Local vs Inter-Regional Travel: A Comparison of Two Regions of Adelaide

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This paper represents the research work of the authors, and should not be interpreted as government policy.

1 Introduction

This paper considers an important aspect of travel behaviour and patterns in our cities. It considers the extent to which travel within cities involves shorter distance local travel within a region, as opposed to longer distance travel between metropolitan regions. It therefore considers the relative spatial focus of travel behaviour.

This is a key issue, for it directly influences a range of urban issues: for example, the role of local and district level facilities; the type and spatial nature of transport services; and the level of emissions from transport, to name just three. Consideration of the issue also forms part of gaining a good understanding of urban travel demand to inform transport policy and planning more generally.

The issue has been addressed from the perspective of the travel behaviour of residents within metropolitan regions. Residents in two metropolitan regions of Adelaide, South Australia have been considered here: the 'northern' region (an outer region of Adelaide); and the 'eastern' region (consisting of suburbs immediately to the east of the Adelaide city centre). The research is based on data from the 1999 metropolitan Adelaide household travel survey, the last sample-based household travel survey undertaken in Adelaide.

The key objectives of the paper are: to highlight the relative size of different market segments for travel by these residents; to highlight the significant size of intra region travel; and to consider some initial policy implications of these patterns.

In the first instance, the paper approaches the issue of spatial focus by categorising residents' trips into a number of 'trip types'. At the first level, the distinction is made between: 'intra regional' trips, i.e. trips wholly within a region; 'inter regional' trips, i.e. trips to and from the region; and 'out of region' trips, i.e. trips undertaken wholly outside the region. This is the primary distinction for contrasting between shorter vs longer trips.

Further breakdowns are then used within these categories. Within the intra regional trip type group, the further breakdowns considered are: trips within (i.e. very short) and between transport analysis 'zones', and home-zone based vs non home-zone based trips. For inter-regional trips, a contrast is drawn between travel to the Adelaide city centre as a unique destination for residents, and to other destinations. These further distinctions become useful when considering options for servicing the travel needs of residents.

The paper also contrasts travel patterns expressed in terms of the number of trips made vs the resulting trip-kilometres. An argument is made for using both of these indicators, with each having a key role when addressing different policy objectives: social and environmental.

Also considered are: mode share across the different trip types by both trip number and trip-kilometres; and some initial implications of the results for urban transport policy and planning.

2 The northern and eastern metropolitan regions

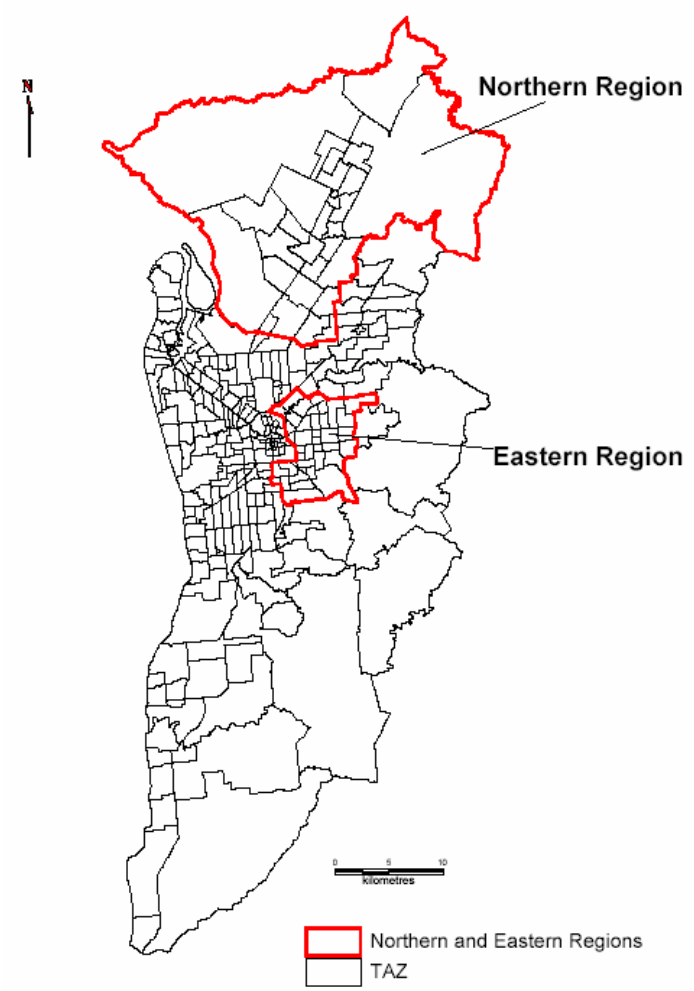


Figure 1: Northern and eastern regions in metropolitan Adelaide

The northern and eastern regions are shown in figure 1 (- the TAZ terminology is explained in section 3.2). These two regions were chosen for several reasons:

- they provided a contrast in spatial location within the Adelaide metropolitan area; and
- they are characterised by quite different socio-economic characteristics.

The northern region is situated on the northern outskirts of the ASD and incorporates the following local government areas – Gawler, Playford and Salisbury. The region has a relatively lower than average socio-economic status, with characteristics such as: higher unemployment rate; below average household income; below average median house price; and a relatively higher than average household size.

The eastern region is situated on the eastern side of the ASD and incorporates all or part of the following local government areas - Walkerville, Norwood Payneham & St Peters, Campbelltown, Burnside, Unley and Mitcham. The region has a relatively higher than average socio-economic status, with characteristics such as: lower unemployment rate; higher than average household income; higher than average median house price; and a relatively lower than average household size.

