LONG-TERM TRENDS IN MODAL SHARE FOR URBAN PASSENGER TRAVEL

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INTRODUCTION

When considering the effects of competition on patronage levels for urban public transport, an awareness of past trends in those levels is typically of significant value. In fact, a sound knowledge of how urban transport patterns have varied over time can be crucial for properly assessing the likely scope for any change to the current modal shares of the various urban passenger tasks.

At the Bureau of Transport and Regional Economics (BTRE), we have compiled datasets on a series of long-term trends in primary passenger tasks; not only at the national level, but also for each of the Australian capital cities. As an aid to discussions concerning either past effects of transport reforms (on passenger modal choice) or the possible extent of future patronage growth (for urban transit), this paper presents a summary of such modal trends, for each State and Territory capital city.

The BTRE has recently conducted a study of the avoidable social costs of congestion in Australia (reported in Working Paper 71, *Estimating Urban Traffic and Congestion Cost Trends for Australian Cities*, BTRE 2007). Congestion imposes significant costs on society – with interruptions to urban traffic flow lengthening average journey times, making trip travel times more variable, and making vehicle engine operation less efficient. The latter leads not only to higher rates of fuel consumption, than would otherwise have occurred, but also to poorer urban air quality (with vehicles under congested conditions typically emitting far higher rates of noxious pollutants than under more freely flowing conditions, resulting in even higher health costs to the community). As part of the investigation of congestion occurrence for Working Paper 71, long-term trends in traffic within the Australian capital cities were analysed. These trend analyses form the basis of the findings discussed in this paper.

The long-term task estimates (typically in terms of metropolitan passenger-kilometres) have been analysed with respect to the major underlying ‘drivers’ or generators of transport demand growth. For example, metropolitan passenger-kilometres *per person* have been increasing gradually for many years, alongside increases in average income levels. However, for most cities, that increase in annual travel per person now appears to be approaching a saturation level, despite income levels still continuing to rise. Therefore, the rate of increase in total city travel will tend, in the medium term, to more closely equal the rate of population growth of the city concerned. Functional forms for these saturating trends (in per capita travel) – that is, with respect to average income per person – have been derived for each capital city, and are illustrated within the paper.

As well as presenting the historical trends in transport tasks and modal shares, the paper also provides aggregate ‘business-as-usual’ forecasts of urban transport demand (and projections to 2020 of the consequent traffic growth in the Australian capital cities). Such forecasting processes entail examining the factors influencing the demand for urban road use, and assessment of trends in population growth and distribution, income growth, and demand for urban freight, service provision and passenger movement. The modal share projections allow for identified trends in public transport patronage and the possible consequences of such factors as rising fuel costs and increasing urban congestion levels.

The *aggregate* modal share analyses presented here are, of course, not meant to be prescriptive (that is, do not imply that prospects for patronage growth are necessarily limited by what has happened in the past, or that *city-wide* statistics on mode choice will also apply at all finer levels of geographic disaggregation). The potential of any *particular* policy aimed at growing transit patronage levels will generally have to be assessed at a greater level of detail, and will typically depend heavily on the particular attributes of the city areas to which it is proposed to apply. The aggregate values of this paper are given more for illustrative purposes – where the current mode share dominance of private car travel within Australian cities serves as a clear indicator of how challenging it would be to obtain any modal shift capable of substantially altering the existing relativity between the task share of cars and that of public transit (or of non-motorised modes).

GROWTH IN URBAN PASSENGER DEMAND

Total travel in the major urban areas of Australia has grown by around ten-fold over the last 60 years (with car travel growing more than twenty-fold).

Over the years since the end of the Second World War, Australian cities have been transformed from fairly tightly knit core-and-spoke configurations, to sprawling suburban low-density configurations. This transformation of urban land use has been accompanied, and made possible, by a rapid improvement and spread of the road system and an even more rapid expansion in car ownership (i.e. motor vehicles per person).

Referring to figure 1, it is evident how remarkably the total (motorised) passenger task in Australian metropolitan areas has grown over the last six decades. Almost all of that growth has come from the increasing use of light motor vehicles – primarily passenger cars, but also with contributions from other road vehicles such as light commercial vehicles (LCVs) when used for non-business purposes, and motorcycles.

Figure 1 shows the task levels, and their growth trends, in terms of total passenger-kilometres travelled (pkm) for the eight Australian capital cities, for all motorised modes. (Note that all data values refer to financial year, i.e. ‘Year ending June 30’, transport utilisation totals).

The total task estimates for 1945 to 1976 were derived from a combination of aggregate national data and, where available, State/Territory-specific travel trend information. The data from 1977 to 2004 represent the summation of estimates made by the authors for each of the 8 capital cities – using detailed jurisdiction-specific passenger data. The 2004 financial year was the most recent for which reasonably full patronage and travel data were available across all the capital cities, and any regression or curve fitting elements of the analysis typically were done using this 1977 to 2004 dataset. Preliminary task estimates have also been made, where feasible, for 2005 and 2006 (financial years), using the partial activity data so-far available. The base case projections (that is, forecasts of likely passenger demand under a business-as-usual scenario), also plotted in Figure 1, are derived on a primarily national aggregate basis – but using a methodology that allows for each State or Territory’s differing vehicle fleet and average personal travel characteristics.

Note that the values in this paper for ‘bus’ passenger tasks (not only in figure 1, but also in all table, figure and text values to follow) refer to total commercial bus usage in metropolitan areas (that is, all travel by commercial passenger vehicles with 10 or more seats). This includes not only the task carried by transit fleets, both privately-owned and government run, but also a lesser component of the total task due to charter/hire vehicles (which are often considerably smaller than a standard transit route bus). Therefore, any values given here for Urban Public Transport (UPT) tasks (which sum heavy rail, light rail, bus and ferry passengers) are generally a little higher than if only the task carried by dedicated transit vehicles was included in the ‘bus’ estimates.

Note also that the analyses of this paper essentially deal with *motorised* transport. Even though non-motorised travel (walking and cycling) forms a significant proportion of the total number of trips undertaken in urban areas, it accounts for only a small share of total urban passenger-kilometres. Walking, in total, would probably account for the order of 20 per cent of *unlinked* urban trips (that is, of the total number of different modal portions constituting complete origin-destination journeys), since a walking portion is involved in most urban travel. However, outings either purely by walking or involving a length greater than a kilometre will tend to entail less than half of this total number of trips. Since the average trip length for walking is quite short (typically in the range of 0.5 to 1.5 kilometres), walking trips potentially substitutable by vehicle travel probably account for only around 1 per cent of total urban passenger-kilometres. Overall, pedestrians probably account for less than 2 per cent of total urban pkm (Adena and Montesin 1988). Similarly, bicycle trips – with an average travel distance of around 2 to 3 km (Wigan 1994) – probably account for less than 1 per cent of the total urban pkm task.

With current urban kilometres travelled by passenger cars being over 15 times greater than at the start of the 1950s, the total metropolitan passenger task is now dominated by car travel. Of the approximately 180 billion passenger-kilometres performed within Australian metropolitan areas in 2005, over 150 billion are estimated as due to car use.

Each of the main modal passenger tasks are forecast to continue growing throughout the projection period (to 2020) – though, in aggregate, typically at a slower average growth rate than that over the last few decades. The aggregate level of metropolitan vehicle travel in Australia is expected to increase appreciably over the next decade and a half. The base case projections have total metropolitan passenger movement in Australia as likely to reach around 225 billion pkm by 2020, with car travel accounting for nearly 190 billion pkm. (Parts of the projection methodology are roughly outlined in a following section of the paper).

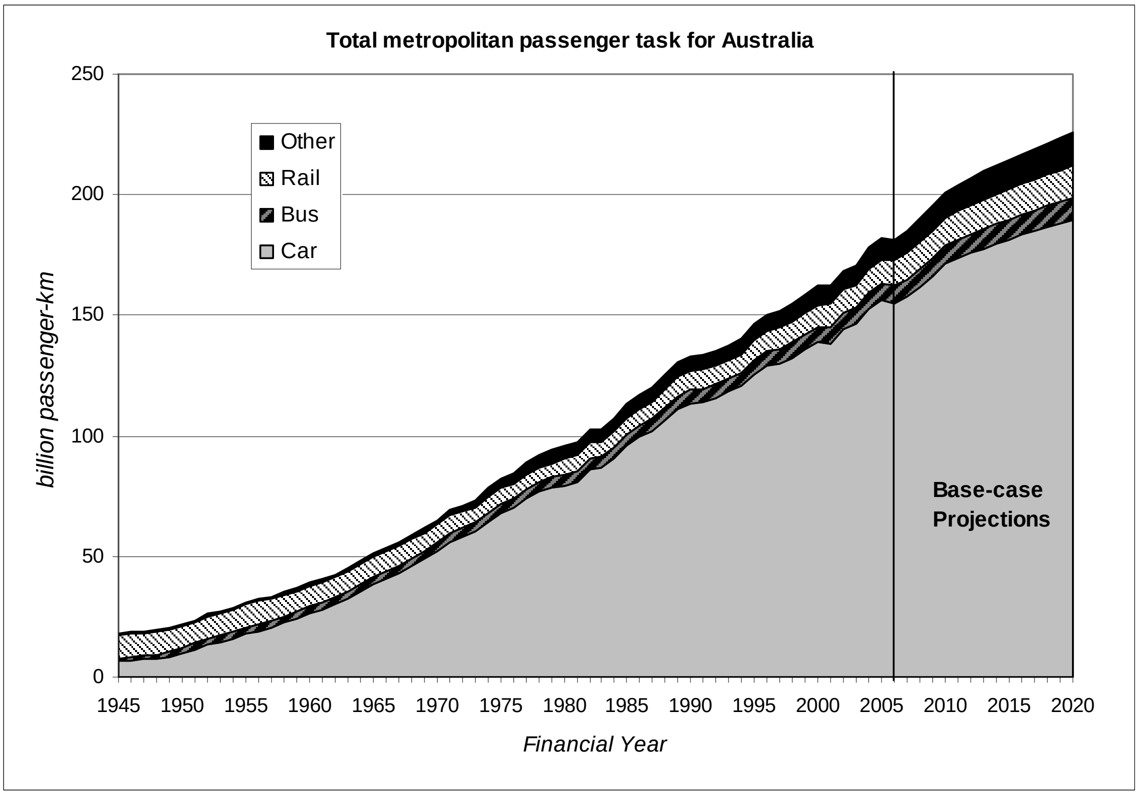

Figure 1: Historical and projected passenger movement, Australian metropolitan total

Note:	‘Other’ primarily consists of non-business use of light commercial vehicles (LCVs) - with small contributions from motorcycles, non-business use of trucks, and urban ferries.
Sources:	BTRE (2002, 2003, 2006, 2007), BTCE (1995, 1996), BTRE estimates.

CHANGES IN AGGREGATE MODAL SHARE

Figure 2 presents the long-term historical trend in passenger mode share, across all metropolitan travel, along with our base case projections to 2020 (using the modal proportions of the total passenger task given in figure 1). As shown in figure 2, private road vehicles (roughly equal to ‘car plus other’ in the graph) now account for about 90 per cent of the motorised passenger task in Australian capital cities. Urban public transport (UPT), though generally a major component of peak travel into central business districts, currently represents only about 10 per cent of the total metropolitan passenger task.

Moreover, UPT’s modal share has been remarkably constant since the early 1980s, when the long downward trend in the transit market share, from a level of over 60 per cent just after World War II, finally halted and levelled off. Rail transport accounted for more than half of total metropolitan passenger-kilometres up until around 1950 – but has since fallen to a national average mode share of only about 6 per cent. (Historical series of passenger task trends, by mode, are presented for each capital city within figures 8 to 23 to follow).

The current dominance of private motor vehicle travel, in aggregate mode share terms, is again clear (figure 2) – and even though our base case projections have annual UPT patronage growing at substantially higher rates than that for car travel, the enormity of the task disparity, between private vehicle use and public transit, means that the projected modal share of cars only decreases slightly over the forecast period to 2020 (under the 'business-as-usual' scenario).

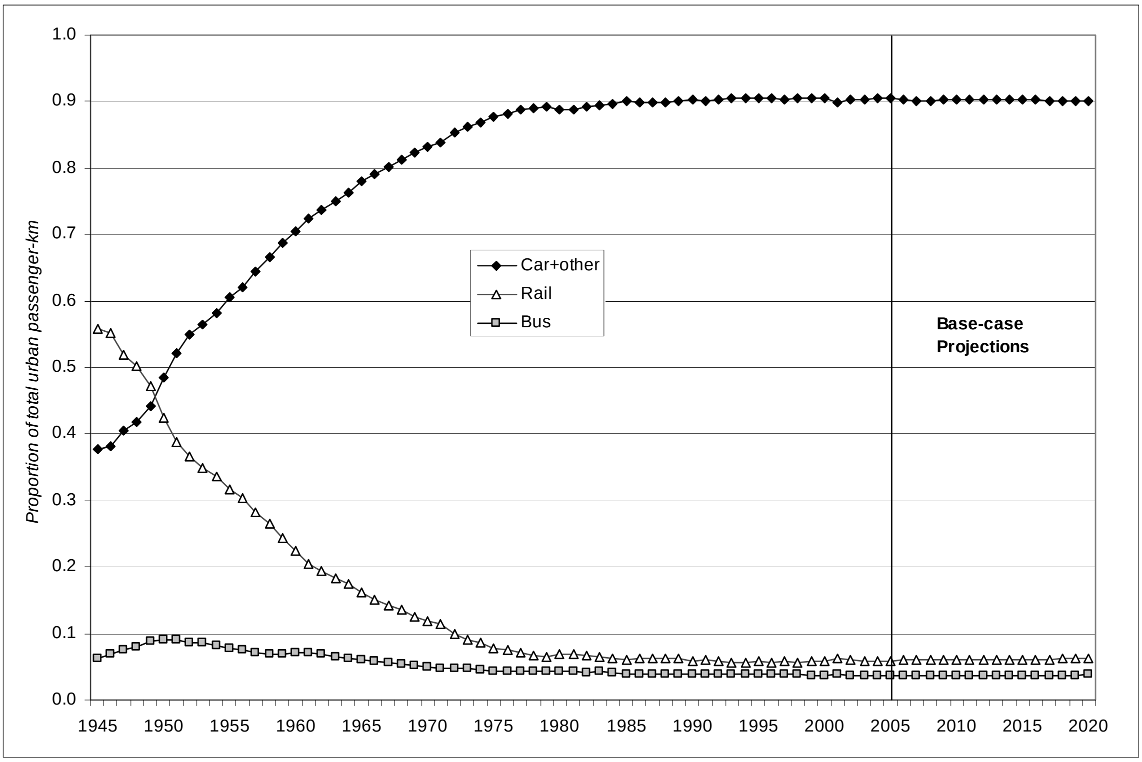

Figure 2: Historical and projected modal share, Australian metropolitan passenger travel

Note: 'Other' primarily consists of non-business use of light commercial road vehicles.
Sources: BTRE (2002, 2003, 2006, 2007), BTCE (1995, 1996), BTRE estimates.

