4.40 Moreover, we suggest that the pricing of different modes of transport is likely to be an important element of any strategy based on modal switch, notwithstanding the importance of other measures such as travel and land use planning. As demonstrated in Section 3, there is clear evidence that households and individuals respond to price changes, both in the short and the longer term. In the following section, we review the research-based evidence of how responsive the demand for travel by different modes is likely to be to specific changes in price. We also draw on this evidence to model the potential impacts of price-based policy initiatives on modal choice and carbon emissions.

5 Pricing and the prospects for public transport

Understanding pricing impacts

The elasticity of demand for travel

5.1 In Section 3 we noted that, while an examination of recent trends in transport prices and travel by mode provides evidence of the potential impacts of price changes, it is insufficient to allow the relationship between price and demand to be determined with any precision. However, in the case of transport, as for other sectors, extensive research has been undertaken in order to establish a better understanding of the relationship and improve the pricing decisions of both transport policy makers and private sector service providers. This research has tended to focus on the estimation of price elasticities through statistical techniques designed to isolate price effects from other impacts on demand, for example as result of changes in income or employment.

5.2 The price elasticity of the demand for transport is simply a ratio of the percentage change in demand to the percentage change in price causing it. It is possible to calculate this ratio for a change in the price of the particular mode of transport under investigation (the own price elasticity) or for a change in the price of a substitute or complementary mode (the cross price elasticity). Own price elasticities are normally negative, as are cross price elasticities relating to complementary modes (for example, bus services interconnecting with rail services), since an increase in price will typically result in a fall in demand. Hence, an own price elasticity of -0.3 indicates that a one per cent increase (reduction) in price will result in a fall (rise) in demand of 0.3 per cent. Cross price elasticities relating to substitute modes tend to be positive since, for example, an increase in the price of motor fuel tends to increase the demand for rail services.

5.3 Where the absolute value of an elasticity is less than one, demand is said to be relatively inelastic, the percentage change in demand being less than the associated percentage change in price. In the case of transport, demand for a given mode will tend to be more elastic the greater the number of substitutes and the more discretionary the reason for travel. For this reason, long distance leisure trips by train are invariably more price elastic than rail commuter trips to and from London. It follows that price-based policy initiatives must take account of different transport markets and reasons for travel if they are to be properly targeted to encourage a significant modal switch and secure the maximum possible reduction in carbon emissions.

5.4 Elasticities also vary over time and research results often distinguish between the short, medium and long term. As discussed in Section 3, a significant rise in the price of petrol can change short run travel decisions concerning whether to use the car or public transport to make a given journey, but it can also change medium term decisions about whether to purchase a car. If sustained over the long term, it might even result in a household moving to a new area, for example in order benefit from easier access to a railway station or other public transport terminal.

5.5 It is also important to recognise that estimated elasticities are derived from analysis of historical price and demand data and represent a snapshot of how demand varies due

to marginal changes in price from the broad level prevailing at a point in time. They are of limited value in understanding how very dramatic changes in price might affect demand, although where such changes have not been observed in the past they may be the only available guide. This is an important point to consider in interpreting the results of the modelling work described later in this section.

The elasticity of the demand for car travel

5.6 The empirical evidence on the elasticity of demand for car travel was extensively reviewed in the *TRACE study: Review of Existing Evidence on Time and Cost Elasticities of Travel Demand and on Value of Travel Time*[1]. This considered variations in elasticities over the short, medium and long term as well as differences by type of motoring cost, area, trip purpose and time of day. The main conclusions were as follows:

- The average fuel price elasticity of car trips is -0.2 in the long run, with lower absolute values observed for commuting and business trips and higher values for other journey purposes. Surprisingly, the average short term elasticity appears to be similar, although this is influenced by a number of outlier estimates suggesting an implausibly high degree of sensitivity of demand to the fuel price.
- The sensitivity of car kilometres to the fuel price is somewhat higher, approximately -0.3 in the long run, indicating that longer distance journeys become relatively less attractive as the fuel price increases. Again, lower absolute values were identified in the case of commuting and business trips.
- The fuel price elasticity of car passenger-km is also around -0.3, although the review also highlighted evidence of a tendency to share the cost of a trip with other travellers when fuel prices rise.

5.7 One of the key pieces of research cited by the *TRACE Study*, undertaken by Goodwin, provides estimates of the fuel price elasticity of car kilometres in the UK over clearly defined time horizons[2]. This indicates a short term value of -0.15 and values of -0.3 and -0.4 in the medium term (five to ten years) and long term (over ten years) respectively. These support the view that demand becomes increasingly responsive to price changes over time, as discussed in Section 3.

5.8 A further study by McCarthy investigated the price elasticity of car purchases and indicated a value of between -0.6 and -0.87[3]. This suggests that purchasing decisions are relatively responsive to changes in the overall costs of motoring, although as noted in Section 3 such changes inevitably take longer to influence the level of car use as new cars tend to be purchased infrequently.

5.9 Overall, the evidence indicates that policy initiatives focusing on the costs of motoring could have a significant effect on the demand for travel by car, particularly in the long term when individuals have greater freedom to materially change their travel behaviour.

The elasticity of demand for public transport

5.10 A primary source of information on the elasticity of demand for public transport is *The Demand for Public Transport: a Practical Guide*, otherwise know as *The White Book*[4]. This reports the results of a wide range of research relating to the price elasticity of demand for bus, metro and suburban rail services.

5.11 The average bus fare elasticity is estimated to be -0.43 in the short run (one to two years), increasing in absolute value to -0.56 in the medium term (five to seven years) and -1.01 in the long run (12 to 15 years). In the case of metro services, the fare elasticity is -0.3 in the short term and -0.6 in the long term. However, these averages mask considerable variation, notably by region, journey type and passenger income.

5.12 For example, *The White Book* provides clear evidence that the demand for one public transport mode can be particularly sensitive to price changes in large conurbations where different modal networks overlap. In London, the level of use of the Underground is, perhaps not surprisingly, relatively sensitive to changes in bus fares, with a cross price elasticity of 0.13. At the same time, bus use appears less sensitive to Underground fares, presumably because large parts of the bus network in Greater London are not served by the Underground.

5.13 Research by Halcrow Fox et al, the results of which are presented in Table 5.1, demonstrates the effect of journey purpose and income level on the price sensitivity of demand[5]. As might be expected, trips between home and work are significantly less price elastic than other journeys. In addition, the evidence suggests that higher income groups tend to be more sensitive to changes in public transport fares than those on lower incomes. This may be because higher income groups are still more likely to have access to a car, not withstanding the growth in car ownership among lower income households discussed in Section 3. However, overall this evidence suggests considerable scope for encouraging greater use of public transport among all income groups, particularly in respect of trips to destinations other than the workplace.

TABLE 5.1 ELASTICITY OF DEMAND BY MODE, INCOME AND JOURNEY TYPE

Trip purpose	Income	Bus	Metro	Suburban rail
Home to work	Low	-0.30	-0.20	-0.40
	Medium	-0.33	-0.30	-0.50
	High	-0.45	-0.50	-0.60
Home to other	Low	-0.50	-0.60	-0.45
	Medium	-0.60	-0.65	-0.55
	High	-0.70	-0.75	-0.70

5.14 The standard source of elasticity data for the rail sector is the *Passenger Demand Forecasting Handbook* (PDFH), a compilation of the results of relevant research, sponsored and periodically updated by the Association of Train Operating Companies[6]. This usefully distinguishes between elasticities by type of rail service, albeit it at a relatively aggregate level, helping to identify the rail markets that might be most responsive to a change in fare levels. As might be expected, the fare elasticity for services in London and the Southeast is relatively low at around -0.3, while that for both long distance and regional services is estimated to be -0.9. This demonstrates the considerable scope for variation in outcomes depending on how any reduction in rail fares is targeted.