The respective populations of the two regions are: northern 196,000; eastern 123,000. The northern region is larger in terms of both size and number of residents. Accordingly, the travel patterns of residents had to be normalised to trips per person in order to allow a comparison of patterns between the two regions.

3 Data and concepts

3.1 The metropolitan Adelaide household travel survey

The research discussed in this paper makes considerable use of data from the 1999 Metropolitan Adelaide Household Travel Survey (MAHTS). MAHTS99 was a face-to-face household interview survey of around 9,000 randomly selected households within the Adelaide Statistical Division (ASD). For each household surveyed, all travel details were collected for all household members for two consecutive days. The survey across all households ran from the 29th of March to the 31st July 1999.

Before proceeding it is important to establish the reliability of the MAHTS99 data. PPK (2001) undertook and extensive process of: data correction and validation, expansion of data and trip linking. A comprehensive series of internal edit checks were undertaken to ensure the final data set was suitable for later travel analysis (such as in this paper). PPK found no bias had been introduced due to factoring, and observed an acceptable comparison between factored survey data and Census data in most cases. Their conclusion was that there was acceptable overall agreement between MAHTS and Census data (with some minor discrepancies), and that the factored data represented ".. *a suitable basis for ongoing model specification and development*." (PPK, 2001). The factored MAHTS99 database has therefore been adopted as a suitable basis for the investigation in this paper.

Further details on the method used to factor the survey data is described in PPK (2001), and on the survey itself in MAHTS (1999) and Transport SA (1999).

3.2 Zones and regions

MAHTS uses a geographical zone system known as transport analysis zones (TAZ). The ASD is divided into around 280 TAZ 'zones', and this is the basis on which household travel information is recorded, i.e. each household is assigned to a TAZ zone. The northern and eastern regions are made up of collections of TAZ zones as shown in Figure 1. A 'zone' also fits loosely with the concept of a 'suburb'.

3.3 Trip types

The focus in the paper is on 'resident' trips, i.e. trips made by residents of a given region. Throughout the paper, resident trips are split into the series of trip types shown in figure 2 below. These can also be thought of as market segments.

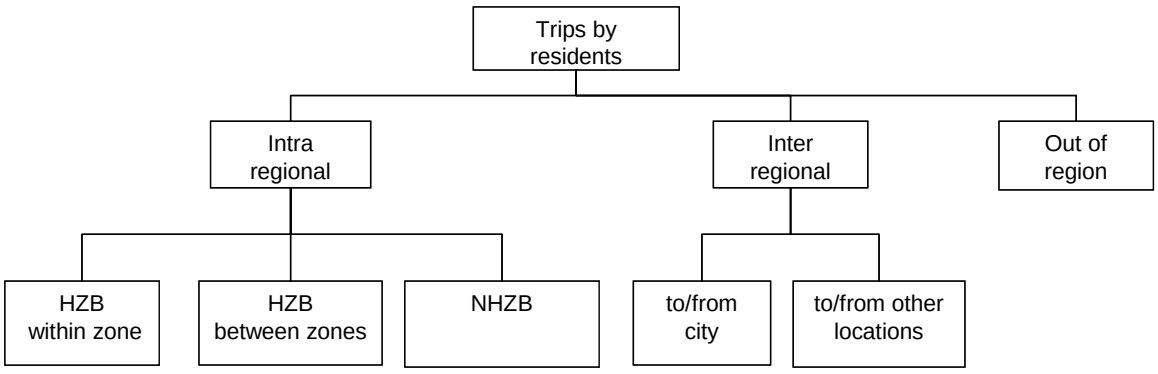


Figure 2: Resident trip types

Figure 2 should be read with the following notes:

1. 'HZB' = home-zone based trips, i.e. origin or destination are within the home-zone (- the zone in which the household is located), and
   'NHZB' = non home-zone based trips, i.e. neither origin nor destination are the home-zone.

2. 'Intra regional' trips, i.e. both origin and destination are within the region. These trips are in turn divided into:
   - 'HZB within zone' trips, i.e. HZB, origin and destination in the home-zone
   - 'HZB between zones' trips, i.e. HZB, one of origin or destination in the home-zone
   - 'NHZB' trips, i.e. both origin and destination are outside the home-zone.

3. 'Inter regional' trips, i.e. the origin is within the region and the destination is outside the region, or vice versa. These are further divided into:
   - ': city', i.e. trips between the region and the Adelaide city council region
   - ': other', i.e. trips between the region and other Adelaide locations (other than the 'city')

4. 'Out of region' trips, i.e. where the origin and destination are both outside the region.

4 Results 1: trips

4.1 Resident vs non-resident trips

As part of the context setting, it is useful to first compare the level of trips made by residents of a given region vs trips by non-residents visiting the region. Tables 1 and 2 summarise this comparison for the northern and eastern regions.

Table 1: Thousands of person trips by residents, average weekday, 1999

Region	Intra regional	Inter regional	Out of region	Total
Northern	428	143	41	612
Eastern	251	171	66	487
Total	679	313	107	1,099

Table 2: Thousands of person trips by non-residents, average weekday, 1999

Region	Intra regional	Inter regional	Total
Northern	15	91	106
Eastern	32	183	215
Total	46	274	320

Note that in table 2, 'out of region' trips by non-residents are not reported. They consist of all other trips by all other residents of Adelaide, and are not relevant to the considerations here.

The tables show that residents of a region account for the vast majority of trips within their region. The balance between the contribution of residents and non-residents to inter regional trips was very even for the eastern region, but more in favour of residents for the northern region.

