9-1-2011

Long-term patterns of Australian public transport use

David C. Cosgrove

Australasian Transport Research Forum 2011 Proceedings
28 - 30 September 2011, Adelaide, Australia
Publication website: http://www.patrec.org/atrf.aspx

Long-term patterns of Australian public transport use

David C. Cosgrove

Bureau of Infrastructure, Transport and Regional Economics
GPO Box 501, Canberra 2601

Email for correspondence: David.Cosgrove@infrastructure.gov.au

Abstract

The last few years have seen substantial rises in passenger numbers across many Australian public transit systems, partially due to periods of higher than average fuel prices and to various infrastructure expansions. To properly assess the likely scope for any future changes in patronage levels, across the various urban passenger modes, a sound knowledge of what has happened over time, in urban transport patterns, can be of significant value. This paper presents long-term time-series for the usage patterns of Urban Public Transport (UPT) – compiled for each of the Australian capital cities, and covering a period of more than a century (1900 to 2010). Such long-term historical estimates demonstrate how radically the share of total urban travel due to UPT has changed over time – with public transit dominant through the early part of last century, and still accounting for more than half of total urban passenger-kilometres up till around 1950, before gradually losing market share with the growing popularity of private car travel (resulting in close to 90 per cent of current urban travel being done in light motor vehicles and about 10 per cent by rail, bus and ferry). Long-term trends in patronage levels (both total and per capita) are given for the various UPT modes, along with aggregate modal share patterns across the Australian capital cities.

1. Introduction

When considering the possible effects of changing economic and social conditions on patronage levels for urban public transport (UPT) – as well as those flowing from any changes to infrastructure provision or urban form – an awareness of past trends in those travel 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 future change to the modal shares of the various urban passenger tasks.

This paper deals with the compilation of long-term time-series for UPT use, across the Australian (State and Territory) capital cities. Putting together such time-series is complicated by a range of data issues, not only involving the accuracy of any particular year's information but also the consistency of patronage estimates for differing years and comparability between the different transit systems. Besides technical issues, of how precisely the primary patronage data are capable of being collected by a particular system, there are also various definitional and methodological issues concerning the estimation of actual passenger volumes. For example, many systems have often relied on using fare data to calculate passenger numbers, as opposed to direct passenger counts – and this entails a variety of approximations, especially dealing with differing ticket types (such as for periodical ticketing, for multi-modal or integrated ticketing, and for concessional or free passenger travel). A further complication typically arises for those systems using such fare-based estimation algorithms, where the calculation processes or fare structures have tended to alter over time (meaning adjustments often have to be made for varying periods when trying to compile consistent time-series).

Problems with data quality or availability can also impede the collation of consistent series, with some components of the various transit systems (e.g. private bus services in Sydney) providing less regular or less complete reporting practices than others. Standardising the patronage statistics also generally involves making allowances for:

- differences in trip type inclusion – where some systems might have periods of reporting passenger numbers only for full-fare-paying customers (as opposed to including all travellers), while others might report only *initial* boardings (instead of also recording transfers between services within a complete journey);
- geographic coverage, especially where some reported patronage statistics include regional services as well as purely metropolitan travel (e.g. the current TransLink service area includes the majority of South East Queensland, as opposed to solely Brisbane; and in NSW, the CityRail services extend well beyond the Sydney metropolitan area, including the Hunter, Southern Highlands and South Coast regions);
- a range of service providers – some wholly government owned, some privately owned but running under government service contracts, and some wholly privately run (the ownership arrangements within various transit systems having changed extensively over the years) – often with widely varying propensities for data provision;
- a range of vehicle types, even within a particular transit mode/corridor, typically requiring a variety of different data sources (e.g. though today's tram networks in Australia are fully electrified, past systems have used horse-drawn, cable and steam trams as well, with even electric trolley-buses sharing electric trams' overhead wires in some Australian cities during the 1930s to 1960s).

The time-series presented here, for Australian metropolitan passenger movement, have been standardised, wherever possible, to cover all trip types (e.g. include UPT transfers as well as initial boardings), to adjust for any differences over time in data collection methodologies or patronage estimation processes, and to refer to all travel within the area of the Statistical Division (SD) – according to Australian Bureau of Statistics (ABS) definitions – of each State or Territory capital city[1]. Estimates are provided for annual urban passenger travel (on a financial year basis, suitably adjusting calendar year statistics where required) covering the period from 1900 to 2010.

These results update and extend previous estimates of urban transport tasks released by the Bureau of Infrastructure, Transport and Regional Economics (BITRE), such as those contained in Working Paper 71 (BTRE 2007), Working Paper 73 (BITRE 2009a), Information Sheet 33 (BITRE 2009b) and Information Sheet 31 (BITRE 2009c). The long-term data on urban travel trends were also used in the derivation of demand relationships (see BITRE 2010, Chapter 2) that form the basis of recent BITRE projections of Australian transport task levels (and resulting transport energy use and emissions output).

2. A brief history of Australian urban transport

Until the latter half of the nineteenth century, urban transport needs in Australian cities were fairly minimal – since all were still relatively small (in 1850 the population of the largest, Sydney, was only about 50 thousand), and walking accounted for the majority of urban trips (with most remaining passenger travel being performed by horse).

However, by 1900 this had changed quite dramatically – largely due to surging income levels, immigration and industrial development flowing from the gold-rush era. Such stimuli to

[1] Note that some statistical collections by various transit authorities refer to urban areas larger than the relevant SDs (e.g. TransLink in Queensland and CityRail in NSW). Purely *regional* travel (e.g. school bus services in an urban centre outside the state capital's metropolitan area) is generally excluded from the estimates presented in this paper. Yet total trips recorded on some metropolitan transit systems will tend to involve an *interurban* component as well as the purely *suburban* contribution – meaning that some *per capita* estimates provided here (particularly if involving urban rail patronage) may slightly overstate the level of trips generated by the capital city SD's resident population.

urbanisation resulted in the Australian mainland state capitals (Sydney, Melbourne, Brisbane, Adelaide and Perth) reaching a combined population of around 1.4 million by the start of the twentieth century. With city areas now growing at a substantial rate, the development of effective transportation systems became a prominent part of furthering the urbanisation process.

Initial forays by Australian cities into mass passenger transport were dominated by horse use, with hansom cabs, wagonettes and horse buses all sharing (generally poor quality) urban roads from about the 1860s onwards. Horse-powered trams also appeared about this time – firstly, trialled (rather unsuccessfully) in Sydney; and later spreading across Adelaide during the 1880s; with Brisbane and Melbourne also opening horse tram lines near the end of the nineteenth century. However, with the subsequent electrification of most tramways, and also due to increasing competition from motor-buses, such horse-drawn public transit started disappearing during the early stages of the twentieth century, leaving horse travel to play a negligible role in Australian urban transport after the 1920s.

Mechanical traction began appearing on Australian city streets during the 1880s, initially with the use of steam trams (primarily in Sydney) and cable trams (primarily in Melbourne). Large scale construction of electric tramways during the early part of the twentieth century saw Australian use of *light* passenger rail transport expand rapidly. By the time of the First World War, metropolitan trams (across the Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart systems) were carrying around half a billion passengers per annum. Melbourne eventually converted its cable networks to electric traction, primarily during the 1920s and 1930s. By the end of the Second World War (with Sydney having by then probably the most heavily patronised tram system – in terms of per capita usage – the world has yet seen) Australian tram patronage had reached truly enormous proportions, with metropolitan use[2] accounting for over a billion passenger trips per year (see Figure 1).

The appearance of urban train services in Australia roughly paralleled that of the trams' introduction – with Melbourne building the first suburban rail line during the 1850s, and with other cities adding steam locomotives to their public transit systems over the following decades. By the turn of the century, each of the State capitals had *heavy* passenger rail systems (with Melbourne possessing by far the most comprehensive suburban network of the time) as well as tramways, carrying in aggregate almost comparable passenger numbers (for the year ending 30 June 1900, metropolitan heavy rail had patronage totalling around 94 million journeys, while light rail had carried close to 145 million – see Figure 1). As for the tram-lines, the early part of the twentieth century saw moves to electrify the major steam railways. By the 1940s, the two suburban rail networks that had electrified (Sydney and Melbourne) accounted for close to 90 per cent of total metropolitan train travel in Australia.