5.15 At the same time, additional research by OXERA suggests that fare elasticities for all services may be significantly higher in the long run[7]. Their results indicate that the elasticity for London and Southeastern services could be as high as -1.0 and those for long distance and regional services -1.14. To the extent that such estimates are considered robust, they highlight the need for a clear distinction between the short and long term, both in modelling the impact of fare changes on demand and in formulating price-based policy initiatives on the basis of the results.

The elasticity of demand for air travel

5.16 The evidence suggests that air travel, particularly short haul air travel, is considerably more price elastic than the other modes covered by this report. A review of air travel demand elasticities undertaken on behalf of the Canadian Department of Finance indicated an average value for short haul business traffic of -0.7 and for short haul leisure traffic of -1.5[8]. Research undertaken by the CAA has indicated that the demand for leisure air travel may be more inelastic, with an elasticity value of around -0.7, reflecting the fact that air fares now account for a relatively low proportion of the overall cost of a holiday[9]. However, these findings relate to overseas travel, and it is possible that demand for domestic leisure travel by air remains elastic given the general preference for overseas holiday destinations.

5.17 In any event, the evidence suggests even greater scope for influencing the level of air travel through price than is the case with other modes.

Transport demand and emissions model

Overview

5.18 In order to illustrate the potential impact of price changes implied by the results of this research, we have constructed a simple model to calculate changes in demand and carbon emissions between 2008 and 2025. This is not intended to produce accurate forecasts of demand under different pricing scenarios, rather to illustrate the potential scope for achieving a significant change in travel behaviour through changes in both motoring costs and public transport fares.

5.19 The model is based on the following key elements:

- We have taken Department for Transport (DfT) demand forecasts, expressed in terms of passenger-km, as representing the likely base case outcome in the event that existing relativities between motoring costs and public transport fare levels are maintained. In practice, DfT's forecasts are arguably more consistent with a continuing relative decline in overall motoring costs. However, since the focus of the analysis is on identifying possible changes in demand and emissions rather than on producing accurate forecasts, we consider that this representation of the base case, assuming constant real prices and fares over time, is reasonable.

- Price changes are applied as a percentage change to the average price of a given mode. In the case of car travel, the model distinguishes between a change in the total lifetime costs, for example following a change in Vehicle Excise Duty, and a change in the price of motoring fuel. Except in the case of a reapplication of the Fuel Duty Escalator, price changes are treated as one-off events occurring in 2008, with relative price differentials maintained over the remainder of the forecasting period.

- In order to estimate pricing impacts, we have applied estimates of the elasticity of demand for different modes sourced from the research summarised above. In order to simplify the model, we have not sought to include all of the elasticity estimates reviewed (in particular the elasticities by income level and journey purpose shown in Table 5.1). In the case of car travel, the model estimates the impact of changes in both overall motoring costs, based on an estimate of the purchase price elasticity, and in fuel prices using fuel price elasticities for the short, medium and long term. In the case of rail demand, the model distinguishes between London and Southeastern, long distance and regional services, while bus services within and outside London are also modelled separately. In addition, separate short, medium and long term elasticities for both main public transport modes are included.

- We have applied own price elasticities in preference to the cross price elasticities in modelling the effects of price changes on demand. This is partly because cross price elasticities are less well understood, and partly to ensure greater transparency and clarity of modelled outcomes.

- Hence, the allocation of passenger-km between modes following a price change is based on a trip generation and abstraction matrix. This contains assumptions about the percentage of traffic that is "priced off" as a result of a price increase and the percentage transferring to each of the other possible modes. These assumptions were primarily sourced from *The White Book*, although we have made modifications in order to ensure that the model generates plausible results.

- We have estimated carbon emissions on the basis of the values of emissions per passenger-km for each mode reported in Figure 4.2. As noted above, these values were sourced from guidelines produced by DEFRA.

5.20 Key parameter values and assumptions, together with data sources, are set out in more detail in Appendix B.

5.21 We have simplified the analysis considerably in order to focus on the impact on demand and mode share of changing prices. As a result, the model has a number of limitations that must be borne in mind when interpreting the results. In particular:

- It takes no account of income, employment or other factors that could change the demand for travel;

- It assumes that there are no capacity constraints on the ability of any given mode to accommodate increases in demand, although in specifying assumptions for the generation and abstraction matrix we have sought to ensure that transfers of traffic from car to public transport are plausible;

- Load factors for each mode are assumed to be fixed such that changes in passenger journeys are proportionate to changes in total passenger-km, although in practice price changes could be expected to result in significant changes in capacity utilisation, particularly in the case of public transport;

- It calculates the impact of a one-off price change in 2008 as a percentage change from the base case forecast in each year thereafter, using the relevant modal elasticity and ignoring possible lags and more complex dynamic effects;

- While including short, medium and long term elasticities, it takes each time horizon as a defined number of years, with the short term represented as the first

three years, the medium term the subsequent four years and the long term the remainder of the forecasting period;

- In terms of cross elasticity effects, the model does not consider what proportion of, say, car trips are susceptible to modal shift and to which mode in particular; and
- It ignores technological changes that might affect real transport costs over time, for example the introduction of more fuel efficient engines.

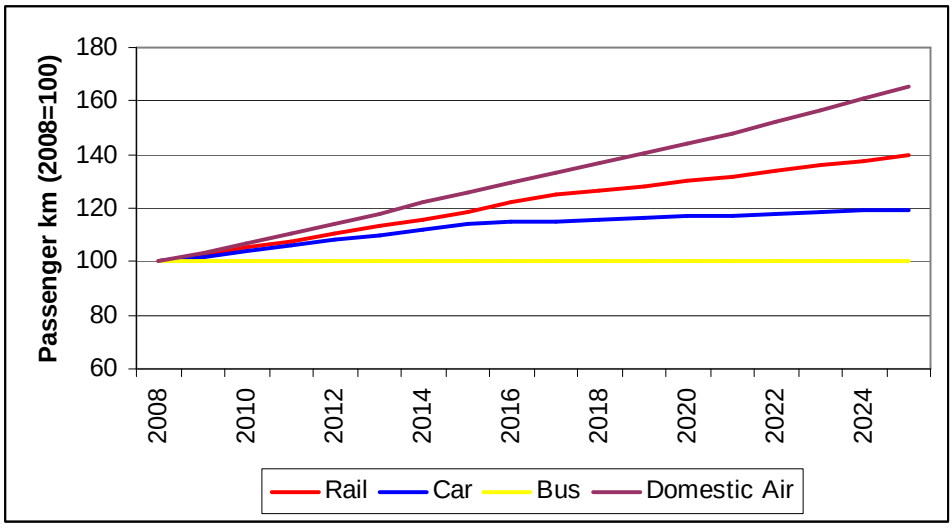
5.22 These are clearly strong assumptions that substantially reduce the model's ability produce reliable forecasts of absolute levels of traffic. However, it can be used to investigate the changes in traffic that might arise from a change in the relative prices of different transport modes and hence help to inform price-based policy initiatives.