4.2 Resident trips by trip type

Figure 3 below reports the split by trip type for residents in the two regions. The columns report the absolute number of trips, while the % summary across the bottom provides a relative perspective. The main features of figure 3 are:

- intra regional trips are by far the largest trip type for both regions (70% for northern and 52% for eastern)
- overall trips per person is higher for the eastern region, probably due to factors such as higher incomes
- the eastern region has a greater proportion of 'inter-region: city' travel, probably because of its geographical proximity next to the 'city', and the closer socio-economic match between eastern socio-economic characteristics and employment types in the 'city' - the difference in size of the eastern and northern regions may also be a factor
- the proportion of 'inter-region: city' travel for the northern region is very small (4%)
- 'out of region' travel is much higher for eastern, again probably due to the proximity to the 'city', where such trips are likely to be relatively more frequent vis a vis in other regions.

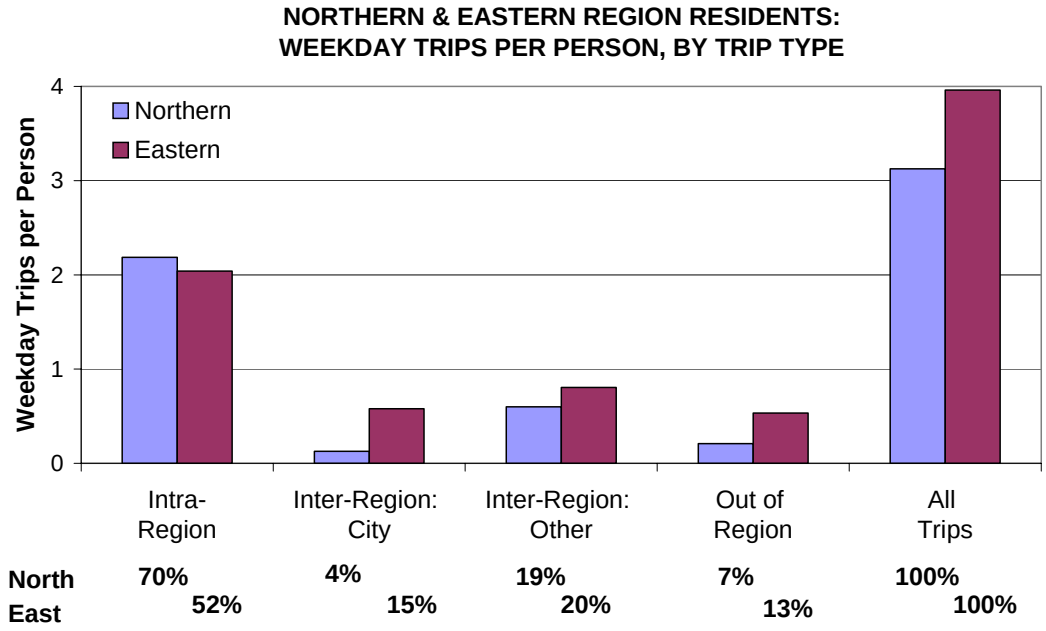


Figure 3: Resident weekday trips per person, by trip type

4.3 Resident trips by mode

Figure 4 below reports mode share (%) across resident trips. As a link to figure 3, the % summary of trip type continues to appear across the bottom of figure 4. It is important to note that the term 'mode' as used here means 'main mode', i.e. the main mode used in a trip. For example, a trip that involves public transport with a short walk at either end of the trip would be classed as a public transport trip here since it is the main mode used. Hence the 'walk' mode in the results that follow refer to walk only trips. This should be remembered when drawing inferences from the results reported here.

The main features of figure 4 are:

- as expected, car based travel dominates in both regions
- intra region walking accounts for about 10 % of resident trips per person
- a large proportion of car based trips are intra region trips (54% northern; 39% eastern)
- the next most significant proportion of car based trips are 'inter region: other' trips (17% northern; 18% eastern)

- public transport mode share is highest for 'inter-region: city' trips
- public transport share is lowest for 'inter-region: other' trips
- 'out of region' trips account for no more than about 10% of trips per person