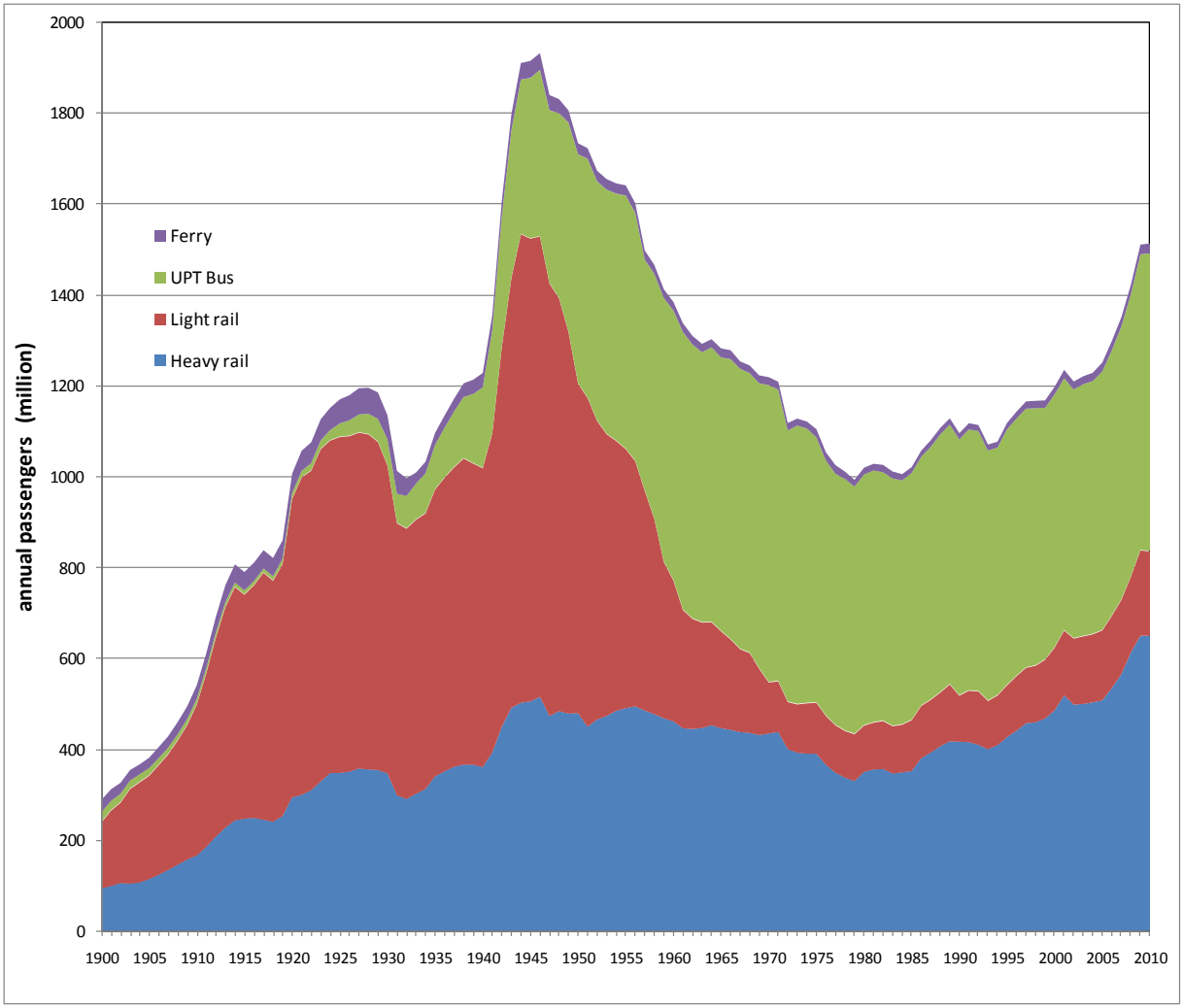
Ferry services were also established in several cities during the latter part of the nineteenth century; though only ever accounting for a significant portion of total urban travel in Sydney and Brisbane. During the early 1900s, Sydney's steam ferries accounted for a considerable part of the city's overall mass transit (with patronage in 1900 roughly matching that of the suburban railways). However, the modal share of the Sydney ferry system was slashed following the opening of the Sydney Harbour Bridge in 1932, with aggregate passenger numbers falling from about 50 million per annum (in the years immediately preceding the bridge's completion) to an annual level of around 21 million (averaged over the five years following the bridge opening).

Powered bus use in Australia began soon into the twentieth century (steam, once again, the first technology to compete with the horse; with steam buses trialled as early as 1905).

---

[2] Total Australian use of trams was even higher than the capital city values provided here – with various regional centres, not directly dealt with in this paper, also introducing tram systems (including Ballarat, Bendigo, Launceston, Newcastle, Rockhampton, Fremantle and Kalgoorlie).

Figure 1: Total metropolitan patronage for Australian public transit modes



Note: Includes total passenger trips on all capital city transit systems. Values for light rail include estimates for the Sydney Monorail (as well as for early horse-drawn trams); values for public transit buses include the use of trolley-buses (and also horse-drawn vehicles).

Sources: BITRE estimates, BITRE (2009a, 2009c, 2010), BTRE (2002, 2007), Adena & Montesin (1988), Cosgrove (2008), Cosgrove & Gargett (1992, 2007), CTEE/ACG (2009 and earlier), CTEE/APC (2010), TDC (2010 and earlier), BTE (1999 and earlier), ABS Yearbooks (2010 and earlier), CBCS Yearbooks (1973 and earlier), Lee (2003), various transport authority statutory reporting (including State Transit Authority of New South Wales annual reports; Rail Corporation New South Wales and CityRail annual reports; Sydney Ferries annual reports; Victorian Department of Transport annual reports; http://www.metlinkmelbourne.com.au/about-metlink/metlink-annual-review/; http://translink.com.au/about-translink/reporting-and-publications/annual-and-quarterly-reports; Brisbane City Council annual reports; Queensland Rail annual reports; South Australian Department for Transport, Energy and Infrastructure annual reports; Western Australian Public Transport Authority annual reports; http://www.transperth.wa.gov.au/; NT Department of Infrastructure, Planning and Environment annual reports; Metro Tasmania annual reports; Darwin Bus Service annual reports; http://www.tams.act.gov.au/; ACTION Canberra annual reports).

Use of petroleum-fuelled buses started becoming widespread during the 1920s, and by the mid-1930s motor-buses were carrying in the order of 100 million metropolitan passengers per annum. As well as this growing sectoral competition for many tram services, the 1930s also saw the introduction of electric trolley-buses to several of the State capitals (though the Australian experimentation with such trolley services ended up being relatively short-lived; and all trolley-bus lines had been phased out, in favour of diesel buses, by 1970).

During the Second World War, Australian UPT usage burgeoned, especially on those city networks that had continued their rail system expansions or electrification programs. By 1945, total metropolitan patronage across all the various public transit modes was approaching 2 billion passenger trips per annum (see Figure 1, and Table 1 which shows the subdivision of this aggregate between the 8 Australian capital cities)[3]. This, however, was the heyday of Australian public transit use, and the post-war era saw a steady decline in aggregate UPT patronage.

In the years following the Second World War, trams were not only competing for passenger market share (and road space) with the expanding bus services, but also with the growing availability of car travel. Such pressures, including motorist associations regularly lobbying for governments to close tram-lines, contributed to most cities (the only major exception being Melbourne) gradually dismantling their tram networks during the 1950s and 1960s – typically replacing them with bus services – despite significant public protest (especially in Sydney and Brisbane) over many line closures. After the war, total annual UPT passenger volumes fell for over three decades; and even though the current number of urban travellers carried on Australian buses, railways and ferries is still considerable, it is well below the aggregate levels reached during mass transit's peak years (in the mid-1940s).