The next two charts (figures 3 and 4) focus on the period 1977-2004, for which more detailed task data were available (on a city-by-city basis) than for the full time-series presented in figures 1 and 2. Within the total task levels of figure 3 – which again refer to summations of metropolitan passenger tasks across the eight Australian State and Territory capital cities – the UPT level has generally exhibited steady growth over the period, but for most jurisdictions only at rates comparable to the growth in travel by private road vehicles. This has resulted in the relative constancy of UPT share, in aggregate terms over the last 30 years (see figure 4), despite many jurisdictions pursuing a variety of operational reforms and infrastructure expansions during this period.

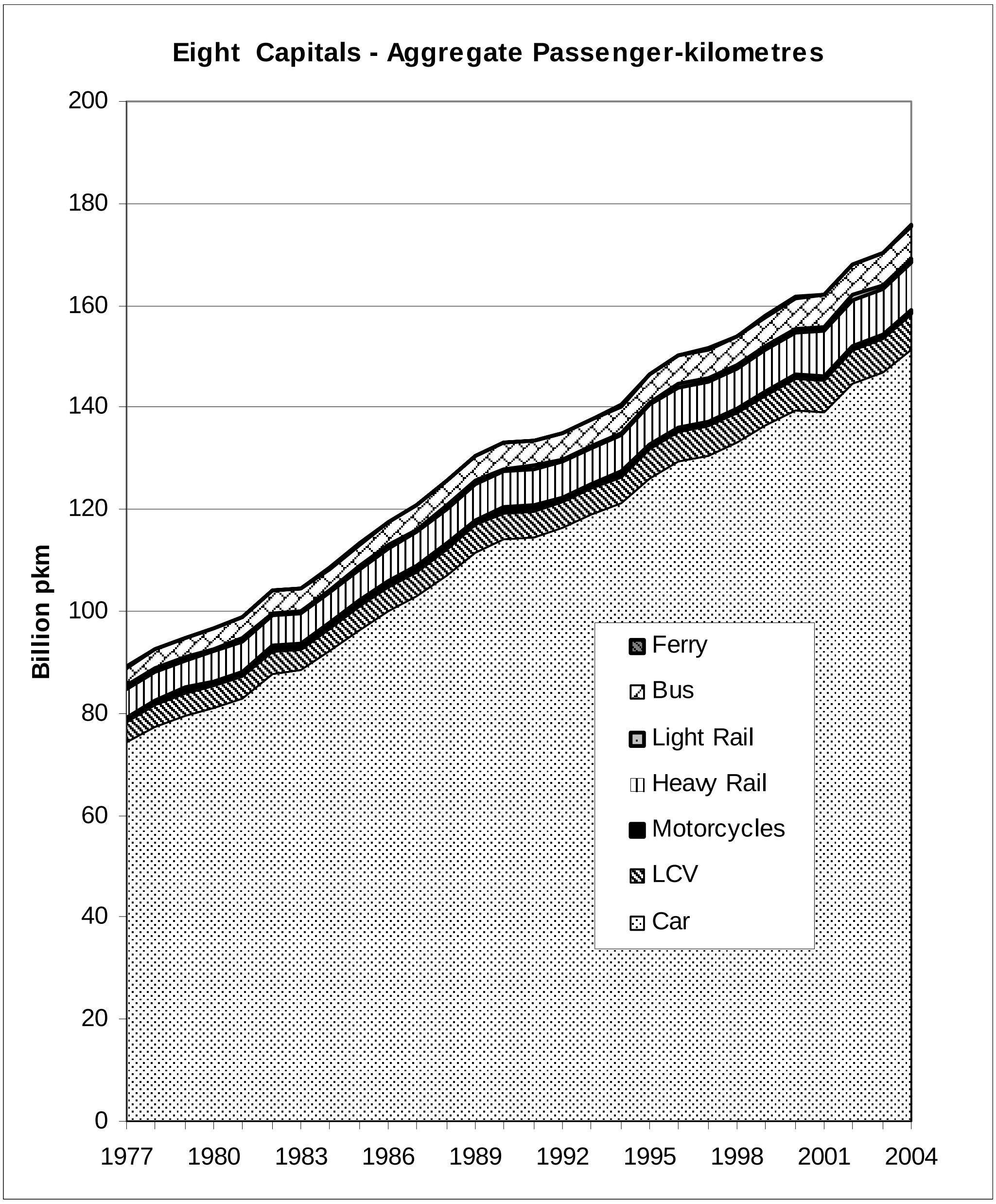

Figure 3: Historical trend in aggregate metropolitan passenger travel

Notes:	The 'LCV' task consists of non-business use of light commercial vehicles (LCVs).. The 'Bus' task comprises all travel by commercial passenger vehicles with 10 or more seats (i.e. not solely the task carried by large transit fleets).
Sources:	BTRE (2006, 2007), BTRE estimates.

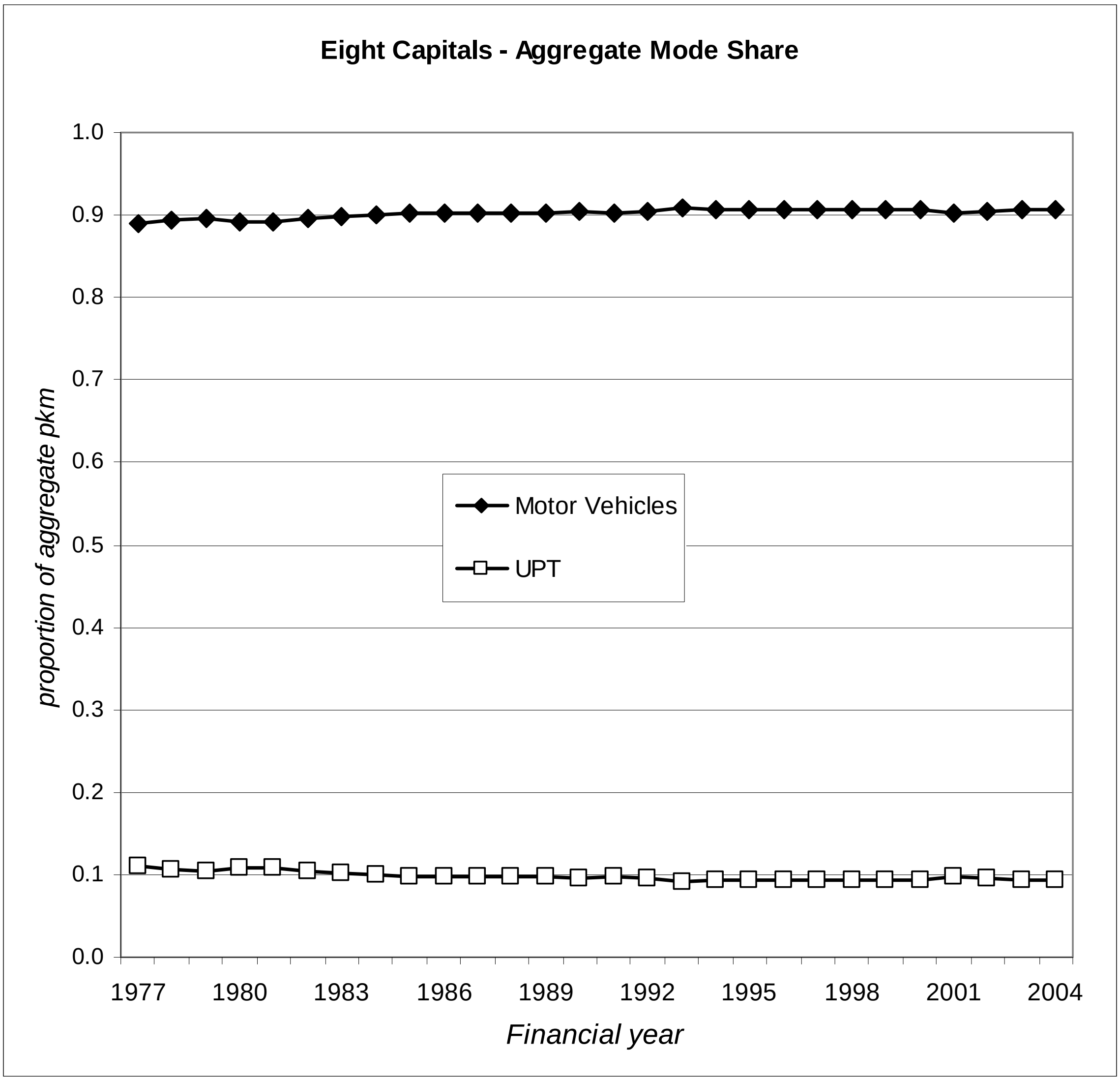

Figure 4: Historical trend in metropolitan passenger mode split

Note: The Urban Public Transport ('UPT') task includes all bus travel by commercial passenger vehicles with 10 or more seats (i.e. not solely the task carried by large transit fleets).

Sources: BTRE (2006, 2007), BTRE estimates

Note that some Australian cities have managed significant expansions to their UPT systems in recent years. Coupled with the current high fuel prices (acting to discourage private vehicle use), this has lead to substantial UPT patronage growth (in average metropolitan terms) over the last few years – especially since fuel sales data for 2006 imply that the spiking petrol prices caused a significant decline in average car use over that year (which can be observed in the estimates of figures 1 and 7). These factors will have lead to a certain amount of modal shift (towards UPT), following on from the end of the trend-lines plotted in figure 4 (which gives values up to 2004). However, the current paramount size of the private motor vehicle task means that it would take either a large decrease in the level of urban car use, or for the current UPT growth rates to continue over a very lengthy period, before the general shape of the modal curves plotted in figure 4 were noticeably altered. For example, preliminary national task estimates for the last couple of years imply that the past mid-term average for aggregate UPT mode share (right-hand values in figure 4) of around 9.5 per cent could have now shifted upwards, to a current value of close to 10 per cent. (Also, note that preliminary fuel sales data, for the first half of 2007, seem to imply that private motorisation levels are starting to rebound from their 2006 downturn).

This relative stability in modal split, over several decades of urban transition, demonstrates how much of a challenge it would be if future UPT patronage had to be grown at a rate high enough to substantially affect the aggregate mode share of cars (e.g. for emission abatement or congestion reduction purposes).

Note that the numerical data values underlying figures 3 and 4 are given in table 1.

Table 1: Aggregate metropolitan passenger task by mode, 1977-2004 (billion passenger-kilometres)

Fin. year	*Car*	*LCV*	*Motor-cycle*	*Heavy Rail*	*Light Rail*	*Bus*	*Ferry*	*Total*
1977	74.25	4.22	0.84	5.44	0.64	3.61	0.11	89.11
1978	77.32	4.53	0.85	5.39	0.62	3.80	0.11	92.62
1979	79.37	4.79	0.85	5.36	0.60	3.87	0.11	94.96
1980	80.89	4.56	0.91	5.75	0.58	4.00	0.11	96.79
1981	82.76	4.50	0.97	5.87	0.57	4.09	0.11	98.88
1982	87.77	4.40	1.02	6.03	0.57	4.16	0.11	104.07
1983	88.35	4.33	1.02	5.83	0.57	4.19	0.11	104.40
1984	92.02	4.64	1.02	5.85	0.58	4.22	0.11	108.45
1985	96.27	4.97	1.02	5.99	0.63	4.28	0.11	113.28
1986	99.96	5.02	1.00	6.38	0.65	4.41	0.11	117.52
1987	102.86	5.10	0.97	6.54	0.66	4.53	0.11	120.77
1988	107.06	5.33	0.95	6.84	0.68	4.68	0.11	125.64
1989	111.62	5.31	0.93	7.09	0.70	4.86	0.11	130.61
1990	114.22	5.24	0.90	6.96	0.64	4.95	0.11	133.03
1991	114.60	5.26	0.84	7.10	0.67	5.04	0.11	133.62
1992	116.25	5.15	0.84	6.96	0.63	5.08	0.11	135.03
1993	118.97	5.21	0.86	6.85	0.58	5.09	0.11	137.68
1994	121.14	5.37	0.84	7.10	0.59	5.22	0.11	140.36
1995	126.13	5.89	0.85	7.51	0.61	5.43	0.12	146.55
1996	129.41	5.99	0.80	7.65	0.64	5.53	0.12	150.14
1997	130.57	5.90	0.80	7.87	0.65	5.65	0.13	151.57
1998	132.98	5.99	0.76	7.87	0.65	5.72	0.12	154.08
1999	136.33	6.20	0.74	8.06	0.69	5.76	0.12	157.90
2000	139.29	6.43	0.74	8.36	0.74	5.87	0.12	161.55
2001	139.00	6.41	0.76	8.91	0.76	6.07	0.14	162.05
2002	144.63	6.74	0.77	8.98	0.78	6.08	0.13	168.11
2003	146.69	6.78	0.79	8.96	0.78	6.19	0.13	170.31
2004	151.27	7.11	0.85	9.23	0.78	6.31	0.14	175.68

Note: ‘Metropolitan’ results refer to all activity within the greater metropolitan areas (Statistical Divisions) of the 8 Australian State and Territory capital cities.