Policy scenarios

5.23 The base case forecasts are shown in Figure 5.1. These indicate that, in the absence of any policy intervention to change relative prices, car passenger-km are expected to increase, although their rate of increase falls after 2015. Rail demand is also expected to grow strongly, while travel by bus remains flat throughout the period. Domestic air travel is assumed to grow rapidly, at the same rate as total air travel from UK airports. Overall, given its dominance at the beginning of the forecasting period, car use retains a mode share of 87 per cent throughout, although the share of rail increases marginally from 5.6 per cent to 6.5 per cent.

5.24 Note that we have not sought to modify these forecasts to take account of the possible impacts of the economic downturn currently in prospect. Depending on the extent of any economic contraction, the demand for all forms of transport could be expected fall, although the outcome in terms of modal shares is difficult to predict. In any event, we would expect traffic growth to recommence well before the end of the forecasting time horizon presented here.

FIGURE 5.1 TRANSPORT DEMAND AND EMISSIONS MODEL BASE CASE



5.25 In order to demonstrate the sensitivity of demand to price changes, we first investigated the impact of reducing public transport fares by 20 per cent, bringing them more in line with the European average identified in the CfIT research discussed in Section 3. The model indicates that this would increase bus travel by 13 per cent

and rail travel by 17 per cent above their respective base case levels by 2015, reducing the modal share of car by one percentage point. This suggests that, had such reductions been made in 2000, at the time of CfIT's research, bus and rail travel combined would now be around 120 billion passenger-km per annum, a level of public transport use not achieved since 1960.

5.26 To illustrate the potential impact of price changes across all transport modes, we have defined a Maximum Impact Policy Scenario that can be tested by the model. Again, we emphasise that the elements of this scenario have been devised in order to demonstrate the price sensitivity of each mode and the scope for securing a change in modal share in favour of public transport through pricing initiatives. They should not be regarded as policy recommendations or even plausible policy measures.

5.27 The Maximum Impact Scenario includes the following:

- A reduction in rail fares across all rail sectors of 25 per cent;
- A reduction in average bus fares across the country of 50 per cent;
- A one-off increase in the price of motor fuel of 15 per cent;
- A reapplication of FDE resulting in further real increases in the price of motor fuel of 1.5 per cent per annum;
- An increase in Vehicle Excise Duty (VED) of 100 per cent; and
- The application of duty to aviation fuel having the effect of increasing the fuel price by 200 per cent and the overall price of air travel by 50 per cent (assuming fuel accounts for 25 per cent of the cost of an airline seat, as indicated by the CAA in the report cited in Section 3).

5.28 Taken together, these measures would result in a substantial increase in motoring costs relative to public transport fares. As we will see below, the impacts on carbon reduction are substantial. In practice, to achieve this would require strong political determination and a desire to make fundamental legislative and contractual changes to our transport system.

5.29 Therefore, for the purpose of comparison, we have defined a Moderate Impact Policy Scenario involving a series of more limited changes to pricing and taxation within the transport sector. Again, these should not be regarded as recommendations, although they arguably represent a more realistic policy scenario that could be realised over a shorter time horizon. The specific measures envisaged are as follows:

- A ten per cent reduction in rail fares focused on the long distance and regional sectors that tend to compete more directly with the private car;
- A 15 per cent reduction in bus fares outside London, recognising that London services already receive significant levels of subsidy;
- A reapplication of the FDE resulting in a real increase in the price of fuel of 0.5 per cent per annum;
- A 25 per cent increase in VED; and
- The introduction of duty on aviation fuel resulting in an increase of 50 per cent in the fuel price and 12.5 per cent in the price of air travel.

5.30 The policy implications of introducing measures of the kind included in these scenarios are considered further in Section 6. Here we note that, aside from the legislative and contractual implications, the financial impacts of some of the price changes could be considerable. While a detailed analysis of the public and private sector cost and revenue effects is beyond the scope of this study, the discussion in Section 6 nevertheless includes some commentary on how such impacts might be accommodated.

Results of scenario analysis

5.31 The results of this analysis are summarised in Table 5.2. This shows changes from base case traffic and emissions levels and modal shares in 2010, 2015 and 2025, providing an indication of impacts in the short, medium and long term.

TABLE 5.2 PRICING SCENARIO IMPACTS

	2010		2015		2025	
	Maximum Impact	Moderate Impact	Maximum Impact	Moderate Impact	Maximum Impact	Moderate Impact
% change in passenger km relative to base case level						
Car	-3.9	-0.5	-9.6	-1.6	-18.2	-4.2
Bus	32.7	5.0	48.4	7.7	97.0	16.0
Rail	16.2	5.5	21.4	8.0	35.5	13.6
Domestic air	-44.1	-16.0	-43.7	-15.8	-45.5	-16.5
Total	-1.0	0.0	-5.1	-0.8	-9.2	-2.2
% point change in mode share relative to base case level						
Car	-2.5	-0.4	-4.1	-0.8	-8.5	-1.8
Bus	2.0	0.3	3.0	0.5	6.0	0.9
Rail	1.0	0.3	1.6	0.5	3.2	1.1
Domestic air	-0.5	-0.2	-0.5	-0.2	-0.7	-0.2
Change in carbon dioxide emissions relative to base case level (million tonnes)						
Car	-3.8	-0.5	-10.3	-1.8	-20.4	-4.5
Bus	1.5	0.2	2.2	0.3	4.3	0.7
Rail	0.5	0.2	0.7	0.3	1.4	0.5
Domestic air	-0.8	-0.3	-0.9	-0.3	-1.3	-0.5
Total	-2.7	-0.4	-8.4	-1.5	-16.0	-3.9

5.32 The Maximum Impact Scenario leads to major changes in traffic levels and modal shares by the end of the forecasting period. Car passenger-km are 18.2 per cent lower than in the base case by 2025, and car travel accounts for 78 per cent of all passenger-km as compared with 87 per cent in 2008. By contrast, travel by bus almost doubles while rail travel increases by some 35.5 per cent. Both public transport modes account

for substantially higher shares of total traffic in 2025 than in the base case. Domestic air travel declines significantly while retaining a small mode share throughout.

5.33 These changes translate into substantial reductions in carbon dioxide as compared with the base case. By 2015 they are already lower by some 8.4 million tonnes and by 2025 the reduction is almost twice that level, any increases in emissions from public transport being substantially outweighed by much lower levels of car emissions. Note, however, that the emissions benefits are partly the result of a much lower level of overall traffic growth, passenger-km growing by only 10 per cent in the Maximum Impact Scenario as compared with 20 per cent in the base case.

5.34 The Moderate Impact Scenario, while clearly less effective in terms of its impact on mode shares, nevertheless delivers a significant reduction in carbon emissions relative to the base case. The reduction in car's share of traffic of just below two percentage points equates to a reduction in car passenger-km of more than four per cent, reducing car-based emissions by 4.5 million tonnes in 2025. Again, coupled with the contribution of aviation, this is more than sufficient to lower overall emissions from transport, although at 3.9 million tonnes the reduction is considerably less than in the Maximum Impact Scenario. Note that total traffic growth in the alternative scenario, some 17 per cent between 2008 and 2025, is much closer to the base case.

5.35 While these overall results are useful in demonstrating the potential effectiveness of a package of measures, it is also important to consider the impact of each element. Table 5.3 shows the effect on car passenger-km, car mode share and total transport carbon emissions if each component of the maximum impact scenario were implemented in isolation.

