Australian Government
Department of Infrastructure and Regional Development
Bureau of Infrastructure, Transport and Regional Economics

RESEARCH REPORT 144

bitre

Cities

Lengthy commutes in Australia

Bureau of Infrastructure, Transport and Regional Economics

Lengthy commutes in Australia

Report 144

Department of Infrastructure and Regional Development
Canberra, Australia

ISSN: 1440-9569
ISBN: 1978-1-925401-39-4
INFRA 2833/May 2016

Ownership of intellectual property rights in this publication

Disclaimer

Creative Commons licence

Use of the Coat of Arms

An appropriate citation for this report is:

Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2016, *Lengthy commutes in Australia*, Report 144, Canberra ACT.

Contact us

Bureau of Infrastructure, Transport and Regional Economics (BITRE)
Department of Infrastructure and Regional Development
GPO Box 501, Canberra ACT 2601, Australia

Telephone: (international) +61 2 6274 7210
Fax: (international) +61 2 6274 6855
Email: bitre@infrastructure.gov.au
Website: www.bitre.gov.au

Foreword

Previously, BITRE has produced analyses of average commuting times for Sydney, Melbourne, Brisbane and South-East Queensland. This report focusses on the link between the social and economic characteristics of commuters and their travel patterns. It concentrates particularly on those who undertake lengthy commutes, i.e. those longer than 45 minutes one way.

This report is authored by Leanne Johnson, Dr Afzal Hossain, Kyle Thomson and Warwick Jones.

Gary Dolman
Head of Bureau
Bureau of Infrastructure, Transport and Regional Economics
May 2016

Acknowledgements

The authors would like to acknowledge the assistance of a number of organisations and individuals who contributed to this lengthy commutes study through provision of data and advice.

The authors recognise the contribution made by the Department of Social Services (DSS) in providing access of national Household Income and Labour Dynamics in Australia (HILDA) survey, the Productivity Commission, who provided the access to the Productivity Commission *Community Survey 2011* data and the NSW Bureau of Transport Statistics, who provided *Household Travel Survey* (HTS) data.

The authors would also like to acknowledge the assistance provided by Dr Ian Byron, Lucy Williams and Ellen West.

While BITRE is grateful for the assistance provided by these organisations and individuals, the views expressed in this report are those of BITRE, and should not be attributed to any other individual or organisation.

At a glance

- The average commuting time in Australia is 29 minutes. Nearly a quarter of commuters, more that 2 million people, travel for 45 minutes or more one way. These lengthy commuters are the focus of this report.
- The main data source is the national Household Income and Labour Dynamics in Australia (HILDA) survey. In addition, the Productivity Commission (PC) Community Survey and the NSW Bureau of Transport Statistics' Household Travel Survey (HTS), along with other data sources (Victorian Integrated Survey of Travel and Activity (VISTA), South East Queensland Household Travel Survey (HTS) and ABS Time Use survey) are used.
- Lengthy commutes are mainly an urban phenomenon and in general terms, the larger the city the longer the commute. Seventy seven per cent of lengthy commuters are in the five largest cities.
- Within Sydney, the prevalence of lengthy commutes is lower for inner ring residents and higher for middle and outer ring residents. The PC Community Survey data showed that this pattern was similar in Brisbane, Perth and Adelaide.
- Nearly three quarters (73.2 per cent) of lengthy commutes in Sydney are on mass transit while 16 per cent of light vehicle drivers are lengthy commuters. One of the main reasons for this is that the average distance commute for light vehicle drivers is a third shorter than mass transit users and their average speed is significantly higher (21 km/h for mass transit and 33 km/h for light vehicles).
- There is very little difference between light vehicle and active transport commute times throughout Sydney. It is a very different story for mass transit users. Inner city residents using mass transit commute for 46 minutes, while those in mid ring suburbs face an average commute of 59 minutes. Mass transit users in outer Sydney have an average commute of 79 minutes. Ninety per cent of them will commute for longer than 45 minutes.
- Commuting times rise with income and skills. Twenty six percent of employed people with a Batchelor degree or higher are lengthy commuters compared to16 per cent of those with Year 11 or below qualifications. Those earning more than $150 000 a year have an average commuting time of 36 minutes while those earning between $20 000-30 000 commute for an average of 26 minutes.
- Based on the HILDA 2012 survey, more males undertook lengthy commuting than females and overseas-born Australians have longer commuting times than Australian born commuters. Commuting times rose with age up to about age forty and then started to decline, particularly for females.
- Lengthy commuting has a significant negative impact on subjective overall life satisfaction, controlling for other relevant factors. Higher levels of overall job satisfaction, higher levels of satisfaction with the amount of free time a person has and higher levels of satisfaction with job flexibility are also associated with a lower probability of being a lengthy commuter.
- Lengthy commuting is a mostly temporary situation. However, the most important factors associated with longer or shorter lengthy commuting stints are: sex, age, employment and place of residence. Changing residences appears to be the key adaptation mechanism.

Contents

List of figures

List of tables

EXECUTIVE SUMMARY

Background

In Australia, there seems to be a general perception that residents of the nation's largest cities (and particularly of the outer suburbs) spend long periods commuting each day and that commuting times are trending strongly upwards. The reality is that significant population growth and rising road congestion levels in Australian major cities have not translated into a significant rise average commuting times.

The best available data for Sydney and Melbourne indicates that average commuting times have shown limited growth during the last decade. Since around 2010, commuting times have either stabilised or fallen.

Research suggests this is due to various processes of adaptation by individuals, including shifting places of residence or work, changing work hours, changing travel modes and reducing non-commuting travel.

In the past, BITRE produced a series of research reports which were based on the analysis of average commuting times for major cities and of how average commuting times vary spatially within a city. The analysis in this report is focused on individuals, rather than cities or regions—namely those individuals who undertake lengthy commutes.

This research provides a solid evidence-base to understand who is undertaking lengthy commutes, their prevalence and trend. It also explores whether the same individuals are consistently taking lengthy commutes or whether this tends to be temporary. The processes of adaptation of locational choices over time are also explored.

Objectives

The principal objective of this report is to provide an understanding of who is undertaking lengthy commutes, their prevalence, trend and whether this is a persistent or temporary state.

To achieve this objective, a range of research questions are raised and addressed through the report. These questions include:

- How prevalent are lengthy commutes? What is the evidence about how transport and land use systems influence individuals commuting times and the prevalence of lengthy commutes?
- Who undertakes lengthy commutes (demographics, income, skills, employment characteristics, place of residence)?
- What are the trip characteristics of lengthy commutes (origin, destination, distance, transport mode, time of day, stopovers)?
- What evidence is there around transient or more persistent processes of adaptation by individuals?
- What are the social and economic effects of lengthy commutes for individuals?

Data sources

The main data source is the national survey of Household Income and Labour Dynamics in Australia (HILDA), a household-based longitudinal survey. It was initiated and funded by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne). Other survey data are also used such as the Productivity Commission (PC) Community Survey and the NSW Bureau of Statistics and Analytics (BSA) Household Travel Survey.

Other data sources used in this report include the Victorian Integrated Survey of Travel and Activity (VISTA) survey, South East Queensland Household Travel Survey (HTS) and ABS Time Use survey.

The distribution of commuting trip duration

The HILDA median commuting trip duration was 24.0 minutes for 2012, while the average is 28.9 minutes.

The distributions of commuting times are quite similar among the three data sources in spite of the differences between collection method, time period, geographic coverage and question wording.

Lengthy commutes are defined as those with commuting trip duration of 45 minutes or more. The literature suggests that a threshold of 45 minutes approximately represents the point at which the length of the commute is no longer considered acceptable to most commuters. This threshold lies well above the national average commuting trip duration and well above the Sydney and Melbourne averages. It captures 22.4 per cent of the national HILDA in-scope population, and delivers a sufficiently large sample to support analysis of lengthy commutes based on each of the study's three data sources.

Lengthy commutes—prevalence and recent trends

According to the HILDA 2012 survey, 22.4 per cent of Australian commuters undertake lengthy commutes. This represents 2.02 million people.

Based on the HTS, a very high proportion of public transport trips involve lengthy commutes (73.2 per cent), compared to 16.0 per cent of private vehicle commuting trips and 1.6 per cent of active transport commuting trips.

Based on HILDA Surveys, the national average measure of commuting trip duration rose steadily from 25.0 minutes in 2002 to 28.4 minutes in 2007, but then remains relatively unchanged between 2007 and 2012 (when it stands at 28.9 minutes). The 15 per cent change observed between 2002 and 2012 is statistically significant, as is the 14 per cent change between 2002 and 2007. However, there is no statistically significant change since 2007.

Again, according to HILDA surveys, the number of employed Australians undertaking lengthy commutes grew from 1.30 million persons in 2002 to 2.02 million persons in 2012. Over seventy per cent of the increase was concentrated in the 2002 to 2007 sub-period. The

national proportion of lengthy commutes increased from 17.4 per cent in 2002 to 22.1 per cent in 2007, but then levelled off between 2007 and 2012 (when it stood at 22.4 per cent).

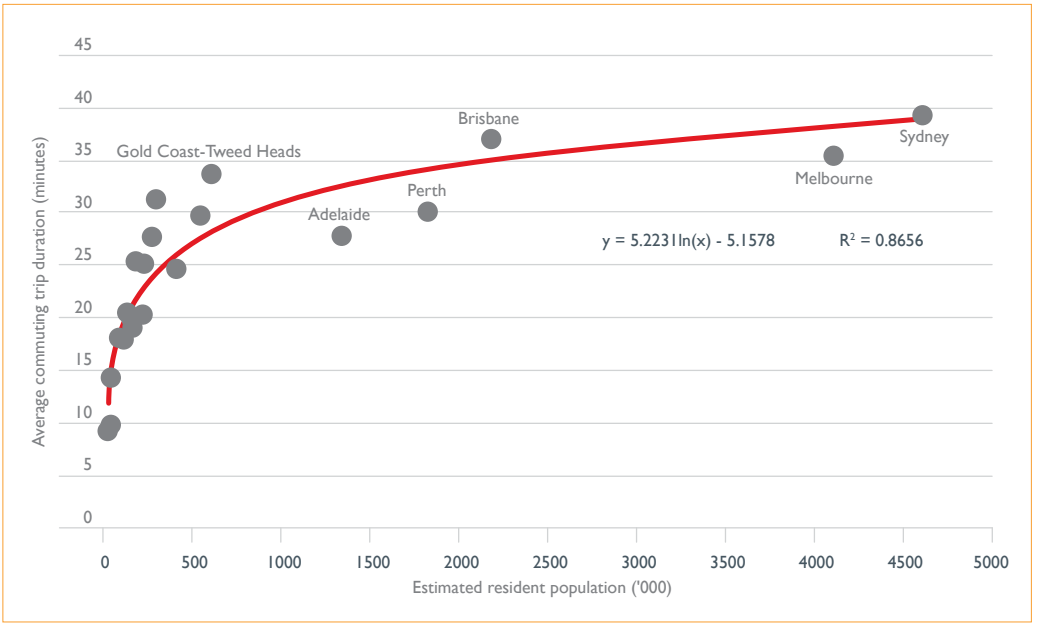
The pronounced growth in the HILDA duration measures between 2002 and 2007 (and the limited growth since then) can be partly explained by stronger employment growth from 2002 to 2007, saturation of Australia's road traffic per person as of 2006, the flow-on effects of the global financial crisis, and increased investment in transport infrastructure since 2007.

Spatial differences

According to the HILDA 2012 Survey, the spatial characteristics of lengthy commuters, based on the commuter's place of usual residence, show that 77 per cent of employed people with lengthy commutes live in one of Australia's five major capital cities, compared to 63 per cent of all employed people. Sydney and Melbourne alone contribute 54 per cent of lengthy commutes, compared to 40 per cent of employed persons. The prevalence of lengthy commutes is highest in the major cities remoteness class (25.4 per cent), lower for inner regional areas (17.0 per cent) and lower again for outer regional and remote areas (11.2 per cent). Similarly, the prevalence of lengthy commutes is highest for major urban centres of 100 000 or more population (24.6 per cent). However, other urban centres with between 1000 and 99 999 people have a lower prevalence (15.1 per cent) than towns of less than 1000 persons and rural areas (20.8 per cent). Further, the HILDA 2012 data show that the prevalence of lengthy commutes is significantly above the national average of 22.4 per cent in Sydney (32.9 per cent) and Melbourne (28.8 per cent), and significantly below the national average in Adelaide (17.8 per cent) and all the state balance categories.

Average commuting times tend to be ordered by city size. To explore this connection, a simple model based on PC Community Survey data showed a statistically significant non-linear (logarithmic) relationship with a highly significant correlation of regression ($R2 = 0.8656$) (see Figure ES.1). It predicts that a city of 30 000 will have an average commuting trip duration of about 13 minutes, compared to about 25 minutes for a city of 300 000 and about 37 minutes for a city of 3 million.

Figure ES.1 Relationship between the estimated resident population and the average commuting trip duration of a city, Productivity Commission *Community Survey*, 2011



Note: Each of the plotted points represents the results for a particular metropolitan or regional city.

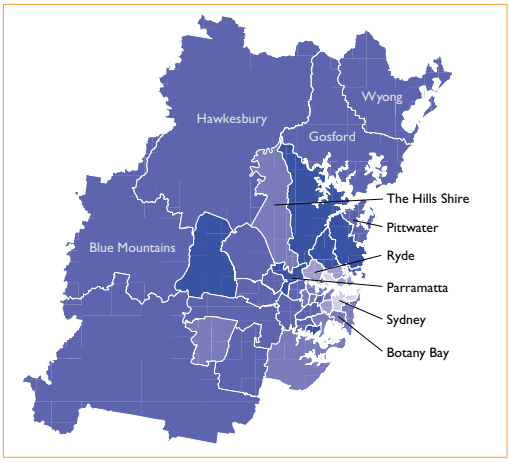
Sources: BITRE analysis of ABS (2015a) and unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Nielsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments*, Research Report, Canberra.

The PC survey data also show that within each of the five major capitals (Sydney, Melbourne, Brisbane, Perth and Adelaide), relatively central locations had the lowest prevalence of lengthy commutes, while the highest rates of prevalence were in a mix of middle and outer suburban areas. Map ES.1 shows the spatial differences in the prevalence of lengthy commuting trip duration within these five cities

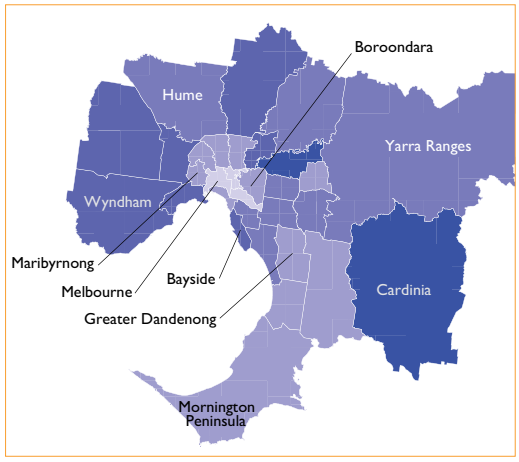
In Sydney, the Household Travel Survey shows the prevalence of lengthy commuting tours is highest for the middle ring locations of Burwood, Auburn, Ku-ring-gai and Kogarah. In Melbourne, the VISTA survey shows the prevalence of lengthy commuting journeys is highest for a mix of middle suburban and urban fringe locations (i.e. Whitehorse, Bayside, Melton and Nillumbik).

Map ES.1 Prevalence of lengthy commuting trips by LGA of residence, Sydney, Melbourne, Brisbane, Perth and Adelaide, Productivity Commission *Community Survey*, 2011

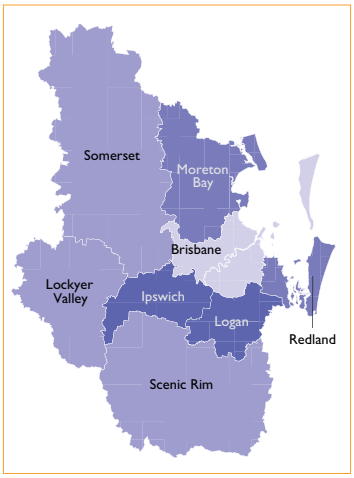
(a) Sydney



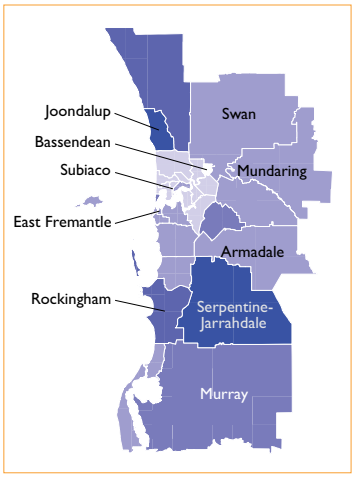
(b) Melbourne



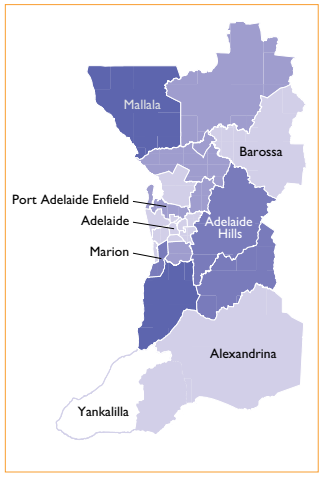
(c) Brisbane



(d) Perth



(e) Adelaide



Prevalence of lengthy commuting trip duration (per cent)

- 50 to 65
- 40 to 50
- 30 to 40
- 20 to 30
- 1 to 20
- Data not available

Note: A lengthy commuting trip is one with a trip duration of 45 minutes or more. Commuting trip duration data are not available for four LGAs in Perth (Claremont, Mosman Park, Peppermint Grove and Bassendean) and one LGA in Adelaide (Yankalilla).

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011): *Performance benchmarking of Australian business regulation: planning, zoning and development assessments.*

From 2002 to 2012, the increase in the prevalence of lengthy commutes was larger for the five major capitals (5.8 percentage points) than for other locations (3.2 percentage points). The net increase was largest for Brisbane (7.1 percentage points), followed by Melbourne (6.7 percentage points) and Sydney (6.2 percentage points). These increases were all statistically significant and were concentrated in the initial 2002 to 2007 subperiod.

Who undertakes lengthy commutes?

Based on the HILDA survey, males account for 59.7 per cent of those undertaking lengthy commutes, and 53.8 per cent of all commuters at the national level. Males have longer average commuting trip durations than females, based on all three of this study's key Australian data sources. The ratio of male to female commuting times ranges from 1.08 to 1.13 and for the proportion of lengthy commutes ranges from 1.13 to 1.28. However, the presence of children in the household increases male commuting times and decreases female commuting times and the ratio of male to female commuting times is 1.21.

Age is an important predictor of commuting times. The HILDA 2012 Survey data shows that commuting times rise with age up to about age forty, before declining. However, the relationship is different for males and females. For males, the two commuting time indicators are at their lowest for the 15–24 age group and at their peak for the 35–44 age group. For females, the two indicators are at their lowest for the 55 plus age group and at their peak for the 25–34 age group. Both indicators are significantly lower than the national gender averages for males aged 15–24 and females aged 55 plus, and significantly higher than the national gender average for females aged 25–34. All remaining estimates do not differ significantly from the national gender benchmarks at the 95 per cent confidence level.

The HILDA 2012 survey data shows that overseas-born Australians have longer commuting times and an eight percentage point higher incidence of lengthy commutes than the Australian-born. The average commute for overseas born workers was 4 minutes longer on average than that of Australian-born workers.

More skilled individuals tend to take longer commutes. The HILDA 2012 survey data shows that the prevalence of lengthy commutes is much higher for those with bachelor degree or higher qualifications (27 per cent) than for those with Year 11 and below qualifications (17 per cent). It is also much higher for Professionals (28 per cent) than Labourers (17 per cent). Advanced producer services and Mining workers are over-represented amongst those with lengthy commutes, while Retail trade workers are under-represented.

According to the HILDA data, lone person households do have a slightly lower prevalence of lengthy commutes than couple only households, but the difference is not statistically significant. Similarly, single and dual earner households showed no significant difference for Australia.

Based on the HILDA 2012 survey, average commuting trip durations and the rate of prevalence of lengthy commutes both rise strongly and systematically with personal income. The average commuting trip durations of the highest income category ($150 000 or more annual income) are 13 minutes longer than the average durations of the lowest income category ($1 to $19 999 annual income). The rate of prevalence of lengthy commutes is 21 percentage points higher for the top income category, compared to the lowest income category. Those earning more than $60 000 make up 51 per cent of lengthy commutes and 41 per cent of all commutes.

Many overseas studies have used regression analysis to identify socio-economic predictors of lengthy commutes. Gender, full-time/part-time status, income, education and region are consistently identified as significant predictors. BITRE has used the HILDA 2012 data as the basis of regression analysis of individuals' average commuting trip duration and whether they undertake a lengthy commute. As was the case for the overseas studies, the explanatory power of the regressions is low (with R-squared's of 9 and 12 per cent). Thus, socio-economic and spatial variables are only capable of explaining a relatively small proportion of the variation in commuting times within Australia. Home ownership, self-employment and full-time/part-time status were found not to be significant predictors in the regression model, as they were associated with other variables.

Trip characteristics of lengthy commutes

According to the Household Travel Survey, between July 2008 and June 2013, 71 per cent of lengthy commuting trips occurred in weekday peak periods, while 24 per cent occur in weekday off-peak periods and 5 per cent on weekends. The prevalence of lengthy commutes is highest for weekday afternoon peak periods (32 per cent) and lowest on weekends (15 per cent).

Public transport is the priority mode for 52 per cent of lengthy commuting trips, while for 46 per cent the priority mode is private vehicle and for 2 per cent it is active transport. For Greater Metropolitan Area (GMA) residents, 73 per cent of public transport commutes take 45 minutes or more, compared to 16 per cent of private vehicle commutes.

The City of Sydney Local Government Area was the place of work for 232 100 (or 37 per cent of) lengthy commutes by GMA residents. Parramatta, North Sydney and Ryde were also prominent places of work for lengthy commutes.

The regression analysis of individuals' commuting trip (tour) duration and whether they undertake a lengthy commute is based on the HTS data. The models' explanatory power is high, with R-squared's exceeding 70 per cent. Thus, information on trip and tour characteristics—such as distance, mode, time of day, direction, place of work, routes and stopovers—can explain the majority of the variation in commuting times for Sydney GMA residents. Much of the explanatory power of these regressions is due to a single trip characteristic, namely distance.

The direct effects of commuting

The direct effects of lengthy commuting appear to be unambiguously negative. Lower overall life satisfaction, lower overall job satisfaction, lower satisfaction with free time and lower satisfaction with job flexibility are all associated with lengthy commuting.

Lengthy commuting has a significant negative impact on subjective overall life satisfaction, controlling for other relevant factors. However, higher levels of overall job satisfaction, higher levels of satisfaction with the amount of free time a person has and higher levels of satisfaction with job flexibility are associated with a lower probability of being a lengthy commuter.

There does not appear to be a significant relationship between being a lengthy commuter and the amount of time a person spends playing with their own children or playing with other

children. In fact, the evidence suggests that people who are lengthy commuters spend more time on household errands, housework and outdoor tasks.

Persistence of lengthy commutes over time

Lengthy commuting is a mostly temporary situation. For most lengthy commuters a stint of lengthy commuting will only last around one year, although for around ten percent of people it will last five or more consecutive years.

The most important factors associated with longer or shorter lengthy commuting stints are: sex, age, employment and place of residence.

Females have a lower probability than males of having a longer lengthy commuting stint. However, the older a person is when they begin their stint, the higher the probability of a longer stint. Other results from the analysis include:

- Being a home owner increases the chance of having a longer stint of lengthy commuting relative to a shorter stint.
- Lengthy commuters who were employed as Technicians and trades workers at either the start or end of a stint are more likely to have longer commuting stints relative to other occupations.
- The work schedule a person has at the end of their lengthy commuting stint appears to be an important factor in the duration of their stint.
- Over the duration of lengthy stints, there is a tendency to move from Outer regional, Remote and Very remote regions and a tendency to move to Inner regional areas and Major cities. Living in Inner regional Australia at the end of a stint appears to increase the likelihood that the stint will be longer, relative to living in other areas.

Adaption

There is strong evidence to suggest that changing jobs or changing residence are ways in which Australians seek to reduce or eliminate lengthy commutes. While lengthy commuting is not associated with an increased probability of changing jobs, those who are lengthy commuters and do change jobs, tend to choose jobs which reduce their commuting time. Similarly, lengthy commuters do not appear more likely to change residence. However, those that do, tend to have lower commuting time, suggesting that the nature of the move is different and that moving house could be a way in which Australians reduce their commuting times.

On the other hand, there is no evidence to suggest that stopping lengthy commuting on average leads to a reduced income, although it does appear to reduce future income growth. However, there is some evidence to suggest that those who stopped lengthy commuting but remained employed work more hours than they would if they were lengthy commuters.

Conclusions

The major contribution of this report is that it shows how the Marchetti's constant works in the context of the Australian transport system and urban form. What is the Marchetti's

constant? Cesare Marchetti was an Italian physicist who studied journey times and noticed that people will only devote around an hour and ten minutes (the constant) to travel. Subsequent work suggests that this has been the case since the Stone Age indicating that it is deeply embedded in the human makeup.

As Marchetti predicted, travel times rise with the size of cities until they reach a limit of around 35 minutes for a one way journey. After that, the perceived costs for the journey rise steeply. Indeed, this report shows that commutes longer than 45 minutes are perceived as unambiguously lessening wellbeing. This has important implications for the transport system and city structures. Commuting times do not expand indefinitely with city size. Once the Marchetti's constant has been reached, the average commuting time stabilises. Sydney is the exemplar of this. It is the largest city in Australia and has the longest commuting times. However, after reaching 35 minutes ten years ago there has been little change. Interestingly, all parts of the city have an average commute time of between 31 and 37 minutes. This opens the question of how cites adapt to the operation of the Marchetti's constant.

Previous BITRE commuting studies (BITRE 2010, 2011, 2012, 2013a, 2013b) have shown that one of the main adaption mechanisms is changes in city structure. Once the CBD jobs fall outside the constant, jobs in the suburbs grow and indeed the earlier reports showed that the number of jobs in the suburbs has grown faster in terms of absolute numbers than jobs in the CBDs. This has led to an increase in cross suburban commuting rather than the radial commuting that have characterised earlier urban transport systems. This is changing. As Australia's economy globalises, the growth in jobs in the CBD is accelerating. This has led to greatly increased housing demand within a 35 minute commuting time of the inner city which has manifested itself in the largest apartment building program in Australia's history.

This report also shows how individuals adapt to the constant. One of the key mechanisms of economic growth in Australia, as in other counties, is greater division of labour. In other words, production is broken down into a series of ever more specialised steps and hence ever more specialised jobs. One of the consequences of this is that the search for a job that fits an individual's speciality takes longer than if there were a high proportion of generalists' jobs. For those with more than baseline skills, there is an incentive to travel up to the constant in order to maximise the choice of jobs. The more specialist and high skilled the job the longer individuals are prepared to travel. This is why high proportions of those who undertake lengthy commutes have higher skills and are well renumerated for commuting longer than the constant.

This report shows that many of those that who do undertake lengthy commutes do so only for a short period before reducing their travel times mainly by changing jobs or changing residence location. This suggests that average commuting times above the constant are perceived as being very costly for individual wellbeing.

This brings the focus onto transport networks. In much of the public discourse, poor transport systems are said to result in people (mainly in the outer suburbs) 'travelling hours to work'. This report shows that it is a myth. The true costs of poorly functioning transport networks is that because the maximum average commute tops out at 35 minutes, poor transport reduces people's access to a jobs. At a personal level, poor transport systems reduce the range of goods and services consumers have access to, further reducing economic growth.

The report also showed that the operation of Marchetti's constant is influenced by transport mode. Continuing the Sydney example, the dominant commuting mode is light passenger

vehicle (67%). Commuting times by this mode show remarkably little variation across the whole Sydney metropolitan area ranging from 25-27 minutes. This suggests that the Marchetti's constant for this mode may be around this level.

Around 5 per cent of commuters in Sydney walk or cycle to work (active travel). The commuting time for this group is again remarkably constant varying from 15-17 minutes across Sydney suggesting the constant for this group is much lower.

Mass transit commuting times are much longer and display greater variability. Inner Sydney mass transit users have a commuting time of 46 minutes. Those from the outer suburbs have an average commute time of 77 minutes. This suggests that the constant may be much longer for mass transit than for light passenger vehicle travel.

What are the take home messages from the report?

1. Commuting times rise from regional areas to cities and with the size of the city.
2. They do not keep rising, reaching a ceiling at 35 minutes on average.
3. Commuting longer than 45 minutes imposes high costs on perceived individual wellbeing and most people who undertake lengthy commutes do so because they are well renumerated.
4. Changing city structure is the main way commuting times are kept at 35 minutes.
5. Individuals also adapt mainly be changing jobs or changing residence.

CHAPTER 1
Introduction

Key points

- This report builds understanding of the characteristics of Australian workers who undertake lengthy commutes. It explores whether the same individuals are consistently taking lengthy commutes, or whether this tends to be temporary. Hence, it investigates processes of adaptation of locational choices over time.
- The main data source is the national Household Income and Labour Dynamics in Australia (HILDA) survey. In addition, other survey data are also used, namely the Productivity Commission (PC) Community Survey, the NSW Bureau of Statistics and Analytics' (BSA) Household Travel Survey (HTS) and the Victorian Integrated Survey of Travel and Activity (VISTA) survey. In addition, other potentially relevant data sources that provide commuting time information are used, which include: South East Queensland Household Travel Survey (HTS) and ABS Time Use survey.
- This chapter introduces some key concepts from the literature; including definitions; advantages and disadvantages of lengthy commutes, search theory; and travel time budgets. Relevant Australian studies are included to provide background for the study.

Context

The majority of the workforce travel to and from work on a daily basis. In Australia, there seems to be a general perception that residents of the nation's largest cities (and particularly of the outer suburbs) spend a long time commuting each day, and that commuting times are trending strongly upwards. In fact, the best available data indicates that average commuting times have shown limited growth—between 2000-01 and 2012-13, Sydney's average commuting times rose by just 0.5 per cent per annum (totalling 2 minutes extra per commute) (BSA 2014a), while Melbourne's figures display a similar long term trend (Victorian Department of Transport 2009).

Significant population growth and rising congestion levels in Australian major cities have not translated fully into rising average commuting times. This is consistent with the 'travel time budget' hypothesis. Research suggests this is due to various processes of adaptation by individuals, including shifting places of residence or work, changing work hours, changing travel modes and reducing non-commuting travel. This study reviews the existing evidences on such processes of adaptation and contributes some new Australian evidence.

In the past, BITRE produced analysis of average commuting times for major cities over the last decade and of how average commuting times vary spatially within a city (see BITRE 2010, 2011, 2012, 2013a, 2013b). In contrast, the analysis in this report is concentrated on individuals, rather than cities or regions—namely those individuals who undertake lengthy commutes.

Evidence-base on travel time

Travel times provide a guide to gauge the impact of transport infrastructure on individuals. Therefore, time spent commuting provides the evidence-base to understand how the transport network is enabling residents to travel to their jobs. New transport infrastructure projects are typically justified based on anticipated travel time savings as significant input into benefit-cost ratios. While this typically involves a focus on aggregate travel time savings, this study provides a relevant contribution by examining the distribution of commuting trip duration and processes of adaptation of individuals with lengthy commutes.

The project is also relevant to the regional development aspects of labour mobility. The Productivity Commission (PC) concluded that long distance commuting is a key form of geographic labour mobility that contributes to economic efficiency and community wellbeing. Commuting can improve matches between employers and workers and can help economies adapt to structural change (Productivity Commission 2011). BITRE (2014b) also highlighted a long term trend of an increasing separation between place of residence and place of work (of which Fly-in fly-out, or FIFO, is an extreme lengthy commute example). This study provides a broader perspective, by investigating the incidence and effects of lengthy commutes in regional Australia as well as cities.

Further, it is expected that the results of this research will provide an evidence-base contribution to other studies and inputs for a range of policy development.

Objectives

The main objective is to provide a solid evidence-base to understand who is undertaking lengthy commutes, their prevalence, trend and whether this is a persistent or temporary state.

To achieve this main objective, a range of research questions are raised and addressed during the course of the research. These questions include:

1. How prevalent are lengthy commutes? What is the evidence about how transport and land use systems influence individuals' commuting times and the prevalence of lengthy commutes?
2. Who undertakes lengthy commutes (demographics, income, skills, employment characteristics, place of residence)?
3. What are the trip characteristics of lengthy commutes (origin, destination, distance, transport mode, time of day, stopovers)?
4. What evidence is there around transient or more persistent processes of adaptation by individuals?
5. What are the social and economic effects of lengthy commutes for individuals?

Data sources

This study is principally based on the *Household Income and Labour Dynamics in Australia* (HILDA) survey. The HILDA survey was chosen due to its national coverage and longitudinal basis. This survey is the best-suited to addressing the project's research questions relating to the prevalence, demographics, effects and permanence of lengthy commutes. The two additional data sources help overcome some of the limitations of HILDA: that it does not collect trip characteristic data and does not support detailed spatial analysis of commuting times. Specifically, the NSW Household Travel Survey (HTS) was used to provide insight into the trip characteristics of lengthy commutes, such as use of different transport modes, vehicle characteristics, trip origins and destinations, trip purposes, time of day of trip, and trip distances and durations, while the PC Community Survey was used for spatial analysis of lengthy commutes. Therefore, by making use of these three data sources, a broader range of research questions can be addressed.

These three data sources differ in their survey methodology, geographic scope, coverage of topics, concepts and definitions, and survey questions. Thus, these surveys have different strengths and limitations in the context of this report. BITRE has access to unit record data from the three surveys.

This study also draws on a range of literature to help address the project's research questions. In addition, other potentially relevant data sources that provide commuting time information were also used, which include: the Victorian Integrated Survey of Travel and Activity (VISTA) survey, South East Queensland Household Travel Survey (HTS) and ABS Time Use survey.

Some key concepts

What constitutes a lengthy commute?

Generally commuting trips occur between home and work. In day-to-day commuting, there are many different practices. Some of these practices were included in defining commuting trips.

Commuting can be measured both in time and distance, either individually or combined. For example, using the US Census Bureau data, Rapino and Fields (2013) classified as extreme commuting (based on time), long-distance commuting (based on distance) and mega commuting (based on both time and distance). 'Extreme commuting' is defined where workers travel 90 or more minutes to work, 'long-distance commuting' where workers travel 50 or more miles to work and 'mega commuting' where workers travel 90 or more minutes and 50 or more miles to work (one way travel). In addition, Rapino and Fields (2013) analysed geographic patterns and distribution of mega commuters, as well as identified transportation and socio-economic characteristics of mega commuters in comparison to other commuters.

However, some authors prefer commuting time over commuting distance, because the reported commuting time is more accurate than the reported commuting distance (e.g. Gottholmseder et al. 2009). According to Gottholmseder et al. (2009), commuters who do not use a car or motorcycle will rarely know the exact distance they travel each day. It is also reasonable to assume that individuals care more about time than about distance, especially if they commute by public transport (ibid, p.564).

Based on commuting time and one way travel, Vaddepalli (2004) defined long commuters as those who commute 60 minutes or more to work, short commuters as those individuals who commute 15 minutes or less to work, medium commuters as those individuals who commute more than 15 minutes but less than 60 to work.

In Australia, VicHealth (2012) defined a long commute as one which involved an average commute of 60 minutes or more one way to work. Other studies have adopted lower thresholds for long commuting. For example, Dargay and Hanly (2003) categorised commutes to work of 30 minutes or more as having 'a long travel time' in the United Kingdom. Similarly, a Californian study defined those with 'long commute times' as having a usual travel time between work and home of 36 minutes or more (Wachs et al. 1993).

Given these variations in definition of length of commutes, BITRE has chosen to define lengthy commutes in this report based on a single threshold level of commuting trip duration (one way), which is 45 minutes or more. According to the literature, a threshold of 45 minutes approximately represents the point at which the length of the commute is no longer considered acceptable to most commuters. This threshold lies well above the national average commuting trip duration. It captures 22.4 per cent of the national HILDA in-scope population, and delivers a sufficiently large sample to support analysis of lengthy commutes based on each of the study's three data sources used.

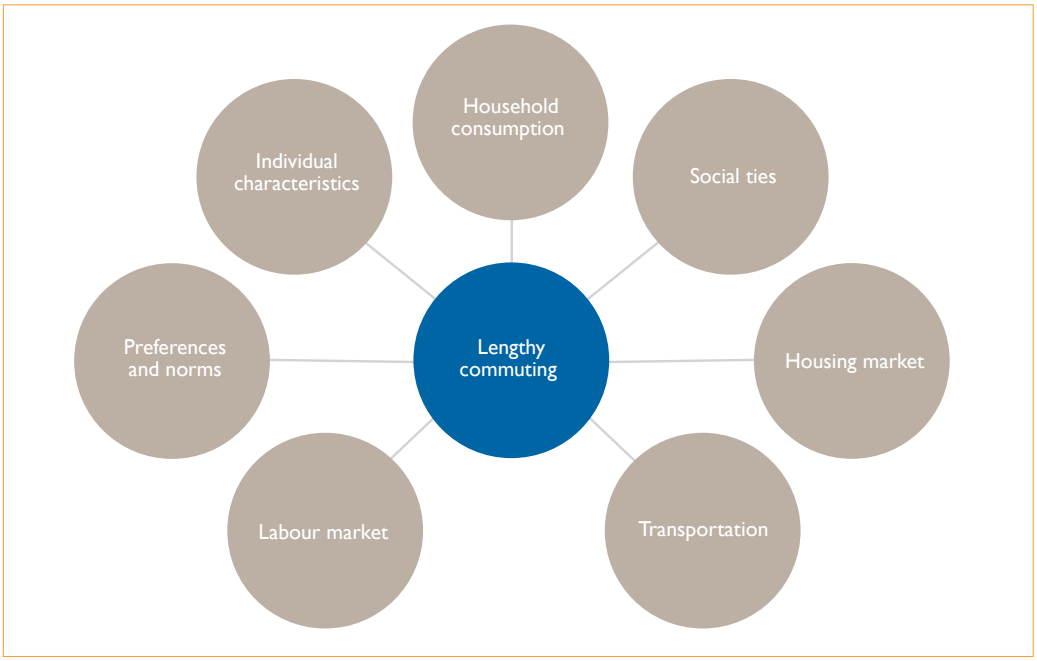
Lengthy commuting as a mobility strategy

Geographic labour mobility is an essential component of the labour market and provides a locational perspective on labour mobility. It plays a key role in a flexible and well-functioning labour market at the national level and is also important for improving economic efficiency and enhancing wellbeing (Productivity Commission 2014). Further, it is considered a mechanism for matching supply and demand of labour in circumstances of acute and long term regional economic change and can reduce economic disparities between regions (Regional Australia Institute 2013). The importance of geographic labour mobility and its impact on individuals and their families, employers, communities, governments and the broader economy is discussed in detail elsewhere (see Chapter 3 of Productivity Commission 2014).

Commuting is considered a mobility strategy. A range of factors influence an individual's decision about where to live and work, and whether or not to move for work (Productivity Commission 2014). In a submission on 'Geographic labour mobility research study' to the Productivity Commission, Department of Education (2014) listed numerous factors, including: remuneration (including the relative cost of living and career prospects), working conditions, skills and other job requirements, relocation and other transaction costs, access to affordable housing, health and social services, transport and schools, the availability of alternative job opportunities, social connections, such as with family and support networks, lifestyle, amenity and historical connections with a location, and the perceived risks of change. The structure of industries, their occupational profiles, wages and other conditions also contribute to greater or lesser mobility (Buchanan et al. 2011).

According to Öhman and Lindgren (2003), there are seven factors driving the lengthy commuting, as shown in Figure 1.1. These include: individual characteristics, preferences and norms, household composition, social ties, labour market conditions, housing market conditions and transportation.

Figure 1.1 A conceptual model of factors behind long-distance commuting



Source: Adjusted from Öhman and Lindgren (2003).

In terms of individual socio-economic characteristics, younger adults are generally more migratory, while the older people prefer to stay (Öhman and Lindgren 2003). Other individual characteristics, such as gender, education level of the individual and foreign-born individuals, are also important factors for long-distance commuting.

The existing literature on gender differences and lengthy commuting consistently finds that men spend more time travelling to and from work than do women, and those men are much more likely to undertake lengthy commutes (Wachs et al. 1993, Flood and Barbato 2005, McKenzie and Rapino 2011, McQuaid and Chen 2012). A number of studies showed that commuting times and distances are longer for more educated workers compared to less educated workers (Lee and McDonald 2003, Van Ham and Hooimeijer 2009, Groot et al. 2012, McQuaid and Chen 2012). Similarly, foreign-born individuals travel longer time to work than non-immigrants (Van Ham and Hooimeijer 2009, McKenzie and Rapino 2011), 'suggesting that they have more problems finding a job on the local labour market' (Van Ham and Hooimeijer 2009, p.140).

In terms of household composition, the presence of a partner and children are important factors for lengthy commuting. Generally, children cause an obstacle to migration, because of the change of school and friends which may be undesirable. Besides the ties to partner and children, an individual has social ties to friends, relatives, colleagues etc. at the location. In a Canadian study, Turcotte (2011) found that commuting time leads to the much greater feeling of not having enough time for family and friends.

Preferences and norms include both individual and societal preferences and norms, which are based on individual life values. Some of these are shared by society while others are unique for each individual. The preferences and norms explain why some individuals strive for stability,

while others search for flexibility and changes in life. These social preferences and norms affect lengthy commuting. For example, Sandow and Westin (2010) analysed people's willingness to commute in in northern Sweden and showed that the geographic and socio-economic structure of the labour market place time restrictions on people's commuting behaviour.

The effect of the labour market on commuting behaviour concerns the kind of job and regional distribution. McQuaid and Chen (2012) found that in the UK, higher occupational levels (professionals, managers and associate professionals) were consistently associated with longer travel times compared to elementary occupations. Similar results are also found in Australia (Flood and Barbato 2005). Some occupations and positions provide the opportunity to work from home one or more days a week.

Lengthy commuting is facilitated by access to fast transportation. However, the accessibility and choice of transportation mode are affected by public transport (rail) infrastructure, availability and cost of travel (Sandow and Westin 2010).

Positive and negative aspects of lengthy commuting

Lengthy commuting has been taken up by individuals with a set of economic and social characteristics and skills as well as in specific industries, such as mining. However, any employee weighs the positive and negative aspects of a particular job or a job opportunity in any given time.

A general theory of commuting behaviour argues that longer commuting journeys are compensated by lower housing prices and higher wages as shown in studies in urban and labour economics (Madden and White 1980, White 1988). However, White (1988) suggests that 'both wages and housing prices adjust to compensate for extra commuting in different circumstances, depending on the direction in which the commuting journey is changed and whether the household moves its job location, its housing location, or both' (ibid, p.131). So et al. (2001) also found that commuting time affects both residential and job location choices. This implies that 'longer commutes require higher wages to leave a worker better off than working in their place of residence' (ibid. p.1042). van Ommeren et al. (1998) also acknowledge that commuting long distances is related to higher incomes and career opportunities for the individual.

According to economic theory, individuals would not choose to have a longer commute unless they were compensated for it in some way, either in the form of improved job characteristics (including pay) or better housing prospects (Stutzer and Frey 2008). In other words, 'if all the participants in a perfect housing and labour market optimise, all the commuters are fully compensated for their traveling costs from home to work, either by higher salaries or by lower rents' (ibid. p.343).

The Productivity Commission (2014) presented 'a framework for understanding how an individual worker decides where to live and work, which is based on the assumption that each individual aims to maximise their expected utility, subject to constraints (such as budget and time) and risk preferences' (ibid. p.43).

In the literature, 'utility maximisation' economic theory is used to explain housing location choice. Basically, this theory suggests that employees seeks to minimise commuting costs by selecting a housing location which provides greater accessibility to their workplace, alternatively they may accept increased commuting costs in exchange for less expensive housing further from their job location. The Productivity Commission (2014) concludes that 'this utility-maximising

framework can apply to a person's decision about how much time, within their total working life, to allocate to a particular work arrangement' (ibid. p.47).

Commuting results in a number of different costs, both external and internal. External costs include congestion and pollution, whilst internal costs include individual time consumption. Various negative aspects of commuting or journey to work have been identified, including the monetary cost of congestion and journey delay, stress and fatigue, and other health impacts (Lyons and Chatterjee 2008).

Lengthy commuting has a serious impact on mental and physical health. There are a number of common impacts of lengthy commuting that have been identified in the medical arena, which include: blood sugar rises, high cholesterol, anxiety increases, declining happiness and life satisfaction, blood pressure and cardiovascular issues, sleeping problems and back aches (Kylstra 2014).

These positive and negative effects of lengthy commuting on selected parameters, including income, family and social connection, health condition, and life satisfaction, are explored using the HILDA data as well as through literature review.

Search theory

Since its introduction in the early 1960s, the search theory has gained much popularity in labour economics and also became a useful approach to study commuting behaviour by both economists and economic geographers (Rouwendal 2004). Later, the model has also been extended by incorporating on-the-job search and by adding the demand side, including duration of employment and wage offer distribution in a non-spatial setting.

The standard version of the search model concerns an unemployed individual who is searching for a job (Rouwendal 1998). Economic theory suggests that job choice, residential choice and commuting behavior are simultaneously determined. This job 'search theory' is an important tool in modern theoretical and empirical labour economics (Rouwendal 2004) and is used to model spatial interaction between residential and employment locations (Rouwendal 1998). Further, van den Berg and Gorter (1996) used a job search model for unemployed individuals to estimate the effects of different wages and commuting time combinations. Rouwendal (2004) used a spatial version of this model to study commuting behaviour in the Netherlands.

Travel time budgets

Throughout urban history, the travel time budget has always been around one hour on average per person per day in every city around the world. This is known as the Marchetti constant, which was developed by Italian physicist Cesare Marchetti. This Marchetti constant is also well known as the 'constant travel time budget hypothesis'. This constant explains how cities throughout history have functioned on the basis of an average of one hour per day per person of travel time. Newman and Jennings (2008) note that the time budget is the 'principle for how people live in cities: the preference of traveling on average half an hour for their main journey to and from home' (ibid. p.125). Thus the Marchetti constant dictates that cities can be no more than 'one hour wide', which essentially means that an average trip can be half an hour and a maximum trip can be one hour.

Although travel time budget has been reported almost as a universal constant across time and space at 1.0 hour (Schafer and Victor 2000) to 1 hour 2 minutes (Ironmonger and Norman (2007) per day, the findings in the literature include various times (between 50 minutes and 90 minutes) per commuter per day (for details, see Ahmed and Stopher 2014).

The issue of constant travel time budget has been discussed for a long time and there are references in favour and against this concept. However, the idea of 'travel time budget' is that, when travel becomes faster, people will travel longer distances in the same amount of time rather than equal distances in less time. van Wee et al. (2002) provided a summary of some of the main theories behind this 'constant travel time budget' concept.

Based on literature review, Peters et al. (2001) (cited in van Wee et al. 2002 and 2006) presented three types of explanations for constant travel time budgets. These are: Reductionistic explanations, Reconstructive explanations and Contextualising explanations. The usefulness of these three categories of explanations is discussed in detail by van Wee et al. (2002).

The first category (the Reductionistic approach) explains that human behaviour is associated with physiological factors and that there is a need for a minimum level of exercise to stimulate muscles in a complex system of hormones related to the costs of travel (discomfort, stress, energy use) and benefits (the access to destinations, the pleasure of cycling, driving a car or travelling by train) in biological clocks.

The reconstructive approach explains human behaviour mathematically (quantitative models) based on theoretical pre-assumptions of behaviour. The assumption is that human behaviour results from (economic) rational behaviour and can be explained as maximising utility.

On the other hand, the contextualising approach explains human behaviour from a historic, social or geographical perspective. According to these strategies, a constant travel time remains unexplained by individual behaviour. It is the context in which an individual functions that explains travel behaviour.

van Wee et al. (2006) caution that the 'three approaches should be seen as different explanations that can be distinguished, but there is not always a sharp distinction between the approaches' and conclude that 'the effects of some changes in society on travel time expenditure might not be fully explained by one approach exclusively' (ibid. p.115).

In the literature, there are two types of studies to measure travel time budget. These are: aggregate studies and disaggregate studies (for a review of more recent studies, see Ahmed and Stopher 2014). Aggregate travel time budget studies are based on relatively large country or citywide averages, whereas disaggregate studies analyse observations at the household or individual level. In addition, the methodologies employed in these two types of studies differ significantly. For example, aggregate studies mainly employed descriptive analysis techniques; a few also used linear regressions. On the other hand, disaggregate studies employed methodologies such as structural equations modelling and survival analysis (Mokhtarian and Chen 2002).

Most of the research into travel time budgets has used large aggregate data sets and has shown that average amounts of time spent travelling are of the order of 1 to 1½ hours, while a number of studies have failed to find evidence of constancy in travel-time budgets (Stopher and Zhang 2011). Although average travel time is a convenient measure to summarise the aggregate travel behaviour of many individuals, it masks the considerable variation between

individuals (Milthorpe 2010). There is a high degree of variation in travel time budgets at a disaggregate level (Ahmed and Stopher 2014).

In Melbourne, analysis of the Victorian Activity and Travel Survey (household-based) between 1994 and 2002, which was projected both forward to 2006 and back to 1991 using the estimated trends, Ironmonger and Norman (2007) found that there was an increase by 6 minutes (from an estimated 1 hour 2 minutes per day in 1991 to 1 hour 8 minutes in 2006) in the travel time budget, but the overall estimate was just over one hour per person per day. Similarly, using Household Travel Surveys from 1981 to 2005 in Sydney Statistical Division, Milthorpe and Daly (2010) found that the average time spent travelling on a weekday increased from 73.2 minutes (both ways) in 1981 to 81.0 minutes in 2005.

In the USA, analysis of the Nationwide Household Travel Surveys between 1983 and 2001 indicated that the average daily travel time per person increased by 1.9 minutes per year which resulted from a combination of factors, such as longer trips, more trips, and slower trips (Toole-Holt et al. 2005). In addition, changes in society, technology, income, attitudes and socio-demographics may have contributed to the travel time growth (Toole-Holt 2004).

This report analyses spatial and key socio-economic characteristics of Australians who undertake lengthy commutes. It provides results on whether the same individuals are consistently taking lengthy commutes, or whether this pattern is temporary. This report also examines the evidence around processes of adaptation of lengthy commutes by individuals.