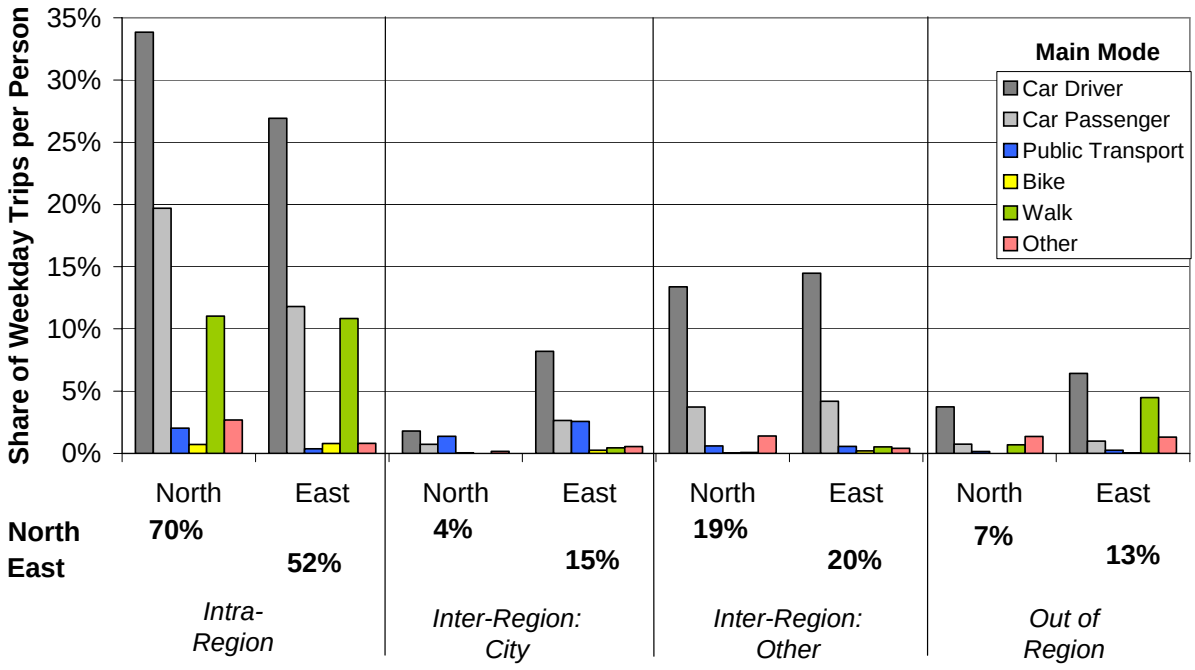


Figure 4: Resident weekday trips per person, by mode share

4.4 Resident trips by mode: disaggregated

Figures 5 and 6 below repeat figure 4, however, this time intra regional trips are presented at a more disaggregated level by showing the three trip types for intra regional travel. The observations in section 4.3 still apply, with the following additional observations now possible:

- walking occurs most frequently for the shortest trips
- car based travel is significant for both 'HZB within zone' and 'HZB between zone' trips within both regions, i.e. the car is frequently used for short trips.

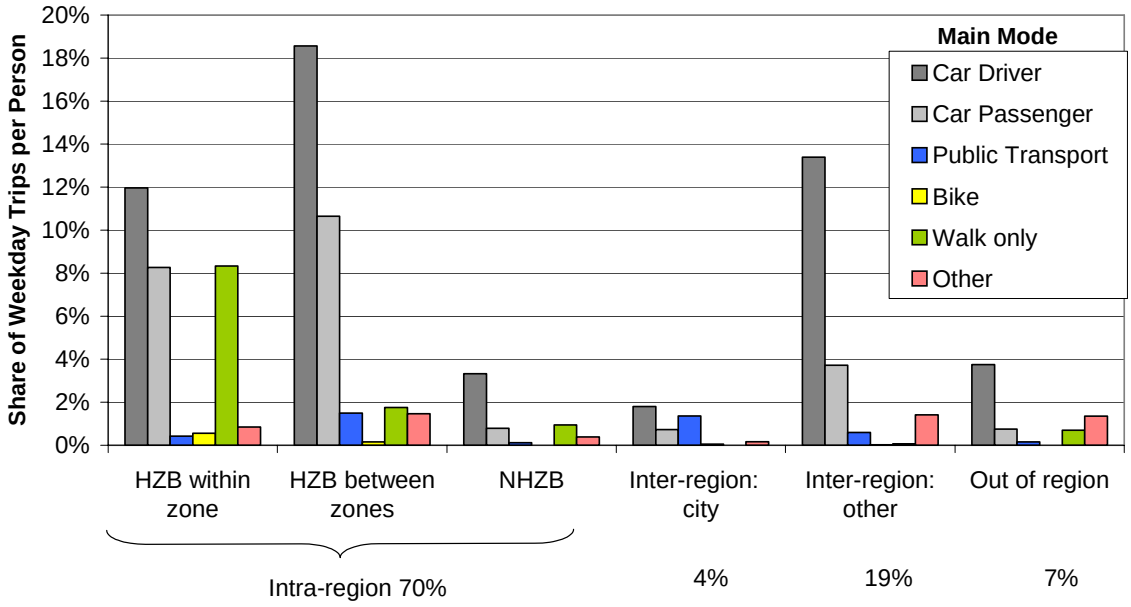


Figure 5: Northern residents weekday trips per person, mode share - disaggregated