Table 1: Total metropolitan patronage on public transit, Australian capital cities, 1900–2010

(million passenger trips)

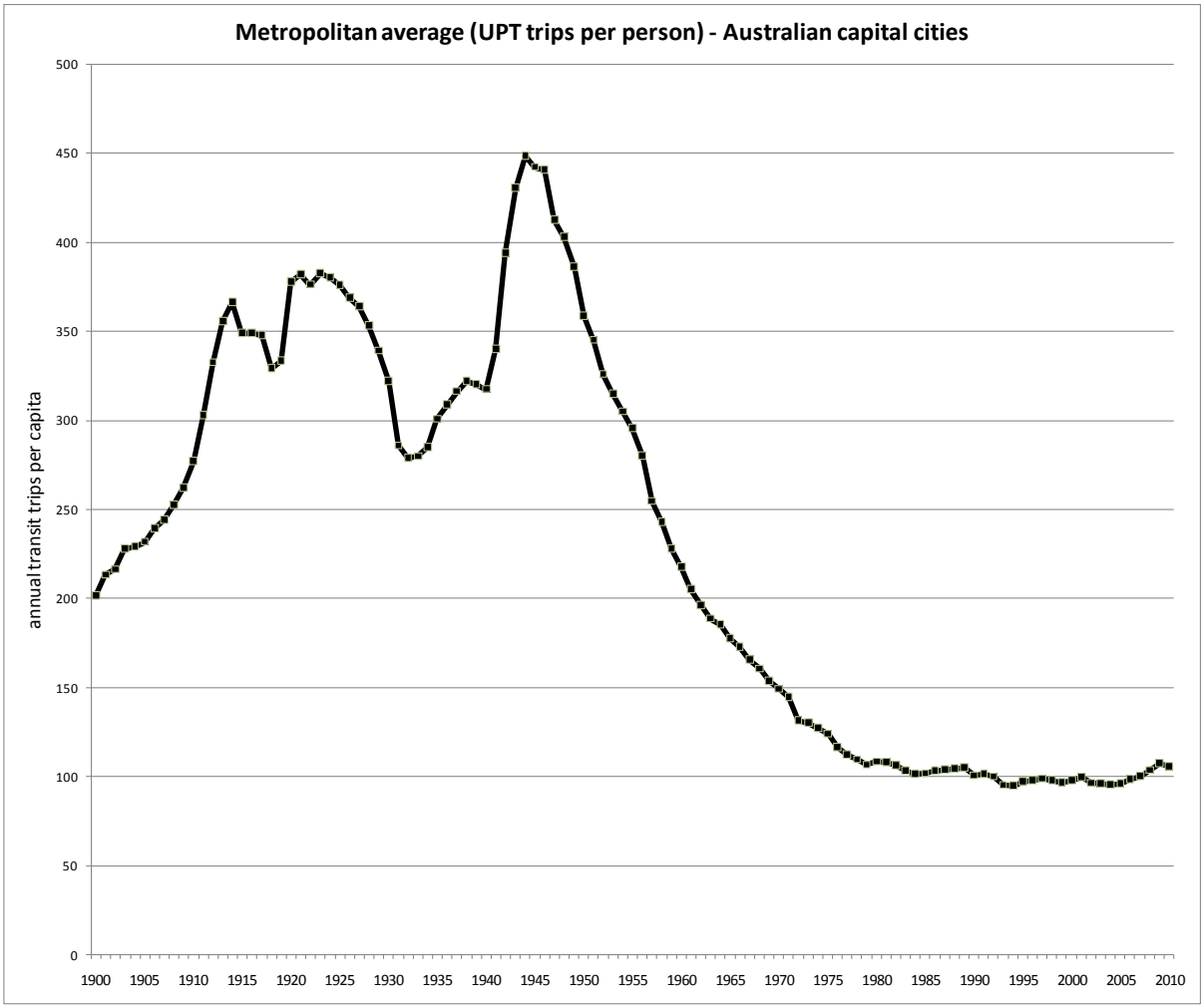
Fin. Year	*Sydney*	*Melbourne*	*Brisbane*	*Adelaide*	*Perth*	*Hobart*	*Darwin*	*Canberra*	*Total metropolitan*
1900	120.3	103.2	27.4	23.8	10.2	3.2	-	-	288.0
1905	191.0	111.6	30.4	25.4	18.4	3.9	-	-	380.7
1910	271.9	157.6	46.7	39.9	19.3	5.0	-	-	540.4
1915	393.1	229.0	72.5	60.3	27.6	7.2	-	-	789.7
1920	455.4	336.5	95.5	72.3	35.9	10.8	-	-	1006.3
1925	498.8	411.0	110.9	87.9	45.9	15.4	-	0.1	1169.9
1930	512.0	382.7	96.1	78.4	50.4	15.0	-	0.5	1135.1
1935	510.4	355.5	99.8	64.8	50.3	14.5	-	0.9	1096.1
1940	557.7	396.3	117.4	80.1	58.8	16.1	-	1.8	1228.1
1945	832.9	630.6	202.5	124.9	89.8	31.5	-	3.3	1915.6
1950	791.2	535.4	173.5	109.6	85.1	34.4	0.2	4.6	1734.0
1955	734.4	522.4	180.2	98.9	74.9	26.3	0.4	3.7	1641.4
1960	588.5	447.2	164.6	84.9	69.7	25.3	0.6	3.9	1384.7
1965	561.0	411.6	143.0	81.3	60.7	18.6	0.9	5.1	1282.2
1970	574.1	361.8	119.1	71.1	67.6	16.1	1.4	7.7	1218.8
1975	495.7	335.9	99.9	72.0	67.3	20.4	0.5	12.8	1104.5
1980	478.4	280.4	89.3	73.6	63.8	13.9	1.2	18.7	1019.3
1985	476.9	293.5	91.5	67.4	54.1	11.3	2.1	24.0	1020.8
1990	537.4	292.5	100.4	63.3	63.9	10.0	2.9	25.1	1095.5
1995	542.3	301.3	103.5	62.5	71.9	9.3	3.1	24.0	1117.9
2000	589.3	338.8	98.4	55.2	78.6	7.5	3.0	26.9	1197.8
2005	569.5	368.4	118.7	61.1	95.1	7.6	3.3	27.3	1251.0
2010	617.1	497.0	156.7	68.6	131.6	7.8	3.7	30.8	1513.4

Note: Includes total annual passenger trips on metropolitan transit systems – across ferries, light and heavy railways, and public transit buses (and also includes horse-drawn vehicle contributions during early years).

Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Cosgrove (2008), ABS (2010a and earlier), CBCS (1973 and earlier).

[3] Note that due to space considerations, the values presented in this paper are primarily displayed graphically (or in summary form, as per Table 1). However, full numerical time-series for each city's UPT use, by mode, are available (upon request to the author).

Figure 2: Aggregate trip generation rate across Australian public transit



Note: Includes total annual passenger trips on the transit systems of the 8 State and Territory capital cities – for ferries, light rail, heavy rail and public transit buses – divided by the resident metropolitan population (as at each year ending 30 June, totalled across the capital city Statistical Divisions).

Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Cosgrove (2008), ABS (2010a and earlier, 2010b), CBCS (1973 and earlier).

2.1. Per capita UPT patronage trends

Figure 2 displays the long-term pattern in *per capita* UPT trips for Australian metropolitan travel. Growth in per capita travel during the early part of the twentieth century resulted in national levels during the 1920s averaging around 370 public transit trips per person per annum. The dire income and employment effects flowing from the Great Depression led to substantial declines from these relatively high levels, but with the 1930s still averaging per capita rates in the vicinity of 300 UPT trips per annum. During the 1940s, the trip generation rates recovered ground; and petrol rationing (brought on by wartime fuel shortages) led not only to a pause in the growth of private car ownership, but also significant modal share moving to public transit. The ensuing increase in per capita UPT travel was both rapid and unprecedented (see Figure 2), with levels climbing as high as 440-450 trips per annum during the latter stages of the Second World War.

After the war (and particularly with the end of fuel rationing), growth in private motorisation accelerated, and UPT systems in all the capitals saw their market share steadily decrease

over time, especially as car travel continued to grow in popularity. The afore-mentioned fall in aggregate UPT patronage is reflected in the per capita trip generation trends, with Figure 2 clearly demonstrating how the long downward trend in the transit participation rate (i.e. annual journeys per person) did not halt until about 1980. The metropolitan average rate has been fairly constant over the last three decades – hovering around the 100 trips per capita level – though there has been a slightly increasing trend over recent years (probably associated with service expansions to some systems and higher than average fuel prices). The national average over the 2010 financial year (at approximately 106 UPT trips per person) is around 10 per cent higher than that for 2005 (see Table 2).

