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## ***Demographic Determinants of Daily Travel Demand***

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### **Abstract**

Per capita demand for daily travel in a number of developed countries has ceased to grow, which means that demographic change, both growth and ageing of the population, will be the main determinant of future travel demand and traffic levels. The effect of demographic change on travel demand arises through changes in land use which in turn are affected by planning policy. In particular, how the additional population will be housed, whether on greenfield or brownfield sites, will be important for decisions on investment in the transport system. Increased population density within existing urban areas facilitates access and is best served by public transport. The declining share of car-based journeys in London illustrates the scope for containing traffic congestion and carbon emissions.

Key words: traffic, travel demand, population, ageing, carbon emissions

### **1. Introduction**

Travel demand has grown historically as incomes have risen. This has been the case for both personal travel and freight transport. However, in recent years in Britain, per capita daily travel demand has uncoupled from income (Metz, 2010), as has freight

tonne-km from GDP (McKinnon, 2007). It was previously proposed that per capita demand for daily travel in Britain has saturated because high levels of access and choice have been achieved through the development of the modern transport system (Metz, 2010; Metz, 2011). If these trends persist, future demand for travel would be driven mainly by population growth and other demographic changes. Where the additional population may live and work will be an important determinant of travel mode choice, as between car-based and public transport.

This paper discusses the implications of population growth in Britain, for which relevant detailed data compilations and projections exist. Also discussed are the implications of the ageing of the population for travel demand and transport provision. Of particular interest are developments in London, an economically dynamic world city with a growing population which is becoming increasingly dependent on public transport and is a possible model for other large growing metropolises. Although the evidence considered is largely from British sources, such data as are available for other developed countries do not suggest that the policy conclusions of the paper need be restricted to Britain.

## **2. Personal travel in Great Britain**

The National Travel Survey of Great Britain is the longest and most comprehensive time series compilation of travel behaviour available. It is based on seven day travel diaries and covers all personal travel other than international travel by air. The data set extends back to 1972-73. Currently the annual sample size is about 20,000. The features of the Survey, including the changes and revisions, have been discussed previously (Metz, 2010). The time series data for average distance, travel time and trip frequency, per person per year, are shown in Figure 1, up to 2010.

[insert Fig 1]

The average trip rate has held steady at about a thousand journeys per person per year over the nearly four decades of the Survey, while the average travel time has been about an hour per person per day throughout. The average distance travelled increased from 4500 miles per year to reach 7000 miles in 1995, since when there has

been little further change (other than a downturn in the past three years, most likely reflecting a temporary effect of the economic recession).

Average distance travelled grew in parallel with real household incomes up to the 1990s, after which these parameters became uncoupled, as shown in Figure 2. A similar phenomenon is seen in relation to the growth of freight moved on roads in Britain by Heavy Goods Vehicles, where tonne-km decoupled from GDP in the late 1990s, as shown in Figures 3 (the recent effect of the recession is particularly visible).

[insert Figures 2 and 3]

The cessation of growth of personal travel, as measured by average distance travelled, has been discussed previously, where it was proposed that the demand for daily travel has saturated (Metz, 2010). For the purposes of the present paper, the implication is that there is no reason to expect per capita personal daily travel to grow in the future. Likewise, it would be reasonable to assume that road freight will also not grow further (see McKinnon (2007) and Metz (2011) for discussion of trends in road freight transport).

### **3. Population growth**

The population of Great Britain (ie the United Kingdom less Northern Ireland) is estimated to be 62m in mid-2010, up from 55m in 1970 (ONS, 2011). The current official principal projection is of a population of 70m by 2035 and, more speculatively, 80m by 2070 (ONS, 2009). This projected population growth, of some 8m over the next quarter century, is the predominant source of the future increase in travel demand and in traffic.

Much depends, however, on where the additional population lives and works.

