JOURNEY TO WORK TRAVEL PATTERNS IN SYDNEY 1981 - 1996

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Journey to work travel patterns in Sydney 1981 - 1996

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Abstract:

In the period 1981 to 1996, as Sydney's population has increased, there have been changes in where people live, work and their mode of travel to work. While travel to work comprises a decreasing proportion of total travel, the majority of new infrastructure investment is determined by the peak demand period in the morning, of which commuting is the dominant contributor. Using the Census Journey to Work data for 1981, 1991 and 1996, the changes in land use patterns and travel to work are examined.

The changes are examined in the current policy context of promoting urban containment and the use of public transport. An investigation of land use changes between 1981 and 1996 shows that in recent years, the policies of urban containment appear to be having some impact in redressing the declining employment and workforce in inner city areas. This change has not been accompanied by a move towards public transport however, with car use for the journey to work increasing at a greater rate. However, it does appear that increases in travel distance to work have been slowed by the recent land use changes.

The findings have implications for understanding the link between land use and transport, modal investment priorities, and the planning of new suburbs.

Introduction

Travel to work remains a key focus for transport planners because of its dominant role in generating peak period demand for transport services. This paper examines trends in travel to work by Sydney residents since 1981 based on patterns in Census-based data for that period. Of particular interest are the changing roles of public transport and the private car over this time. These changes are examined within the framework of changes in residential and workplace location, and changes in government policies towards urban development, the environment, and the promotion of public transport. A critical challenge when examining such time series data is ensuring a consistent series over time, and the first section of the paper discusses the major issues affecting comparison of the data over time.

Comparing "Journey to Work" Data Sets Over Time

Information on where a person usually works, and how they travel to work on census day, is collected every five years as part of the Australian Bureau of Statistics Census of Population and Housing. The data set that results from these work-travel related questions is referred to as the Journey to Work (JTW) data set. Over the period to be examined, 1981-1996, there have been several scope and definitional changes which affect the comparability of the data sets. These are set out in Table 1.

Table 1 Changes in scope of JTW data set, Sydney 1981-1996

Scope Issue	1981 JTW	1991 JTW	1996 JTW
Geographic coverage	Sydney SD, Newcastle and Wollongong SSD	1981 area plus Wingecarribee SLA and part of Shoalhaven SLA	1991 area plus remainder of Shoalhaven SLA
Destinations outside the Study Area	Included	Excluded	Included
No fixed workplace	Respondents instructed to write "N/A"	Respondents instructed to provided address of depot or head office	Respondents instructed to write "No fixed address"
Employed persons	Included if residents of the Study Area	Included if residents of the Study Area	Included if enumerated in the Study Area (ie including visitors)
Changes in index quality	141,000 unknown (not stated) destinations	135,000 unknown (not stated) destinations	69,000 unknown (not stated) destinations
Travel zone changes	842 zones	1083 zones, but can be mapped back to 1981	1134 zones but can be mapped back to 1991

Note: The 1986 JTW data set was unable to be produced by ABS due to technical problems.

For the sake of comparison, this analysis is of residents of Sydney Statistical Division (SD) who are employed within the bounds of the 1981 JTW geography. Table 2a shows the differences in scope (in italics) which were filtered out of each year's data to reach a relatively comparable basis. The final scope for this analysis is shown in the second last row, which is residents of Sydney SD who are employed within the 1981 JTW Study Area, excluding those with no fixed workplace or with an unknown/undefined employment destination.

Table 2a Components of employment destination removed from JTW for comparison across years

Employment Destination	1981	1991	1996
Unknown/Not stated/Undefined	*140,913*	*145,168*	*82,903*
No fixed workplace	*28,658*	*724*	*49,605*
Outside TDC Study Area	*4,321*	*na*	*19,456*
Outside 81JTW Study Area	*na*	*497*	*991*
Within 81JTW Study Area	1,216,991	1,366,118	1,521,960
Total JTW Employment	**1,390,883**	**1,512,507**	**1,674,917**

Table 2b shows that approximately 90% of those captured in the JTW are included in the scope of this study for comparison. However, it is worth noting that the JTW data does underenumerate total employment from the Census, though the level of underenumeration has been steadily reducing, and this is reflected in the final row of Table 2b.

