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Spatial distribution of the journey to work by sustainable modes in Australian cities

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Abstract

To understand the impacts of current policies and to guide planning for future infrastructure and services, it is important to monitor and analyse trends in transport behaviour. The ABS Census is an under-utilized source of travel behaviour data that, because of its method of collection, avoids the problems associated with other survey methodologies that rely on generalisations from small samples.

This paper reports on an analysis of travel mode and destination zone for people in the labour force using data from the 2001 and 2006 censuses for the Australian state capitals and Canberra. Destination-zone data is publicly available only for these two censuses. This work builds on earlier analysis of Australian journey to work data between 1976 and 2006.

We analyse the spatial distribution of recent growth in urban public transport patronage, as well as walking and cycling, to determine the extent to which inner-city workers are contributing to recent increases in travel by sustainable modes. We expected that, because services and infrastructure are principally designed for this market, work travel to the inner zones of Australian cities would account for most of the growth in the use of sustainable modes of transport. However, for public transport, the results did not follow this pattern. The proportion of work trips by public transport to destinations in the inner zones fell between 2001 and 2006 in all cities except Sydney and Canberra.

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1. Introduction

This paper reports on an analysis of data from the 2001 and 2006 censuses for the method of travel to work by the location of the place of work.

Typically, analysis of mode choice for the journey to work uses data organised by residential location (or place of origin). For example, Rickwood & Glazebrook (2009) analysed the relationship between the urban density of trip origins and the share of trips to work made by different modes. However, the characteristics of trip destinations (in the case of trips to work, workplaces) also influence the usage of different transport modes. Thomson (1977) studied a range of cities throughout the world and concluded that the strength of the city's centre is the primary determinant of transport outcomes (see also Mees, 2010, p. 65).

The distribution of workplaces and associated travel modes in Melbourne has been mapped by the Victorian Department of Transport in their useful *Transport Demand Information Atlas* (2008). Now, in this paper, data is provided for all the Australian state capitals and Canberra. This complements our earlier compilation of data and analysis of the journey to work in Australian capital cities between 1976 and 2006 (Mees, O'Connell and Stone 2008).

The analysis in this paper focuses on the performance of the principal sustainable modes – walking, cycling and public transport – through comparisons between the rates of use of these modes in CBDs and adjacent inner-city locations and their overall performance across the urban region. The inner-city locations are of interest because our urban public transport systems are generally set up to cater for these work trips and the greatest efforts to improve facilities for walking and cycling are typically concentrated in these areas.

We also examine the spatial distribution of the growth in travel by more sustainable modes that occurred between 2001 and 2006 to explore the hypothesis that this growth was driven, in part, by a disproportionate concentration of new jobs in the CBDs and adjacent inner-city locations, for which these sustainable modes offer attractive travel alternatives.

This analysis provides a strong framework for future assessment of results from the 2011 census that will be available in late 2012, and which are expected to show an accelerated trend to travel by more sustainable modes in most, if not all, cities.

2. Methodology and the data

The ABS Census is an under-utilized source of travel behaviour data that, because of its method of collection, avoids the problems associated with survey methodologies such as travel diaries that rely on generalisations from small samples, and which, due to methodological changes over time, make comparative analysis problematic, even within the same city.

While there are obvious limitations to analysis of travel patterns that uses only journey to work data, the availability of higher quality data for this trip purpose from the ABS provides a pragmatic rationale for our analysis. In addition, work journeys are typically longer than other trips, and are more concentrated in time, so they are the major factor behind peak-hour traffic volumes and problems with public transport capacity.

Journey to work data, sorted by place of work, is publicly available from the ABS only for the 2001 and 2006 censuses. It is organised around 'destination zones', which, for the most part, correspond to Local Government Areas. As described earlier, we have chosen to focus our attention on two aspects of the data. First, we look at differences in the mode shares for public transport, walking and cycling in the 2006 census for destinations in the inner city and for destinations in the remainder of the urban region. Second, we analyse changes between 2001 and 2006 in the number, distribution, and mode for work trips.

Boundaries between the inner city and the remainder of the urban region are hard to define and, whatever the definition might be, will seldom follow the borders used by the ABS to delineate their 'destination zones'. Typically, the ABS includes a zone based on the CBD of each capital city. However, commercial and retail land-uses also predominate in precincts adjacent to the CBD, and we wanted to work with destination zones that included as many of these precincts as possible.

In the four largest capitals, further inner zones with predominantly commercial land-uses are defined by the ABS. In Melbourne and Sydney, these zones surround the CBD, and so we have called the called the aggregation of these zones 'CBD frames'. In Brisbane and Perth, a single additional inner zone is defined by the ABS. These are adjacent to, but do not surround, the CBD, so we have labelled them 'remainder inner'. For the three smallest cities, there is only one useful inner-city zone. The inner zones used in our analysis do exclude some precincts of predominantly commercial character. For example, one side of St Kilda Road in Melbourne and Northbridge in Perth fall outside our inner zones. However, the ABS zones that include these precincts largely cover suburban residential areas and so are not suited to our purposes. The boundaries of the inner city zones are described in detail in the appendix and maps can be found on the ABS website.

In all cases except Sydney, the ABS uses identical zones for the 2001 and 2006 censuses. In Sydney, the merger of the Cities of Sydney and South Sydney in 2004 led to changes in the boundaries for the presentation of data by the ABS. As a result, comparisons for Sydney between 2001 and 2006 must be made with care.

The data for 2001 is from the Journey to Work Study Areas and, for 2006, the Place of Work – Statistical Local Areas.