TABLE 5.3 MAXIMUM IMPACT SCENARIO: EFFECT OF INDIVIDUAL ELEMENTS 2025

Element	% change in car passenger-km	Car modal share (%)	Change in emissions (million tonnes)
Base case	-	87	-
25% reduction in rail fares	-1.2	85	0.8
50% reduction in bus fares	-1.5	84	1.4
15% increase in motoring fuel prices	-5.4	86	-5.9
FDE introduction -1.5% per annum real increase in fuel prices	-7.9	84	-7.5
100% increase in VED	-3.6	86	-3.8
200% duty on aviation fuel	0.0	87	-0.8

5.36 The table demonstrates risks associated with applying individual initiatives and with focusing on simple measures of policy success such as mode share. Both of the initiatives involving substantial reductions in public transport fares, while they have a

significant effect on car's share of total traffic, have relatively little impact on overall car passenger-km. Moreover, since they lead to significantly more passenger-km overall, they actually result in an increase in carbon emissions, notwithstanding that travel by both bus and rail results in lower per unit emissions than travel by car. Conversely, those measures impacting directly on the cost of motoring, particularly those affecting motor fuel prices, have a much greater direct impact on travel by car, the dominant mode, and hence lead to significant reductions in emissions overall.

5.37 These results are partly dependent on the particular assumptions within the model, notably those underpinning the trip generation and abstraction matrix, and should therefore be treated with caution. Moreover, we do not suggest that reductions in public transport fares should be excluded from any package of measures targeted towards reducing carbon emissions from the passenger transport sector. Indeed, fare reductions are likely to be essential if policy makers are to contemplate major increases in motoring costs and change perceptions among motorists of the benefits of using public transport. At the same time, this analysis demonstrates the need for considerable caution in designing price-based policy initiatives, a point to which we return below when discussing the longer term dynamic impacts of price changes. We also note that, in practice, the perverse effects of a single policy initiative could extend to modes of transport not covered by our analysis. For example, reductions in bus fares in isolation might, in some circumstances, result in less walking or cycling.

5.38 Figures 5.2 and 5.3 summarise the outcome under each policy scenario in terms of the total level of car passenger-km and total transport carbon emissions.

FIGURE 5.2 CAR TRAFFIC AND TOTAL TRANSPORT EMISSIONS: MAXIMUM IMPACT

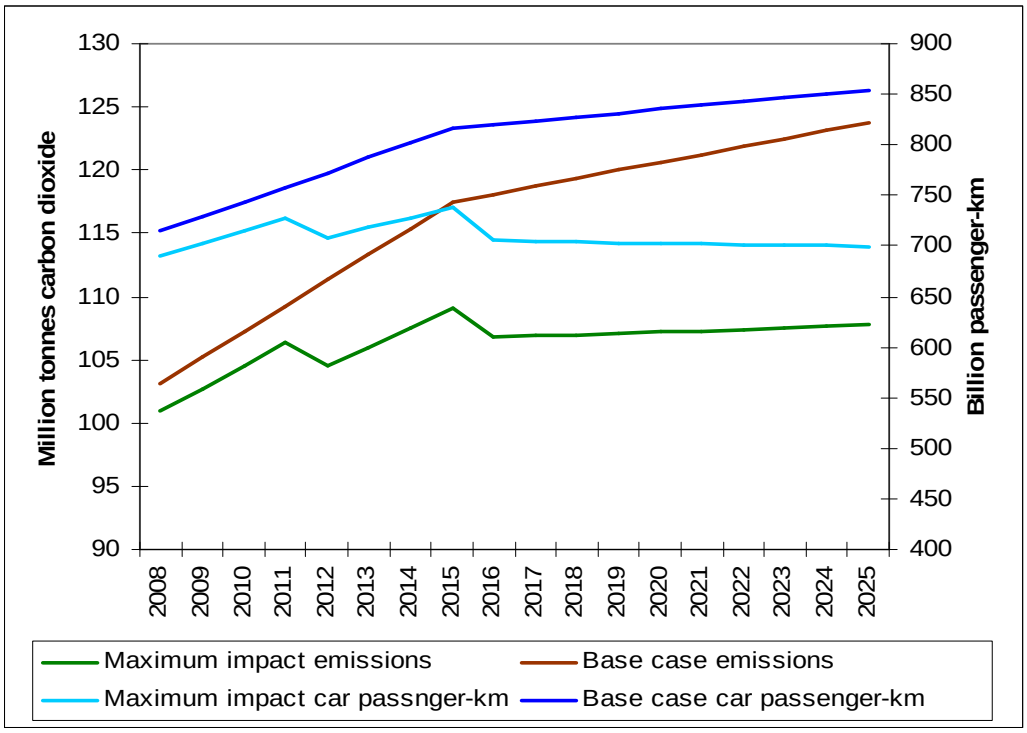
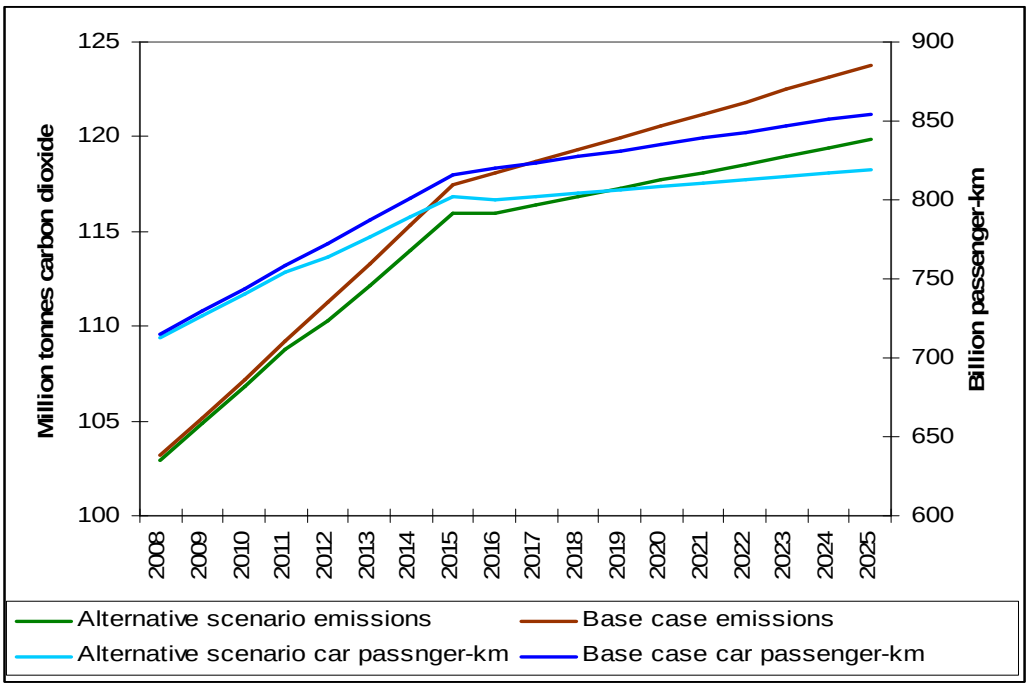


FIGURE 5.3 CAR TRAFFIC AND TOTAL TRANSPORT EMISSIONS: MODERATE IMPACT



5.39 The Maximum Impact Scenario results in an actual fall in car passenger-km, driven by the substantial increases in motoring costs experienced over the period. Hence, the reduction in passenger transport carbon emissions is substantial, equivalent to 12.7 per cent of base level emissions in 2025. Moreover, absolute emissions levels rise only slightly over the forecasting period as a whole. The alternative scenario, while it does not reduce car traffic in absolute terms, nevertheless secures a 3.2 per cent reduction in carbon relative to base case levels by the same date, although total emissions continue to rise throughout.