Structure of report

The structure of this report is organised as follows:

Chapter 2 provides detailed description of three Australian data sources containing surveys on individuals on their time spent commuting—the HILDA survey, BSA Sydney *Household Travel Survey* and the PC *Community Survey 2011*.

Chapter 3 explores how the duration of commuting trips varies across different individuals, by examining the measure's statistical distribution.

Chapter 4 provides some introductory information on the prevalence of lengthy commutes in different subgroups of the Australian population, and then examines recent trends in the prevalence of lengthy commutes.

Chapter 5 considers the spatial characteristics of lengthy commuters, based on the commuter's place of usual residence.

Chapter 6 examines how the likelihood of a person undertaking a lengthy commute relates to the socio-economic characteristics of those individuals, including key demographic characteristics and employment characteristics.

Chapter 7 examines how the likelihood of a person undertaking a lengthy commute relates to the characteristics of the commuting trip, such as the day and time of travel, the direction of travel, transport mode, trip distance, stopover inclusion and place of work.

Chapter 8 explores the direct effects of commuting on individuals including various positive and negative aspects of commuting, such as overall life satisfaction, job satisfaction, satisfaction

with flexibility and satisfaction with free time, feeling rushed or pressed for time and feeling tired, and time spent on selected activities (i.e. household errands, housework, outdoor tasks, playing with own children and playing with other people's children) in a typical week.

Chapter 9 briefly examines whether individuals undertake lengthy commuting consistently for a long period of time or if they do it temporarily, i.e. persistence of lengthy commuting over time.

Chapter 10 examines the evidence around processes of adaptation by individuals, including changing hours/labour force status, working from home, mode shifts, changing responsibilities regarding stopovers, cutting out non-commute trips. It also explores influence of systemic factors, including traffic congestion, transport infrastructure investment, land use planning on individuals commuting times and the prevalence of lengthy commutes.

The final chapter (Chapter 11) provides a summary of the main findings and discusses some of the implications for transport infrastructure and strategic planning.

CHAPTER 2
Data sources

Key points

- This study is based on three Australian data sources which survey individuals on their time spent commuting—the Household Income and Labour Dynamics of Australia (HILDA) survey, the Bureau of Statistics and Analytics' (BSA) Sydney *Household Travel Survey* (HTS) and the Productivity Commission's (PC) *Community Survey* 2011.
- The HILDA survey will be this study's principal data source. The survey's national scope and wide-ranging coverage of demographic, employment and family variables enables a nationally representative profile of those undertaking lengthy commutes to be built. Its longitudinal basis enables investigation of the permanence/transience of lengthy commutes and some processes of adaptation. However, in the context of this study, the HILDA survey has some notable limitations—it does not collect trip characteristic data and does not support detailed spatial analysis of commuting times.
- While the HTS is restricted to travel by Sydney Greater Metropolitan Area residents, this purpose-designed survey provides the highest quality measure of commuting trip duration and collects detailed information on trip characteristics (e.g. transport mode, distance, stopovers). The HTS will largely be used to investigate the trip characteristics of lengthy commutes.
- The PC *Community Survey* 2011 collected information from residents of 174 urban local government areas, including data on peak hour door-to-door durations for the journey from home to work. For this study, the survey's main strength is that it supports detailed spatial analysis of those undertaking lengthy commutes in Australia's capital cities and in some regional cities.
- A key benefit of using multiple data sources is that it provides an opportunity to cross-validate findings and assess their robustness.
- For the purposes of this study, the commuting time information from all three sources needs to be expressed on a common basis. Therefore the HILDA commuting time data has been converted from a per week to a per trip basis.
- The wave 12 HILDA data and the PC commuting time data are both available for a sample of around 9000 respondents, while the HTS data is based on a pooled sample of 17 700 commuting trips taken by around 9000 respondents.
- This chapter sets out the conceptual and methodological differences between the different duration measures. While the definitions and scope of the HTS-based duration measures are very clearly established, there is some uncertainty around precisely what the HILDA-based measure is capturing.

Overview

This study will be principally based on three separate Australian data sources which survey individuals on their time spent commuting. The three data sources have different strengths and limitations in the context of this research project.

- **Household Income and Labour Dynamics in Australia (HILDA) survey**[1]: HILDA is a household-based longitudinal[2] survey that began in 2001 and now has 13 annual 'waves' of data available. It collects data on wellbeing, labour market dynamics and family dynamics (as well as time use). The survey's national coverage and inclusion of a wide range of demographic, employment and family variables enabled BITRE to build a nationally representative profile of those undertaking lengthy commutes and to explore the effects of lengthy commutes. Its longitudinal basis will enable investigation of the permanence/transience of lengthy commutes, and some processes of adaptation. However, HILDA cannot support detailed spatial analysis and does not provide information on the trip characteristics of lengthy commutes.
- **Bureau of Statistics and Analytics' (BSA) Household Travel Survey (HTS):** The HTS collects rather comprehensive personal travel data from residents of the Sydney Greater Metropolitan Area (GMA), and has been running continuously since 1997–98. While it has a narrower geographic scope than the other two data sources, this purpose-designed survey provides a higher quality measure of commuting trip duration and collects detailed information on trip characteristics (e.g. transport mode, distance, time of day, stopovers). Respondents are not tracked over time, so the HTS cannot be used to investigate permanence/transience or adaptation.
- **Productivity Commission (PC) Community Survey 2011:** The PC engaged AC-Nielsen to conduct this survey to gain insights into community views on various aspects of planning systems and their community impacts. This one-off survey collected information from residents of 174 urban local government areas, including data on peak hour door-to-door commuting trip durations. The principal advantage of this survey for BITRE's study is that it supports spatial analysis of the place of residence and place of work of those undertaking lengthy commutes in Australia's capital cities and in some regional cities.

BITRE has access to unit record data from all three surveys. The study will rely primarily on the HILDA survey because its national coverage and longitudinal basis mean it is the best-suited to addressing the project's research questions relating to the prevalence, demographics, effects and permanence of lengthy commutes. BITRE has chosen to incorporate the two additional data sources into the study to help overcome some of the limitations of HILDA when it comes to understanding the time people spend commuting. Specifically, the HTS will largely be used to provide insight into the trip characteristics of lengthy commutes, while the PC *Community Survey* will largely be used for spatial analysis of lengthy commutes. Thus, by making use of all three data sources, a broader range of research questions can be addressed.

1 The HILDA Survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

2 A longitudinal survey involves data being gathered for the same subjects repeatedly over a period of time. New data is collected from the HILDA panel members on an annual basis.

The three data sources differ in their survey methodology, geographic scope, coverage of topics, concepts and definitions, and question wording. As a result, estimates of commuting trip duration from the three sources will not be directly comparable to one another.

A key benefit of using multiple data sources is that it provides an opportunity to cross-validate findings and assess their robustness. For example:

- All three data sources support analysis of how commuting trip duration differs by gender, and if all three sources generate a similar empirical result, that provides much greater confidence in the validity of the finding.[3]
- The purpose-designed HTS commuting trip duration measure provides a high-quality benchmark against which the HILDA measure for Sydney can be assessed. This provides a means of assessing whether concerns about the quality of the HILDA time use data (and the assumptions involved in converting it into a trip-based measure) are significant in a quantitative sense.

There are also some additional Victorian data sources that provide commuting time information that is relevant to this study, and will be used occasionally within this report, namely the Victorian Integrated Survey of Travel and Activity (VISTA)[4] (Victorian Department of Transport 2009) and the VicHealth Indicators Survey 2011 (VicHealth 2012). In particular, Chapter 7 makes considerable use of the VISTA 2009–10 data to assess whether the HTS findings for the Sydney GMA on the role of key trip characteristics are replicated in a different geographic setting (i.e. Melbourne and selected Victorian regional cities).

While the HILDA, HTS and PC *Community Survey* are the three main information sources, BITRE's study also draws on a range of government and academic literature to help address the project's research questions.

The remainder of this chapter contains more detailed descriptions of each of the three data sources, focusing particularly on the measurement of commuting times.

3 Table 6.1 provides commuting trip duration results by gender from all three surveys.
4 This is the Victorian Government's equivalent of the New South Wales government's *Household Travel Survey*, but is conducted on an irregular basis (and not on an ongoing basis, like the HTS).

HILDA survey

Methodology

The HILDA survey is a nationally representative longitudinal study of Australian households (Melbourne Institute of Applied Economic and Social Research (MIAESR) 2014). It collects annual information on family relationships, employment, education, income, health, attitudes, values and life events. Most questions are repeated each year, but information is collected less frequently for some topics (e.g. household wealth, retirement, diet) (ibid).

As the same households and individuals are interviewed each year, the survey reveals how people's lives are changing over time. Longitudinal data can provide a more complete picture than traditional cross-sectional household survey data, by providing insight into the persistence- and recurrence of different life outcomes, and into the causes and consequences of these life outcomes (MIAESR 2014).

The HILDA survey includes several instruments (Summerfield et al. 2014):

- Household form—master document that records basic information about the composition of the household and is used by interviewers to decide who to interview, and to record call information and non-interview reasons.
- Household questionnaire—used by the interviewer to collect more detailed information about the household and is typically only administered to one member of the household.
- Continuing person questionnaire—used by the interviewer to collect information from people aged 15 and over who have been interviewed in a previous wave of HILDA.
- New person questionnaire—used by the interviewer to collect information from people aged 15 and over who have not previously been interviewed, and includes the collection of family background and personal history information in addition to the regular content.
- Self-completion questionnaire (SCQ)—all people completing a person questionnaire are asked to complete the SCQ which contains questions relating to health, wellbeing, lifestyle, time use, finances, attitudes and values. The interviewer collects the SCQ at a later date or it is returned by mail, and in recent years about 87–90 per cent of those who complete a person questionnaire (PQ) also fill out the SCQ.

The HILDA survey began in 2001 with a national probability sample of 7682 Australian households occupying private dwellings (MIAESR 2014).[5] A total of 13 969 persons aged 15 and over were interviewed in wave 1. All members of the 7682 original survey households formed the basis of the panel that was pursued in each subsequent wave (ibid). The sample has gradually increased over time due to children in the original households turning 15 and to the inclusion of new household members resulting from changes in the composition of the original households (Summerfield et al. 2014). The sample was also topped up in wave 11 with an additional 2153 households containing 4009 extra individuals (MIAESR 2014). By wave 12 (in 2012), the total sample size was 17 476 persons aged 15 and over.

Despite the additions to the HILDA sample over time, sample attrition is a major issue in all longitudinal surveys, and can cause the sample to slowly become less representative of

5 Households in very remote areas were out of scope, as were persons resident in non-private dwellings and non-resident visitors.

the population from which it is drawn (MIAESR 2014). Issues of non-response and attrition are overcome by weighting the survey data. The weights adjust for differences between the characteristics of the HILDA sample and the characteristics of the Australian population[6] and allow users to make inferences about the Australian population from the HILDA survey data. For a particular wave, each responding person has a population weight, which can be interpreted as the number of individuals in the Australian population that the person represents (ibid). The sum of the population weights is equal to the estimated in-scope population of Australia (i.e. 22.5 million in wave 12, of which 18.2 million are aged 15 and over).

This study makes use of HILDA data from wave 1 (2001) through to wave 12[7] (2012). While the cross-sectional analysis in Chapters 3 to 6 relies largely on the 2012 data, the longitudinal analysis in Chapters 9 and 10 focuses principally on the 2001–2012 period. Unless otherwise noted, all of the presented HILDA results are population-weighted, using either the cross-sectional weights for the relevant wave, or—as in Chapters 9 and 10—the longitudinal weights. The HILDA data used in this study has been confidentialised to reduce the risk that individual sample members can be identified (Summerfield et al. 2014). This involved withholding of detailed geographic information, aggregating some variables and top-coding income and wealth data (ibid).

Like all sample surveys, estimates based on the HILDA survey are subject to sampling error. In this report, we have adopted the convention of marking with an asterisk those tabulated or charted results which have a relative standard error of over 25 per cent.

Information on time spent commuting

The HILDA SCQ collects information on the time spent in a typical week undertaking various activities. The full question from wave 12 is reproduced in Figure 2.1. For the purposes of this study, it is the time spent travelling to and from a place of paid employment (i.e. part b) that is of particular interest. The full question from wave 12 is reproduced in Figure 2.1 below.

6 For example, non-response to wave 1 of HILDA was slightly higher in Sydney than in the rest of Australia, so Sydney residents were assigned a slightly higher weight (MIAESR 2014).

7 Wave 12 data was the latest available at the time the project commenced in early 2015.

Figure 2.1 HILDA survey time use question from self-completion questionnaire

B24 How much time would you spend on each of the following activities in a typical week?

IMPORTANT: *• Please do not count any activity twice*
• If you do not do an activity, write "0" in the hours box

		Hours per week	Minutes (if applicable)
a	Paid employment		
b	Travelling to and from a place of paid employment		
c	Household errands, such as shopping, banking, paying bills, and keeping financial records (but do not include driving children to school and to other activities)		
d	Housework, such as preparing meals, washing dishes, cleaning house, washing clothes, ironing and sewing		
e	Outdoor tasks, including home maintenance (repairs, improvements, painting etc.), car maintenance or repairs and gardening		
f	Playing with your children, helping them with personal care, teaching, coaching or actively supervising them, or getting them to child care, school and other activities		
g	Looking after other people's children (aged under 12 years) on a regular, unpaid basis		
h	Volunteer or charity work (for example, canteen work at the local school, unpaid work for a community club or organisation)		
i	Caring for a disabled spouse or disabled adult relative, or caring for elderly parents or parents-in-law		
	TOTAL: *This cannot exceed 168 hours and typically will not be greater than 120. If it is, please re-think your answers.*		*Add total hours (whole hours only)*

Source: Extract from HILDA survey wave 12 SCQ, available from <www.melbourneinstitute.com/hilda/doc/questionnaires/q12.html>.

As the survey instrument is a self-completion questionnaire and contains limited user instructions, respondents will exercise their own discretion as to what constitutes time spent travelling to and from a place of paid employment.[8] The HILDA user manual (MIAESR 2014, p.97) identifies some quality issues with the time use data.

While we undertake a large amount of checking and editing on the time use questions in the SCQ, it is likely that problems remain. The problem areas are:

- Excessive hours reported suggest respondents find it difficult to think in terms of hours in a week.
- The same hours may be recorded against multiple tasks if respondents are doing more than one thing at a time (e.g. looking after children while doing the housework)
- Some confusion was caused by the layout of the boxes as some respondents tried to record both hours and minutes.

8 For example, consider a respondent who on the way home from work picks up their child from school and stops by the local shops for ten minutes to purchase some groceries, with the entire door-to-door trip taking one hour. Some respondents in this situation may diligently attempt to split this one hour between the household errands, time with your children, and travelling to and from work categories. Others may simply count the whole hour as time spent travelling to and from work, or just exclude the ten minutes spent shopping, so that 50 minutes is allocated to travelling to and from work.

In wave 1, data was only collected on hours (not minutes) and the time use question did not collect data on time spent in paid employment or looking after other people's children. However, the question wording has been stable since wave two.

The HILDA question collects information on the time spent commuting in a typical week from persons aged 15 and over. Consequently, those who work five days a week will tend to report higher values than those who work just two or three days a week. For the purposes of this study, the HILDA commuting time data will be more meaningful if it can be expressed on a 'per commuting trip' basis (rather than a 'per week' basis), like the measures from the HTS and PC *Community Survey*.

The HILDA person questionnaires collect information on hours usually worked per week (i.e. full-time/part-time status) and the days of the week usually worked. If certain assumptions are made,[9] this information can be used to convert the time spent commuting responses from a 'per week' to a 'per commute' basis.

The SCQ information on time spent commuting is available for only a subset of those identified as employed in the HILDA person questionnaire. Of the 17 476 persons aged 15 and over who responded to wave 12, 12 per cent did not return the SCQ, 5 per cent returned the questionnaire but did not provide a valid response to the time spent commuting questionnaire[10], and 83 per cent provided a valid response. Of the respondents to this question, 39 per cent reported zero time spent commuting to work (largely because they were not in paid employment) and the remaining 61 per cent provided a non-zero response. This amounted to a sample size of 8934 valid non-zero responses to the time spent commuting question in 2012. Only the 8756 persons who were classified as being employed in the PQ were retained for further analysis. This sample of 8756 forms the basis of the population-weighted analysis in Chapters 3 to 6. Some of the analysis also draws on the earlier waves of HILDA data.

9 For example, by assuming that:
- each day of work involves two one-way commuting trips (i.e. that employed people do not make multiple return trips between their home and work address in a single day)
- the full-time employed undertake 10 commutes per week, except where they specifically advise that they worked something other than five days a week
- time spent travelling on work-related business during the course of the work day is not reported as time spent travelling to and from a place of paid employment.

The HTS data for the Sydney Greater Metropolitan Area provides some opportunity to test out the validity and potential impact of such assumptions.

10 This is a mix of refused, not stated and implausible responses (as assessed by the HILDA survey team).

BSA Household Travel Survey

Methodology

The HTS is a detailed survey of personal travel by residents of the Sydney Greater Metropolitan Area (GMA)[11] that has been running continuously since 1997–98 (BSA 2014a). It collects information on household and personal demographics, labour force characteristics, use of different transport modes, vehicle characteristics, trip origins and destinations, trip purposes, time of day of trip, and trip distances and durations (ibid). The survey is designed to be representative of usual residents of private dwellings in the GMA (BSA 2013).

The HTS is collected via face-to-face interviews to ensure high data quality and maximise response rates (BSA 2014a). Each household selected for the survey is allocated a travel day, with household members asked to record their trips over a 24 hour period (from 4am on their travel day to 4am the next day) (BSA 2013). An interviewer then interviews each household member to collect the details of each trip (BSA 2014a). The HTS involves the following instruments:

- Household form—collects household details such as dwelling structure, number of residents, and characteristics of household vehicles, from a responsible adult member of the household
- Adult person form—collects trip details and demographic information from every member of the household aged 15 years and older
- Child person form—collects trip details and information about child care arrangements, education and mobility restrictions for every member of the household aged 14 years or younger, with proxy interviewing permitted for those aged 10 and below (BSA 2014b).

The HTS sample is designed on a three-yearly cycle, with all travel zones in the GMA being sampled within a three year period (BSA 2013). The HTS sample is also spread across all days of the year (ibid). The estimates published in the 2012–13 HTS report are based on three years of pooled data collected from July 2010 to June 2013 (BSA 2014a). A total of 14 636 GMA households were approached during this period, of which 9 859 responded, representing a 67 per cent response rate. Information was collected from more than 25 000 individuals in these 9 859 households, with data collected for over 106 000 trips (ibid).

The HTS sample data is weighted so it represents the travel of the GMA population for a given period. Weights are based on ABS *Estimated Resident Population* (ERP) *and Census of Population and Housing data* (BSA 2014a).

This study makes use of a pooled five year HTS dataset, containing data from July 2008 to June 2013. The rationale for the pooled approach is to create a larger sample so as to reduce the variability of the survey-based estimates (BSA 2013). All HTS-based estimates presented in this report are weighted estimates, unless otherwise noted.

11 The GMA includes the Sydney Greater Capital City Statistical Area (GCCSA) and the Illawarra and Lower Hunter regions, and extends from Port Stephens in the North to Shoalhaven in the South and the Blue Mountains in the West (BSA 2014a).

Information on time spent commuting

The HTS adult person form initially establishes the physical location of respondents at 4am on their travel day. Respondents are then asked to provide detailed information on each trip made throughout the travel day. Figure 2.2 shows some of the information that is collected for each trip.

The survey responses on departure time (question 39) and arrival time (question 41) are used to derive trip duration. Commuting trips are identified using the purpose information provided in response to question 42.

The HTS commuting trip duration measure is regarded as the highest quality of the three data sources, due to:

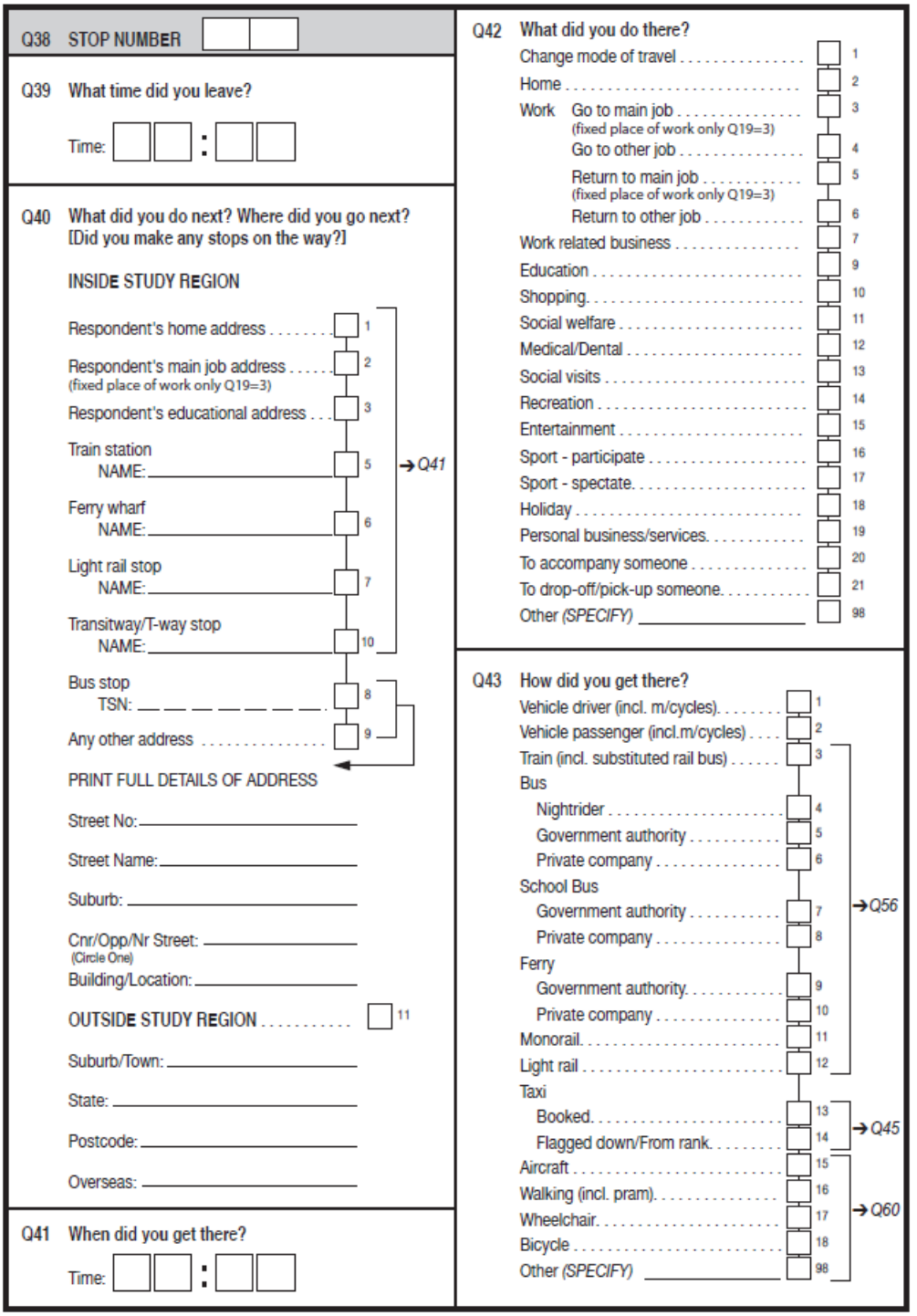
- the HTS being specifically designed to collect personal travel information, including data on trip durations
- the data being collected via face-to-face interview, rather than through a self-completion questionnaire
- the well-articulated concepts, definitions and methods making it clear what is being captured by the measure.

Nevertheless, a particular quality issue that arises in travel surveys, such as the HTS, is that respondents tend to round the times that trips depart and arrive to multiples of 5, 10 and 15 minutes (Milthorpe 2007). A similar rounding issue is also evident in the PC *Community Survey* and HILDA survey data.

The pooled five year HTS dataset provided by the BSA relates to trips by employed GMA residents aged 15 and over that involved a priority purpose of commuting. The unit record dataset relates to the concept of a 'linked trip', which comprises a journey from one activity to another, ignoring changes of mode (BSA 2014a).[12] The dataset provided contains a selection of HTS variables considered most relevant to the scope of this study. BSA provided some of the HTS variables in an aggregated format in order to protect the confidentiality of HTS respondents.

12 For example, a person who walks from their home to the station, then catches the train to the CBD, then walks to their office is making three unlinked trips. These unlinked trips combine to form a single linked trip (BSA 2013).

Figure 2.2 Extract from HTS adult person questionnaire



Source: Extract from BSA HTS 2011–12 person form (adult), available from <www.BSA.nsw.gov.au/Statistics/HTS/default.aspx#top>.

Data based on linked commuting trips does not capture stopovers made for other purposes on the way to or from work (e.g. dropping off and picking up children, shopping, gymnasium). However, BSA have provided some additional HTS data, based around the concept of a 'home to work' or 'work to home' tour leg, which supports analysis of the impact of trip chaining and stopovers on commuting trip duration (see Box 4.1 and Chapter 7).

The HTS-based analysis in this report is based on a pooled five year unit record dataset, which contains a sample of 17 700 linked one-way commuting trips undertaken between July 2008 and June 2013 by 8899 different individuals who live in the Sydney GMA.

Productivity Commission Community Survey 2011

Methodology

This one-off survey was commissioned by the PC to inform its benchmarking study of States and Territories' planning and zoning systems, undertaken in 2010 and 2011. The PC engaged a consultant (AC Nielsen) to conduct this population survey 'to gain insights into the community's views on various aspects of the planning systems and its impact on the community' (PC 2011, p. 561). Respondents were asked about a range of issues, including commuting times, attitudes to population growth, planning priorities, personal experience with development applications, and how they rated their local and state/territory government's planning-related performance. The consultant collected the data through an internet survey of registered participants in selected Australian cities (Productivity Commission 2011).

Twenty four Australian metropolitan areas and regional cities were selected for this study (PC 2011). All eight capital cities were included, as were all remaining Australian cities of over 100 000 population, and a selection of regional cities (e.g. Alice Springs, Geraldton, Mount Gambier). The selected cities included 174 local government areas (LGAs) plus the city of Canberra. The consultant sought to obtain responses from at least 100 people aged 18 and over in each of these LGAs (and in Canberra). The aim was to achieve a margin of error of around 10 per cent for each area (ibid). A total of 15 954 persons responded to the survey.

The survey was issued in January 2011. Due to the flooding in parts of South East Queensland, Victoria and New South Wales between December 2010 and January 2011, the survey was refined for respondents located in flood affected areas to ensure residents provided responses that represented the more regular conditions prevailing prior to the floods (Productivity Commission 2011).

The PC *Community Survey* dataset includes a set of weights that appear to be designed to make the data more representative of the underlying population of the selected cities, by correcting for particular groups that have been over-enumerated (e.g. females) or under-enumerated (e.g. males) in the sample.

Information on time spent commuting

Respondents who report that they are in paid employment are asked to complete a series of commuting-related questions. The relevant questions are shown in Figure 2.3.

Figure 2.3 Extract from PC Community Survey questionnaire

10. Now a few questions about how you travel to work.
    What is your normal method of **travelling from home to work** (Please select more than one if applicable)?

- Work from home
- Walk
- Bicycle
- Motorcycle
- Car or similar
- Bus
- Train
- Tram
- Ferry
- Other (Please specify) ……

11. When travelling **to work**, do you go directly **to work** or do you go via somewhere else, such as dropping children at day care or school, shopping or going to the gym?

- Go directly
- Go via somewhere else

12. When your journey to work is **at peak hour**, what is your total travel time in getting to work from home, door to door using your normal route? (This is the time for the journey in one direction only, the **to work** journey, not the journey **from work to home after work.** This estimate should exclude time spent at any in-between destinations, such as the day care, school, shopping or the gym)

- (Specify) minutes ……
- Don't know
- Don't travel at peak times

Source: Extract from PC *Community Survey* 2011 questionnaire, available from <www.pc.gov.au/inquiries/completed/regulation-benchmarking/planning/report>.

The data collected on commuting trip duration in the PC survey therefore differs from the other two sources because it relates solely to peak-hour travel, and because it is confined to the journey from home to work and so does not cover the return journey. While this is a self-completion questionnaire, a reasonable amount of written guidance is provided to respondents to help them consistently fill out this part of the questionnaire and the form directly addresses how stopovers on the way to work should be treated when reporting peak hour commuting times.

While the PC *Community Survey* will primarily be used in this report as the basis for spatial analysis of lengthy commutes (Chapter 5), it also supports analysis of the impact of stopovers, place of work and transport mode on commuting times.

Of the 11 319 survey respondents who reported they were in paid employment, 10 per cent did not travel at peak times, 3 per cent responded 'don't know' to the commuting time question and 5 per cent did not respond. The remaining 81 per cent who provided a non-zero response to question 12 form the sample of 9 218 individuals upon which the PC Community Survey analysis in this report is based.

Comparison of three data sources

Table 2.1 brings together the information presented in the last three sections in order to summarise and compare some of the key features of the three principal data sources for this study—HILDA, the HTS and the PC *Community Survey*.

Table 2.1 shows that, of the three data sources, the HILDA survey has the most comprehensive geographic scope and the most extensive coverage of demographics, labour market and life outcomes, and is the only source which supports longitudinal analysis. The HTS has the narrowest geographic scope, but has the most comprehensive coverage of trip characteristics. The PC *Community Survey* differs from the two preceding sources in that it is a one-off survey. However, the PC survey can support more comprehensive spatial analysis of commuting times than the other two sources.

While Table 2.1 compares the general characteristics of each survey, Table 2.2 compares the commuting time data collected from these data sources. The table highlights some important differences in the basis of the commuting time data collected from each source. It reveals that the wave 12 HILDA and PC *Community Survey* data are both available for a sample of around 9000 respondents,[13] while the HTS data is available for a pooled sample of 17 700 commuting trips undertaken by just under 9000 respondents. It further reveals that rounding of responses is likely to be an issue for all three data sources, but particularly for the PC *Community Survey*.

A key difference is that the commuting time data in the HTS and PC *Community Survey* is collected on a per trip basis, while the HILDA survey collects the data on a per week basis. For the purposes of this study, it is important that the commuting time information from all three sources is expressed on a common basis. Therefore, the HILDA commuting time data has been converted to a per trip basis.

13 The HILDA data is available for a sample of around 9000 respondents each year (compared to an average of 1780 respondents per year in the HTS), but because the same respondents are tracked over time in HILDA, multiple waves of HILDA data cannot be pooled.

Table 2.1 Comparing key features of three principal data sources

	HILDA survey	HTS	PC Community Survey
Data collection method	Face-to-face interviews, coupled with self-completion questionnaire	Face-to-face interviews, plus memory jogger in which each household member records trip details for their travel day	Internet survey of registered participants
Geographic scope	Australia (initial sample excluded households in very remote areas)	Sydney GMA	24 Australian metropolitan areas and regional cities
Any other exclusions from scope of survey	Excludes persons resident in non-private dwellings and non-resident visitors	Excludes persons resident in non-private dwellings and non-resident visitors	None identified. Implicitly excludes persons who do not use the Internet.
Time period for which data collected	Data collected annually since 2001. Data collection is ongoing.	Data collected annually since 1997–98. Data collection is ongoing.	Data collected in the first few months of 2011.
Survey purpose	To support research into income dynamics, labour market dynamics and family dynamics	To meet the needs of transport data users for timely information on personal travel by GMA residents	To gain insights into community views on various aspects of urban planning systems
Collects data on time spent commuting	Yes	Yes	Yes
Spatial capability	Limited to high-level analysis by remoteness class, section of state, state/territory and capital city/state balance	Supports spatial analysis by LGA and planning subregion within Sydney GMA	Supports spatial analysis by LGA, city, city size and state/territory
Longitudinal basis	Yes. Supports longitudinal analysis of how people's lives have changed since 2001.	No	No
Coverage of demographics, labour market and life outcomes	Extensive coverage.	Good coverage of employment characteristics. Reasonable coverage of demographics.	Limited to age, gender, employment status, household type and dwelling type
Coverage of trip characteristics	Limited to data on which days of week go to work and summary information on place of residence	Detailed information collected on trip purpose, transport mode, trip origin/destination, time of day, day of week, distance and stopovers	Some information collected on transport mode, LGA of residence, LGA of work and whether trip involved stopovers
Total number of survey respondents	In 2012 (wave 12) the total sample size was 17 476 persons aged 15 and over	The pooled five year dataset (July 2008 to June 2013) is based on a sample of over 27 000 individuals.	15 954 persons
Weighting	Data weighted to be representative of characteristics of Australian population	Data weighted to be representative of characteristics of the GMA population	Data can be weighted. Details of weighting basis are not provided.

Source: BITRE analysis.

Table 2.2 Comparing collection of commuting time information across the three principal data sources

	HILDA survey	HTS	PC Community Survey
Data collection method for commuting time information	Self-completion questionnaire	Face-to-face interviews, plus memory jogger	Internet survey of registered participants
Who is asked commuting time question(s)?	Persons aged 15 and over who completed the person questionnaire	Persons aged 15 and over	All persons (of any age) who are in paid employment
Question wording	How much time would you spend on each of the following activities in a typical week? b. Travelling to and from a place of paid employment • (Specify) hours and minutes ……	Respondents are asked the following questions for each trip from one stop to the next stop on the travel day: • When did you leave? • (Specify time in hours and minutes ….) • Where did you go next? (Specify address) • When did you get there? (Specify time in hours and minutes ….) • What did you do there? (Specify trip purpose)	When your journey to work is **at peak hour**, what is your total travel time in getting to work from home, door to door, using your normal route? (This is the time for the journey in one direction only, the **to work** journey, not the journey from **work to home** after work. This estimate should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym) • (Specify) minutes ……
Reference period to which commuting time data relates	Total time spent commuting in a typical week	Time spent on each commuting trip, including trips to work and return trips home from work	Time spent on one-way commute to work
Treatment of peak and off-peak periods	No information collected on whether travel was during peak or off-peak periods	Detailed data is collected on time of day for each trip, enabling production of separate measures for peak and off-peak periods	Information only collected from people who commute during 'peak hour'
Treatment of stopovers while travelling to or from work	The question wording provides no guidance on how to treat stopovers. This is left to the judgement of the respondent and it is therefore likely that respondents would vary in how they treat stopovers when reporting their time spent commuting.	Survey collects details of all stops made, enabling a range of duration measures to be produced, reflecting different treatments of stopovers. The published HTS duration measure is based on the concept of a 'linked trip' and does not capture stopovers made for other purposes on the way to or from work.	Question wording provides specific guidance on how to treat stopovers. Reported commuting time should relate to door-to-door travel time from home to work, excluding time spent at any in-between destinations.
Sample who provided commuting time information	8756 employed persons provided a non-zero response in wave 12 (2012)	8899 persons provided trip duration responses for 17 700 linked commuting trips in pooled five-year dataset	9218 persons in paid employment provided a non-zero response
Extent of response rounding	Moderate to high, with 69 per cent of non-zero weekly commuting time responses relating to 1-hour multiples and a further 15 per cent to half-hour multiples. Most common response is 5 hours, with a 14 per cent share.	Moderate to high, with 80 per cent of commuting trip duration responses relating to 5-minute multiples. Most common responses are 30 minutes (11 per cent share) and 15 minutes (10 per cent).	High, with 91 per cent of non-zero travel time responses relating to 5-minute multiples. Most common responses are 15, 20 and 30 minutes (each with an 11 per cent share).

Source: BITRE analysis.

Table 2.3 describes and compares the measures of commuting trip duration that have been derived from these three data sources. Two different HTS-sourced measures are included in the table—based on the HTS linked commuting trips data and the HTS home-based tour data. The table sets out some of the conceptual and methodological differences between the different duration measures.[14] The empirical differences that may flow from these conceptual and methodological differences will be explored in the chapters that follow.

Due to the purpose-designed nature of the HTS, the definitions and scope of the HTS-based duration measures are very clearly established and documented. There is more uncertainty around precisely what the other two surveys are capturing, particularly with regard to the HILDA survey, where the preferred treatment of stopovers and work-related business travel is not specified and so is likely to vary across respondents. BITRE's conversion of the HILDA data to a 'per commuting trip' basis also introduces some additional scope for error, due to the assumptions involved. However—as highlighted in Tables 2.1, 2.2 and 2.3—the HILDA-based measure of commuting trip duration also has some major advantages for the purposes of this study, relating to its national scope, longitudinal basis, consistent 11-year time-series, and wide-ranging coverage of demographics, labour market and wellbeing outcomes. For these reasons, the HILDA survey is used as the principal data source in this study, commencing with the analysis of commuting trip duration in the chapter that follows.

14 A further difference between the surveys.

Table 2.3 Comparing the characteristics of the different measures of commuting trip duration

	HILDA survey	HTS linked trip data	HTS tour data	PC Community Survey
Derivation of commuting trip duration measure	A person's reported weekly total time spent commuting is divided by the estimated number of commuting trips. The latter is set equal to twice the reported days of work (except for those who report they work a split shift).	A 'linked trip' is a journey from one activity to another, ignoring changes in mode. The departure time from the previous activity and the arrival time for the current activity are used to derive trip duration. The specified trip purposes are used to identify commuting trips.	A 'tour leg' can involve multiple linked trips and captures the entire home-to-destination or destination-to-home travel time. Reported departure and arrival times are used to derive tour duration. The specified trip purposes are used to identify home-to-work and work-to-home tour legs.	None—a person's commuting trip duration is set equal to their response to the survey question
Subset of respondents/ trips/tours the measure is derived for	Employed persons aged 15 and over who reported a plausible non-zero commuting time	Persons aged 15 and over who went to work on their assigned travel day and have a fixed place of work outside the home. Only linked trips assigned a priority purpose of commuting are covered.	Persons aged 15 and over who went to work on their assigned travel day and have a fixed place of work outside the home. Only home-based tours with a tour purpose of work are covered.	Persons in paid employment who commuted during peak hour and reported a non-zero commuting time
Which commuting trips are covered	Covers all time spent travelling to and from work	Covers all linked trips with a priority purpose of commuting. This includes trips to work and return trips home from work.	Covers the tour leg from 'home-to-work' and the return leg	Covers only the one-way commute to work
Coverage of peak and off-peak periods	Covers both peak and off-peak periods	Covers both peak and off-peak periods. Separate measures available for each period.	Covers both peak and off-peak periods. Separate measures available for each period.	Measure relates only to those who commute during 'peak hour'
Treatment of stopovers	Unclear—no guidance is provided to respondents on how to treat stopovers	Measure relates to duration of a linked commuting trip. Stopovers made for other purposes on the way to or from work are treated as separate trips, and are excluded from measure.	Measure relates to door-to-door travel time from home-to-work or work-to-home, excluding time spent at any in-between destinations	Measure relates to door-to-door travel time from home-to-work, excluding time spent at any in-between destinations
Treatment of people with no fixed place of work	Potentially included	Excluded from measure	Excluded from measure	Potentially included

(continued)

	HILDA survey	HTS linked trip data	HTS tour data	PC Community Survey
Treatment of work-related business travel	Unclear—no guidance is provided to respondents on how to treat work-related business travel	Linked trips with a priority purpose of 'work related business' are excluded from measure	Work-related business travel is captured if it is part of a home-to-work or work-to-home tour leg. Tour legs with a tour purpose of 'work related business' are excluded.	Work-related business travel as part of the home-to-work journey is captured. Other work-related travel is not captured.
Treatment of fly-in fly-out workers (see Box 7.1)	Potentially included, but can't be easily identified	Excluded, as dataset focused on travel within GMA	Excluded, as dataset focused on travel within GMA	Included
Time period to which measure relates	Consistent unit record data available for each year from 2002 (wave 2) to 2012 (wave 12)	A five year pooled unit record dataset was made available, covering the period from July 2008 to June 2013	A five year pooled unit record dataset was made available, covering the period from July 2008 to June 2013	The publicly available unit record data was collected in the first few months of 2011

Source: BITRE analysis.

CHAPTER 3
The distribution of commuting trip duration

Key points

- This study focuses on a per trip measure of duration, which controls for differences in the number of days worked across individuals and provides a useful guide to how efficiently the transport network enables residents to travel to their jobs.
- The most common commuting trip duration in the HILDA 2012 data was 30 minutes (representing 15.5 per cent of non-zero responses from employed individuals). Other common responses were 1 hour (8.8 per cent), 15 minutes (7.7 per cent) and 6 minutes (5.4 per cent).
- Nationally, the HILDA median commuting trip duration is 24.0 minutes for 2012, while the average is 28.9 minutes. For 27.1 per cent of commuters the commuting trip duration was 10 minutes or less, while it was over an hour for 7.0 per cent of commuters and over 2 hours for 0.5 per cent of commuters.
- The distribution of the duration measure differs widely for those who live in Australia's five major capital cities and those who live in other locations, with 54 per cent of the other locations sample having a commuting trip duration of 15 minutes or less, compared to 33 per cent of the five major capitals sample.
- From 2002 to 2012, the HILDA distributional data shows a trend towards higher commuting trip durations. The more pronounced increases were at the top end of the distribution (i.e. for those undertaking lengthy commutes).
- Despite the differences between this study's three data sources in collection method, time period, geographic coverage and question wording, the distributions of the per trip duration measures are quite similar. When the HILDA measure is restricted to responses from residents of the five major capitals, the average commuting trip duration is 32.1 minutes. This is not that different from the *Household Travel Survey* 2008–13 average for Sydney GMA residents (31.6 minutes) and the Productivity Commission's *Community Survey 2011* peak hour average (33.4 minutes).
- BITRE has defined lengthy commutes as those with a commuting trip duration of 45 minutes or more. According to the literature, a threshold of 45 minutes approximately represents the point at which the length of the commute is no longer considered acceptable to most commuters. This threshold lies well above the national average commuting trip duration, and well above the Sydney and Melbourne averages. It captures 22.4 per cent of the national HILDA in-scope population, and delivers a sufficiently large sample to support analysis of lengthy commutes based on each of the study's three data sources.

Background

This chapter explores how the duration of commuting trips varies across different individuals, by examining the measure's statistical distribution. The analysis primarily relies on the *Household Income and Labour Dynamics in Australia* (HILDA) survey wave 12 data (for 2012) which provides the best guide to the current national distribution of commuting trip duration. Comparisons are also made to the Sydney *Household Travel Survey* (HTS) and the Productivity Commission (PC) *Community Survey* distributions of commuting trip duration.

This information on the overall distribution of commuting trip durations will be used to establish a definition of what constitutes a 'lengthy commute', which will then be applied throughout the remainder of this study.

HILDA distribution of weekly time spent commuting

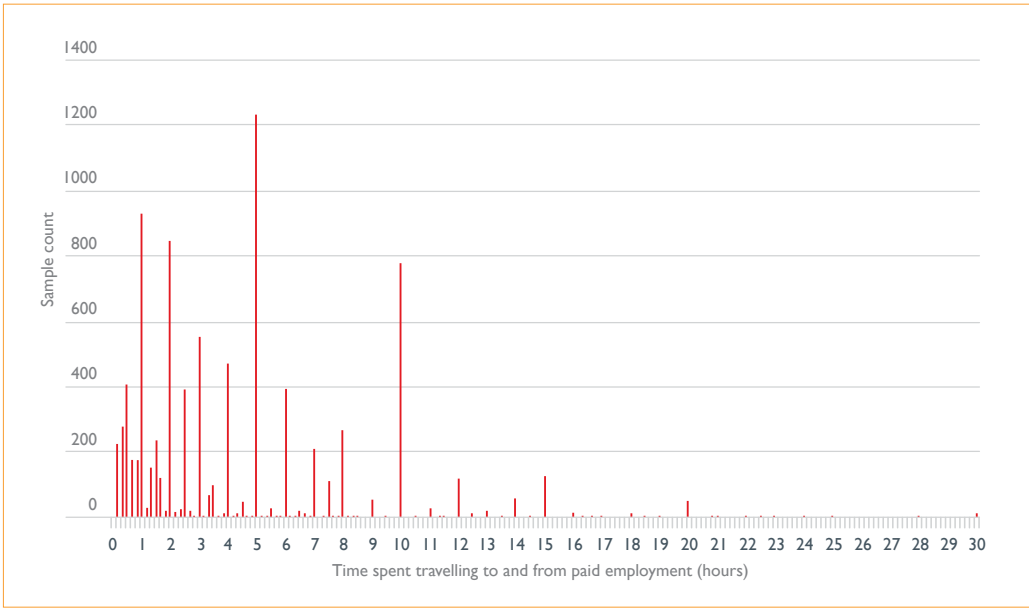
Before considering the distribution of commuting trip duration, it is worth considering the distribution of the HILDA data in its original (unadjusted) form. As made clear in Figure 2.1, the HILDA self-completion questionnaire (SCQ) collects information on the time spent travelling to and from a place of paid employment in a typical week.

The analysis in this section is based on the 8934 plausible[15] non-zero responses to the HILDA weekly commuting time question in 2012. The 5627 zero responses for time spent commuting were excluded from further analysis, on the basis that they did not involve a commute. The great majority (91 per cent) of the zero responses were from people who were not in paid employment, while a large proportion of the remaining zero responses appeared to relate to employed persons who worked from home.

Figure 3.1 illustrates the distribution of responses to the weekly time spent commuting question. The most common response was 5 hours, which corresponds to a one-way commuting time of 30 minutes for a person who works five days a week (and undertakes 10 commuting trips). A total of 1234 persons reported spending five hours travelling to and from a place of paid employment in a typical week, representing 13.8 per cent of non-zero responses. Other common responses were 1 hour (representing 10.4 per cent of non-zero responses), 2 hours (9.4 per cent) and 10 hours (8.7 per cent). There were a small number of more extreme responses, with a maximum reported weekly commuting time of 30 hours, which corresponds to a 3 hour commute undertaken twice a day, five days a week.

15 The HILDA survey team categorised 110 responses to the commuting time question as 'implausible value', and the original responses are not available in the HILDA unit record file.

Figure 3.1 HILDA distribution of weekly time spent commuting, Australia, 2012



Note: Zero responses are excluded.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 3.1 presents some summary statistics for the national distribution of this HILDA measure, with data presented on both a weighted basis and an unweighted basis (so as to be representative of the national in-scope population). The weighted and unweighted distributions are quite similar. While the most frequent response is 5 hours, the median response (corresponding to the 50th percentile or midpoint of the distribution) is 3 hours.

The average time spent commuting in a typical week is 4 hours 20 minutes on a weighted basis and 4 hours 26 minutes on an unweighted basis. If the practice adopted in Flood and Barbato (2005) of excluding weekly commuting times of more than 15 hours per week is followed, the 2012 HILDA weighted average drops to 4 hours 12 minutes. This remains well above the 2002 HILDA average of 3 hours 37 minutes originally reported by Flood and Barbato (2005)[16]—and replicated by BITRE—suggesting there has been an increase of around 16 per cent in weekly commuting times over the period.

The weighted HILDA wave 12 data reveals that 24 per cent of Australian commuters spent one hour or less travelling to and from their place(s) of paid employment in a typical week. At the other end of the distribution, 28 per cent spent more than five hours commuting in a typical week, 16 per cent spent more than 8 hours, and 6 per cent spent more than 10 hours.

16 Wilkins, Warren and Hahn (2009) report a broadly similar HILDA average of 3.5 hours (i.e. approximately 3 hours 30 minutes) weekly time spent commuting in 2002, rising to 3.7 hours (i.e. approximately 3 hours 42 minute) in 2006. The authors do not specify any exclusion or topcoding of outlying values.

Table 3.1 Summary statistics for HILDA distribution of weekly time spent commuting, Australia, 2012

Statistical measure	Unweighted data	Weighted data
Average	4 hours 20 minutes	4 hours 26 minutes
Minimum	1 minute	1 minute
5th percentile	20 minutes	20 minutes
10th percentile	30 minutes	30 minutes
25th percentile	1 hour 15 minutes	1 hour 20 minutes
50th percentile (median)	3 hours	3 hours
75th percentile	6 hours	5 hours 50 minutes
90th percentile	10 hours	10 hours
95th percentile	12 hours	12 hours
Maximum	30 hours	30 hours

Note: Zero responses are excluded.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Some of the key factors influencing the amount of time spent commuting per week are the individual's labour force status and days of work. Those employed full-time (i.e. those who work 35 or more hours per week) have a median time spent commuting of 5 hours per week and an average of 5 hours 12 minutes. Those employed part-time have a median time spent commuting of just 2 hours and an average of 2 hours 52 minutes. Some of the potential consequences of commuting (as explored in Chapter 8) will be linked to the total amount of time an individual spends commuting. However, in this study, we are primarily interested in a per trip measure of duration, which controls for differences in the number of days worked across individuals, and provides a much more useful guide to how efficiently the transport network is enabling residents to travel to their jobs. The remainder of this chapter considers the distribution across individuals of commuting time measures that are expressed on a per trip basis, based on data from HILDA, the HTS and the PC *Community Survey*.

HILDA distribution of commuting trip duration

Deriving commuting trip duration estimates

The HILDA person questionnaire (PQ) identifies the labour force status of all respondents, including whether each person is employed on a full-time or part-time basis. Labour force status is defined based on ABS labour statistics concepts, standards and methods. While there were 8934 plausible non-zero responses to the HILDA weekly commuting time question in 2012, only 8756 of these responses related to employed individuals. All remaining analysis of HILDA commuting durations is based only on responses from individuals classified as employed.

For each employed individual, the commuting trip duration estimate is derived by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week. The PQ contains several questions which enable the number of commuting trips to be estimated for responding individuals. Figure 3.2 shows that the PQ collects information on whether the person holds one or more jobs and the days of the week the person usually works in their main job. For individuals whose work days vary, information is collected on the number of days usually worked within a 28 day period. Additional information on work schedules and shift arrangements is also gathered.

The standard practice adopted was to estimate the number of (one-way) commuting trips an individual undertakes in a typical week as twice the number of days usually worked per week (i.e. a commuting trip from home to work, and a return trip from work to home).

About 92 per cent of employed persons with a non-zero weekly commuting time reported that they only had one job. For individuals with only one job, the information collected in questions c9a and c9b can be directly used to derive the number of days usually worked per week. For example, individuals who responded:

- "Monday to Friday" were assigned 5 days of work per week
- "Nine day fortnight" were assigned 4.5 days of work per week[17]
- "Days vary from week to week" and "Days vary from month to month" were assigned a value calculated as the response to question c9b (how many days do you usually work in a four week period) divided by four
- "Other" was assigned a value calculated as the sum of the number of specified days of work in a usual week.