The ABS permits multiple answers to its 'method of travel to work' question. In analysing the small proportion of trips for which multiple modes are reported, the ABS uses a coding hierarchy to allocate the 'main mode'. The five-step hierarchy puts train at the top followed by bus, ferry/tram, car-driver and car-passenger. This means that they underestimate the role of buses, in particular, as feeders to rail services. This role is not very important in most Australian cities, because few rail passengers access stations using buses, except in Perth, which has stronger integration of rail and bus services. The 'main mode' data also slightly overstate the importance of buses at the expense of trams, since the ABS codes 'bus-tram' trips as 'bus' trips; however, there are relatively few bus-tram trips in Melbourne or Adelaide. The ABS also understates the importance of ferries in Sydney, because 'bus-ferry' trips are also counted as 'bus' trips on a main-mode basis. This understatement is more significant because a high proportion of ferry passengers use buses as feeders.

In 2001, the ABS reported the numbers of two- or three-mode journeys that include a train or a bus leg. Combinations of modes that do not include train or bus are reported as 'other'. In 2006, details were given of the second mode used in combination with train or bus in a two-mode trip. Although the reporting methods differ, the results are comparable, largely because these differently reported trips account for such a small proportion of the total reported journeys even in the larger cities. In our analysis, a composite category has been created by bringing together the census 'other' option with the census options of motorcycle, taxi and truck. This allows the focus to remain on the trends in passenger car travel and in travel by the major public transport modes. In no destination zone or year do more than 5% of trips

come within our definition of 'other', and most are less than 3%. For simplicity, this category is not included in our comparisons of the data from 2001 and 2006.

A very small proportion of responses to the ABS question about method of travel to work are clearly erroneous. Whether by accident or design, respondents have included impossible trips such as 'travel by train' for work trips to destinations in Hobart. No attempt has been made to correct for these errors.

For consistency with our earlier analysis, we have maintained the ferry/tram grouping, even though these were made separate categories after 2001. There is little problem with this because, for each city, the mode used is obvious. Melbourne and Adelaide have no ferries. In Sydney, work trips on the Metro light rail and the Darling Harbour monorail are included in the 'ferry/tram' category, but these are few even compared with the small numbers of workers carried on the Sydney ferries.

Tables 1 to 7 show the numbers of work trips and the major mode used for these trips for the entire urban region, for those with destinations in the inner zones (as described in the appendix), and in the suburban remainder.

Table 1: Share of work trips and modes used by destination zones in 2006 (Sydney)

	Sydney SD		Sydney CBD		Sydney CBD 'Frame'		Remainder Sydney SD	
	2006	%	2006	%	2006	%	2006	%
Share of Work Trips	**1,608,683**	**100%**	**210,099**	**13.1%**	**111,108**	**6.9%**	**1,287,476**	**80.0%**
MODES:								
Public Transport	**341,076**	**21.2%**	**152,256**	**72.5%**	**37,134**	**33.4%**	**151,686**	**11.8%**
Train	232,525	14.5%	100,257	47.7%	26,403	23.8%	105,865	8.2%
Ferry/Tram	6,709	0.4%	5,376	2.6%	416	0.4%	917	0.1%
Bus	101,842	6.3%	46,623	22.2%	10,315	9.3%	44,904	3.5%
Car Total	**1,119,307**	**69.6%**	**39,155**	**18.6%**	**58,665**	**52.8%**	**1,021,487**	**79.3%**
Car driver	1,019,117	63.4%	31,906	15.2%	53,549	48.2%	933,662	72.5%
Car pass.	100,190	6.2%	7,249	3.5%	5,116	4.6%	87,825	6.8%
Bicycle	**10,886**	**0.7%**	**1,631**	**0.8%**	**1,624**	**1.5%**	**7,631**	**0.6%**
Walked Only	**79,570**	**4.9%**	**12,129**	**5.8%**	**9,715**	**8.7%**	**57,726**	**4.5%**
Other Modes	***57,844***	***3.6%***	***4,928***	***2.3%***	***3,970***	***3.6%***	**48,946**	***3.8%***

Table 2: Share of work trips and modes used by destination zones in 2006 (Melbourne)

	Melbourne SD		Melbourne CBD		Melbourne CBD 'Frame'		Remainder Melbourne SD	
	2006	%	2006	%	2006	%	2006	%
Share of Work Trips	**1,415,489**	**100%**	**137,853**	**9.7%**	**125,050**	**8.8%**	**1,152,586**	**81.4%**
MODES:								
Public Transport	**196,721**	**13.9%**	**85,007**	**61.7%**	**38,997**	**31.2%**	**72,717**	**6.3%**
Train	142,359	10.1%	66,782	48.4%	29,541	23.6%	46,036	4.0%
Ferry/Tram	33,462	2.4%	14,662	10.6%	7,395	5.9%	11,405	1.0%
Bus	20,900	1.5%	3,563	2.6%	2,061	1.6%	15,276	1.3%
Car Total	**1,106,172**	**78.1%**	**38,440**	**27.9%**	**71,967**	**57.6%**	**995,765**	**86.4%**
Car driver	1,027,149	72.6%	32,145	23.3%	66,293	53.0%	928,711	80.6%
Car pass.	79,023	5.6%	6,295	4.6%	5,674	4.5%	67,054	5.8%
Bicycle	**18,909**	**1.3%**	**3,135**	**2.3%**	**4,090**	**3.3%**	**11,684**	**1.0%**
Walked Only	**50,894**	**3.6%**	**7,676**	**5.6%**	**6,565**	**5.2%**	**36,653**	**3.2%**
Other Modes	**42,793**	**3.0%**	**3,595**	**2.6%**	**3,431**	**2.7%**	**35,767**	**3.1%**