Dynamic effects

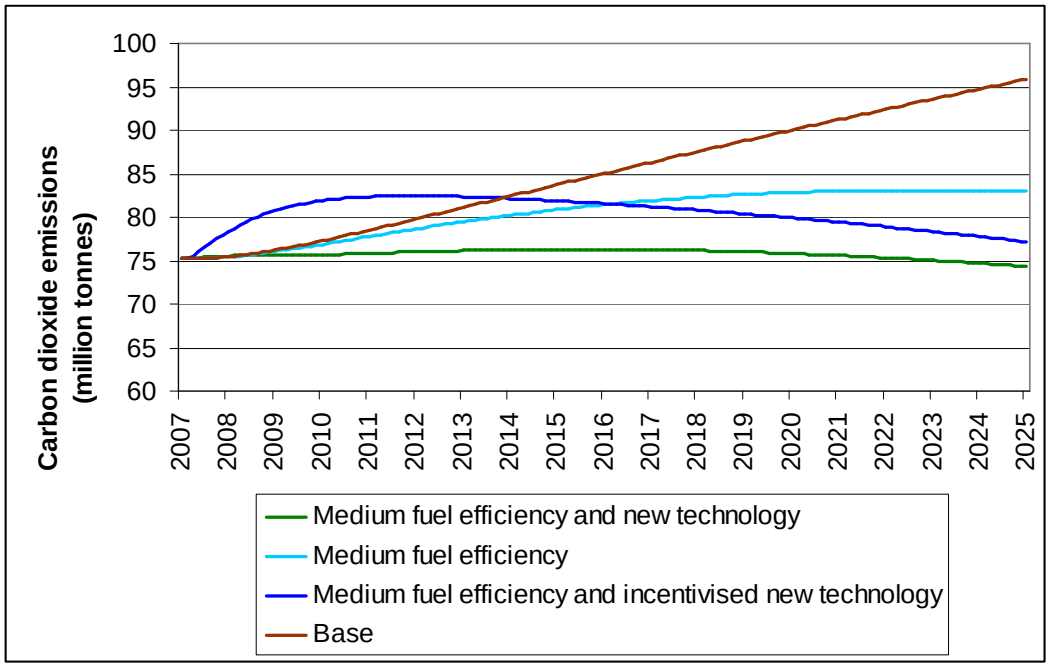
5.40 We have already alluded to the limitations of the model used to generate these results, in particular its inability to take account of the dynamic effects of price changes and the lack of any recognition of the role of technological change, for example in relation to vehicle fuel efficiency. In the absence of a fuller analysis, going beyond the scope of this study and taking full account of such factors, we are only able to provide a broad indication of the results of the policy scenarios described above. Such analysis would require a more sophisticated modelling approach similar to that applied in the development of Steer Davies Gleave's car ownership model[10].

5.41 Since the car ownership model focuses on a single mode, we have not used it to assess the impact of price changes across transport modes, as required for this study. However, it can usefully demonstrate the dynamic interaction of pricing and technological change on the propensity to travel by car under different policy scenarios, as shown in Figure 5.4.

5.42 The figure shows various estimates of the level of carbon dioxide emissions from the UK car stock between 2007 and 2025. The steady rise under the base case, in which there is no technological change and no policy intervention, can be moderated to some degree by improving fuel efficiency over time, as illustrated by the "medium fuel efficiency curve". The introduction of new technology constrains growth even further,

emissions remaining broadly flat over the forecasting period. However, incentivising the earlier renewal of the car stock by reducing the purchase price of vehicles incorporating the new technology has perverse effects, illustrated by the "medium fuel efficiency and incentivised technology" curve. As a result of lower overall motoring costs, more cars are purchased, total vehicle kilometres increase and emissions rise above base case levels, at least to 2014 when the impacts of overall car renewal are sufficient to more than compensate.

FIGURE 5.4 POTENTIAL IMPACT OF INCENTIVISING PURCHASE OF FUEL EFFICIENT CARS



5.43 Again therefore, we emphasise the need to exercise care in developing policy designed to incentivise changes in behaviour through changes in price. In general, the scope for perverse outcomes should be explored exhaustively before particular initiatives are implemented.

Conclusions

5.44 Notwithstanding this note of caution, this analysis has demonstrated that price-based policy initiatives can make a substantive contribution to the reduction of car traffic and overall carbon emissions from passenger transport. Our main conclusions are as follows:

- The short term price elasticity of demand for most modes of transport is less than one and, therefore, significant price changes would be needed to encourage an immediate major shift from car travel to travel by public transport. Nevertheless, more moderate changes could be an important means of supporting a broader package of transport measures of the kind applied elsewhere in Europe. Further, long run elasticities are higher, demonstrating the potential for achieving greater impacts through pricing over longer timescales.
- Policies designed to increase the cost of motoring appear to be the most effective in terms of reducing emissions levels. This is perhaps not surprising

since car is the dominant mode and price changes resulting in, say, a one per cent reduction in car traffic will inevitably have a greater impact than any resulting in a one per cent increase in the demand for public transport.

- Reductions in public transport fares can help to encourage modal switch and are likely to be an essential element of any overall package of price-based measures. However, substantial reductions in fares applied in isolation could have perverse effects when considered from a climate change perspective.

- The demand for air travel is generally regarded as more elastic than that for surface transport, implying even greater potential for using taxation and other price-based measures to constrain demand and reduce emissions. It is possible, however, that the prevalence of low cost fares, which typically account for a much lower proportion of total holiday costs than full service fares, could have reduced elasticities to some degree.

- In all cases, policy measures must take account of differences in travel behaviour between regions and types of traveller. Price changes should generally be targeted on markets where they are likely to have the greatest impact.

- In developing policy initiatives involving significant changes in price, it is also important to consider longer term, dynamic impacts and take account of the full range of factors potentially affecting both price and demand. This would require more detailed analysis than has been possible within the scope of this study.

5.45 Having reviewed the evidence relating to the potential impact of price changes on demand and carbon emissions, we now turn in the final section to a discussion of the policy implications.

6 Policy implications

Overview

6.1 The evidence presented in this report supports the view that transport pricing initiatives, broadly defined, can have a substantial impact on modal choice and could play an important role in reducing transport-based carbon emissions in the UK. In simple terms, the greater the re-balancing of prices, the greater the carbon reductions that can be achieved. This section considers how price changes might be introduced, recognising some of the policy constraints that can be expected to apply, at least in the short run.

6.2 The modelling analysis undertaken in this study points to the following conclusions:

- That changing prices across all modes, and specifically raising motoring costs while reducing public transport fares, can substantially reduce transport carbon emissions; but
- That initiatives focused on individual public transport modes will tend to have less effect and may even be perverse.

6.3 The clear policy implication is that, while public transport pricing will be an important part of an overall approach, it should be used in combination with other policies designed to increase the cost of motoring. This reflects the dominance of car travel in overall transport demand and the consequent difficulties of influencing modal choice through public transport policy alone.

6.4 The proposals presented here seek to achieve the kinds of changes we have modelled and should be regarded as options for further consideration rather than firm policy recommendations. Given the scope of this report, we have not examined the implications of the initiatives described for public finances, nor have we investigated their possible macroeconomic impacts. At a time when the UK economy is facing a significant and possibly substantial contraction, such considerations are clearly important. Nevertheless, in view of the need to give urgent attention to the longer term impacts of climate change, we suggest that it would be inappropriate to discount options simply because it would be difficult to implement them during a recession.