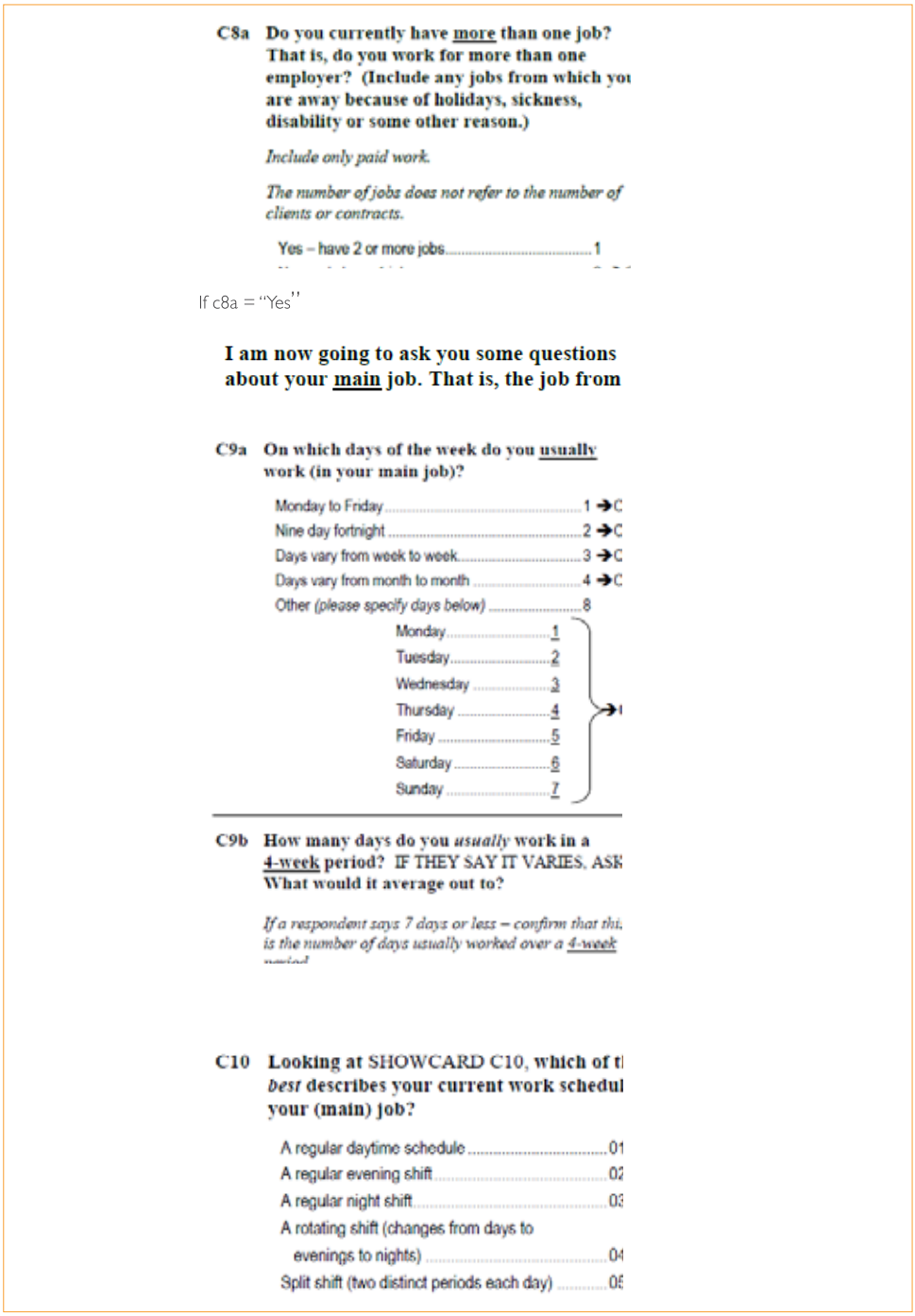
Information on the number of days usually worked per week in the main job was provided by 99.8 per cent of employed respondents with a non-zero weekly commuting time. The most common response was "Monday to Friday", chosen by just over half of all respondents. These respondents were assigned 5 days of work and 10 commuting trips in a typical week. All employed respondents were assigned at least 1 day of work and 2 commuting trips in a typical week.

For individuals who did not respond to these questions, or provided internally inconsistent information on their hours and days of work[18], the number of days usually worked per week (and the number of commuting trips) was imputed. The imputed values were 5 days per week for full-time employed persons and 3 days per week for part-time employed persons. These imputed values were chosen as they represented the most typical number of days worked in each category.

17 It is most likely that one week would involve 4 days of work and the next would involve 5 days of work. The average of 4.5 was used to avoid any bias being introduced, given that the weekly time spent commuting question is framed in terms of "a typical week".

18 For example, there were a few full-time employed individuals (i.e. persons working 35 or more hours per week), who reported that they worked only one day on average per week. The reported days of work was not used for these respondents.

Figure 3.2 Extracts from HILDA person questionnaire that are relevant to estimating a respondent's number of commuting trips



C8a Do you currently have more than one job? That is, do you work for more than one employer? (Include any jobs from which you are away because of holidays, sickness, disability or some other reason.)

Include only paid work.

The number of jobs does not refer to the number of clients or contracts.

Yes – have 2 or more jobs 1

If c8a = "Yes"

I am now going to ask you some questions about your main job. That is, the job from

C9a On which days of the week do you usually work (in your main job)?

Monday to Friday ..... 1 →C
Nine day fortnight ..... 2 →C
Days vary from week to week ..... 3 →C
Days vary from month to month ..... 4 →C
Other *(please specify days below)* 8

Monday 1
Tuesday 2
Wednesday 3
Thursday ..... 4 →
Friday 5
Saturday 6
Sunday 7

C9b How many days do you *usually* work in a 4-week period? IF THEY SAY IT VARIES, ASK What would it average out to?

If a respondent says 7 days or less – confirm that this is the number of days usually worked over a 4-week period

C10 Looking at SHOWCARD C10, which of t *best* describes your current work schedul your (main) job?

A regular daytime schedule 01
A regular evening shift 02
A regular night shift 03
A rotating shift (changes from days to evenings to nights) 04
Split shift (two distinct periods each day) 05

Note: Some intervening questions are omitted to keep the presentation concise.

Source: Extract from HILDA survey wave 12 continuing person questionnaire, available from <www.melbourneinstitute.com/hilda/doc/questionnaires/q12.html>.

For individuals who hold more than one job, the total number of days worked across all jobs may be significantly higher than the number of days worked in the main job (as reported in Questions C9a and C9b). Unfortunately, HILDA does not collect information on the days worked in jobs other than the main job. However, the responses to questions c9a and c9b do provide a lower bound estimate of the total number of days worked per week for these individuals. Full-time employed persons with multiple jobs who reported working more than 5 days a week in their main job were assigned this lower bound estimate (as it was considered more accurate for this individual than an imputation of 5 days), as were part-time employed persons with multiple jobs who worked more than 3 days a week in their main job. Other multiple job holders were assigned the imputed values for full-time and part-time employed persons (i.e. 5 and 3 days, respectively), due to the absence of solid information on their total days usually worked per week.

Overall, the number of days usually worked per week was imputed for 6.5 per cent of the sample of employed persons with a non-zero weekly commuting time. Nearly all of the imputations related to multiple job holders, and imputation was more common for the part-time employed than it was for the full-time employed.

While the standard practice was to estimate the number of commuting trips as double the number of days usually worked per week, an exception was made for individuals who reported working a split shift, involving two distinct periods of work each day (in question c10). For this subset of 91 respondents, it was assumed that the respondent returned home in-between their two work shifts, and the number of commuting trips was calculated as four times the number of days usually worked per week.

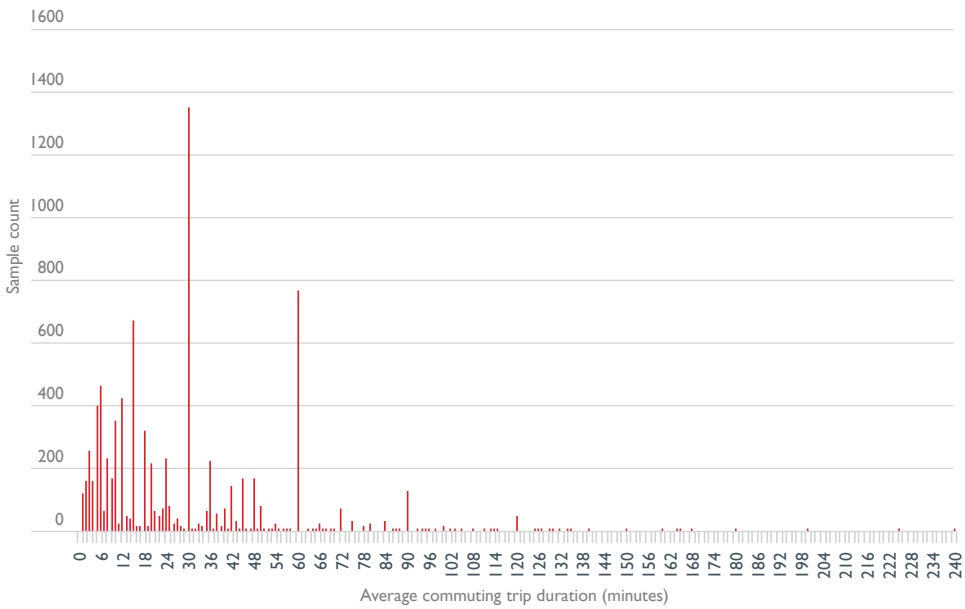
Dividing the weekly commuting time responses by the estimated number of commuting trips resulted in a small number of outlying values.[19] Average commuting trip duration values of more than 4 hours (i.e. 240 minutes) were top-coded to 240 minutes to avoid these observations having undue influence on tabulations for particular sub-populations. The top-coding had minimal effect on the population-wide estimate of average commuting trip duration (reducing it by only 0.03 minutes).

Wave 12 results

Figure 3.3 illustrates the distribution of BITRE's HILDA-based estimates of average commuting trip duration for employed individuals. The most common result was an average commuting trip duration of 30 minutes, which was applicable to 1356 respondents, representing 15.5 per cent of non-zero responses from employed individuals. Other common responses were 1 hour (representing 8.8 per cent of non-zero responses from employed individuals), 15 minutes (7.7 per cent) and 6 minutes (5.4 per cent).

19 There were 5 individuals with a commuting trip duration estimate of more than 4 hours in wave 12. These were typically individuals employed on a part-time basis whose responses to the commuting time and days of work questions appeared at face value to be inconsistent.

Figure 3.3 HILDA distribution of average commuting trip duration, Australia, 2012



Note: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week. The number of commuting trips in a typical week is estimated based on reported work schedules and days of work. Zero commuting time responses are excluded. Commuting trip duration estimates of more than 240 minutes were top-coded to 240 minutes.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 3.2 presents some summary statistics for the national distribution of this HILDA measure, with data presented on both an unweighted basis and a weighted basis (so as to be representative of the national in-scope population). While the most frequent response is 30 minutes, the median response (corresponding to the 50th percentile or midpoint of the distribution) is 22.5 minutes on an unweighted basis and 24.0 minutes on a weighted basis. The average is 28.2 minutes on an unweighted basis and 28.9 minutes on a weighted basis. The process of weighting the sample so it is representative of the national in-scope population gives a little more weight to the longer commutes and has the effect of boosting up the average and median duration estimates.

The weighted HILDA wave 12 data reveals that 27.1 per cent of Australian commuters had an average commuting trip duration of 10 minutes or less. At the other end of the distribution, 7.0 per cent had an average commuting trip duration of more than 1 hour and 0.5 per cent had an average commuting trip duration of more than 2 hours.

Table 3.2 Summary statistics for HILDA distribution of average commuting trip duration, Australia, 2012

Statistical measure	Unweighted data	Weighted data
Average	28.2	28.9
Minimum	0.1	0.1
5th percentile	3.0	3.0
10th percentile	5.0	5.0
25th percentile	10.0	10.0
50th percentile (median)	22.5	24.0
75th percentile	37.5	40.0
90th percentile	60.0	60.0
95th percentile	72.0	75.0
Maximum	240.0*	240.0*

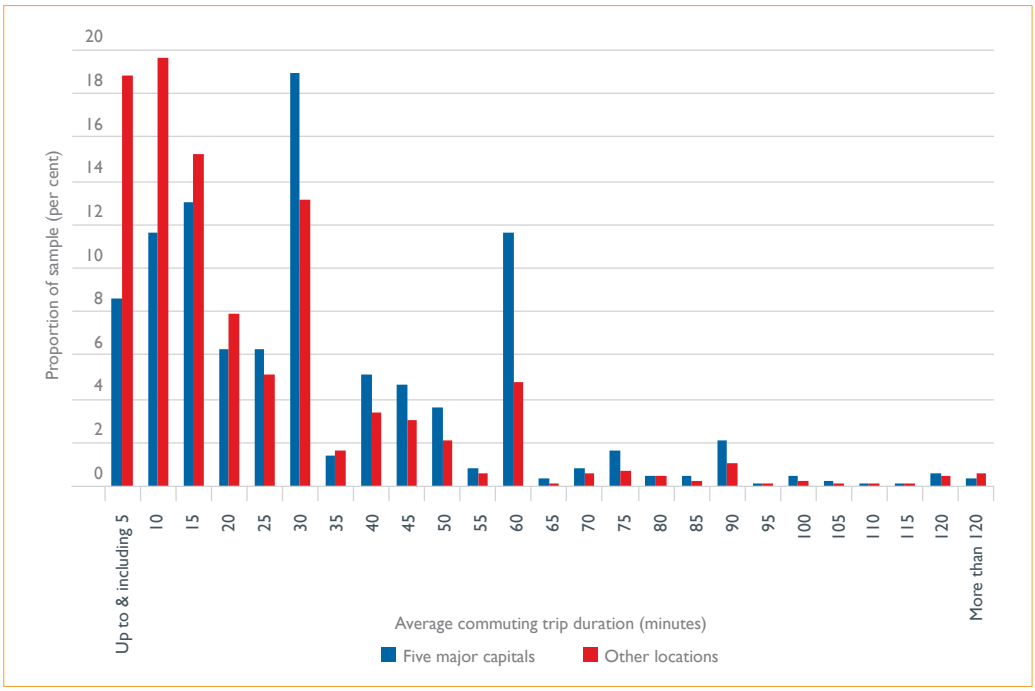
Note: Average commuting trip duration is expressed in minutes and is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week. The number of commuting trips in a typical week is estimated based on reported work schedules and days of work. Zero commuting time responses are excluded.

* Commuting trip duration estimates of more than 240 minutes were top-coded to 240 minutes.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Figure 3.3 and Table 3.2 summarise the overall national distribution of this HILDA-based duration measure, but particular population sub-groups will have differing distributions. Place of residence is a particularly significant influence on the distribution, as can be seen from Figure 3.4. The chart shows that the distribution of the duration measure for those who live in the five major capital cities (i.e. Sydney, Melbourne, Brisbane, Perth and Adelaide Statistical Divisions) is vastly different to its distribution for those who live in other parts of Australia. For residents of these 'other locations', the distribution is heavily skewed towards lower commuting trip durations, of 15 minutes or less. Fifty four per cent of the 'other locations' sample has an average commuting trip duration of 15 minutes or less, compared to 33 per cent of the five major capitals sample.

Figure 3.4 HILDA distribution of average commuting trip duration by place of residence, Australia, 2012



Note: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week. The number of commuting trips in a typical week is estimated based on reported work schedules and days of work. Zero commuting time responses are excluded. Commuting trip duration estimates of more than 240 minutes were top-coded to 240 minutes. Data is unweighted.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 3.3 presents some summary statistics comparing the weighted distribution of the commuting trip duration measure for residents of the five major capitals and residents of other locations. The median is 30 minutes in the five major capitals, compared to 15 minutes in other locations. The average is 32.1 minutes in the five major capitals, compared to 23.1 minutes in other locations. The non-overlapping 95 per cent confidence intervals (and significance testing) show that the difference in the average commuting trip duration between the five major capitals and other locations is statistically significant.

Of the three data sources in this project, HILDA is the only one with national geographic coverage. The PC survey is restricted to a selected range of cities (including all eight capital cities), while the HTS is restricted to the Greater Sydney Metropolitan Area. Given the important influence place of residence has on average commuting trip duration, it is expected that the average durations from the PC survey and the HTS will more closely resemble the HILDA results for the five major capitals in Table 3.3 than the national HILDA results in Table 3.2.

Table 3.3 Summary statistics for HILDA distribution of average commuting trip duration by place of residence, Australia, 2012

Statistical measure	Five major capitals	Other locations
Average	32.1	23.1
Relative standard error (per cent)^	1.5	2.5
95 per cent confidence interval^	31.1–33.1	21.9–24.2
5th percentile	3.6	2.0
10th percentile	6.0	3.3
25th percentile	12.0	6.0
50th percentile (median)	30.0	15.0
75th percentile	45.0	30.0
90th percentile	60.0	51.4
95th percentile	84.0	60.0

Note: Average commuting trip duration is expressed in minutes and is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week. The number of commuting trips in a typical week is estimated based on reported work schedules and days of work. Zero commuting time responses are excluded. Data in table is weighted so as to be representative of total in-scope population. Commuting trip duration estimates of more than 240 minutes were top-coded to 240 minutes.

^ Derived using Taylor Series linearisation method, implemented in SAS. This method is one of several recommended in Hayes (2008) to produce standard errors that take the complex HILDA sample design into account by adjusting for the effect of clustering and stratification.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The distribution of the HILDA duration measure also differs between males and females, and between the full-time employed and the part-time employed. These drivers of commuting trip duration are explored in some depth in Chapter 6.

Changes in the distribution over time

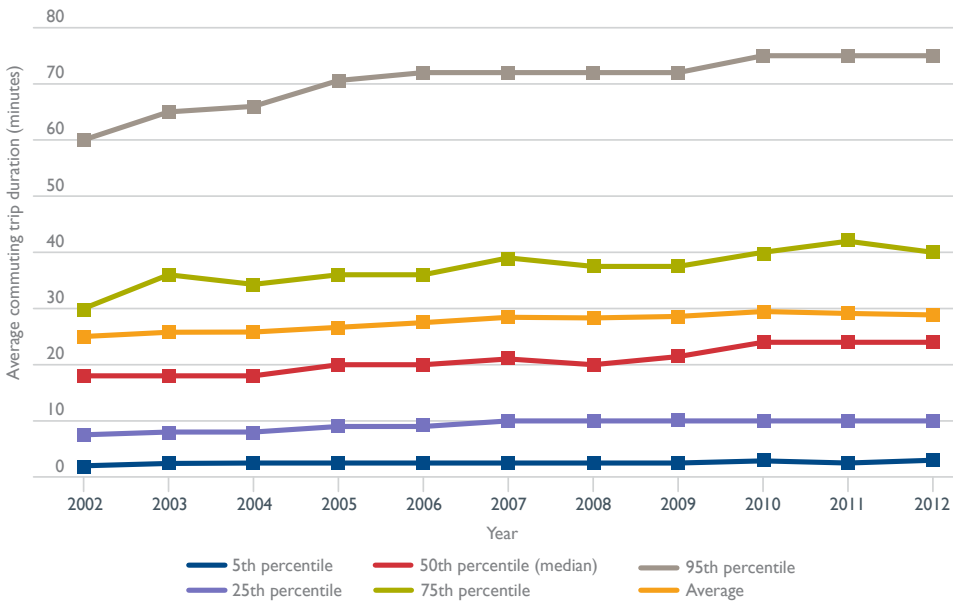
Figure 3.5 presents selected summary statistics for the national HILDA distribution of average commuting trip duration for each year between 2002 (wave 2) and 2012 (wave 12).[20]

Over this 11 year period there has been a general upward drift in most of the distribution's summary statistics, reflecting a trend towards higher commuting trip durations. The most pronounced increase occurred at the top end of the distribution, with the 95th percentile of the 2002 distribution standing at 60 minutes, compared to 75 minutes in 2012. The 75th percentile of the distribution also increased notably, from 30 minutes in 2002, to 40 minutes in 2012. At the lower end of the distribution, the 25th percentile rose from 7.5 minutes in 2002 to 10 minutes in 2007, and then stayed steady at 10 minutes through to 2012. The national average measure of commuting trip

20 Note that the HILDA sample of employed persons with non-zero commuting time was between 6400 and 7000 from 2002 to 2010, but then rose significantly to 8851 in 2011 and 8756 in 2012 (due to the top-up sample).

duration displays a similar pattern, rising steadily from 25.0 minutes in 2002 to 28.4 minutes in 2007, but then remaining reasonably stable from 2007 to 2012[21].

Figure 3.5 Summary statistics for HILDA distribution of average commuting trip duration, Australia, 2002 to 2012



Note: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week. The number of commuting trips in a typical week is estimated based on reported work schedules and days of work. Zero commuting time responses are excluded. Commuting trip duration estimates of more than 240 minutes were top-coded to 240 minutes. Data in table is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

This distributional analysis suggests that the moderate increase observed in average commuting trip durations over the last decade may be obscuring more pronounced changes for people undertaking relatively lengthy commutes. Chapter 4 will explore recent trends in the prevalence of lengthy commutes in greater detail.

21 The net increase between 2007 and 2012 was 0.4 minutes, and this was not a statistically significant difference (at the 95 per cent confidence level). The 2002 and 2007 average commuting trip durations were significantly different from one another, as were the 2002 and 2012 durations (at the 95 per cent confidence level).

HTS distribution of commuting trip duration

The *Household Travel Survey* (HTS) provides an alternative source of information on the distribution of commuting trip duration. The key distinction is that the HTS distribution relates solely to residents of the Sydney Greater Metropolitan Area (GMA), while HILDA provides a national distribution. Another important difference is that the HTS collects trip arrival and departure times for all trips undertaken on a designated travel day, while the HILDA measure is reliant on a weekly average reported commuting time. In total, the HTS pooled dataset contains information on 17 700 linked commuting trips undertaken by GMA residents between July 2008 and June 2013.

Due to the purpose-designed nature of the HTS and the collection of the commuting time data through face-to-face interviews, rather than a self-completion questionnaire, BITRE had greater confidence in the quality of HTS responses than HILDA responses. Commuting trip durations of more than four hours (240 minutes) have nevertheless been top-coded to 240 minutes to ensure a consistent approach across data sources, and avoid these observations having undue influence on results for particular sub-populations.[22]

Figure 3.6 illustrates the distribution of HTS commuting trip durations. As was the case for the HILDA survey, the most common commuting trip duration was 30 minutes. There were 1901 linked commuting trips with a duration of 30 minutes, representing 10.7 per cent of all linked commuting trips. Other common responses were 15 minutes (representing 10.4 per cent of linked commuting trips), 10 minutes (9.3 per cent), 20 minutes (8.5 per cent) and 5 minutes (7.4 per cent).

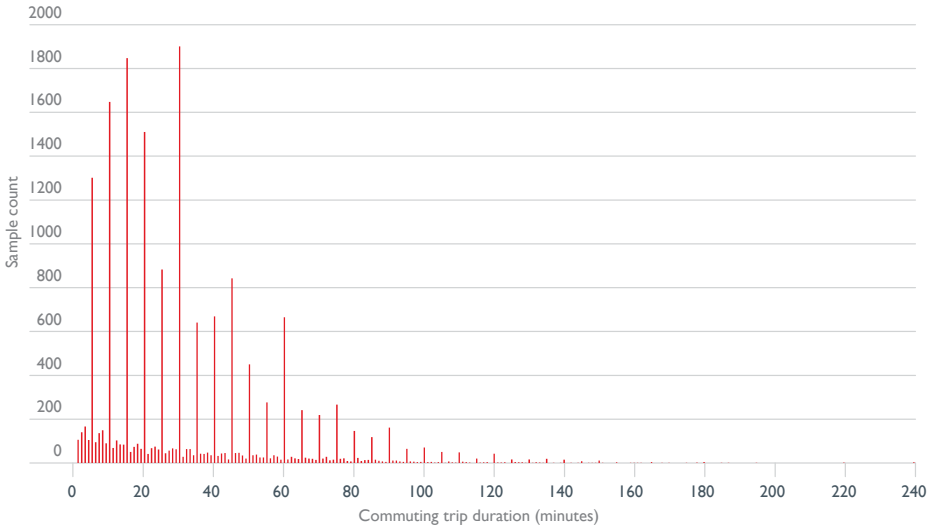
Table 3.4 presents some summary statistics for the distribution of this HTS measure, with data presented on both an unweighted basis and a weighted basis, and separately for the Sydney Greater Capital City Statistical Area (GCCSA) and the Sydney GMA as a whole.[23] The weighted average commuting trip duration is 33.3 minutes for the Sydney GCCSA and 31.6 minutes for the Sydney GMA. The median response (corresponding to the 50th percentile or midpoint of the distribution) is 30 minutes in the Sydney GCCSA and 25 minutes for the Sydney GMA as a whole. The 90th and 95th percentiles of the distribution are also both a little higher for the GCCSA than they are for the GMA as a whole.

The weighted HTS data reveals that 22.7 per cent of Sydney GMA commuters had a commuting trip duration of 10 minutes or less. At the other end of the distribution, 11.4 per cent had a commuting trip duration of more than 1 hour and 0.8 per cent had a commuting trip duration of more than 2 hours.

22 The dataset contains 2 commuting trips with a duration of more than 4 hours. Both have a duration of between 6 and 8 hours. Top-coding had minimal effect on the Sydney GMA average (reducing it by less than 0.03 minutes).

23 The GMA includes the Sydney Greater Capital City Statistical Area (GCCSA) and the Illawarra and Lower Hunter regions, and extends from Port Stephens in the North to Shoalhaven in the South and the Blue Mountains in the West (BSA 2014a).

Figure 3.6 HTS distribution of commuting trip duration, Sydney GMA, 2008–13 pooled dataset



Notes: Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. The departure time from the previous activity and the arrival time for the current activity are used to derive trip duration. The specified trip purposes are used to identify commuting trips. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is unweighted.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Table 3.4 Summary statistics for HTS distribution of commuting trip duration, Sydney GCCSA and GMA, 2008–13 pooled dataset

Statistical measure	Sydney GCCSA		Sydney GMA	
	Unweighted data	Weighted data	Unweighted data	Weighted data
Average	33.6	33.3	32.1	31.6
Minimum	1	1	1	1
5th percentile	5	5	5	5
10th percentile	7	6	5	5
25th percentile	15	15	15	15
50th percentile (median)	30	30	25	25
75th percentile	45	45	45	45
90th percentile	70	70	65	65
95th percentile	85	85	83	80
Maximum	240*	240*	240*	240*

Notes: Average commuting trip duration based on linked commuting trips and expressed in minutes. A linked trip is a journey from one activity to another, ignoring changes in mode. The departure time from the previous activity and the arrival time for the current activity are used to derive trip duration. The specified trip purposes are used to identify commuting trips.

* Commuting trip durations of more than 240 minutes were top-coded to 240 minutes.

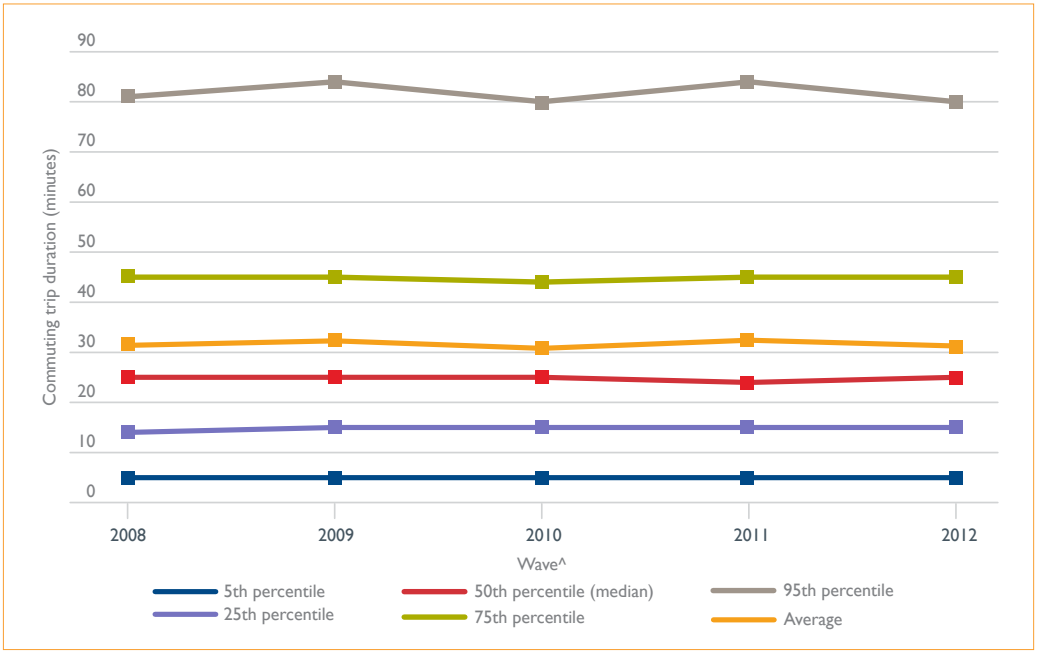
Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

The HTS distribution summary statistics are broadly similar to the HILDA summary statistics for the five major capitals, which were shown in Table 3.3.

Changes in the distribution over time

Five separate waves of HTS data are available, so it is worth investigating whether there have been any significant shifts in the HTS distribution over this period. Figure 3.7 presents selected summary statistics for the HTS distribution of commuting trip duration for each of the five waves. The chart displays minor fluctuations, but no clear trends are evident for the average, median or other summary measures over this five year period.

Figure 3.7 Summary statistics for HTS distribution of commuting trip duration by wave, Sydney GMA, 2008–13



Notes: Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. The departure time from the previous activity and the arrival time for the current activity are used to derive trip duration. The specified trip purposes are used to identify commuting trips. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is weighted so as to be representative of total in-scope population.

^ Waves relate to financial years—the 2008 wave refers to the financial year commencing July 2008.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

PC *Community Survey*—distribution of commuting trip duration

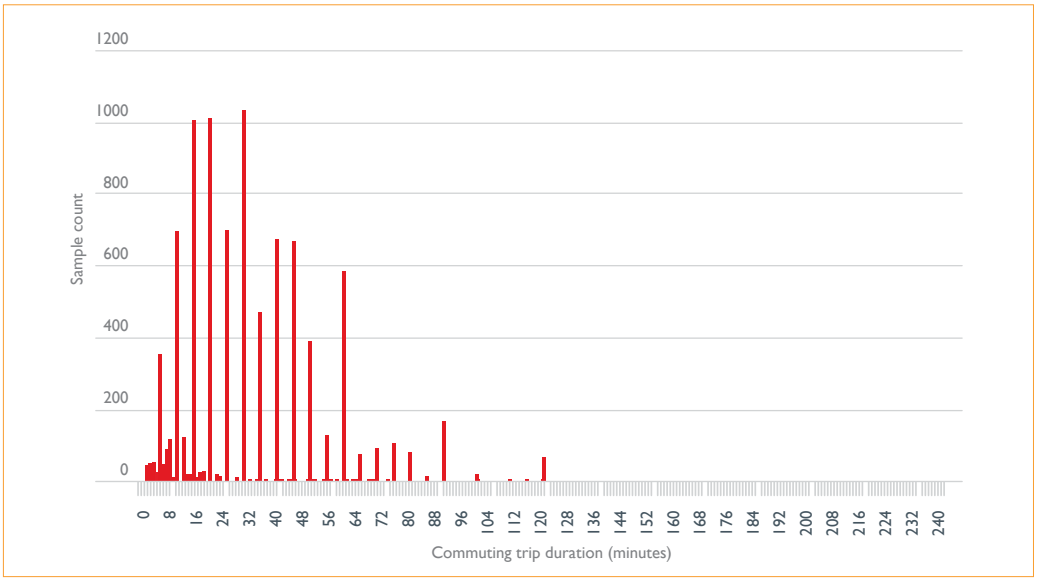
The PC *Community Survey* collected data from registered participants in 24 Australian cities, but excluded regional/rural areas. There were 15 954 responses to the 2011 survey. Of these responses, 11 319 related to employed individuals (both full-time and part-time employed) and the rest were not in paid employment.

The PC *Community Survey* captures journey to work travel time at 'peak hour' in getting to work from home, door to door using your normal route. This is the time for the journey in one direction only, the 'to work' journey, not the 'journey from work to home after work'. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym.

Based on this question, 9219 respondents specified their travel time (81.4 per cent), while 380 people responded 'don't know', 1116 people responded that they were not travelling to work in peak times, and 605 did not respond at all (left blank). The following analysis of the distribution of commuting trip duration is based only on responses from individuals classified as employed (full time or part time) who specified a travel time in the survey.

Figure 3.8 illustrates the distribution of responses to the PC *Community Survey* question on peak-hour commuting trip duration for employed individuals travelling to work. The most frequent response was a duration of 30 minutes, nominated by 1034 respondents, representing 11.2 per cent of all responses where travel time was specified. However, 20 minutes (1014 respondents or 11.0 per cent) and 15 minutes (1006 respondents or 10.9 per cent) were also very common responses.

Figure 3.8 Productivity Commission *Community Survey* distribution of peak hour commuting trip duration, selected cities, 2011



Notes: The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. The survey covers 24 Australian metropolitan areas and regional cities. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is unweighted.

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments,* Research Report, Canberra.

There were 5 respondents reporting a one-way commuting trip duration of more than 4 hours. Commuting trip durations of more than four hours (240 minutes) have been top-coded to 240 minutes to ensure a consistent approach across data sources, and avoid these observations having undue influence on results for particular sub-populations. The top-coding had a relatively minor impact on the sample-wide average duration measure, reducing it by 0.07 minutes.

Table 3.5 presents some summary statistics for the distribution of this PC *Community Survey* measure on both a weighted and unweighted basis. The most frequent response was 30 minutes, and the median response (corresponding to the 50th percentile or midpoint of the distribution) was also 30 minutes. While 16.3 per cent of the sample had a peak hour commuting trip duration of 10 minutes or less, at the other end of the distribution, 7.4 per cent had a duration of more than 1 hour and 0.3 per cent had a duration of more than 2 hours.

The PC *Community Survey* average commuting trip durations in 2011 are 32.3 minutes (unweighted) and 33.4 minutes (weighted). These are considerably higher than the HILDA national average duration of 28.9 minutes for 2012. This reflects the PC survey being restricted to cities, and excluding rural and regional locations, which tend to have shorter commuting trip durations. The PC survey is also restricted to peak-hour commuting trips, which are likely to be of generally longer duration than off-peak commuting trips. However, the PC survey result is nevertheless of a broadly similar magnitude to the HILDA average duration for the five major

capitals (32.1 minutes in 2012, weighted) and to the HTS average for the Sydney GMA (31.6 minutes for 2008–13, weighted).

Table 3.5 Summary statistics for Productivity Commission *Community Survey* distribution of peak-hour commuting trip duration, selected cities, 2011

Statistical measure	Average commuting trip duration - Unweighted	Average commuting trip duration - Weighted
Average	32.3	33.4
Minimum	0.05	0.05
5th percentile	5	5
10th percentile	10	10
25th percentile	15	15
50th percentile (median)	30	30
75th percentile	45	45
90th percentile	60	60
95th percentile	75	75
Maximum	240 [a]	240 [a]

[a] Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Prior to top-coding the maximum value was 525 minutes (8 hours 45 minutes).

Notes: The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. The survey covers 24 Australian metropolitan areas and regional cities.

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments*, Research Report, Canberra.

Comparing the distributions for the three data sources

Table 3.6 brings together the results from the previously presented tables in order to compare the summary statistics for the commuting trip duration measure from HILDA, the HTS and the PC *Community Survey*. The most geographically comprehensive measure is presented from each survey, and the HILDA five major capitals data has also been included to facilitate comparisons.

The numerous differences between the commuting trip duration measures from these three data sources were previously highlighted in Tables 2.2 and 2.3. Despite the widespread differences in collection method, time period, geographic coverage and question wording, the distributions are not that different from one another. If the HILDA measure is restricted to responses from residents of the five major capitals, its distribution more closely resembles the city-based HTS and PC *Community Survey* distributions.

Table 3.6 Summary statistics for distribution of commuting trip duration measure derived from the three different data sources

Survey	Commuting trip duration (minutes)			
	HILDA, Australia, 2012	HILDA, Five major capitals, 2012	HTS, Sydney GMA, 2008–2013	PC Community Survey, selected cities, 2011
Average	28.9	32.1	31.6	33.4
5th percentile	3	4	5	5
10th percentile	5	6	5	10
25th percentile	10	12	15	15
50th percentile (median)	24	30	25	30
75th percentile	40	45	45	45
90th percentile	60	60	65	60
95th percentile	75	84	80	75

Notes: All measures are weighted. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes.

Sources: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period; unit record data from PC *Community Survey* 2011, which was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011); and HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Identifying a threshold for lengthy commutes

This report is particularly focused on individuals who undertake lengthy commutes. In this study, lengthy commutes are defined based on trip duration, not based on trip distances.

BITRE has chosen to define lengthy commutes based on a single threshold level of commuting trip duration, which will be applied across all data sources and time periods. In selecting a threshold, the aim is to capture a sizeable subset of the workforce with commuting times that are significantly above-average, and for which the sample is sufficiently large to support detailed analysis of worker and trip characteristics (including longitudinal analysis).

Clearly, a lengthy commute should significantly exceed the national average commuting trip duration, which HILDA shows was 28.9 minutes in 2012, with a 95 per cent confidence interval of 28.1–29.7 minutes. This leaves many different options (e.g. more than 30 minutes, more than 60 minutes) for selecting a threshold to identify those individuals undertaking lengthy commutes. BITRE has only considered thresholds of 40 minutes or higher, in order to ensure the definition did not capture the average Sydney or Melbourne worker.[24]

At the United States Census Bureau, 'extreme commuting' has been defined as workers who travel 90 minutes or more to work, one way (Rapino and Fields, 2013). This definition captures

24 The HILDA wave 12 average for Sydney was 35.4 minutes, with a 95 per cent confidence interval of 33.6 to 37.2, while the Melbourne average was 33.3 minutes, with a 95 per cent confidence interval of 31.6 to 35.0. The HTS average for the Sydney GCCSA was 33.3 minutes based on the 5-year pooled dataset. The averages from the PC *Community Survey* are higher at 39.2 minutes for Sydney and 35.2 minutes for Melbourne, reflecting the narrower focus on only peak hour commuting trips to work.

only a very small fraction of the full-time employed workforce of the United States—2.4 per cent. Applying this threshold in Australia would capture just 3.6 per cent of the HILDA in-scope population, and just 289 respondents. This focus on an extreme minority was not compatible with the aims of the present BITRE study and was not pursued.

A threshold commuting trip duration of 60 minutes or more has been used in some previous studies (e.g. Vaddepalli 2004). A particularly relevant example is VicHealth (2012), which identifies the proportion of employed and unemployed respondents undertaking long commutes as part of its set of indicators of community wellbeing, defining a long commute as one which involves an average commute of 60 minutes or more one way to work (or mutual obligation activity). Overall, 11.6 per cent of Victorian respondents were categorised as having long commutes in 2011 (ibid).

Other studies have adopted lower thresholds. For example, using the British Household Panel Survey (BHPS), Dargay and Hanly (2003) categorised commutes to work of 30 minutes or more as having "a long travel time", which captured 21 per cent of individuals in the 2000 BHPS. A Californian study by Wachs et al. (1993) defined those with "long commute times" as having a usual travel time between work and home of 36 minutes or more. The study also concluded that:

> 'Though most employees are generally satisfied with their commute distances, the point of indifference - the estimated travel time when responses shift from being satisfied to being dissatisfied - occurs at about 46 minutes' (Wachs et al. 1993, p. 1725).

A more recent Californian study by Milakis et al. (2015) found that the average acceptable commute time was 43 minutes, compared to an ideal commute time of 18 minutes. Turcotte (2011) reports that 16 per cent of those who commute 30 to 44 minutes to work are dissatisfied with their commuting time, compared to 45 per cent of those who commute 45 minutes or more to work—this implies that the *point of indifference* lies a little above 45 minutes in Canada. In the context of northern Sweden, Sandow and Westin (2010) find that the longest acceptable commuting time is 40 to 45 minutes when travelling by car, bus or train, and that the inclination to accept a job declines rapidly when travel times exceed 45 minutes as daily commuting is no longer considered feasible or tolerable.

For the purposes of this study, BITRE has considered potential thresholds of '40 minutes or more', '45 minutes or more', '50 minutes or more', and '60 minutes or more'. Table 3.7 presents the proportion of each survey's in-scope population that is captured under each potential threshold, as well as the sample count.

For each data source, as the threshold rises, the sample size falls as does the proportion of the survey's in-scope population that is captured. A '40 minutes or more' threshold captures 25.3 per cent of the national population (according to HILDA), compared to 22.4 per cent for the '45 minutes or more' threshold, 18.2 per cent for the '50 minutes or more' threshold, and 16.0 per cent for the '60 minutes or more' threshold.

Table 3.7 Options for selecting a commuting trip duration threshold to define lengthy commutes

Threshold	Indicator	HILDA, Australia, 2012	HTS, Sydney GMA, 2008–2013	PC Community Survey, selected cities, 2011
40 minutes or more	Sample count	2117	5517	3162
	Share of in-scope population (per cent)	25.3	30.6	36.4[a]
45 minutes or more	Sample count	1851	4709	2477
	Share of in-scope population (per cent)	22.4	26.0	28.5[a]
50 minutes or more	Sample count	1495	3718	1799
	Share of in-scope population (per cent)	18.2	20.5	21.0[a]
60 minutes or more	Sample count	1347	2763	1271
	Share of in-scope population (per cent)	16.0	15.1	15.0[a]

Note: [a] This is the share of the PC weighted sample that exceeds the threshold.

Sources: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period; unit record data from PC *Community Survey* 2011, which was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011); and HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

With its definition of lengthy commutes, BITRE aims to capture a sizeable proportion of the workforce who have relatively lengthy commuting trip durations. BITRE has chosen to define lengthy commutes as those which involve commuting trip duration of 45 minutes or more. This choice involved making a tradeoff between:

- the sample size available for analysis under each threshold (giving particular weight to HILDA, as the only longitudinal data source),[25] and
- the degree of separation between what is considered a typical or average commuting trip duration and the lengthy commutes threshold.[26]

This threshold of 45 minutes lies well above the national average commuting trip duration, and well above the average commuting trip duration in major cities, such as Sydney and Melbourne. It captures 22.4 per cent of the national HILDA in-scope population, 26.0 per cent of the HTS Sydney GMA in-scope population, and 28.5 per cent of the PC *Community Survey* sample. A HILDA sample of 1851 records will support reasonably detailed analysis of the characteristics of those undertaking lengthy commutes (including longitudinal analysis). The HTS and PC *Community Survey* samples of 4709 and 2477 records, respectively, should also be sufficient for the intended analysis.

25 An issue with the alternate threshold of '60 minutes or more' (and to a lesser extent the '50 minutes or more' threshold) was that it involved a considerably smaller sample size for HILDA and the PC *Community Survey,* which could limit the quality and depth of analysis of lengthy commutes undertaken in this study.

26 An issue with the alternate threshold of '40 minutes or more' was its proximity to the average Sydney peak-hour commuting time of 39.2 minutes (according to the PC *Community Survey* 2011) and the average commuting time for all employed Sydney residents of between 33.6 and 37.2 minutes (according to HILDA 2012 data).

The literature also suggests that a threshold of 45 minutes approximately represents the point at which the length of the commute is no longer considered satisfactory or acceptable to most commuters (Wachs et al. 1993, Turcotte 2005, Sandow and Westin 2010, Milakis et al. 2015).

In the remainder of this study, individuals who undertake lengthy commutes of 45 minutes or more in duration (one-way) will be investigated in some detail, commencing with Chapter Four's examination of the prevalence of lengthy commutes within each data source and changes in the rate of prevalence over time.

CHAPTER 4

Lengthy commutes—prevalence and recent trends

Key points

- The HILDA 2012 survey identifies a total of 2.02 million employed Australians as having an average commuting trip duration of 45 minutes or more. This amounts to 22.4 per cent of Australian commuters having lengthy commutes.
- According to the HILDA survey, residents of the five major capitals have a relatively high prevalence of lengthy commutes (26.9 per cent), while other locations have a low prevalence (14.2 per cent).
- All three data sources show that lengthy commutes are more prevalent for males than females. For example, based on HILDA, the prevalence of lengthy commutes is 24.9 per cent for males and 19.5 per cent for females.
- The *Household Travel Survey* (HTS) shows that 28.8 per cent of commuting trips by Sydney residents are lengthy commutes, compared to just 11.1 per cent for residents of the rest of the Greater Metropolitan Area (GMA). Within Sydney, the prevalence of lengthy commutes is relatively low for Inner ring residents and higher for Middle and Outer ring residents.
- The HTS duration measures tend to vary more widely with respect to trip characteristics than with respect to key demographic and geographic variables. Trip characteristics such as time of day, day of week and place of work all have an important influence on the HTS duration measures.
- Based on the HTS, a very high proportion of public transport trips involve lengthy commutes (73.2 per cent), compared to 16.0 per cent of private vehicle commuting trips and 1.6 per cent of active transport commuting trips. The prevalence of lengthy commutes is very high for trips of 15 to 30 kilometres (43.9 per cent) and for trips of over 30 kilometres (80.6 per cent).
- The number of employed Australians undertaking lengthy commutes grew by 720 000 persons from 2002 to 2012. The national proportion of lengthy commutes rose from 17.4 per cent in 2002 to 22.1 per cent in 2007, but then levelled off between 2007 and 2012 (when it stood at 22.4 per cent).
- The pronounced growth in the HILDA duration measures between 2002 and 2007 (and the limited growth since then) can be partly explained by stronger employment growth from 2002 to 2007, saturation of Australia's road traffic per person as of 2006, the flow-on effects of the global financial crisis, and increased investment in transport infrastructure since 2007.

Context

In the previous chapter it was established that 22.4 per cent of the national commuter population—as measured by the HILDA survey in 2012—have an average (one-way) commuting trip duration of 45 minutes or more, and are therefore categorised as having lengthy commutes. This amounts to a total of 2.02 million employed Australians identified as having lengthy commutes. This chapter provides information on the prevalence of lengthy commutes in different subgroups of the Australian population, and then examines recent trends in the prevalence of lengthy commutes.

Prevalence of lengthy commutes

This section provides some introductory information on the prevalence of lengthy commutes in different geographic regions, and for key demographic groups and types of commutes. In this way, the section serves as a preview for the following chapters which explore these issues in greater depth:

- Chapter 5 examines the spatial distribution of lengthy commutes
- Chapter 6 examines the demographic and labour market characteristics of those who undertake lengthy commutes
- Chapter 7 investigates the trip characteristics of lengthy commutes.

HILDA survey

Table 4.1 presents the prevalence rate of lengthy commutes (as well as average commuting trip duration) for some key population subgroups, based on the HILDA wave 12 data. The table includes 95 per cent confidence intervals for each estimate, and information on whether the prevalence rate or the average duration are significantly different from the corresponding national figures (of 22.4 per cent and 28.9 minutes, respectively). The table presents three different geographic variables (all based on the respondent's place of residence) and three different variables based on the worker's demographics. Both the proportion of lengthy commutes and the average commuting trip duration show statistically significant variation across all six variables. However, more extreme variation is evident for the geographic variables.

Table 4.1 shows that the five major capitals (when considered as a single category) have a relatively high prevalence of lengthy commutes (26.9 per cent), and other locations have a relatively low prevalence (14.2 per cent). However, there are notable differences across the five major capitals. Sydney and Melbourne have a relatively high prevalence of lengthy commutes, at 32.9 and 28.8 per cent, respectively. The prevalence of lengthy commutes in Brisbane and Perth is similar to the national average prevalence of 22.4 per cent, while Adelaide has a relatively low prevalence of 17.8 per cent. The average commuting trip duration shows a similar ordering across the five major capitals.

Table 4.1 HILDA average commuting trip duration and prevalence of lengthy commutes for key population subgroups, Australia, 2012

Population subgroup	Average commuting trip duration (minutes)			Proportion of employed persons with lengthy commutes (per cent)		
	Estimate	95 per cent confidence interval	Significantly different?^	Estimate	95 per cent confidence interval	Significantly different?^
All employed Australians	28.9	28.1–29.7	n/a	22.4	21.1–23.7	n/a
Five major capitals	32.1	31.1–33.1	H	26.9	25.3–28.6	H
Sydney	35.4	33.6–37.2	H	32.9	30.0–35.7	H
Melbourne	33.3	31.6–35.0	H	28.8	25.8–31.7	H
Brisbane	29.8	27.6–32.0	no	22.4	18.6–26.1	no
Perth	29.1	26.5–31.7	no	21.4	17.3–25.4	no
Adelaide	25.9	23.4–28.5	L	17.8	12.9–22.6	no
Other locations	23.1	21.9–24.2	L	14.2	12.6–15.9	L
Major cities	31.4	30.4–32.3	H	25.4	23.8–27.0	H
Inner regional	24.2	22.6–25.8	L	17.0	14.8–19.3	L
Outer regional and remote	20.2	18.2–22.1	L	11.2	8.0–14.5	L
Major urban	30.9	29.9–31.8	H	24.6	23.1–26.3	H
Other urban	21.8	20.0–23.5	L	15.1	12.7–17.5	L
Bounded localities and rural balance	28.6	26.6–30.7	no	20.8	17.7–23.9	no
Male	30.4	29.4–31.4	H	24.9	23.1–26.6	H
Female	27.1	25.9–28.2	L	19.5	17.6–21.3	L
Full-time employed	30.6	29.6–31.6	H	24.8	23.2–26.4	H
Part-time employed	25.1	23.8–26.4	L	17.1	14.8–19.3	L
Aged 15–24	25.2	23.5–27.0	L	17.2	14.2–20.3	L
Aged 25–34	32.4	30.4–34.4	H	27.0	23.2–30.8	H
Aged 35–44	29.5	28.2–30.8	no	23.7	21.4–25.9	no
Aged 45–54	28.6	27.1–30.1	no	22.1	19.9–24.3	no
Aged 55 and over	27.3	25.5–29.2	no	20.1	17.5–22.6	no

Notes: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Zero commuting time responses are excluded. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Standard errors and confidence intervals were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). Data in table is weighted so as to be representative of total in-scope population.