Table 2b Proportion of employed people used in analysis

Scope	1981	1991	1996
Within 81JTW Study Area	1,216,991	1,366,118	1,521,960
Total Employed people (JTW)	1,390,883	1,512,507	1,674,917
% of JTW used in this analysis	*87.5%*	*90.3%*	*90.9%*
Total Employed people (Census)	1,452,025	1,563,365	1,675,461
% employed people in JTW	96%	97%	100%
% employed people in this analysis	**84%**	**87%**	**91%**

The major issues of comparability which remain after this filtering are the impact of improved index quality, manifested by reduced number of "unknown" destinations in 1996 and the inclusion of "no fixed workplace" in 1991 data. There is no scientific way to control for these remaining differences.

Further details on comparability over time are available in the 1996 Journey to Work User Guide prepared by the Transport Data Centre (1998).

Policy context

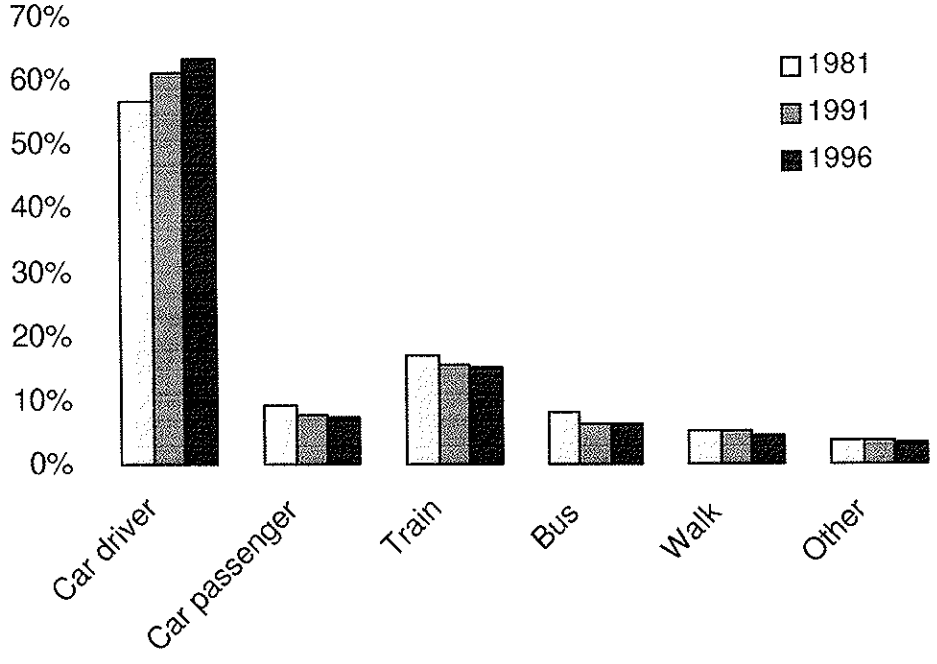
In the late 1980s and early 1990s there was a recognition from NSW Government agencies responsible for transport and land use planning that Sydney was sprawling in an unsustainable manner, and that there was a need to focus future housing and employment development in existing areas which were already well served by public transport (NSW Government 1995). The Government strongly advocated urban containment and urban consolidation policies. These have been pursued through land release and development approvals at State and Local levels.

In addition, the Government has been focusing on the promotion of public transport. New public transport infrastructure and priority measures have been and continue to be implemented in order to redress the decline in public transport use evidenced during the 1980s (NSW Department of Transport Annual Report 1996/97)

The release of the 1996 Journey to Work data set provides an important opportunity to monitor the progress and success of these Government transport and land use policies.

Modal shares of the journey to work

Figure 1 shows how the mode split, or percentage share of each mode, used for travel to work by Sydney residents has changed between 1981 and 1996. It reveals that the only category to increase its share in that time has been the *car driver,* which has increased from 57% to 63% of all trips to work. All other modes have declined or remained the same in terms of percentage share of the journey to work trip.