6.5 In considering these proposals, it should be remembered that identifying potential policy tools is only a first step towards the development of an effective carbon reduction strategy for the transport sector. As discussed in Section 4, economically efficient pricing across the transport modes, following the recommendations of both Stern and Eddington, should ideally take account of both the value and costs of measures to reduce carbon mode-by-mode and recognise the importance of relative prices in influencing modal choice.

6.6 Hence, given the current policy imperatives, it is essential to revisit the unrelated set of policies that determine transport prices at the present time. Further, the use of pricing tools as a means of driving more sustainable land use patterns, which in turn will encourage less carbon intensive lifestyles, is also important and requires clear linkages between transport and planning policy. Once this is recognised, it will be

simpler to both design and implement policy levers to deliver a more sustainable outcome for transport.

6.7 Against this background it is perhaps surprising that the DfT's recent work on carbon 'reduction pathways', ahead of its forthcoming carbon reduction strategy, makes scant reference to the role that changing national pricing policy might play in reducing carbon emissions[1]. The proposals set out below are intended to help inform the further discussion of the strategy as it develops.

Car travel

6.8 We have set out a strong body of evidence demonstrating the sensitivity of car use to changes in the fuel price. The analysis of historical trends indicates that the growth of car passenger-km was moderated during periods of high motoring fuel prices. In addition, our modelling analysis indicates that real increases in fuel prices of around 1.5 per cent per annum would reduce car travel by some eight per cent by 2025 relative our base case scenario. This is the largest impact of any of the pricing initiatives investigated.

6.9 We also note that, at the time of writing, fuel prices have fallen back substantially from their 2008 peak, raising the prospect of a short term increase in car travel. As we noted in Section 4, the immediate changes to fuel taxation announced in the *Pre-Budget Report (PBR)* are intended to be neutral in terms of their effect on fuel prices, while changes planned for 2009 and 2010 are unlikely to affect car use significantly. At the same time, it is probable that car use will be moderated by rising unemployment and general economic uncertainty. Moreover, the US-based research cited in Section 3 provides some evidence that substantial price increases, even if they are temporary, may influence long term behaviour. Nevertheless, we believe that there is a case for considering a more pro-active approach to the use of fuel duty as a means of influencing demand over the long term.

6.10 Such an approach might involve varying the level to ensure a steady increase in the real price of fuel over the long term, while seeking to maintain it at a given level during any period of economic downturn. While this would mean that households and businesses could not expect to enjoy significant reductions in fuel prices following a fall in oil prices, in some respects they would benefit since more predictable fuel prices would enable them to plan more effectively. In any event, we suggest that signalling that fuel prices must be expected to rise year on year, preferably steadily, is of fundamental importance to establishing a lower carbon and more sustainable future.

6.11 Over the long term, we would expect fuel duty taxation and additional VED to increase Government revenue from motoring taxation, although revenue from the former could vary significantly in the short term depending on the prevailing underlying fuel price (and hence the level of duty needed to ensure a steady increase in the pump price). The level of additional tax revenue would need to be investigated but would provide a source of funds to balance greater subsidisation of public transport fares. It would make sense to introduce a parallel reduction in rail and bus fares if policy makers were to make the case for significant increases in motoring taxation. This combination of measures appears practical from a public finance perspective and would also help to secure public and business acceptability. It would, however, require a more holistic approach to transport pricing policy than that taken to date.

6.12 These national measures would need to be supported at the local level through initiatives designed to address specific issues in individual regions, cities and towns. While the road pricing schemes being developed in Manchester and elsewhere are primarily intended to reduce congestion rather than carbon emissions, they would help, especially with the planned parallel investment programmes, to encourage greater use of public transport while providing a source of funds for investment in enhanced service levels. Other measures of the kind adopted elsewhere in Europe, for example restrictions on parking, would also be likely to prove effective, and these could be reinforced through taxation of free work-place parking in the same way as other benefits provided by employers.

6.13 We identified that motor manufacturers are likely to respond to these policy levers and to increase fuel prices by producing more efficient/lower emissions vehicles. While this is to be welcomed, pricing policies and alternative travel options must be in place to prevent the benefits of lower emissions being outweighed by increased vehicle mileage, since our previous modelling work indicates that this is a serious risk.

Public transport

Bus and light rapid transit travel

6.14 Reducing bus fares while making bus travel more attractive relative to motoring, and increasing the capacity of the bus network, are perhaps the key challenges to be overcome in delivering low carbon alternative transport. We have identified various measures that would help in achieving these goals, including the better targeting of subsidy, deployment of smartcard technology and increases in subsidy in specific areas.

6.15 Government has demonstrated that it is willing to subsidise bus fares directly through concessionary fares schemes to meet specific policy aims, most recently social inclusion for the over 60s. In our view, it is realistic to envisage an expansion of policy in order to provide for a more general subsidised fare reduction programme, targeted at creating attractive bus-based alternatives to car use. Reduced fares for bus travel into urban areas and the provision of tax benefits for season ticket purchases, coupled with road pricing measures, could make a significant impact on carbon emissions within city regions. Such measures could be introduced in parallel with Quality Partnership arrangements, encouraged by the Local Transport Bill, providing improved infrastructure and lower emissions vehicles.

6.16 At the same time, short of any fundamental changes to the legislative framework governing bus services outside London, the commercial basis of bus operations must be acknowledged. Bus operators argue that free market operation is critical to constraining bus fares, a proposition that relies on effective competition between service providers, encouraged by minimising barriers to entry into bus markets. However, Government is also in a position to influence commercial incentives through more effective structuring of subsidy payments. For example, in targeting public transport spending via the bus service operators grant, it could structure grant payments to encourage the delivery of more bus passengers rather than more bus miles – and on routes on which abstraction from car trips is likely to be greatest. Importantly, such an approach could make a significant contribution to reducing fares and improving the modal share of bus without necessarily increasing the required level of subsidy.

6.17 We also suggest that there is a case for encouraging a more rapid introduction of smartcards across the country, building on London's experience of the roll out of Oyster cards. There is evidence that the introduction of Oyster has itself contributed to the growth of bus patronage in the capital and experience elsewhere in Europe suggests that integrated ticketing is highly valued by passengers. Hence, the introduction of smartcards in metropolitan areas and other regions in the UK could potentially increase the use of bus services in their own right, more so if coupled with investment in high quality public transport systems, such as Fastrack in Kent and the guided busway in Cambridge.

6.18 Raising the additional tax to support pricing policy will be challenging. However, this might be achieved by reallocating existing revenue sources, for example through ring-fencing of a proportion of business rates to city regions, as proposed in a forthcoming paper on *Connecting for Competitiveness: The future of transport in UK city regions*[2]. Alternatively, the Versement transport in operation in Paris and outlined in Section 5 could be considered. More generally, reallocation with a view to ensuring that stronger city regions have the devolved power and funding capability to subsidise their public transport could be an important element of any carbon reduction strategy, particularly if carbon targets are also devolved.

Rail travel

6.19 We have already noted that some rail fares are regulated through the application of an RPI+1 formula defined in the franchise agreements between the Department for Transport and rail operators. The formula is applied to average fare levels, providing operators with the flexibility to set specific fares to compete in different travel markets while protecting consumers from exploitation of overall market power. The Government's expectation is that real increases in fare levels, coupled with continuing growth in rail passenger travel, will enable a shift in the balance of funding towards the passenger and away from the taxpayer.