Historically, the growth of the housing stock has largely taken place on greenfield sites, on the edges of existing settlements or, on occasion, in the form of entirely new towns. In recent years, however, new housing in Britain has predominantly been erected on 'brownfield' sites, that is, on previously developed land. This is the result of national policy that at least 60% of new housing should be provided on previously developed land (DCLG, 2010a), as well as of local resistance to greenfield

development. Indeed, in 2009 80% of new dwellings, including conversions, were on previously developed land (DCLG, 2010b).

New houses on greenfield sites at relatively low densities in pleasant environments, priced to sell, have always been attractive. Car-based mobility is the preferred transport mode. On the other hand, brownfield developments within existing urban boundaries allow little opportunity for additional carriageway construction and thus for car use, particularly when the road network is already congested at times of peak usage. Hence more public transport provision is the natural response to the mobility needs of growing urban populations. The recent and future development of London illustrates the possibilities.

#### **4. London**

At the beginning of the nineteenth century the population of London was one million. It grew to over six million by the beginning of the twentieth century, reaching a peak of over eight million by mid-century. There was then a period of decline, with a loss of 1.2m during the 1960s and 1970s, as some people chose suburban and rural lifestyles. After a period of stability in the 1980s, London's population has grown steadily from 6.8m to reach 7.6m by 2008. In this context, London comprises the administrative area of Greater London within which there are 32 boroughs together with the small historic City of London. The population of London constitutes about 12 % of the UK population, 80% of which live in urban areas.

The forward projection is for continued growth, with around 1.3m more people and more than 750,000 additional jobs by 2031 (TfL, 2010). Population growth has been within the existing urban boundaries, such that 96% of capacity for new housing comes from formerly used sites (GLA, 2009).

Population growth in London over the past two decades has been accompanied by declining relative car use and increasing popularity of public transport. Figure 4 shows data from the National Travel Survey for London: average distance travelled by all modes held steady over the decade to 2005, while distance travelled by public transport increased perceptibly while distance by car use fell. Figures 5 shows estimates made by Transport for London of share of journeys by mode, 1993-2008:

again, private transport has been declining while public transport use has been increasing, with walking and cycling staying level. Note that the total number of car-based trips – driver and passenger - has held steady over the period at about 10m per day, consistent with a fixed amount of road space, but the share of car-based journeys has fallen on account of population growth (TfL, 2010, Table 2.1). Private transport mode share is projected to decline to 37% by 2031 (Mayor, 2010, Chapter 2), compared with peak car use in London of 50% of all trips in the early 1990s.

[insert Figures 4 and 5]

The recent past and projected future experience of London illustrates the way in which increasing population density in an urban area may be accompanied by a shift from private to public transport use.

## **5. Population ageing**

The population of Britain is ageing as well as growing. Over the period 2008-2035, on the official principal projection, the proportion of the population age under 16 years is expected to fall from 18.8% to 17.8%, while the proportion age 65 and over increases from 16.2% to 22.9% (ONS, 2009). In the longer run, the proportion over age 65 is sensitive to assumptions made about life expectancy, fertility and migration, and by 2080 could be in the range 20-35%.

The ageing of the population arises from two main developments: life expectancy is increasing, and the baby boom generation is approaching later life. The implications of a larger cohort of older people, the baby boomers, might be projected on the assumption that their travel behaviour would be similar to earlier cohorts, allowing for trends such as the increase in the proportion of older women holding a driving licence. However, life expectancy has been growing rapidly – period life expectancy at birth in Britain has increased by more than two years per decade in recent years and is projected to continue to increase in the coming years. The question that arises concerns the propensity to travel in these extra years of later life, which depends importantly on health status.

Debate continues about whether late life disability is increasing or decreasing; the balance of evidence suggests that deterioration is being postponed, so that levels of health that used to be prevalent at age 70 now prevail at age 80 (Vaupel, 2010). One implication is that people will continue to drive until more advanced ages, given the attractions of the car for gaining easy access to desired destinations. On the other hand, the larger baby boom cohort will mean greater numbers reaching the point when people give up driving on account of the impact of multiple minor morbidities – musculo-skeletal, sensory and cognitive. This in turn implies a greater need for provision of alternative means for providing mobility and access.