Sources: BTRE (2002, 2003, 2006), BTCE (1995, 1996), ABS (2006 and earlier), Cosgrove and Mitchell (2001), Cosgrove and Gargett (1992), BTRE estimates.

Per capita metropolitan travel

There are a whole series of underlying causes or ‘drivers’ of growth in transport demand (and in consequent transport energy consumption and transport emission levels). The main drivers (or generators) behind the growth in total passenger travel in our cities (as well as behind the growth in travel by private road vehicles) are increases in population and increases in per capita daily travel. The latter trend increase has principally been the result of rising per capita incomes, typically allowing greater choices in trip selection, and higher potential travel speeds, as urban road networks have developed over time. Demographic effects (including changes to land-use, urban form, or city density patterns) can also be important, with respect to how much daily travel increases; especially with the tendency for Australian cities to grow ever outwards (as the demand for increasing levels of residential living space has typically lead to more and more greenfield developments), often leading to longer average trip lengths.

People’s transport choices will furthermore depend on a whole range of factors – such as perceived safety, comfort or affordability. The desirability of any *extra* travel will depend on the overall costs of that travel – not only direct expenses like fuel prices or bus fares, but also in a more generalised sense, such as the travel time limits imposed by traffic congestion delays.

For many years, Australia has seen the complex interplay of all these underlying effects lead to steadily increasing levels of both personal mobility and the distribution of goods and services – particularly in parallel with the wider availability of motor vehicles.

The resulting historical trend of increasing passenger and freight tasks, essentially ever since the end of World War II, along with the increasing mode shares of motor vehicles, has lead to steadily increasing transport energy use and to the growing incidence of urban traffic congestion. Of course, transport systems that operate with such high private motorisation levels, and relatively low public transit patronage, will often not only have high social costs from congestion delays, but will also typically exhibit a range of detrimental environmental impacts. These can involve increased community health costs (e.g. from respiratory conditions associated with noxious vehicle emissions) and higher than optimal greenhouse emission levels (especially if the car fleet continues to be largely gasoline-fuelled) – particularly in the absence of any pricing mechanisms (such as carbon or congestion charges) to make motorists more aware of the social costs their travel imposes on other travellers and the wider community, as opposed to simply making their travel choice decisions based on their own private costs.

An important relationship underlying BTRE projections of these historical task trends into the future concerns the connection between rising income levels and per capita daily travel. Figure 5 plots approximately five decades of per capita passenger and freight movement estimates, for total Australian transport tasks, against the average income level at which the aggregate transport activity was undertaken.

Referring to Figure 5, note how markedly the growth rate in pkm (per person) has reduced in recent years (righter-most points on curve), especially compared with past very high growth in travel (for values on the left-hand side on the curve – roughly corresponding to the 1950s to 1970s). Basically, as income levels (and motor vehicle affordability) have increased over time, average travel per person has increased. However, there are limits to how far this growth can continue. Eventually people are spending as much time on daily travel as they are willing to commit – and are loath to spend any more of their limited time budgets on yet more travel, even if incomes do happen to rise further. The (per capita) pkm versus income curve is in fact already quite flat if we restrict it to urban daily travel (see Figure 6) – where the slight upward trend still evident in the figure 5 *national total* pkm curve is essentially due to continuing strong growth in air travel (with its inherent advantages in reducing travel time spent per kilometre).

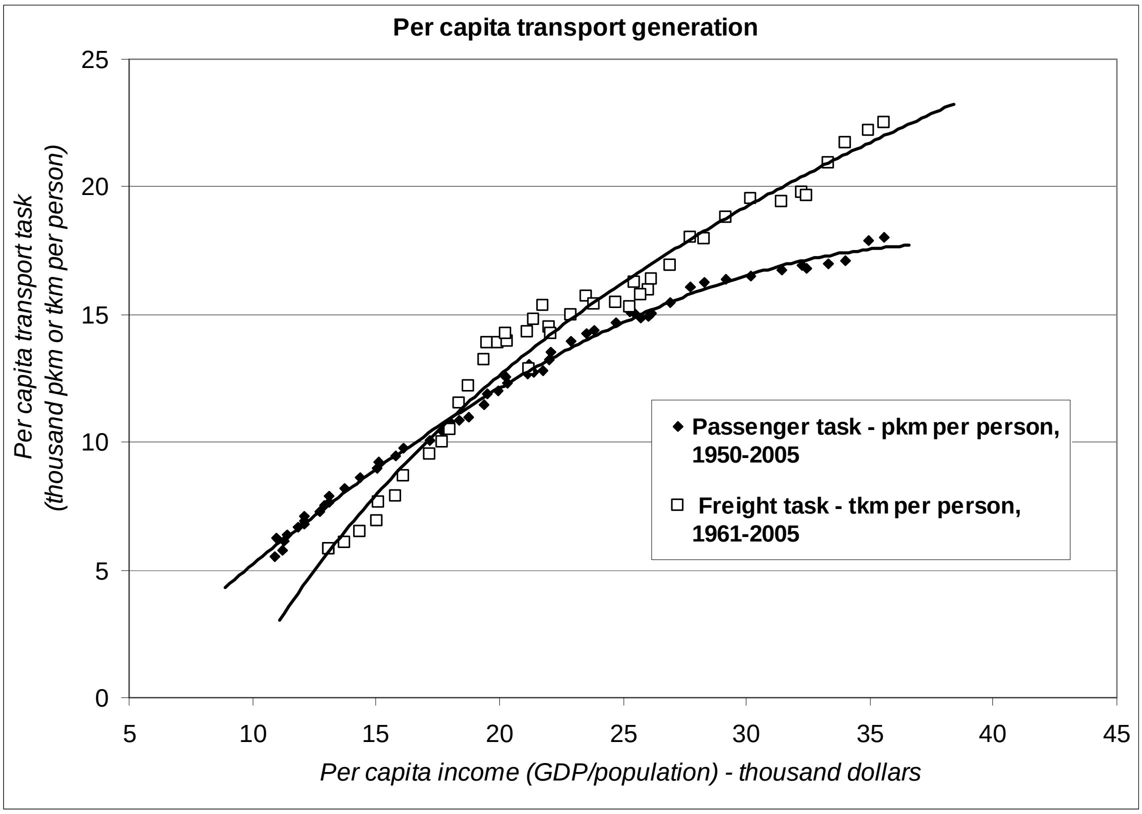

Figure 5: Relationship of national per capita transport tasks to per capita income

Sources: BTRE (2002, 2006), BTRE estimates.

So future increases in Australian passenger-kilometres travelled are likely to be more dependant on the rate of population increase, and less dependent on increases in general prosperity levels. As shown in figure 6, which restricts the correlation plot to metropolitan travel (based on the task values in Table 1), this saturating relationship between increases in annual passenger-kilometres per person and per capita income is even stronger for urban travel. This relationship implies that saturation in per person urban travel could be virtually achieved in Australia by around 2020. Thereafter, population increase will tend to be the primary driver of increases in travel in Australian cities. Yet, at least until then, income increases will likely continue to add to per capita travel, and total passenger travel will tend to grow at a faster rate than population. Growth in per capita personal travel is thus likely to be lower in the future than for the long-term historical trend.

Also note, from Figure 5, that this decoupling of income levels from personal travel trends is not apparent in the current freight movement trends. Tonne-kilometres (tkm) performed per capita are still growing quite strongly – and even though the freight trend curve is slightly concave, there is no saturating tendency evident yet. Eventually this trend curve will have to shallow off too, over the longer term, but there is no sign of it occurring any time in the near future. Growth in freight and service vehicle traffic is therefore projected (over the next decade and a half) to be substantially stronger than for passenger vehicles.

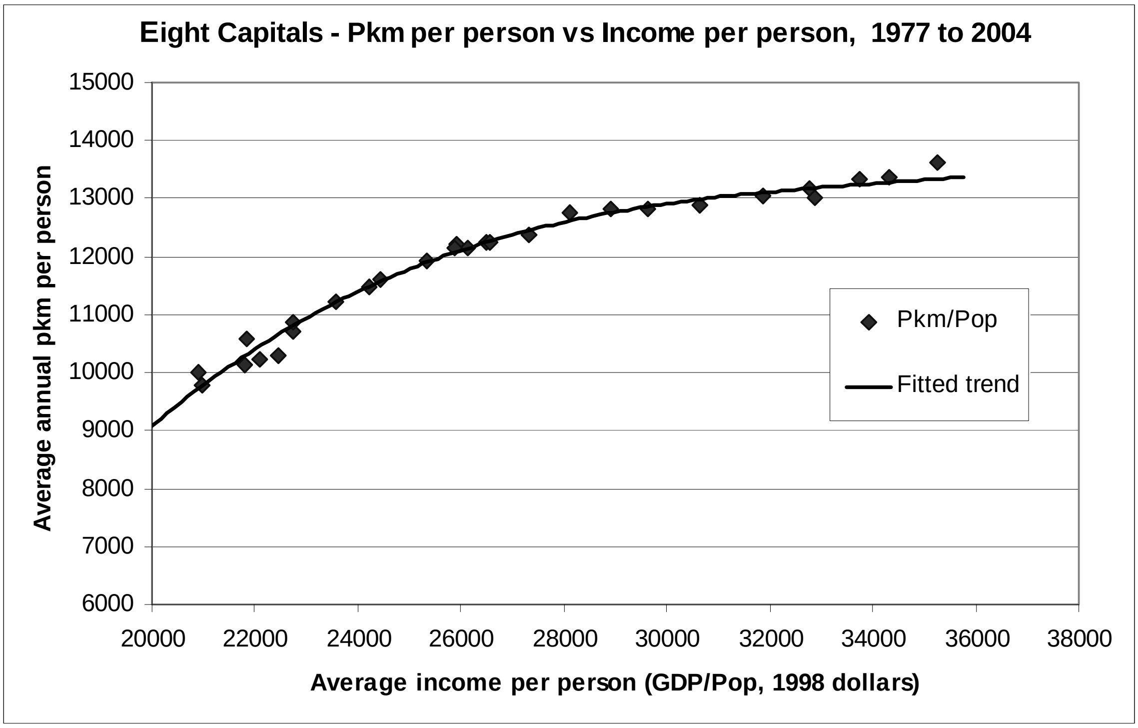

Figure 6: Relationship of metropolitan per capita travel to per capita income

Sources: BTRE (2006, 2007), BTRE estimates.

Figure 7 shows a longer term view of the correspondence between per capita income changes and personal urban travel levels – here restricted to metropolitan passenger car use. The flattening off in the trend curve, especially from the 1980s onwards, is again very evident.

City-by-city passenger travel trends

The trend patterns for (motorised) travel within each of the Australian capital cities are generally quite similar to those for the national metropolitan aggregates (i.e. task levels summed across all 8 capitals) already presented (e.g. in figures 3, 4 and 6). This section briefly describes the separate city trends.

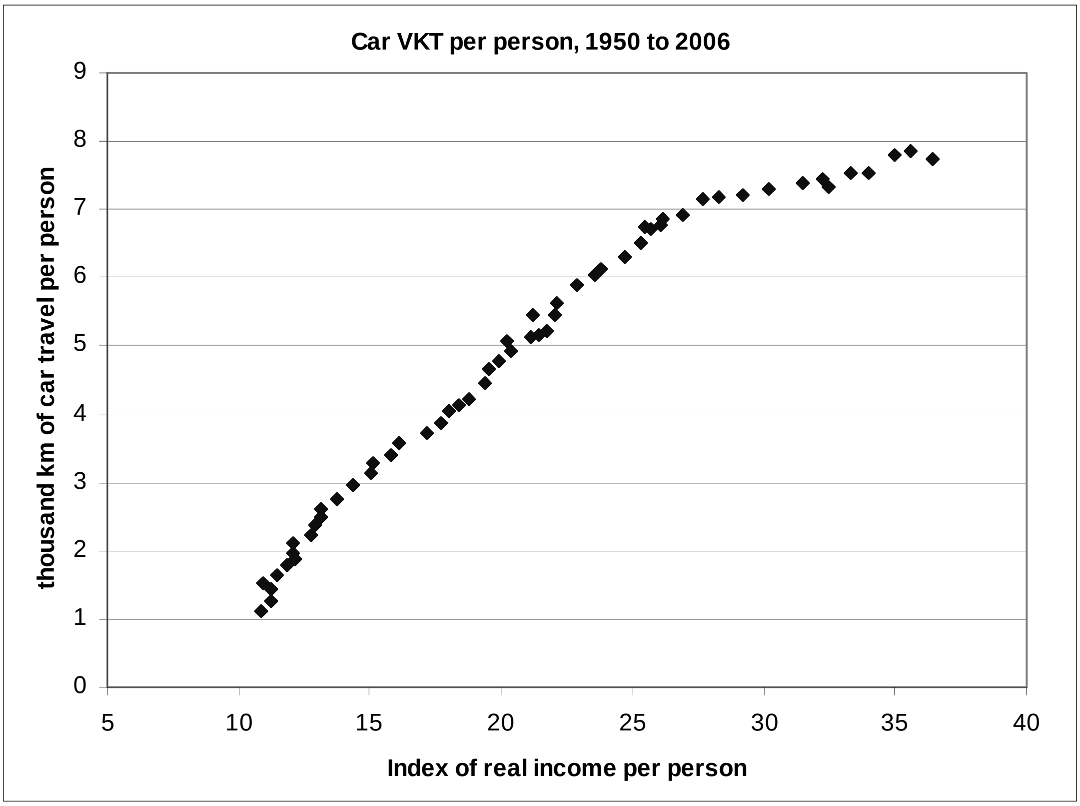

Figure 7: Relationship of metropolitan per capita car travel to per capita income

Sources: BTRE (2002, 2006), BTCE (1995, 1996), BTRE estimates.