Table 2 also displays how the per capita UPT trip levels vary between the different capital cities. Australia's three largest cities (Sydney, Melbourne and Brisbane) all had reasonably similar trends (in transit trip generation rates) over the first half of the twentieth century, with their respective high points (towards the end of the Second World War) even in fairly close accord. However, by about the mid-1960s their rates had tended to diverge, with Brisbane the lowest and Sydney the highest (primarily due to a considerably higher average participation rate on its suburban railway network than that of the other cities).

Table 2: Average trip generation rates for public transit, Australian capital cities, 1900–2010

(annual passenger trips per capita)

Fin. Year	*Sydney*	*Melbourne*	*Brisbane*	*Adelaide*	*Perth*	*Hobart*	*Darwin*	*Canberra*	*Total metropolitan*
1900	235.3	199.9	220.7	142.3	139.8	86.1	-	-	201.6
1905	319.9	194.9	214.0	134.7	185.8	93.5	-	-	231.8
1910	363.3	240.8	285.7	184.6	158.5	110.2	-	-	277.0
1915	444.5	302.3	379.4	248.1	200.8	155.2	-	-	349.1
1920	432.4	393.7	396.2	255.3	208.8	187.3	-	-	377.8
1925	420.8	400.1	374.2	268.6	221.2	238.9	-	34.3	375.8
1930	361.4	341.8	293.5	227.4	210.7	220.8	-	71.7	322.1
1935	344.1	315.0	278.8	185.1	207.9	198.2	-	112.8	300.8
1940	360.9	327.7	300.4	217.9	226.8	202.3	-	140.9	317.5
1945	471.2	485.0	450.8	296.7	310.3	383.7	-	200.8	442.2
1950	411.6	372.4	336.7	225.3	246.1	362.5	26.5	177.7	358.5
1955	346.7	308.4	299.3	176.3	178.9	235.2	37.5	104.3	295.6
1960	246.6	226.8	243.2	130.8	145.9	196.5	38.8	68.6	217.6
1965	211.5	185.4	186.3	106.9	108.4	133.2	43.2	54.2	177.7
1970	194.5	144.9	138.7	84.4	97.0	106.7	40.7	55.4	149.1
1975	159.3	124.5	102.8	78.7	82.8	127.2	14.0	65.1	124.1
1980	146.9	100.6	84.0	77.7	70.9	82.2	22.2	84.1	108.4
1985	139.2	100.9	77.5	67.8	53.1	63.7	27.8	96.1	101.8
1990	147.5	93.6	75.0	60.6	54.4	53.1	33.3	89.3	100.7
1995	141.9	92.9	69.1	58.2	56.6	47.7	33.2	78.7	97.2
2000	144.8	99.0	60.3	50.1	57.3	38.2	28.5	85.4	98.1
2005	134.2	100.1	65.2	53.9	64.0	37.4	29.9	82.8	96.1
2010	134.7	122.0	76.6	57.1	77.5	36.6	29.1	85.9	105.8

Note: Includes total annual passenger trips on each metropolitan transit system – across ferries, light and heavy railways, and public transit buses (and also includes horse-drawn vehicle contributions during early years) – divided by the resident population (as at each year ending 30 June) of the relevant capital city Statistical Division.

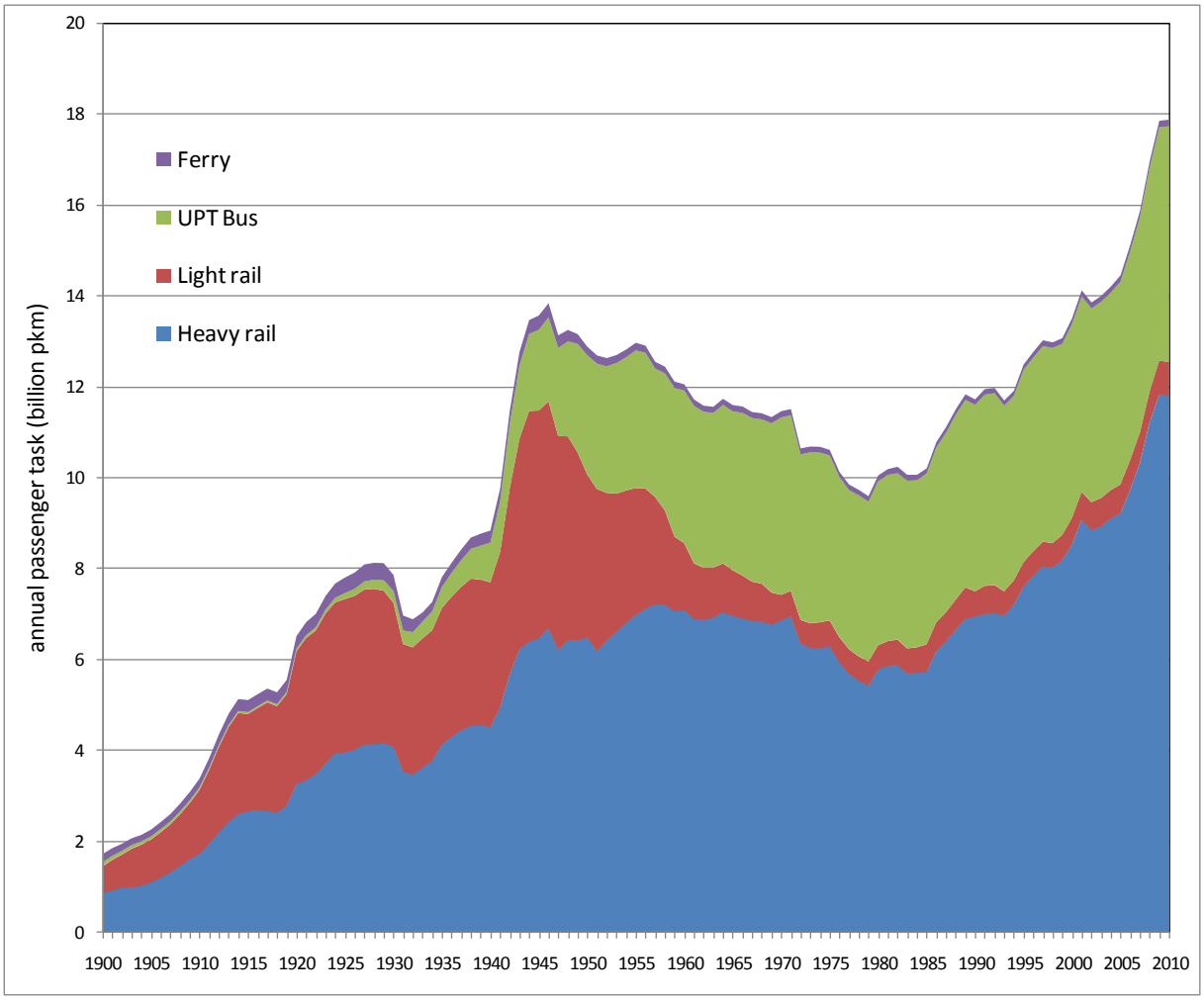
Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Cosgrove (2008), ABS (2010a and earlier, 2010b), CBCS (1973 and earlier).

Over the last few years, several UPT systems (most noticeably in Melbourne, Brisbane and Perth) have seen fairly substantial increases in such trip generation rates (with Melbourne's per capita trips growing 22 per cent since 2005, and re-approaching the aggregate level of Sydney); while other cities (including Sydney and Hobart) have not encountered such gains.

2.2. Long-term trends in urban transport task levels

While patronage levels (in terms of annual passenger numbers) form an important indicator of the intensity that a particular mode is operating at, typically a more complete measure of actual sectoral activity can be provided by passenger-kilometre (pkm) estimates (i.e. passenger trip numbers multiplied by the average trip length). Figure 3 displays the long-term trends in the aggregate passenger tasks performed by Australian UPT modes, in terms of annual pkm.