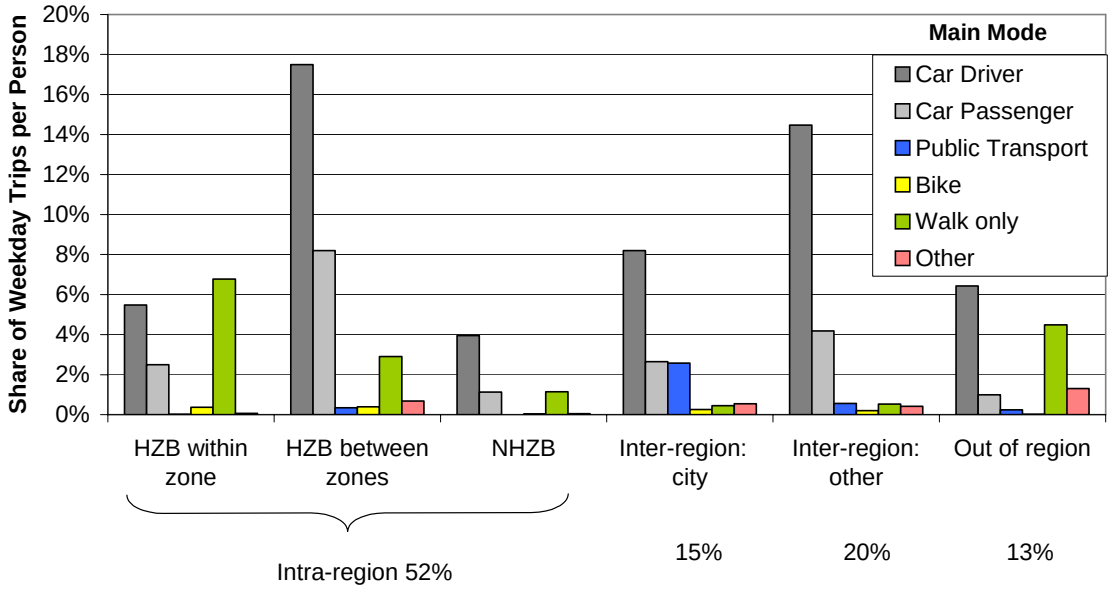
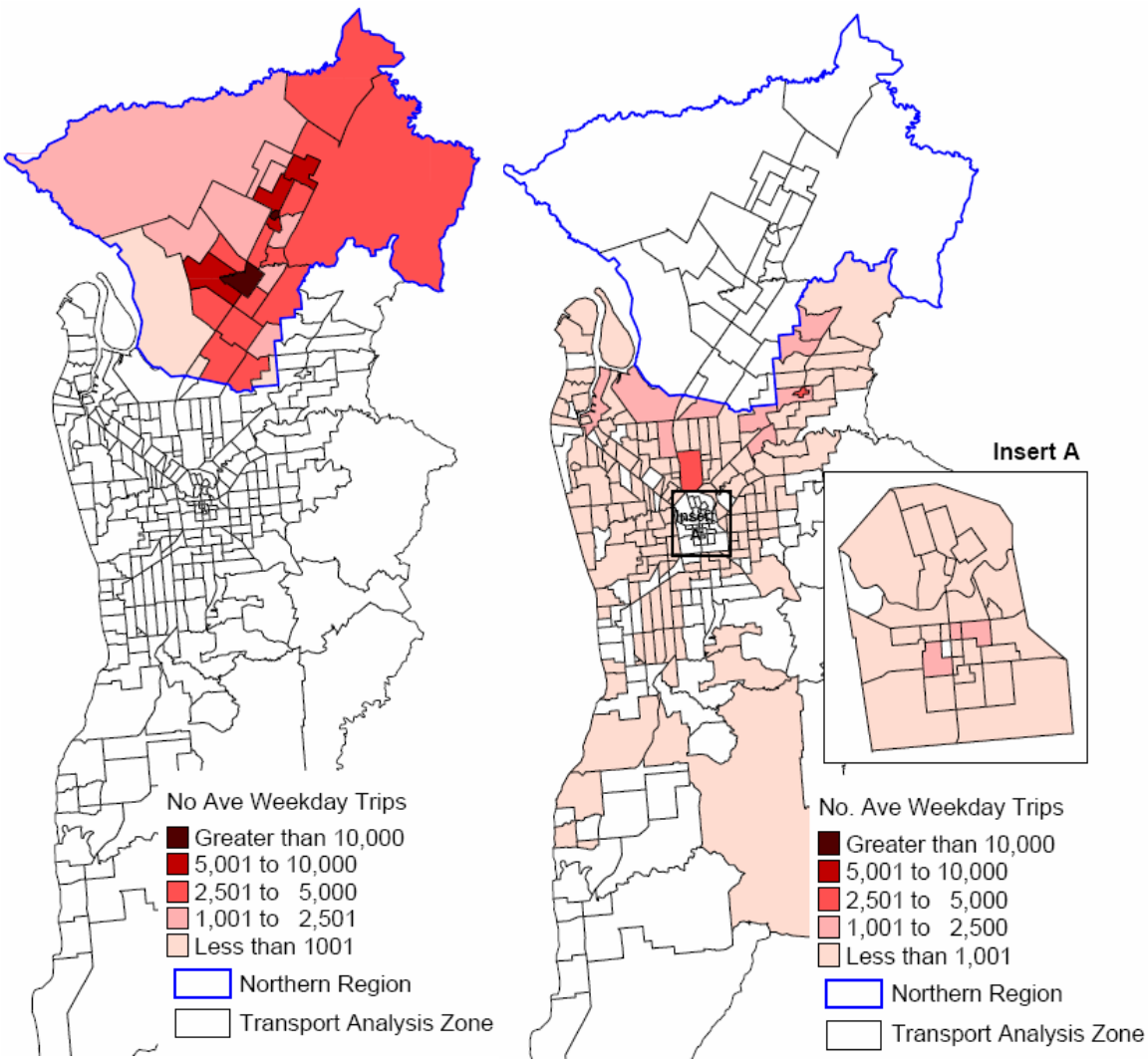


Figure 6: Eastern residents weekday trips per person, mode share - disaggregated

4.5 Resident trips: zone based presentations

It is also possible to present results at the finer 'zone' level. Figure 7 below demonstrates this for the northern region. It shows, using GIS tools, the concentration of trips to various zones. The left hand panel of figure 7 shows the northern residents' intra regional 'HZB between zones' trips; whilst the right hand panel of figure 7 shows their inter regional trips.

Information on travel patterns at this finer spatial level is helpful for the detailed design of transport services.



5 Results 2: trip-kilometres

The analysis of trips per person in section 4 provides one way of assessing the travel patterns by the residents of a region. Another equally important indicator is trip-kilometres per person. Residents' travel patterns on a trip-kilometre basis were derived by factoring, on a zone pair basis, the trip information discussed in section 4 with trip length estimates. Results were then aggregated up to trip type categories.

5.1 Trip length estimation

For car based travel, trip distance between any pair of zones was estimated using the measured shortest path distance between the centroid of each pair of zones. In reality, this underestimates the true distance travelled, since travel between any pair of zones will be undertaken using more than one route due to differing road user perceptions and preferences, and the diversionary effects of congestion. Shortest path estimates were, however, considered a reasonable first indicator. More accurate information was unavailable at the time of this work.