^ In the "Significantly different?" column, "H" denotes the estimate is significantly higher than the national estimate at the 95 per cent confidence level, "L" denotes the estimate is significantly lower than the national estimate at the 95 per cent confidence level, and "no" means the estimate is not significantly different from the national estimate. n/a = not applicable.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The prevalence of lengthy commutes also varies significantly according to the ABS Remoteness Structure. The prevalence of lengthy commutes is relatively high in the major cities (25.4 per cent). Inner regional Australia has a lower than average prevalence (17.0 per cent), while Outer regional and remote Australia has a particularly low prevalence of lengthy commutes (11.2 per cent).

The ABS Section of State structure highlights an interesting feature of the relationship between lengthy commutes and place of residence. The major urban category refers to urban centres containing more than 100 000 population, and has a relatively high prevalence of lengthy commutes (24.6 per cent). By contrast, other urban centres with between 1000 and 99 999 population have a relatively low prevalence (15.1 per cent). The 'bounded localities and rural balance' category refers to population clusters of less than 1000 persons and rural areas. The prevalence of lengthy commutes in bounded localities and the rural balance is not significantly different from the overall national prevalence of lengthy commutes.

The average commuting trip duration results show the same ordering across both the ABS Remoteness Structure and the ABS Section of State structure.

Turning to the worker demographics, Table 4.1 shows that the prevalence of lengthy commutes is relatively high for males (24.9 per cent) and relatively low for females (19.5 per cent). It is also relatively high for the full-time employed (24.8 per cent) and relatively low for the part-time employed (17.1 per cent). This suggests the low rate of lengthy commutes amongst female workers may be partly due to females greater tendency to be employed on a part-time basis—this question will be explored further in Chapter 6.

Individuals aged between 15 and 24 have a relatively low prevalence of lengthy commutes (17.2 per cent), while individuals aged between 25 and 34 have a relatively high prevalence (27.0 per cent). Each of the older age categories (from 35 upwards) have a rate that is not significantly different from the overall national prevalence rate. Many 15 to 24 year old workers are employed on a part-time basis (often while studying) and this together with other job characteristics (e.g. industry, work schedule) may help explain the low prevalence of lengthy commutes amongst this group—again, this question will be explored further in Chapter 6.

For all three demographic variables, the average commuting trip duration results show the same ordering as the prevalence results.

Sydney Household Travel Survey

Based on the Sydney *Household Travel Survey* (HTS), Table 4.2 presents estimates of the prevalence of lengthy commutes (and average commuting trip duration) for some key population subgroups and for some key types of commuting trip. The main value add of the HTS for the purposes of this study is the detailed information it collects on trip characteristics (e.g. time of day, day of week, distance, transport mode), and so the majority of the table relates to trip characteristics rather than to commuter demographics.

BITRE was not able to estimate confidence intervals or undertake significance testing for the HTS estimates in Table 4.2. While Relative Standard Errors (RSEs) can readily be derived based on the assumption of simple random sampling, the HTS involves a complex sample design

including stratification and clustering, and so these RSEs could significantly understate actual HTS error margins.[27]

The simple random sampling RSEs do nevertheless provide some (limited) indication of which estimates are likely to be significantly different from the Greater Metropolitan Area (GMA) average. They suggest that both the proportion of lengthy commutes and the average commuting trip duration show significant variation across all but one of the variables included in Table 4.2.[28] The sole exception is the direction variable, with 'commutes to work' and 'commutes back home' having very similar durations and proportions of lengthy commutes.

Table 4.2 shows that a relatively high proportion of commuting trips by residents of Sydney are lengthy commutes (28.8 per cent) and the prevalence of lengthy commutes is much lower in the rest of the GMA (11.1 per cent). Within Sydney, the prevalence of lengthy commutes is relatively low for Inner ring residents (24.0 per cent) and relatively high for Middle and Outer ring residents (31.6 and 29.1 per cent, respectively). Similarly, average commuting trip durations are low for Inner ring residents (30.3 minutes) and higher for Middle and Outer ring residents (33.8 and 34.1 minutes, respectively).

The HTS estimates for linked commuting trips by Sydney Greater Capital City Statistical Area (GCCSA) residents are a little lower than the HILDA estimates for Sydney residents in Table 4.1, with an average duration of 33.3 minutes (compared to 35.4 minutes for HILDA) and a prevalence of lengthy commutes of 28.8 per cent (compared to 32.9 per cent). However, the HTS tour-based estimates[29] for Sydney residents are higher than the HILDA estimates, with the average duration of a tour between home and work being 40.1 minutes, and 37.2 per cent of such tour legs taking 45 minutes or more. The fact the HILDA estimates lie somewhere between the HTS linked trip and tour estimates for Sydney residents highlights the uncertainty around exactly what concept of travel time the HILDA respondents have in mind when responding to the survey question. Other potential contributors to the observed differences include sampling errors, the different time periods, survey methods, and the assumptions made by BITRE in converting the HILDA data to a per commuting trip basis.

27 Note that the HTS unit record file did not contain information on stratum and clusters. In contrast, the HILDA unit record data file contained variables identifying stratum and clusters that enabled RSEs to be derived that reflected the complex sample design.

28 Even if the true RSEs were double the simple random sampling RSEs, all variables (apart from the direction variable) would display statistically significant variation at the 95 per cent confidence level

29 Box 4.1 provides further information on the HTS concept of tours.

Table 4.2 HTS average commuting trip duration and prevalence of lengthy commutes for key population subgroups and types of commuting trip, Sydney GMA, 2008–13

	Average commuting trip duration (minutes)	Proportion of commuting trips involving lengthy commutes (per cent)
All employed GMA residents	31.6	26.0
Residents of Sydney GCCSA	33.3	28.8
Inner ring suburbs	30.3	24.0
Middle ring suburbs	33.8	31.6
Outer ring suburbs	34.1	29.1
Residents of rest of GMA	22.7	11.1
Male	33.5	28.7
Female	29.6	23.1
Weekday	32.3	27.1
Peak	34.2	30.2
Off-peak	28.4	20.8
Weekend	24.9	14.8
Commutes to work	32.0	26.5
Commutes back home	31.3	25.5
Commutes involving a CBD workplace	45.5	49.6
Commutes involving a non-CBD workplace	28.3	20.3
Linked trip with no intermediate stops	24.2	14.6
Linked trip with one or more intermediate stops	58.5	67.8
Priority mode^		
Private vehicle (driver or passenger)	25.5	16.0
Public transport	61.7	73.2
Active transport (walking or cycling)	15.8	6.1
Road network distance~		
Less than 5km	11.9	1.6
Between 5 and 15km	26.8	14.6
Between 15 and 30km	43.5	43.9
30km or more	68.4	80.6

Notes: Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. Departure and arrival times are used to derive trip duration. A lengthy commuting trip is one with a (one-way) trip duration of 45 minutes or more. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data in table is weighted so as to be representative of total in-scope population. Inner, middle and outer rings defined based on Local Government Area (LGA) classification in Appendix A of BITRE (2012a). Peak period is defined as trips arriving at their destination from 6.31 to 9.30am on weekdays and trips departing from 3.01 to 6.00pm on weekdays, while trips arriving/departing outside these timeslots are considered off-peak weekday trips (BSA 2014a). A location within the City of Sydney LGA is considered a CBD workplace. The assigned workplace is the address of the person's main job, or the address of another job if the main job was not attended on the travel day. km = kilometres

^ Where a linked trip involves more than one transport mode, the BSA allocates a priority mode to the linked trip according to a hierarchy, which is generally the mode with the largest likely trip duration (BSA 2014a, p.42). Nine priority modes were identified by BSA, simplified into three categories for presentation purposes in this table, with 'other' mode excluded.

~ BSA derived road network distance between trip origin and trip destination.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Table 4.2 shows that commuting trips that relate to workplaces in the Central Business District (CBD) are much more likely to be 45 minutes or more in duration (49.6 per cent) than commuting trips involving workplaces in other locations (20.3 per cent).

As was the case in the HILDA-based Table 4.1, the HTS-based Table 4.2 shows that the prevalence of lengthy commutes is relatively high for males (28.7 per cent) and relatively low for females (23.1 per cent).

Table 4.2 shows that the day of the week and the time of day that a commuting trip is undertaken have an important influence on its duration. The prevalence of lengthy commutes is relatively low on weekends (14.8 per cent) and higher on weekdays (27.1 per cent). On weekdays, a relatively high proportion of commuting trips undertaken during peak periods involve lengthy commutes (30.2 per cent), whereas during off-peak periods the prevalence is lower (20.8 per cent). Chapter 7 will investigate these and other trip characteristics in greater detail.

The HTS data in Table 4.2 is based on the concept of linked trips, which is a journey from one activity to another, ignoring changes in mode. For example, a person who walks from their home to the station, then catches the train to the CBD, then walks to their office is making three unlinked trips. These unlinked trips combine to form a single linked trip from home to office, which involves two intermediate stops at the two train stations (Bureau of Statistics and Analytics (BSA) 2013). The prevalence of lengthy commutes is much higher for linked commuting trips with one or more intermediate stops (67.8 per cent) than for linked commuting trips with no intermediate stops (14.6 per cent).

The HTS linked commuting trips data in Table 4.2 does not reflect travel made for other purposes on the way to or from work. For example, a person who drives from home to drop their kids off at school and then continues to drive to work is making two separate linked trips, one for education purposes and one for commuting purposes. However, BSA have provided some additional HTS data, based around the concept of a 'home to work' or 'work to home' tour, which supports analysis of the impact of trip chaining and stopovers on commuting trip duration and will be investigated in greater detail in Chapter 7. Some initial findings about duration and lengthy commutes based on the HTS tour data are provided in Box 4.1.

The BSA has identified a priority transport mode for each linked commuting trip (BSA 2014a, p.42). The BSA classification identifies nine separate modes, which have been collapsed into three broad mode categories for the purposes of Table 4.2 (with 'other' mode excluded). A very high proportion of public transport trips involve lengthy commutes (73.2 per cent). In contrast, a relatively low proportion of private vehicle trips involve lengthy commutes (16.0 per cent), and a very low proportion of active transport trips involve lengthy commutes (6.1 per cent). Average commuting trip durations are also much higher for public transport trips (61.7 minutes), than for private vehicle (25.5 minutes) or active transport (15.8 minutes) trips.

The final section of Table 4.2 shows a very close connection between commuting trip distance and commuting trip duration. Not surprisingly, trips of less than 5 kilometres (km) road distance are very unlikely to involve 45 minutes or more duration. The prevalence of lengthy commutes is very high for trips of between 15 and 30km (43.9 per cent) and for trips of more than 30km (80.6 per cent).

Box 4.1 HTS data on commuting tours

The HTS data identifies 'home to work' (outbound) and 'work to home' (return) tours, which can be comprised of one or more linked trips. Typically, at least one of the linked trips that contribute to a 'home to work' or 'work to home' tour will be classified as a commuting trip, but other contributing linked trips may be taken for different purposes (e.g. shopping, education).

BITRE has calculated the total travel time for all outbound and return tours which have an overall tour purpose of 'main job' or 'other job'. Tours with an overall tour purpose of 'work-related business' are excluded from the analysis.

BITRE's tour-level duration measure only captures travel time, not time spent at intermediate stopovers. For example, consider a person who departs from work by car at 5:00pm and arrives at the local shops at 5:20pm, where they spend 10 minutes shopping, before undertaking a further 5 minute drive to arrive home at 5:35pm. The tour consists of two linked trips that have durations of 20 minutes and 5 minutes, respectively. The total travel time is 25 minutes, while the door-to-door elapsed time is 35 minutes.

On this basis, the average commuting tour duration for the HTS 2008–13 dataset is 38.3 minutes for the Sydney GMA.[30] This is 21 per cent higher than the average commuting trip duration of 31.6 minutes. The average duration for outbound tours is 36.2 minutes and the average duration of return tours is 40.3 minutes.

For the Sydney GMA for 2008–13, 34.1 per cent of all commuting tours (outbound and return) have a tour duration of 45 minutes or more. This compares to 26.0 per cent of linked commuting trips with a trip duration of 45 minutes or more. For the Sydney GMA, the HTS identifies a total of 623 500 lengthy commuting trips being undertaken on an average day and a total of 837 700 lengthy commuting tours.

Further information on commuting tours is provided in Chapter 7. Some limited analysis of tour-based spatial patterns and demographic differences is included in Chapters 5 and 6, respectively.

30 If time spent at intermediate stops is included so as to provide a door-to-door elapsed time (rather than a travel time), the average commuting tour duration is considerably higher at 51.7 minutes. This reflects many commuters making quite lengthy stopovers, particularly on their way home from work.

Overall, Table 4.2 shows that the two duration measures tend to vary more widely with respect to several trip characteristics, than with respect to key demographic and geographic variables. Chapter 7 explores these key trip characteristics—including day and time of travel, place of work, stopovers, transport mode and trip distance—in much greater detail.

Productivity Commission Community Survey

Based on the Productivity Commission (PC) *Community Survey* (conducted in 2011), Table 4.3 presents estimates of the prevalence of lengthy commutes (i.e. the proportion of employed persons with lengthy commutes) and average commuting trip duration for some key population subgroups.

Table 4.3 shows that a relatively high proportion (28.5 per cent) of commuting trips by residents of the selected cities are lengthy commutes. Among these selected cities, the combined five major capital cities (i.e. Sydney, Melbourne, Brisbane, Perth and Adelaide) showed a much

higher proportion of employed persons with lengthy commutes (32.6 per cent) than the other selected cities (12.0 per cent). Compared to the survey average, Sydney, Melbourne and Brisbane had a relatively high prevalence of lengthy commutes, while Adelaide and Perth had a relatively low prevalence of lengthy commutes.

The PC *Community Survey* average commuting trip duration is 33.4 minutes. Compared to this average, people in Sydney, Melbourne and Brisbane spend considerably more time travelling to work in peak hour, while people in Perth and Adelaide spend less time. People in other smaller cities spend much less time (24.4 minutes, on average).

Gender and age have an influence on the estimates of the prevalence of lengthy commutes. As was the case in the HILDA-based data (see Table 4.1) and the HTS-based data (refer Table 4.2), the PC *Community Survey* data, presented in Table 4.3, shows that the prevalence of lengthy commutes is relatively high for males (30.6 per cent) and relatively low for females (26.3 per cent). The average commuting trip duration is also relatively high for males and lower for females. Individuals aged 25–29 years and 30–39 years have a higher prevalence of lengthy commutes compared to the average prevalence across all individuals. Older individuals (aged 50–65 years) have a relatively low prevalence of lengthy commutes.

Full-time and part-time paid employment have an important influence on the estimates of the prevalence of lengthy commutes, with the full-time employed having a much higher prevalence of lengthy commutes (31.8 per cent) than the part-time employed (21.0 per cent). Similarly, the average duration of a commuting trip taken by full-time employed persons is higher than that for part-time employed persons.

Table 4.3 Average commuting trip duration and prevalence of lengthy commutes for key population subgroups and types of commuting trip, Productivity Commission *Community Survey*, selected Australian cities, 2011

Population subgroup	Average commuting trip duration (minutes)	Proportion of employed persons with lengthy commutes (per cent)
All employed persons in selected cities	33.4	28.5
Male	35.0	30.6
Female	31.7	26.3
Five major capital cities	35.6	32.6
Sydney	39.2	39.2
Melbourne	35.3	32.0
Brisbane	37.1	34.1
Perth	30.0	23.6
Adelaide	27.7	17.7
Other cities	24.4	12.0
Commutes to work in CBDs of 5 major capital cities~	44.6	49.0
Commutes to other locations in 5 major capital cities~	30.7	24.0
Full time employed	35.4	31.8
Part time employed	29.0	21.0
Aged 18-24	31.7	26.1
Aged 25-29	35.9	32.1
Aged 30-39	34.9	30.8
Aged 40-49	33.6	29.0
Aged 50-65	31.9	25.6
Aged 65+	32.2	28.6
Direct travel*	33.4	28.6
Indirect travel*	33.7	28.3
Priority mode^		
Private vehicle	29.1	20.7
Public transport	45.3	49.8
Active transport	16.9	4.8

Notes: The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. A lengthy commuting trip is one with a commuting trip duration of 45 minutes or more. The survey covers 24 Australian metropolitan areas and regional cities. Data is weighted to be representative of total in-scope population.

~ Brisbane CBD is defined as the area containing postcodes from 4000 to 4004, 4006 and 4101 only, while the CBDs of Sydney, Melbourne, Perth and Adelaide are defined as the central LGA.

* Direct travel means people travelling from home to work directly, while indirect travel means people travelling to work via somewhere else, such as dropping children at day care or school, shopping or going to the gym.

^ Where a commuting trip involves more than one transport mode, a priority mode has been allocated to the trip based on the BSA hierarchy, which is generally the mode with the largest likely trip duration (BSA 2014a, p.42). Nine priority modes were identified by BSA, simplified into three categories for presentation purposes in this table, with 'other' mode excluded. Private vehicle includes car or similar, motorcycle, motor scooters. Public transport includes bus, train, tram, ferry, taxi and plane. Active transport includes walking and cycling. The PC's 'work from home' mode option was excluded, as no commuting trip is involved.

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments.*

The PC *Community Survey* identifies whether individuals travel directly from home to work, or travel indirectly via somewhere else (e.g. dropping children off at day care or school, shopping, gym). There is virtually no difference between direct and indirect trips to work with respect to either the prevalence of lengthy commutes or average commuting trip duration.

The PC *Community Survey* also sought information on the transport mode(s) used to travel from home to work. The BSA priority mode classification was used to summarise responses into three priority mode categories (as previously used in Table 4.2). About half of public transport trips involve lengthy commutes (49.8 per cent). In contrast, a relatively low proportion of private vehicle trips involve lengthy commutes (20.7 per cent), and a very low proportion of active transport trips involve lengthy commutes (4.8 per cent). Estimates of average commuting trip duration are also much higher for public transport trips (45.3 minutes), than for private vehicle (29.1 minutes) or active transport trips (16.9 minutes).

Commutes to work in the Central Business Districts (CBDs) of the five major capital cities (Sydney, Melbourne, Brisbane, Perth and Adelaide) are much more likely to be 45 minutes or more in duration (49.0 per cent) than commuting trips to other cities (24.0 per cent).

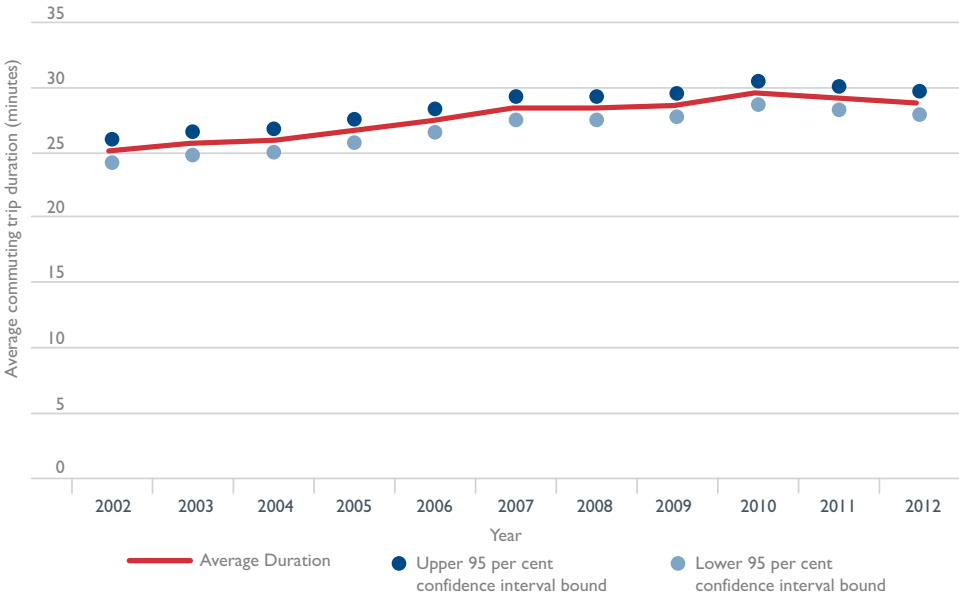
Recent trends

The HILDA survey provides an eleven-year long time-series that provides useful insight on recent trends regarding lengthy commutes. Figure 4.1 displays the national average commuting trip duration between 2002 and 2012. The 95 per cent confidence interval for each year's estimate is also presented as it provides a guide to what changes should be regarded as statistically significant and what changes should simply be attributed to sampling variation.

Figure 4.1 shows that the national average measure of commuting trip duration rises steadily from 25.0 minutes in 2002 to 28.4 minutes in 2007, but then remains relatively unchanged between 2007 and 2012 (when it stands at 28.9 minutes). The 15 per cent change observed between 2002 and 2012 is statistically significant, as is the 14 per cent change between 2002 and 2007. However, there is no statistically significant change since 2007.

The number of individuals undertaking lengthy commutes (of 45 minutes or more) increased from 1.30 million persons in 2002 to 2.02 million persons in 2012, representing an increase of 720 000 persons nationally. Over seventy per cent of the increase was concentrated in the 2002 to 2007 subperiod.

Figure 4.1 HILDA average commuting trip duration, Australia, 2002 to 2012



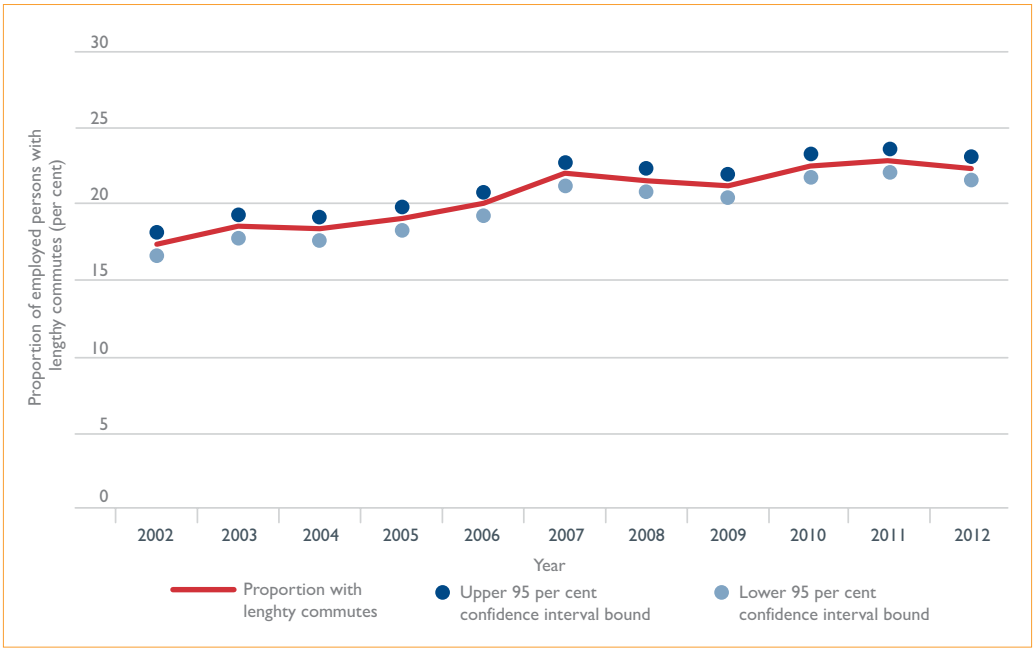
Note: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). Zero commuting time responses are excluded. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Standard errors and confidence intervals were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). Data in table is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Figure 4.2 displays the recent changes in the proportion of employed persons with lengthy commutes, as well as the 95 per cent confidence interval for each year's estimate. It is evident that the confidence intervals for this categorical variable are wider than those for the continuous duration variable in Figure 4.1.

Figure 4.2 shows that the national proportion of lengthy commutes rose strongly from 17.4 per cent in 2002 to 22.1 per cent in 2007, but then levelled off between 2007 and 2012 (when it stood at 22.4 per cent). The 5.0 percentage point change observed between 2002 and 2012 is statistically significant, as is the 4.7 percentage point change between 2002 and 2007. However, there is no statistically significant change since 2007.

Figure 4.2 HILDA proportion of employed persons with lengthy commutes, Australia, 2002 to 2012



Note: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Zero commuting time responses are excluded. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Standard errors and confidence intervals were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). Data in table is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

There are a number of factors—summarised in Table 4.4—that may be contributing to these national trends in the prevalence of lengthy commutes (and average commuting trip duration), including:

- Strong employment growth between 2002 to 2007
- Saturation of Australia's road traffic per person as of 2006, and the flow-on effects of the global financial crisis on traffic levels
- Increased investment in transport infrastructure.

Growth in national employment translates fairly directly into growth in the number of commuting trips (given that the proportion working from home in Australia is relatively small and stable). Rapid growth in commuting trips, particularly during peak periods, will potentially increase congestion and lengthen commuting times. Given that employment growth was notably more rapid in the 2002 to 2007 subperiod, the flow-on impacts on congestion and travel times would be expected to be more pronounced between 2002 and 2007, than between 2007 and 2012.

About 80 per cent of commuting trips in Australia are by private vehicle[31] and a significant proportion of commuter public transport trips are also reliant on the road network. Thus, growth in road traffic is a potentially important influence on commuting trip durations. "As income levels increase, typically allowing broader travel options, the general tendency is for per capita travel to also increase, until approaching eventual 'saturation' levels, when the relevant amount of daily travel starts taking up as much time as people are willing to commit" (BITRE 2014a). In Australia, based on the number of vehicle kilometres travelled per person (vktpp), the estimated saturated date is 2006, at a saturation level of 10 800 vktpp (BITRE 2014b).

In addition to this long term saturation effect which tends to flatten out per capita traffic levels, higher fuel prices and unemployment rates and the flow-on effects of the global financial crisis have been exerting downward pressure on traffic levels in recent years (BITRE 2012b). Table 4.4 shows that there was slight positive growth in vktpp between 2002 and 2007 and slight negative growth between 2007 and 2012. Aggregate traffic growth was also stronger in the earlier subperiod, averaging 1.8 per cent per annum, compared to 1.2 per cent for the 2007 to 2012 period. Consequently, the flow-on effects of aggregate traffic growth on congestion and travel times would be expected to be more pronounced between 2002 and 2007, than between 2007 and 2012.

Table 4.4 Potential drivers of recent national trends in the prevalence of lengthy commutes, Australia, 2002 to 2012

Indicator	2002 to 2007	2007 to 2012	2002 to 2012
Average annual growth in employment (per cent)	2.6	1.7	2.2
Average annual growth in vehicle kilometres travelled per capita (per cent)	0.4	–0.5	0.0
Average annual growth in aggregate vehicle kilometres travelled (per cent)	1.8	1.2	1.5
Transport engineering construction, total value of work done ($billion, chain volume measure)	80	128	208

Source: BITRE analysis of ABS (2015b) Cat. 6202.0 *Labour force, Australia* (May 2015 release), BITRE VKT estimates (unpublished data, May 2015 update) and BITRE *Yearbook 2014—Australian Infrastructure Statistics* Table 12.1d.

The national journey-to-work public transport mode share was unchanged at 11.2 per cent in 2001 and 2006, but then increased notably to 12.6 per cent in 2011.[32] The effect of this recent mode shift on commuting times is ambiguous. A significant shift of commuters away from private vehicles towards public transport would be expected to reduce congestion pressures on the road network. However, this could be offset by the fact that public transport commuters tend to undertake particularly lengthy commutes (as seen from Tables 4.2 and 4.3).

The construction of new transport infrastructure can significantly boost the capacity of the existing transport network to cater to commuter's travel needs, and thereby impact on commuting times. New transport infrastructure investments are typically proceeded with on the basis that the project will create significant net economic benefits in the form of reduced travel times. The total

31 Based on ABS Basic Community Profile data from 2011 Census of Population and Housing. Did not go to work, work from home and mode not stated responses were excluded from mode share denominator.

32 Based on ABS Basic Community Profile data from 2001, 2006 and 2011 Censuses of Population and Housing. All single mode trips by train, bus, tram/light rail, ferry or taxi were regarded as public transport trips, as were all multiple mode trips involving at least one bus or train leg. Did not go to work, work from home and mode not stated responses were excluded from mode share denominator.

value of transport engineering construction was $80 billion in the 2002 to 2007 period, and rose considerably to $128 billion in the subsequent period. This increased level of transport investment between 2007 and 2012 should have helped to alleviate any upward pressure on commuting times caused by employment growth and aggregate traffic growth.

Recently, BITRE (2015b) estimated 'avoidable' social costs of congestion (where the benefits to road users of some travel in congested conditions are less than the costs imposed on other road users and the wider community) for the eight Australian capitals (using an aggregate modelling approach) and found that total congestion cost was approximately $16.5 billion for the 2015 financial year (real cost in terms of 2010 Australian dollars), having grown from about $12.8 billion for the 2010 financial year. This 2015 metropolitan total congestion cost is comprised of approximately $6 billion in private time costs, $8 billion in business time costs, $1.5 billion in extra vehicle operating costs and $1 billion in extra air pollution costs.

In the United States, estimates of the average travel time to work based on the *American Community Survey* exhibit stability over the 2005 to 2011 period (American Association of State Highway and Transportation Officials 2013).[33] "This plateauing of commute travel time is generally attributed to moderating congestion levels associated with softening overall travel demand and, specifically, slowing growth in workforce size" (ibid, p.13).

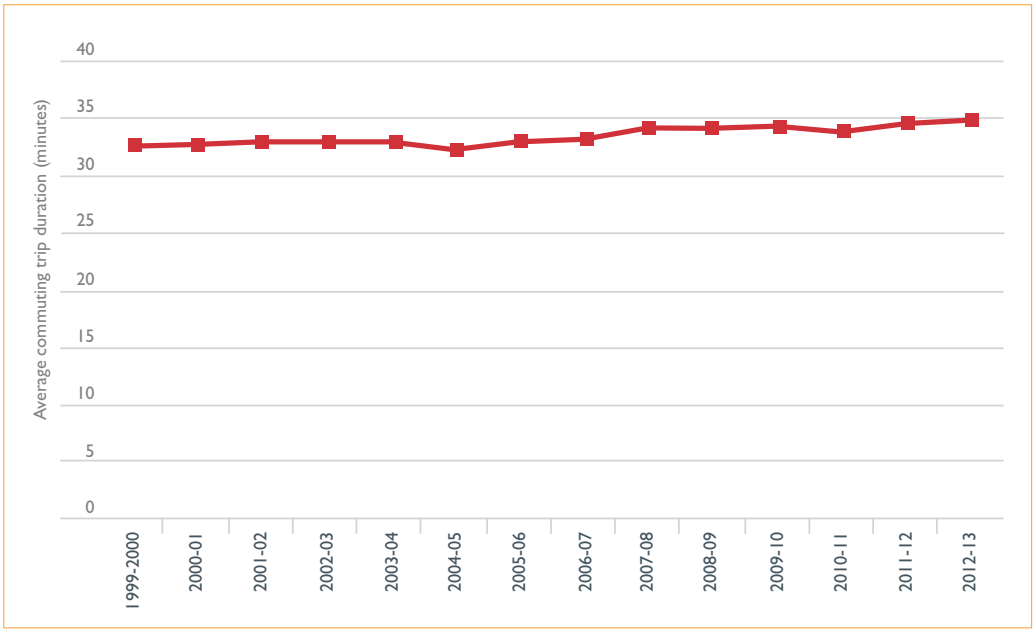
The Sydney HTS is another source of information on recent trends in commuting trip durations, albeit only for the Sydney GMA. The pooled HTS unit record dataset does not reveal any significant trends in average commuting trip duration or the prevalence of lengthy commutes between 2008–09 and 2012–13. However, the BSA has published a time-series of HTS estimates of average commuting trip duration for the Sydney Statistical Division (SD)/GCCSA.[34] Figure 4.3 presents the HTS time-series data. The average duration of a commuting trip on an average weekday in Sydney was 32.5 minutes in 1999–2000, and reached its lowest point of 32.3 minutes in 2002–03, before rising gradually to reach 34.8 minutes in 2012–13. This represents an overall increase of 2.3 minutes, or 7.1 per cent, in the average commuting trip duration over the 14 year period.

The Sydney HTS data is broadly consistent with the national HILDA data in showing stronger growth in trip duration between 2002–03 and 2007-08 (3.8 per cent growth) than between 2007–08 and 2012–13 (1.8 per cent growth). Information on standard errors is not available to determine whether the latter increase is statistically significant or not.

33 Average travel times barely changed from 2000 to 2011, but changes in methodology create some questions about trends prior to 2005.

34 This average commuting trip duration data in BSA (2014a) Table 4.5.2 is not directly comparable to that in Table 4.2 as it relates to the Sydney GCCSA (not the broader GMA) and to an average weekday (rather than an average day).

Figure 4.3 HTS average commuting trip duration on an average weekday, Sydney, 1999–2000 to 2012–13



Notes: Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode.

Source: Special data request from NSW Bureau of Statistics and Analytics, consistent with BSA (2014a) Table 4.5.2. Based on *Household Travel Survey* three-year pooled datasets.

This section has identified a significant increase in the national prevalence of lengthy commutes between 2002 and 2012, but the increase was very much concentrated between 2002 and 2007, with no significant change occurring since 2007. The next two chapters will explore whether these overall HILDA trends in the prevalence of lengthy commutes are replicated for particular cities (Chapter 5) or demographic groups (Chapter 6).

CHAPTER 5
Spatial differences

Key points

- The HILDA 2012 data show that 77 per cent of employed people with lengthy commutes live in one of Australia's five major capital cities, compared to 63 per cent of all employed people. Sydney and Melbourne alone contribute 54 per cent of lengthy commutes, compared to 40 per cent of employed persons.
- The prevalence of lengthy commutes is highest in the major cities remoteness class (25.4 per cent), lower for inner regional areas (17.0 per cent) and lower again for outer regional and remote areas (11.2 per cent).
- The prevalence of lengthy commutes is highest for major urban centres of 100 000 or more population (24.6 per cent). However, other urban centres with between 1000 and 99 999 people have a lower prevalence (15.1 per cent) than towns of less than 1000 persons and rural areas (20.8 per cent).
- Workers from the more socio-economically advantaged locations have longer commuting trip durations and a higher incidence of lengthy commutes.
- The HILDA 2012 data show that the prevalence of lengthy commutes is significantly above the national average of 22.4 per cent in Sydney (32.9 per cent) and Melbourne (28.8 per cent), and significantly below the national average in Adelaide (17.8 per cent) and all the state balance categories.
- Average commuting times tend to be ordered by city size. A simple model based on Productivity Commission (PC) *Community Survey* data has an explanatory power of 87 per cent. It predicts that a city of 30 000 will have an average commuting trip duration of about 13 minutes, compared to about 25 minutes for a city of 300 000 and about 37 minutes for a city of 3 million.
- The PC survey data show that within each of the five major capitals, relatively central locations had the lowest prevalence of lengthy commutes, while the highest rates of prevalence were in a mix of middle and outer suburban areas.
- In Sydney, the Household Travel Survey shows the prevalence of lengthy commuting tours is highest for the middle ring locations of Burwood, Auburn, Ku-ring-gai and Kogarah. In Melbourne, the VISTA survey shows the prevalence of lengthy commuting journeys is highest for a mix of middle suburban and urban fringe locations (i.e. Whitehorse, Bayside, Melton and Nillumbik).

- From 2002 to 2012, the increase in the prevalence of lengthy commutes was larger for the five major capitals (5.8 percentage points) than for other locations (3.2 percentage points). The net increase was largest for Brisbane (7.1 percentage points), followed by Melbourne (6.7 percentage points) and Sydney (6.2 percentage points). These increases were all statistically significant and were concentrated in the initial 2002 to 2007 subperiod.

Background

This chapter considers the spatial characteristics of lengthy commuters, based on the commuter's place of usual residence.[35] The spatial analysis takes place at several different geographic scales, starting with an analysis of spatial differences by broad region type (e.g. remoteness class, urban centre size), before considering the overall incidence of lengthy commutes for particular cities, and then exploring patterns of variation *within* the larger cities. The chapter concludes by presenting evidence about trends over the past decade in the prevalence of lengthy commutes in different Australian geographic locations.

The chapter draws on all three data sources, but is particularly reliant on the HILDA survey (for analysis by broad region type, and of trends over time) and the Productivity Commission (PC) *Community Survey* (for analysis of differences between 24 different Australian cities, and analysis of patterns of variation within the largest cities).

Regional summary classifications

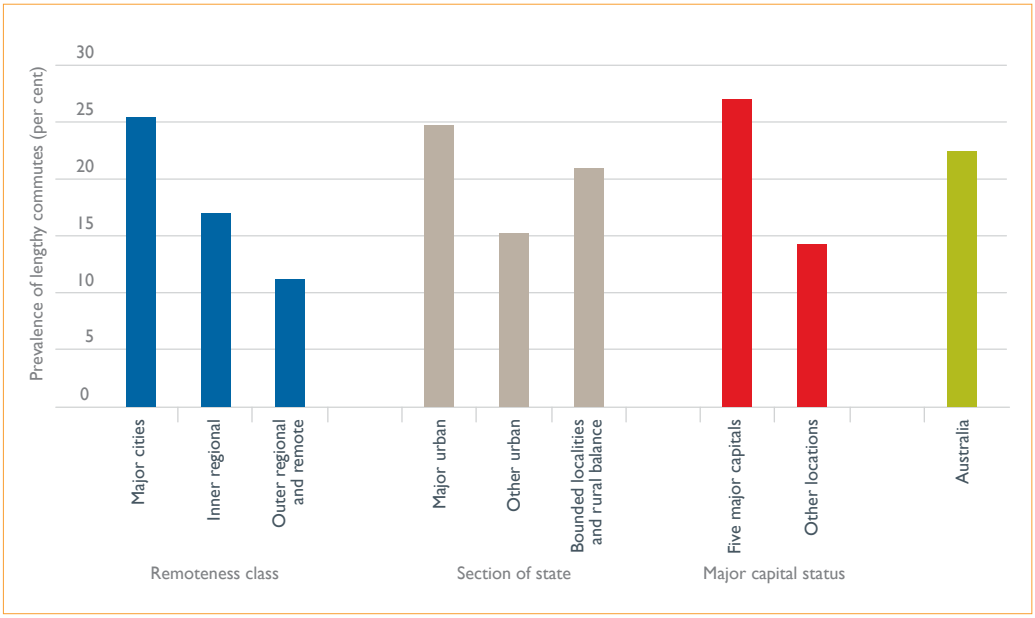
This section is based on the HILDA survey wave 12 data. The HILDA survey preserves confidentiality by withholding details of where respondents live, but does categorise each respondent's place of residence using several standard geographic classifications that identify the broad type of region in which the respondent lives.

Table 4.1 previously presented estimates of average commuting trip duration and the rate of prevalence of lengthy commutes for these broad region types, and the latter set of results are represented below in Figure 5.1. The higher prevalence of lengthy commutes in Australia's five largest capital cities (i.e. Sydney, Melbourne, Brisbane, Adelaide and Perth) is in line with the findings of previous studies. For example, based on the HILDA commuting time data, Wilkins, Warren and Hahn (2009) found that the mean commuting time for full-time workers was 5.2 hours per week in the five major capitals and 3.2 hours per week in other locations in 2006.

Across the remoteness categories, the prevalence of lengthy commutes is highest in the major cities, significantly lower for inner regional areas, and significantly lower again for outer regional and remote areas. The only geographic category in Figure 5.1 for which the prevalence rate does not significantly differ from the national average is the 'bounded localities and rural balance' category that captures people who live in small towns of less than 1000 people or in rural areas (e.g. farms). Note that the prevalence of lengthy commutes amongst these rural residents is significantly higher than the prevalence in the 'other urban' midsized centres of between 1000 and 99 999 population.

35 Analysis of the relationship between lengthy commutes and a commuter's place of work is considered in Chapter 7.

Figure 5.1 HILDA rate of prevalence of lengthy commutes by broad region type, Australia, 2012



Notes: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Zero commuting time responses are excluded. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data in table is weighted so as to be representative of total in-scope population. Confidence intervals and significance testing for these estimates are provided in Table 4.1.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 5.1 shows how people with lengthy commutes are distributed across the different types of regions. It also includes comparison to all commuters (with a plausible non-zero response to the HILDA commuting time question) and to all employed persons.

The table shows that 77 per cent of individuals with a (one-way) commuting trip duration of 45 minutes or more live in one of the five major capitals. In comparison, 64 per cent of commuters and 63 per cent of employed persons live in the five major capitals. Reflecting the high prevalence of lengthy commutes in the larger cities (as shown in Figure 5.1), those with lengthy commutes are also significantly over-represented in the major cities remoteness class and the major urban section of state category.

Eighty per cent of individuals with lengthy commutes live in the major cities remoteness class, while 15.2 per cent live in inner regional areas and just 4.9 per cent live in outer regional and remote areas, even though outer regional and remote areas contribute 10.6 per cent of national employment.

Three-quarters of those with lengthy commutes live in the major urban section of state category (which captures urban centres of 100 000 or more population), while 12.9 per cent

live in other urban centres (of between 1000 and 99 999 population) and 11.8 per cent live in smaller towns and rural areas.

Table 5.1 HILDA proportion of commuters and employed persons living in different types of region, Australia, 2012

Region type of residence	Proportion of commuters/employed persons (per cent)		
	Persons with lengthy commutes	All commuters*	All employed persons
Five major capitals	77.2	64.1	63.2
Other locations	22.8	35.9	36.8
All locations	100.0	100.0	100.0
Major cities	80.0	70.4	69.1
Inner regional	15.2	19.9	20.2
Outer regional and remote	4.9	9.7	10.6
All remoteness classes	100.0	100.0	100.0
Major urban	75.3	68.3	67.0
Other urban	12.9	19.0	18.8
Bounded localities and rural balance	11.8	12.7	14.2
All section of state categories	100.0	100.0	100.0

Notes: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data in table is weighted so as to be representative of total in-scope population.

* Commuters are defined as those employed persons who provided a plausible non-zero response to the HILDA commuting time question.

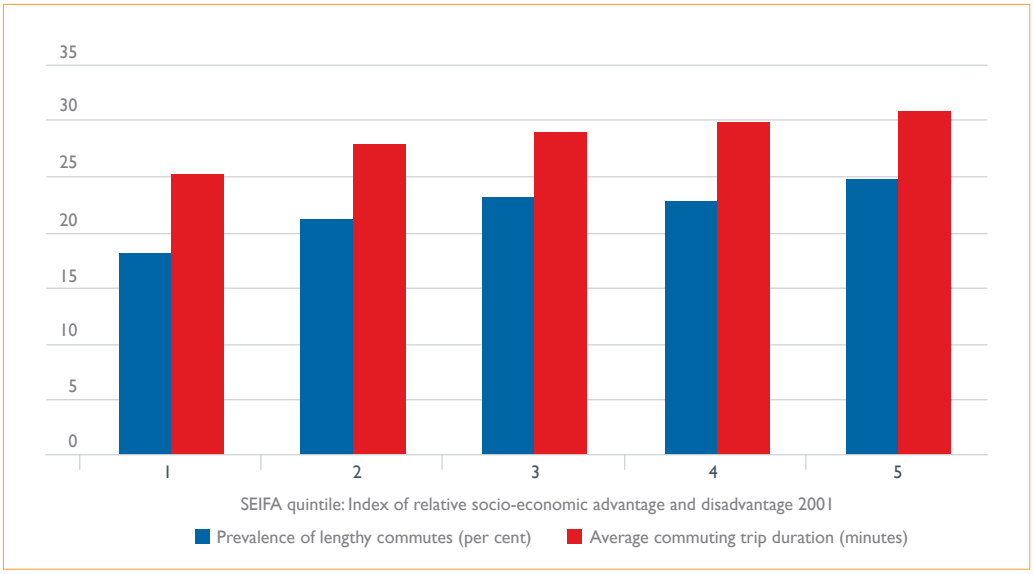
Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Another way of categorising geographic locations is by their socio-economic status. The HILDA survey includes information on the SEIFA (Socio-economic Indexes for Areas) Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) score for the location in which each respondent lives. Flood and Barbato (2005) investigated the relationship between IRSAD and average weekly time spent commuting for full-time workers in 2002, finding that workers from more advantaged areas typically had longer commuting times.

Figure 5.2 illustrates how this SEIFA index is related to lengthy commutes, using the 2012 HILDA data. The chart shows that there is a general tendency for people who live in the more advantaged areas (i.e. in the higher SEIFA IRSAD quintiles) to have a higher average commuting trip duration, with the more advantaged areas consequently having a higher prevalence of lengthy commutes. The average commuting trip durations is about 23 per cent higher for the most advantaged quintile than it is for the least advantaged (most disadvantaged) quintile. This difference is statistically significant, but represents a much weaker effect than observed for the other region type variables (see Table 4.1, Figure 5.1).

As a result, lengthy commuters are over-represented in the more advantaged locations. The most advantaged SEIFA quintile accounts for 25.3 per cent of lengthy commutes, compared to 22.3 per cent of Australian employment. In contrast, 11.6 per cent of lengthy commutes are undertaken by residents of the least advantaged quintile, which accounts for 15.0 per cent of employment.

Figure 5.2 HILDA rate of prevalence of lengthy commutes and average commuting trip duration by SEIFA quintile, Australia, 2012



Notes: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Zero commuting time responses are excluded. Commuting trip durations of over 240 minutes were top-coded to 240 minutes. The SEIFA deciles were aggregated into five quintiles to produce more reliable results. Quintile one represents the two least advantaged deciles, while quintile five represents the two most advantaged deciles. Data in table is weighted to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Comparing individual cities and regions

Flood and Barbato (2005) have previously investigated how the 2002 HILDA survey data on weekly time spent commuting varied across the 13 HILDA capital city/state balance categories, concluding that Sydney stood out with the longest average commute.

> 'If we control for the number of days worked each week, Sydneysiders still have the longest journeys to and from work and travel for significantly longer periods than workers in all other cities and states.' (Flood and Barbato 2005).

Also using the HILDA commuting time data, Wilkins, Warren and Hahn (2009) note that average commuting times tend to be ordered by city size, with Sydney having the highest

average weekly commuting time of 5.8 hours for full-time workers in 2006, followed by Melbourne, Brisbane, Perth, and finally, Adelaide.

This ordering is replicated in the 2012 HILDA data, as displayed in Table 5.2. It is also evident that each of the five major capital cities have a longer average commuting trip duration and a higher prevalence of lengthy commutes than their respective state balances.

Table 5.2 HILDA average commuting trip duration and prevalence of lengthy commutes by capital city and state balance, Australia, 2012

Population subgroup	Average commuting trip duration (minutes)			Proportion of employed persons with lengthy commutes (per cent)		
	Estimate	95 per cent confidence interval	Significantly different?^	Estimate	95 per cent confidence interval	Significantly different?^
Sydney	35.4	33.6–37.2	H	32.9	30.0–35.7	H
Rest of NSW	23.5	21.5–25.5	L	15.2	12.6–17.8	L
New South Wales	31.1	29.5–32.6	H	26.4	24.1–28.7	H
Melbourne	33.3	31.6–35.0	H	28.8	25.8–31.7	H
Rest of Victoria	22.9	19.5–26.3	L	15.0	11.1–18.9	L
Victoria	31.1	29.5–32.7	H	25.9	23.3–28.5	H
Brisbane	29.8	27.6–32.0	no	22.4	18.6–26.1	no
Rest of Queensland	23.1	20.9–25.3	L	14.3	10.8–17.8	L
Queensland	26.3	24.6–28.0	L	18.2	15.5–20.9	L
Perth	29.1	26.5–31.7	no	21.4	17.3–25.4	no
Rest of WA	22.5	18.5–26.5	L	18.1	11.3–24.9	no
Western Australia	27.7	25.4–29.9	no	20.7	17.2–24.1	no
Adelaide	25.9	23.4–28.5	L	17.8	12.9–22.6	no
Rest of SA	18.7	15.8–21.6	L	12.4	7.0–17.9	L
South Australia	24.5	22.2–26.7	L	16.7	12.6–20.8	L
Tasmania	22.9	18.8–27.0	L	12.1	6.4–17.8	L
Northern Territory	18.6	14.0–23.3	L	5.2*	0.2–10.2	L
Australian Capital Territory	27.5	24.9–30.0	no	9.4*	4.8–14.1	L
Australia	**28.9**	**28.1–29.7**	**n/a**	**22.4**	**21.1–23.7**	**n/a**

Notes: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Zero commuting time responses are excluded. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Standard errors and confidence intervals were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). Data in table is weighted so as to be representative of total in-scope population.

^ In the "Significantly different?" column, "H" denotes the estimate is significantly higher than the national estimate at the 95 per cent confidence level, "L" denotes the estimate is significantly lower than the national estimate at the 95 per cent confidence level, and "no" means the estimate is not significantly different from the national estimate. n/a = not applicable.

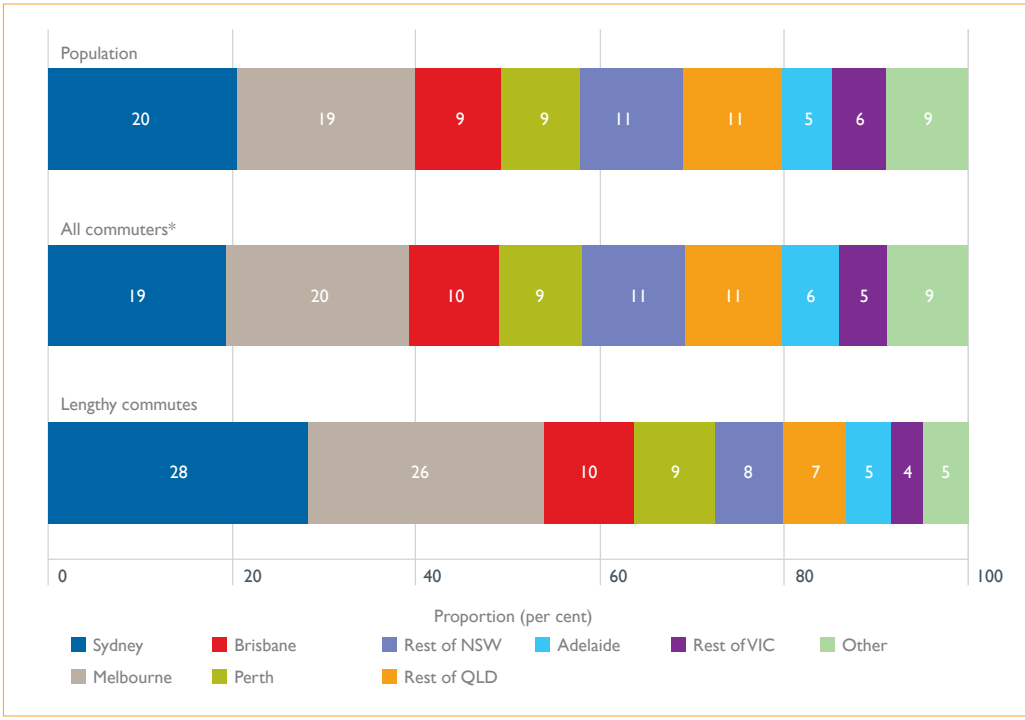
* These estimates have a Relative Standard Error of more than 25 per cent.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The proportion of employed persons with lengthy commutes and the average commuting trip duration are significantly higher than the national estimates in Sydney and Melbourne, and in their respective states of NSW and Victoria. For all other cities, regions and states, these two measures are either significantly lower than the national average (e.g. Rest of New South Wales, Rest of Victoria, Rest of Queensland, South Australia, Tasmania), or not significantly different from the national average (e.g. Brisbane, Perth, Western Australia). The confidence intervals on the estimates of the prevalence of lengthy commutes for Tasmania, Northern Territory and the Australian Capital Territory are very wide, reflecting relatively low underlying samples, and so the estimates for these jurisdictions have little practical value.