Sydney (see Figure 8) has experienced almost a doubling of the passenger transport task between 1977 and 2004. It has a somewhat higher UPT mode share, of total pkm task, than the other capitals; largely due to the sizeable number of passengers taken relatively long distances by the rail system. However, even though the UPT mode share at around 13 to14 per cent is relatively high for Australia, it has not shown much variation for many years (as is the case for most of the other capitals). Per person travel is showing fairly clear signs of nearing saturation (see figure 9), at below 14000 km per person. As is the case for all the capitals, the majority of the current aggregate passenger task is undertaken by light motor vehicles (i.e. cars and personal use of LCVs).

Melbourne (figure 10) has also approximately doubled its aggregate passenger task over this period (1977 to 2004). It has a lower UPT share of total pkm (currently between 8 to 9 per cent) than Sydney. Average travel per capita is slightly above 14000 km (see Figure 11) and still showing some signs of further increase.

In terms of population, South-East Queensland, including the city of Brisbane, is one of Australia’s fastest growing regions. Passenger travel in Brisbane (figure 12) by 2004 had increased by a factor of almost 2.5 times over the 1977 aggregate pkm level. Over the investigation period (i.e. 1977 to 2004), the UPT mode share was fairly close to being constant, at about 8 per cent; though recent strong patronage growth could possibly have lifted the current level closer to 10 per cent. Per person travel is showing signs of approaching stability at about 13000 km per person per year (see Figure 13).