Table 3: Share of work trips and modes used by destination zones in 2006 (Brisbane)

	Brisbane SD		Brisbane CBD		Remainder Brisbane Inner		Remainder Brisbane SD	
	2006	%	2006	%	2006	%	2006	%
Share of Work Trips	**720,572**	**100%**	**58,867**	**8.2%**	**35,707**	**5.0%**	**625,998**	**86.9%**
MODES:								
Public Transport	**99,444**	**13.8%**	**35,892**	**61.0%**	**19,830**	**55.5%**	**43,722**	**7.0%**
Train	52,212	7.2%	19,285	32.8%	10,401	29.1%	22,526	3.6%
Ferry/Tram	2,452	0.3%	1,037	1.8%	550	1.5%	865	0.1%
Bus	44,780	6.2%	15,570	26.4%	8,879	24.9%	20,331	3.2%
Car Total	**553,888**	**76.9%**	**17,347**	**29.5%**	**12,077**	**33.8%**	**524,464**	**83.8%**
Car driver	500,723	69.5%	13,363	22.7%	9,359	26.2%	478,001	76.4%
Car pass.	53,165	7.4%	3,984	6.8%	2,718	7.6%	46,463	7.4%
Bicycle	**7,951**	**1.1%**	**863**	**1.5%**	**765**	**2.1%**	**6,323**	**1.0%**
Walked Only	**26,339**	**3.7%**	**3,093**	**5.3%**	**1,765**	**4.9%**	**21,481**	**3.4%**
Other Modes	**32,950**	**4.6%**	**1,672**	**2.8%**	**1,270**	**3.6%**	**30,008**	**4.8%**

Table 4: Share of work trips and modes used by destination zones in 2006 (Perth)

	Perth SD		Perth CBD		Remainder Perth Inner		Remainder Perth SD	
	2006	%	2006	%	2006	%	2006	%
Share of Work Trips	**585,536**	**100%**	**54,780**	**9.4%**	**42,358**	**7.2%**	**488,398**	**83.4%**
MODES:								
Public Transport	**60,884**	**10.4%**	**27,549**	**50.3%**	**10,033**	**23.7%**	**23,302**	**4.8%**
Train	29,650	5.1%	13,597	24.8%	5,709	13.5%	10,344	2.1%
Ferry/Tram	266	0.0%	68	0.1%	18	0.0%	180	0.0%
Bus	30,968	5.3%	13,884	25.3%	4,306	10.2%	12,778	2.6%
Car Total	**480,216**	**82.0%**	**23,340**	**42.6%**	**29,402**	**69.4%**	**427,474**	**87.5%**
Car driver	438,867	75.0%	19,179	35.0%	26,732	63.1%	392,956	80.5%
Car pass.	41,349	7.1%	4,161	7.6%	2,670	6.3%	34,518	7.1%
Bicycle	**6,790**	**1.2%**	**1,108**	**2.0%**	**806**	**1.9%**	**4,876**	**1.0%**
Walked Only	**15,530**	**2.7%**	**1,628**	**3.0%**	**1,140**	**2.7%**	**12,762**	**2.6%**
Other Modes	**22,116**	**3.8%**	**1,155**	**2.1%**	**977**	**2.3%**	**19,984**	**4.1%**

Table 5: Share of work trips and modes used by destination zones in 2006 (Adelaide)

	Adelaide SD		Adelaide Inner		Remainder Adelaide SD	
	2006	%	2006	%	2006	%
Share of Work Trips	**425,129**	**100%**	**84,702**	**19.9%**	**340,427**	**80.1%**
MODES:						
Public Transport	**42,238**	**9.9%**	**28,928**	**34.2%**	**13,310**	**3.9%**
Train	10,787	2.5%	7,488	8.8%	3,299	1.0%
Ferry/Tram	1,289	0.3%	993	1.2%	296	0.1%
Bus	30,162	7.1%	20,447	24.1%	9,715	2.9%
Car Total	**349,092**	**82.1%**	**48,149**	**56.8%**	**300,943**	**88.4%**
Car driver	320,735	75.4%	41,179	48.6%	279,556	82.1%
Car pass.	28,357	6.7%	6,970	8.2%	21,387	6.3%
Bicycle	**6,476**	**1.5%**	**2,208**	**2.6%**	**4,268**	**1.3%**
Walked Only	**13,508**	**3.2%**	**3,530**	**4.2%**	**9,978**	**2.9%**
Other Modes	**13,815**	**3.2%**	**1,887**	**2.2%**	**11,928**	**3.5%**

Table 6: Share of work trips and modes used by destination zones in 2006 (Hobart)

	Hobart SD		Hobart CBD		Remainder Hobart SD	
	2006	%	2006	%	2006	%
Share of Work Trips	**73,556**	**100%**	**14,179**	**19.3%**	**59,377**	**80.7%**
MODES:						
Public Transport	**4,723**	**6.4%**	**2,062**	**14.5%**	**2,661**	**4.5%**
Train	41	0.1%	3	0.0%	38	0.1%
Ferry/Tram	39	0.1%	5	0.0%	34	0.1%
Bus	4,643	6.3%	2,054	14.5%	2,589	4.4%
Car Total	**59,880**	**81.4%**	**9,892**	**69.8%**	**49,988**	**84.2%**
Car driver	52,936	72.0%	7,853	55.4%	45,083	75.9%
Car pass.	6,944	9.4%	2,039	14.4%	4,905	8.3%
Bicycle	**834**	**1.1%**	**204**	**1.4%**	**630**	**1.1%**
Walked Only	**5,565**	**7.6%**	**1,685**	**11.9%**	**3,880**	**6.5%**
Other Modes	**2,554**	**3.5%**	**336**	**2.4%**	**2,218**	**3.7%**