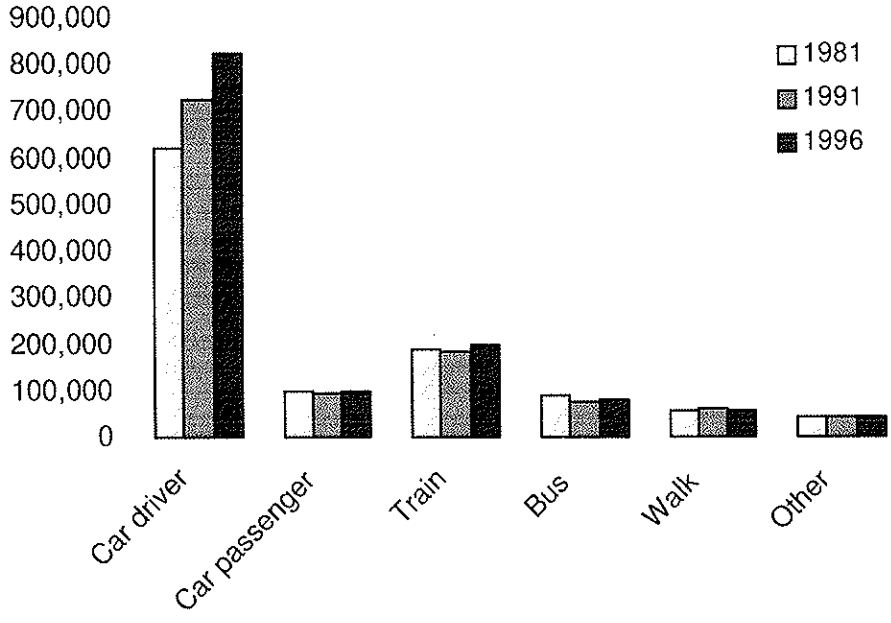
Note: Figures relate to priority mode

Figure 1 Changes in mode share, Sydney 1981-1996

The percentage share of *car passenger* has fallen in the period 1981-1996. There are a range of factors which may have contributed to this fall, including higher rates of car ownership (from approximately 0.40 cars per person in 1981 to 0.45 cars per person in 1996), decreasing household size, and more complex trip patterns because of greater numbers of women in the workforce and part time employment.

The mode share of train and bus for travel to work fell by 2% each between 1981 and 1996, with *train* falling from 17% to 15%, and *bus* from 8% to 6%. There also appears to be decreasing reliance on *walking* to work, with mode share dropping from 5.1% to 4.5% between 1981 and 1996.

Figure 2 shows changes in the actual number of people using each mode. While public transport's share of the commuting market has declined steadily since 1981, patronage numbers have grown steadily for rail, by 11,000 between 1981 and 1996, and bus patronage has grown by 6,000 since 1991 after a 14,000 decline between 1981 and 1991. The recent increase in bus use coincides with the implementation of cross-regional bus routes and the introduction of significant bus priority measures in Sydney.



Note: Figures relate to priority mode
Source: TDC Journey to Work data sets

Figure 2 Actual numbers using each mode, Sydney 1981-1996

Another important feature of Figure 2 is that it shows that the car driver category grew by 100,000 in the 10 years to 1991, and grew by another 100,000 in the *5 years* to 1996, suggesting an increasing rate of growth.

Focus on public transport

Figures 1 and 2 are based on the primary mode used for the journey to work, but public transport travel patterns are more complex than that, involving access to and egress from the station or bus stop.

Figure 3 shows that the only access mode which grew consistently between 1981 and 1996 was car, for access to train and bus services. Walk trips to public transport declined between 1981 and 1991, but increased again between 1991 and 1996. This would suggest that more people live within walking distance of services in 1996 than in 1991. Combined bus and train trips for the journey to work have decreased in actual numbers by 6,000 trips between 1981 and 1996, while combined bus and ferry trips to work have declined by 700 trips in the same period.