Road based shortest path distance was also used for travel between zones for bike, walk and 'other' modes.

For public transport, actual public transport route distances for buses, trains and trams were supplied by the Transport Systems Centre at the University of South Australia from recent travel demand model estimation (Transport Systems Centre, 2005).

For trips within a zone, no trip length information was available. The following purely indicative figures were used: car-based, public transport, other - 1 km; bike, walk - 0.5 km. Whilst indicative only, they are of the right order of magnitude, and are sufficient for use in the task of obtaining an overview of travel patterns on a regional basis.

5.2 Trip-kilometre results

Figures 8 and 9 present trip-kilometre results. It is useful to first make an overall comparison between figures 5 & 6 (trips) vs figures 8 & 9 (trip-kilometres). Whereas on a trip basis intra regional trips dominate, on a trip-kilometre basis intra regional trips play a much smaller role and inter regional trips a much greater role. This outcome is due to the relative dampening effect of the shorter distances of intra regional trips vis a vis inter regional trips.

More specific observations are as follows:

- Intra-region 'HZB within zone' trip-kilometres are effectively negligible
- intra-region 'HZB between zones' trip-kilometres remain a significant element in the trip-kilometre picture
- by far the most significant element with respect to trip-kilometres is 'inter regional: other' travel

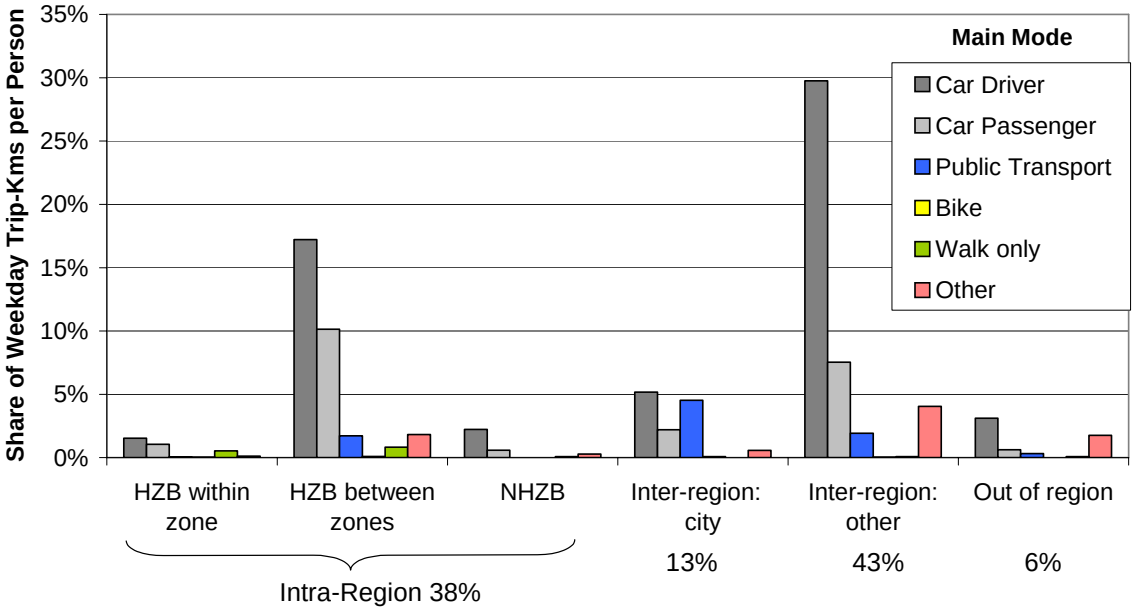


Figure 8: Northern residents share of weekday trip-kilometres

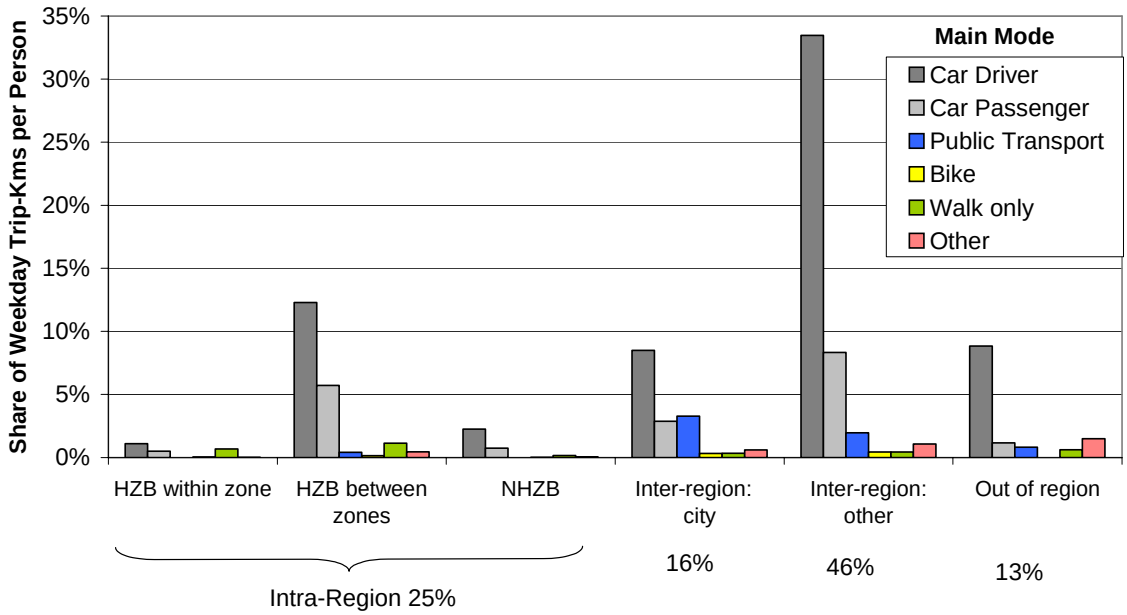


Figure 9: Eastern residents share of weekday trip-kilometres

6 Reconciling trip and trip-kilometre perspectives

The above trip and trip-kilometre results provide useful perspectives for considering the travel patterns of residents in specific metropolitan regions of Adelaide. The question can be asked, however, 'which is most relevant to policy considerations?' The perspective advanced here is that both are relevant in different ways, depending on the type of objective being addressed.

6.1 Environmental objective

Travel patterns measured in terms of 'trip-kilometres' are particularly relevant for the *environmental* policy aspects of urban transport. The longer trips are, the greater the externalities associated with motorised transport: pollution, greenhouse and accidents.[1] Accordingly, trip-kilometres is a key indicator of environmental impacts and therefore for environmental policy. The other dimension of environmental impact, the level of externality per kilometre of travel, is not the focus here (but is reported elsewhere, e.g. Pratt, 2002).

From this perspective, the main feature of figures 8 and 9 is that car based 'inter region: other' travel, and to a lesser extent 'intra region: between zones' travel, have the greatest environmental impact.

6.2 Social objective

Travel patterns measured in terms of 'trips' are particularly relevant for the *social* policy aspects of urban transport. Transport is universally recognised as one of the key elements for achieving accessibility to services for people in the community (- transport is generally considered a means to an end). For people to satisfy their access needs, they must be able to undertake trips to relevant services and facilities. Undertaking the trip is the key to achieving the access outcome sought. Trip distance is less relevant, although there are various affordability advantages of services being closer rather than further away, including people without access to a car finding it easier to access services the closer they are.

From this perspective, the main feature of figures 5 and 6 is the significance of intra regional trips, and to a lesser extent inter-region travel.

7 Policy considerations

One of the key concerns of governments and communities is a desire to achieve transport outcomes that are more sustainable. This is often expressed as a desire for less travel by car based transport, and more by walking, cycling and public transport.[2] This section considers what the travel patterns reported here tell us about achieving such outcomes?