Figure 5.3 shows how people with lengthy commutes are distributed across the different capital city and state balance categories. It also includes a comparison to all commuters and to all employed persons.

Figure 5.3 HILDA proportion of commuters and employed persons living in different cities and regions, Australia, 2012



Notes: Average commuting trip duration is calculated for each employed individual by dividing the time spent commuting to and from work in a typical week by the estimated number of commuting trips in a typical week (which is estimated based on reported work schedules and days of work). A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is weighted so as to be representative of total in-scope population. Other category comprises Rest of South Australia, Rest of Western Australia, Tasmania, Northern Territory and the Australian Capital Territory.

* Commuters are defined as those employed persons who provided a plausible non-zero response to the HILDA commuting time question.

Source: BITRE analysis of HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Those who undertake lengthy commutes are predominantly resident in either Sydney (28 per cent) or Melbourne (26 per cent). These two cities alone contribute 54 per cent of lengthy commuters, compared to 39 per cent of all commuters and 40 per cent of Australian employed persons. Residents of Brisbane and Perth account for a fairly similar proportion of lengthy commutes and of employment. The state balances of New South Wales, Victoria and Queensland are all very much under-represented amongst lengthy commutes, relative to their share of national employment.

The PC's *Community Survey 2011* is another source of information on how commuting times vary across Australia's cities. Table 5.3 shows the average commuting trip duration (in minutes) and the prevalence of lengthy commutes (as a percentage) for a range of metropolitan and regional cities, based on this survey.

Table 5.3 Average commuting trip duration and prevalence of lengthy commutes for selected metropolitan and regional cities, Productivity Commission *Community Survey*, 2011

Cities*	Average commuting trip duration (minutes)	Proportion of employed persons with lengthy commutes (per cent)
Sydney	39.2	39.2
Brisbane	37.1	34.1
Melbourne	35.3	32.0
Wollongong	31.3	23.4
Perth	30.0	23.6
Newcastle	29.6	20.8
Adelaide	27.7	17.7
Hobart	25.0	12.2
Canberra-Queanbeyan	24.7	10.7
Darwin	20.6	5.6
Albury-Wodonga	18.2	3.8
Launceston	17.8	9.4
Other cities^	23.5	10.2
All cities (selected)	33.4	28.5

Notes: The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. The survey covers 24 Australian metropolitan areas and regional cities. A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. Data is weighted to be representative of the total in-scope population.

* Cities with a sample of more than 100 responses to the commuting time question are individually presented here and the cities are sorted based on average commuting trip duration.

^ Other cities include Geelong, Gold Coast-Tweed Heads, Sunshine Coast, Toowoomba, Townsville, Cairns, Geraldton-Greenough, Mount Gambier and Alice Springs.

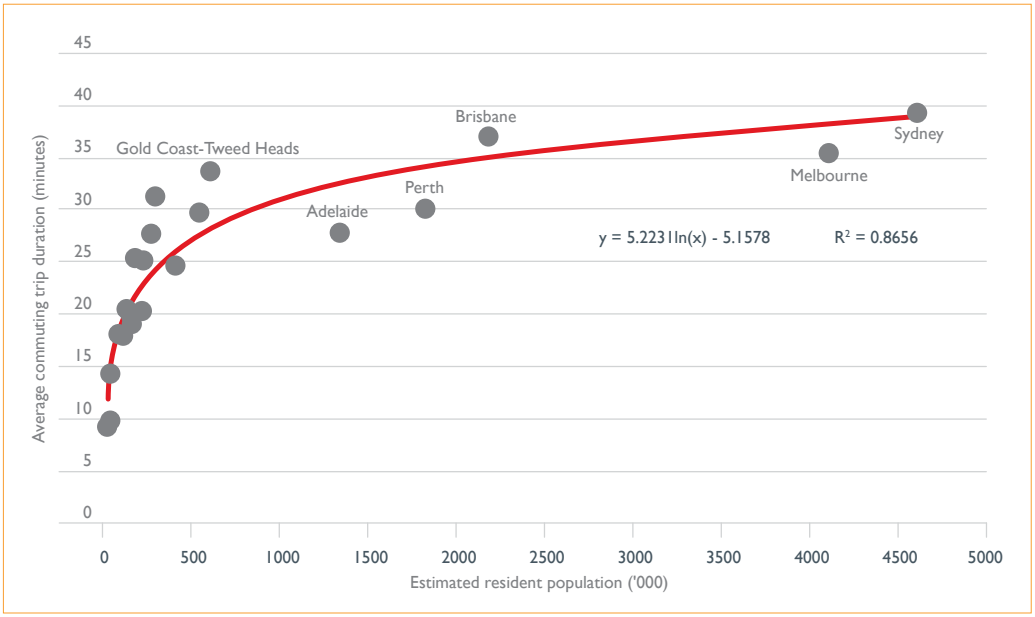
Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments,* Research Report, Canberra.

Among the cities listed in Table 5.3, only Sydney, Melbourne and Brisbane have a longer average commuting trip duration and a higher prevalence of lengthy commutes than the respective 'all cities' average for these two measures. For all other individual cities and for the combined 'other cities' category, these two measures are lower than the average for all cities. Darwin and Albury-Wodonga stand out with a particularly low prevalence of lengthy commutes.

Previous research has identified a positive association between city size and commuting times. For example, the American Association of State Highway and Transportation Officials (2013, p.14) concluded that 'in general, large metropolitan agglomerations, with a propensity for greater congestion, longer commute possibilities (larger metro areas), and greater transit use, tend to have higher travel times'. Turcotte (2011) also identify a positive relationship between a city's population size and its commuting times.

To explore this connection further, Figure 5.4 illustrates the relationship between each city's estimated resident population and its average commuting trip duration for the set of cities included in the PC *Community Survey* 2011. Estimates of average commuting trip duration and population in these selected metropolitan and regional cities showed a statistically significant non-linear (logarithmic) relationship with a highly significant correlation of regression ($R^2 = 0.8656$).

Figure 5.4 Relationship between the estimated resident population and the average commuting trip duration of a city, Productivity Commission *Community Survey*, 2011



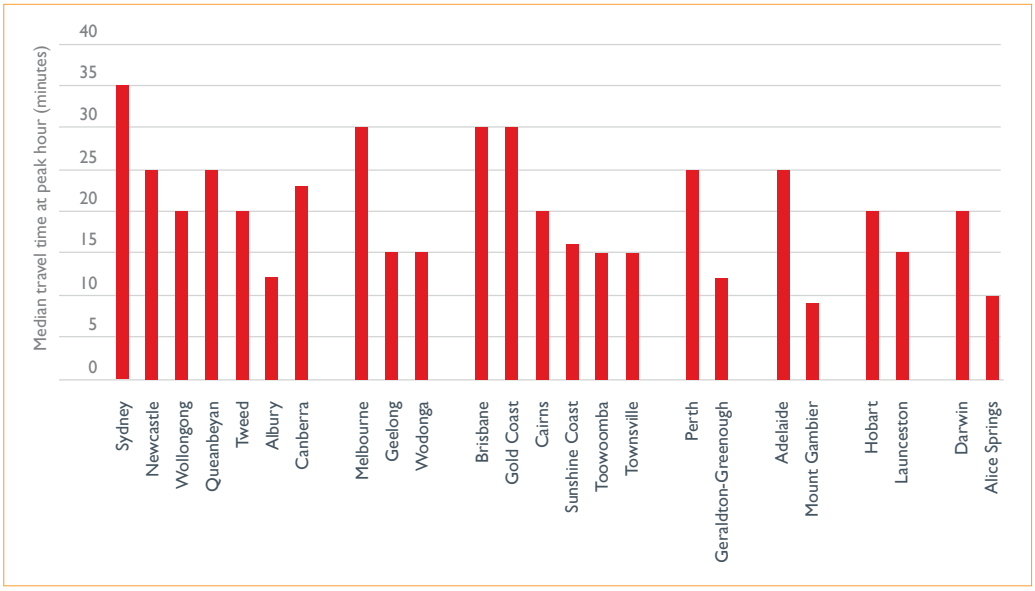
Note: Each of the plotted points represents the results for a particular metropolitan or regional city.

Sources: BITRE analysis of ABS (2015a) and unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments,* Research Report, Canberra.

While there is some variation around the line of best fit, the population of a city will generally be quite a useful predictor of its average commuting trip duration. Note that this relationship implies that a city of 30 000 population will have a predicted commuting time of about 13 minutes, compared to about 25 minutes for a city of 300 000 and about 37 minutes for a city of 3 million population.

The *median* travel time for commuters who travel from home to work during peak time in 24 Australian metropolitan and regional cities was presented in the 'Productivity Commission Research Report (Volume 1)' (PC 2011) and is reproduced in Figure 5.5.The median commuting time shows a similar ordering across cities to the average commuting trip duration. People in Sydney have the longest median commuting times (35 minutes), followed by Melbourne, Brisbane and Gold Coast (30 minutes for all three cities).The shortest median commuting time is in Mount Gambier (9 minutes).

Figure 5.5 **Median travel time at peak hour in selected metropolitan and regional cities, Productivity Commission *Community Survey*, 2011**



Note: For some of the cities presented, there was a sample of less than 100 responses to the commuting time question (e.g. Gold Coast, Geelong, Cairns, Launceston).

Source: Productivity Commission (2011).

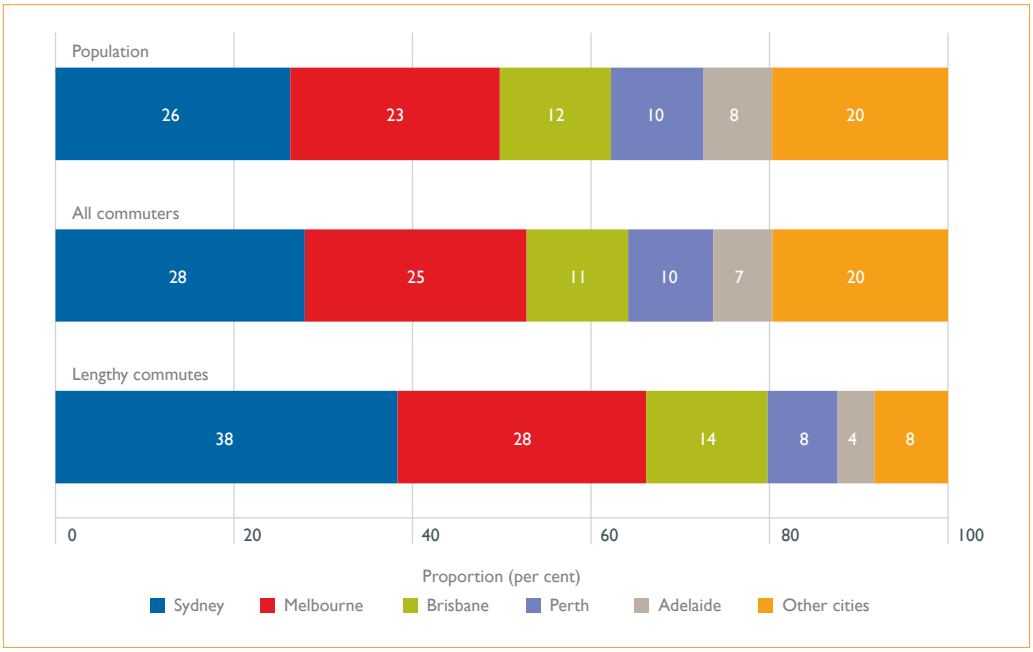
Figure 5.6 shows how people with lengthy commutes are distributed across the five main cities and other selected cities.[36] It also includes a comparison to all commuters and to the total estimated resident population of these cities.

Those who undertake lengthy commutes are predominantly resident in either Sydney (38 per cent) or Melbourne (28 per cent). These two cities alone contribute nearly two-thirds (66 per cent) of lengthy commuters, compared to 53 per cent of all commuters and 49 per cent of the estimated resident population of the selected cities. Residents of Brisbane are also over-represented amongst lengthy commuters, as they account for 14 per cent of lengthy

36 This chart differs from Figure 5.3 in that its scope is restricted to the 24 selected cities that form the basis of the PC survey (while Figure 5.3 has a national scope).

commutes, but represent a smaller proportion of total commuters and of population. Perth residents account for 8 per cent of lengthy commutes and Adelaide residents for 4 per cent, but both cities are under-represented relative to their population shares. The other selected cities are very much under-represented amongst lengthy commutes (8 per cent), compare to their share of estimated resident population (20 per cent).

Figure 5.6 Proportion of commuters at peak hour in selected metropolitan and regional cities, Productivity Commission *Community Survey*, 2011



Note: A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. The PC survey data is weighted to be representative of the total in-scope population. Other cities include Newcastle, Wollongong, Albury-Wodonga, Geelong, Gold Coast-Tweed Heads, Sunshine Coast, Cairns, Townsville, Toowoomba, Hobart, Launceston, Darwin, Alice Springs, Geraldton-Greenough, Mount Gambier and Canberra-Queanbeyan.

Sources: BITRE analysis of ABS (2015a) and unit record data from PC *Commuting Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), *Performance benchmarking of Australian business regulation: planning, zoning and development assessments,* Research Report, Canberra.

The Sydney *Household Travel Survey* (HTS) provides estimates of the prevalence of lengthy commutes for three cities—Sydney, Newcastle and Wollongong. As previously noted, the rate of prevalence of lengthy commutes is 28.8 per cent for the Sydney Greater Capital City Statistical Area (GCCSA), according to the HTS. If we define the cities of Newcastle and Wollongong according to the Local Government Area (LGA) based boundaries used for the PC survey,[37] the prevalence of lengthy commutes is 10.4 per cent for Newcastle and 13.9 per cent for Wollongong.[38] Even though Newcastle has a considerably larger population than Wollongong, it has a lower prevalence of lengthy commutes. This is influenced by Wollongong

37 The PC *Community Survey defines Newcastle as the aggregate of the LGAs of Newcastle, Lake Macquarie, Maitland, Port Stephens and Cessnock, while Wollongong is defined as the aggregate of the LGAs of Wollongong, Shellharbour and Kiama.*

38 While the PC survey also estimates that the prevalence of lengthy commutes is higher in Wollongong than Newcastle, it delivers much higher estimates for both cities (see Table 5.3). This will be influenced by the PC survey's restriction to focus just on peak hour commuting times, and also its prompting to provide the entire 'door to door' travel time.

having a much higher proportion of its employed residents commuting to work in Sydney, at 15 per cent, compared to 4 per cent for Newcastle in 2006, according to BITRE (2012a).

The Victorian Integrated Survey of Travel and Activity (VISTA) provides information on the commuting patterns of residents of Melbourne and selected Victorian regional cities (i.e. Geelong, Ballarat, Bendigo, Latrobe and Shepparton).[39] Based on the 2009–10 survey, on an average weekday, 38 per cent of journeys to and from work by Melbourne residents involved a commuting journey duration of 45 minutes or more.[40] In comparison, 20 per cent of residents of the regional cities undertook lengthy commutes. The prevalence of lengthy commutes was relatively high for Victoria's second largest city of Geelong (29 per cent), and ranged between 12 and 17 per cent for the smaller cities. The higher rate of prevalence for Geelong is not just a factor of city size, but is also influenced by the relatively high proportion of Geelong's employed residents that commute to a place of work in Melbourne (BITRE 2011, p.211).

Spatial differences within cities

The Sydney HTS, the VISTA survey and the PC *Community Survey* all provide information on spatial differences in the prevalence of lengthy commutes within Australian cities. The spatial analysis in this section is based on the Local Government Area (LGA) of residence.

HTS—spatial differences within the Sydney GMA

Spatial differences in the prevalence of lengthy commutes within the Sydney GMA were previously highlighted in Table 4.2. The Sydney GCCSA had a much higher prevalence of lengthy commutes (28.8 per cent) than the rest of the GMA (11.1 per cent). Within the Sydney GCCSA, a relatively low proportion of Inner ring residents undertook lengthy commutes (24.0 per cent). For Middle and Outer ring residents, the proportion of commuting trips that were 45 minutes or more in duration was higher, at 31.6 and 29.1 per cent, respectively.

Map 5.1 maps how the rate of prevalence of lengthy commutes varies across LGAs of residence within the Sydney GMA. The lowest rates of lengthy commuting trips are concentrated outside of the Sydney GCCSA, in the Lower Hunter and Illawarra. Only 4 per cent of residents of the Shoalhaven and Shellharbour LGAs (in the southern part of the Illawarra) undertake lengthy commutes and only 6 per cent of Newcastle LGA residents undertake lengthy commutes. There is also a cluster of LGAs within a 10km radius of the Sydney Central Business District (CBD) that have a relatively low proportion of residents with lengthy commutes, including Botany Bay (17 per cent), Woollahra and Willoughby (19 per cent each), and North Sydney and the City of Sydney LGA (21 per cent each). In the outer suburbs of Sydney, the Penrith LGA stands out with a lower proportion of lengthy commutes (22 per cent) than surrounding LGAs.

The LGAs with the highest incidence of lengthy commutes are scattered through Sydney's middle ring suburbs and located between 10 and 20 kilometres from the CBD—Burwood (39 per cent), Auburn (38 per cent), Manly (36 per cent), Ku-ring-gai (36 per cent) and Hurstville (35 per cent). These LGAs have average commuting distances of between 10 and 14 kilometres, compared to

39 VISTA data is available online. For further information see <www.dtpli.vic.gov.au/transport/research-and-data/statistics/victorian-integrated-survey-of-travel-and-activity#reports>

40 The VISTA duration data relates to the concept of a journey from home to work (or work to home). A journey merges all the trips made between home and a main destination. It is therefore similar to the HTS concept of a tour leg.

15 kilometres for the GMA. However, average commuting trip travel speeds tend to be quite slow (averaging 16–23 kilometres per hour) for residents of these five LGAs.

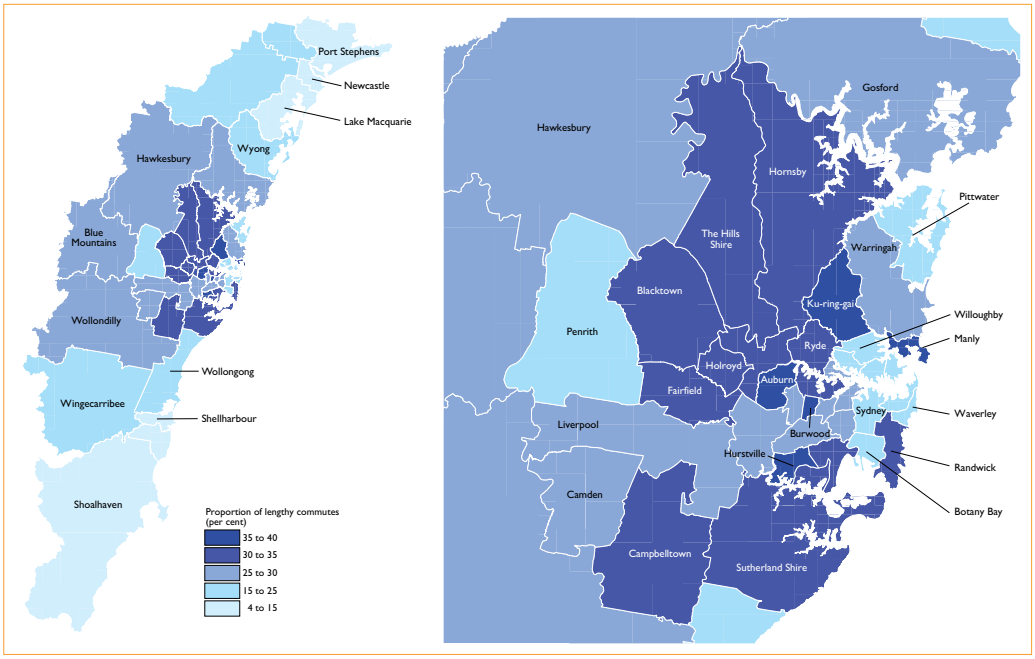
There is a large cluster of LGAs in Sydney's north-western suburbs (including the growth LGAs of Blacktown and The Hills Shire) that have between 30 and 35 per cent undertaking lengthy commutes, as well as smaller clusters of LGAs to the south of the city.

Many of Sydney's urban fringe LGAs—such as Camden, Wollondilly, Liverpool, Blue Mountains, Penrith, Hawkesbury, Gosford and Wyong—have only a moderate incidence of lengthy commutes, with between 16 and 30 per cent[41] of commuters travelling 45 minutes or more one-way. This reflects the small proportion (less than 10 per cent, according to the HTS) of employed residents of each of these LGAs who commute to work in the CBD.[42] Instead, residents of these urban fringe LGAs tend to work locally or commute to work in a neighbouring LGA. The HTS data also shows that average commuting trip travel speeds also tend to be considerably higher for residents of outer suburban LGAs (33 kilometres per hour), compared to residents of the inner and middle suburbs (16 and 21 kilometres per hour, respectively). Thus, even though residents of these urban fringe LGAs tend to have higher than average commuting distances, those distances can be travelled comparatively quickly.

41 Recall that the Sydney GCCSA average rate of prevalence is 28.8 per cent (see Table 4.2).

42 See also BITRE (2012, p.257) which shows that for each of these LGAs the proportion commuting to a place of work in the CBD was less than 10 per cent in 2006.

Map 5.1 HTS rate of prevalence of lengthy commuting trips for Local Government Areas of residence, Sydney Greater Metropolitan Area, 2008–2013



Notes: Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. Departure and arrival times are used to derive trip duration. A lengthy commuting trip is one with a (one-way) trip duration of 45 minutes or more. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

The proportion of lengthy commutes displays a very similar spatial pattern across LGAs to the average commuting trip duration measure, which is not presented here. However, there are a few LGAs which are ranked quite differently on the two measures. The Sydney urban fringe LGA of Wollondilly is ranked 31 of the 53 LGAs in terms of the prevalence of lengthy commutes, but has the 3rd highest average commuting trip duration (after Auburn and The Hills Shire).[43] The Blue Mountains and Gosford LGAs are also ranked relatively highly in terms of average commuting trip duration, and midrange for the proportion of lengthy commutes.

Some of the LGAs with a high proportion of lengthy commutes have relatively low populations. To better understand the geographic distribution of individuals who undertake lengthy commutes, Map 5.2 presents the number of individuals undertaking lengthy commutes in each LGA of residence.

The outer north-western LGA of Blacktown contains 43 800 individuals who undertook lengthy commutes, contributing 7.1 per cent of the GMA total. This LGA was also the principal contributor to Sydney's population growth over the past decade (BITRE 2012a). The prevalence of lengthy commutes in the Blacktown LGA was only slightly above the Sydney GCCSA

43 The average commuting trip duration of 37 minutes for Wollondilly is strongly influenced by the relatively high proportion of commuters taking commuting trips of between 30 and 45 minutes.

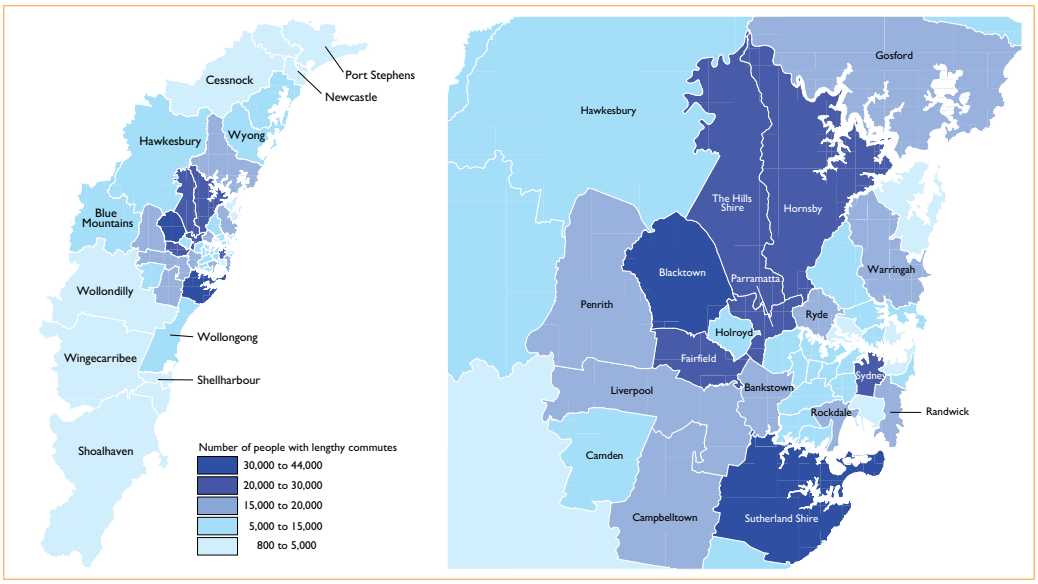
average, at 30 per cent. However, the LGA's very large (and growing) population base has led to it being the single largest geographic source of lengthy commutes in Sydney.

Other LGAs where a large number of residents undertake lengthy commutes include the Sutherland Shire (31 500), The Hills Shire (29 400), Parramatta (27 400), Fairfield (26 400), Hornsby (25 400) and the City of Sydney (23 500). The first five of these LGAs all have an above-average prevalence of lengthy commutes, of between 32 and 35 per cent. However, the City of Sydney has a relatively low incidence of lengthy commutes (21 per cent), and its significant contribution arises largely from the size of its population base.

Given the proximity of all City of Sydney residents to the CBD's very large concentration of jobs, it is perhaps surprising that as many as 21 per cent of resident commuters would have a one-way commuting trip duration of 45 minutes or more. The majority of the lengthy commuters who reside in the City of Sydney (72 per cent) have a place of work located outside the City of Sydney, with Parramatta, Willoughby and Strathfield amongst the most common work locations. In contrast, only 23 per cent of City of Sydney residents with a commuting trip duration of under 45 minutes work outside the City of Sydney.

The middle ring LGAs which stood out in Map 5.1 as having a particularly high prevalence rate for lengthy commutes (i.e. Hurstville, Burwood, Auburn, Manly and Ku-ring-gai), do not have a particularly large number of individuals undertaking lengthy commutes in Map 5.2, due to their lower population base.

Map 5.2 HTS number of people with lengthy commuting trips by LGA of residence, Sydney GMA, 2008–2013



Notes: Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. Departure and arrival times are used to derive trip duration. A lengthy commuting trip is one with a (one-way) trip duration of 45 minutes or more. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

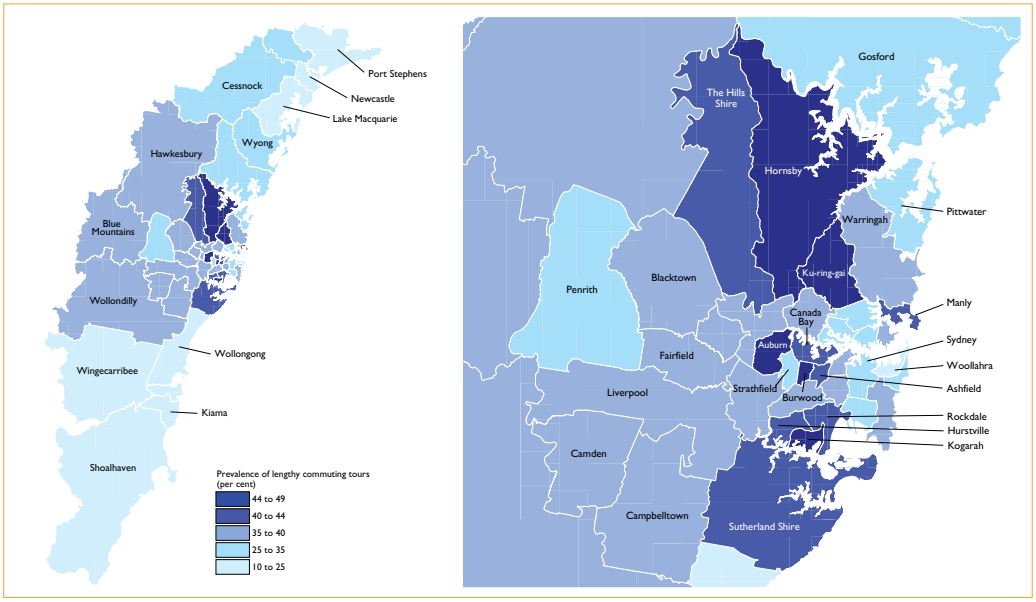
As outlined in Box 4.1, the HTS data also identifies 'home to work' and 'work to home' tours, which can be comprised of one or more linked trips. This data has been used by BITRE to construct a measure of the prevalence of lengthy commuting tours. Map 5.3 maps this measure for all LGAs in the Sydney GMA.

The lowest rates of lengthy commuting tours (i.e. tours of 45 minutes or more from 'home to work' or 'work to home') are located in the Lower Hunter and Illawarra, particularly in Shoalhaven, Shellharbour and Newcastle (12 per cent each). However, the Woollahra LGA in Sydney's inner eastern suburbs also has a relatively low prevalence of lengthy commutes (25 per cent). The Penrith and Strathfield LGAs also stand out as having a lower prevalence of lengthy commutes than the LGAs that surround them.

As was the case for lengthy commuting trips (Map 5.1), the LGAs with the highest prevalence of lengthy commuting tours (Map 5.3) are predominantly middle ring suburbs located 10 to 20 kilometres from the CBD. They include Ku-ring-gai (in which 49 per cent of commuting tours are 45 minutes or longer), Burwood (48 per cent), Auburn (46 per cent) and Kogarah (44 per cent). The Hornsby LGA is further from the CBD but also has a very high prevalence of lengthy commuting tours (44 per cent).

The LGAs on Sydney's urban fringe generally do not have a particularly high prevalence of lengthy commuting tours. However, The Hills Shire (43 per cent) and Sutherland Shire (41 per cent) are two key exceptions, exceeding the GMA average prevalence of 34 per cent and the Sydney GCCSA average prevalence of 37 per cent.

Map 5.3 HTS rate of prevalence for lengthy commuting tours by LGA of residence, Sydney GMA, 2008–2013



Notes: Based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing linked trips, and excludes time spent at stopovers. A lengthy commuting tour is one with a (one-way) tour duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

VISTA—spatial differences within Melbourne

The *Victorian Integrated Survey of Travel and Activity* (VISTA) provides information on the duration of commuting journeys undertaken by residents of Melbourne LGAs. A journey from home to work (or work to home) merges all the trips made between home and a main destination (or the main destination and home). It is therefore similar to the HTS concept of an outward or return tour. However, while the HTS tour data presented in Map 5.3 relates to an average day, the VISTA journey data relates to an average weekday (and the duration estimates are consequently higher). Based on the 2009–10 survey, on an average weekday, 38 per cent of journeys to and from work by Melbourne residents involved a commuting journey duration of 45 minutes or more.

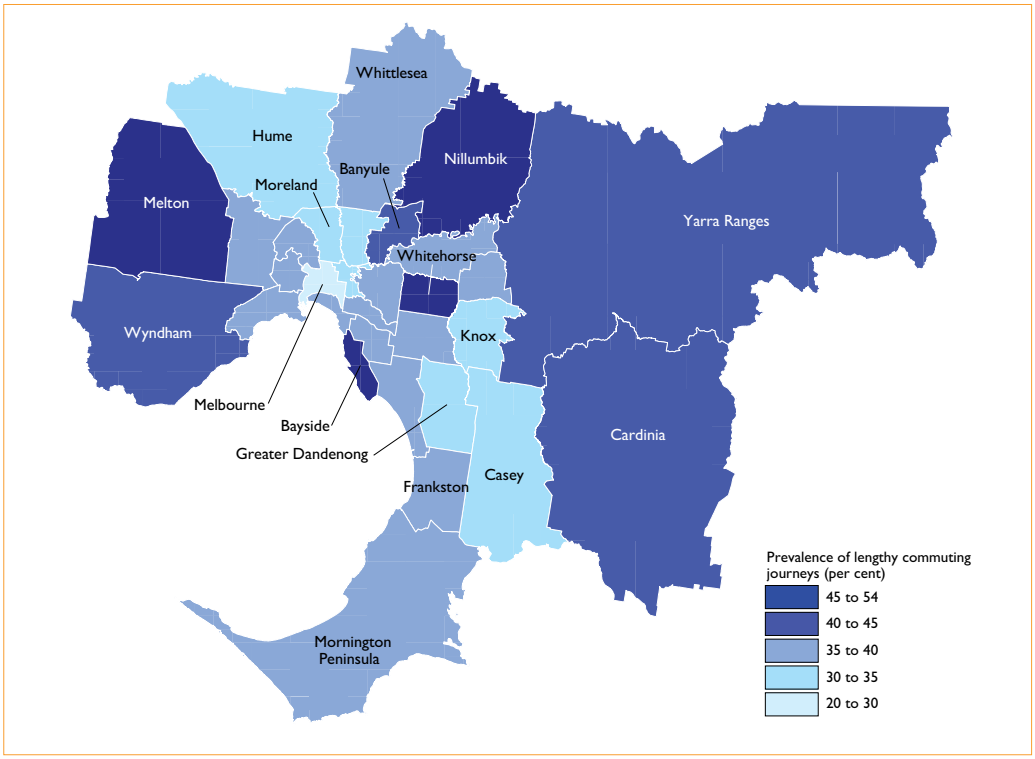
The VISTA survey data relates to a single year—whereas the HTS survey data relates to five years of pooled data—and consequently estimates for individual LGAs in Melbourne can have reasonably high RSEs. For this reason, the estimates of the rate of prevalence of lengthy commuting journeys for Melbourne's LGAs are presented only in the form of broad ranges (as used in Map 5.4), rather than as point estimates.

Map 5.4 shows that the central LGA of the City of Melbourne has the lowest prevalence of lengthy commutes. There are two principal clusters of LGAs with a below-average incidence of lengthy commuting journeys:

- a cluster that stretches north and east of the CBD and includes the Melbourne, Moreland, Hume, Darebin and Yarra LGAs
- a cluster in the outer south-eastern suburbs, that includes the Knox, Greater Dandenong and Casey LGAs.

The highest incidence of lengthy commutes occurs in a mix of middle suburban LGAs (such as Whitehorse and Bayside) and urban fringe LGAs (such as Melton and Nillumbik). Above-average prevalence rates are also observed in the urban fringe LGAs of Wyndham, Yarra Ranges and Cardinia, as well as in the middle suburban LGA of Banyule.

Map 5.4 VISTA rate of prevalence of lengthy commuting journeys for LGAs of residence, Melbourne, 2009–10



Notes: Based on commuting journeys from home to work or work to home on an average weekday. A journey merges all the trips made between home and a main destination. A lengthy commuting journey is one with a (one-way) journey duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of Victorian Integrated Survey of Travel and Activity (VISTA) data for 2009–10, using VISTA's online tabulation software.

The Melbourne LGA with the largest number of people commuting 45 or more minutes one-way to or from work is the Casey LGA, with residents undertaking 58 800 lengthy one-way commuting journeys on an average weekday. Note that the Casey LGA has a prevalence rate of 34 per cent, which is below the Melbourne-wide average of 38 per cent. The Casey LGA

has a very large, and growing, population base. Other LGAs with a large number of lengthy commutes by residents include Whitehorse (56 000) and Wyndham (54 900).

PC Community Survey—spatial differences within major cities

Map 5.5 shows the spatial differences in the prevalence of lengthy commuting trip duration within the five largest cities (i.e. Sydney, Melbourne, Brisbane, Perth and Adelaide), based on the PC's *Community Survey 2011*.

In Sydney, there were several outer and middle suburban LGAs (such as Warringah, Parramatta, Kogarah, Hornsby, Penrith and Ku-ring-gai) where more than 50 per cent of commuters undertook lengthy commutes. This is well above the PC survey's average prevalence of lengthy commutes for Sydney, which was 39 per cent (see Table 4.3). Similarly, a large number of LGAs had a prevalence of lengthy commutes of between 40 and 50 per cent. There are three LGAs (Sydney, Lane Cove and Woollahra) where the prevalence of lengthy commutes is under 20 per cent, and all are fairly centrally located LGAs.

For Melbourne, the average prevalence of lengthy commutes was 32 per cent (refer Table 4.3). Of the 31 LGAs, only two LGAs (Cardinia and Manningham) had a prevalence of more than 50 per cent, while another 7 LGAs (Wyndham, Brimbank, Banyule, Hobsons Bay, Bayside, Melton and Whittlesea) had a prevalence of between 40 and 50 per cent. The City of Melbourne, Yarra and Stonnington LGAs all had a prevalence of less than 20 per cent. All three of these LGAs are centrally located.

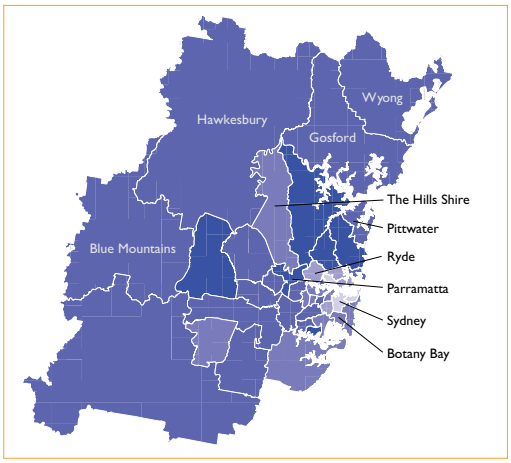
In Brisbane, two LGAs (Ipswich and Logan) had the highest prevalence of lengthy commutes (more than 40 per cent). The average prevalence of lengthy commutes for Brisbane was 34 per cent (see Table 4.3). The City of Brisbane LGA had a relatively low prevalence with less than 20 per cent of peak hour commutes to work taking 45 minutes or more.

For Perth, the average prevalence of lengthy commutes was 24 per cent (refer Table 4.3). There were two LGAs (Serpentine-Jarrahdale and Joondalup) that had a prevalence of more than 50 per cent and another two LGAs (Rockingham and Wanneroo) that had a prevalence of between 40 and 50 per cent. On the other hand, a large number of more centrally located LGAs had a prevalence of lengthy commutes of less than 20 per cent.

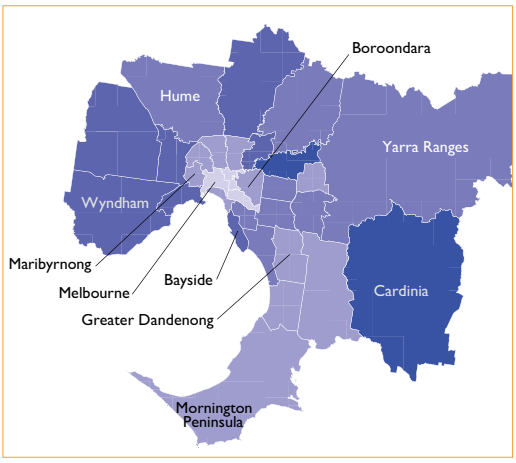
In Adelaide, two LGAs (Onkaparinga and Mallala) had the highest prevalence of lengthy commutes (more than 40 per cent). This is much higher than the average prevalence of lengthy commutes for Adelaide, which was only 18 per cent (see Table 4.3). There were three LGAs (Marion, Mount Barker and Adelaide Hills) which had a prevalence of 30 to 40 per cent. On the other hand, there were numerous LGAs (including both inner and outer suburban LGAs) where the proportion undertaking lengthy commutes was less than 20 per cent.

Map 5.5 Prevalence of lengthy commuting trips by LGA of residence, Sydney, Melbourne, Brisbane, Perth and Adelaide, Productivity Commission *Community Survey*, 2011

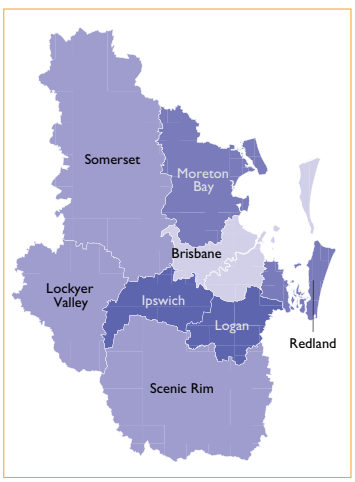
(a) Sydney



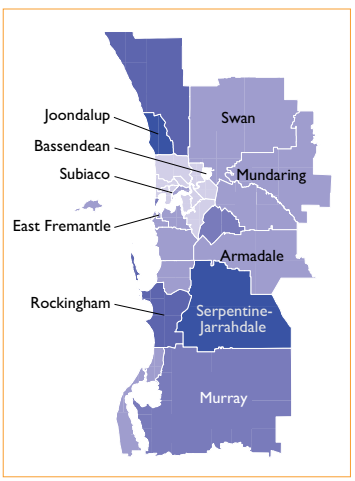
(b) Melbourne



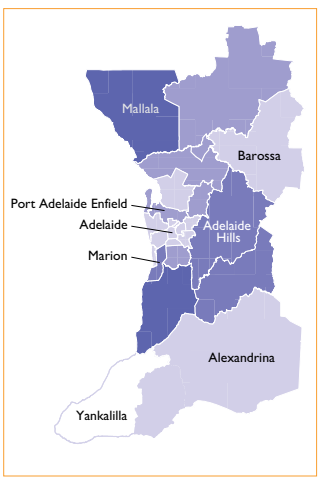
(c) Brisbane



(d) Perth



(e) Adelaide



Prevalence of lengthy commuting trip duration (per cent)

- 50 to 65
- 40 to 50
- 30 to 40
- 20 to 30
- 1 to 20
- Data not available

Note: A lengthy commuting trip is one with a trip duration of 45 minutes or more. Commuting trip duration data are not available for four LGAs in Perth (Claremont, Mosman Park, Peppermint Grove and Bassendean) and one LGA in Adelaide (Yankalilla).

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011): *Performance benchmarking of Australian business regulation: planning, zoning and development assessments.*

In conclusion, in all five cities, relatively central LGAs had the lowest prevalence of lengthy commutes, while the highest prevalence of lengthy commutes occurred in a mix of middle and outer suburban LGAs. In addition, the state government travel surveys show different Sydney and Melbourne LGAs as having the highest prevalence of lengthy commutes (refer Maps 5.3 and 5.3), compared to the PC *Community Survey* data in Map 5.5. This probably reflects the different survey concepts and methods. However, the LGAs with the lowest prevalence of lengthy commutes are similar across the different datasets.

Spatial trends

Chapter Four revealed a significant increase in the national prevalence of lengthy commutes between 2002 and 2012. This national increase was very much concentrated between 2002 and 2007, with no significant change occurring since 2007. This section uses HILDA data to explore whether these national trends are repeated across the different types of regions and for individual cities.

Table 5.4 shows the percentage point change in the prevalence of lengthy commutes between 2002 and 2012 (and the two contributing subperiods) for each of the HILDA region type classifications. Over the entire 2002 to 2012 period, the increase in the prevalence of lengthy commutes was relatively large for the five major capitals (5.8 percentage points), as well as for the major cities remoteness class and the major urban section of state category (5.6 percentage points, each). There was a smaller, but still statistically significant, increase in the prevalence of lengthy commutes for 'other locations' (outside the five major capitals) and for other urban centres of between 1000 and 99 999 population. There was no significant change in the prevalence of lengthy commutes for inner regional areas, outer regional and remote areas, or bounded localities and the rural balance.

In the earlier subperiod from 2002 to 2007, significant increases in the prevalence of lengthy commutes were observed for the most urbanised categories (i.e. five major capitals, major cities and major urban areas). In the more recent subperiod from 2007 to 2012, none of the different types of region recorded a statistically significant change in the prevalence of lengthy commutes.

Between 2002 and 2012, the largest increases in the prevalence of lengthy commutes were observed in Australia's largest cities, and these increases were heavily concentrated between 2002 and 2007. Locations outside the five major capitals and urban centres of between 1000 and 99 999 population recorded more modest increases in the prevalence of lengthy commutes, and these increases were fairly evenly split between the two subperiods.

The number of individuals undertaking lengthy commutes (of 45 minutes or more) increased from 1.30 million persons in 2002 to 2.02 million persons in 2012, representing an increase of 720 000 persons nationally. The increase was concentrated in the larger cities, particularly Melbourne (29.6 per cent) and Sydney (20.9 per cent), with Brisbane (12.7 per cent), Perth (10.3 per cent) and the rest of Queensland (7.8 per cent) also making a significant contribution.

Table 5.4 HILDA percentage point change in the prevalence of lengthy commutes by region type, Australia, 2002 to 2012

Region type of residence	2002 to 2007		2007 to 2012		2002 to 2012	
	Percentage point change	Is this significant?	Percentage point change	Is this significant?	Percentage point change	Is this significant?
Five major capitals	6.2	Yes	–0.4	No	5.8	Yes
Other locations	1.7	No	1.5	No	3.2	Yes
Major cities	5.9	Yes	–0.3	No	5.6	Yes
Inner regional	0.9	No	2.4	No	3.2	No
Outer regional and remote	2.8	No	0.5	No	3.3	No
Major urban	5.9	Yes	–0.3	No	5.6	Yes
Other urban	1.8	No	1.9	No	3.7	Yes
Bounded localities and rural balance	2.6	No	0.8	No	3.4	No

Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data in table is weighted so as to be representative of total in-scope population. Standard errors and confidence intervals were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). The cells shaded in blue are those that displayed a statistically significant change (at the 95 per cent confidence level) over the relevant time period.

Source: BITRE analysis of HILDA survey unit record data for wave 2 through to wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 5.5 shows the percentage point change in the prevalence of lengthy commutes between 2002 and 2012 (and the two contributing subperiods) for each of the five major capitals, individually. Between 2002 and 2012, all five cities recorded an increase in the prevalence of lengthy commutes of at least 4 percentage points, but the increase was not statistically significant for either Adelaide or Perth (reflecting the smaller HILDA samples for these two cities). The net increase in the prevalence of lengthy commutes was largest for Brisbane (7.1 percentage points), closely followed by Melbourne (6.7 percentage points) and Sydney (6.2 percentage points).

Between 2007 and 2012, none of the five cities recorded a statistically significant change in the prevalence of lengthy commutes. However, between 2002 and 2007, Sydney, Melbourne, Brisbane and Adelaide all recorded a statistically significant increase in the prevalence of lengthy commutes, with the Brisbane increase being of a particularly large magnitude (10.7 percentage points). The upward pressure on Brisbane's commuting trip durations in this period reflect the city's strong job growth—Brisbane added more jobs (119 200) than Sydney or Melbourne between 2001 and 2006 (BITRE 2013)—and relatively rapid growth in Brisbane's road traffic between 2002 and 2007.[44] These changes were reflected in a marked increase in Brisbane's morning peak period congestion delays between 2001–02 and 2006–07 (BITRE 2013). The significant increases in the prevalence of lengthy commutes in Sydney and Adelaide in this initial subperiod occurred in the context of much more modest rates of employment growth and traffic growth that were well below the national average growth rates of 2.6 and 1.8 per cent, respectively.

44 BITRE estimates that average annual growth in aggregate vehicle kilometres travelled (VKT) between 2002 and 2007 was 2.8 per cent for Brisbane, compared to 1.8 per cent for Australia as a whole. Based on BITRE vehicle kilometres travelled estimates (unpublished estimates, May 2015 update).

Table 5.5 HILDA percentage point change in the prevalence of lengthy commutes for five major capitals, Australia, 2002 to 2012

Region type of residence	2002 to 2007		2007 to 2012		2002 to 2012	
	Percentage point change	Is this significant?	Percentage point change	Is this significant?	Percentage point change	Is this significant?
Sydney	7.9	Yes	–1.7	No	6.2	Yes
Melbourne	4.8	Yes	1.9	No	6.7	Yes
Brisbane	10.7	Yes	–3.5	No	7.1	Yes
Adelaide	8.5	Yes	–4.0	No	4.5	No
Perth	–0.5	No	4.5	No	4.0	No

Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data in table is weighted so as to be representative of total in-scope population. Standard errors were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). The cells shaded in blue are those that displayed a statistically significant change (at the 95 per cent confidence level) over the relevant time period.

Source: BITRE analysis of HILDA survey unit record data for wave 2 through to wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Between 2002 and 2012, the largest increases in the prevalence of lengthy commutes were observed in Sydney, Melbourne and Brisbane (between 6.2 and 7.1 percentage points), and consistent with the national trend, these increases were heavily concentrated between 2002 and 2007. Adelaide also recorded a significant increase in the prevalence of lengthy commutes between 2002 and 2007 (but not between 2002 and 2012).

Perth does not follow this national trend (and nor do locations outside the five major capitals). While Perth's changes are not statistically significant, its increase is concentrated in the more recent (2007 to 2012) subperiod. The different patterns in the Perth data may reflect impacts of the mining boom, such as the upturn in population growth after 2006, or increased fly-in fly-out (FIFO) commuting[45] by Perth residents. The next chapter will consider many of the demographic and labour market influences on the prevalence of lengthy commutes, including factors such as occupation and industry.

45 Box 7.1 provides further information about the treatment of FIFO workers in each of this study's key datasets.

CHAPTER 6
Who undertakes lengthy commutes?

Key points

- Males have longer average commuting trip durations than females, based on all three of this study's key Australian data sources. The ratio of male to female commuting times ranges from 1.08 to 1.13 and for the proportion of lengthy commutes ranges from 1.13 to 1.28.
- The presence of children in the household increases male commuting times and decreases female commuting times and the ratio of male to female commuting times is 1.21.
- Age is an important predictor of commuting times. HILDA 2012 data shows that commuting times rise with age up to about age forty, before declining.
- Overseas-born Australians have longer commuting times and an 8 percentage point higher incidence of lengthy commutes than the people born in Australia.
- More skilled individuals tend to take longer commutes. HILDA 2012 data shows that the prevalence of lengthy commutes is much higher for those with bachelor degree or higher qualifications (27 per cent) than for those with Year 11 and below qualifications (17 per cent). It is also much higher for Professionals (28 per cent) than Labourers (17 per cent). Advanced producer services and Mining workers are over-represented amongst those with lengthy commutes, while Retail trade workers are under-represented.
- Commuting times rise with income—lengthy commutes are 21 percentage points more common for those earning over $150 000 per annum than for the lowest income earners ($1 to $19 999). Those earning more than $60 000 make up 51 per cent of lengthy commutes and 41 per cent of all commutes.
- Many previous studies have used regression analysis to identify socio-economic predictors of lengthy commutes. Gender, full-time/part-time status, income, education and region are consistently identified as significant predictors.
- BITRE has used the HILDA 2012 data as the basis of regression analysis of individuals' average commuting trip duration and whether they undertake a lengthy commute. As was the case for the overseas studies, the explanatory power of the regressions is low (with R-squared's of 9 and 12 per cent). Thus, socio-economic and spatial variables are only capable of explaining a relatively small proportion of the variation in commuting times within Australia.