Within the broad pattern of demographic change encompassed by the term ‘population ageing’, there may be other trends of relevance to travel demand. Figure 6 shows how driving licence holding varies with age in Britain. For men in their thirties, licence holding has held steady at above 85% since 1975, whereas for men in their twenties there has been a significant decline since the early 1990s to 67% at present. Licence holding by both men and women over age 70 has been increasing, approaching saturation for the former, while the latter lag considerably.

[insert Figure 6]

## **6. Discussion**

The findings of the British National Travel Survey show that personal daily travel has ceased to grow since about 1995 (see Figure 1). This survey covers all personal travel other than international travel by air. Car travel per capita has also ceased to grow in recent years in Britain (Lucas and Jones, 2009). Puentes and Tomer (2008) have reported that vehicle-miles travelled per capita in the US ceased to grow after 2000 and have been falling since 2005. Millard-Ball and Schipper (2011), analysing data for eight developed countries, have noted signs of a levelling out, or saturation of growth, of total motorised per capita passenger travel since the early years of the twenty first century. There is therefore emerging evidence of a general phenomenon in developed economies of cessation of growth of personal daily travel.

Both the cessation of growth of personal travel and of road-born freight transport arose at about the same time (the mid-nineteen-nineties) in Britain, even though real personal incomes and GDP have continued to rise (Figures 2 and 3). The cessation of growth of personal travel has been attributed to a saturation of demand for daily travel on account of the high levels of access and choice available from modern transport systems (Metz, 2010). McKinnon (2007), discussing the possible reasons for freight decoupling, notes that the spatial concentration of economic activity has traditionally been one of the main drivers of road freight growth, but that this process is now at an advanced stage and cannot continue indefinitely. In effect, the development of the modern trunk road system allowed improved access to outlets for the freight distributors, a process in which returns inevitably diminish, leading to demand saturation. There is therefore the possibility of a common cause for cessation of growth of both personal travel and road freight, arising from the high levels of access achieved with a modern road transport system.

Regardless of the causal explanation, the absence of future growth in per capita personal daily travel would seem a reasonable assumption for a central case, business-as-usual scenario. The future growth in travel demand and in traffic would therefore arise essentially from population increase and other demographic changes. Growing incomes would not be a driver of travel demand – a significant departure from assumptions made in conventional modelling and forecasting.

The implications of population increase for travel demand depend importantly on where the additional population is located, both as regards employment and residence. The UK Department for Transport's National Trip End Model (NTEM) dataset allows transport planners to draw upon projected multi-modal travel data related to car ownership and population and workforce planning data, taking account of projected population growth (DfT, 2008). However, the fine detail of this model does not facilitate a strategic perspective in which a useful high level distinction can be made between greenfield and brownfield locations for additional dwellings and employment. Greenfield developments have been the main means in which population growth has been accommodated over the past two centuries, as faster modes of travel have allowed cities to expand their suburbs and surrounding towns

and villages to grow as dormitories for commuters. Car-based mobility has become central to suburban and rural living.

In contrast, there has been a revival in urban living in recent years, for which the car is less central. This is exemplified by London, where the share of journeys by car has been declining as the population has grown within existing boundaries (Figures 4 and 5 ) and is projected to decline further as population growth continues. The relegation of the car is most marked in the urban regeneration that has taken place in the former Docklands area, particularly on the north side of the River Thames to the east of central London. London was the UK's largest port until the coming of the container revolution, the result of which was that the working docks migrated downriver and elsewhere, and the historic London docks were entirely closed by 1980.