In doing so, a clear distinction first needs to be drawn. The discussion considers the areas where car use is most pronounced, and focuses on these as 'potential' areas for mode shift. This paper does not address the bigger question of the degree of mode shift that may be achievable. That is a much broader and complex question. Without doubt, the challenge for achieving major mode shifts is a significant one. [3]

[1] Although, when short car trips are associated with cold starts, the emissions per kilometre are higher. In the context of this paper, this is particularly relevant for intra regional trips.
[2] The parallel approach of making travel by any given mode more sustainable is the other, equally important, side of the coin, but is not considered here.
[3] Stopher (2004) discusses the difficulty of obtaining mode shifts to public transport, and the limited impact it may have on car based mode share and problems such as road congestion.

7.1 Healthier residents

Figures 5 and 6 show the large number of car based 'intra regional' trips. Many of these would be suitable for switching to walking and cycling. Both these modes of transport are feasible[4] options for relatively short trips, with intra regional 'HZB within zone' trips, as well as 'HZB between zone' trips, being the best candidate market segments. Hence there are ample 'opportunities' for people to switch to walking or cycling for intra regional trips. Research has shown that even modest degrees of switching could yield considerable health benefits (Cavill, 2001; Mason, 2000; Lumsdon and Mitchell, 1999).

7.2 Local accessibility

As discussed earlier, a key objective of our society is to facilitate for people reasonable minimum levels of access to services and facilities. Many of these services are within the region a resident lives in. Hence, intra regional travel options are critical for social equity. Car ownership facilitates this local access for those who have a car at their disposal. For those without access to a car – some young people, some aged people, people who do not own a (reliable) car, and people with disabilities – alternative options are required.

Conventional public transport services meet some of these needs. In addition, concepts such as community transport, local transport, paratransit and specialised transport have also been regularly advocated, and sometimes used, to address these needs. In recent times, the category of 'flexible' transport has arisen in the policy dialogue to describe these less conventional transport options (e.g. Denmark, 2005; Enoch *et al*, 2004). Flexible transport (defined in its broadest terms) would cover all the above alternatives, and may also include mini-buses, coordinated bus-taxi services and other such options. It provides a contrast to the more conventional notion of public transport as mass-transit.

The South Australian government has for some time been investigating flexible forms of public transport. Initial work has concentrated on country areas, where the focus has been on identifying the broad range of transport assets that exist in those areas, and considering innovative approaches for better use of those resources to best meet the travel needs of the community (Saunders *et al,* 2004). The focus is equally applicable to urban areas.

Local flexible transport options need not be thought of as only suitable for those with poor or no access to a car. Use of such options, if attractive enough, may also appeal to some car users.

In figures 5 and 6, the local accessibility issue is represented by the intra regional trips market segment, both travel within zones and between zones. A couple of important examples are: travel by residents to their regional/district centres; and cross regional travel. The former example is partly catered for by feeder services, while the latter is a potentially new market segment. The high existing levels of car travel for intra regional travel in figures 5 and 6 highlights an area of 'potential' for flexible transport options to meet the needs of residents in these regions.