- Home ownership, self-employment and full-time/part-time status were found ***not*** to be significant predictors in the regression model, as they were associated with other variables.
- The national prevalence of lengthy commutes rose by 5.0 percentage points from 2002 to 2012. Groups with an above-average increase included the foreign-born, those aged 25 to 34, full-time workers, holders of bachelor degree and higher qualifications, Professionals and Technicians and trades workers. Those earning less than $20 000 per annum had the lowest increase. The increased incidence of lengthy commutes is falling more on the relatively advantaged socio-economic groups than on the most disadvantaged groups.

Introduction

This chapter examines how the likelihood of a person undertaking a lengthy commute relates to the socio-economic characteristics of those individuals, including key demographic characteristics and employment characteristics. This will help build up a profile of the types of individuals who are most likely to engage in lengthy commutes. The chapter will also explore whether the overall HILDA trends in the prevalence of lengthy commutes are replicated for particular demographic groups.

For each socio-economic characteristic, the chapter presents an overview of the evidence from previous studies of commuting times. This is complemented by the presentation of results from the three Australian data sources that form the basis of this study. As the HILDA survey collects a much richer array of demographic, social and economic information than the Sydney *Household Travel Survey* (HTS)[46] or the Productivity Commission's (PC's) Community Survey, the majority of the Australian evidence is sourced from the HILDA survey.

The analysis in this chapter examines how the prevalence of lengthy commutes is related to each socio-economic characteristic, and using the HILDA data, examines the statistical significance of these relationships. It also presents multi-variate analysis identifying the socio-economic characteristics that are the most powerful predictors of lengthy commutes. This analysis is focused on correlations, and does not assign causality, although for some of the pre-determined demographic characteristics (e.g. gender, age, country of birth) the direction of any causal relationship is clearcut. The chapter should be read in conjunction with Chapter 8, which summarises the evidence about the effects that lengthy commutes have on family and social connections, stress, health, life satisfaction and income.

Gender

The existing literature consistently finds that men spend more time travelling to and from work than do women, and that men are much more likely to undertake lengthy commutes. For example:

- OECD (2010) reports on the average weekday commuting time for male and female commuters in 17 different countries. In all 17 countries, the male average commuting time

46 So as to minimise confidentiality concerns, BITRE requested only a limited number of socio-economic variables be included in its HTS unit record dataset, instead focusing on the trip characteristic information which is a comparative strength of the HTS. Consequently, variables such as age and income are collected in the HTS, but were not included in BITRE's HTS dataset.

was higher than the female average, with the male to female ratio ranging from a low of 1.02 in Finland to a high of 1.60 for Japan.

- Based on the 2009 *American Community Survey* (ACS), McKenzie and Rapino (2011) found that men took an average of 26.7 minutes to get to work, compared with 23.4 minutes for women.
- A Californian study by Wachs et al. (1993) found that 35.9 per cent of males had a long travel time (defined as 36 minutes or more), compared to 30.3 per cent of females.
- Using 2008 data from the United Kingdom's Labour Force Survey, McQuaid and Chen (2012) find that males travelled an average of 29 minutes to work, compared to 23 minutes for females.
- In Australia, based on the 2002 HILDA data, Flood and Barbato (2005) find that men in paid employment travelled an average of 4 hours 6 minutes to and from work per week, compared to 3 hours per week for women. For each day that men worked, they travelled an average of 50 minutes (return), compared to 44 minutes for women.
- VicHealth (2012) reports that 13.4 per cent of participating adult Victorian males commuted 60 or more minutes one-way to work, compared to 9.5 per cent of adult Victorian females.

This gender difference in commuting times can be partly explained by men having less domestic responsibilities and better-paid full-time jobs to compensate for the travel expenses (Giminez-Nadal and Molina 2015, Ohman and Lindgren 2003). Other authors attribute much of the gender difference to occupational segregation, with female employment often concentrated in the lower status and poorer paid occupations which have relatively short commuting times (Hanson and Johnstone 1985, Flood and Barbato 2005).

Table 6.1 summarises gender differences in commuting times according to the three Australian surveys that form the basis of the present study. The average commuting trip duration and proportion of lengthy commutes differ across the data sources due to differences in methodology and geographic scope. However, each of the measures shows males having a higher average commuting trip duration than females, with the proportion of lengthy commutes also being considerably higher for males than females.

Based on the HILDA survey, these gender differences are statistically significant at the 95 per cent confidence level. For Australia as a whole, males account for 59.7 per cent of those undertaking lengthy commutes, and 53.8 per cent of all commuters.

The ratio of male to female commuting times is fairly consistent across the three Australian data sources, ranging from 1.08 to 1.13. In the context of OECD countries for which results were reported in OECD (2010), this places Australia in the same range as countries such as France (1.11) and Italy (1.12), but with a much smaller gender gap than the United Kingdom (1.25), Germany (1.29), United States (1.30) or Japan (1.60).

Women are known to trip-chain[47] more than men, reflecting their greater household responsibilities (Taylor and Mauch 1998). The two Australian measures in Table 6.1 that specifically aim to reflect the entire travel time between home and work (i.e. the HTS tour-based measure and the PC Community Survey measure) provide the two lowest estimates of the male to female ratio. These two measures better capture the time spent travelling to intermediate stopovers as part of the journey between home and work. The HTS data

47 Trip chaining is the combining of trips into a 'chain' in order to get more done in a given period. An example would be picking a child up from school and/or shopping for groceries on the way home from work.

shows that, compared to males, females tend to make more intermediate stopovers for non-commuting purposes as part of their commuting tours (i.e. they undertake more trip-chaining), and fully capturing this tends to narrow the gender difference in commuting times. The greater incidence of intermediate stopovers is largely attributable to females making more stopovers to 'serve passengers' (e.g. drop off or pick up kids from school or childcare) or to go shopping. About 10 per cent of commuting tour legs by females involve a 'serve passenger' trip, compared to 6 per cent for males. About 8 per cent of these female tour legs involve a shopping trip, compared to 5 per cent for m***ales***.

Table 6.1 Gender differences in average commuting trip duration and proportion of lengthy commutes in HILDA survey, Sydney HTS and PC Community Survey

	HILDA survey, 2012	Sydney HTS, 2008–13		PC *Community Survey* 2011
		Linked commuting trips	'Home to work' and 'work to home' tours	
Average commuting trip duration (minutes)				
Males	30.4	33.5	39.6	35.0
Females	27.1	29.6	36.8	31.7
All persons	28.9	31.6	38.3	33.4
Male to female ratio	1.12	1.13	1.08	1.10
Proportion of lengthy commutes (per cent)				
Males	24.9	28.7	36.2	30.6
Females	19.5	23.1	32.0	26.3
All persons	22.4	26.0	34.1	28.5
Male to female ratio	1.28	1.24	1.13	1.16

Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Sources: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period; unit record data from PC *Community Survey* 2011, which was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011); and HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The influence of gender, presence of children and working hours (full time/part time work) on commuting trip durations are highly inter-related (McQuaid and Chen 2012). Table 6.2 shows gender differences in the HILDA commuting time variables, controlling for hours worked and presence of children.

- When full-time and part-time employment status is controlled for, the gender difference in commuting times is diminished—with a male to female ratio of 1.05 for full-time workers and 1.09 for part-time workers—and is no longer statistically significant at the national scale.
- The presence of children in the household increases male commuting times and decreases female commuting times, which is consistent with OECD (2010) findings. The gender difference in Australian commuting times is particularly large for those with children, where the male to female ratio is 1.21.

Table 6.2 Gender differences in average commuting trip duration and proportion of lengthy commutes in HILDA survey, controlling for hours worked and presence of children, Australia, 2012

	Males	Females	Male to female ratio	Is the gender difference statistically significant?
Average commuting trip duration (minutes)				
Full-time employed	31.2	29.6	1.05	No
Part-time employed	26.6	24.4	1.09	No
No children resident in household	29.8	27.6	1.08	Yes
One or more children resident in household	31.5	26.1	1.21	Yes
Proportion of lengthy commutes (per cent)				
Full-time employed	25.9	22.9	1.13	No^
Part-time employed	19.7	15.9	1.24	No
No children resident in household	23.3	20.4	1.14	No^
One or more children resident in household	27.9	17.6	1.59	Yes

Notes: Includes resident children aged 17 and under only. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data in table is weighted so as to be representative of total in-scope population. Standard errors were derived using the Taylor Series linearisation method, as recommended in Hayes (2008). Statistical significance was assessed at the 95 per cent confidence level.

^ The gender difference in this indicator was statistically significant at the 90 per cent confidence level, but not at the 95 per cent confidence level.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Age

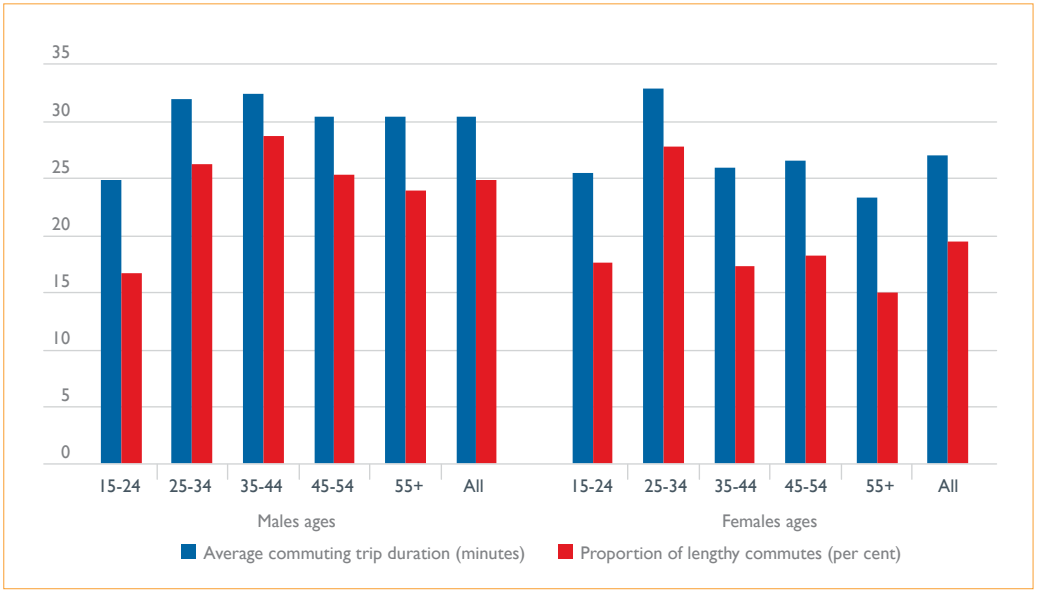
Commuting times depend on the age of the commuter, as well as their gender. Ohman and Lindgren (2003) point out that younger adults are generally more migratory, with the preference to stay put because of local attachments increasing with age. This unwillingness to move and start over again in a new place may make long-distance commuting an increasingly attractive solution with age (ibid).

The American Association of State Highway and Transportation Officials (AASHTO 2013) finds that younger workers (aged 16–24) and older workers (aged 65 plus) tend to have more shorter trips and fewer longer trips, implying shorter commuting trip durations. However, Van Ham and Hooimeijer (2009) found that age was not a statistically significant predictor of long commutes in the Netherlands. Closer to home, VicHealth (2012) identified no statistically significant differences across age categories with respect to the proportion who commute 60 minutes or more one-way to work.

Figure 6.1 uses HILDA data to illustrate how commuting times vary with age in Australia. The relationship is different for males and females. For males, the two commuting time indicators are at their lowest for the 15–24 age group and at their peak for the 35–44 age group. For females, the two indicators are at their lowest for the 55 plus age group and at their peak for the 25–34 age group. Both indicators are significantly lower than the national gender averages

for males aged 15–24 and females aged 55 plus, and significantly higher than the national gender average for females aged 25–34. All remaining estimates do not differ significantly from the national gender benchmarks at the 95 per cent confidence level.

Figure 6.1 HILDA average commuting trip duration and proportion of lengthy commutes by gender and age group, Australia, 2012



Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

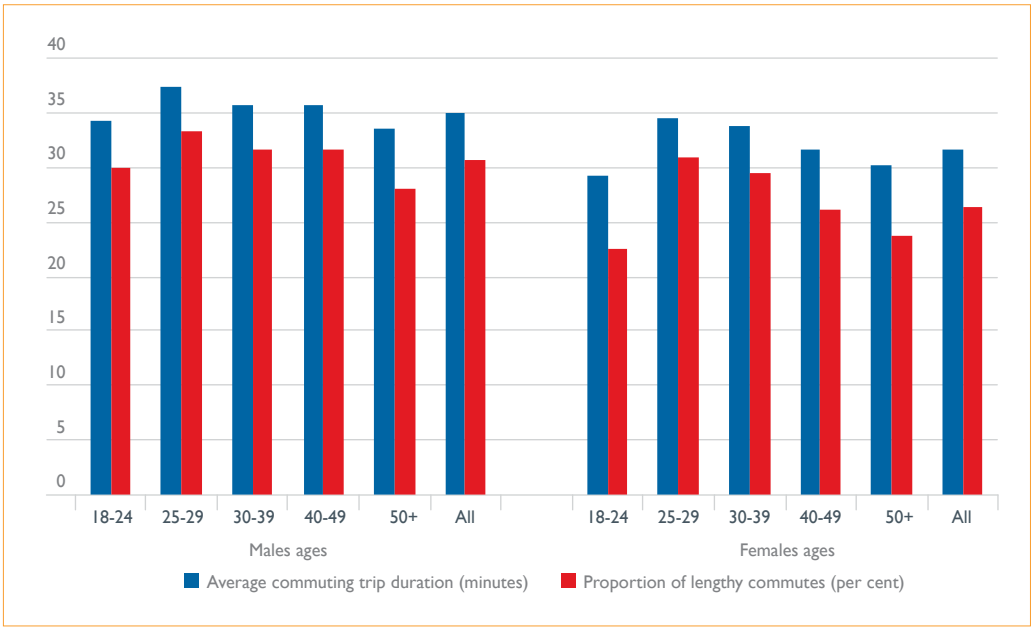
Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Significance testing reveals that male and female average commuting trip durations (and the proportion of lengthy commutes) do not differ significantly from each other for 15–24 or 25–34 year olds, but for each of the older age groups, males have a significantly higher duration (and proportion of lengthy commutes) than females. This may reflect the different gender impacts of child-rearing responsibilities and full-time/part-time status on commuting times (see Table 6.1).

Nationally, people aged 25 to 34 make up the largest proportion of those undertaking lengthy commutes (26 per cent), followed by those aged 35 to 44 (24 per cent) and those aged 45 to 54 (22 per cent). People aged 15 to 24 and 55 and over make up relatively small shares of lengthy commutes, at 13 and 15 per cent, respectively.

The PC's *Community Survey* also provides information on the relationship between commuting times and age, but uses different age categories. Figure 6.2 presents the two commuting time indicators, disaggregated by age and gender. Generally, commuting trip durations follow a hump-shaped pattern for both males and females, being relatively low for 18–24 year olds, peaking for 25–29 year olds, and then tending to decline with age.

Figure 6.2 PC *Community Survey* average commuting trip duration and proportion of lengthy commutes by gender and age group, selected cities, 2011

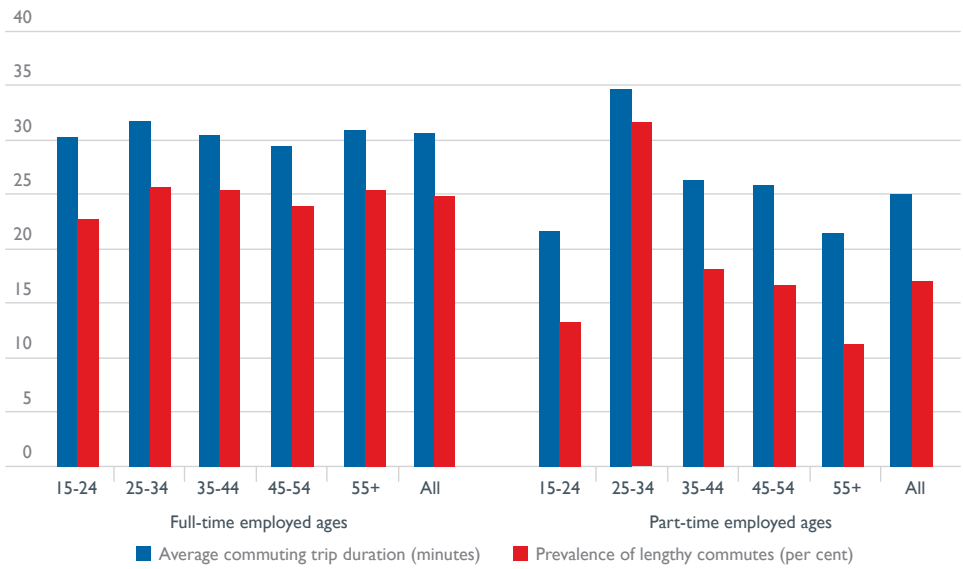


Notes: The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. The survey covers 24 Australian metropolitan areas and regional cities. Data in table is weighted so as to be representative of total in-scope population. The 50 to 64 and 65 plus age groups were combined, due to small samples in the 65 plus age group.

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011).

The relationship between age and commuting times is also inter-related with hours worked, as shown in Figure 6.3 using HILDA data. There is no statistically significant difference in the commuting times (or prevalence of lengthy commutes) of full-time employed persons across the different age categories. However, there is considerable variation in the commuting times of part-time employed persons according to their age. Those aged between 25 and 34 have an average commuting trip duration that significantly exceeds the part-time employed benchmark of 25.1 minutes, while those aged 15 to 24 or 55 and over have an average commuting trip duration that is significantly below the national benchmark. Those aged between 25 and 34 have a prevalence of lengthy commutes that significantly exceeds the part-time employed benchmark of 17.1 per cent, while those aged 55 and over have a prevalence that is significantly below the national benchmark.

Figure 6.3 HILDA average commuting trip duration and prevalence of lengthy commutes by age and employment status, Australia, 2012



Notes: Those who usually work 35 hours or more per week are classified as full-time employed and all other employed persons are classified as part-time employed. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

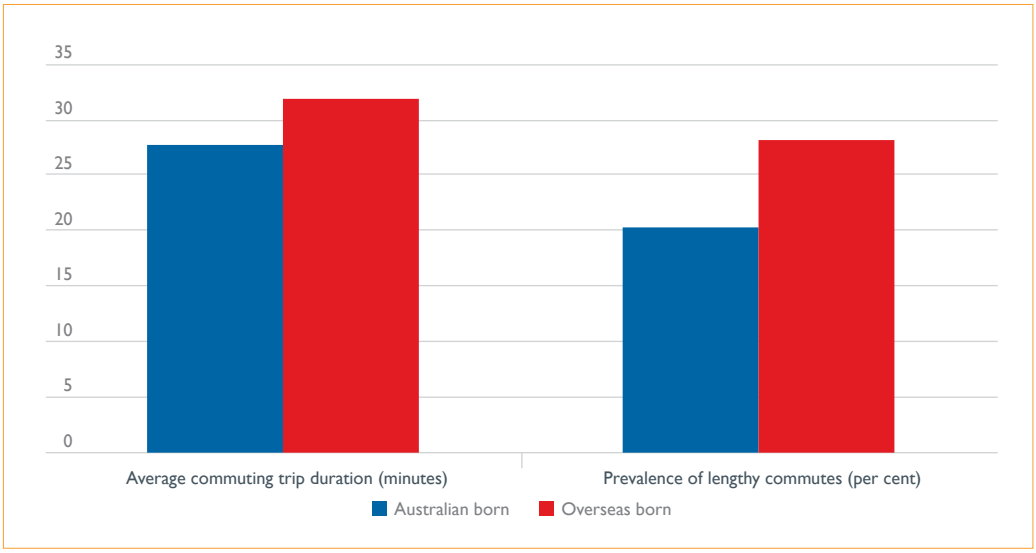
Foreign-born status

Ohman and Lindgren (2003) note that due to foreign-born individuals commonly having weaker location-specific attachments than natives, foreign-born individuals are expected to have less obstacles to migration, and less need for long-distance commuting. Consistent with this, their empirical analysis for Sweden found that being a foreign-born worker had a statistically significant negative effect on the likelihood of long-distance commuting (ibid). However, based on the 2009 *American Community Survey*, McKenzie and Rapino (2011) found that the average commuting time for foreign-born workers was higher than that of native-born workers (28.1 minutes versus 24.9 minutes). For the Netherlands, Van Ham and Hooimeijer (2009) found that immigrants were more likely to have long commutes (of 75 minutes or more per day, return) than non-immigrants, 'suggesting that they have more problems finding a job on the local labour market' (p.140).

The HILDA wave 12 data was used to explore whether a worker's country of birth had any significant impact on commuting times in Australia. Figure 6.4 shows that overseas-born workers had an average commuting trip duration 4 minutes higher than that of Australian-born workers, while the prevalence of lengthy commutes was 8 percentage points higher for overseas-born

workers. These differences are statistically significant at the 95 per cent confidence level. Due to this higher rate of prevalence, overseas-born workers contribute 34 per cent of lengthy commutes in Australia, compared to their 27 per cent share of all commutes.

Figure 6.4 HILDA average commuting trip duration and prevalence of lengthy commutes by foreign-born status of worker, Australia, 2012



Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

A complicating factor is that overseas-born workers are concentrated in Australia's five largest cities, and these cities tend to have much longer commuting times than other Australian locations (see Table 4.1). Therefore, it is possible the patterns observed in Figure 6.4 could simply reflect overseas-born workers tending to reside in the five major capitals. Further analysis of the HILDA data, controlling for place of residence, showed that this was not the case. In the five major capitals, the rate of prevalence of lengthy commutes was 30.6 per cent for the overseas-born and 25.0 per cent for the Australian-born (and this difference was statistically significant). In other locations, the rate of prevalence of lengthy commutes was 18.8 per cent for the overseas-born and 13.4 per cent for the Australian-born (but this difference was not statistically significant at the 95 per cent confidence level—only at the 90 per cent level).

Household composition

Household composition is another factor which can affect commuting times. Ohman and Lindgren (2003) note that while single person households are not without local ties, the presence of a partner and children increases the location-specific attachments of a household and leads to a more complicated decision on where to live and work. As noted previously, the

presence of children in a household can impact on both male and female commuting times (OECD 2010).

It is often argued that dual earner households act as a constraint on the goal of reducing commuting times in cities, as job heterogeneity may prevent two-worker households from finding jobs close together, making it difficult for both workers to have short commutes (Guiliano and Small 1993, Cervero 1989). However, Sultana (1995) finds that the commutes of single-earner households in Atlanta tend to be not significantly different from or longer than those of dual-earner households. For the Netherlands, Van Ham and Hooimeijer (2009) find that those in traditional family settings (with a single breadwinner) are more likely to undertake lengthy commutes than dual-earner households.

The HILDA wave 12 data was used to investigate commuting times for different types of households in Australia. Figure 6.5 shows that couple family households with children aged under 15 make up the largest share of lengthy commutes (30 per cent), and that this is in line with their share of all commutes. Couple households without children also make up a large share of lengthy commutes (26 per cent), and are slightly over-represented amongst lengthy commutes. In general, the distribution of lengthy commutes closely resembles the distribution of all commutes across the household type categories.

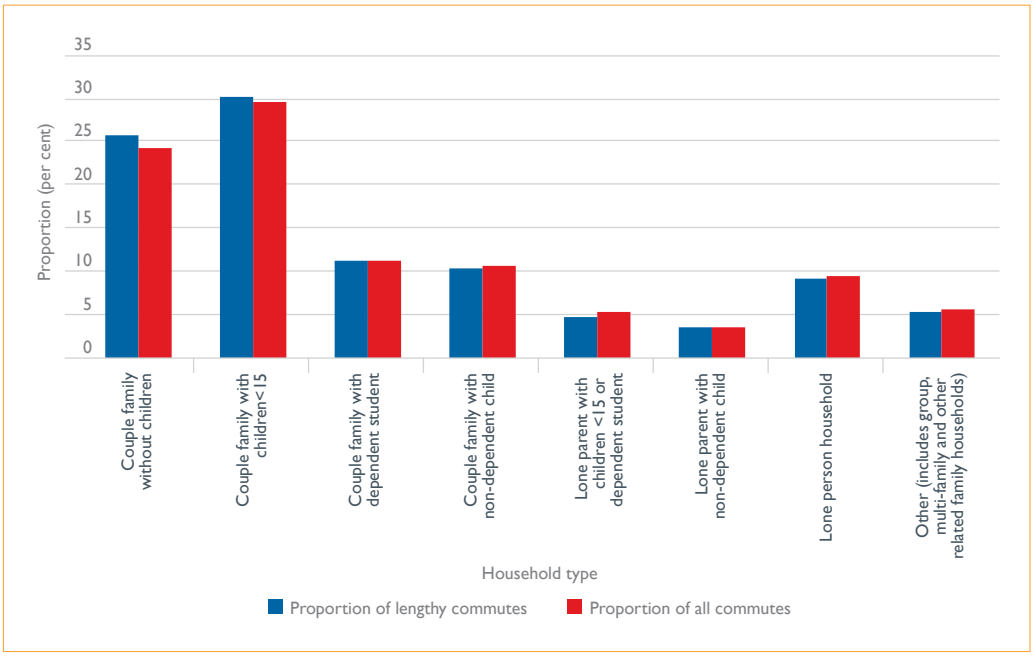
According to the HILDA data, lone person households do have a slightly lower prevalence of lengthy commutes than couple only households, but the difference is not statistically significant. The rate of prevalence of lengthy commutes was not significantly different from the national figure of 22.4 per cent for any of the eight HILDA household type categories (at the 95 per cent confidence level). Similarly, there was no statistically significant difference in the average commuting trip duration for these household type categories.

The HILDA data was also used to investigate whether dual earner households had lengthier commutes than single earner households, but there was no significant difference for Australia.

The PC's *Community Survey* also provides information on the relationship between commuting times and household composition, but uses different household type categories. Table 6.3 presents this survey's estimates of average commuting trip duration and proportion of lengthy commutes by household type. It shows that for the cities covered by the PC survey the prevalence of lengthy commutes tends to be relatively high for single/couple households with mainly preschool kids and relatively low for single person households and older couple households with no kids at home. [48]

48 Due to limited information on the sample design and methodology, BITRE did not undertake statistical significance testing of the PC survey results.

Figure 6.5 HILDA proportion of lengthy commutes and all commutes by household type, Australia, 2012



Notes: The total number of commutes is defined as the subset of employed persons who provided a plausible non-zero response to the HILDA commuting time question. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 6.3 Average commuting trip duration and prevalence of lengthy commutes by household type, PC *Community Survey,* selected Australian cities, 2011

Household type	Average commuting trip duration (minutes)	Prevalence of lengthy commutes (per cent)
Single person	32.0	24.6
Group household	34.4	30.1
Young couple, no kids	34.1	31.1
Single/Couple with mainly preschool kids	36.5	33.1
Single/Couple with mainly school aged kids	33.5	28.4
Single/Couple with mainly adult kids at home	32.2	28.4
Older couple with no kids at home	32.2	25.2
Total: All household type categories	33.4	28.5

Notes: A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

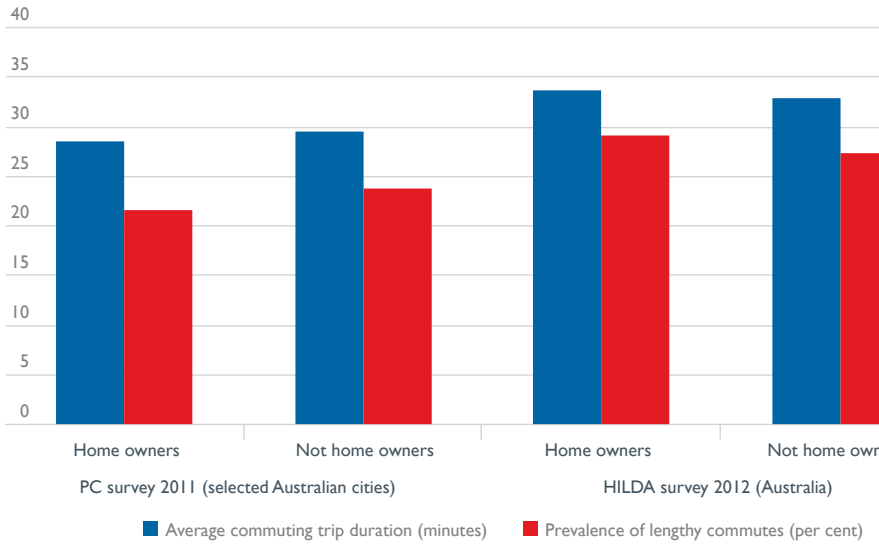
Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Nielsen, as an input to Productivity Commission (2011),

Housing tenure

Home ownership status can affect commuting times by influencing a person's willingness to change their place of residence to minimise commuting times when they change jobs. Home owners may be less willing to relocate than renters due to high relocation costs and strong social ties to their current neighbourhood (Straszheim 1975). McQuaid and Chen (2012) found that male owner occupiers in the United Kingdom (UK) had a higher mean travel time to work (30 minutes versus 27 minutes for renters), but there was no difference for women (23 minutes for both). Male home owners were also more likely to undertake lengthy commutes (of 30 minutes or more) than male non-owners (ibid). For Bangkok, Punpuing (1993) found that respondents who owned their own home commuted about 10 minutes longer on average than those who were not home owners. However, Wang (2001) found that the proportion of home owners in a census tract was not a significant explanator of commuting times for census tracts in Colombus, Ohio.

Both the HILDA survey and the PC *Community Survey* 2011 collect data on whether respondents are home owners or not. Figure 6.6 presents the average commuting trip duration and the rate of prevalence of lengthy commutes by home ownership status for these two surveys. In the HILDA survey, both indicators are marginally lower for home owners than non-owners, whereas in the PC survey, both indicators are marginally higher for home owners.

Figure 6.6 Average commuting trip duration and prevalence of lengthy commutes by home ownership status



Notes: Home owners include those who own their home outright as well as those paying off a mortgage. Persons who responded 'don't know' or did not answer the home ownership question are excluded from the chart. A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of PC *Community Survey* 2011 unit record data, which was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011), and HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Significance testing on the national HILDA data reveals that neither indicator shows a statistically significant difference with respect to home ownership status (at the 95 per cent confidence level).[49] The HILDA data also shows that home owners contributed 69 per cent of lengthy commutes in 2012, compared to 71 per cent of all commutes.

Education

Human capital theory predicts that a person will undertake training if the life-time incremental earnings to be gained are believed to exceed the cost of the investment. Those with higher educational attainment tend to have higher labour force participation rates so as to recoup the costs of investing in training, and in order to gain the full benefits, they may need to look further afield to find a job that provides a good fit for their skills, experience and interests. Thus, as Trendle and Sui (2007 p.224) point out, 'human capital theory predicts that individuals with higher educational attainment will be prepared to travel greater distances in order to earn higher incomes compared to those who invest less in education.' Search theory similarly predicts longer commutes for more educated individuals, because the more specialised nature of their work can create greater search frictions (Groot et al. 2012).

There are a range of empirical studies that show that university-educated individuals are generally willing to travel further to work. Harsman and Quigley (1998) estimated gravity models of commuting flows within the Stockholm metropolitan area disaggregated by education level, and identified a systematic decline in the deterrent effect of travel time on commuting as the education level increased. Trendle and Sui (2007) undertook a similar analysis for residents of Australia's Sunshine Coast, finding that higher levels of education were associated with longer commutes, and that distance had less of a deterrent effect on commuting for more highly educated workers.

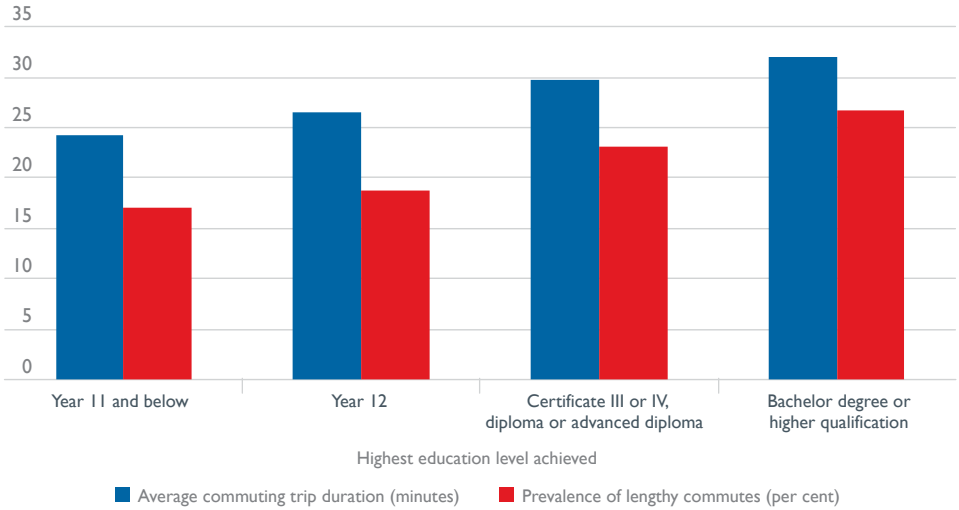
McQuaid and Chen (2012) found that travel time in the UK rose with higher educational attainment, with men at Level 4 (post school professional qualifications) or above travelling 31 minutes and women 25 minutes, compared to 22 and 19 minutes respectively for those with only Level 1 education. Van Ham and Hooimeijer (2009) conclude that education plays a very prominent role in explaining lengthy commutes in the Netherlands, with long commutes twice as common for the highly educated than for those with a lower level of education. Lee and Mcdonald (2003) found that commuting distances and times were longer for more educated workers in Seoul, South Korea. Similarly, Groot et al. (2012) reported that higher educated Dutch workers commuted further, in terms of distance and time. More educated workers were also more likely to commute towards agglomerated areas and high-wage locations, while they were more likely to live in areas with high land values (ibid).

The HILDA wave 12 data was used to explore the relationship between an individual's highest educational qualification and their commuting time. Figure 6.7 shows there is a clearcut bivariate relationship between educational attainment and commuting times, with both indicators at their lowest for those with Year 11 and lower qualifications, rising systematically with educational attainment, and peaking for those with bachelor degree or higher qualifications. Those in the highest educational attainment category have an average commuting trip duration that is 8

49 Due to limited information on the sample design and methodology, BITRE did not undertake statistical significance testing of the PC survey results.

minutes more than those in the lowest category, while the gap in the rate of prevalence of lengthy commutes is 10 percentage points.

Figure 6.7 HILDA average commuting trip duration and prevalence of lengthy commutes by highest educational qualification, Australia, 2012



Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

For individuals with bachelor degree or higher qualifications, the average commuting trip duration and prevalence of lengthy commutes are both significantly higher than the national average values of the respective indicators. For those with Year 12 qualifications and Year 11 and below qualifications, both commuting time indicators lie significantly below the national average figures. However, commuting times do not differ significantly from the national average figures for those with Certificate III or IV, diploma and advanced diploma qualifications.

As a result of the patterns displayed in Figure 6.7, those with bachelor degree or higher qualifications are over-represented amongst lengthy commutes, contributing 38 per cent of lengthy commutes, compared to 32 per cent of all commutes. Individuals with Year 12 and below qualifications are under-represented amongst those whose commuting trips take 45 minutes or more.

It can be difficult to disentangle the effect of higher educational attainment from the effects of occupation and higher wages on commuting times (Groot et al. 2012). Both occupation and income are considered separately later in this chapter, while multivariate regression analysis of commuting times is presented at the end of this chapter.

Employment characteristics

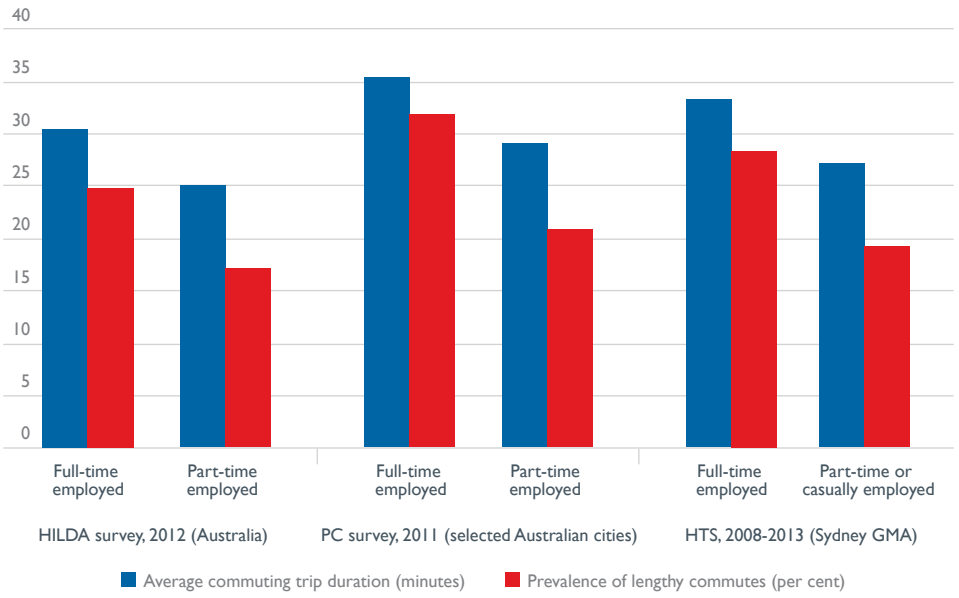
Hours worked

The literature provides evidence that average commuting trip durations tend to be positively associated with hours worked. AASHTO (2013) reports that in the United States, those working limited hours tend to have short commuting times, and that the likelihood of commuting more than 60 minutes to work tends to increase with hours worked. For the Netherlands, Van Ham and Hooimeijer (2009) found that the probability of undertaking a long commute (of 75 minutes or more return per day) increased with the number of hours worked per week. Another Dutch study by Giminez-Nadal and Molina (2014) found a positive relationship between commuting time and labour market hours up to six hours of daily work for men and four hours for women, before the relationship turned negative. McQuaid and Chen (2012) found that full-time workers in the UK commuted much further than part-timers, with 27 per cent of full-time workers commuting 30 minutes or more, compared to 13 per cent of part-time workers. Male full-time workers travelled an average of 30 minutes, compared to 22 minutes for male part-time workers, while the corresponding figures for females were 26 and 19 minutes respectively. An earlier British study by Benito and Oswald (2000) similarly found that full-time workers spent about 7 minutes more commuting to work than the part-time employed.

Figure 6.8 illustrates how average commuting trip duration and the prevalence of lengthy commutes differ between the full-time and part-time employed, based on three Australian surveys. All three data sources show a consistent pattern, with both indicators taking higher values for the full-time employed. Figure 6.8 shows that the average commuting trip duration of full-time workers exceeds that of part-time workers by about 6 minutes in all three surveys. The rate of prevalence of lengthy commutes is 8 to 11 percentage points higher for the full-time employed than for the part-time employed.

Significance testing of the HILDA wave 12 data revealed that both commuting time indicators are significantly above the respective national benchmarks for the full-time employed, and significantly below the national benchmarks for the part-time employed. Consequently, the full-time employed are over-represented amongst lengthy commutes, contributing 75 per cent of Australians with an average commuting trip duration of 45 minutes or more, compared to their 68 per cent share of all Australian commuters.

Figure 6.8 Average commuting trip duration and prevalence of lengthy commutes by full-time and part-time employment status

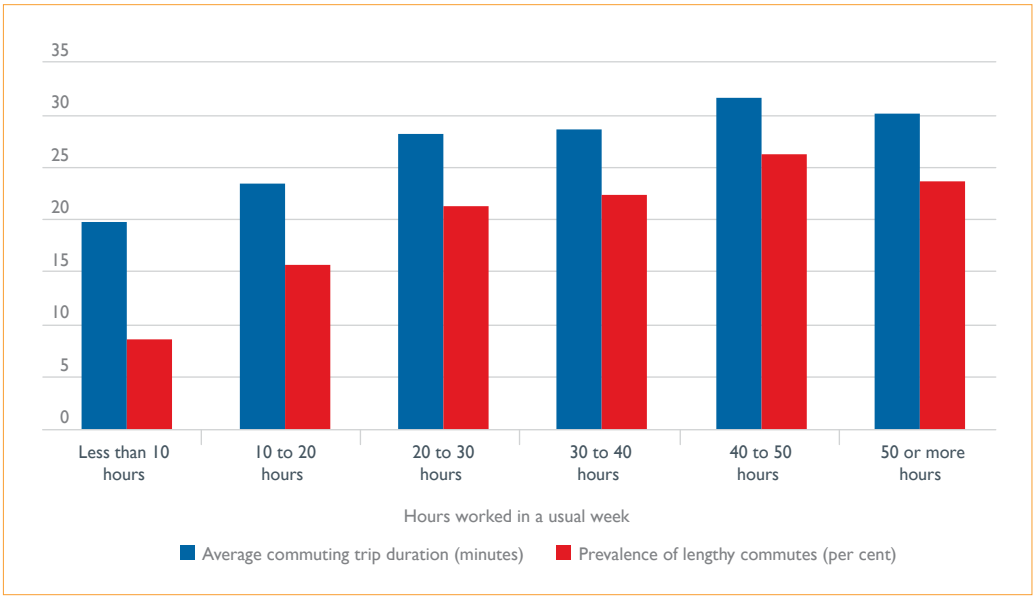


Notes: In the HILDA survey, those who usually work 35 hours or more per week are classified as full-time employed and all other employed persons as part-time employed. In the PC *Community Survey*, respondents are asked to self-nominate whether they are in full-time paid employment, part-time paid employment or not in paid employment. In the Sydney HTS, respondents are also asked to self-nominate, and while most commuters choose 'full time worker' or 'part-time or casually employed', some identify as students, retirees, pensioners, keeping house, unemployed or volunteers (and have been excluded from the above chart). A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Sources: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period; unit record data from PC *Community Survey* 2011, which was collected by the consultants, AC-Nielsen, as an input to Productivity Commission (2011); and HILDA survey wave 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Figure 6.9 considers the relationship between commuting time and hours worked in more detail, based on HILDA wave 12 data. It shows that there is a positive relationship between average commuting trip duration and hours worked up until 40 to 50 hours of work per week, but that the average commuting trip duration then declines slightly for those who work 50 or more hours per week. A similar pattern is evident for the rate of prevalence of lengthy commutes.

Figure 6.9 HILDA average commuting trip duration and prevalence of lengthy commutes by hours worked, Australia, 2012



Notes: Hours worked measure relates to hours worked in a usual week in all jobs. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

As noted previously, the influences of working hours and gender on commuting trip durations are very much inter-related. HILDA average commuting trip durations were previously disaggregated by both gender and labour force status in Table 6.2. Once gender is controlled for, the difference in commuting times between the full-time and part-time employed does narrow a little. The average commuting trip duration for male full-time employed persons exceeds that of male part-time employed persons by 4.6 minutes, while the gap is 5.2 minutes for females and 5.5 minutes across all persons. The rate of prevalence of lengthy commutes for male full-time employed persons exceeds that of male part-time employed persons by 6.2 percentage points, while the gap is 7.0 percentage points for females and 7.7 percentage points for all persons.

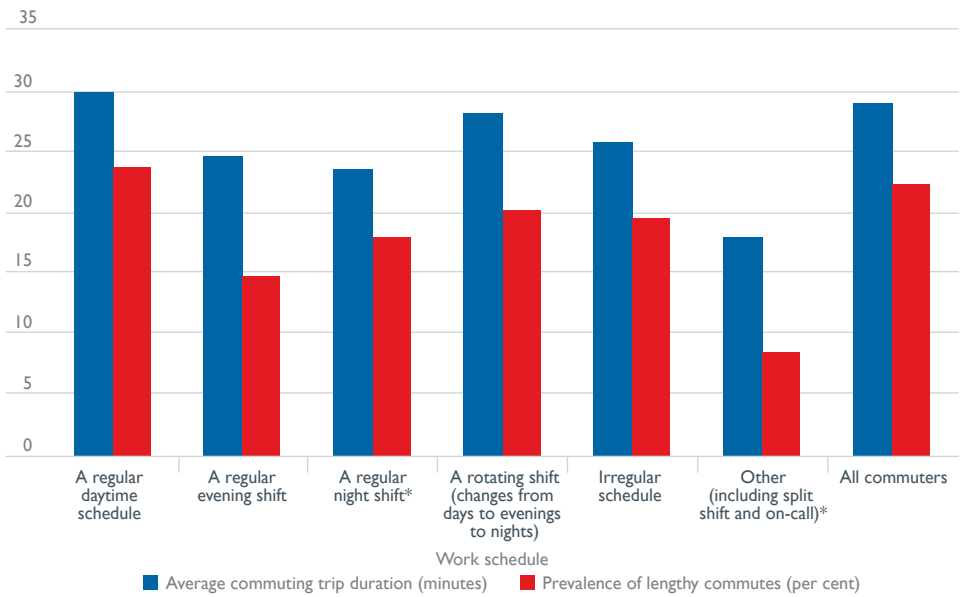
The relationship between working hours and commuting times is also inter-related with the age of the commuter, as shown previously in Figure 6.3. According to the HILDA data, there is no significant difference in the commuting times of full-time employed persons across the different age categories. However, there is considerable variation in the commuting times of part-time employed persons according to their age, with average commuting times being particularly high for those aged between 25 and 34, and relatively low for those aged 15 to 24 or 55 and over.

Work schedule

There are several Australian studies showing that worker's commuting times may be shaped by their typical work schedules, and particularly by whether their work schedules require them to commute in peak periods (when congestion delays are greatest). Wilkins et al (2009) report that full-time workers who work daytime hours Monday to Friday spent an average of 4.8 hours commuting to and from work in 2006, compared to 3.9 hours for other full-time workers, who may work on weekends and/or at night. Flood and Barbato (2005) find that the weekly time spent travelling to and from work is lowest for people who work a regular night shift or a regular evening shift and highest for people who work a rotating shift, an irregular schedule or a regular daytime schedule.

Both the HILDA survey and the Sydney HTS provide information on work schedules, although they use different classifications. The majority of commuters work a regular daytime schedule, and using HILDA data, Figure 6.10 shows that those working a regular daytime schedule have the highest average commuting trip duration and prevalence of lengthy commutes. All other work schedule categories lie below the 'all commuters' benchmarks.

Figure 6.10 HILDA average commuting trip duration and prevalence of lengthy commutes by work schedule, Australia, 2012



Notes: Split-shift and on-call responses were combined with the 'other' category due to a small sample size. Split shift workers are assumed to return home between shifts, undertaking 4 commuting trips per work day rather than 2, which results in a lower commuting trip duration. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

* The estimate of the prevalence of lengthy commutes has a Relative Standard Error of more than 25 per cent for those working a regular night shift or other (including split shift and on-call) work schedule.

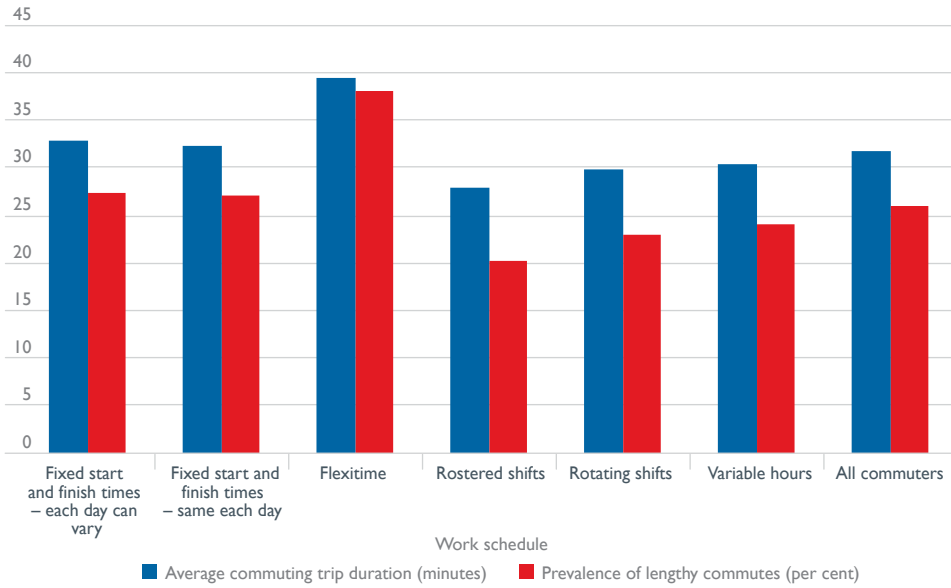
Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University

of Melbourne).

The average commuting trip duration is significantly below the national benchmark (at the 95 per cent level of probability) for those who worked a regular evening shift, a regular night shift, or had an irregular or other schedule. The prevalence of lengthy commutes was significantly below the national benchmark for those who worked a regular evening shift or had some other schedule (including split-shift and on-call).

Figure 6.11 shows how HTS commuting times vary according to work schedules for the Sydney Greater Metropolitan Area (GMA). Commuters who are on flexitime have the highest average commuting trip duration and prevalence of lengthy commutes.[50] Those with fixed start and finish times (irrespective of whether they are the same each day) also have an above-average commuting trip duration and prevalence of lengthy commutes. Average commuting times and the prevalence of lengthy commutes are lowest for those on rostered shifts, which corresponds to the relatively low values seen for regular evening and night shifts in the HILDA data (Figure 6.10). Those on rotating shifts and variable shifts also have below-average commuting times and prevalence of lengthy commutes.

Figure 6.11 HTS average commuting trip duration and prevalence of lengthy commutes by work schedule, Sydney GMA, 2008–13



Notes: 'Other' responses are excluded due to a small sample size. A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

50 This result is somewhat counter-intuitive as flexitime should provide workers with some capacity to shift their commuting trips to a less congested time of day. Flexitime is prominent in the public service, and the HTS data show that a relatively high proportion of flexitime workers have a place of work in the Sydney CBD. Commutes to CBD workplaces tend to be of very long duration (see Tables 4.2 and 4.3) and it is likely this result reflects the CBD-based nature of flexitime jobs, rather than a direct effect of flexitime schedules on commuting durations.