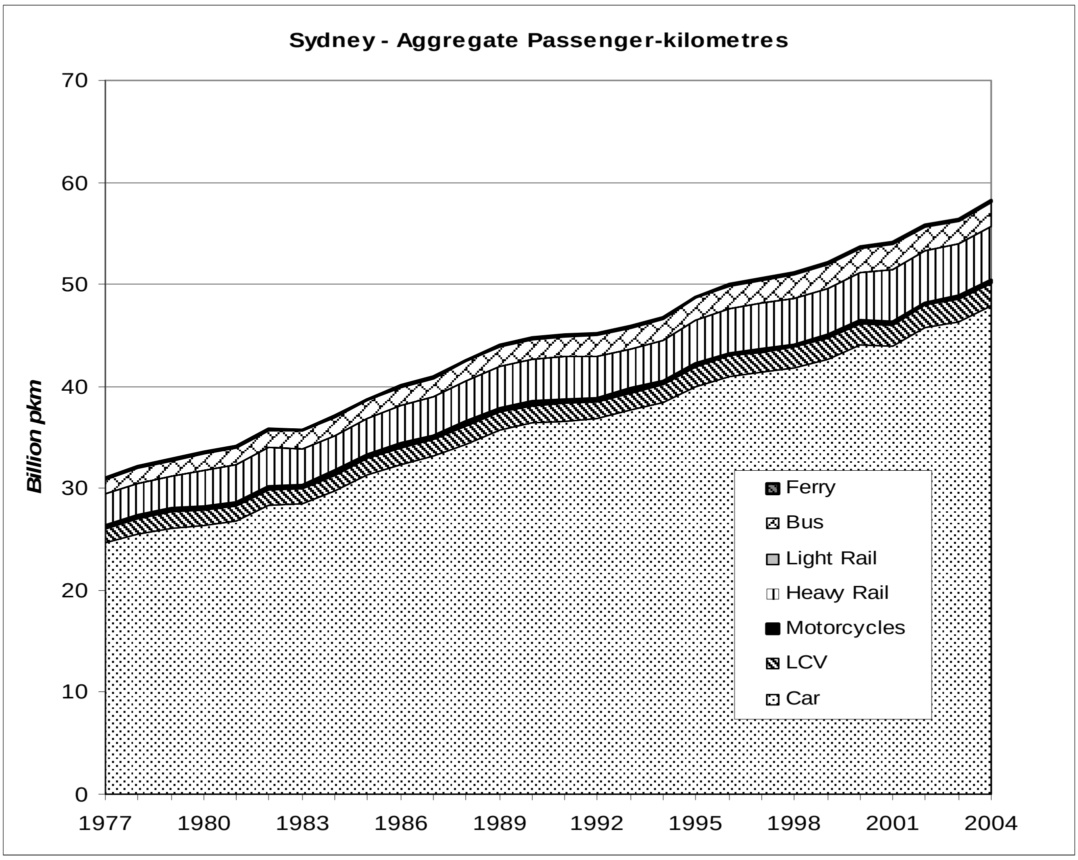

Figure 8: Historical trend in Sydney passenger travel

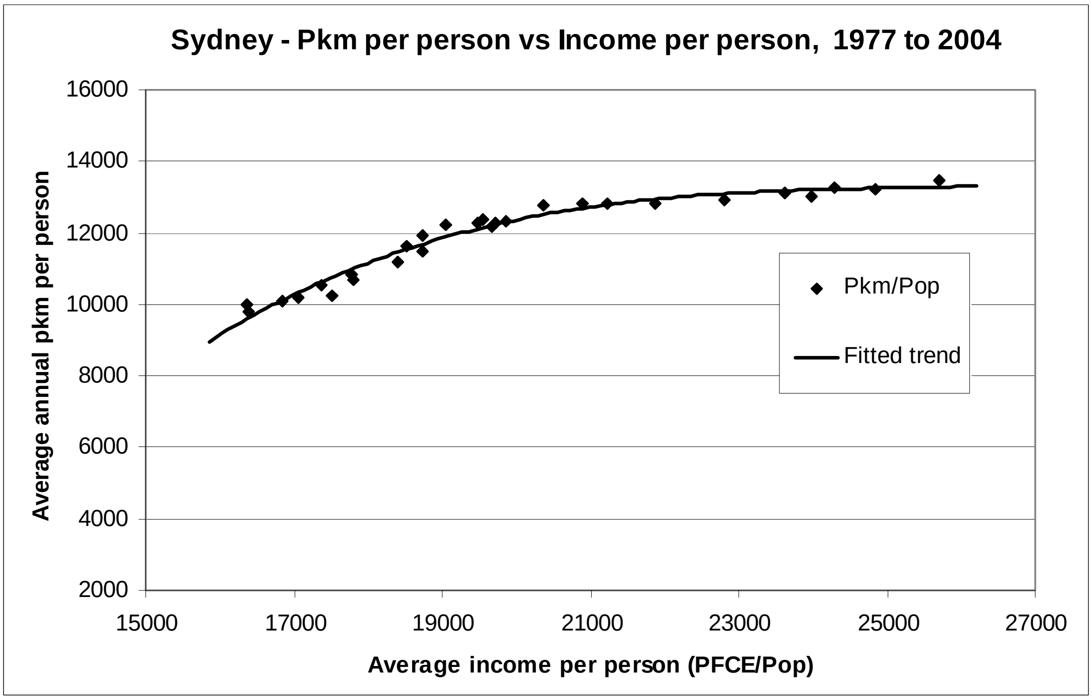

Figure 9: Relationship of per capita travel to per capita income, Sydney

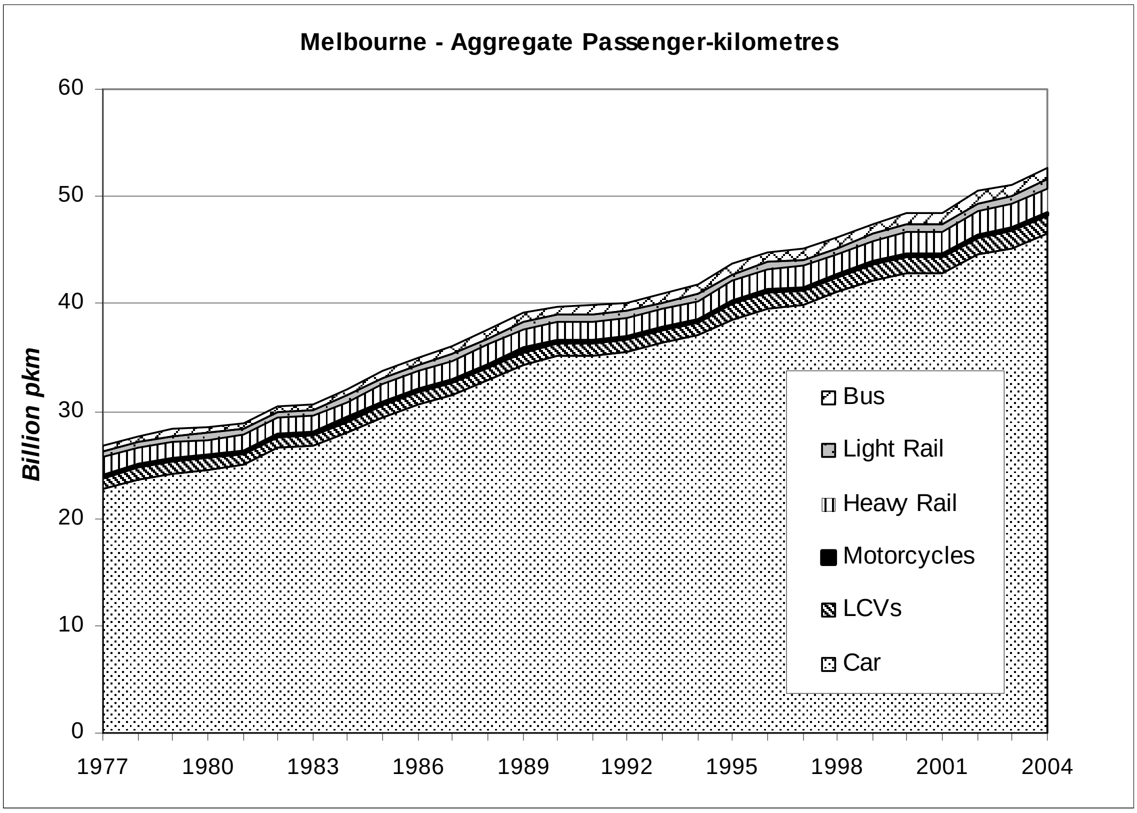

Figure 10: Historical trend in Melbourne passenger travel

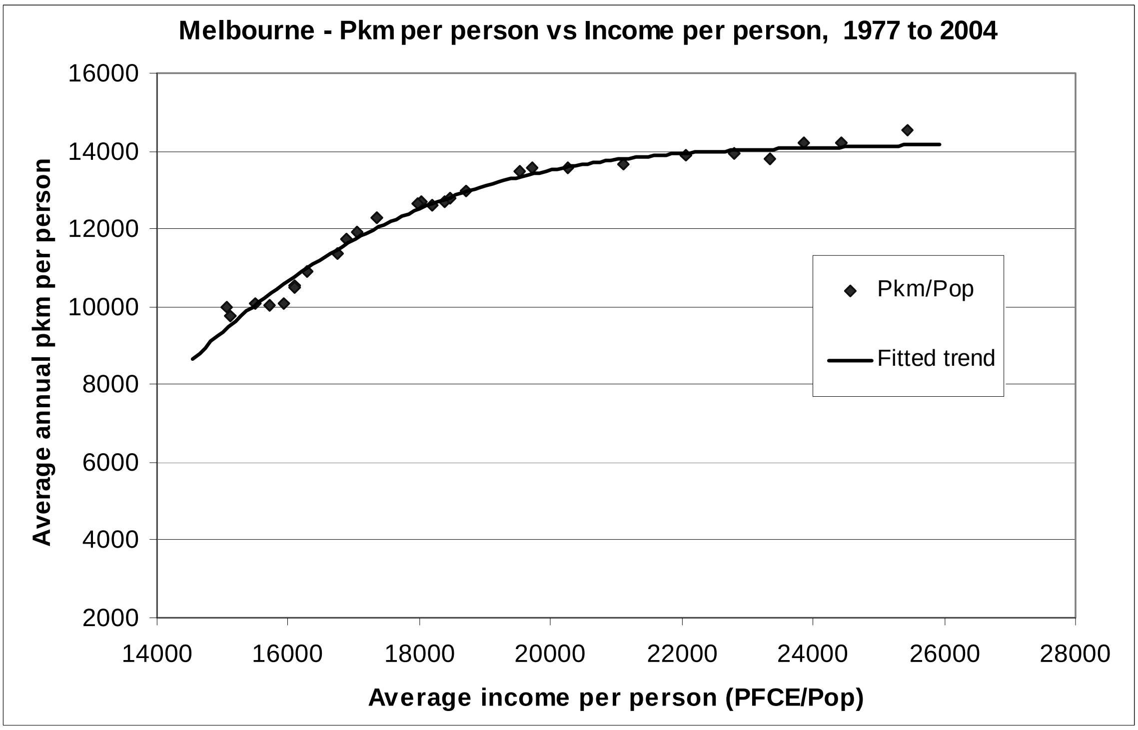

Figure 11: Relationship of per capita travel to per capita income, Melbourne

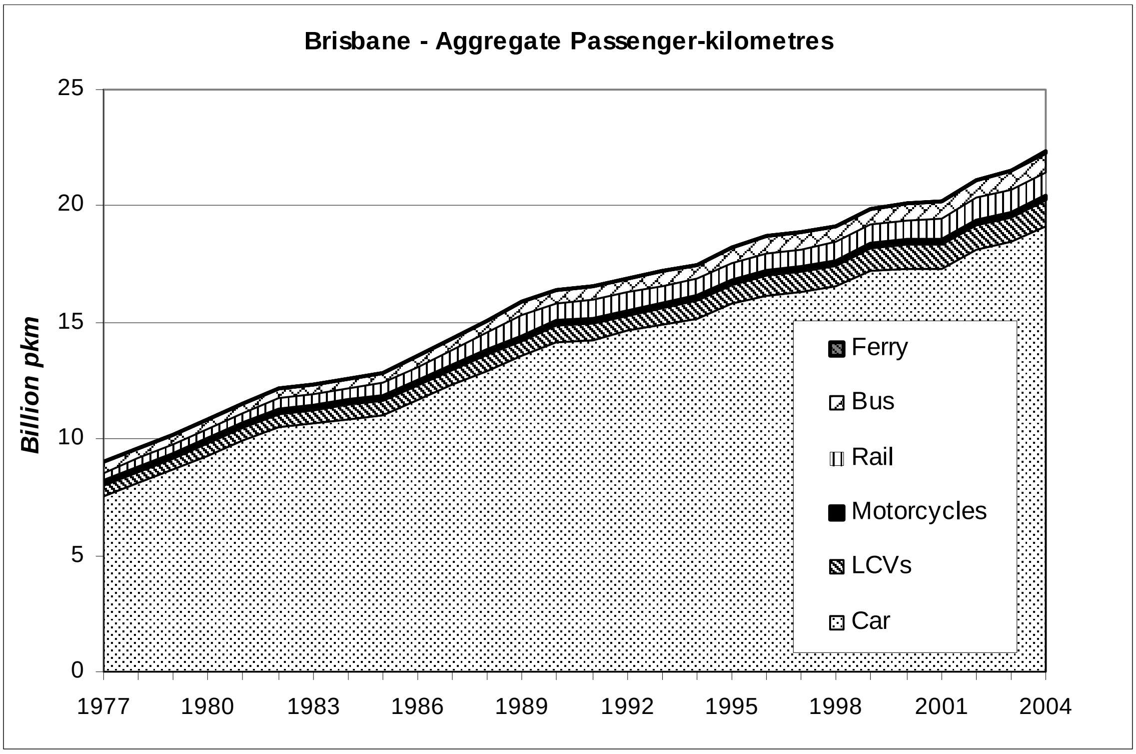

Figure 12: Historical trend in Brisbane passenger travel

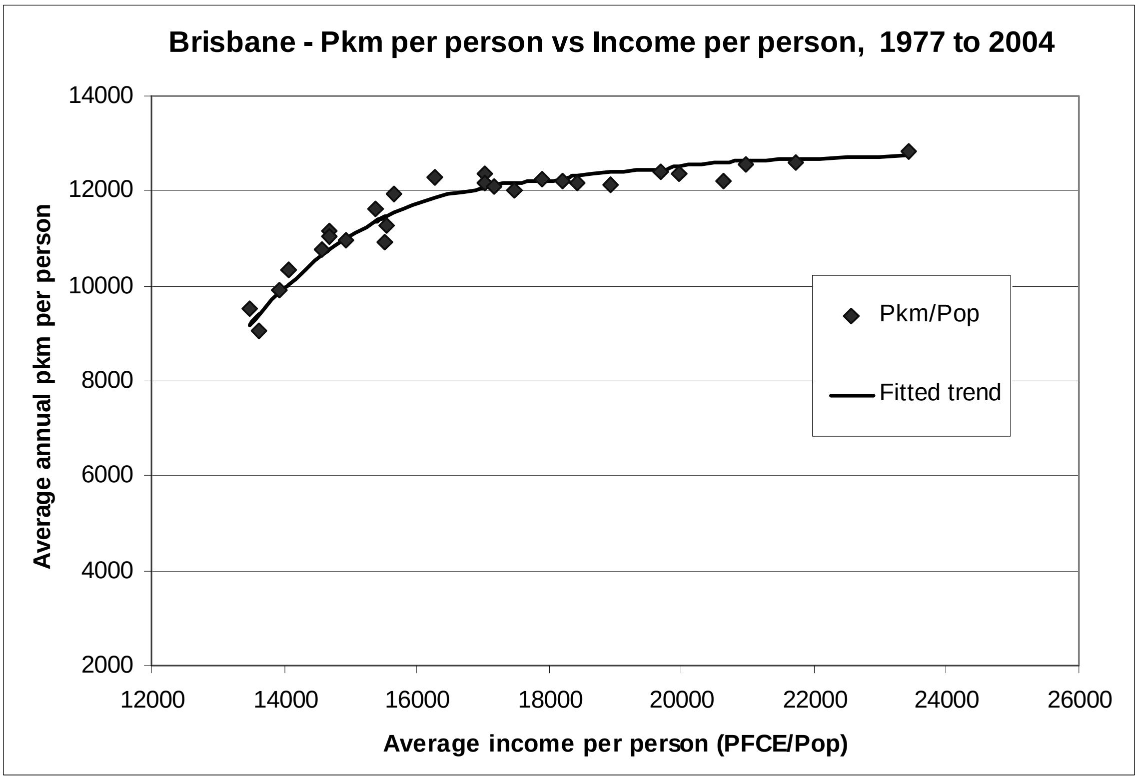

Figure 13: Relationship of per capita travel to per capita income, Brisbane

Adelaide (Figure 14) has shown relatively slower growth in demand for passenger travel, with total pkm task increasing about 1.7 times between 1977 and 2004. The UPT mode share had tended to drift slowly downwards during the 1980s and 1990s, but in recent years has stabilised, and remained virtually constant at between 5 to 6 per cent. Annual per capita travel in Adelaide could possibly still be growing slightly, and is currently around 13000 km per person (Figures 15).

Passenger travel in Perth (another of Australia's regions with faster than average population growth) slightly more than doubled from 1977 to 2004 (see figure 16). The UPT share has come up from around 5.5 per cent (in the early 1990s) to around 8 per cent currently, with the opening of the northern rail line; and could possibly approach 9-10 per cent with the opening of the new southern line. But barring further new rail lines, the UPT share is likely to remain fairly constant thereafter. Per person travel, currently around 13000 km per annum, is still increasing, and does not appear to have saturated yet with respect to per capita income levels (Figure 17).

Hobart (Figure 18) has shared with Adelaide relatively slower historical growth in passenger travel (2004 level at about 1.75 times the 1977 level). Its total 'bus' task has remained fairly constant over time (i.e. allowing for increasing bus travel in charter/smaller buses, since it appears that Hobart's UPT bus patronage dropped fairly steadily between the 1970s and the late 1990s) – so 'bus' mode share has tended to decline in the Hobart area. As well, Hobart travel per person was at the lowest level of all the capitals, at the start of the period investigated (i.e. at about 8000 km per annum in the late 1970s – see Figure 19), and looks set to saturate at a relatively low level (probably in the vicinity of 12000 km per annum).

Darwin (Figure 20) has registered high growth in passenger travel over the period examined (2004 pkm task at nearly 2.7 times 1977 levels) – though from a comparatively low base. It has also seen mode share for total bus travel increase over the period (although lately this has levelled off at around 10 per cent of total pkm). Darwin's per capita passenger travel also appears to be approaching saturation (at somewhere between 11000 and 12000 km per annum - see Figure 21).

Canberra's passenger travel (Figure 22) has more than doubled over the period of 1977 to 2004. Mode share for buses has been reasonably constant, at close to 6 per cent, and passenger travel per person appears to have practically saturated in recent years, at the relatively high level of about 15500 km per annum (see Figure 23).

(Note that the current methodology does not deal with all Australian urban areas, but addresses estimated transport tasks for the Statistical Divisions of the eight State and Territory capital cities. The task estimates would be higher to some extent if all the regional urban areas, such as Newcastle, Geelong or non-metropolitan parts of South-East Queensland, were also included.)

Over the roughly three decades of growth examined in this section, various jurisdictions have had periods where their UPT patronage levels were successfully expanded – however, overall growth in the public transport sector during this period was basically matched, proportionally, by increased travel in private motor vehicles, meaning that aggregate mode shares have generally shown little alteration – in fact, aggregate UPT mode share in 2007 is likely to be very close in value to that for 1977 (national average terms).