7.3 Mass transit: concentrated travel

The market in which conventional public transport has always had its greatest mode share is travel to/from the city centre (as is the case for both the northern and eastern regions). This

[4] The word 'feasible' has been used here rather than attractive. The former assumes that trip distance is short enough to be within reasonable walking/cycling distances. That, of course, is generally not sufficient to entice people to walk/cycle (otherwise more would), hence the term attractive has been avoided.

is despite the fact that public transport patronage levels have steadily declined on a consistent basis across much of the western world for much of the 20th century as the shape of cities has changed. Public transport to the city continues to play a particularly important social role given the unique role played by the city centre.

Figures 5 and 6 show that there is, however, a considerable degree of car use for 'inter regional: city' trips, more so in the eastern region. An important question is whether public transport's mode share in this market segment can be further increased. Policy options that may facilitate this include *inter alia* a city centre commuter parking levy, and increasing the attractiveness of public transport services to the city (often advocated as one of the most likely approaches for increasing patronage). The challenge is, however, significant for a range of reasons, for example: some employees need a car at work; the strong preference for car travel amongst much of the community; the practical difficulties of using public transport for certain activities, e.g. some shopping trips; and the need for an adequate density of bus services within suburbs.

Even if further mode shift is achieved for the 'inter regional: city' market segment, the overall impact on public transport's mode share across all travel by region residents would be quite small given the relatively modest overall quantum of these 'city' trips. A similar conclusion arises if one makes the comparison on a trip-kilometre basis (figures 8 and 9). For the northern region, this means that shifts to public transport in this market segment would produce a small effect on environmental outcomes. The effect would be greater for the eastern region, although far more modest than might be generally thought.

7.4 Dispersed inter regional travel

The other very significant pattern is the role and scale of the 'inter regional: other' market segment. It consists of travel between the respective region and all non-city locations throughout the rest of the metropolitan area. Figures 5, 6, 8 and 9 show that this market segment is significant in terms of both trips and trip-kilometres.

The dispersed nature of trips has traditionally made this market segment more difficult to serve by mass transit. This has several implications.

First, it can result in problems for people with poor access to a car, a key example being the difficulty these people can experience competing for employment opportunities.

Second, car travel is by far the most attractive, and hence most popular mode choice in these circumstances, which is reflected in the very high car based mode share. Given the long average trip lengths involved, car based travel in this market segment plays a dominant role in terms of trip-kilometres. This makes it clearly the worst contributor to environmental problems of all the market segments.

The environmental problems of this market segment are not easy to address. As mentioned above, it is difficult to serve by mass transit at a reasonable cost. Policies aimed directly at car travel are likely to be most effective.

7.5 The role of land use policies

The above discussion effectively assumes that land use patterns remain relatively similar to what they are now. That need not be the case, particularly over the longer term. In fact, governments across Australia have agreed to a national transport and land use charter aimed at achieving different land use patterns that may be more amenable to more sustainable transport modes of walking, cycling and public transport (Australian Transport Council, 2003).

To the extent that alternative land use policies can be brought about in the future, they could have an impact on the nature of the travel market segments. For example, a higher proportion of activities in the city centre could facilitate a potentially greater role for mass transit within the established fixed public transport corridors. Higher concentrations of residential abodes and activity opportunities along fixed public transport corridors could lead to a greater proportion of intra regional travel, and inter regional 'other' travel, being better suited to public transport along these corridors. This could create a better match between mass transit for both longer and shorter distance travel.

To some extent, some policy tensions may arise. For example, there may be tensions between focusing on flexible public transport options to meet current intra regional travel needs, versus putting greater efforts on improving mass transit within fixed public transport corridors to enhance the attractiveness of more concentrated land use development along these fixed corridors.

8 Conclusions

This paper set out to consider the extent to which travel within cities involves shorter distance local travel within a region, as opposed to longer distance travel between metropolitan regions. This was considered a key issue directly influencing a number of urban issues, and an important dimension for gaining a good understanding of urban travel demand to inform transport policy and planning more generally.

The issue was addressed through consideration of the travel behaviour of residents of two contrasting metropolitan regions in Adelaide, South Australia.

The research demonstrated the key role played by intra regional travel in both the investigated regions. The different proximities of the two regions with respect to the Adelaide city centre explained a number of patterns, particularly the eastern region's higher proportion of inter regional trips to/from the city. Car based travel dominated all market segments, with public transport mode share being highest for travel to/from the city.

The results were shown to be quite different depending on whether one looked at travel patterns from the perspective of number of trips made, versus the level of trip-kilometres. It was also argued that these two indicators are primarily suited to different objectives: trips for social considerations, and trip-kilometres for environmental considerations.

From a social perspective, the paper demonstrated the key local access role played by intra regional trips. From an environmental perspective, inter regional trips to non-city destinations were most pronounced, with intra regional trips between zones also significant.

The paper concluded with consideration of a range of potential policy implications, including the respective roles of mass and flexible transit as two parts of public transport.

The approach outlined in this paper requires further attention. For example, it would be useful to complement the trip type results with actual trip length distributions for each trip type. The approach appears quite suitable for application to any specified region, and in due course it is expected that similar investigations will be undertaken for all metro regions in Adelaide. It could also be extended to travel patterns on weekends and by time periods.

The household travel data used in this work provides a static observation of travel patterns at a point in time. Whilst an excellent tool for observing and understanding travel patterns, it doesn't directly provide the capability to look into the future, or to test the response of travel patterns to policy changes. The use of a travel demand model would assist in this respect.

The department has recently updated its travel demand model using the Citilabs CUBE platform, which will provide a tool for these more sophisticated interrogations.

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