Table 7: Share of work trips and modes used by destination zones in 2006 (Canberra)

	Canberra SD		Canberra CBD		Remainder Canberra SD	
	2006	%	2006	%	2006	%
Share of Work Trips	**148,511**	**100%**	**22,560**	**15.2%**	**125,951**	**84.8%**
MODES:						
Public Transport	**11,690**	**7.9%**	**4,082**	**18.1%**	**7,608**	**6.0%**
Train	110	0.1%	12	0.1%	98	0.1%
Ferry/Tram	55	0.0%	8	0.0%	47	0.0%
Bus	11,525	7.8%	4,062	18.0%	7,463	5.9%
Car Total	**120,375**	**81.1%**	**15,627**	**69.3%**	**104,748**	**83.2%**
Car driver	107,397	72.3%	12,633	56.0%	94,764	75.2%
Car pass.	12,978	8.7%	2,994	13.3%	9,984	7.9%
Bicycle	**3,753**	**2.5%**	**679**	**3.0%**	**3,074**	**2.4%**
Walked Only	**7,339**	**4.9%**	**1,447**	**6.4%**	**5,892**	**4.7%**
Other Modes	**5,354**	**3.6%**	**725**	**3.2%**	**4,629**	**3.7%**

3. Patterns in 2006 data

The share of workers employed in the CBD core and frame areas varies considerably between cities. Hobart and Adelaide are tightly centralised. Even though their inner zones have very constrained definitions, the proportion of work trips to these destinations is around 20%. This is the same as for the combined inner zones of Sydney. Brisbane has by far the least centralised workforce with only 13.2 % of workers travelling on census day having destinations in either of the two inner zones. However, Brisbane's relatively low degree of workforce centralisation does not prevent it achieving a higher than average public transport mode share for the journey to work, with a metropolitan-wide figure similar to Melbourne's. Brisbane's dispersed workforce, relative to Melbourne, is balanced by higher public transport mode shares for suburban and inner-remainder workers than in Melbourne.

Sydney has by far the highest overall mode share for public transport, with a figure more than 50% higher than in Melbourne. Yet, the shares of CBD core and frame workers travelling by train are identical in the two cities. Sydney's higher mode share is due to substantially higher use of buses by CBD workers in Sydney, compared with trams and

buses in Melbourne, and substantially higher shares for all public transport modes for trips to suburban workplaces.

Success for public transport in catering for trips by those with centralised job locations varies considerably and does not follow the same pattern as the variation in the centralisation of the workforce. The highest mode share for trips to CBDs is in Sydney (72.5%) and the lowest is in Hobart (14.5%). The fall in mode share for public transport between the CBD and the adjacent inner zone is dramatic in three of the four cities where two inner zones are defined – in Melbourne, Sydney and Perth, public transport in the 'frame' or inner remainder zones have a mode share of less than half that seen in the CBD zone. Only Brisbane went against this pattern with only a small fall in market share between the CBD and the inner remainder zones.

As expected, there is a very large fall in the share of travel made by sustainable modes from the CBD zones to the suburban remainders. However, it is interesting to note that the mode share for public transport for trips to destinations in suburban Melbourne (6.3%) is around half that of suburban Sydney (11.8%), lower than Brisbane (7.0%), and only just higher than suburban Canberra (6.0%).

As noted in our 2008 analysis of the ABS journey to work data, Hobart is the standout performer in walking to work. Walking makes up 7.6% of all work trips across the whole of the Hobart SD: well ahead of its nearest rivals in Sydney and Canberra (both 4.9%); Perth is lowest with only 2.7%. Hobart's superior performance is even more marked when looking at walking to destinations in the inner zones. 11.9% of Hobart CBD employees walked to work – almost double the next best in Canberra and Sydney.

As we noted earlier, despite the enthusiasm that greeted evidence of an increase in cycling as a travel mode for the journey to work in 2006, this mode plays only a very small part in the JTW statistics: only in Canberra do overall cycling rates go above 1.5%. There is considerable variation in the concentration of cycling trips around destinations in the inner zones. The highest concentrations of cycling work-trips to destinations in the inner zones are in Melbourne (37%). and Adelaide (33%). The most dispersed distribution is found in Canberra (only 19% trips of cycling trips to the inner zone) and Brisbane (21%) to the two inner zones.

Also of interest in the cycling data is the observation that, in three of the four cities with two inner zones, cycling rates are lower in the CBD than in the remainder or frame zones. This difference is as much as twofold in Sydney, the worst performing cycling city. The exception is Perth where cycling rates in the two inner zones are virtually the same.

4. Comparing the 2001 and 2006 data

4.1 Context

Our earlier analysis showed evidence of modest growth in the performance of sustainable modes in all the cities between 2001 and 2006, with the exception of public transport in Sydney. In most cities, this turn around began in 1996 after many years of decline. This is shown in Figures 1 & 2, which are taken from our 2008 work. These depict changes in mode share for public transport and walking across the seven urban regions.