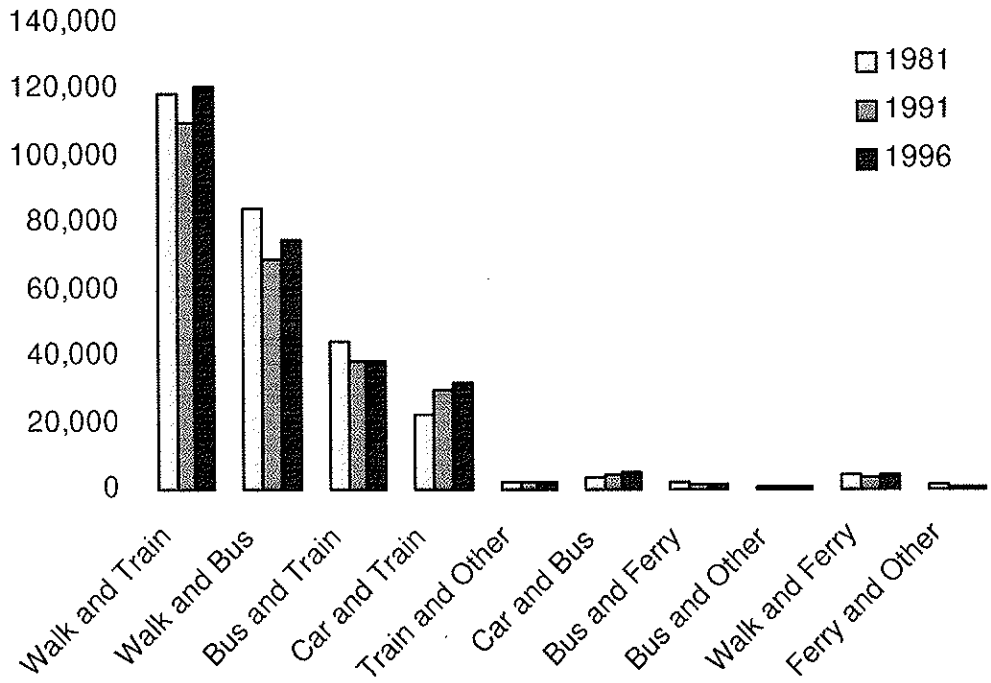


Figure 3 Number of Sydney residents using public transport for the journey to work, 1981-1996

It is clear from Figures 1, 2 and 3 that the car has had an increasingly important role, with public transport having a declining modal share. The remainder of this paper focuses on some possible land use explanations for these changes, recognising that there are many non-spatial factors such as greater numbers of females in the workforce and the increasing incidence of part time work that may be influencing travel behaviour.

Spatial distribution of workforce

Changes in where the workforce has chosen to live between 1981 and 1996 are shown in Figure 4 in terms of distance from the Central Business District (CBD).

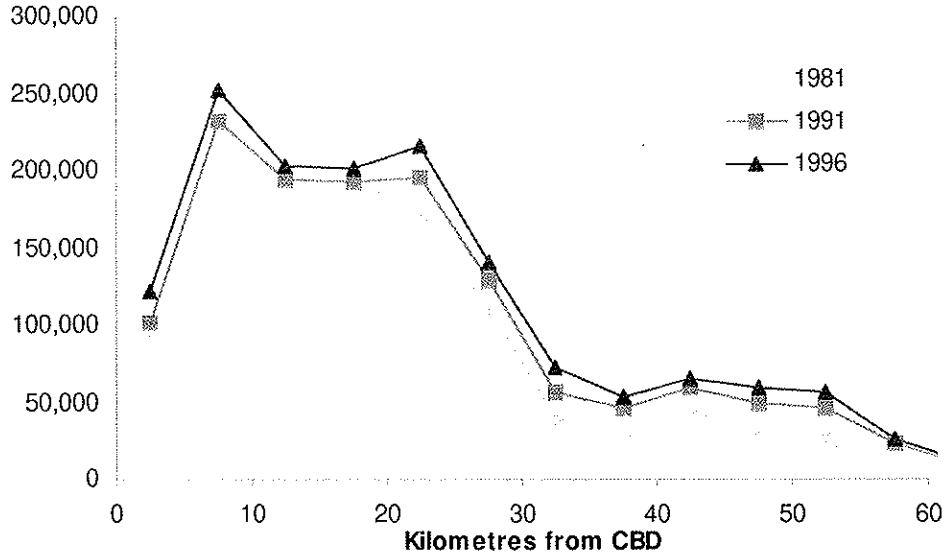


Figure 4 Residential location of workers by distance from Sydney CBD and year

Figure 4 shows that the greatest density of workers live in the band between 5 and 10 kilometres from the CBD, covering the relatively high density areas of the Eastern Suburbs, Inner West and Lower North Shore. The density of workers remains fairly high up until about 25kms from the city, where it drops off sharply, to a relatively sparse level which is maintained for the 30-55km band, whereupon it drops off to background levels of rural areas.