Self-employment

A number of studies show that the self-employed tend to have relatively short commuting times. Lee and Mcdonald (2003) found that in Seoul, employers, self-employed persons and unpaid family workers all had shorter commutes than salaried employees. Van Ham and Hooimeijer (2009) found that in the Netherlands the self-employed are less likely to commute more than 75 minutes, most probably because they have more freedom to choose their place of work than other workers. Based on a sample of Los Angeles workers, Guiliano (1998) reports that the self-employed commuted 4.6 minutes less than salaried employees (excluding those who worked at home).

HILDA wave 12 data was used to explore the relationship between self-employment status and commuting times in Australia. However, the average commuting trip durations of the self-employed[51] did not differ significantly from the national benchmark (28.7 and 28.9 minutes, respectively), and the rate of prevalence of lengthy commutes did not differ (22.5 and 22.4 per cent, respectively).

Occupation

McQuaid and Chen (2012) found that higher occupational levels were consistently associated with longer travel times in the UK, with professionals, managers and associate professionals having the highest commuting times (34–35 minutes) and elementary occupations the lowest (22 minutes). The authors consider that this pattern may be due to lower pay making longer journeys less worthwhile for the lower-ranked occupations, and the spatially-concentrated nature of professional jobs resulting in longer commutes being undertaken (ibid).

In Australia, Flood and Barbato (2005) used the HILDA 2002 data to investigate the relationship between commuting times and occupation. They found that managers and administrators and tradespeople and related workers had the longest weekly time spent travelling to and from work (4.2 hours) and elementary clerical, sales and service workers the shortest time (2.6 hours). A more recent HILDA-based study by Wilkins et al. (2009) focuses on full-time workers, reporting that professionals had the highest weekly time spent commuting (5.0 hours) and elementary clerical, sales and service workers had the least weekly time spent commuting (3.5 hours) in 2006. They also note that tradespersons have a relatively high average commuting time (4.8 hours), 'which may reflect the need for many tradespersons to work at different sites' (ibid, p.203).

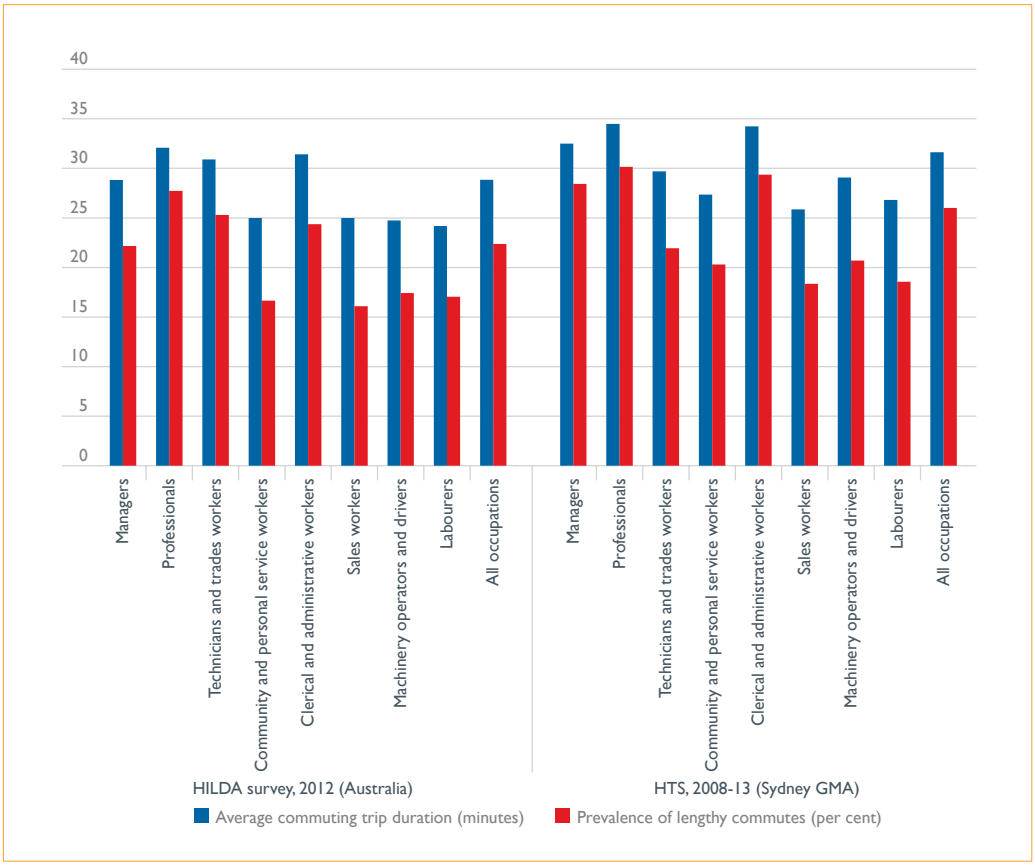
The results for tradespersons highlight the significant influence that question wording can have on commuting time results. The Sydney HTS, a purpose-designed travel survey, pays particular attention to distinguishing commuting trips from work-related business trips, with travel by tradespersons from one work site to another being considered a work-related business trip, not a commuting trip. However, in the HILDA survey, no guidance is provided to respondents on whether such travel should be included in the reported time spent travelling to and from a place of paid employment. Consequently, we should expect tradespersons to have a lower-ranked commuting time in the HTS than in HILDA.

Figure 6.12 presents the HILDA and HTS results for the different occupational categories. In both surveys, commuting times vary widely across occupations. The gap in average commuting trip durations between the highest and lowest occupational categories is 9 minutes for both

51 Self-employment was defined to capture 'employees of own business' and 'employers/self-employed'.

surveys, while the gap in the rate of prevalence of lengthy commutes is 13 percentage points for HILDA and 12 percentage points for the HTS. Professionals have the highest average commuting trip duration and the highest prevalence of lengthy commutes in both surveys.

Figure 6.12 Average commuting trip duration and prevalence of lengthy commutes by occupation, Australia



Notes: Occupational data uses the Australian and New Zealand Standard Classification of Occupations (ANZSCO) 2006 1-digit classification. The HILDA occupational data is based on occupation in the person's main job. Zero commuting time responses are excluded. A person is regarded as having a lengthy commute if they have a commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period, and HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

In the national HILDA data, there are three occupational categories which lie significantly above the 'all occupations' benchmark for average commuting trip duration—Professionals, Clerical and administrative workers and Technicians and trade workers. The average commuting times of Managers do not differ significantly from this benchmark,[52] while the remaining four

52 Wilkins et al. (2009) hypothesise that the relatively low commuting time of Managers in HILDA may reflect managers who run a business from home. BITRE's HILDA analysis specifically excludes zero commuting time responses, and so should exclude those who work exclusively from home. However, managers of a home-based business who report a non-zero commuting time are retained in the analysis.

occupational categories lie significantly below the benchmark. With regard to the prevalence of lengthy commutes, only Professionals lie significantly above the 'all occupations' benchmark, while Sales workers, Labourers, Machinery operators and drivers and Community and personal service workers all lie significantly below it.

As a result of the HILDA-based national patterns displayed in Figure 6.12, those employed as Professionals are over-represented amongst lengthy commutes, contributing 31 per cent of lengthy commutes, compared to 25 per cent of all commutes. Community and personal service workers, Sales workers and Labourers are all under-represented amongst those whose commuting trips take 45 minutes or more.

In the Sydney HTS, Professionals, Managers and Clerical and administrative workers all have an above-average commuting time and prevalence of lengthy commutes. The remaining occupational categories lie below the 'all occupations' average on both indicators, with Sales workers and Labourers having the lowest average commuting trip durations and prevalence of lengthy commutes. In the HTS, the Technicians and trades workers category is slightly below average on both indicators, reflecting the survey's exclusion of time spent travelling between different work sites from the measurement of commuting time.

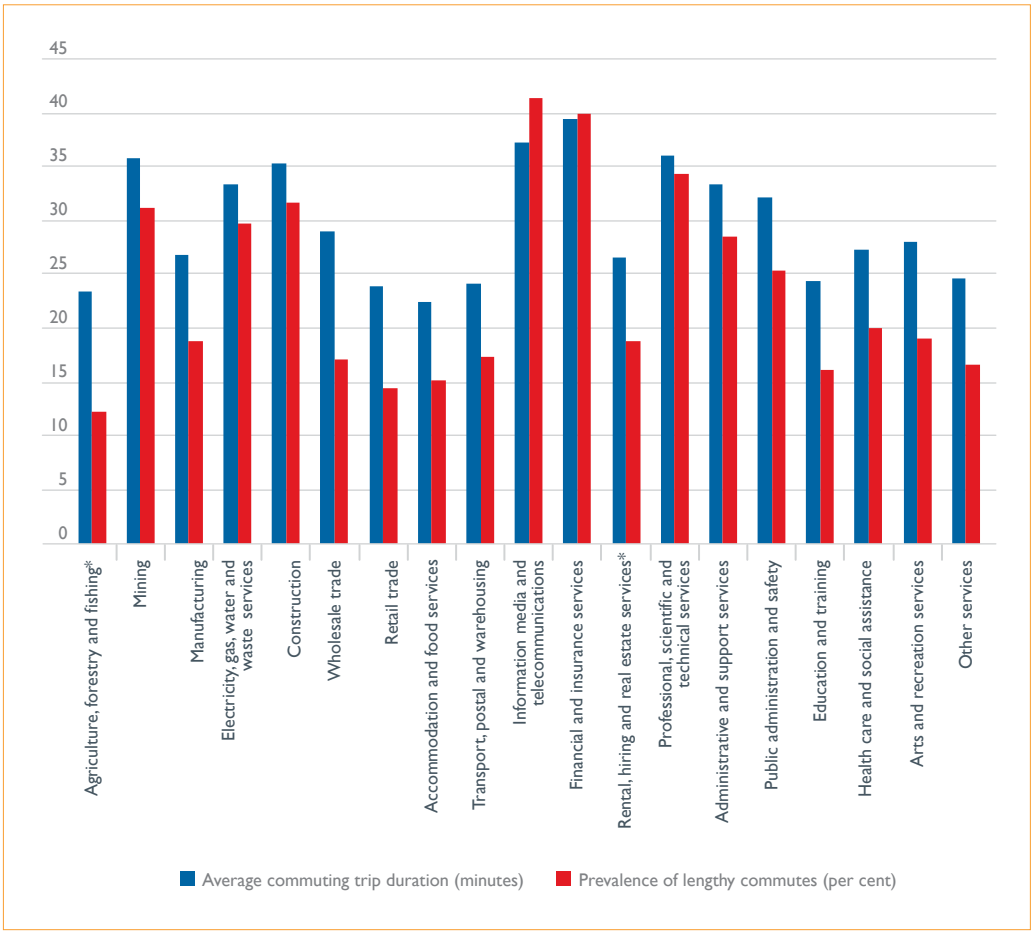
Industry

The connection between industry of employment and lengthy commutes has been examined in several studies, but largely focuses on commuting distances rather than commuting times. Williams (2012) found that in the UK workers in higher income service industries (i.e. Financial intermediation, Real estate, renting and business activities and Public administration and defence, social security) and in the Transport storage and communication industry have longer commuting distances, while those in Agriculture, hunting and forestry and Hotels and restaurants have the shortest average commuting distances. Öhman and Lindgren (2003) found that working in the healthcare and education sectors has a negative effect on long-distance commuting in Sweden, attributing this to the dispersed nature of employment in these sectors reducing the need for long commutes. Lee and Mcdonald (2003) find that workers in Seoul's service industries have relatively short commuting times, because these jobs are relatively dispersed throughout the city. However, a Dutch study by Groot et al. (2012) finds no strong relationship between commuting time and the industry in which a worker is employed.

BITRE (2012a) shows that for Sydney, average commuting distances are greatest for the Mining, Electricity, gas, water and waste services, and Public administration and safety industries, and lowest for the Accommodation and food services, Agriculture, forestry and fishing and Retail trade industries. An industry's average commuting distance was found to be strongly positively correlated with the spatial concentration of that industry's jobs (ibid).

Figure 6.13 uses HILDA wave 12 data to illustrate the relationship between commuting times and a worker's industry of employment. Both commuting time measures vary widely across the industry classification. Average commuting trip duration is lowest for the Accommodation and food services industry (22.4 minutes) and highest for the Financial and insurance services industry (39.3 minutes). The rate of prevalence of lengthy commutes is low for Agriculture, forestry and fishing and Retail trade and much higher for Information media and telecommunications and Financial and insurance services.

Figure 6.13 HILDA average commuting trip duration and prevalence of lengthy commutes by industry of employment, Australia, 2012



Notes: Industry data uses ANZSIC 2006 1-digit classification and is based on the person's main job. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

* The estimated prevalence of lengthy commutes has a Relative Standard Error of more than 25 per cent for the Agriculture, forestry and fishing and the Rental, hiring and real estate services industries.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The following industries have a rate of prevalence of lengthy commutes that is significantly above the 'all industries' benchmark of 22.4 per cent—Information media and telecommunications, Financial and insurance services, Professional, scientific and technical services, Construction and Mining.[53] With the exception of Construction, jobs in each of these industries are heavily concentrated in particular locations (see BITRE 2012), such as capital city CBDs or major mine sites. The industries with a prevalence rate significantly below the benchmark are Agriculture,

53 The Mining result may be influenced by FIFO workers. Box 7.1 provides further information on how FIFO workers are captured in the HILDA-based commuting time measures.

forestry and fishing, Retail trade, Accommodation and food services, Education and training, Other services and Transport, postal and warehousing.

As a result of the patterns displayed in Figure 6.13, those employed in the Professional, scientific and technical services industry are over-represented amongst lengthy commutes, contributing 12.6 per cent of lengthy commutes, compared to 8.2 per cent of all commutes. Retail trade workers are under-represented, contributing 6.6 per cent of lengthy commutes, compared to 10.2 per cent of all commutes.

Income

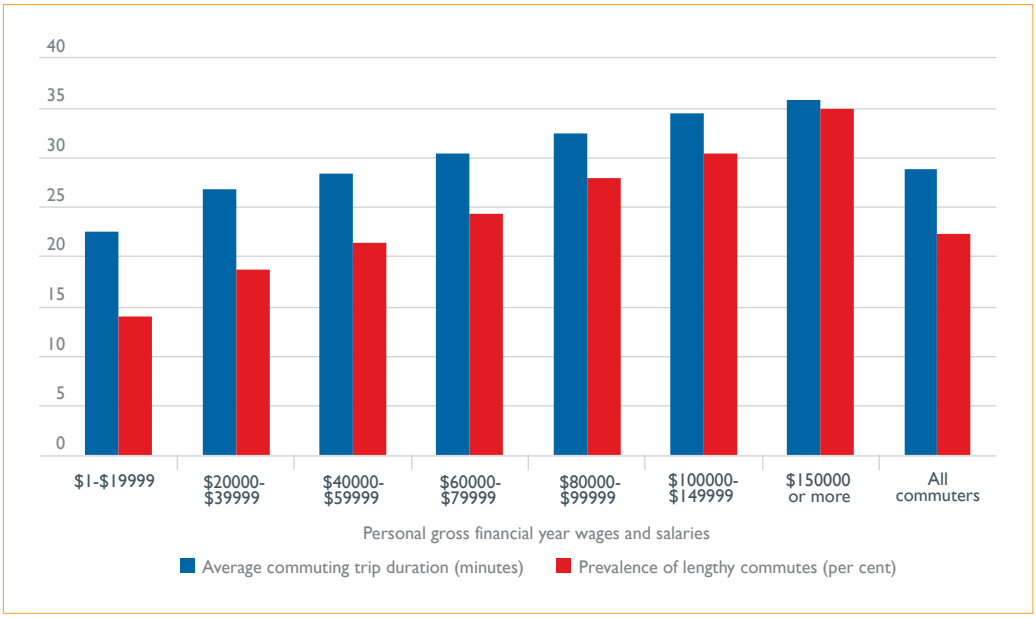
A range of studies have identified a positive empirical relationship between wages/incomes and commuting times. People may be willing to, or need to, travel further for a high paying job (McQuaid and Chen 2012, Van Ham and Hooimeijer 2009). AASHTO (2013) points out that higher-paid jobs will often be specialised and scarce, and may involve a worker travelling a longer distance to find a suitable job opportunity. High-income workers have greater capacity to choose where they live, which may result in them opting to live close to work, or alternatively may result in them opting to live in a more distant location that is attractive to them for other reasons (ibid).

McQuaid and Chen (2012) find that UK commuting times tend to rise in association with wages, with workers earning a gross weekly wage of £750 or more commuting an average of 43 minutes to work, compared to 31 minutes for those earning between £500 and £749. AASHTO (2013) finds that higher-income households tend to dominate longer duration commuting trips in America. The proportion commuting more than 60 minutes to work was reasonably stable up to a household income of $50 000, and then rose steadily with income (ibid). An earlier Californian study by Wachs et al. (1993) similarly found that employees with long commuting times were more likely to have a household income of over $40 000. Van Ham and Hooimeijer (2009) conclude that the probability of commuting more than 75 minutes a day increases with higher levels of household income in the Netherlands.

In Australia, Flood and Barbato (2005) found a positive correlation between an individual's weekly time spent commuting and their annual gross wages and salary, using HILDA wave 2 data. However, there were no significant differences in commuting time amongst the highest paid individuals earning between $70 000 and $250 000 per annum (in 2002 dollars). The study's regression analysis identifies a significant positive association between income and commuting time, even after controlling for days of work, full-time/part-time status, occupation, gender and place of residence.

The HILDA wave 12 data is used to illustrate the relationship between commuting times and personal wage and salary income in Figure 6.14. Average commuting trip durations and the rate of prevalence of lengthy commutes both rise strongly and systematically with personal income. The average commuting trip durations of the highest income category ($150 000 or more annual income) are 13 minutes longer than the average durations of the lowest income category ($1 to $19 999 annual income). The rate of prevalence of lengthy commutes is 21 percentage points higher for the top income category, compared to the lowest income category.

Figure 6.14 HILDA average commuting trip duration and prevalence of lengthy commutes by personal annual gross wages and salary income, Australia, 2012



Notes: Income data relates to income from all jobs in the last financial year and is subject to weighted topcoding. Eleven per cent of those with a non-zero commuting time did not provide a valid response to this income question, and are excluded from the chart. Four respondents who reported zero wage and salary income are also excluded from the chart. Note that the average commuting trip duration of non-respondents did not differ significantly from that of all commuters. A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Significance testing reveals that, for both commuting time measures, the $1 to $19 999 and $20 000 to $39 999 income categories are significantly below the 'all commuters' benchmark, while all three income categories above $80 000 lie significantly above the benchmark.

As a result of the patterns displayed in Figure 6.14, those earning more than $100 000 personal annual gross wages and salary income are over-represented amongst lengthy commutes, contributing 20 per cent of lengthy commutes, compared to 14 per cent of all commutes. Those earning annual income of between $60 000 and $100 000 are also over-represented, contributing 31 per cent of lengthy commutes, compared to 27 per cent of all commutes. Individuals earning less than $60 000 (particularly those earning less than $20 000) are under-represented amongst those with lengthy commutes.

Many of the international studies relate commuting time to a household-based measure of income, rather than a personal income measure. The HILDA household income measure[54] was also positively correlated with the two commuting time indicators, but the relationship was

54 Specifically, the household financial year gross total income (imputed) measure was used. The correlation coefficient of the household income measure with average commuting trip duration was 0.05, compared to a correlation coefficient of 0.11 between the personal income measure and average commuting trip duration.

much weaker (and less systematic) than the relationship between an individual's commuting times and their personal income.

An individual's income is closely linked to their hours worked and skills (e.g. educational attainment, occupation). The multivariate regression analysis in the next section will show whether income has any independent effect on commuting times, above and beyond the effects of hours worked and skills.

Best predictors of lengthy commutes

Empirical literature

There are a number of studies which have used multivariate regression analysis to identify significant demographic, socio-economic and spatial predictors of lengthy commutes at the scale of the individual commuter,[55] a selection of which are listed in Table 6.4.

In Australia, using HILDA wave 2 data, Flood and Barbato (2005) found five independent variables (i.e. gender, hours worked, annual wages and salary, index of relative socio-economic advantage or disadvantage, and Sydney/not Sydney) significantly predict commuting times. This relatively simple model explained 11.3 per cent of the variation in weekly commuting times across individuals.

In the UK, McQuaid and Chen (2012) tested a wider range of variables as predictors of the likelihood a person would have a long duration commute. They concluded that a worker's age, occupation, weekly pay, the presence and age of children, and mode of transport were of particular importance to the length of the commuting trip. For the Netherlands, Van Ham and Hooimeijer (2009) identified several significant determinants of long duration commutes, including gender, immigrant status, hours worked, education, income, transport mode and region of residence. Another Dutch study by Groot et al. (2012) emphasised the role that education and land use variables play as predictors of commuting times.

These regression analyses typically have low to moderate explanatory power, with reported R-squared's of between 8 and 27 per cent.[56] The significance of explanatory variables depends on the geographical context, with Punpuing (1993) noting that the empirical relationships established for developed societies are not directly transferable to a developing society such as Bangkok, Thailand. In the studies of developed countries, several factors are rather consistently identified as important predictors of commuting times (or lengthy commutes), namely:

- gender
- hours worked or full-time/part-time employment status
- income or wages
- education, and
- region of residence.
- The empirical significance of other factors—such as age, home ownership, industry, marital status and ethnicity—depends on the specific geographic context.

55 There are also several studies that use multivariate regression to analyse the predictors of the average commuting trip duration at a small area scale (e.g. Wang 2001, Shen 2000). These small area regressions are excluded from Table 6.4.

56 Not all of the studies in Table 6.4 reported an R-squared statistic.

Table 6.4 Predictors of lengthy commutes in the literature

Authors	Location	Dependent variable	Significant predictors	Insignificant variables
Flood and Barbato (2005)	Australia	Commuting times (weekly time spent commuting)	Gender, hours worked, annual wages and salary, index of relative socio-economic advantage or disadvantage, and location	None
McQuaid and Chen (2012)[a]	UK	Long commuting times (30 minutes or more to work one-way)	Gender, age, having children and the age of youngest child, employment status, occupation, weekly wages, home ownership, region and transport mode	Ethnicity, health problems, disabled
Punpuing (1993)[b]	Thailand (Bangkok)	Commuting times (one-way) and distances	Commuting times—age and home ownership Commuting distances—occupation and home ownership	Sex, marital status, education, spouse's work status, school age children, family type, strength of community ties, housing and community satisfaction
Lee and McDonald (2003)[c]	South Korea (Seoul)	Commuting times (one-way) and distances	Commuting times—gender, marital status, age, employment status, education, home ownership, number of rooms, occupation, industry, residential mobility Commuting distances—as for commuting times	Each included variable group was significant, but some individual classes within a group were not (e.g. for commuting times, under 20s and over 50s did not differ significantly from the 36 to 50 reference class)
Van Ham and Hooimeijer (2009)[d]	Netherlands	Long commuting times (more than 75 minutes two-way)	Gender, dual earner households, immigrant, higher education, household income, hours worked, self-employed, work at home, recent mover, transport mode, job access and region	Age, home ownership
Groot et al. (2012)[e]	Netherlands	Commuting times (one-way) and distances	Commuting times—gender, employment status, hourly wage, marital status, education, area density, jobs to population ratio, land rents Commuting distances—as for commuting times	Industry sector
Öhman and Lindgren (2003)	Sweden	Long commuting distances (200km or more)	Gender, age, foreign born, presence and age of children, dual-earner households, education, income, detached housing, industry, region and previous experience of long-distance commuting	Having a spouse, working in data consultancy or construction sectors

Notes:

a The significant predictors are based on the 'all workers' model. Separate models were also estimated for males, females, female full-time and female part-time workers.

b The significant predictors are based on model specification 3 (the specification with the widest range of predictor variables).

c The significant predictors are based on the pooled sample of male and female workers.

d The significant predictors are based on model specification 3 (the specification with the widest range of predictor variables.

e The significant predictors are based on model specification IV (the specification with the widest range of predictor variables.

Source: BITRE analysis of cited studies.

New evidence for Australia

This chapter has presented bivariate analysis of the relationship between commuting times and a wide range of socio-economic variables for Australia. Given the large number of statistically significant relationships that have been identified and the inter-connectedness of many of these variables, there is value in undertaking multivariate regression analysis, in order to distinguish the relative importance of different socio-economic variables in terms of their influence on commuting times in Australia. This section presents the results of regression analysis of individuals' average commuting trip durations and whether they undertake a lengthy commute, based on the HILDA wave 12 data. The dependent variables included in the regression analysis are the demographic, social, economic and employment characteristic variables considered previously in this chapter (focusing on those that displayed significant bivariate relationships), as well as the HILDA summary spatial classifications analysed in Chapter Five.

The average commuting trip duration measure is a continuous variable and ordinary least squares regression is used. The lengthy commutes measure is a categorical variable, and logistic regression was used to model the probability of an individual having an average commuting trip duration of 45 minutes or more.

With such a large number of independent variables, there is the potential for multicollinearity issues to arise. Such problems were minimised by excluding some (non-significant) variables and respecifying others.[57] With the exception of age and age squared, no pair of explanatory variables has a correlation greater than 55 per cent. More generally, we did not attempt to refine the model down to a more parsimonious specification, as one aim of the analysis was to identify which variables are insignificant predictors of commuting times in the Australian context.

Table 6.5 presents the results of the regression analysis. The explanatory power of the regressions is low, but within the range reported in overseas studies (e.g. Lee and Mcdonald 2003, Groot et al. 2012).58 Thus, socio-economic and spatial variables are only capable of explaining a relatively small proportion of the variation in commuting times within Australia. Individuals with identical socio-economic and spatial characteristics display a great deal of heterogeneity in their commuting times.

The colour coding in the table identifies discrete sets of explanatory variables, such as education, work schedule, industry and remoteness class. Each of these sets of explanatory variables was jointly significant in the model of an individual's average commuting trip duration. In the lengthy commutes model, each set of explanatory variables—with the exception of the work schedule variables—was jointly significant at the 95 per cent confidence level.

There are a number of explanatory variables that do *not* have a statistically significant influence on commuting times in either regression model, namely:

- Whether the individual is a home owner
- Whether the person is employed on a part-time basis
- Whether the person is self-employed

57 For example, the detailed HILDA household type categories and the SEIFA index were omitted from the regressions, due to their correlations with other included variables.

58 Note that Flood and Barbato (2005) reported an adjusted R-squared of 11.3 per cent for the HILDA wave 2 data using only five explanatory variables. This result reflects the different specification of the commuting time measure, with a good deal of the variation in the amount of time spent commuting per week able to be explained by reference to the number of days worked (or hours worked) per week.

- Those with a bachelor degree or higher qualification do not differ significantly from those reporting a Year 11 or below education
- Those who work an evening shift, rotating shift or irregular shift do not differ significantly from those who work a regular daytime schedule
- The occupations of Managers, Community and personal service workers, and Machinery operators and drivers do not differ significantly from the reference category of Labourers
- People who work in the following industries do not differ significantly from the reference category of Retail trade—Agriculture, forestry and fishing, Manufacturing, Wholesale trade, Accommodation and food services, Transport, postal and warehousing, Rental, hiring and real estate services, Education and training, Arts and recreation services and Other services.

Table 6.5 Estimating the relationship between commuting times and socio-economic and spatial characteristics, Australia, 2012

	Individual's average commuting trip duration (minutes)		Individual had a lengthy commute of 45 minutes or more	
Model information				
Model type	Ordinary least squares regression		Logistic regression	
Number of observations	8673		8673	
Adjusted R-squared	9.4 per cent		11.6 per cent[a]	
Explanatory variables	Parameter estimate	Significance level	Parameter estimate	Significance level
Constant	20.737	***	–2.355	***
Female (Ref=male)	–1.568	**	–0.167	**
Age	0.428	***	0.054	***
Age squared	–0.005	***	–0.001	***
Child(ren) resident in household (Ref=no children)	–1.217	*	–0.068	
Foreign born (Ref=Australian born)	1.477	**	0.250	***
Home owner (Ref=not home owner)	–0.588		–0.057	
Highest educational qualification (Ref=Year 11 or below education)				
Bachelor degree or higher qualification	1.530		–0.059	
Advanced diploma, diploma or certificate III/IV	2.511	***	0.094	
Year 12 education	–0.662		–0.181	*
Gross personal financial year income[b] ($'000)	0.019	***	0.001	**
Employed part-time (Ref=employed full-time)	–0.603		–0.051	
Work schedule (Ref=regular daytime schedule)				
Evening shift	–0.074		–0.181	
Night shift	–3.054	*	–0.103	
Rotating shift	0.593		–0.016	
Explanatory variables	Parameter estimate	Significance level	Parameter estimate	Significance level
Irregular shift	–1.565		–0.034	
Other schedule (including on-call and split-shift)	–7.460	***	–0.888	***
Self-employed (Ref=employee)	–1.528		–0.126	
Occupation (Ref=labourers)				
Managers	0.873		0.113	
Professionals	4.331	***	0.442	***
Technicians and trades workers	2.971	**	0.268	**
Community and personal service worker	1.948		0.142	
Clerical and administrative workers	4.599	***	0.315	**
Sales workers	3.806	***	0.367	**
Machinery operators and drivers	–1.386		–0.064	
Industry (Ref=Retail trade)				
Agriculture, forestry and fishing	3.648		0.121	
Mining	12.698	***	1.107	***

(continued)

	Individual's average commuting trip duration (minutes)		Individual had a lengthy commute of 45 minutes or more	
Explanatory variables (continued)	Parameter estimate	Significance level	Parameter estimate	Significance level
Manufacturing	0.364		0.051	
Electricity, gas, water and waste services	9.134	***	0.973	***
Construction	9.486	***	0.870	***
Wholesale trade	1.581		–0.116	
Accommodation and food services	–0.209		0.161	
Transport, postal and warehousing	0.194		0.131	
Information media and telecommunications	7.784	***	1.013	***
Financial and insurance services	8.754	***	0.872	***
Rental, hiring and real estate services	1.187		0.194	
Professional, scientific and technical services	6.886	***	0.728	***
Administrative and support services	8.359	***	0.793	***
Public administration and safety	5.448	***	0.548	***
Education and training	–1.950		–0.049	
Health care and social assistance	1.725		0.284	*
Arts and recreation services	2.173		0.222	
Other services	–0.573		0.050	
City of residence (Ref=Sydney)				
Melbourne	–1.528	*	–0.126	
Brisbane	–4.926	***	–0.492	***
Perth	–6.428	***	–0.608	***
Adelaide	–7.667	***	–0.692	***
Rest of Australia	–8.790	***	–0.948	***
Reside in non-urban area[c] (Ref=urban)	6.695	***	0.437	***
Remoteness class of residence (Ref=Major cities)				
Inner regional	–3.656	***	–0.058	
Outer regional	–6.948	***	–0.441	***
Remote and very remote	–12.595	***	–0.967	***

Notes: Regression analysis is undertaken on a weighted basis. With the exception of the income variable, socio-economic variable specifications match those used earlier in this chapter. Wald tests used to test significance of logistic regression parameters. Ref=reference category for categorical variables.

* p<0.10 (i.e. 90 per cent confident the parameter estimate is significantly different from zero);

** p<0.05 (i.e. 95 per cent confident the parameter estimate is significantly different from zero);

*** p<0.01 (i.e. 99 per cent confident the parameter estimate is significantly different from zero).

a. Nagelkerke's pseudo R-Squared is presented for the logistic regression model.

b. The imputed version of the income measure was used in the regression, so that the maximum number of observations would be retained. This differs from Figure 6.14 which was based on the unimputed income measure, and thus excludes 11 per cent of the in-scope sample who did not report income.

c. Urban refers to the ABS' section of state categories 'major urban' and 'other urban' which capture urban centres with populations of 1000 or more. Non-urban refers to the remaining section of state categories (i.e. bounded localities and rural balance).

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The remaining discussion considers each of the statistically significant socio-economic variables in turn, followed by the spatial variables. The variable signs, and to a lesser extent the significance levels, are generally consistent across the two models, and the signs of the statistically significant variables are in-line with prior expectations and the bivariate relationships highlighted previously in this chapter.

Being female has a significant negative effect on an individual's average commuting trip duration and probability of undertaking a lengthy commute (relative to the reference category of being male). Being born overseas (rather than in Australia) has a significant positive effect on both commuting time measures, controlling for other factors. The presence of children in a household has a (borderline significant) negative influence on an individual's average commuting trip duration.

A person's age is an important predictor for both commuting time measures, and the relationship is non-linear, with commuting times tending to initially rise with age up to about forty years of age, before declining.

Perhaps surprisingly, given the systematic pattern displayed in Figure 6.7, the education variables are generally non-significant. It seems that the higher commuting times of the well-educated are largely being captured by other included variables, such as income and the occupational variables. Nevertheless, the holding of an advanced diploma, diploma or certificate III or IV qualifications does have significant positive influence on an individual's average commuting trip duration, relative to having Year 11 or lower education.

An individual's annual income has a significant positive influence on an individual's average commuting trip duration and probability of undertaking a lengthy commute. The effect is not of particularly large magnitude, with an extra $100 000 income associated with a 1.9 minute longer commuting duration.

Relative to working a regular daytime shift, working a night shift or some other work schedule (including on-call or split-shifts) is associated with a significantly shorter average commuting trip duration. Other work schedules are also associated with a significantly lower probability of undertaking lengthy commutes. Those on night shift are expected to have shorter commutes, as trips will be less affected by congestion. It is considered likely that those working on-call or working split-shifts would tend to live relatively close to their workplace.[59]

A person's occupation is an important predictor for both commuting time measures. Relative to the reference category of Labourers, being a Professional, Clerical or administrative worker, Sales worker or Technician and trades worker has a significant positive influence on an individual's average commuting trip duration and their probability of undertaking a lengthy commute.

Industry is also a very important predictor for both commuting time measures. Relative to the reference category of Retail trade, working in the Mining, Construction, Electricity, gas, water and waste services, Financial and insurance services, Administrative and support services, Information media and telecommunications, Professional, scientific and technical services or Public administration and safety industries has a significant positive influence on both commuting time measures.

59 Note that BITRE's construction of the average commuting trip duration variable for split-shift workers may also contribute to this result. Those working split-shifts are assumed to return home in-between shifts, thereby undertaking four commuting trips per workday (rather than two).

The spatial variables included in the regressions are responsible for much of the models' explanatory power. Compared to the reference category of Sydney, living in Melbourne has a (borderline significant) negative influence on average commuting trip duration. Melbourne does not differ significantly from Sydney with respect to an individual's probability of undertaking a lengthy commute. Compared to Sydney, living in Brisbane, Perth, Adelaide or the rest of Australia has a significant negative influence on average commuting trip duration and the probability of undertaking a lengthy commute. The magnitude of this effect is greatest for the rest of Australia, where commuting times are predicted to be 8.8 minutes less than for Sydney residents, holding other factors constant.

Compared to residents of the major cities remoteness class, living in one of the other remoteness classes has a significant negative influence on an individual's predicted average commuting trip duration. The size of the effect increases with the degree of remoteness, with residents of remote and very remote areas predicted to have commuting times that are 12.6 minutes less than major cities residents, holding other factors constant.

Compared to the reference category of living in an urban area (i.e. an urban centre of 1000 or more people), living in a non-urban area has a significant positive influence on an individual's average commuting trip duration and the probability they will undertake a lengthy commute. The tendency for rural living to be associated with longer commutes than living in small urban centres has previously been noted by Turcotte (2011) and BITRE (2015a).

Demographic trends

Chapter Four revealed a significant 5.0 percentage point increase in the national prevalence of lengthy commutes between 2002 and 2012. This section uses HILDA data to explore whether this national increase varied across key demographic and socio-economic groups. Specifically, the groups that were examined were: male and female, foreign-born and Australian-born, age group, full-time employed and part-time employed, income range, education and occupation.

Table 6.6 presents the percentage point change in the prevalence of lengthy commutes for each socio-economic variable between 2002 and 2012. All of the displayed categories show an increase in the prevalence of lengthy commutes, but not all of the increases are statistically significant. Both males and females recorded a significant increase of approximately 5.0 percentage points in the prevalence of lengthy commutes between 2002 and 2012. There was a larger increase in the prevalence of lengthy commutes for the overseas-born than for the Australian-born, but both increases were statistically significant. The full-time employed recorded a larger increase than did the part-time employed, with both increases being significant at the 95 per cent confidence level.

There was some variation across the different age groups. The largest increase occurred for the 25 to 34 age group, and the increases observed for this age group, along with the 35 to 44 and 45 to 54 age groups, were statistically significant. However, for the 15 to 24 and 55 and over age groups, there was no statistically significant change in the prevalence of lengthy commutes between 2002 and 2012.

Table 6.6 HILDA percentage point change in the prevalence of lengthy commutes for selected socio-economic characteristics, Australia, 2002 to 2012

Socio-economic characteristic		Percentage point change	Is this significant?
Gender	Male	4.9	Yes
	Female	5.3	Yes
Country of birth	Australian-born	4.2	Yes
	Foreign-born	6.1	Yes
Age	15 to 24	4.0	No
	25 to 34	8.5	Yes
	35 to 44	5.5	Yes
	45 to 54	3.6	Yes
	55 and over	2.4	No
Employment status	Employed full-time	5.9	Yes
	Employed part-time	3.2	Yes
Personal gross financial year income ($2012)[a]	$1 to $19 999	1.9	No
	$20 000 to $39 999	4.7	Yes
	$40 000 to $59 999	4.3	Yes
	$60 000 to $79 999	3.5	No
	$80 000 or more	4.9	Yes
Highest educational qualification	Bachelor degree or higher qualification	5.5	Yes
	Advanced diploma, diploma or Certificate III/IV	4.1	Yes
	Year 12 education	4.8	Yes
	Year 11 or below education	2.7	No
Occupation	Managers	4.1	No
	Professionals	7.3	Yes
	Technicians and trades workers	6.4	Yes
	Community and personal service workers and Sales workers	3.8	Yes
	Clerical and administrative workers	3.5	No
	Machinery operators and drivers and Labourers	3.7	No

Notes: A person is regarded as having a lengthy commute if they have an average commuting trip duration of 45 minutes or more. Data in table is weighted so as to be representative of total in-scope population. Standard errors and confidence intervals were derived using the Taylor Series linearisation method, as recommended in Hayes (2008), and statistical significance is assessed at the 95 per cent confidence level. The eight 1-digit ANZSCO occupational categories were collapsed into six categories with samples of more than 1000 in wave 12, based on similarity in commuting durations. This step was undertaken to keep relative standard errors for each category below 10 per cent so as to support a more meaningful analysis of change over the period.

a. 2002 income has been converted to 2012 dollars using the Consumer Price Index weighted average of the eight capital cities. Those with zero or non-reported income are excluded.

Source: BITRE analysis of HILDA survey unit record data for wave 2 through to wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Those with a personal gross annual income (expressed in 2012 dollars) of more than $80 000 recorded a slightly larger increase in the prevalence of lengthy commutes than those earning $20 000 to $39 999 or $40 000 to $59 999. From 2002 to 2012, there was no statistically significant change in the prevalence of lengthy commutes for those earning $1 to $19 999 or $60 000 to $79 999.

People with bachelor degrees and higher qualifications recorded the largest increase in the prevalence of lengthy commutes across the education categories. Those with a Year 12 education or 'Advanced diploma, diploma or Certificate III/IV' qualifications also recorded a significant increase, but there was no statistically significant change in the prevalence of lengthy commutes for those with Year 11 or below education.

Professionals recorded the largest increase in the prevalence of lengthy commutes across the occupational categories, followed by Technicians and trade workers. However, for Managers, Clerical and administrative workers, and the combined 'Machinery operators and drivers and Labourers' category, there was no statistically significant change in the prevalence of lengthy commutes between 2002 and 2012.

Summary

This chapter has shown that those who undertake lengthy commutes are relatively likely to be male, foreign-born, and aged between 25 and 44. High income earners, Professionals and those who work in the Mining or advanced producer service industries are also over-represented amongst those undertaking lengthy commutes. The national rate of prevalence of lengthy commutes increased from 17.4 per cent in 2002 to 22.4 per cent in 2012. Amongst the groups which recorded an above-average increase were the foreign-born, those aged 25 to 34, full-time workers, holders of Bachelor degree and higher qualifications, Professionals and Technicians and trades workers. Those earning less than $20 000 per annum recorded a particularly low increase in the prevalence of lengthy commutes. Overall, lengthy commutes are more likely to be undertaken within relatively advantaged socio-economic groups, and the increased incidence of lengthy commuting trips is falling more on the relatively advantaged socio-economic groups than on the most disadvantaged groups.

The bivariate analysis presented in the first part of this chapter revealed connections between commuting times and many different socio-economic variables. However, the multivariate regression analysis revealed that these socio-economic variables were only able to explain a relatively small proportion of the overall variation in commuting times across individuals. The HILDA survey has several limitations which may contribute to the relatively low explanatory power of these regression models:

- There is limited spatial detail available on a person's place of residence (i.e. city and broad region of residence only),[60] and the HTS, VISTA and PC survey evidence presented in Chapter 5 shows there is considerable variation in commuting times within these cities/regions.

60 The unconfidentialised HILDA files contain greater spatial detail, but the conditions of use restrict reporting of results for more detailed regions.

- The HILDA survey does not collect information on trip characteristics—such as transport mode, day and time of travel, trip distance, place of work, and whether there were stopovers made during the commute. The HTS and PC survey results presented in Tables 4.2 and 4.3 suggest that trip characteristics such as these may account for much of the variation in commuting times across individuals. The relationship between commuting times and trip characteristics is investigated in detail in the next chapter.[61]

61 Chapter 7 presents multivariate regression analysis that takes trip characteristics into account, alongside place of residence and socio-economic variables. The Chapter 7 results suggest that the HILDA-based regression results in Table 6.5 are potentially subject to omitted variable bias, as known predictors of commuting times (i.e. the trip characteristic variables) are necessarily omitted, due to these items not being collected in the HILDA survey. For omitted variable bias to exist, the omitted variables must be correlated with some of the included variables. This is likely, given established relationships between place of residence (an included variable) and trip characteristics, such as place of work, commuting distance, and use of different transport modes. The bias is created when the model compensates for the omitted factor by over- or under-estimating the effect of one of the included factors. Consequently, greater reliance should be placed on the HTS-based regression results in Chapter 7, than the HILDA-based regression results presented in Chapter 6.

CHAPTER 7
Trip characteristics of lengthy commutes

Key points

- Based on the Sydney *Household Travel Survey* (HTS) 2008–13, 71 per cent of lengthy commuting trips (of 45 minutes or more) occur in weekday peak periods, while 24 per cent occur in weekday off-peak periods and 5 per cent on weekends. The prevalence of lengthy commutes is highest for weekday afternoon peak periods (32 per cent) and lowest on weekends (15 per cent).
- Public transport is the priority mode for 52 per cent of lengthy commuting trips, while for 46 per cent the priority mode is private vehicle and for 2 per cent it is active transport. For Greater Metropolitan Area (GMA) residents, 73 per cent of public transport commutes take 45 minutes or more, compared to 16 per cent of private vehicle commutes. Public transport commutes have long durations because they cover long distances at relatively low travel speeds.
- Forty one per cent of lengthy commuting trips covered a road distance of more than 30 kilometres (km), while 38 per cent covered 15 to 30km, 19 per cent covered 5 to 15km and 2 per cent covered less than 5km.
- The City of Sydney Local Government Area was the place of work for 232 100 (or 37 per cent of) lengthy commutes by GMA residents. Parramatta, North Sydney and Ryde were also prominent places of work for lengthy commutes.
- Tours between an Outer Sydney residence and an Inner Sydney workplace are the most common type of lengthy tour between home and work (with a 21 per cent share), followed by tours between a Middle Sydney residence and an Inner Sydney workplace (19 per cent).
- The prevalence of lengthy commutes is higher on the return tour leg (37 per cent) than on the outward leg (31 per cent), as people make more stopovers on their trip home, particularly for shopping or social/recreation purposes.
- The Sydney GMA relationships between lengthy commutes and key travel characteristics (e.g. time of day, mode, distance, direction, place of work) are also evident for Melbourne and Victoria's larger regional cities (using VISTA).
- BITRE has used the HTS data as the basis of regression analysis of individuals' commuting trip (tour) duration and whether they undertake a lengthy commute. The models' explanatory power is high, with R-squared's exceeding 70 per cent. Thus, information on trip and tour characteristics—such as distance, mode, time of day, direction, place of work, routes and stopovers—can explain the majority of the variation in commuting times for Sydney GMA residents. Much of the explanatory power of these regressions is due to a single trip characteristic, namely distance.

Introduction

This chapter examines how the likelihood of a person undertaking a lengthy commute relates to the characteristics of the commuting trip, such as the day and time of travel, the direction of travel, transport mode, trip distance, inclusion of stopovers and place of work.[62] This will help build up a profile of the nature of lengthy commuting trips.

The chapter will largely be based on data from the New South Wales (NSW) Bureau of Statistics and Analytics (BSA) *Household Travel Survey* (HTS) for the Sydney Greater Metropolitan Area (GMA). The HTS results will be presented on two separate bases:

- Duration of a linked commuting trip—a linked trip is a journey from one activity to another, ignoring changes in mode, and takes 31.6 minutes on average in the Sydney GMA (with 26.0 per cent taking 45 minutes or more).
- Duration of a tour leg from 'home to work' or 'work to home'—a tour leg can involve multiple linked trips and captures the entire home-to-destination or destination-to-home journey.[63] A tour leg takes 38.3 minutes, on average, in the Sydney GMA, with 34.1 per cent of tour legs taking 45 minutes or more.

Results from the empirical literature and relevant data from the Productivity Commission's (PC) *Community Survey* and the *Victorian Integrated Survey of Travel and Activity* (VISTA) will also be presented in order to broaden out the evidence base beyond the Sydney metropolitan area. The HILDA data does not feature in this chapter as the survey does not collect any information on the characteristics of commuting trips.

In line with the structure of the previous chapter, the bivariate analysis of the relationship between each of these trip (or tour) characteristics and commuting times, will be followed by a multivariate regression analysis of HTS data. This will help to distinguish the relative importance of the different trip (tour) characteristics in terms of their influence on commuting times.

Direction of travel

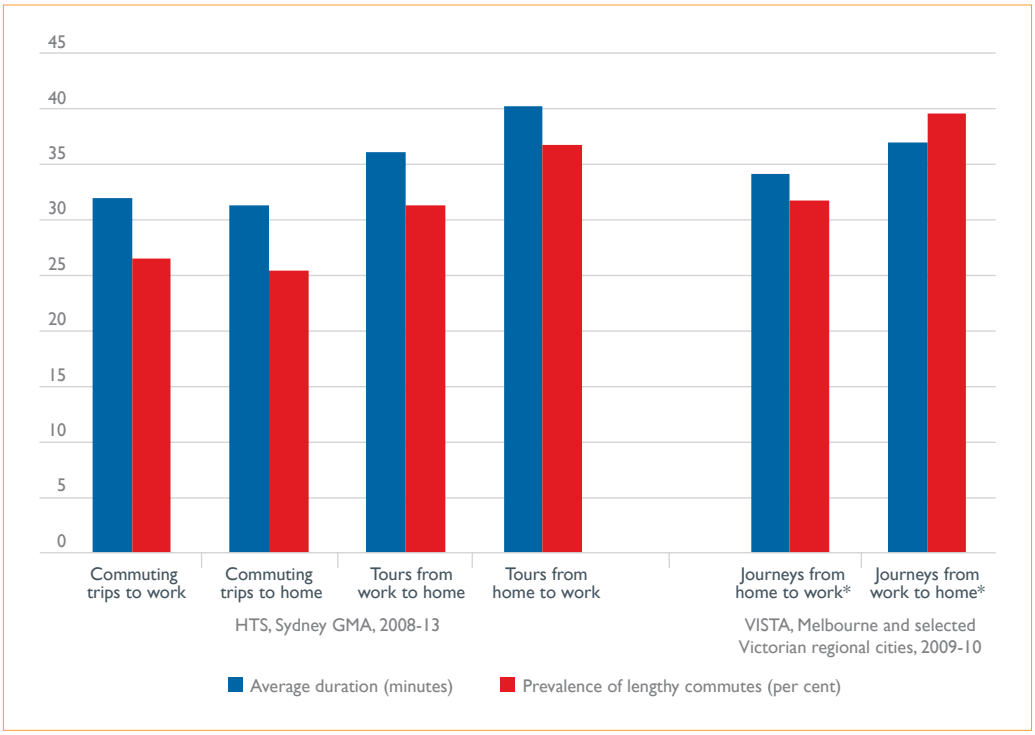
Table 4.2 previously showed that commuting trips to work and commuting trips back home have very similar durations and proportions of lengthy commutes.

Figure 7.1 extends this analysis to consider commuting tour legs, as well as linked commuting trips, for residents of the Sydney GMA. Figure 7.1 also incorporates VISTA data for Victorian residents based around the duration of a commuting journey from 'home to work' or 'work to home' (similar to the HTS concept of a tour leg). When the broader concept of tours or journeys (rather than commuting trips) is adopted, the picture changes. Tours (journeys) from work to home are of longer duration than those from home to work, and are more likely to meet or exceed the lengthy commutes threshold of 45 minutes. In the Sydney GMA, tours from work to home have an average duration that is 4 minutes more than tours from home to work, while the rate of prevalence of lengthy commutes is 5 percentage points higher for work to home tours. In Victoria, tours from work to home have an average duration that is 3 minutes

62 Place of residence information was analysed in some detail in Chapter 5.
63 A more detailed explanation of each of these measures is provided in Table 2.3, while Box 4.1 provides further detail on the tour-based measure.

more than tours from home to work, while the rate of prevalence of lengthy commutes is 8 percentage points higher on the return journey.

Figure 7.1 Average duration and prevalence of lengthy commutes by direction of travel



Notes: A lengthy commute is one with a (one-way) duration of 45 minutes or more. HTS commuting trip data relates to linked trips, which are journeys from one activity to another, ignoring changes in mode. HTS tour data based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour (journey) duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. Data is weighted so as to be representative of total in-scope population. The areas in scope of VISTA are metropolitan Melbourne, along with the regional cities of Geelong, Ballarat, Bendigo, Latrobe Valley and Shepparton.

* The VISTA data relates to journeys undertaken on an average weekday, whereas the HTS data relates to travel on any day of the week.

Sources: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period and *Victorian Integrated Survey of Travel and Activity* (VISTA) data for 2009–10, using VISTA's online tabulation software.