Redevelopment was catalysed by crucial rail-based transport developments – the Docklands Light Railway and subsequently the extension of the underground Jubilee Line. This rendered Canary Wharf readily accessible – ten minutes travel time – from the historic financial centre of the City, with the result that a second financial district has grown up over a twenty year period, with a working population of approaching 100,000. There are only 3000 car parking spaces at Canary Wharf, reflecting the very large reliance on urban rail travel, with a further underground line – Crossrail – under construction.

The trend of declining car use in London is remarkable – from 50% of all journeys in 1993 to 41% in 2008. Historically and globally, as incomes have grown so has car use. Yet in London, a world city with a vibrant economy and median incomes in the inner boroughs 50% above the national average, this trend has gone into reverse. Moreover, the Mayor of London's Transport Strategy plans for continued population growth and continued decline in car mode share to 37% in 2031. This strategy involves substantial investment in public transport, both rail and bus, and there is also encouragement of walking and cycling, with the aim of increasing the mode share of cycling from 2% to 5% of trips by 2031 (Mayor, 2010). A cycle hire scheme has recently been started in Central London, which is planned to grow to 8000 bikes available from 14000 docking points.

The relative decline in car use in London has been fostered by the provision of more and better public transport, but also by a number of circumstances that constrain car use, in particular: a fixed road network, with a greater share of carriageway allocated to bus lanes; enforced restrictions on, and general charging for, parking during working hours; and the Central London Congestion Charging scheme. The increasing population density implies smaller catchment areas, whether for schools or supermarkets, which in turn allows readier access by walking, cycling and public transport. Higher population density of urban areas is associated with greater use of public transport (Pisarski, 2006; CIFT, 2009).

The trend of increasing urban density in inner city areas first seen in London has spread to other economically buoyant British cities over the past decade, including Manchester, Nottingham, Bristol and Sheffield, as employment in finance and business services has grown. This reflects a break from the previous long term trend of declining inner city populations and shift of employment to low density residential areas in the urban periphery and beyond (WSP, 2010).

The population of Britain is not only growing. In common with other developed countries, it is ageing. The proportion of older people is increasing, as life expectancy increases and as the baby boom cohort moves into later life. The implications of an ageing population for transport provision have attracted increasing interest (Metz, 2003; Schwanen and Paes, 2010). Mobility is important for quality of life, and loss of mobility in later life is detrimental, not just in respect of access to desired destinations, but also loss of the incidental benefits – getting out and about, exercise and social engagement (Metz, 2000; Banister and Bowling, 2004).

Population ageing has implications for travel demand and for transport provision. On the one hand, the growing proportion of older women able to drive (Figure 6) allows the convenience of car-based mobility for more people in later life. On the other hand, this increases the impact of a key decision - the timing of giving up driving, usually prompted by the cumulative impact of a number of minor disabilities – visual, hearing, musculo-skeletal, and cognitive. Alternative means of mobility and access are then needed, the demand for which will increase as the population ages. In Britain, one response has been the provision of free off-peak travel on buses for older

people. Another is the growing use of pavement-running mobility scooters, well suited to preserving personal mobility in dense urban areas for those with ambulatory disabilities (DfT, 2010).

A further noteworthy demographic trend in Britain is the decline in driving licence holding by men in their twenties, from a peak of over 80% to 67% currently (Figure 6). The most common reasons given by this group for not driving are the cost of learning to drive, of car ownership and insurance (NTS, 2009, Table 0203). Possible further factors are the larger proportion of the age group entering higher education, where the car is not central to the student life style, and the increasing popularity of a range of mobile telecommunications devices for keeping in touch with friends and relatives.

In recent years, there has been a growing interest in a range of transport policy initiatives designed to influence people's travel behaviour away from single-occupancy car use and towards more benign and efficient options, through a combination of marketing, information, incentives and tailored new services – often described as 'Smarter Choice' measures. Such measures include workplace and school travel plans, personalised travel planning, information and awareness campaigns, car clubs and car sharing schemes, and tele-working, -conferencing and – shopping. There is debate about the efficacy of such measures. One review has concluded that Smarter Choice measures have the potential to reduce national traffic levels by about 11% (Cairns et al, 2008). Another review identified a number of interventions as potentially effective but concluded it was difficult to draw robust conclusions from current evidence given the small number of methodologically strong studies (Graham-Rowe et al, 2011). Both older people and younger people could be new target groups for efficacious interventions. Older people may be persuaded to give up the car earlier, and younger people to defer car ownership for longer, if the needs for access and mobility of both groups could be met adequately in other ways.