4.2 Trends in the data: 2001 to 2006

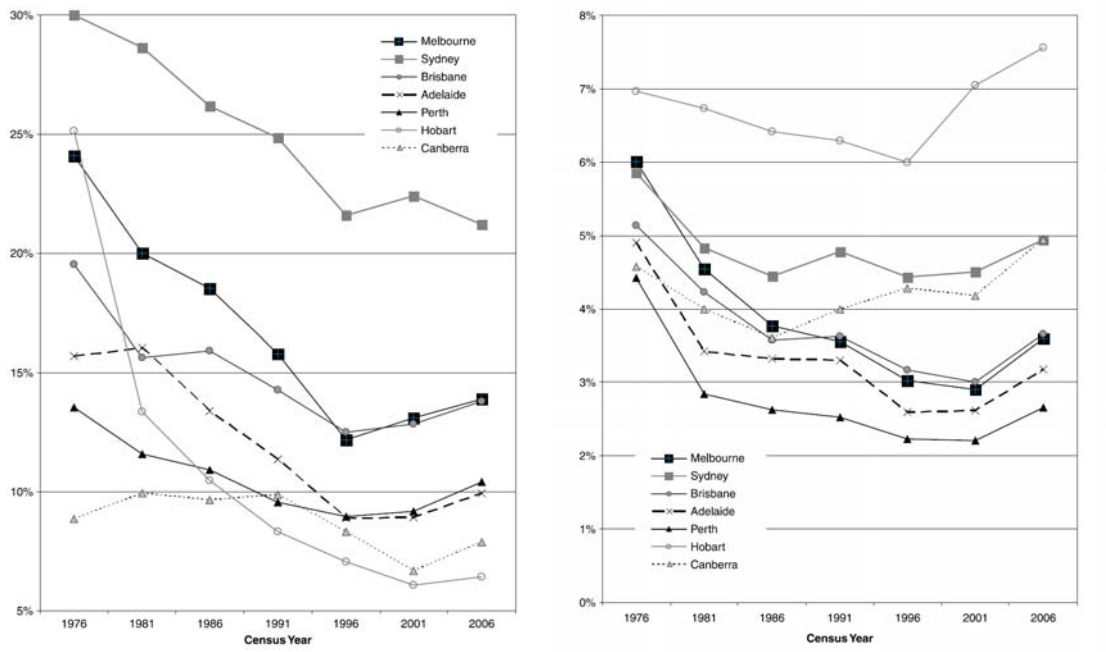
The differences between the 2001 and 2006 data is analysed in two ways (see Tables 8-21). For each city, we have assembled two tables. The first table shows the share of work trips made to each destination zone and the distribution of trips by each mode to all destination

zones. The second table shows how the increase in work trips between 2001 and 2006 is distributed between the different destination zones and travel modes.

City by city, the following observations can be made.

For Sydney, differences in the zones used by the ABS in 2001 and 2006 (as described in the Appendix), make it impossible to make comparisons between the two years for the CBD and 'frame' zones used in the earlier discussion of the 2006 data. The boundaries of the aggregated inner city zones are the same for 2001 and 2006 except for the addition of Glebe in the ABS 2006 Inner West zone. However, because of the relatively low numbers of workplaces in Glebe, it is reasonable to make comparisons based on the data for these boundaries. On this basis, we can see some concentration of workplaces in the aggregated inner zone, and an associated concentration of the use of sustainable modes to reach these destinations.

Figure 1 & 2: Modes shares for the journey to work (public transport and walking): 1976-2006



(Source: Mees et al. 2008)

The data also sheds more light on the fall in the mode share for public transport in Sydney that was noted in our 2008 work. At that time, we remarked on the sizeable fall in the number of train journeys between 2001 and 2006: down by 4% despite an increase in the total workforce. We can now see that this fall included a disproportionately large drop in rail travel to jobs in the inner zone and a significant increase in bus trips for these work journeys.

In Melbourne, destinations for the increased number of work trips were distributed evenly between each of the two inner zones and the rest of the urban region. Of the growth in Melbourne's public transport use (27,800 extra trips), around half were to destinations outside the inner zone and around 7,000 to each of the inner zones. This represents a slight dispersal of public transport destinations with trips to CBD destinations falling from 46.0% to 43.2% of total public transport work trips. Both cycling and walking trips became more concentrated in the inner zones: only 20% of walking trips in 2001 were to destinations in the two inner zones compared with 28% in 2006; while cycling went from 32.4% to 38.2%.

In Brisbane, there was some dispersal of employment between 2001 and 2006. Numbers of work trips grew by 17% but growth was slowest in the CBD. The proportion of trips to destinations in the inner zones fell from 14.0% to 13.1%. So, while the mode share for work trips by public transport to the CBD grew from 56.2% to 61.0%, the proportion of public

transport work trips with destinations in the two inner zones fell from 59.5% in 2001 to 56% in 2006. As in Melbourne, there was an increased concentration of walking and cycling destinations in the inner zones: from 13.1% to 18.4% for walking and 17.6% to 20.5% for bikes.

In Perth, an overall growth of 86,000 work trips between 2001 and 2006 masks a fall of 8% (or 3,655 trips) to the inner remainder zone. So, while there was some concentration of work trips to the CBD, the overall trend was a modest dispersal of work trips to locations outside the inner zones. Public transport mode share followed and amplified this trend to dispersal: while the proportion of trips by public transport grew from 42.7% to 45.2% for destinations in the CBD, the proportion for destinations in the inner remainder zone fell from 21.5% to 16.5%. As in the previous cities, destinations for walking and, especially, cycling became more concentrated in the CBD. However, the fall in overall job numbers in the remainder zone saw a drop in the proportional rate of cycling and walking to this destination.

Adelaide follows a similar pattern with a slight dispersal of work trips to destinations outside the inner zone and a corresponding re-distribution of public transport journeys. Again, a move towards a stronger concentration of destinations reached by bike and on foot is observed in the inner zone.

Hobart also saw a slight dispersal of employment destinations outside the tightly defined CBD and a greater rate of dispersal of destinations served by public transport: the proportion of public transport work trips that had destinations in the CBD fell from 46.2% to 43.7%.