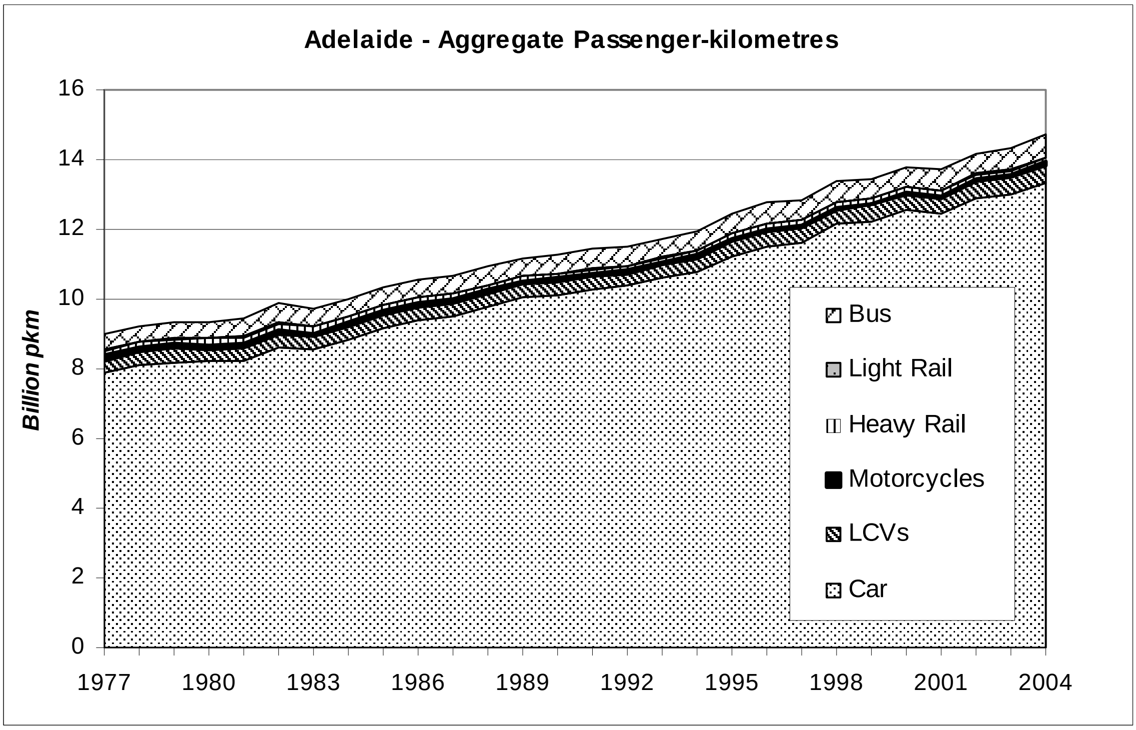

Figure 14: Historical trend in Adelaide passenger travel

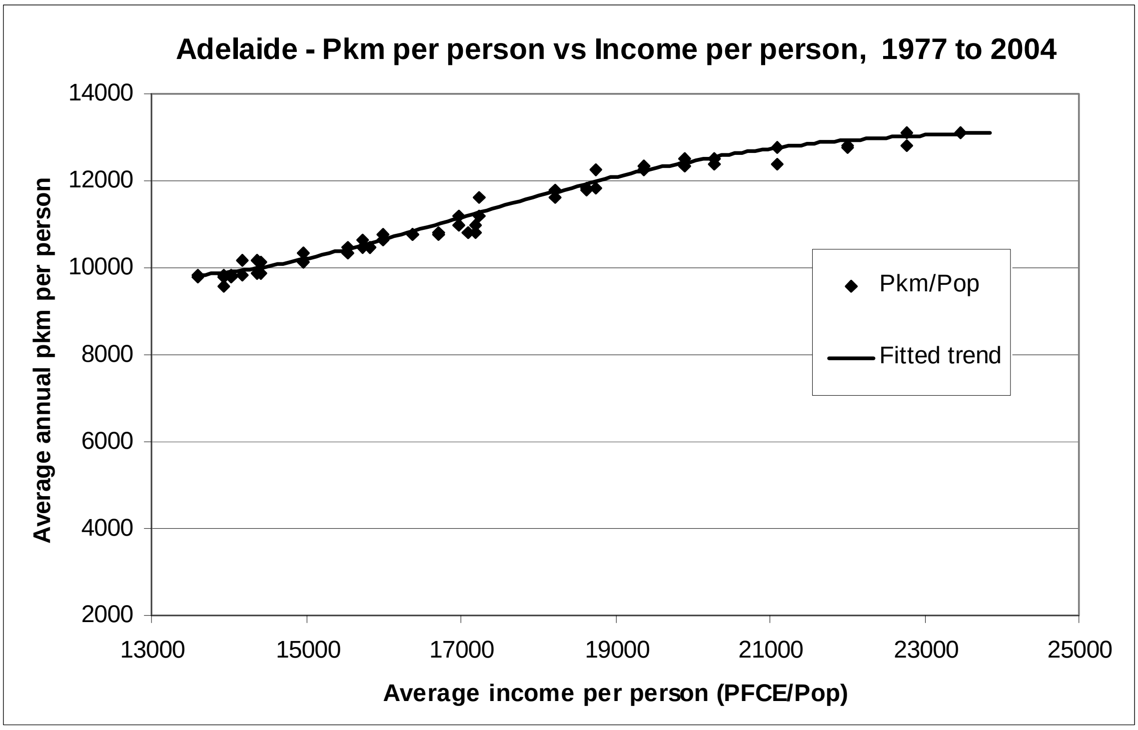

Figure 15: Relationship of per capita travel to per capita income, Adelaide

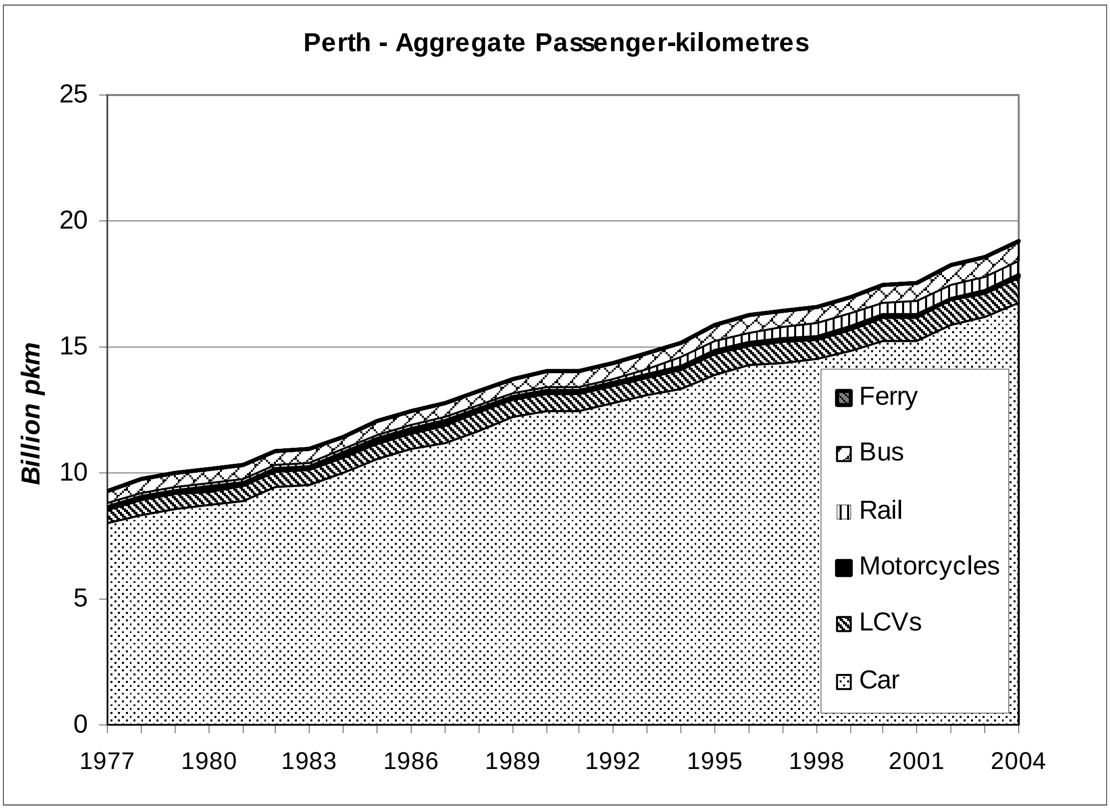

Figure 16: Historical trend in Perth passenger travel

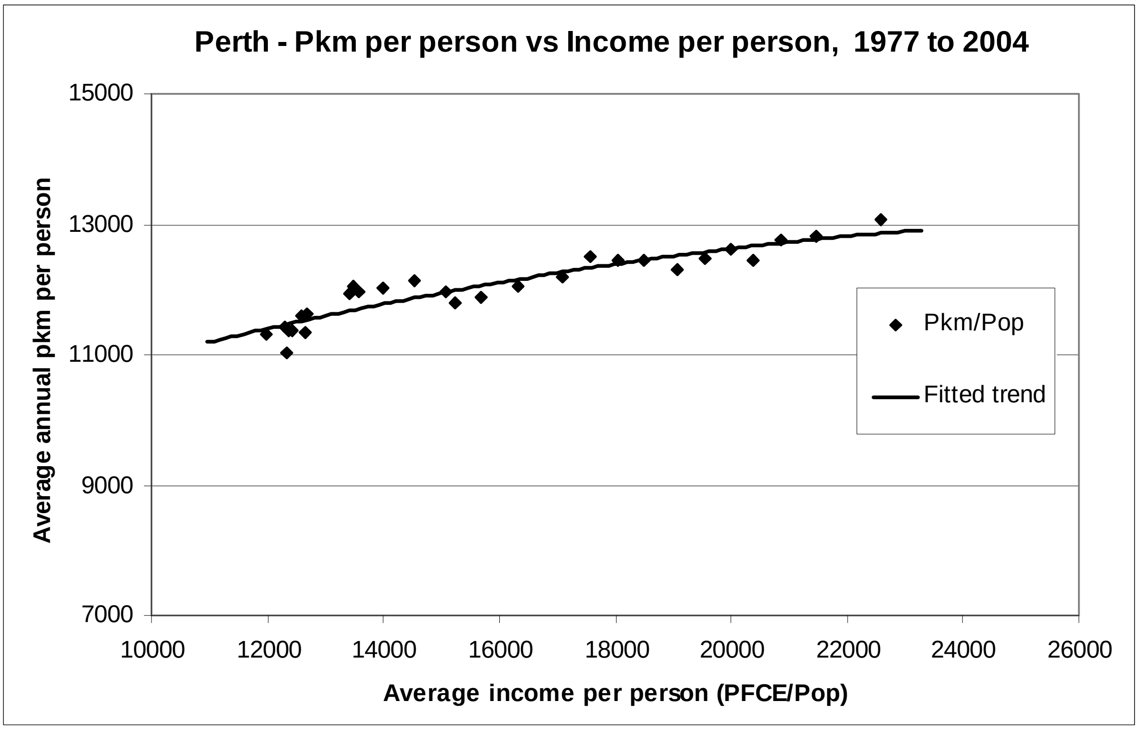

Figure 17: Relationship of per capita travel to per capita income, Perth

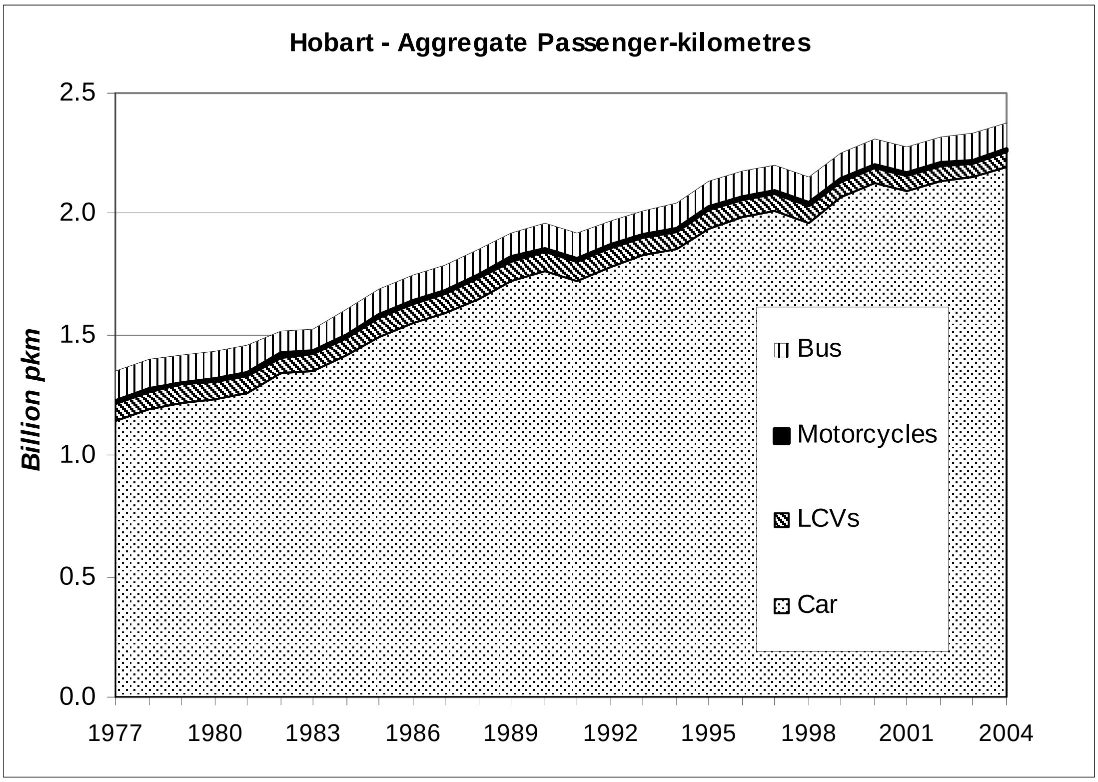

Figure 18: Historical trend in Hobart passenger travel

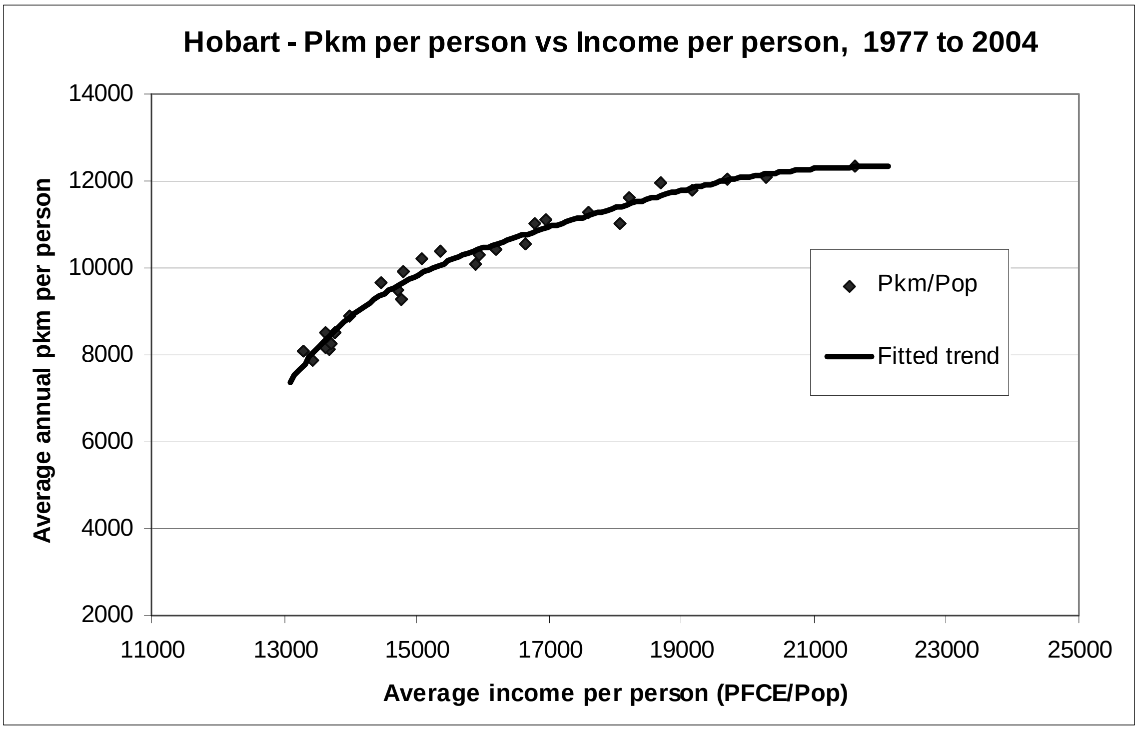

Figure 19: Relationship of per capita travel to per capita income, Hobart

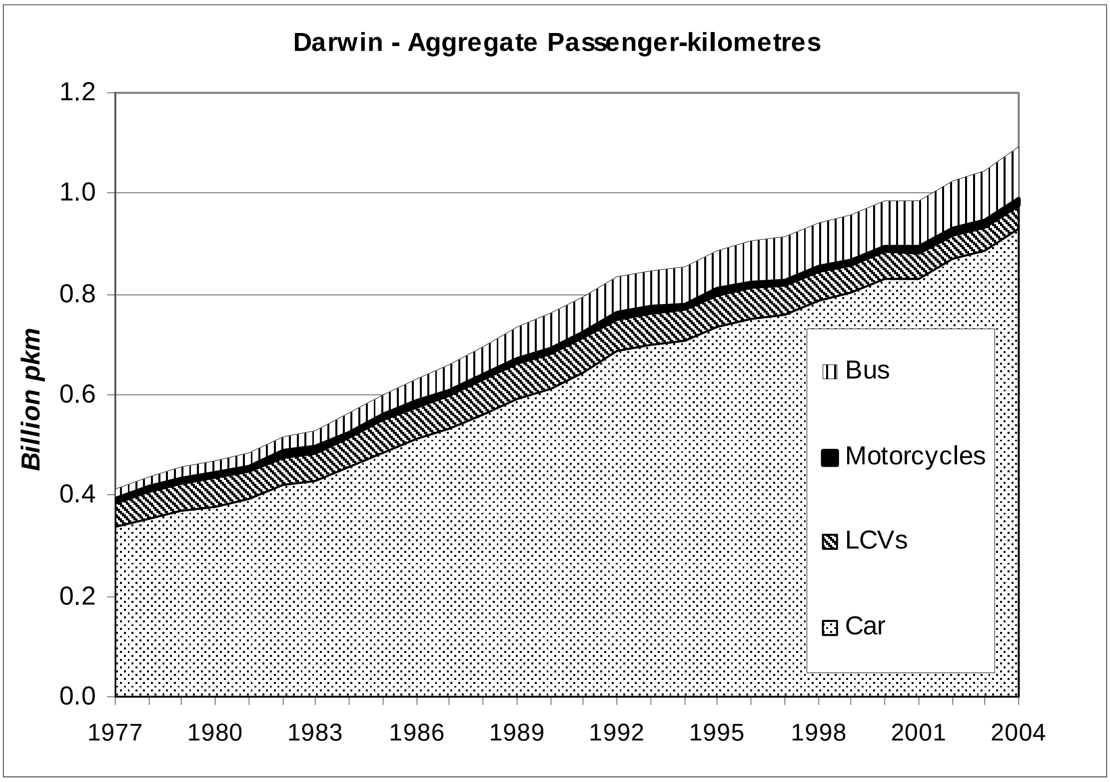

Figure 20: Historical trend in Darwin passenger travel

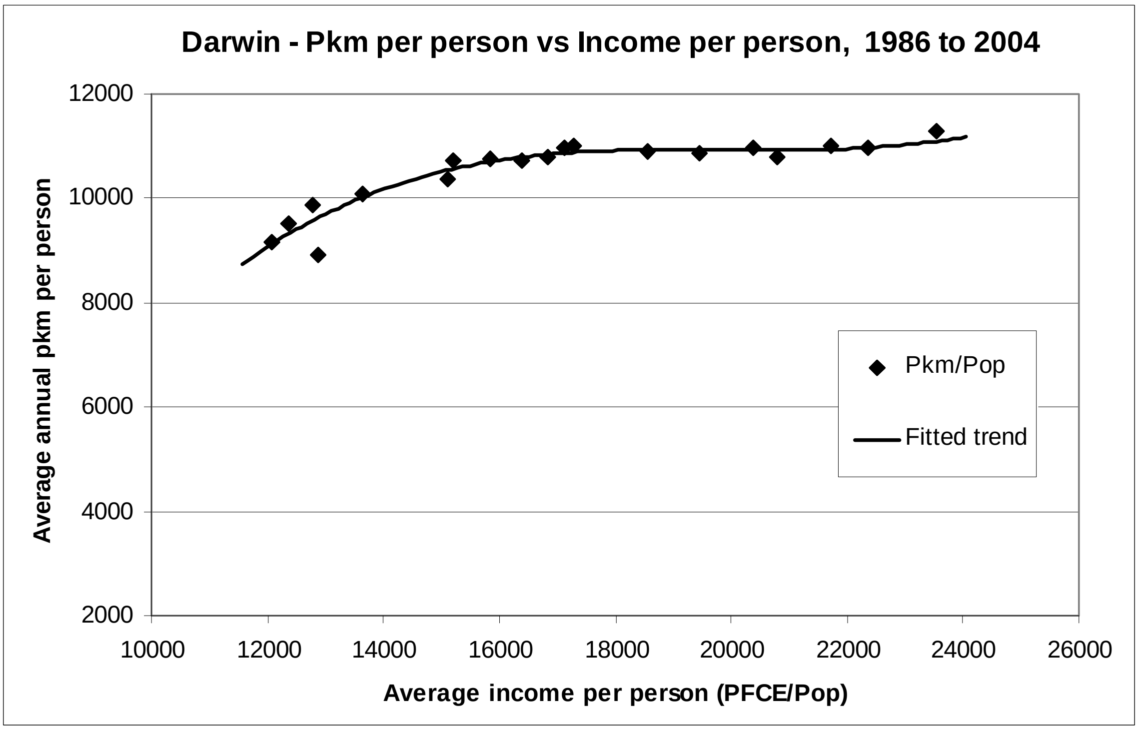

Figure 21: Relationship of per capita travel to per capita income, Darwin

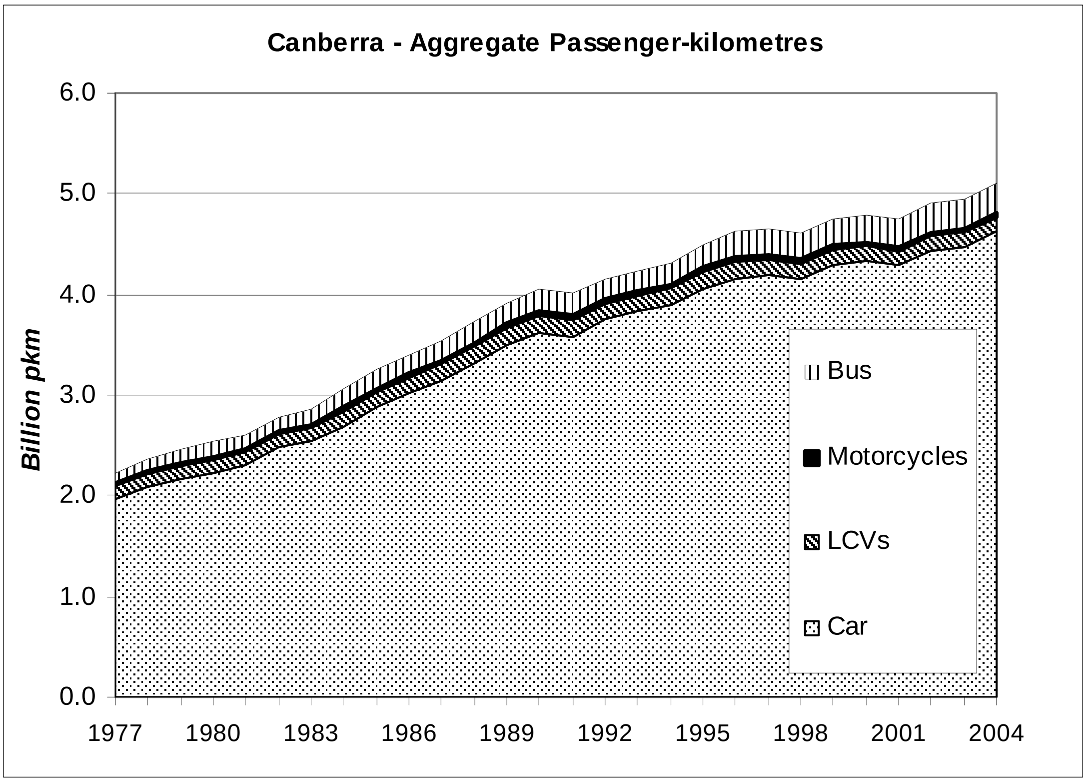

Figure 22: Historical trend in Canberra passenger travel

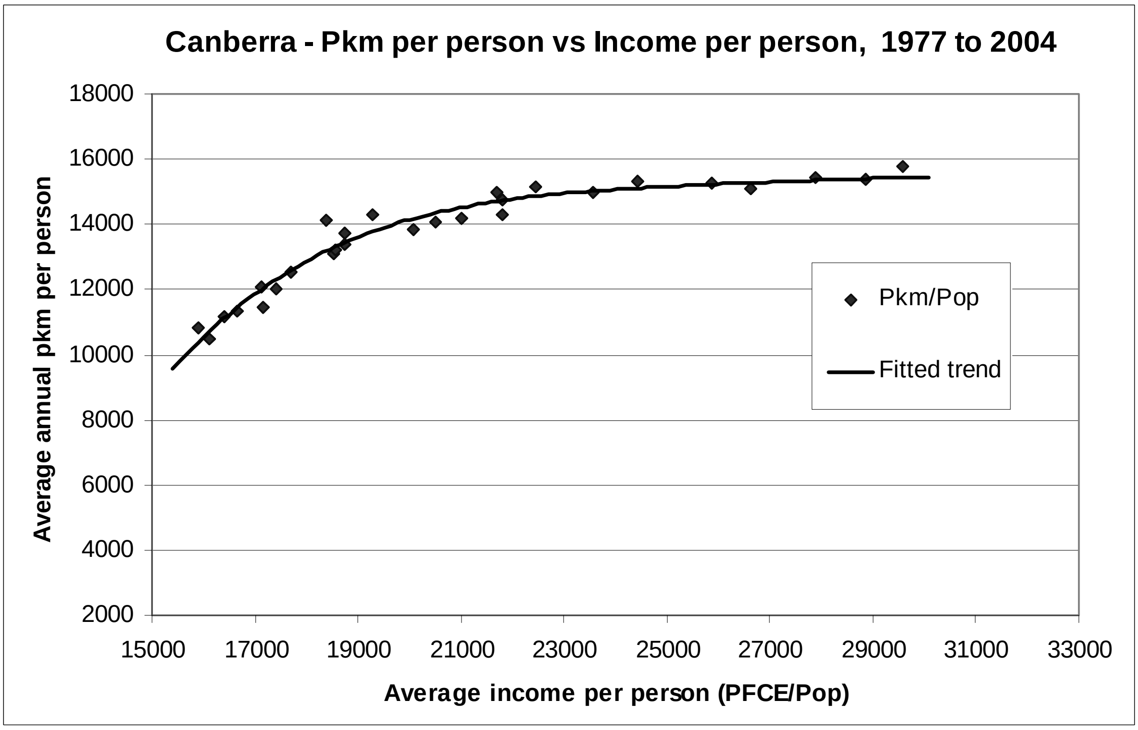

Figure 23: Relationship of per capita travel to per capita income, Canberra

Projecting transport demand and modal shares

BTRE base case projections of Australian transport activity are derived from forecasts of population and income levels for each of the relevant regions – allowing for projected trends in fuel prices and other travel expenses (such as fares or vehicle purchase prices) using a variety of aggregate demand models and modal competition/substitution models. For some background material on our projection processes and methodologies see: BTRE Report 107 (BTRE 2002), *Greenhouse Gas Emissions from Australian Transport: Base Case Projections to 2020* (BTRE 2006), and *Urban Pollutant Emissions from Motor Vehicles: Australian Trends To 2020* (BTRE 2003).

Utilising derived functional forms (such as those in the previous section, relating per capita travel levels with income trends), Australian Bureau of Statistics (ABS) population projections, and the BTRE suite of transport demand models, 'business-as-usual' projections (to 2020) have been prepared for each metropolitan area's likely trends in passenger task and modal split. The current base case transport forecasts use population growth trends from the ABS mid-range (Series B) long-term projections (e.g. see ABS 2005), where national population by 2020 is forecast to be in the vicinity of 23 and a half million, with a total metropolitan population of around 15.2 million persons.

Since identifying solely the passenger task portion, of total transport activity, is not typically sufficient when analysing many environmental or social consequences of transport (e.g. the emission levels arising from transport energy use, or the degree of congestion resulting from total traffic levels), our projection processes derive forecasts of utilisation by all vehicle types (i.e. including freight and service vehicles, as well as passenger vehicles).