In the recent past, investment in the transport system responded largely to the growth of car ownership and use that accompanied the rise of personal incomes. Since the mid-1990s rising incomes are no longer the prime driver of travel demand in Britain and the other developed economies that have been studied. Accordingly, it is now

demographic change, both the increase in total population and in the numbers in later life, which drives the growth of travel demand and the need for further transport investment. However, the impact of population growth is modulated by policy decisions on the location of new housing. Additional people housed on greenfield sites would depend largely on the car, and would need more and better managed road capacity. Extra people on brownfield sites within existing urban areas, where scope for creating additional road capacity is very limited, would need to use public transport and well as walking and cycling – hence the need for more and better local buses for young and old; urban and commuter rail and Bus Rapid Transit for reliable work-related journeys; and high speed rail for city centre to city centre travel.

In recent years, residential growth in Britain has been substantially in city living developments in urban cores. Government policy has been successful in focusing new developments on brownfield land and in cities and in achieving an increase in residential density. Nationally, 80% of new dwellings in recent years have been on previously developed land. The intensification of high density suburbs has proved crucial, accommodating in excess of 95% of all new dwellings in London (DCLG, 2010b). However, the new National Planning Policy Framework, issued for consultation in 2011, proposes to withdraw the previous target that 60% of new dwellings be built on brownfield land (DCLG 2011). If implemented, this could make it more difficult to achieve carbon reduction and other policy objectives.

The potential impact of such a policy shift is illustrated by a comparison of car ownership and use in London with the adjacent South East region. These two regions are broadly similar in respect of average household income and life expectancy although London has a smaller proportion of the population over age 65 (11.5%) compared with the South East (17%). 43% of London households are without a car (South East 19%) while the average distance travelled by car (driver and passenger) is 2740 miles per person per year in London (South East 6030 miles) (2008/09 data from NTS, 2020). These factor of two differences indicate the importance of location for travel behaviour.

Meeting the access needs of a growing urban population mainly by means of improved public transport serves wider policy objectives. It helps constrain the

growth of carbon emissions from the transport sector, both by substituting for car use and facilitating electrification (CCC, 2010). It better meets the needs of non-car owning younger and older people, as well as reducing traffic congestion and promoting economic development. These aspects are facilitated by an integrated approach to policy, as provided by the governance arrangements for London which give the Mayor of London responsibilities for oversight of economic development, housing and land use as well as transport. The Mayor's Transport Strategy projects employment growth very largely in the inner boroughs, hence the need for investment in radial rail-based schemes such as Crossrail and Thameslink (Mayor, 2010). However, there is less coherence nationally, and in other regions of England, as regards coordination of transport investment in response to demographic trends, land use changes and economic development.

The transport sector has generally been seen as less tractable than other sectors of the economy in respect of reducing greenhouse gas emissions. However, there are two emerging lines of evidence which point the other way. First, there is the cessation of per capita growth of daily travel in developed economies, as discussed above. Second, there is the global trend to urban living, with 50% of the world's population now resident in urban areas, up from 36% in 1970 and projected to grow to 69% by 2050 (UN 2009). The experience of London, involving a declining share of journeys by car while population and prosperity are both increasing, potentially has implications for other major urban centres. A high quality public transport system, particularly rail-based for journey time reliability and low emissions, can serve to constrain the historic growth of private transport, even amongst those who can readily afford to own a car. It is noteworthy that London's new financial centre, at Canary Wharf in the former Docklands, has been made possible by new high quality rail transport, which has proved acceptable, despite overcrowding at times of peak use, to the well-paid staff of the international businesses that have chosen to locate there.