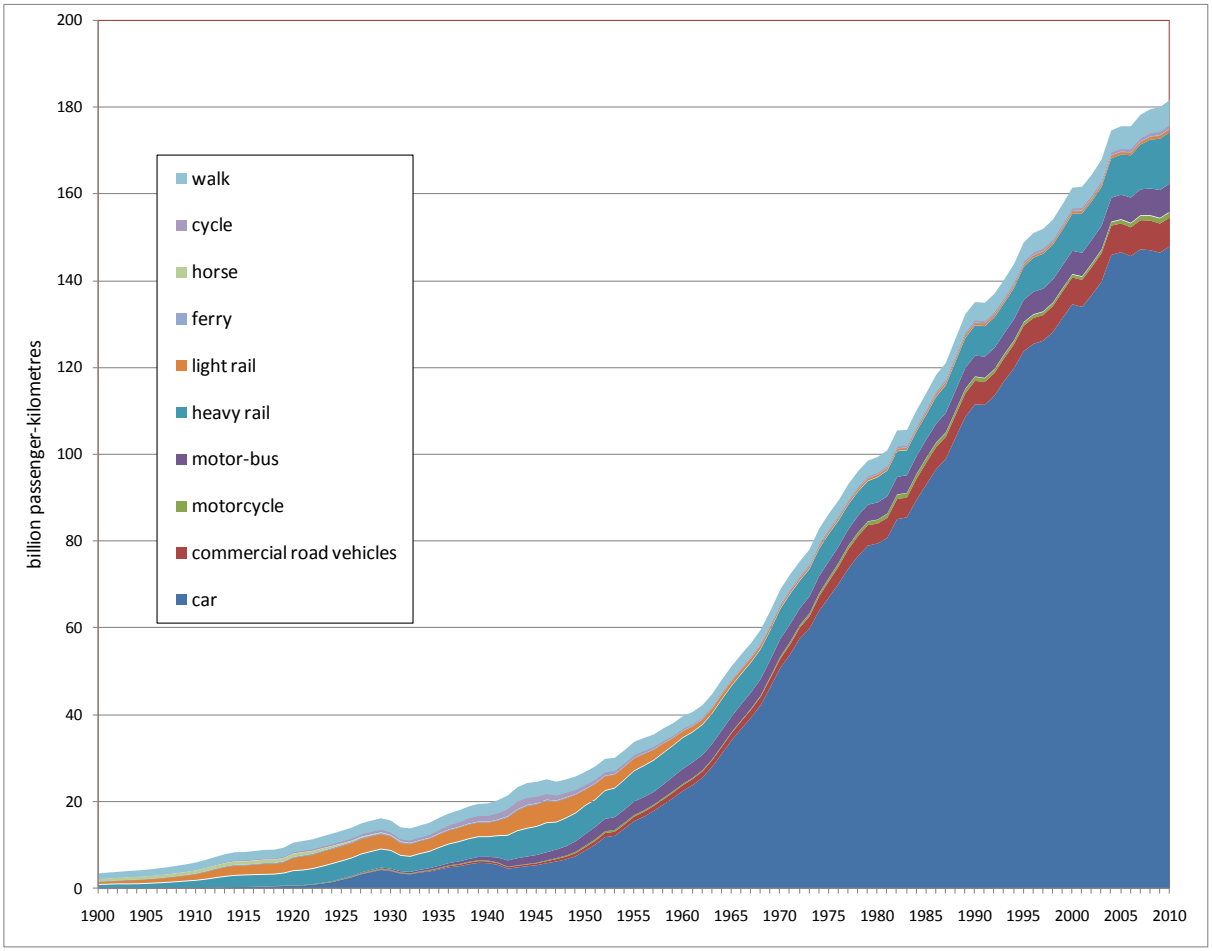
Figure 3: Total metropolitan passenger task performed by Australian public transit modes



Note: Includes total passenger travel on the capital city transit systems. Values for light rail include estimates for the Sydney Monorail (as well as for early horse-drawn trams); values for public transit buses include the use of trolley-buses (and also early horse-drawn transit vehicles).

Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Adena & Montesin (1988), Cosgrove (2008), Cosgrove & Gargett (2007), ABS (2010a and earlier), CBCS (1973 and earlier), CTEE/ACG (2009 and earlier), TDC (2010), Hensher (2000).

Figure 4: Total metropolitan passenger task for Australia, across all modes, 1900–2010



Notes: Includes total passenger travel within the 8 State and Territory capital cities, across all available transport modes (including non-motorised travel).

Estimated values for *walk* include any relocation portions of a complete multi-modal journey as well as trips taken solely on foot; values for *horse* include all horse use for urban passenger transport (saddle horses and harness horses – for all horse-drawn carriage use, horse trams and horse buses); values for *motor-bus* include all motor vehicles with 10 or more seats (i.e. charter/hire buses and private minibuses as well as UPT buses); values for *commercial road vehicles* are primarily due to non-business travel by light commercial vehicles (such as utilities and panel vans).

Pkm estimates are typically less precise than those for passenger volumes – due to the relative paucity of data on average trip lengths for the various transport modes. Estimated values for walking and cycling are order-of-magnitude only, also due to a general scarcity of detailed data available.

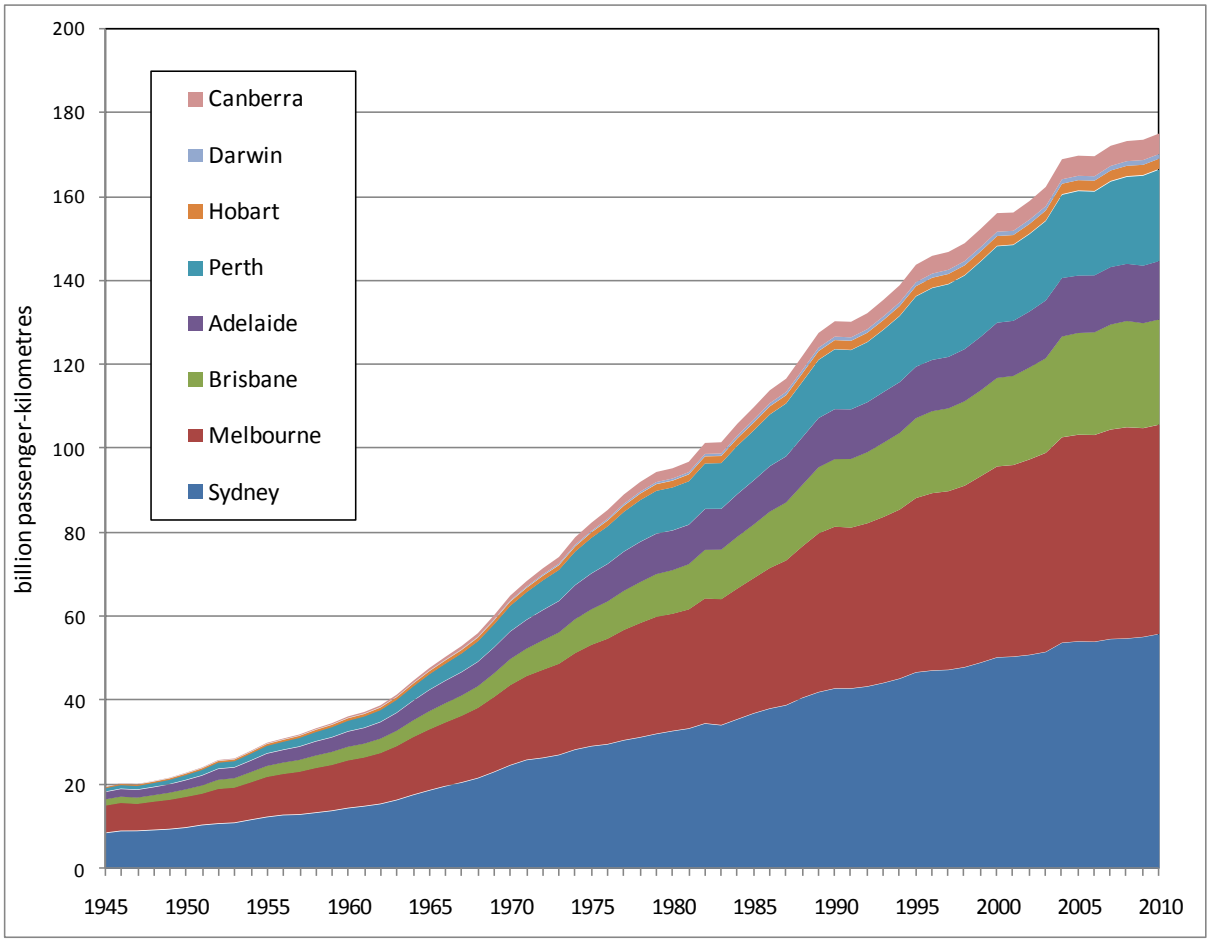
Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Adena & Montesin (1988), Cosgrove (2008), Cosgrove & Gargett (2007), Cosgrove & Mitchell (2001), ABS *Survey of Motor Vehicle Use* (2008 and earlier), ABS *Motor Vehicle Census* (2011 and earlier), ABS Yearbooks (2010a and earlier), CBCS Yearbooks (1973 and earlier), CTEE/ACG (2009), CTEE/APC (2010), TDC (2010), Hensher (2000).