Most of the projection methods rely on using the historical trend data to determine functional or econometric relationships between growth in a particular transport task and relevant income level or price changes – either constant elasticity values (typically for tasks not exhibiting constraints in their growth behaviour) or curve fitting (typically for saturating trends, such as for the per capita passenger tasks plotted in figures 5 and 6). Some aggregate tasks projected by these methods are then split into finer modal subdivisions, based on market share competitiveness models (again fit from the historical data, typically allowing for generalised cost parameters – which take account of average travel times for the various modes, as well as direct expenses such as fuel prices and fares).

An example result of such processes is the quantification of the association between economic activity levels and vehicle travel – where, as related previously, the long-term trend in per capita car travel (vehicle-kilometres per person) in Australia has been found to be following a logistic (saturating) curve against real per capita income – measured in this case by real Australian Gross Domestic Product (GDP) per person (see figure 24). An assumed base case rate of GDP growth of around 2.7 per cent per annum over the 15 years from 2005 to 2020 implies that Australia-wide per capita car travel should level out at close to 9000 kilometres per person per annum by 2020 – about a 6 per cent increase on the 2005 level. The resulting projection to 2020 is for an average increase in car traffic, across the Australian capital cities, in the order of 23 per cent over 2005 aggregate levels.

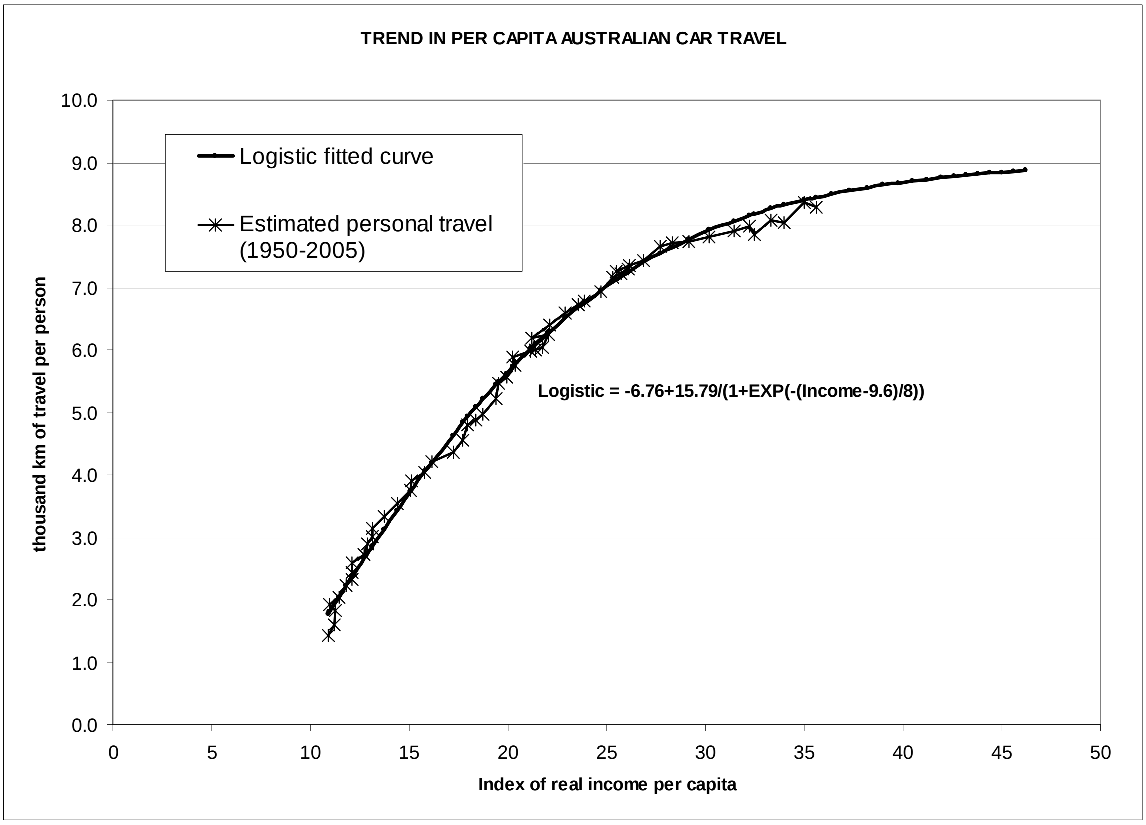

Figure 24: Relationship of per capita car travel to per capita income

Sources: BTRE (2002, 2003, 2006), BTRE estimates.

Another of the major direct influences of economic development on transport levels is through increases in the freight task. Current tonne-kilometre growth has been found to still react proportionally to the growth rate of the economy. While this relationship cannot continue indefinitely, as mentioned previously there are no signs yet of nearing saturation in Australian road freight movement per person (as there are in car travel per person). Similarly, there are no obvious signs of saturation in recent levels of United States truck freight per person, and US levels of road freight per person are already much higher than those in Australia.

Though it is worth noting that there are clear signs of a decoupling of aggregate economic growth (in GDP terms) and freight transport demand having already occurred in the United Kingdom. The UK Commission for Integrated Transport (2007) has presented results showing a gradual decline there, in average tonne-kilometres per unit of GDP, over recent years. This is likely due to changes in the structure of the UK economy, with shifts over time, away from traditional primary industries, and towards service-based and Information Technology-related sectors (in which freight transportation tends to play a lesser role). Since the GDP compositions of many countries show similar trends (i.e. of movements towards higher-value, less freight intensive production), this UK *decoupling* experience could be replicated more widely in the coming years.