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## Figures

Figure 1 Average distance travelled (miles), travel time (hours) and trips, per person per year. Source: NTS 2010, Table NTS0101

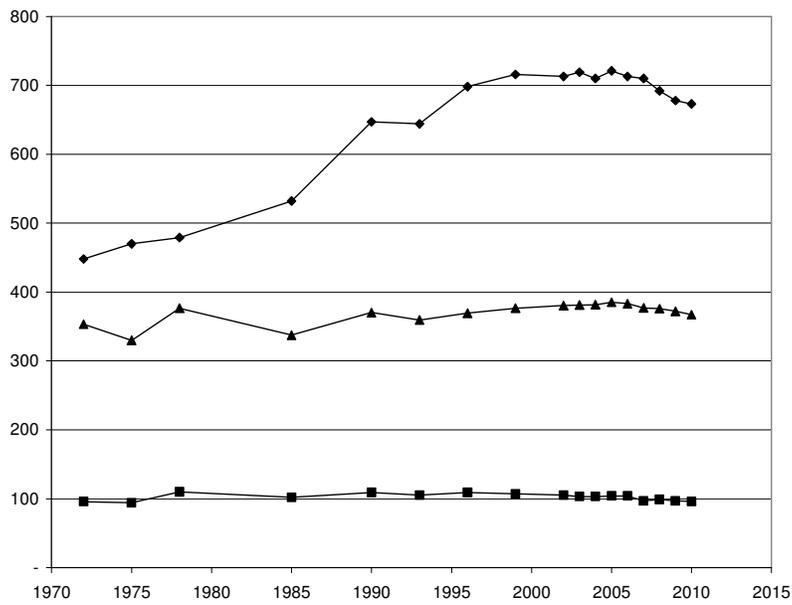


Figure 2 Growth of real household disposable income and average distance travelled (1972 = 1.0). Source: Economic and Labour Market Review Nov 2010, UK Economic Accounts Table 1.6, (London: Office for National Statistics); and NTS 2010.