Between 1981 and 1991 there was virtually no change in the number of workers living within 20kms of the city. Virtually all growth occurred from 20 to 60 kilometres from the CBD, and the growth rate was very high. It was this pattern which induced Government action to promote urban containment and consolidation.

The pattern of growth in the residential location of the workforce shifted significantly in the period from 1991 to 1996. The inner 20-25 kilometre ring around the CBD grew significantly in this period, with lower, yet consistent levels of growth from 25 to 55kms from the city. This suggests that there has been some success for the policies of urban consolidation and containment.

However, this success has been largely negated by higher than expected levels of growth, both in the general population and in the workforce in the 5 years to 1996. Growth in the workforce averaged 1.3% per annum in the 10 years from 1981, but has averaged 2.3% since 1991. There are several possible reasons for this increase, being partly related to the 1991 recession, and partly to changing work practices such as higher female participation

rates, an increase in part time work, and higher than expected population growth in the period.

Spatial distribution of employment

The changes in workforce distribution are more meaningful when compared with the changes in the distribution of employment over the same period. These changes are shown in Figure 5 in terms of distance from the CBD.

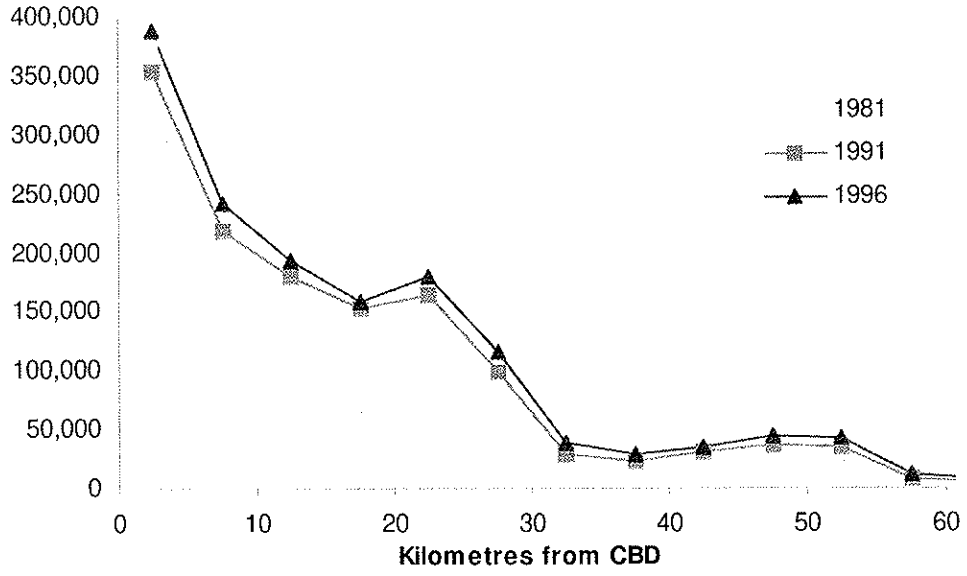


Figure 5 Distance of employment locations from Sydney CBD by year

The central 5 kilometres around the CBD is clearly the focus of employment for Sydney. It has maintained its level of employment since 1981, though it contracted between 1981 and 1991, but then expanded in the 5 years to 1996 to a higher level than that in 1981.

In the 5 years to 1996, the pattern of employment growth was fairly uniform across the whole city in relative terms, while in actual numbers, the inner areas increased more than the outer areas. In the 10 years to 1991 however, there was a decline in employment within 5 kilometres from the CBD, and an accompanying concentration of growth in the 20-30 kilometre band from the CBD. This distance band contains several commercial centres, such as Macquarie/North Ryde, Parramatta and Liverpool, all of which grew significantly in that period.