As a comparison of Figures 1 and 3 shows, even though present Australian UPT passenger volumes are well below historical highs (encountered over 60 years ago), the national passenger *task* performed by metropolitan transit systems is currently at the highest levels yet (at about 17.9 billion pkm, across the 8 capital cities, over the year ending 30 June 2010). This difference in the estimated trends is essentially due to average trip distances gradually

increasing over time, especially as city areas have expanded – with current UPT averages (for kilometres travelled per trip) being almost twice those typical of urban transit trips taken at the start of last century.

Figure 4 then displays the long-term trend in *total* metropolitan passenger tasks – for private travel (including non-motorised contributions) as well as public transit. The chart displays the vast increase in urban travel over the years, with aggregate metropolitan pkm growing from only about 3.5 billion pkm annually at the start of the twentieth century to current levels over fifty times higher, at about 181.7 billion pkm during 2010. A substantial component of this increase has been due to rising population levels (with the number of Australian metropolitan inhabitants estimated as growing from about 1.43 million in 1900 to 4.33 million by 1945, and reaching about 14.3 million by 30 June 2010). However, the amount of personal daily travel also rose significantly over this time (with per capita levels at the start of the previous century averaging about 2.5 thousand pkm per annum, growing to about 5.7 thousand pkm per annum by the end of the Second World War, and with eventual levels then averaging around 13 thousand pkm per annum during this century's first decade).

Figure 5: Aggregate motorised passenger travel for the Australian capital cities, 1945–2010



Note: Includes all powered passenger travel within each of the State and Territory capital cities (i.e. does not include non-motorised travel).

Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Adena & Montesin (1988), Cosgrove (2008), Cosgrove & Gargett (2007), ABS (2008, 2010a, 2011), CBCS (1973), CTEE/ACG (2009), CTEE/APC (2010), TDC (2010).

Over the years, and particularly since the end of the Second World War, many Australian cities have gradually transformed from quite tightly knit layouts (typically well suited to passenger movement by mass transit systems), to more sprawling suburban (generally low-density) configurations. This transformation of urban form – as the major cities have tended to grow ever outwards, often leading to longer and longer average trip lengths – has been accompanied, and assisted, by considerable improvement and spread of road systems and an even faster expansion in car ownership. Another factor clearly displayed by Figure 4 is this rapid escalation of car use (especially in the post-war era), leading to the current dominance of private motor vehicle travel, in terms of aggregate pkm share, within the Australian urban transport sector.

Figure 5 concentrates on the post-war years, and plots total motorised passenger-kilometres for the various metropolitan areas, displaying the differing task levels of the 8 capital cities. Current aggregate values for Sydney and Melbourne are roughly comparable (where jointly these two largest of Australian cities account for 60 per cent of the national pkm total for metropolitan travel), and both have seen roughly seven-fold growth over the period (i.e. in motorised pkm between 1945 and 2010).

However, recent growth rates in passenger activity are more noteworthy for some of the other cities. Over the last decade, task level growth has been highest (amongst the capital cities) for Brisbane and Perth, averaging in the order of 1.8 per cent per annum (2000 to 2010); well above the more moderate pkm growth of Sydney, Melbourne, Darwin and Canberra – each averaging in the order of 1 per cent per annum; and with Adelaide and Hobart having the lowest averages (at little more than 0.5 per cent per annum).

Most of the aggregate urban growth displayed in Figure 5, with total motorised pkm rising close to nine-fold between 1945 and 2010, has come from the increasing use of light motor vehicles, with metropolitan car travel in Australia (in total pkm terms) growing by almost a factor of 28 over the last 65 years.

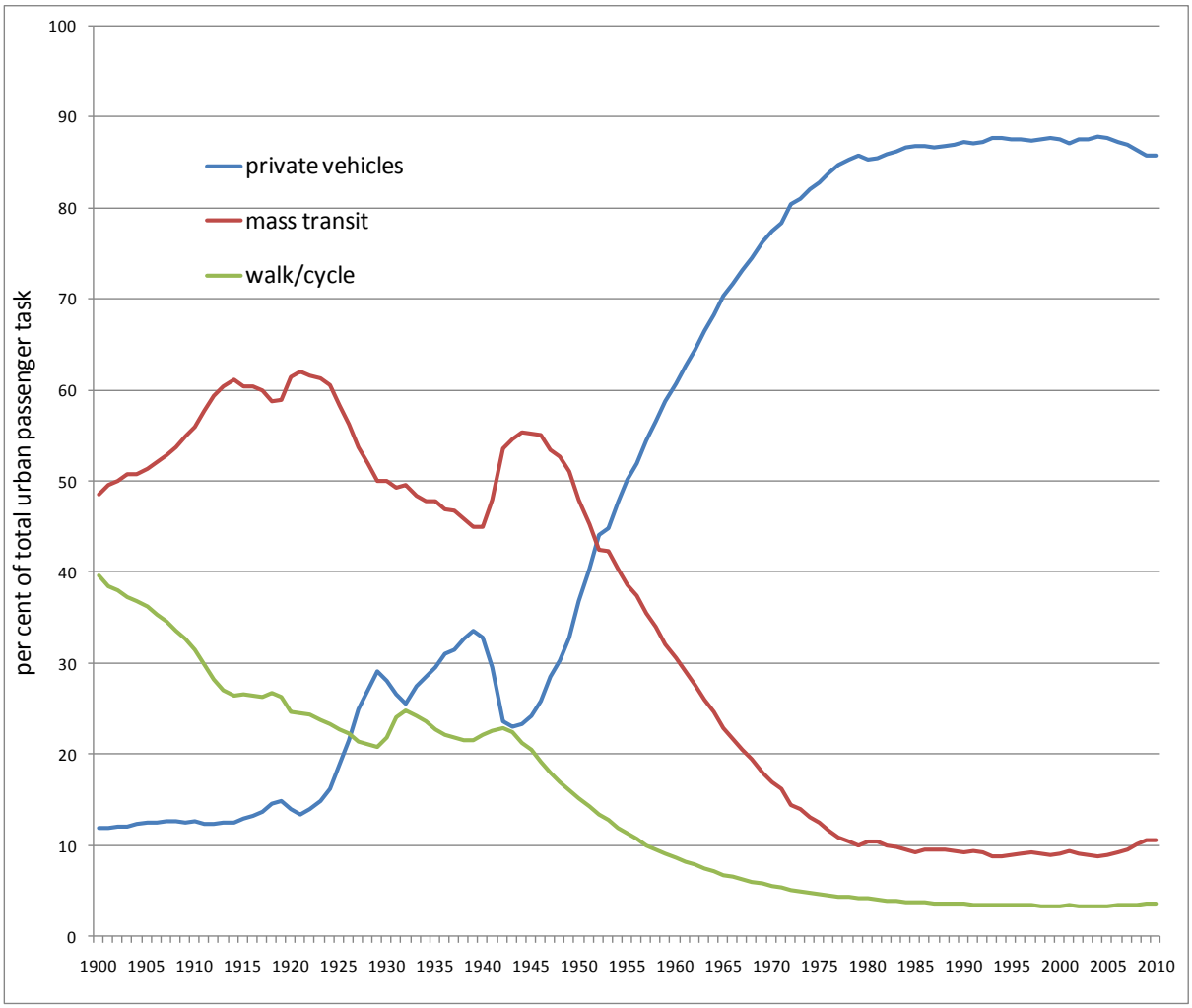
3. Mode share patterns

The derived transport task levels allow the calculation of modal share trends for the various types of urban travel, where Figure 6 plots the proportion of total metropolitan pkm due to private travel and mass transit (using the task estimates given in Figure 4).