Besides economic growth, the other main aggregate influence on the demand for urban freight transport is the real freight rate. Real road freight rates in Australia have fallen dramatically since 1965, mainly driven by the progressive introduction of larger articulated vehicles, but also by technological change which has made possible lighter vehicles and improved terminal efficiencies. Real freight rates fell around 45 per cent from 1965 to 1990, and then around a further 3 per cent in the 1990s.

The BTRE truck use forecasts are based on projected growth in GDP (where the income elasticity has been derived as between 0.96 and 1.02, depending on the freight category) and reductions in freight rates (with a real freight rate elasticity between -0.7 and -0.8). The road freight model, incorporating parameter estimates for each capital, gives an expected growth in aggregate metropolitan tkm, across the eight capitals, totalling slightly above 3 per cent per year to 2020.

Under the base-case scenario settings, the aggregate modal share of urban public transport is not projected to vary significantly, from current levels, over the next decade and a half (see figure 2). Expected public transit patronage has reasonably strong growth in the base case (stronger than that for total car use) – but since over 90 per cent of the total pkm task is done by light vehicles, the portion of mode share that cars lose to buses and rail over the projection period does not make much of a change to the level of car dominance. The BTRE projects private travel volumes (averaged across the 8 capital cities) to increase by about 1.7 per cent per annum over the period of 2000 to 2020, with a stronger growth trend for the commercial road sector (with business kilometres, for freight and service vehicles, expected to increase by around 3.5 per cent per annum, 2000 to 2020).

Buses and motorcycles form a small part of passenger vehicle traffic in Australian cities. In most of our cities, they account for only 1-3 per cent of the total vehicle kilometres travelled (VKT) by non-business vehicles (i.e. cars routinely account for 97-98 per cent of dedicated passenger vehicle traffic). For the small bus and motorcycle VKT shares, bus travel has tended, on average, to grow slightly over the last decade and a half, while the motorcycle share reduced during the 1990s – though often with a relatively high year to year variability. Motorcycle use appears to be currently growing again, after many years of decline – and could possibly see its share increase in the future, especially if their manoeuvrability in traffic becomes more attractive as congestion levels grow. Equivalently, if significant numbers of drivers find the hassle of coping with congested driving conditions not worthwhile, as future congestion becomes more widespread, UPT patronage also could possibly gain some extra modal shift. (Though from a purely delay point of view, *standard* buses will not generally show any benefits over congested car travel. However, for buses which have their own dedicated roads, such as *bus rapid transit* systems, these travel time advantages could become considerable in the future.)

The aggregate base case forecasts of urban passenger tasks and modal shares, resulting from the various sub-sector projection processes, have already been presented – in the summary charts of figures 1 and 2. The resulting forecast growth in total road traffic, by vehicle type, across the 8 capital cities, is displayed in figure 25 (for the base case). Table 2 then weights these VKT projections by vehicle type to more accurately reflect the traffic-impedance value of each vehicle class – where typical weights versus passenger cars (set equal to 1) include values of 2 for rigid trucks and buses, and 3 for a 6-axle articulated truck. The weighted values, or passenger car equivalent units (PCUs), are generally preferable for gauging the congestion potential of total traffic streams. The table gives the projected trend in aggregate PCU-km (for the BTRE base case scenario) for each of the Australian capital cities.

For aggregate metropolitan traffic growth, the BTRE base case (or business-as-usual) projections have total road vehicle travel (in passenger car equivalent units, PCU-km) increasing by close to 37 per cent between 2005 and 2020 – from an estimated 138 billion PCU-km in 2005 (across all 8 capital cities) to around 188 billion in 2020. By city, the projected PCU-km increases (using base case input assumptions to the BTRE transport demand models) are about 38 per cent for Sydney, 33 per cent for Melbourne, 46 per cent for Brisbane, 27 per cent for Adelaide, 44 per cent for Perth, 13 per cent for Hobart, 40 per cent for Darwin and 29 per cent for Canberra. Variations in forecast city growth rates for VKT (e.g. the high growth in Brisbane, Perth and Darwin, and the low growth in Hobart) are due largely to variations in projected population growth. (Though it should be noted that there could be several reasons for actual future traffic growth to be constrained below these forecasts, possibly through a stronger than expected demand response to increasing levels of congestion, through higher than expected changes in demand patterns due to traffic control measures or modal shifts, or from higher than projected fuel prices).

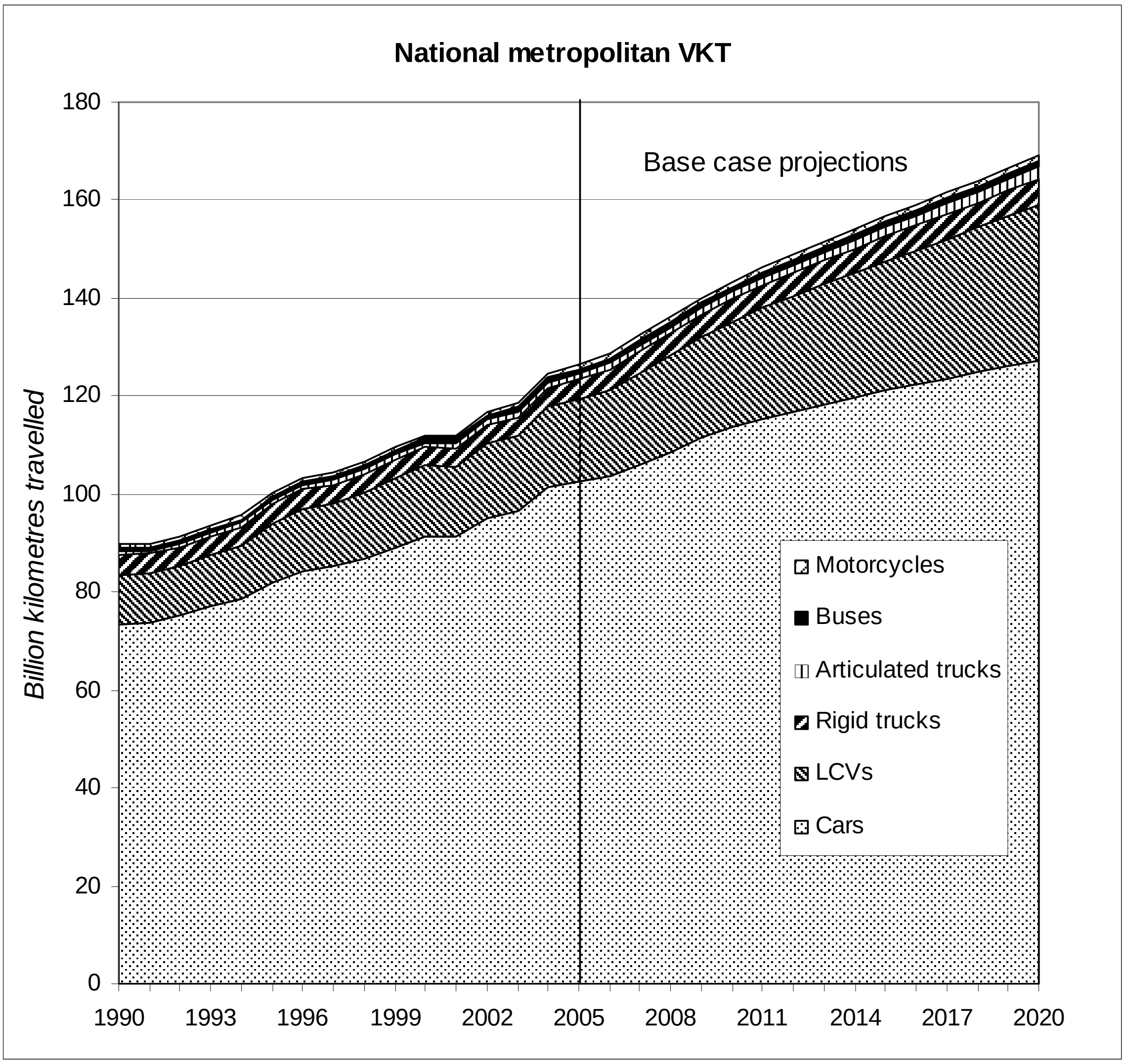

Figure 25: Projected travel by motor vehicles, Australian metropolitan TOTAL

Sources: BTRE (2002, 2003, 2006, 2007), BTRE estimates.

Table 2: National Base case Projections of total metropolitan vehicle travel – passenger car equivalents, 1990-2020
(billion PCU-km)

Year	*Sydney*	*Melbourne*	*Brisbane*	*Adelaide*	*Perth*	*Hobart*	*Darwin*	*Canberra*	*Total*
1990	32.07	29.07	12.53	8.47	11.15	1.51	0.68	2.83	98.3
1991	31.99	28.92	12.52	8.54	11.08	1.47	0.70	2.81	98.0
1992	32.29	29.24	12.86	8.63	11.37	1.52	0.73	2.93	99.5
1993	33.04	29.93	13.17	8.81	11.67	1.55	0.75	3.00	101.9
1994	33.74	30.57	13.48	8.99	11.96	1.59	0.76	3.06	104.1
1995	35.41	32.06	14.21	9.42	12.61	1.66	0.80	3.21	109.4
1996	36.38	32.95	14.65	9.67	13.01	1.71	0.83	3.31	112.5
1997	36.85	33.34	14.83	9.75	13.18	1.73	0.84	3.35	113.9
1998	37.40	34.29	15.16	10.17	13.39	1.71	0.87	3.35	116.3
1999	38.32	35.30	15.76	10.29	13.76	1.78	0.89	3.48	119.6
2000	39.37	35.93	15.94	10.53	14.14	1.83	0.92	3.52	122.2
2001	39.41	35.97	15.99	10.47	14.19	1.80	0.92	3.50	122.2
2002	41.08	37.53	16.74	10.87	14.83	1.86	0.96	3.64	127.5
2003	41.63	38.00	17.04	10.96	15.07	1.86	0.98	3.68	129.2
2004	43.68	39.86	17.94	11.45	15.85	1.93	1.02	3.87	135.6
2005	44.38	40.41	18.31	11.57	16.15	1.94	1.04	3.91	137.7
2006	45.28	41.10	18.76	11.73	16.53	1.95	1.07	3.97	140.4
2007	46.67	42.25	19.43	12.02	17.10	1.99	1.10	4.08	144.6
2008	48.08	43.44	20.10	12.32	17.66	2.02	1.14	4.18	148.9
2009	49.53	44.67	20.78	12.62	18.24	2.06	1.17	4.29	153.4
2010	50.81	45.72	21.40	12.88	18.77	2.08	1.20	4.38	157.2
2011	51.91	46.60	21.95	13.08	19.23	2.10	1.23	4.45	160.6
2012	52.96	47.44	22.49	13.28	19.68	2.11	1.25	4.52	163.7
2013	53.96	48.23	23.01	13.46	20.11	2.13	1.28	4.59	166.8
2014	54.98	49.02	23.53	13.64	20.55	2.14	1.30	4.65	169.8
2015	55.99	49.81	24.05	13.82	20.98	2.15	1.33	4.72	172.8
2016	56.97	50.56	24.57	13.99	21.41	2.16	1.35	4.77	175.8
2017	58.01	51.35	25.11	14.16	21.86	2.17	1.38	4.84	178.9
2018	59.02	52.11	25.64	14.34	22.30	2.18	1.41	4.90	181.9
2019	60.06	52.89	26.19	14.51	22.75	2.19	1.43	4.96	185.0
2020	61.12	53.70	26.75	14.69	23.21	2.20	1.46	5.03	188.2
Projected Growth 2005-2020	37.7%	32.9%	46.1%	27.0%	43.8%	13.4%	40.2%	28.5%	36.6%

***NOTE*:** PCU-km estimates calculated using traffic contribution values (relative to passenger car = 1) of: LCV = weighted sum of standard light commercials (PCU=1) and large vans (PCU=1.5); rigid truck = 2; articulated truck = weighted sum of standard 6-axle semi-trailer (PCU=3) and B-doubles (PCU=4); motorcycle = 0.5; and bus = 2.

Sources: BTRE (2002, 2003, 2006, 2007), BTRE estimates.

Referring to figure 25, the study has thus identified near linear increases in aggregate Australian urban traffic over recent years (i.e. between 1990 and the present), and forecasts this aggregate trend as likely to continue over the projection period (i.e. the present to 2020). In other words, approximately as much traffic in absolute terms will probably be added to our city networks in the next 15 years as was added in the past 15 years.

The increases in total travel implicit in our base case projections (of passenger tasks, road vehicle activity and their modal shares) will likely impose continuing pressures on our cities' environmental and social welfare. As traffic levels increase, the average social costs of congestion are likely to rise considerably – as average delays become longer, congestion more widespread and the proportion of freight and service vehicles increases. As well, even though technological progress is continually improving the emissions performance of new vehicles, the scale of the forecast traffic increases are likely to outweigh such business-as-usual efficiency gains – leading to steadily increasing emissions of greenhouse gases by urban transport, and future levels of noxious emissions still capable of imposing significant health costs on our societies.

Given the scale of such problems, it will be a challenge for future transport and congestion management measures to adequately address the increasing task (and associated modal share) trends identified by this study. Of course, modal shift to more energy efficient transport modes, such as by encouraging some urban car users to travel by rail or bus instead, will typically be an important element in managing the increasing environmental and social pressures that our rising transport demand levels produce. However, given the size of the passenger task performed by private road vehicles (and its current dominance over public transport levels), gradually increasing patronage on UPT systems (even at the current quite high growth rates) – in isolation to any management of total transport demand – would take many years before making a sizeable change in aggregate passenger trends. To make significant adjustments to the *overall* performance of the urban passenger sector, mode shifts to urban public transport will need to be allied with measures aimed at controlling either the amount of urban car use or the environmental impact of each of the vehicles. Suffice to say, increases in traffic of the size foreseen here will have major implications for mobility and amenity in Australian cities.

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AGPS	Australian Government Publishing Service
BTCE	Bureau of Transport and Communications Economics
BTRE	Bureau of Transport and Regional Economics
FORS	Federal Office of Road Safety

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