The figures for Canberra show an increase of 44% in the number of work trips made to the CBD between 2001 and 2006, compared with 9% across the whole SD. It is not clear if this unusual data represents a real shift in employment locations or if it is in some way an artefact of the ABS collection and reporting methods. The data also shows significant increases in the mode share for public transport and walking for trips to the CBD (12.5% to 18.1% and 3.9% to 6.4% respectively), and, with the strong proportional growth in employment destinations, all sustainable modes exhibited considerable concentration of destinations in the CBD. Some harsh cuts to public transport services took place around 2001 and were later reversed. It is possible that the variation in public transport use reflects this. However, the change in the number of work trips to the CBD requires verification.

Overall, the comparisons between 2001 and 2006 show a decline in the concentration of workplaces in the inner zones of all cities except Sydney and Canberra and an associated, but generally greater, dispersal of destinations served by public transport. Conversely, despite the dispersal of workplaces, trips by walking and cycling have become more concentrated to destinations in the inner zones.

Table 8: Proportion of work trips and trips by each mode to each destination zone (Sydney)

	Sydney Inner		Remainder Sydney SD	
	2001	2006	2001	2006
Share of Work Trips	**19.1%**	**20.0%**	**79.9%**	**80.0%**
MODE:				
Public transport	**54.3%**	**55.5%**	**45.7%**	**44.5%**
Train	53.9%	54.5%	46.1%	45.5%
Ferry/Tram	81.6%	82.3%	12.4%	13.7%
Bus	53.2%	55.9%	46.8%	44.1%
Car Total	**9.1%**	**8.7%**	**90.9%**	**91.3%**
Car driver	8.8%	8.4%	91.2%	91.6%
Car passenger	12.5%	12.3%	87.5%	87.7%
Bicycle	**23.0%**	**29.9%**	**77.0%**	**70.1%**
Walked Only	**23.4%**	**27.5%**	**76.6%**	**72.5%**

Table 9: Change in number and distribution of work trips, 2001 to 2006, by mode (Sydney)

	Sydney SD	Sydney Inner	Remainder Sydney SD
	change 2001-2006	change 2001-2006	change 2001-2006
No. of Work Trips	**75,430**	**12,758**	**62,672**
MODE:			
Public Transport	**-2,616**	**2,632**	**-5,248**
Train	-9,267	-3,710	-5,557
Ferry/Tram	498	352	146
Bus	6,153	5,990	163
Car Total	**72,077**	**2,306**	**69,771**
Car driver	73,446	2,605	70,841
Car passenger	-1,369	-299	-1,070
Bicycle	**1,663**	**1,134**	**529**
Walked Only	**10,472**	**5,686**	**4,786**

Table 10: Proportion of work trips and trips by each mode to each destination zone (Melbourne)

	Melbourne CBD		Melbourne CBD 'Frame'		Remainder Melbourne SD	
	2001	2006	2001	2006	2001	2006
Share of Work Trips	**10.0%**	**9.7%**	**8.7%**	**8.8%**	**81.3%**	**81.4%**
MODE:						
Public transport	**46.0%**	**43.2%**	**18.8%**	**19.8%**	**35.2%**	**37.0%**
Train	50.7%	46.9%	19.6%	20.8%	29.7%	32.3%
Ferry/Tram	46.3%	43.8%	21.0%	22.1%	32.7%	34.1%
Bus	17.6%	17.0%	9.9%	9.9%	72.5%	73.1%
Car Total	**4.2%**	**3.5%**	**7.0%**	**6.5%**	**88.8%**	**90.0%**
Car driver	3.8%	3.1%	7.0%	6.5%	89.3%	90.4%
Car passenger	9.0%	8.0%	7.4%	7.2%	83.7%	84.9%
Bicycle	**13.9%**	**16.6%**	**18.5%**	**21.6%**	**67.6%**	**61.8%**
Walked Only	**9.8%**	**15.1%**	**10.2%**	**12.9%**	**80.0%**	**72.0%**

Table 11: Change in number and distribution of work trips, 2001 to 2006, by mode (Melbourne)

	Melbourne SD	Melbourne CBD	Melbourne CBD 'Frame'	Remainder Melbourne SD
	change 2001-2006	change 2001-2006	change 2001-2006	change 2001-2006
No. of Work Trips	**124,952**	**9,389**	**12,550**	**103,013**
MODE:				
Public Transport	**27,816**	**7,242**	**7,326**	**13,248**
Train	23,812	6,672	6,279	10,861
Ferry/Tram	2,758	459	940	1,359
Bus	1,246	111	107	1,028
Car Total	**74,195**	**-4,515**	**-168**	**78,878**
Car driver	74,264	-3,705	-23	77,992
Car passenger	-69	-810	-145	886
Bicycle	**6,072**	**1,353**	**1,714**	**3,005**
Walked Only	**13,408**	**4,004**	**2,752**	**6,652**

Table 12: Proportion of work trips and trips by each mode to each destination zone (Brisbane)