A comparison of Figures 4 and 5 suggests that changes in employment and workforce location, in terms of distance from the city, largely parallel each other. In the 5 years to 1996, there was fairly uniform growth in both employment and the workforce at all distances from the CBD. This is a significant change from the pattern in the 10 years prior to 1991, in which virtually all growth in workforce and employment occurred more than 20 kilometres from the CBD.

In terms of share of employment, the CBD is losing its dominance, with more employment moving to centres 5-30 kilometres from the city, and to dispersed suburban locations. At the same time, the workforce is beginning to grow again in suburbs close to the CBD, which did not occur in the 10 years to 1991. Thus, in the 5 years to 1996, there appears to be more of a match in where the workers are living and where the jobs are, or a better jobs/housing balance. Levinson (1998) argues that, all other things being equal, in a car dominated transport system, policies favouring a jobs/housing balance will, at the margin, reduce commuting duration, while policies preventing balance will increase that duration. This is discussed further in the next section on trip length distribution.

Centres employment

Table 3 summarises the employment changes in designated commercial centres over the 15 years from 1981 to 1996. *Sydney CBD* is clearly the major centre in the region, though its size has fluctuated over the 15 years from 1981 to 1996. It declined from 182,000 employees in 1981 to 158,000 employees during the recession in 1991. Since then, it has recovered, reaching 184,000 employees in 1996. However, whilst maintaining its size, the CBD is declining in its share of employment in the Sydney Statistical Division (SD). It accounted for 15% of all employment in 1981, but has declined to hold only 12% of Sydney's employment in 1996.

Table 3 Number and proportion of Sydney SD residents working in major centres, 1981 to 1996

	1981		1991		1996	
Centres	**Number**	**Per Cent**	**Number**	**Per Cent**	**Number**	**Per Cent**
Sydney CBD	182,026	15.0%	157,954	11.6%	184,028	12.1%
Parramatta	19,787	1.6%	29,963	2.2%	34,393	2.3%
Total Primary Centres	**201,813**	**16.6%**	**187,917**	**13.8%**	**218,421**	**14.4%**
Bankstown	8,568	0.7%	10,395	0.8%	11,157	0.7%
Blacktown	6,309	0.5%	7,459	0.5%	8,268	0.5%
Campbelltown	4,512	0.4%	5,737	0.4%	6,435	0.4%
Chatswood	11,079	0.9%	16,435	1.2%	20,092	1.3%
Hornsby	9,928	0.8%	12,347	0.9%	13,267	0.9%
Liverpool	8,601	0.7%	13,240	1.0%	13,244	0.9%
North Sydney/Milsons Pt	27,361	2.3%	28,102	2.1%	32,964	2.2%
Penrith	6,758	0.6%	9,040	0.7%	10,462	0.7%
St Leonards/Crows Nest	24,131	2.0%	28,326	2.1%	32,387	2.1%
Total Secondary Centres	**107,247**	**8.8%**	**131,081**	**9.6%**	**148,276**	**9.8%**
Macquarie/Nth Ryde	10,815	0.9%	18,686	1.4%	22,469	1.5%
Central Industrial Area	60,007	4.9%	56,919	4.2%	61,810	4.1%
Total Other Centres	**70,823**	**5.8%**	**75,605**	**5.6%**	**84,279**	**5.6%**
Total Centres Employment	**379,882**	**31.3%**	**394,603**	**29.0%**	**450,976**	**29.7%**
Total Dispersed Employment	833,571	68.7%	967,096	71.0%	1,065,099	70.3%
Total Sydney SD Employment	**1,213,453**	**100%**	**1,361,698**	**100%**	**1,516,075**	**100%**

Note: These figures exclude residents living outside of Sydney SD

Employment in *Parramatta*, Sydney's second "CBD", has been growing steadily at a rate of about 1,000 employees a year for the period 1981 to 1996. However, it still only represents 2.3% of all employment in the Sydney SD. The largest "centre" after the Sydney CBD is actually the *Central Industrial Area*, between the CBD and the Airport. It has maintained its size at around 60,000 employees in the 15 year period, but has declined from 5% to 4% in its share of employment.