6.20 The reaction to this planned change in the pattern of funding has been surprisingly muted, particularly in view of the overall level of funding required in order to meet the costs of the planned expansion of network and train capacity. The Government's *Rail White Paper* indicates that while the contribution of passenger revenue is expected to increase from £6.7 billion to £9 billion per annum between 2009/10 and 2013/14, subsidy levels defined by the Statement of Funds Available will remain at around £3 billion throughout. The lack of debate surrounding these payment profiles may reflect the fact that the concept of 'user pays' is now well established as a basis for pricing a range of public services. Nevertheless, it remains the case that the decision to obtain a higher contribution from the passenger is the result of a policy choice rather than a necessary outcome.

6.21 In our view, the very significant increase in the proportion of the costs of the railway to be derived from passengers can be challenged on the basis that the wider costs to the economy of not providing for rail use would greatly exceed the annual subsidy. Therefore, we suggest that the current plan for changing the balance of funding between users and tax-payers should be re-visited, particularly at a time when progress towards a carbon reduction target is essential.

6.22 A key element of any policy review would be a reassessment of the impact of the RPI+1 formulation. It has been argued that the application of RPI+1 to season tickets can be justified since the annual price rise is less than the annual average increase in take-

home pay, with the result that the proportion of income spent on rail fares falls over a commuter's lifetime. This may be true for the average commuter but it can be challenged:

- Several franchises are now subject to RPI+3 rather than RPI+1, with the result that regulated fares can rise more rapidly than average annual earnings, discouraging rail commuting and potentially increasing carbon emissions.
- Arguably, rail fares are already too high for those who may be seeking work or who are working on low wages or part-time, regardless of the annual increment.

6.23 The policy review would also need to consider other fares, which, while they are set freely in the market should play an increasing role as working practice becomes more flexible, for instance with the opportunity to work from home. Operators naturally seek to maximise their income from unregulated fares, recognising the constraints of a largely pre-determined timetable and fixed number of seats on offer. In practice, this leads to a wide and widening range of fares, with some very cheap fares available on a restricted advance-purchase basis on longer distance routes, and some very expensive tickets suitable for use in peak periods. The aim is to actively discriminate between those customers that value their journey more highly and are able to pay and those whose willingness or ability to pay is more limited.

6.24 However, while this market-oriented behaviour increases revenue and reduces the demand on the taxpayer, it raises the question of whether fare levels are reinforcing perceptions that rail travel is generally poor value for money. Such perceptions tend to be heightened when increases in peak period fares aimed at business travellers are announced, but they may also be driven by a lack of fares available to those on modest incomes. This suggests that a suite of policy measures, encouraging demand in a range of markets, is required.

6.25 Such measures might include the following:

- The real price of regulated fares could be maintained by allowing nominal increases at the prevailing rate of inflation (RPI+1 would be replaced with RPI+0). This would result in an increase in franchise subsidies but would also help to support revenues during an economic downturn. The DfT should also investigate whether there is evidence of increases in unregulated fares suppressing demand and, if so, give consideration to extending the scope of the regulated fares basket.
- DfT should work with train operators to introduce a new multi-ride fare, providing discounts closer to those available with season tickets. The fare would allow a fixed number of return journeys over commutable distances and could be offered now through an advance card-based system, although it would be facilitated through the roll out of smartcard technology. This would ensure a competitive alternative to car travel for those with more flexible working arrangements, for whom season tickets tend to be uneconomic.
- The Government could under-write the cost of issuing an initial free Railcard to all people entering each of two qualifying ages (for those entitled to a young persons' Railcard and for Senior Citizens). Customers would continue to pay for renewals but the benefits of Railcards, which offer discounts of up to one third of the fare, would be established at an early stage. Consideration should also be given to extending the Railcard concept to include other groups.

6.26 Policy initiatives of this kind would normally be subject to the objection that they would add to over-crowding on the railway, creating further pressure to undertake costly enhancement work. However, while it is difficult to judge the extent of the economic downturn currently in prospect, it is clear that peak period commuting volumes are likely to ease, if not fall markedly (as happened in the recession of the early 1990s). Moreover, redundancies in financial services and in the retail sector tend to have a disproportionately large effect on commuter volumes. Hence, while the current financial crisis is likely to be damaging to the transport sector as well as the economy as a whole, it could provide an opportunity to encourage more rail travel, including in peak periods, without worsening travel conditions.

Aviation

6.27 Our analysis of aviation suggests that the air travel elasticities are as high as, or higher than those for surface modes, although there is some uncertainty surrounding these values. Our analysis also suggests that a significant reduction in carbon emissions could be achieved through the introduction of a substantial duty on aviation fuel. In principle, this would be the most effective means of ensuring that the price of air travel reflected the carbon emissions generated since, as is the case for cars, emissions are directly related to the quantity of fuel consumed. However, given the international framework of agreements and regulations governing aviation, such a duty could not be introduced unilaterally by the UK Government, even for domestic aviation in isolation.

6.28 In any event, there are a number of other policy measures already in prospect that could be used to send a clear price signal about the impact of air travel on carbon emissions. Following proposals put forward in 2006, a new EU directive is being introduced that will include aviation in the European Union Emissions Trading Scheme (EUETS). Under the new directive, greenhouse gas emissions from flights to, from and within the EU will be included in the EUETS from 2012, with all airlines covered regardless of nationality. The impact of this change will be to increase airline costs and some of the increase is likely to be passed onto customers, potentially reducing their demand for air travel.

6.29 However, the extent of the impact of EUETS on air travel is not yet clear, depending critically on the price of emissions allowances set by the market and any resulting impact on ticket prices. Hence, while some of the key parameters (for example the overall cap on aviation emissions and the number of allowances to be auctioned compared with the number issued for free) have been determined, we suggest that the Government cannot rely solely on the EUETS to ensure that aviation makes an appropriate contribution to meeting specific targets, at least until the effects of the scheme on air travel have been properly understood.

6.30 The Aviation Passenger Duty (APD), levied on domestic and international air passengers since 1993, has hitherto been the main policy lever available to Government for influencing demand. Until recently, the Government was proposing to implement a change, levying an Aviation Duty (AD) on flights in recognition of the fact that the number of flights provides a better indication of emissions levels than the number of passengers. The new levy was to be implemented by 1 November 2009, covering freight and transit flights as well as passenger services from UK airports. However, in the PBR the Government announced that in order to ensure stability in aviation tax policy during the recession, it does not now intend to introduce the AD. Rather it will

retain the APD, albeit restructured around four distance bands with a view to signalling the greater contribution to emissions of longer flights. Further, the rates of duty on flights of less than 2,000 miles, to be introduced from November 2009, are not significantly above those currently charged on domestic flights.

6.31 In our view, the introduction of the AD originally proposed would have encouraged more efficient use of flights, as well as providing an important opportunity to re-balance the price of domestic long distance travel as between rail and air, taking account of the emissions levels generated by each mode. Over the long term, it could be used to maintain steady upward pressure on the price of air travel, encouraging modal switch in markets where rail can compete effectively. We therefore suggest that, while there may be a case for postponing significant reform of aviation taxation in the short term, both the structure and level of taxation should be reviewed at the earliest opportunity.