	Brisbane CBD		Remainder Brisbane Inner		Remainder Brisbane SD	
	2001	2006	2001	2006	2001	2006
Share of Work Trips	**9.2%**	**8.2%**	**4.8%**	**5.0%**	**86.0%**	**86.9%**
MODE:						
Public transport	**40.3%**	**36.1%**	**19.2%**	**19.9%**	**40.5%**	**44.0%**
Train	41.3%	36.9%	19.1%	19.9%	39.6%	43.1%
Ferry/Tram	44.9%	42.3%	20.7%	22.4%	34.4%	35.3%
Bus	38.7%	34.8%	19.4%	19.8%	41.9%	45.4%
Car Total	**4.3%**	**3.1%**	**2.5%**	**2.2%**	**93.1%**	**94.7%**
Car driver	3.7%	2.7%	2.2%	1.9%	94.1%	95.5%
Car passenger	9.9%	7.5%	5.4%	5.1%	84.7%	87.4%
Bicycle	**9.4%**	**10.9%**	**8.1%**	**9.6%**	**82.4%**	**79.5%**
Walked Only	**8.9%**	**11.7%**	**4.1%**	**6.7%**	**86.9%**	**81.6%**

Table 13: Change in number and distribution of work trips, 2001 to 2006, by mode (Brisbane)

	Brisbane SD	Brisbane CBD	Remainder Brisbane Inner	Remainder Brisbane SD
	change 2001-2006	change 2001-2006	change 2001-2006	change 2001-2006
No. of Work Trips	**107,198**	**2,401**	**6,164**	**98,633**
MODE:				
Public transport	**20,723**	**4,186**	**4,685**	**11,852**
Train	8,462	1,226	2,047	5,189
Ferry/Tram	781	287	204	290
Bus	11,480	2,673	2,434	6,373
Car Total	**74,055**	**-3,451**	**-36**	**77,542**
Car driver	70,136	-2,549	-96	72,781
Car passenger	3,919	-902	60	4,761
Bicycle	**1,163**	**223**	**213**	**727**
Walked Only	**7,905**	**1,446**	**1,005**	**5,454**

Table 14: Proportion of work trips and trips by each mode to each destination zone (Perth)

	Perth CBD		Remainder Perth Inner		Remainder Perth SD	
	2001	2006	2001	2006	2001	2006
Share of Work Trips	**8.2%**	**9.4%**	**9.2%**	**7.2%**	**82.6%**	**83.4%**
MODE:						
Public transport	**42.7%**	**45.2%**	**21.5%**	**16.5%**	**35.8%**	**38.3%**
Train	41.9%	45.9%	22.8%	19.3%	35.4%	34.9%
Ferry/Tram	31.4%	25.6%	9.7%	6.8%	58.9%	67.7%
Bus	43.7%	44.8%	20.3%	13.9%	36.0%	41.3%
Car Total	**4.6%**	**4.9%**	**8.0%**	**6.1%**	**87.4%**	**89.0%**
Car driver	4.1%	4.4%	7.9%	6.1%	88.0%	89.5%
Car passenger	10.2%	10.1%	9.2%	6.5%	80.6%	83.5%
Bicycle	**9.9%**	**16.3%**	**13.6%**	**11.9%**	**76.5%**	**71.8%**
Walked Only	**6.7%**	**10.5%**	**9.0%**	**7.3%**	**84.3%**	**82.2%**

Table 15: Change in number and distribution of work trips, 2001 to 2006, by mode (Perth)

	Perth SD	Perth City Inner	Perth City Remainder	Perth SD Remainder
	change 2001-2006	change 2001-2006	change 2001-2006	change 2001- 2006
No. of Work Trips	**86,316**	**13,737**	**-3,655**	**76,234**
MODE:				
Public transport	**15,093**	**7,997**	**191**	**6,905**
Train	6,790	4,030	505	2,255
Ferry/Tram	59	3	-2	58
Bus	8,244	3,964	-312	4,592
Car Total	**62,885**	**3,986**	**-3,824**	**62,723**
Car driver	55,893	3,346	-3,340	55,887
Car passenger	6,992	640	-484	6,836
Bicycle	**1,210**	**555**	**45**	**610**
Walked Only	**4,538**	**889**	**155**	**3,494**

Table 16: Proportion of work trips and trips by each mode to each destination zone (Adelaide)

	Adelaide Inner		Remainder Adelaide SD	
	2001	2006	2001	2006
Share of Work Trips	**20.7%**	**19.9%**	**79.3%**	**80.1%**
MODE:				
Public transport	**69.5%**	**68.5%**	**30.5%**	**31.5%**
Train	69.9%	69.4%	30.1%	30.6%
Ferry/Tram	79.3%	77.0%	20.7%	23.0%
Bus	69.0%	67.8%	31.0%	32.2%
Car Total	**15.6%**	**13.8%**	**84.4%**	**86.2%**
Car driver	14.5%	12.8%	85.5%	87.2%
Car passenger	27.2%	24.6%	72.8%	75.4%
Bicycle	**29.9%**	**34.1%**	**70.1%**	**65.9%**
Walked Only	**21.8%**	**26.1%**	**78.2%**	**73.9%**

Table 17: Change in number and distribution of work trips, 2001 to 2006, by mode (Adelaide)

	Adelaide SD	Adelaide Inner	Remainder Adelaide SD
	change 2001-2006	change 2001-2006	change 2001-2006
No. of Work Trips	**39,105**	**4,901**	**34,204**
MODE:			
Public transport	**7,738**	**4,959**	**2,779**
Train	2,730	1,857	873
Ferry/Tram	316	221	95
Bus	4,692	2,881	1,811
Car Total	**26,143**	**-2,276**	**28,419**
Car driver	25,101	-1,814	26,915
Car passenger	1,042	-462	1,504
Bicycle	**1,904**	**841**	**1,063**
Walked Only	**3,412**	**1,334**	**2,078**

Table 18: Proportion of work trips and trips by each mode to each destination zone (Hobart)