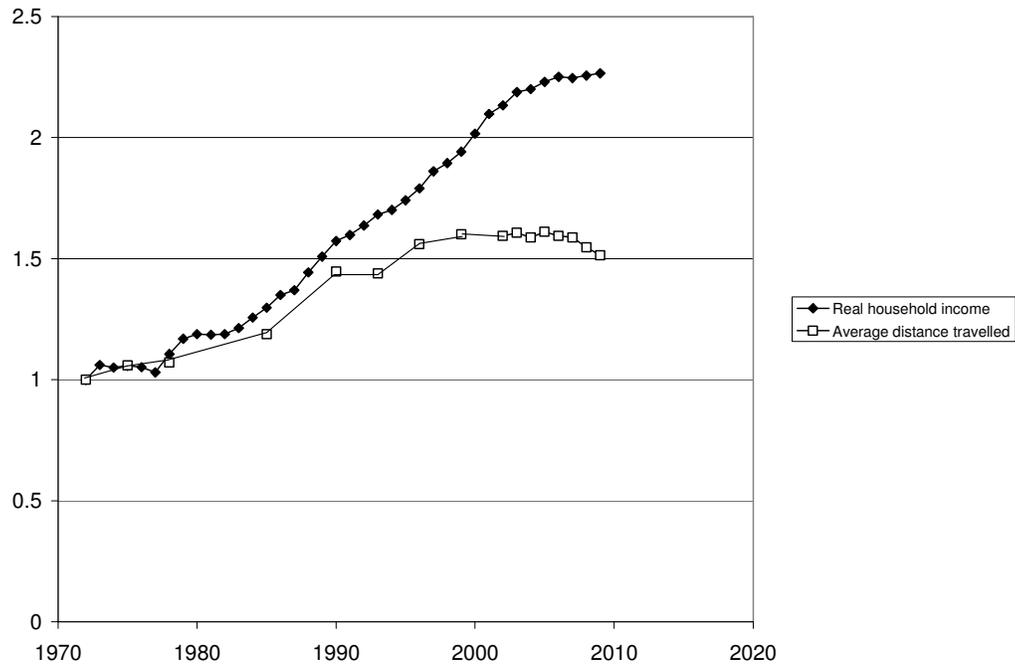


Figure 3 Growth of GDP and road freight tonne-km (1980 = 100) Source: GDP at market prices (chained volume measures, series ABMI) (London: Office for National Statistics); Continuing Survey of Road Goods Transport, Road Freight Statistics 2009, Table 1.1, Department for Transport.

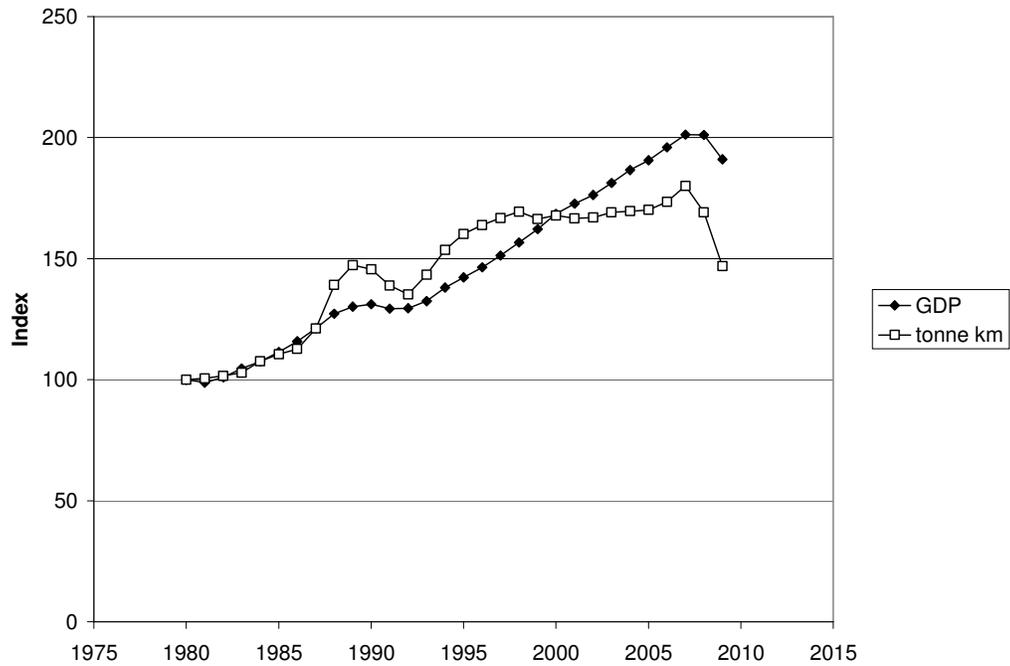


Figure 4 Average distances travelled (miles per person per year) in London, by car (driver and passenger), public transport (bus and rail), and by all modes including walking ('total'). Source: NTS data, three year rolling averages, supplied by the Department for Transport.