The next largest centres are on the Lower North Shore of Sydney. North Sydney/Milsons Point and St Leonards/Crows Nest each contain a little over 2% of Sydney's employment, and are only just smaller than Parramatta in 1996. As a whole, the secondary centres listed in Table 3 have grown by 1% in their share of employment in the period 1981 to 1996.

The sum of employment in all the designated centres listed in Table 3 is around 30% of total employment in Sydney, and has been declining over time in proportional terms, though actual numbers of employees have increased. This is a little misleading because not all large centres are included in the designated centres listed in Table 3. When all centres with employment over 3,000 are included, employment in Centres amounts to about 37% of total employment. This means that the majority of employment in Sydney (over 60%), is dispersed in suburban locations and small centres. Dispersed employment has increased by almost 200,000 in the 15 years to 1996. The dispersal of employment is a challenge for public transport which is designed for mass transit to large centres.

More details on travel and other characteristics of designated commercial centres are available in Gee *et al.* (1998).

Distance of travel to work

The impact of changes in workforce and employment distribution on the length of travel to work in Sydney is examined in this section. Table 4 shows that the distance of the trip to work in Sydney has been gradually increasing in the 15 years to 1996. The mean distance of the trip to work has increased by just over one kilometre on average, from 10.05 kilometres in 1981 to 11.36 kilometres in 1996. The five yearly growth in the period 1981 to 1991 averaged 500 metres, while between 1991 and 1996 it fell to 300 metres. This may be evidence of a slowing in the growth of the work trip.

The median work trip length is much lower than the mean, at between 7 and 8 kilometres. This indicates that there are some very long trips in the JTW data which are creating a negative skew in the distribution of trip lengths. The relatively high standard deviation associated with these estimates is also worth noting.

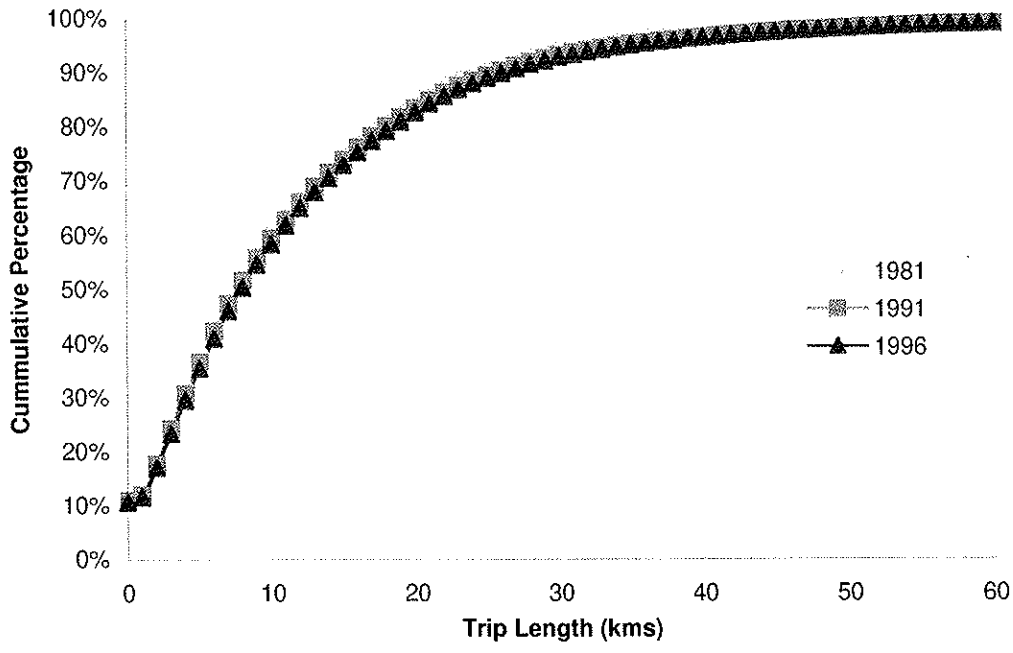
The second half of Table 4 reports the length of trips within the given percentiles for each survey year. For example, in 1981, 75% of work trips were less than or equal to 14.15 kilometres, while in 1996 75% of work trip were less than or equal to 15.87 kilometres.