	Hobart CBD		Remainder Hobart SD	
	2001	2006	2001	2006
Share of Work Trips	**20.0%**	**19.3%**	**80.0%**	**80.7%**
MODE:				
Public transport	**46.2%**	**43.7%**	**53.8%**	**56.3%**
Train	28.1%	7.3%	71.9%	92.7%
Ferry/Tram	31.4%	12.8%	68.6%	87.2%
Bus	46.5%	44.2%	53.5%	55.8%
Car Total	**17.4%**	**16.5%**	**82.6%**	**83.5%**
Car driver	15.7%	14.8%	84.3%	85.2%
Car passenger	30.4%	29.4%	69.6%	70.6%
Bicycle	**24.3%**	**24.5%**	**75.7%**	**75.5%**
Walked Only	**30.4%**	**30.3%**	**69.6%**	**69.7%**

Table 19: Change in number and distribution of work trips, 2001 to 2006, by mode (Hobart)

	Hobart SD	Hobart CBD	Remainder Hobart SD
	change 2001-2006	change 2001-2006	change 2001-2006
No. of Work Trips	**8,696**	**1,198**	**7,498**
MODE:			
Public transport	**776**	**237**	**539**
Train	9	-6	15
Ferry/Tram	4	-6	10
Bus	763	249	514
Car Total	**6,820**	**676**	**6,144**
Car driver	5,909	472	5,437
Car passenger	911	204	707
Bicycle	**208**	**52**	**156**
Walked Only	**992**	**297**	**695**

Table 20: Proportion of work trips and trips by each mode to each destination zone (Canberra)

	Canberra CBD		Remainder Canberra SD	
	2001	2006	2001	2006
Share of Work Trips	**11.5%**	**15.2%**	**88.5%**	**84.8%**
MODE:				
Public transport	**21.5%**	**34.9%**	**78.5%**	**65.1%**
Train	14.8%	10.9%	85.2%	89.1%
Ferry/Tram	21.4%	14.5%	78.6%	85.5%
Bus	21.6%	35.2%	78.4%	64.8%
Car Total	**10.7%**	**13.0%**	**89.3%**	**87.0%**
Car driver	9.9%	11.8%	90.1%	88.2%
Car passenger	17.7%	23.1%	82.3%	76.9%
Bicycle	**13.6%**	**18.1%**	**86.4%**	**81.9%**
Walked Only	**10.8%**	**19.7%**	**89.2%**	**80.3%**

Table 21: Change in number and distribution of work trips, 2001 to 2006, by mode (Canberra)

	Canberra SD	Canberra CBD	Remainder Canberra SD
	change 2001-2006	change 2001-2006	change 2001- 2006
No. of Work Trips	**12,484**	**6,950**	**5,534**
MODE:			
Public transport	**2,589**	**2,124**	**465**
Train	-39	-10	-29
Ferry/Tram	13	-1	14
Bus	2,615	2,135	480
Car Total	**8,043**	**3,554**	**4,489**
Car driver	7,904	2,828	5,076
Car passenger	139	726	-587
Bicycle	**641**	**255**	**386**
Walked Only	**1,660**	**835**	**825**

5. Conclusions

The evidence does not support the assertion made in our earlier work that an increased concentration of employment in inner zones was a key factor in the general growth in public transport numbers and mode share observed in most Australian capitals between 2001 and 2006. Instead, there was some dispersal of workplaces away from the inner zones but a greater proportion of work trips to these destinations were served by public transport. The greater concentration of cycling and walking trips in the inner zones, against the trend in distribution of workplaces, suggests that much greater efforts are needed to create conditions that will favour the choice of these modes for trips to suburban workplaces.

It would be necessary to further examine the ABS data, perhaps through the use of customised data tables, to see if the growth in public transport trips is concentrated around destinations in the next ring of inner suburbs or further afield. In any case, this trend, if it has continued beyond 2006, is good news for public transport planners as trips to suburban destinations make less demand on the central hubs where it is proving so difficult to provide additional services.

The obvious question from this research is whether or not the distribution patterns for work trips by sustainable modes since 2006 follow the trends that we have observed for the period from 2001 to 2006. This will be answered through examination of the 2011 census data when it is released late next year.

Appendix

The Sydney data for 2006 is based on a CBD zone that extends from Circular Quay to Central Station, and a surrounding 'frame', made up of four ABS destination zones, that takes in Potts Point to the east, Roseberry and St Peters to the south, and Glebe and Pyrmont to the west. For 2001, the inner zones are made up of three ABS destination zones (two for the City of Sydney and one for the City of South Sydney). The boundaries of the 2001 zones make it impossible to assemble a zone that is comparable to the 2006 CBD zone. However, the combined inner zones for the two censuses do have common boundaries except that the ABS 2006 Sydney City West zone includes Glebe.

The Melbourne inner areas in this analysis are the CBD grid of the 'Golden Mile' and a 'frame' encircling the CBD, which includes the remainder of the City of Melbourne (comprising Southbank, Docklands, West and North Melbourne, Kensington, Parkville, Carlton, East Melbourne, and part of the St Kilda Road commercial district).

In Brisbane, the CBD destination zone lies between Ann and Charlotte Streets and the 'Remainder Brisbane Inner' zone extends north and west from the CBD to Hale St, College Rd and Wickham Terrace and south to the river at Gardens Point.

The Perth CBD is bounded by the river, the Mitchell Freeway, the railway and Victoria Ave. The inner remainder zone includes Kings Park and the suburbs of East and West Perth.

In Adelaide, the inner zone covers the CBD grid, its surrounding parks and the North Adelaide precinct.

In Hobart, the inner zone is a constrained area of the CBD bounded by Macquarie, Barrack, Brisbane and Campbell Streets.

In Canberra, the inner zone is the CBD (or Civic).

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