Use of private road vehicles currently accounts for almost 86 per cent of the aggregate passenger task in Australian cities, despite mass transit accounting for over half of total pkm during much of last century's initial decades. Urban public transport, though generally still a major component of peak travel into central business districts, currently represents only around 10 per cent of the total metropolitan passenger task (in pkm terms). Both these market shares have remained reasonably constant since the early 1980s – after the long downward trend in the UPT share finally levelled off – though public transit has seen some gains in the modal split over the last few years (moving from 8.9 per cent of total metropolitan pkm in 2005 to about 10.5 per cent in 2010).

Figure 7 then subdivides the aggregated market shares given in Figure 6, showing the long-term trends in several of the major modal components. Some of the main developments over the last century are clear: the effective disappearance of horse travel by the 1920s, followed by an expansion of motor-bus services; the major decline in importance of light rail, as many tram networks close, from the 1950s on; suburban train travel, once the dominant mode, starting to lose market share, also from about the 1950s, before levelling off at about 6 per cent of metropolitan pkm; and the prominent growth in the share of car travel, with car's original rise (to over 80 per cent market share from the 1980s onwards) only really interrupted by the effects of the Great Depression and the Second World War.

Figure 6: Aggregate mode share for main types of metropolitan travel in Australia



Note: Share due to 'private vehicles' is mostly from passenger cars, but also has some contributions from other road vehicles such as light commercial vehicles (LCVs) when used for non-business purposes, and motorcycles (and for early years also from horse use – such as for private carriages). Values for 'mass transit' include passenger task performed by all metropolitan buses, ferries, light rail and heavy rail (including early horse-drawn transit vehicles).

Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Cosgrove & Gargett (2007).

4. Saturation effects

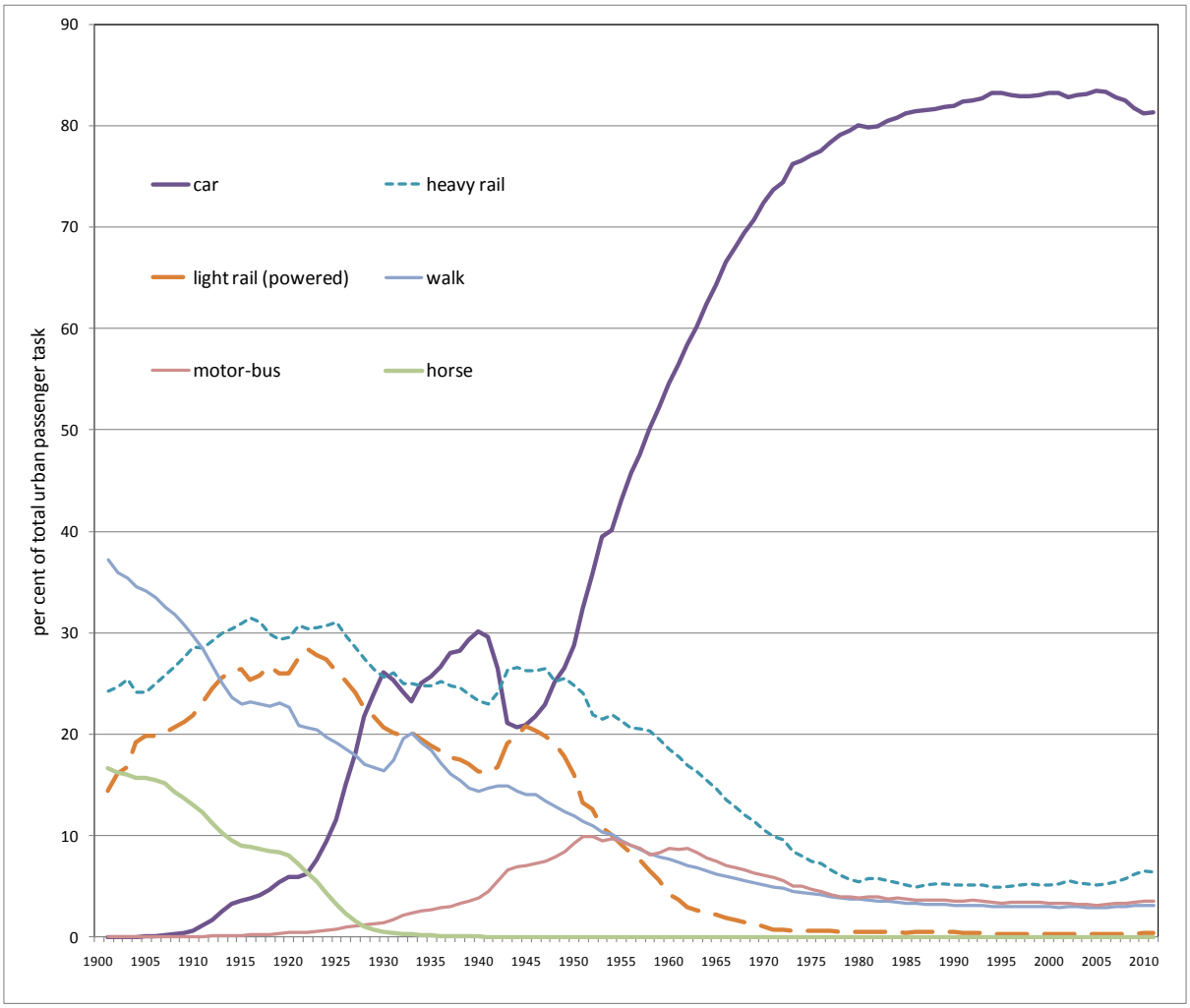
In closing, another of the wide variety of transport analyses made possible by the compilation of such long-term historical series is outlined: eventual saturation levels for personal travel.

An important relationship underlying BITRE projections of the historical task trends into the future concerns the connection between rising income levels and per capita daily travel. Figure 8 plots over six decades of per capita passenger task estimates, for Australian urban travel (using Figure 4), against the average income level at which the aggregate transport activity was undertaken. Note how markedly the growth rate in pkm per person has reduced in recent years (right-most points on the Figure 8 data curve), especially compared with past very high growth in per capita travel (i.e. for values towards the left-hand side on the curve, roughly corresponding to the 1950s to 1970s).

Basically, as income levels (and motor vehicle affordability) have tended to increase over time, average travel per person has increased. However, there are constraints on 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. Therefore, future increases in Australian urban passenger-kilometres travelled are likely to depend more directly on the rate of population increase, and be less dependent on increases in general prosperity levels.

Figure 7: Modal share for major urban travel choices, 1900–2010



Note: Share of total metropolitan passenger-kilometres – with values for 'light rail' including steam, cable and electric powered trams (as well as the Sydney Monorail); values for 'horse' include all horse use for urban passenger transport (both saddle horses and harness horses – for all horse-drawn carriage use, horse trams and horse buses); values for 'motor-bus' include all motor vehicles with 10 or more seats (i.e. charter/hire buses and private minibuses as well as UPT buses, and include trolley-buses).

Sources: BITRE estimates, BITRE (2009c, 2010), BTRE (2007), Cosgrove & Gargett (2007).

Figure 8 also gives the resulting curve fit (using non-linear, iterative least squares estimation) for the underlying trend in (latent) per capita urban passenger movement (where the x-axis uses per capita real Gross Domestic Product, in thousands of 2007 Australian dollars, as a proxy for national average income levels). The functional form giving the best fit to the urban travel data was a Dose Response Logistic equation:

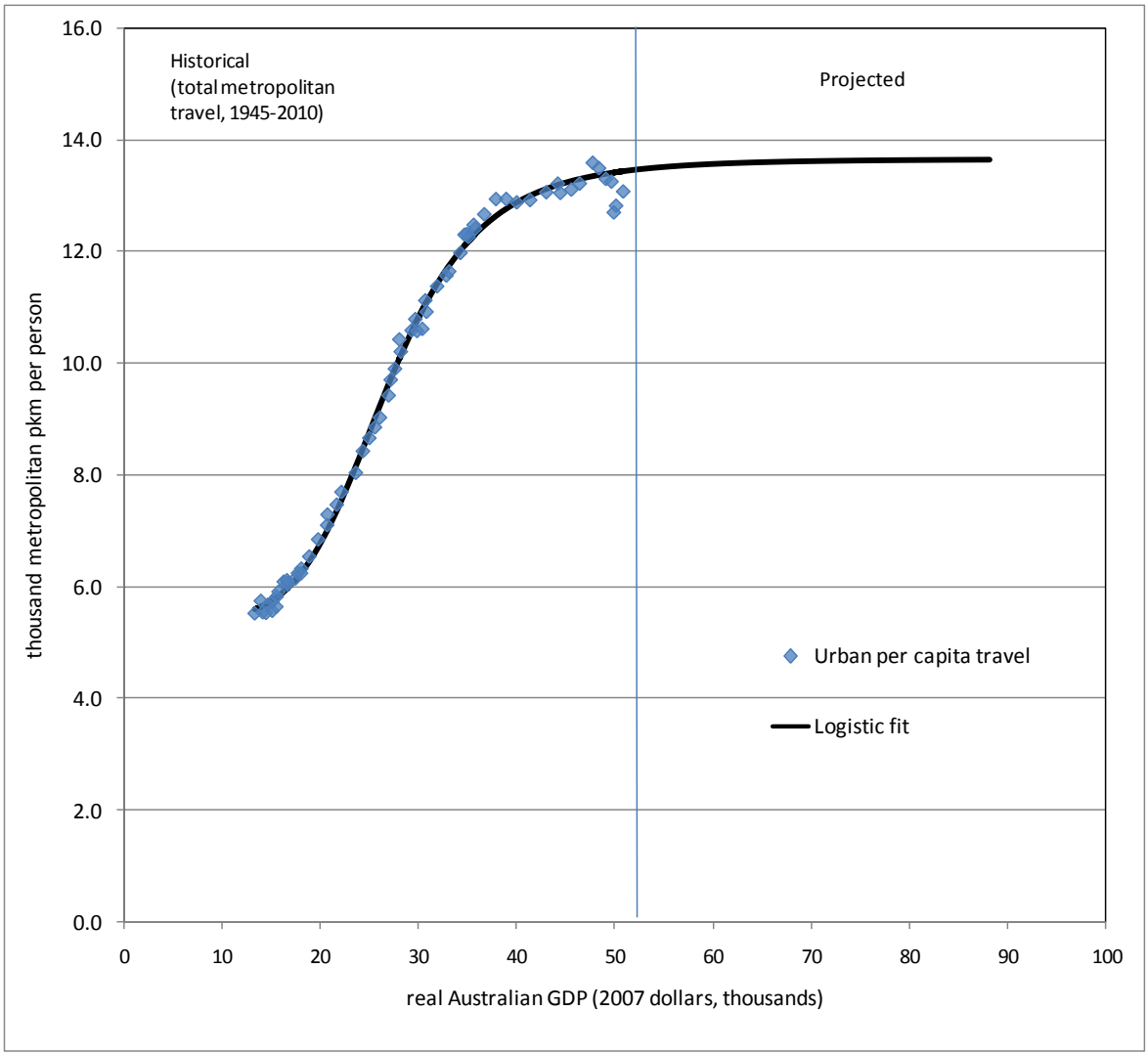
$$\text{Annual urban pkm per capita (thousands)} = 5.46+8.19/(1 + (\text{Income}/26.71)^{-5.62})$$

This saturating relationship suggests that an upper bound to per capita urban travel could effectively apply to Australia within the next decade or so. From the curve fitting for Figure 8, this 'saturation level' (for average urban travel) is estimated as likely to fall in the vicinity of

13.7 thousand pkm per annum. Such curves can be fit individually for each of the major Australian cities, with slightly differing saturating trends. With such asymptotic or limiting behaviour being identified within the data, the implication is that growth in per capita urban travel is likely to be lower in the future than for the long-term historical trend.

The results provided, particularly in Figures 6–8, serve to demonstrate that, as an aid to discussions concerning a variety of urban issues (e.g. past effects of transport reforms, on passenger modal choice; the influence of fuel price or UPT fare variations; the results of changes to infrastructure provision; congestion impacts on travel behaviour; economic effects on travel patterns; or even the possible extent of future patronage growth for public transit in Australian cities), the datasets compiled for this paper (on long-term trends in urban passenger tasks) have a wide range of potential uses.

Figure 8: Relationship of per capita Australian urban travel to per capita income



Note: For each data point: y-axis value refers to total annual passenger travel (in pkm) within the State and Territory capital cities, divided by the resident metropolitan population (as at each year ending 30 June, totalled across the capital city Statistical Divisions); x-axis value refers to average Australian income level, calculated here as national GDP for the relevant year (ending 30 June), divided by the national population level.

Sources: BITRE estimates, BITRE (2010), BTRE (2002, 2007), Cosgrove & Gargett (2007).

Abbreviations

ABS	Australian Bureau of Statistics
ACG	Apelbaum Consulting Group
APC	Adam Pekol Consulting
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BTCE	Bureau of Transport and Communications Economics
BTE	Bureau of Transport Economics
BTRE	Bureau of Transport and Regional Economics
BTS	NSW Bureau of Transport Statistics
CBCS	Commonwealth Bureau of Census and Statistics
CTEE	Centre for Transport, Energy and the Environment
pkm	passenger-kilometres
SD	Statistical Division
UPT	urban public transport

References

ABS (2008) *Survey of Motor Vehicle Use, Australia*, Catalogue no. 9208.0, Canberra: ABS

ABS (2010a) *Year Book Australia, 2009-10*, Catalogue no. 1301.0, Canberra: ABS

ABS (2010b) *Regional Population Growth, 2008-09,* Cat. no. 3128.0, Canberra: ABS

ABS (2011) *Motor Vehicle Census, Australia*, Catalogue no. 9309.0, Canberra: ABS

Adena, M A & Montesin, H J (1988) *Day-to-Day Travel in Australia 1985-86*, report by INTSTAT Australia Pty Ltd for Federal Office of Road Safety, Canberra: FORS

BITRE (2009a) *Greenhouse Gas Emissions from Australian Transport: Projections to 2020*, Working Paper 73, Canberra: BITRE

BITRE (2009b) *Urban public transport: recent bus transport statistics*, Information Sheet 33, Canberra: BITRE

BITRE (2009c) *Urban Passenger Transport: How people move about in Australian cities*, Information Sheet 31, Canberra: BITRE

BITRE (2010) *Long-term Projections of Australian Transport Emissions: Base Case 2010*, Report for the Department of Climate Change and Energy Efficiency, Canberra: BITRE www.climatechange.gov.au/publications/projections/~/media/publications/projections/bitre-transport-modelling-pdf.pdf

BTE (1999) *Transport Indicators*, Canberra: BTE

BTRE (2002) *Greenhouse Gas Emissions from Transport: Australian Trends to 2020*, Report 107, Canberra: BTRE

BTRE (2007) *Estimating urban traffic and congestion cost trends for Australian cities*, Working Paper 71, Canberra: BTRE

CBCS (1973) *Official Year Book of the Commonwealth of Australia, No.58, 1972*, Canberra

Cosgrove, D C (2008) Long-term Emission Trends for Australian Transport, *Papers of the 31st Australasian Transport Research Forum*, Gold Coast: ATRF

Cosgrove, D C & Gargett, D (1992) The Australian Domestic Transport Task, *Papers of the Australasian Transport Research Forum*, vol. 17, part 1, pp. 231–249, Canberra: BTCE.

Cosgrove, D C & Gargett, D (2007) *Long-Term Trends in Modal Share for Urban Passenger Travel*, Conference proceedings of Thredbo10: The 10th International Conference on Competition and Ownership in Land Passenger Transport, Hamilton Is: University of Sydney

Cosgrove, D C & Mitchell, D (2001) Standardised Time-series for the Australian Road Transport Task, *Proceedings of the 24th Australasian Transport Research Forum*, Hobart

CTEE/ACG (2009) *Australian Transport Facts 2009*, ACG, Clayton, Victoria

CTEE/APC (2010) *Australian Transport Facts 2010*, APC, Spring Hill, Queensland

Hensher, D A (2000) Urban Transport Challenges, *The Drawing Board: An Australian Review of Public Affairs*, vol. 1, no. 2, pp. 47–62, University of Sydney

Lee, R (2003) Linking a Nation: Australia's Transport and Communications 1788 – 1970, *Australia: Our national stories*, Australian Heritage Commission

TDC (2010) *2008/09 Household Travel Survey, Summary Report – 2010 Release*, Sydney: Transport NSW, BTS web-release:
www.bts.nsw.gov.au/ArticleDocuments/79/2008_09_HTS_Summary_Report.pdf.aspx?Embed=Y