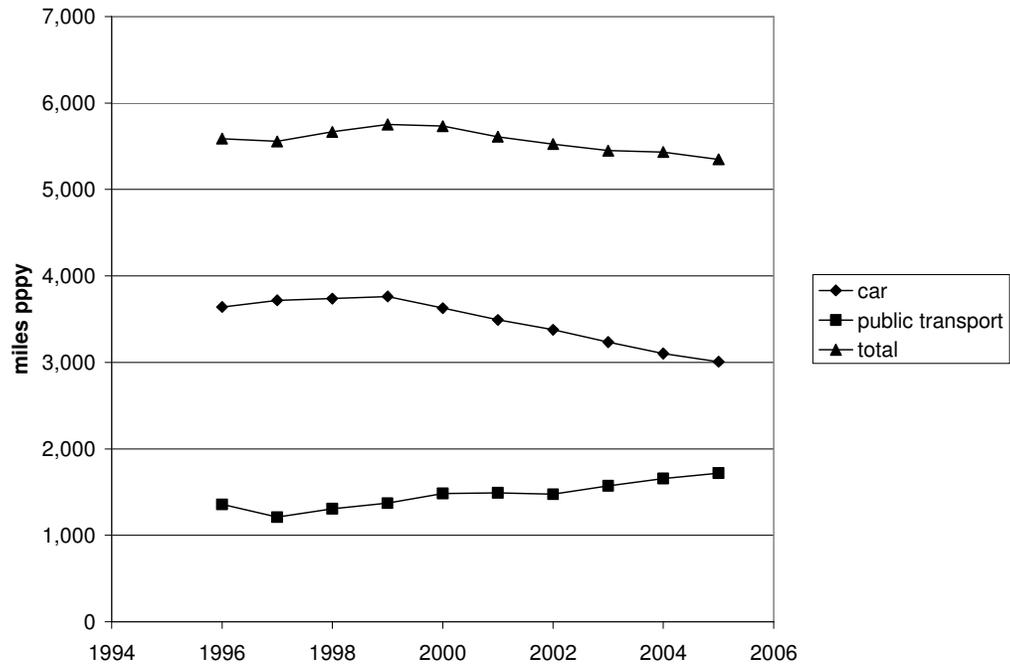


Figure 5 Trip based mode share by main mode in London. Source: TfL, 2010 Table 2.2.

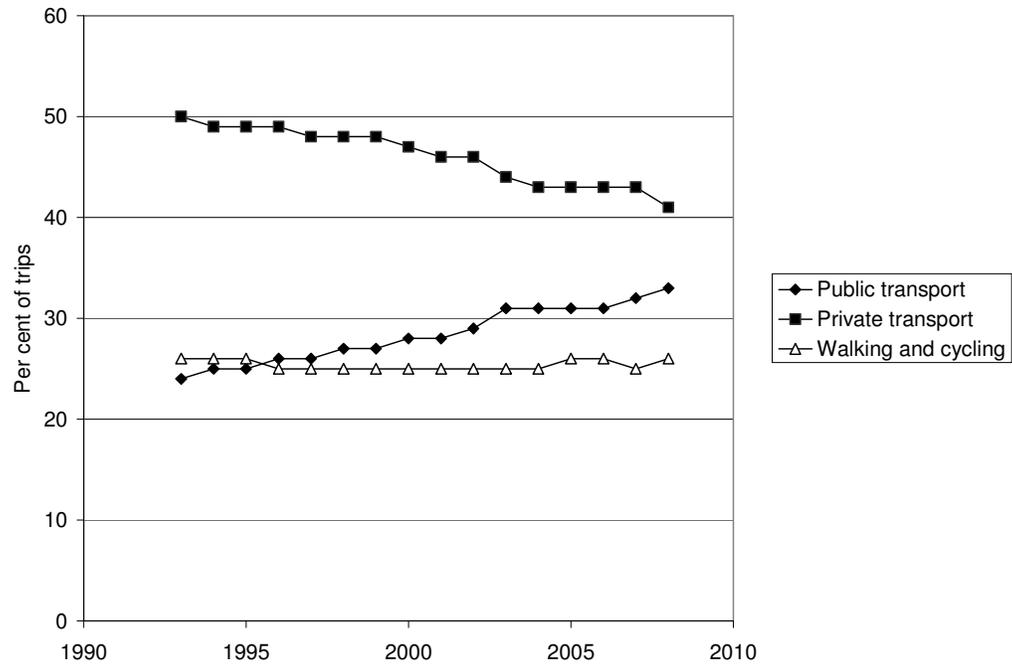


Figure 6 Driving licence holding in Great Britain by age and gender. Source: NTS, 2009, Table 0201