6.32 Changes to airline taxation also need to be considered alongside the use of airport charges as a means of encouraging the use of less polluting, more fuel efficient aircraft. A number of airports within the UK already levy a surcharge for certain types of aircraft for which noise and emissions levels are relatively high. In general, however, these surcharges are insufficient to have a significant impact on the economics of an individual flight, typically being between £200 and £600 per aircraft. Again, there is a need to revisit individual charges with a view to producing an overall structure of prices that supports the carbon reduction strategy for transport.

Summary

6.33 The policy framework set out in TASTS will require considerable development if it is to be translated into an effective carbon reduction strategy for transport. Price-based initiatives will be an important component in any such strategy, although they will need to be implemented as part of a broader package of measures including, *inter alia*, land use planning, green travel planning and investment in public transport infrastructure. While the Government has already demonstrated that it is prepared to send strong signals concerning modal choice through the price mechanism, for example by providing for free bus travel for the over 60's, a more coherent approach to transport pricing in the round will be required if significant changes in travel behaviour in support of carbon reductions are to be achieved.

6.34 In particular, price changes applied to public transport will be most effective if they are introduced alongside changes to motoring costs. Essentially, a rebalancing of prices that recognises the different contribution of each transport mode to carbon emissions is required. In our view, this re-balancing should have at least four main elements, to be implemented through specific policy initiatives at the national, regional and local levels:

- In the case of car travel, fuel duty should be used to ensure steadily increasing motor fuel prices over the long term, creating an expectation among motorists that car use will become gradually more expensive at the margin and encouraging the use of other modes and more sustainable land use patterns. In the short term, duty could be used to stabilise the overall fuel price, postponing real increases for the duration of the recession but offsetting the substantial fall in prices that can be expected to accompany an economic downturn. In addition, congestion charging, parking and other policies applied within city regions, possibly supported by taxation of free parking provided by employers, should be

used to both manage city centre traffic and provide revenue sources to fund improvements in public transport.

- Bus and light rail subsidies at both the national and local level should be targeted to achieve the maximum possible abstraction from car use and ensure improved service quality. Such measures can be usefully supplemented with the deployment of smartcard and other technology that makes public transport much simpler and more convenient for passengers to use. Policies of this kind can be expected to benefit lower income groups while encouraging those on higher incomes to consider bus and light rail services for local journeys.

- Current policy to increase the share of passenger revenue in overall rail funding should be revisited. Specifically, policy in respect of rail fares should be redefined to ensure that the real level of regulated fares remains at the current level. This would involve replacing the RPI+1 formula currently applied with RPI+0. In addition, DfT should work with train operators to enable them to offer a wider range of discounts to encourage greater rail travel on the part of those groups most willing and able to switch from car.

- In the case of aviation, the impact of the EU Emissions Trading Scheme on the demand for air travel is uncertain, not least because it will only apply to aviation from 2012. However, the introduction of the Aviation Duty in the UK affords a more immediate opportunity to use the price mechanism to reduce carbon emissions from domestic and international flights.

6.35 In addition, any short term measures designed to reduce the effects of recession should be assessed in terms of their potential impacts on the transport sector as a whole together with any associated effects on carbon emissions and climate change. Hence, reductions in motoring taxation, while they could provide relief for businesses and households, should be avoided if they are likely to undermine the viability of commercial transport operators at a time when demand for public transport is anyway likely to fall. Equally, even temporary measures must take account of the substantial additional costs of deferring attempts to address climate change, as highlighted by the *Stern Review on the Economics of Climate Change*.

6.36 The success of transport pricing policy in both the short and the long term will depend partly on the detailed design of individual measures. However, more critically it will require a clear commitment on the part of Government to set well-defined carbon reduction targets for transport and to demonstrate effectively the link between the targets and the package of initiatives proposed. As is invariably the case with a challenging policy agenda, once the commitment has been set in legislation and the will to act established through political leadership, developing the detailed policy levers will be much more straightforward.

APPENDIX

A

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APPENDIX

B

MODELLING ASSUMPTIONS

B1. MODELLING ASSUMPTIONS

APPENDIX: TABLE B1.1 CAR - PRICE ELASTICITY W.R.T FUEL PRICES

Horizon	Segment	Elasticity	Source
Short Term	Urban	-0.15	Goodwin (1992) (referenced in TRACE study cited in Section 5)
	Rural	-0.15	Goodwin (1992) (referenced in TRACE study cited in Section 5)
Medium Term	Urban	-0.3	Goodwin (1992) (referenced in TRACE study cited in Section 5)
	Rural	-0.3	Goodwin (1992) (referenced in TRACE study cited in Section 5)
Long Term	Urban	-0.4	Goodwin (1992) (referenced in TRACE study cited in Section 5)
	Rural	-0.4	Goodwin (1992) (referenced in TRACE study cited in Section 5)

APPENDIX: TABLE B1.2 CAR - PRICE ELASTICITY W.R.T. PURCHASE PRICE

Horizon	Segment	Elasticity	Source
Short Term	Urban	-0.0	SDG Assumption
	Rural	-0.0	SDG Assumption
Medium Term	Urban	-0.74	McCarthy (1996)
	Rural	-0.74	McCarthy (1996)
Long Term	Urban	-0.74	McCarthy (1996)
	Rural	-0.74	McCarthy (1996)

APPENDIX: TABLE B1.3 RAIL PRICE ELASTICITY

Horizon	Segment	Elasticity	Source
Short Term	LSE	-0.3	PDFH
	Long Distance	-0.9	PDFH
	Regional	-0.9	PDFH
Medium Term	LSE	-0.3	PDFH
	Long Distance	-0.9	PDFH
	Regional	-0.9	PDFH
Long Term	LSE	-1.0	OXERA
	Long Distance	-1.14	OXERA
	Regional	-1.14	OXERA

APPENDIX: TABLE B1.4 BUS PRICE ELASTICITY.

Horizon	Segment	Elasticity	Source
Short Term	London	-0.43	White Book
	Non-London	-0.42	White Book
Medium Term	London	-0.56	White Book
	Non-London	-0.56	White Book
Long Term	London	-1.01	White Book
	Non-London	-1.01	White Book

APPENDIX: TABLE B1.5 AVIATION PRICE ELASTICITY

Horizon	Segment	Elasticity	Source
Short Term	Domestic Air	-1.0	SDG assumption (based on sources cited in Section 5)
Medium Term	Domestic Air	-1.0	SDG assumption (based on sources cited in Section 5)
Long Term	Domestic Air	-1.0	SDG assumption (based on sources cited in Section 5)

APPENDIX: TABLE B1.6 GENERATION ABSTRACTION MATRIX

To	From	Rail			Car		Bus		Dom air	Generated
		LSE	LD	REG	Urban	Rural	Lon	Non Lon		
Rail	LSE	0.0%	0.0%	0.0%	16.2%	16.8%	16.4%	24.6%	0.0%	26.0%
	LD	0.0%	0.0%	0.0%	30.0%	10.0%	0.0%	0.0%	25.0%	35.0%
	REG	0.0%	0.0%	0.0%	29.4%	30.6%	8.0%	12.0%	0.0%	20.0%
Car	Urban	10.0%	5.0%	1.2%	0.0%	0.0%	2.0%	3.0%	1.0%	78.0%
	Rural	5.0%	1.0%	1.0%	0.0%	0.0%	0.0%	2.0%	1.0%	90.0%
Bus	Lon	5.4%	0.3%	0.3%	15.2%	15.8%	0.0%	0.0%	0.0%	63.0%
	Non-Lon	54.0%	3.0%	3.0%	10.8%	11.2%	0.0%	0.0%	0.0%	18.0%
Domestic air		0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	50.0%

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