Table 4 Journey to work trip lengths* over time, Sydney

JTW Distance (kms)	1981	1991	1996
Mean	10.05	11.07	11.36
Median	7.01	7.58	7.91
Standard Deviation	10.15	11.51	11.64
Percentiles	**1981**	**1991**	**1996**
50%	7.01	7.58	7.91
75%	14.15	15.42	15.87
80%	16.34	17.94	18.44
85%	19.11	21.01	21.45
90%	22.67	25.44	25.98

*Trip lengths calculated as straight-line distance between travel zone centroids.

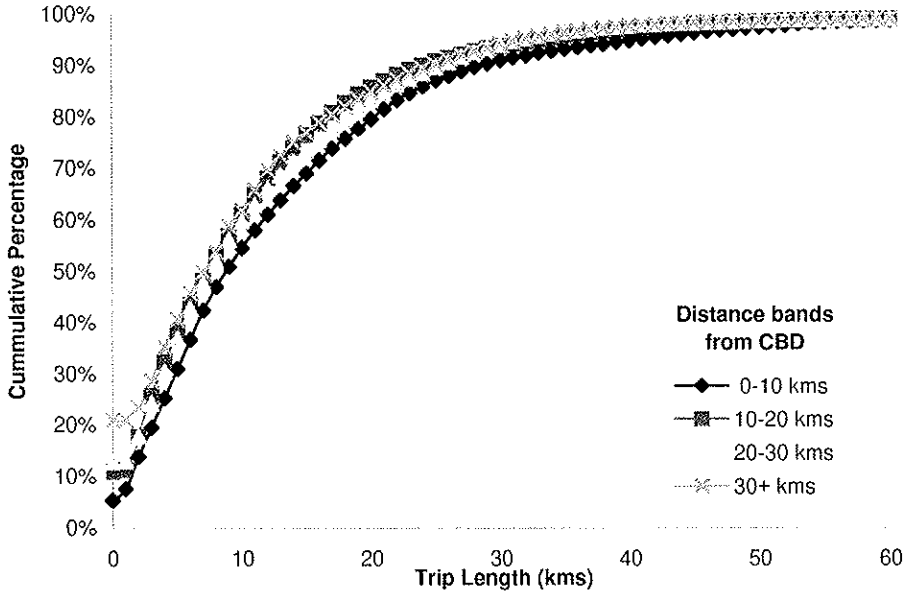
Figure 6 is a cumulative plot of all the percentiles of work trip length. It shows that the slight increase in trip length over time is fairly evenly distributed across all trip distances.



Note: Distances are straight-line distances between travel zone centroids

Figure 6 Journey to work trip length distribution by year, Sydney

In the light of policies towards urban consolidation, and encouraging residential growth in inner areas, it is informative to look at the current trip lengths to work for people living at differing distances from the CBD. Figure 7 shows how far people travelled to work in 1996 by how far they live from the CBD in 4 distance bands. It clearly demonstrates that people who live closer to the CBD are more likely to have shorter journeys to work. In the 10 kilometre band around the CBD, 85% of work trips are less than 10 kilometres long. For



Note: Distances are straight-line distances between travel zone centroids

Figure 8 JTW trip length distribution by employment location, Sydney 1996

Conclusions

The use of the car for the journey to work, especially by single occupants, has increased at an increasing rate over the 15 years to 1996. Public transport has maintained patronage numbers for the work journey in that time, but with a decreased modal share. An examination of land use changes over the same period shows that the NSW Government policies of urban consolidation and containment appear to have begun to take effect in the 5 years to 1996. In this period an increase in both employment and workforce numbers occurred in inner areas, following a declining trend over the 10 years previous.

This shift towards greater consolidation and an improved jobs/housing balance appears not to have encouraged public transport use, with even higher proportions choosing the car. One positive that is revealed, however, is that the rate of increase in trip lengths to work appears to have decreased in the 5 years to 1996, and this may be a product urban consolidation.

Future work should investigate travel times instead of travel distance to better understand the validity of the jobs/housing balance concept and the constant travel time budget concept, and the ability of Governments to manipulate these concepts to improve the effectiveness and livability of cities like Sydney.

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