A key reason for the longer duration of return commutes, compared to outward commutes, is the greater incidence of trip-chaining (i.e. making stopovers for other purposes) on the return commute from work to home. The HTS linked trip data does not capture this effect, as when stopovers are made for a non-commuting purpose, the travel to that stopover is counted as a separate (non-commuting) trip. The effect is, however, reflected in the tour and journey data.[64] The HTS tour data has an average of 1.25 linked trips per 'home to work' tour, and 1.41 linked trips per 'work to home' tour.

'Serve passenger' stopovers (e.g. to drop kids off at school or child care) are very common on both the outward tour (11 per cent of tours) and return tour (9 per cent). However, shopping

64 Note that the tour (journey) duration data relate to travel time only, and exclude the time spent at each stopover activity.

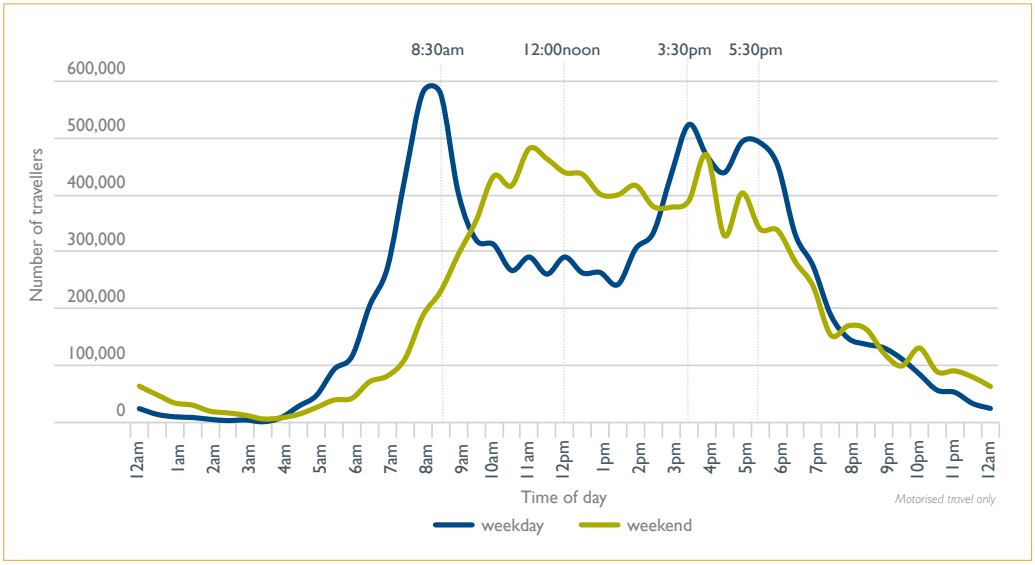
stopovers are much more common on the return tour (11 per cent) than on the outward tour (4 per cent), as are social/recreation stopovers (8 per cent on return tour, compared to 3 per cent on outward tour). Further information on stopovers is provided later in this chapter.

Day and time of travel

'On weekdays, the most critical period for our transport system is the morning peak around 8:30am, when people travel to work, take their children to school, transport freight and make deliveries to homes and businesses. There are two further afternoon peaks, around 3:30pm and 5:30pm, which coincide with trips to/from work and education . . . Weekend travel does not have the same peak-patterns as weekday travel, but tends to be more evenly spread throughout the day, with two small peaks at approximately 11:00am and 4:00pm.' (BSA 2014a, p.12).

Figure 7.2 illustrates peak travel periods in the Sydney Greater Capital City Statistical Area (GCCSA). Congestion delays are likely to be greatest during these peak travel periods, resulting in longer commuting trip durations.

Figure 7.2 Persons travelling by motorised modes by time of day and weekday/ weekend, Sydney GCCSA, 2012–13



Source: Bureau of Statistics and Analytics *Household Travel Survey report: Sydney 2012/13* Figure 3.5.

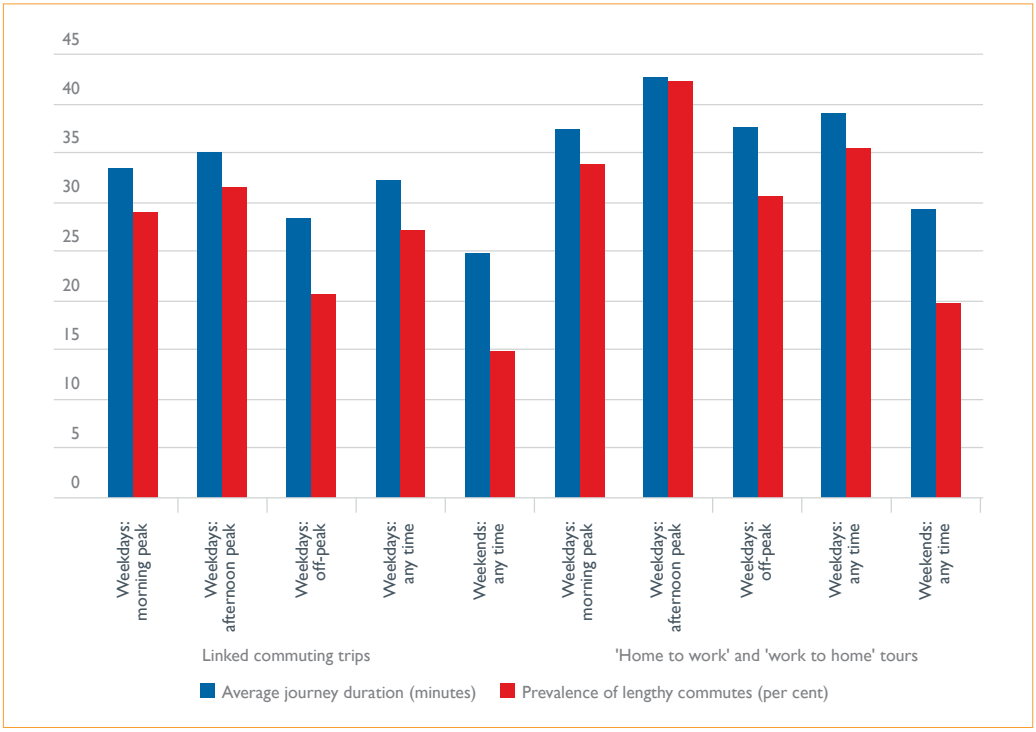
For the United States, McKenzie and Rapino (2011) found that the longest commuting trip durations were associated with early morning departures, with commuting times decreasing as the morning progressed.

Table 4.2 previously showed that average commuting trip durations (and the rate of prevalence of lengthy commutes) in the Sydney GMA were considerably lower on weekends than on weekdays, reflecting the generally lower travel volumes on weekends. It also showed that average commuting trip durations (and the rate of prevalence of lengthy commutes) were considerably higher during weekday peak periods than during weekday off-peak periods.

Figure 7.3 extends this to consider both morning and afternoon peak periods separately, and to consider HTS tour-based data as well as the linked trip data. It shows that the average commuting trip duration is slightly higher in the afternoon peak period (35.0 minutes) than in the morning peak period (33.5 minutes), as is the prevalence of lengthy commuting trips (31.6 versus 29.0 per cent). The average commuting trip duration is at its lowest on weekends (24.9 minutes), as is the prevalence of lengthy commutes (14.8 per cent).

As commuter travel is concentrated in peak periods, 71 per cent of lengthy commuting trips in the Sydney GMA occur in weekday peak periods, while 24 per cent occur in weekday off-peak periods and 5 per cent on weekends.

Figure 7.3 HTS average duration and prevalence of lengthy commutes by time and day of travel, Sydney GMA, 2008–13



Notes: Peak period is defined as trips arriving at their destination from 6.31 to 9.30am on weekdays and trips departing from 3.01 to 6.00pm on weekdays, while trips arriving/departing outside these timeslots are considered off-peak weekday trips (BSA 2014a). A lengthy commute is one with a (one-way) duration of 45 minutes or more. Commuting trip data relates to linked trips, which are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. Data is weighted so as to be representative of total in-scope population.

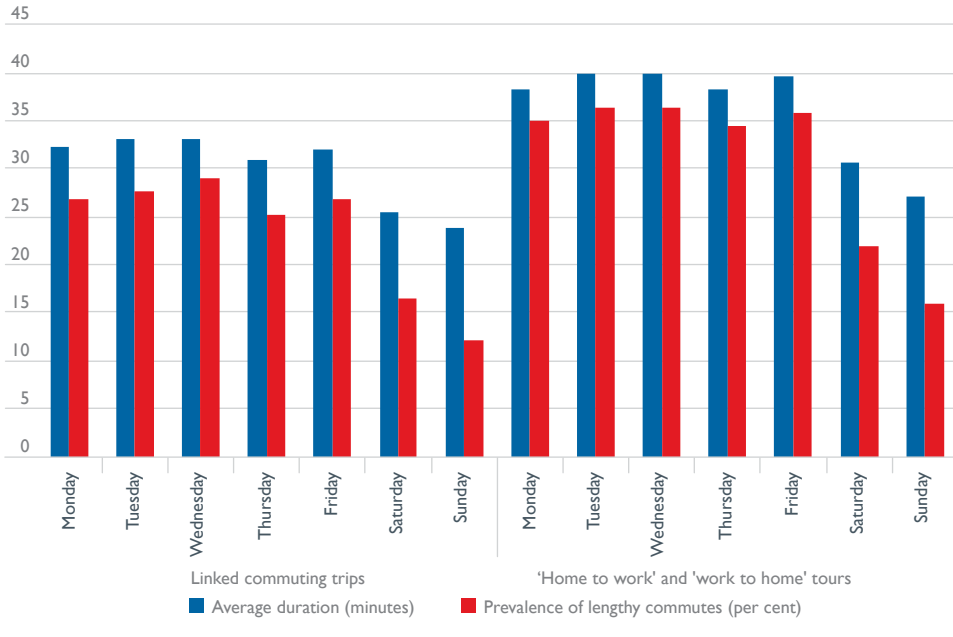
Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

The average duration of 'home to work' and 'work to home' tours is consistently higher than that of commuting trips. Tour durations and the prevalence of lengthy commuting tours are greatest in the afternoon peak period, reflecting the higher incidence of stopovers on return tours. During the afternoon peak period, the average 'home to work' or 'work to home' tour duration is 42.8 minutes and 42.2 per cent of tours take 45 minutes or more. Morning peak

and off-peak tours have similar average tour durations[65], but lengthy commutes are more common during the morning peak. 'Home to work' and 'work to home' tours that occur on weekends are of a comparatively short average duration,

Figure 7.4 disaggregates the HTS commuting trip and tour data by the day of the week. The trip and tour data follow a consistent pattern. Average durations and the rate of prevalence of lengthy commutes peak on Tuesday and Wednesday. Both measures are at their lowest on Sunday, and are also relatively low on Saturday.

Figure 7.4 HTS average duration and prevalence of lengthy commutes by day of week, Sydney GMA, 2008–13



Notes: A lengthy commute is one with a (one-way) duration of 45 minutes or more. Commuting trip data relates to linked trips, which are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. Data is weighted so as to be representative of total in-scope population.

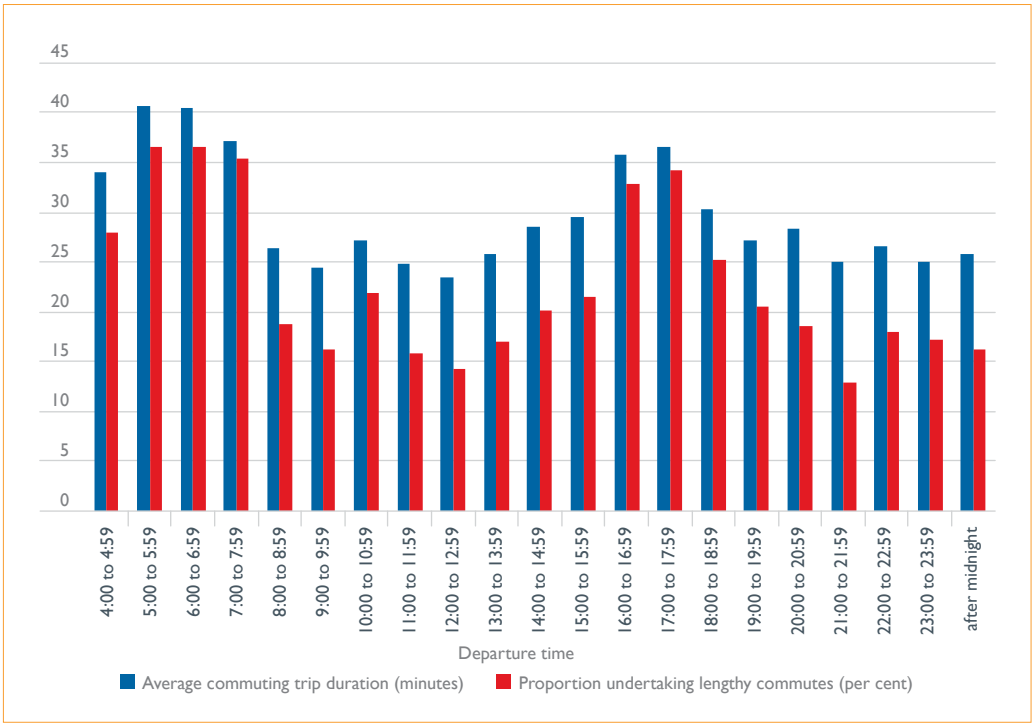
Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

A further disaggregation of weekday commuting trips by time of day is provided in Figure 7.5. Note that while Figure 7.3 previously showed that the entire afternoon peak period has higher average commuting trip durations than the entire morning peak period, Figure 7.5 reveals that there are hour-long periods within the morning peak that have longer durations than any hour-long period within the afternoon peak. Average commuting trip durations are highest for trips that depart between 5:00 and 7:59am, but fall considerably for trips departing between

65 Note that off-peak weekday tours involve a relatively large number of stopovers for non-commuting purposes, which causes the average off-peak tour duration to be 9 minutes longer than the average off-peak commuting trip duration. In contrast, the gap between the morning peak average tour and trip duration is only 4 minutes (reflecting a low incidence of stopovers for non-commuting purposes).

8:00 and 8:59am, and continue to decline reaching a minimum for departures between 12:00 and 12:59pm. Average commuting trip durations then rise, reaching a second peak for departures between 16:00 and 17:59pm, before again declining. The rate of prevalence of lengthy commutes is greatest for departures between 5:00 and 6:59am and at its lowest for departures between 21:00 and 21:59pm.

Figure 7.5 HTS average duration and prevalence of lengthy commutes by time of departure for weekday commuting trips, Sydney GMA, 2008–13

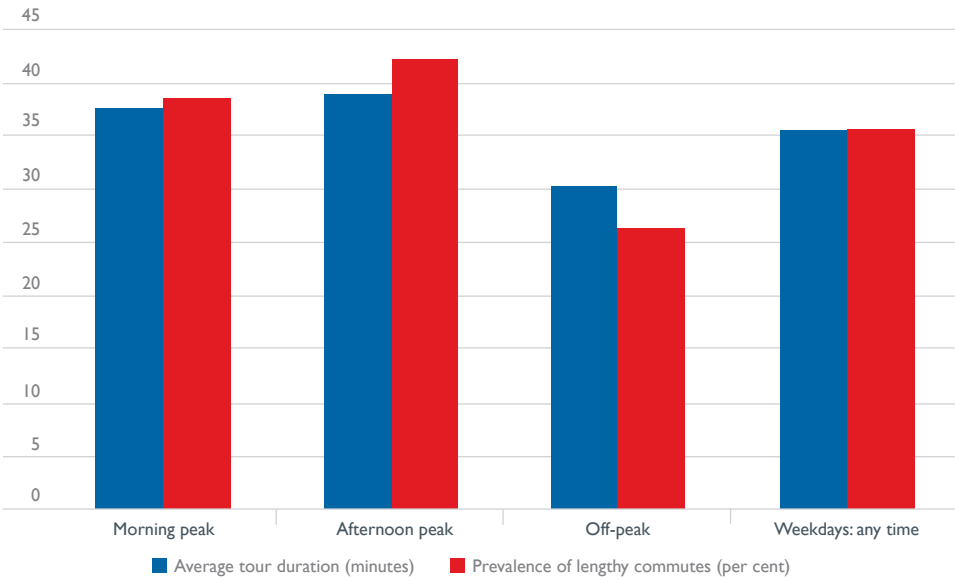


Notes: Commuting trip data relates to linked trips, which are journeys from one activity to another, ignoring changes in mode. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

To see whether the patterns observed for the Sydney GMA translate to other areas, the VISTA 'home to work' and 'work to home' journey data for Melbourne and selected Victorian regional cities is examined. The VISTA journey data relates to the average weekday in 2009–10 and peak periods are defined a little differently than in the HTS. Figure 7.6 shows that the average duration of a journey from 'home to work' or 'work to home' is longest during the afternoon peak (38.7 minutes), followed by the morning peak (37.7 minutes) and off-peak periods (30.3 minutes). The rate of prevalence of lengthy commutes is also greatest during the afternoon peak (42.1 per cent) and lowest during off-peak periods (26.4 minutes) on weekdays. These results are quite consistent with the results for the Sydney GMA (see Figure 7.3).

Figure 7.6 VISTA average journey duration and prevalence of lengthy commutes by time of travel on weekdays, Melbourne and selected Victorian regional cities, 2009–10



Notes: Peak periods are defined in VISTA as 7:00 to 9:00am on weekdays and 3:00 to 6:00pm on weekdays (note that the morning peak definition differs from that adopted in the Sydney HTS). VISTA journey data based on 'home to work' and 'work to home' journeys undertaken on an average weekday. A journey may comprise one or more trips. Journey duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) journey duration of 45 minutes or more. The areas in scope of VISTA are metropolitan Melbourne, along with the regional cities of Geelong, Ballarat, Bendigo, Latrobe Valley and Shepparton. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of *Victorian Integrated Survey of Travel and Activity* (VISTA) data for 2009–10, using VISTA's online tabulation software.

Stopovers

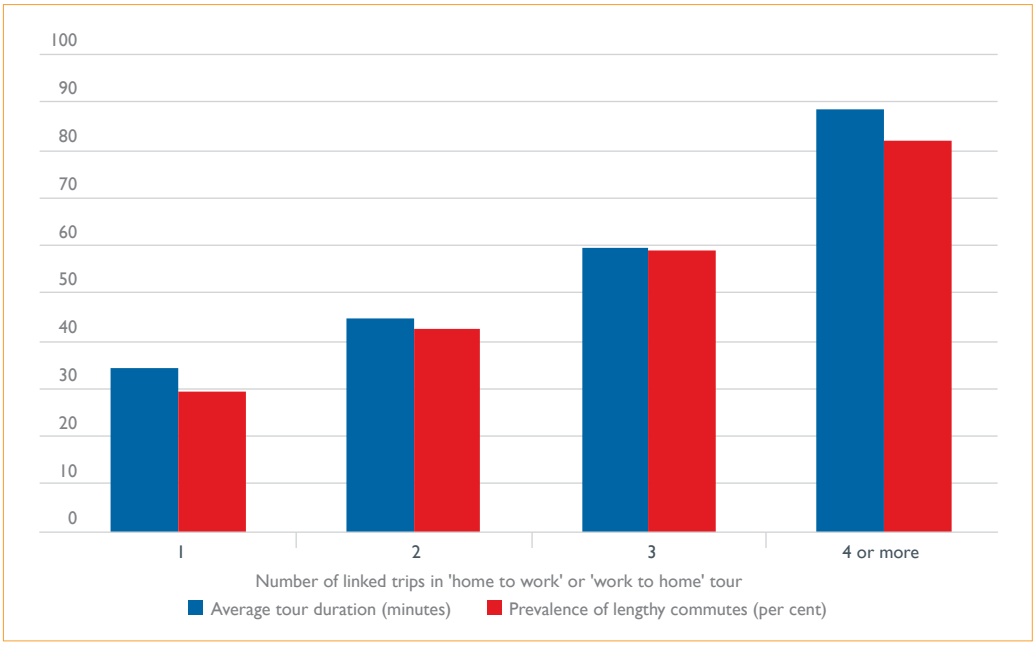
A linked trip is a journey from one activity to another, ignoring changes in mode. A linked commuting trip is a linked trip that has been assigned a priority purpose of commuting. Any stops made for non-commuting purposes (e.g. shopping, work-related business) on the way to or from work will be classified as a separate linked trip.

Consequently, the point of origin of a sizeable proportion of outward linked commuting trips is not the worker's home address, but rather the previous non-commute related stopover (18 per cent). Similarly, the point of origin of a sizeable proportion of linked commuting trips in the return direction is the last non-commute related stopover (28 per cent), rather than the address of the worker's main job. Outward commuting trips that depart from home tend to have a much longer duration than those that depart from elsewhere (34 versus 23 minutes), as they reflect the full journey between home and work, rather than only part of that journey. Similarly, return commuting trips that depart from the worker's main job location have a longer average duration than those that depart from elsewhere (36 versus 20 minutes).

In order to get a more complete picture of the duration of the entire journey between home and work (in either direction), and the role that stopovers play in the total travel time of such journeys, the remainder of this section focuses on the HTS concept of 'tours'.

While the great majority of 'home to work' or 'work to home' tours involve a single linked trip (77 per cent),[66] 17 per cent of tours involve two linked trips, 4 per cent involve three linked trips and 2 per cent involve four or more linked trips. Figure 7.7 illustrates the strong dependence of the average tour duration on the number of linked trips within that tour. Tour legs that involve a single linked trip (also referred to as 'direct commutes') have an average duration of 34 minutes, with 30 per cent meeting or exceeding the lengthy commutes threshold of 45 minutes. Indirect commutes (involving two or more linked trips) tend to be of much longer duration (averaging 51 minutes) and involve a much greater prevalence of lengthy commutes (49 per cent). Turcotte (2005) reports that the average duration of a Canadian round trip commute was 75 minutes where stops were made during the commute, compared to 59 minutes where no stops were made. For the Sydney GMA, the gap between indirect and direct commutes was considerably larger at 17 minutes for a one-way commute.

Figure 7.7 HTS average tour duration and prevalence of lengthy commutes by number of linked trips within tour, Sydney GMA, 2008–13



Notes: Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

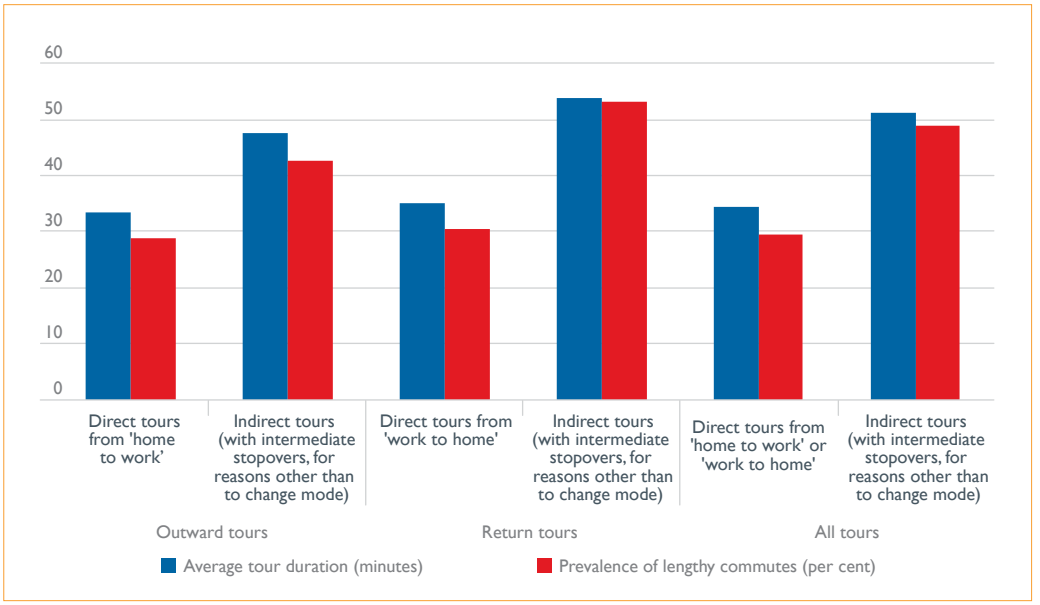
Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

66 This aligns with the results of Milthorpe and Daly (2010), who report that for the 2004–09 period, 75 per cent of weekday home to work and work to home tours in the Sydney Statistical Division involved no intermediate activities (i.e. a single linked trip).

Overall, 66 per cent of lengthy tours involve a direct tour between home and work, while 33 per cent involve an indirect tour, with intermediate stopovers for non-commuting purposes.

Outward tour legs (from home to work) were more likely to involve a single linked trip than return tour legs (81 per cent versus 72 per cent). Figure 7.8 shows that indirect commutes operating in the outward direction tend to of shorter duration than those in the return direction (48 versus 54 minutes), reflecting the larger number of stopovers on return trips. However, direct commutes are of similar duration in the outward and return directions (34 versus 35 minutes).

Figure 7.8 HTS average tour duration and prevalence of lengthy commutes by direction of travel and direct/indirect tour, Sydney GMA, 2008–13



Notes: Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Direct tours are those that involve a single linked trip, while indirect tours involve two or more linked trips. Outward tours are tours from home to work, while return tours are tours from work to home. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Tours between home and work are more likely to involve a single linked trip when they occur on a weekend (83 per cent) than when they occur on a weekday (76 per cent). A key reason is that 'serve passenger' trips (e.g. to drop off or pick up kids from school or childcare) are less likely to occur as part of weekend tour legs than as part of weekday tour legs (4 per cent versus 10 per cent). Tours between home and work are also more likely to involve a single linked trip when they occur in peak weekday periods (77 per cent) than when they occur in off-peak weekday periods (74 per cent). This is consistent with the findings of Strathman et al. (1994) who found that workers in Portland in the United States who commuted in peak periods were less likely to add non-work travel to the work commute.

Table 7.1 shows the incidence of linked trips with different purposes on 'home to work' and 'work to home' tours. Over 97 per cent of 'home to work' and 'work to home' tour legs involve a linked trip with a priority purpose of commuting.[67] Shopping trips and 'serve passenger' trips are also relatively common, occurring within 8 and 10 per cent of tour legs, respectively. However, while serve passenger trips are slightly more common on the outward leg than the return leg, shopping trips are much more common on the return tour leg. Social/recreation trips are also more common on return legs than outward legs.

Table 7.1 HTS proportion of tour legs involving trips with different purposes, Sydney GMA, 2008–13

Tour leg involves at least one linked trip with a priority purpose of:	Proportion of home to work tours (per cent)	Proportion of work to home tours (per cent)	Proportion of all tours between home and work (per cent)
Commuting	97	97	97
Work-related business	2	3	2
Social/recreation	3	8	5
Serve passenger	11	9	10
Shopping	4	11	8
Education	0*	0*	0*
Personal business	2	3	2
Other	3	3	3

Notes: Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Data is weighted so as to be representative of total in-scope population.

* Education trips occur within 0.2–0.3 per cent of tours.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

As was noted previously in Chapter 5, females tend to make more intermediate stopovers than males as part of their 'home to work' and 'work to home' tours. The greater incidence of intermediate stopovers is largely attributable to females making more stopovers to serve passengers or to go shopping.

While only a very small proportion of 'home to work' and 'work to home' tours involve an education stopover, the tours that do involve an education stopover tend to be of a particularly long average duration (79 minutes), as do tours that involve a work-related business stopover (76 minutes) or a social/recreation stopover (63 minutes). The implication is that these stopovers involve a significant detour from the direct route between home and work, involving considerable additional travel time. Tours that involve a stopover for serve passenger or shopping purposes have an average duration of 49 and 48 minutes, respectively. In contrast, the tours that involve a stopover for 'other' purposes tend to be of very short average duration (21 minutes).

67 In any day the first trip to work in the main job (and the first trip to a second job) is assigned a purpose of commuting (BSA 2014a). However, if the person makes a second trip to their main job, this is not assigned a purpose of commuting, and instead falls into the 'other' purpose category. This is why less than 100 per cent of 'work to home' and 'home to work' tour legs involve a linked commuting trip.

Turcotte (2005) found that the average duration of a Canadian round trip commute was 82 minutes if a stop was made to drop off children, compared to 62 minutes if no such stop was made. For the Sydney GMA, one-way tour legs that involved a serve passenger stop (whether to drop off children, partners or other people or accompany someone)[68] had an average duration that was 12 minutes longer than if no such stop was made.

The evidence for the Sydney GMA (and for Canada) shows that the incidence of stopovers on the way to and from work is a major influence on the total time spent travelling between home and work. However, according to the results from the PC's *Community Survey 2011*—which were previously presented in Table 4.3—for the selected Australian cities (in aggregate) there is virtually no difference between direct and indirect trips to work with respect to either the average commuting trip duration or the prevalence of lengthy commutes. For Sydney, the PC *Community Survey's* estimated average commuting trip duration was only a little lower for direct commutes (39 minutes) than for indirect commutes to work (41 minutes). If the HTS results are presented on a comparable basis to the PC data (i.e. for weekday peak period commutes to work by Sydney SD residents), the average 'home to work' tour duration is 38 minutes for direct commutes and 43 minutes for indirect commutes.[69] Thus, much of the apparent difference in results for direct and indirect commutes can be attributed to the differences in scope and definitions of the commuting time measures from the two surveys. The more rigorous data collection process in the HTS may also be a factor.

Transport mode

International evidence

There have been numerous international studies which investigate the relationship between commuting times and transport mode.

- Turcotte (2011) reports that, in Canada, public transport users spend the most time travelling to work (44 minutes), compared to 24 minutes for those who travel by private vehicles and 14 minutes for those who walk or cycle to work. While 43 per cent of public transport users have a commuting time of 45 minutes or more, only 15 per cent of private vehicle users undertake such a lengthy commute.
- For the United States, the American Association of State Highway and Transportation Officials (AASHTO, 2013) report an average one-way commute time of 69 minutes for those who travel by railroad, compared to 65 minutes for ferryboat, 46 minutes for subway (including streetcar, elevated line), 45 minutes for bus/trolleybus, 25 minutes for car/truck/van, 22 minutes for motorcycle, 19 minutes for bicycle or taxi, and 12 minutes for walking in 2010.
- McQuaid and Chen (2012) highlight major differences in commuting times by mode for the United Kingdom. Average commuting times are lowest for those cycling or walking to work (17 minutes for men and 13 minutes for women), followed by car drivers and passengers (27 minutes for men and 21 minutes for women), with public transport users having the longest commuting times (51 minutes for men and 42 minutes for women).

68 Shaz and Corpuz (2008) provide an in-depth analysis of serve passenger trips in Sydney.

69 In contrast, the HTS outward tour leg data presented in Figure 7.8 related to all days and travel periods and to the entire GMA, in reporting that the average 'home to work' tour duration was 34 minutes for direct commutes and 48 minutes for indirect commutes.

Their regression analysis found that long commutes (of 30 minutes or more) were about 20 times more likely for public transport users than for those who cycled or walked to work, and about three times more likely for car/van drivers and passengers.

- For the Netherlands, Groot et al. (2012) report that 20 per cent of commutes by public transport take more than one hour, compared to just 3 per cent of commutes by private transport. Another Dutch study by Van Ham and Hooimeijer (2009) finds that the probability of undertaking a long commute (of 75 minutes or more two-way) is significantly higher for those who commute by train than for those who commute by car.
- These studies are very consistent in finding that commuting durations are highest for public transport users, considerably lower for those commuting by private vehicle, and lowest for those commuting by active transport (cycling or walking).

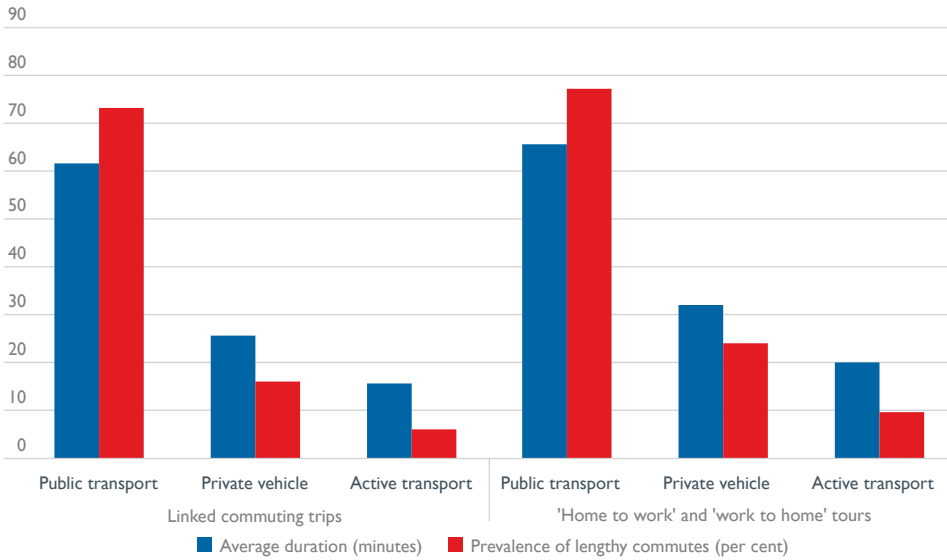
New evidence for Sydney Greater Metropolitan Area

Figure 7.9 summarises the HTS results for the Sydney GMA for three broad categories of priority transport mode. Average durations and the prevalence of lengthy commutes are presented on both a linked commuting trip and tour basis. The private vehicle mode share of commuting trips is 74 per cent for the Sydney GMA for the 2008–13 period, compared to 19 per cent for public transport and 7 per cent for active transport. The results in Figure 7.9 are very much aligned with the international results, with average duration and the prevalence of lengthy commutes both at their highest for public transport, much lower for private vehicles, and lower again for active transport.

A particular stand-out is that 73 per cent of linked commuting trips by public transport and 77 per cent of 'home to work' and 'work to home' tours by public transport take 45 minutes or more. This compares to only 16 per cent of private vehicle commuting trips and 24 per cent of private vehicle tours between home and work involving a lengthy commute. The gap between trip duration and tour duration is largest for private vehicles (7 minutes), and lower for public transport and active transport (4 minutes). This reflects the greater incidence of stopovers on private vehicle tours, which average 1.36 linked trips per tour, compared to 1.27 for public transport tours and 1.15 for active transport tours. In particular, 'serve passenger' linked trips are more likely to form part of a private vehicle tour between home and work (12 per cent) than part of a public transport or active transport tour between home and work (5 per cent and 1 per cent, respectively).

Public transport commuting trips are relatively concentrated in weekday peak periods, when the public transport mode share of commuting trips is 22 per cent, compared to 15 per cent in weekday off-peak periods and 10 per cent on weekends. However, public transport commuting trips tend to have a very long duration, irrespective of when they occur, with an average duration of 57 minutes for weekday off-peak periods, 61 minutes for weekends and 63 minutes for weekday peak periods.

Figure 7.9 HTS average duration and prevalence of lengthy commutes by broad priority transport mode, Sydney GMA, 2008–13



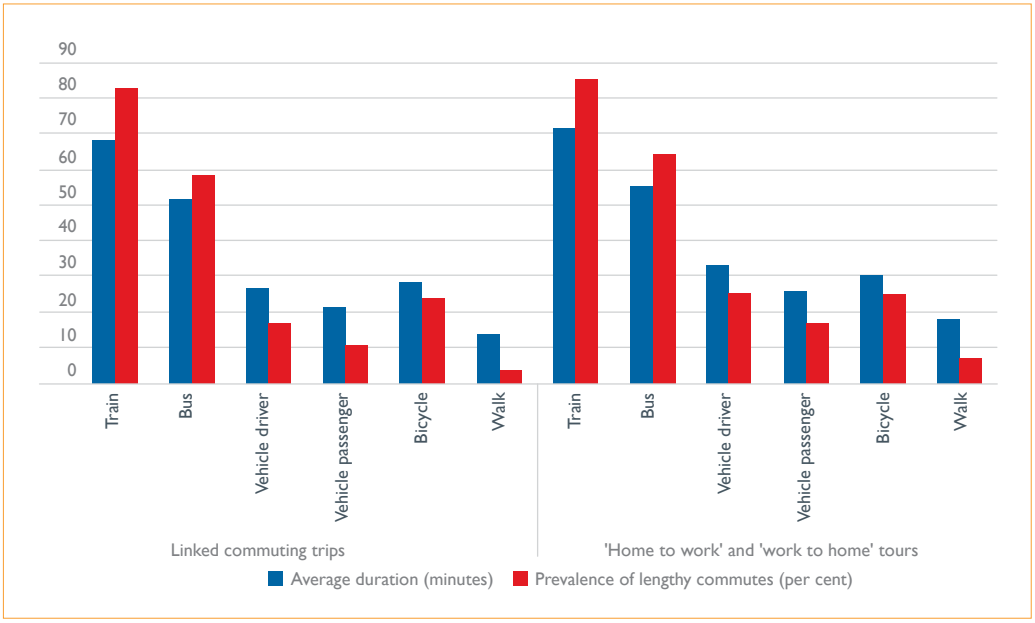
Notes: Where a trip or tour involves more than one transport mode, a single priority mode is assigned according to a hierarchy, which is generally the mode with the largest likely trip duration (BSA 2014a, p.42). Nine priority modes were identified by BSA, simplified into three categories for presentation purposes in this chart, with 'other' mode excluded (due to a small sample size). Linked trips are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Of the 623 500 lengthy commuting trips by Sydney GMA residents on an average day between 2008 and 2013, 52 per cent have a priority mode of public transport, while for 46 per cent the priority mode is private vehicle and for 2 per cent the priority mode is active transport. Of the 837 700 lengthy tours between home and work, 53 per cent have a priority mode of private vehicle, while for 46 per cent the priority mode was public transport and for 2 per cent it was active transport. The greater representation of private vehicles in lengthy tours relates to the higher incidence of trip chaining for those travelling by private vehicle.

Figure 7.10 presents HTS results for a more detailed disaggregation of transport mode. Train commutes tend to be of much longer duration than bus commutes, with over 80 per cent of train commuting trips and train tours between home and work taking 45 minutes or more. Vehicle driver commutes tend to be of longer duration than vehicle passenger commutes, and bicycle commutes have a longer average duration than walking commutes.

Figure 7.10 HTS average duration and prevalence of lengthy commutes by detailed priority transport mode, Sydney GMA, 2008–13



Notes: Where a trip or tour involves more than one transport mode, a single priority mode is assigned according to a hierarchy, which is generally the mode with the largest likely trip duration (BSA 2014a, p.42). Nine priority modes were identified by BSA. Six are presented here, with ferry, taxi and other not presented due to small sample sizes. Linked trips are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Table 7.2 presents the commuting time measures disaggregated by place of residence and broad transport mode. The most extreme result relates to the 'home to work' and 'work to home' tour data for Outer Sydney residents with a priority mode of public transport—91 per cent of this group undertake a lengthy commute.[70] At the opposite end of the spectrum, lengthy commutes are very rare for residents of the rest of the GMA with a priority mode of active transport.

Within each sector of residence the ordering is identical, with average duration and the prevalence of lengthy commutes highest for public transport use and lowest for active transport use (irrespective of which measure is used).

Public transport commuting times are lowest for Inner Sydney residents, and higher for Middle Sydney, Outer Sydney and Rest of GMA residents, with the precise ordering varying across the different measures. Private vehicle commuting times are at their lowest for residents of the rest of the GMA, and tend to be slightly higher for Outer Sydney residents than for Inner or Middle Sydney residents. Active transport commuting times are also at their lowest for residents of the rest of the GMA.

70 Note that 16 per cent of 'home to work' and 'work to home' tours by Outer Sydney residents have a priority transport mode of public transport,

Table 7.2 HTS average duration and prevalence of lengthy commutes by place of residence and priority transport mode, Sydney GMA, 2008–13

Place of residence	Priority transport mode	Linked commuting trips		'Home to work' and 'work to home' tours	
		Average duration (minutes)	Prevalence of lengthy commutes (per cent)	Average duration (minutes)	Prevalence of lengthy commutes (per cent)
Inner Sydney	Public transport	46	48	50	56
	Private vehicle	25	15	32	24
	Active transport	17	6	22	11
Middle Sydney	Public transport	59	79	63	83
	Private vehicle	26	15	32	24
	Active transport	16	6	20	9
Outer Sydney	Public transport	77	90	82	91
	Private vehicle	27	19	34	27
	Active transport	15	8	18	12
Rest of GMA	Public transport	79	74	80	75
	Private vehicle	21	10	27	17
	Active transport	12	2	13	3

Notes: Inner, middle and outer rings defined based on Local Government Area (LGA) classification in Appendix A of BITRE (2012a). Where a trip or tour involves more than one transport mode, a single priority mode is assigned according to a hierarchy, which is generally the mode with the largest likely trip duration (BSA 2014a, p.42). Nine priority modes were identified by BSA, simplified into three categories for presentation purposes in this table, with 'other' mode excluded (due to a small sample size). Linked trips are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

More than half of all public transport commuting trips (57 per cent) involve a place of work in the Central Business District (CBD)—i.e. the City of Sydney Local Government Area (LGA)—compared to 41 per cent of active transport commuting trips and just 8 per cent of private vehicle commuting trips. Private vehicle commuting trips/tours involving a place of work in the CBD tend to be of longer duration than those involving a non-CBD workplace, and the same pattern is evident for active transport trips and tours. These results are likely to reflect greater road traffic congestion in and around the CBD. However, public transport commuting trips involving a CBD workplace are 4 minutes shorter on average than those with a non-CBD workplace, and public transport tours between home and a CBD workplace are 6 minutes shorter. This may reflect the public transport network's CBD-orientation, and the need for additional connections to be made to access non-CBD workplaces.

Table 7.3 presents the average distance travelled and average speeds for linked commuting trips and for tours between home and work. On average, tours cover 3 kilometres (km) more distance than commuting trips, reflecting the extra travel involved in making stops for non-commuting purposes. The average speed is 28km per hour on both linked commuting trips and tours between home and work.

Table 7.3 HTS average distance and speed of commuting trips and tours by priority transport mode, Sydney GMA, 2008–13

Priority transport mode	Linked commuting trips		'Home to work' and 'work to home' tours	
	Average road distance (kilometres)	Average speed (kilometres per hour)	Average road distance (kilometres)	Average speed (kilometres per hour)
Public transport	22	21	23	21
Train	27	24	28	23
Bus	12	14	13	14
Private vehicle	14	33	17	33
Driver	15	34	18	33
Passenger	10	29	12	27
Active transport	2	7	2	7
Bicycle	7	14	7	14
Walk	1	5	1	5
Any mode—total	15	28	18	28

Notes: Where a trip or tour involves more than one transport mode, a single priority mode is assigned according to a hierarchy, which is generally the mode with the largest likely trip duration (BSA 2014a, p.42). Nine priority modes were identified by BSA. Due to small sample sizes, results for ferry, taxi and other mode are not presented in this table. Linked trips are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Road distance for each trip was derived by BSA based on the latitude and longitude co-ordinates of each trip origin and destination. Tour road distance is an aggregate of the road travel distance for each contributing trip. Average speeds are derived from average road distances and average travel durations, and relate to the average speed across the whole trip/tour, and not to average speeds while in-vehicle. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

A key reason why public transport commutes have such long durations is that they involve relatively long travel distances. The average road distance of a public transport commuting trip is 22km, compared to 14km for a private vehicle trip and 2km for an active transport trip. For tours between home and work, the average road distances are 23km for public transport tours, 17km for private vehicle tours and 2km for active transport tours. Vehicle driver trips and tours tend to cover longer distances than vehicle passenger trips and tours, while train trips/tours cover longer distances than bus trips/tours, and bicycle trips/tours cover longer distances than walking trips/tours.

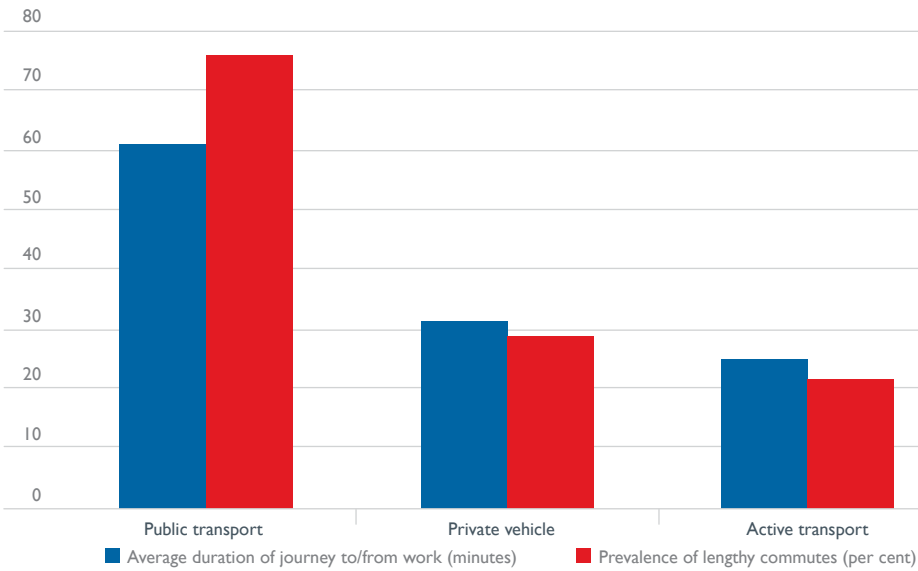
While public transport commutes involve longer distances than private vehicle commutes, public transport commutes are undertaken at a slower average speed, which also contributes to their long average durations. The average speed of a public transport commuting trip or tour is 21km per hour, compared to 33km per hour for private vehicle commuting trips and tours. Active transport trips and tours involve a relatively low average speed of 7km per hour. Overall, vehicle driver commuting trips involve the most rapid speeds, followed by vehicle passenger trips, train trips, bus and bicycle trips, and walking trips.

Other Australian evidence

To see whether the patterns observed for the Sydney GMA translate to other areas, the VISTA 'home to work' and 'work to home' journey data for Melbourne and selected Victorian regional cities is examined. The VISTA journey data in Figure 7.11 relates to the average weekday in 2009–10. The Victorian results for public transport and private vehicle journeys are similar to the Sydney GMA tour results displayed in Figure 7.9. The average journey duration is 61 minutes for public transport and 32 minutes for private vehicles, compared to 66 and 32 minutes, respectively, for Sydney GMA tours. The prevalence of lengthy commutes in the Victorian cities is 76 per cent for public transport and 29 per cent for private vehicles, compared to 77 and 24 per cent, respectively, for Sydney GMA tours. However, travel to and from work by active transport tends to be of longer duration (25 versus 20 minutes) and have a higher prevalence of lengthy commutes (21 versus 10 per cent) in the Victorian cities than in the Sydney GMA. This reflects bicycle travel making up a much more sizeable proportion of all active transport travel to and from work in the Victorian cities.

Of the 1.1 million lengthy journeys between home and work undertaken by residents of Melbourne and the selected Victorian regional cities on an average weekday, 64 per cent have a priority mode of private vehicle, while for 32 per cent the priority mode was public transport and for 3 per cent it was active transport.

Figure 7.11 VISTA average journey duration and prevalence of lengthy commutes by main transport mode, Melbourne and selected Victorian regional cities, 2009–10



Notes: Public transport includes tram, train, public bus or school bus. Active transport includes bicycle or walking. Private vehicle includes vehicle driver and vehicle passenger. Other modes (including taxi and motorcycle/scooter) are excluded. VISTA journey data based on 'home to work' and 'work to home' journeys undertaken on an average weekday. A journey may comprise one or more trips. Journey duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) journey duration of 45 minutes or more. Journeys to/from work with a main transport mode of other are excluded from the chart. The areas in scope of VISTA are metropolitan Melbourne, along with the regional cities of Geelong, Ballarat, Bendigo, Latrobe Valley and Shepparton. Data is weighted so as to be representative of total in-scope population.

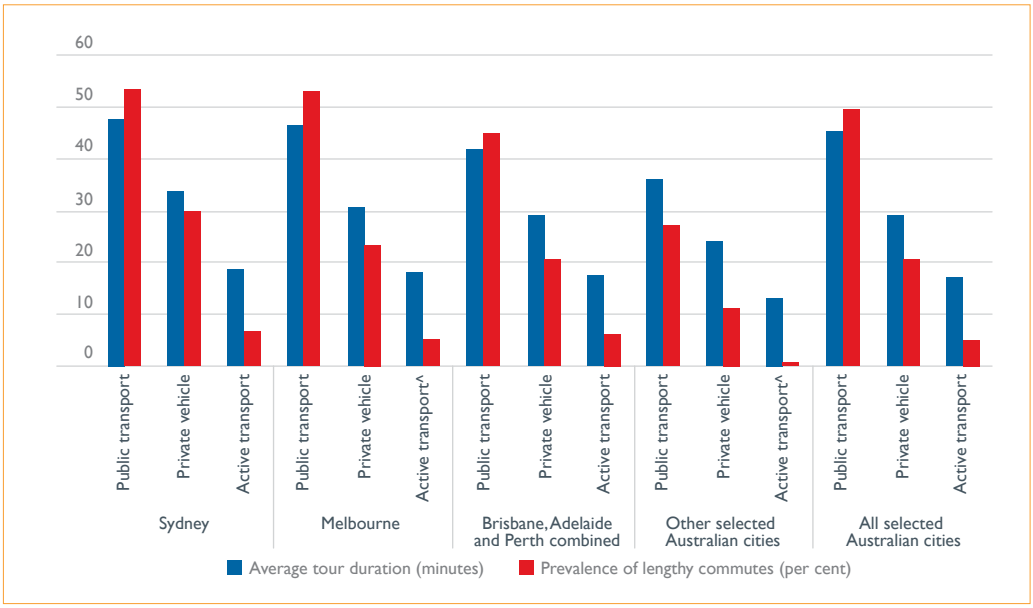
Source: BITRE analysis of *Victorian Integrated Survey of Travel and Activity* (VISTA) data for 2009–10, using VISTA's online tabulation software.

Table 4.3 previously presented results from the PC *Community Survey 2011* on the relationship between commuting trip durations and priority transport mode for the surveyed Australian cities. While the ordering of modes by duration in the PC survey is consistent with the results of the HTS and VISTA surveys, the PC survey reports much lower average durations (and prevalence of lengthy commutes) for public transport commutes. This may reflect methodological and scope differences, such as the PC survey's much broader geographic coverage and its focus on peak period journeys to work only.

Figure 7.12 separates the PC survey's results for Sydney and Melbourne from results for the remaining major capitals and the other selected cities. The ordering of modes by duration is the same for each place of residence category. There is a general tendency for the average commuting trip duration to decline with city size across all three modes. This results in average trip durations and the prevalence of lengthy commutes being highest for Sydney and lowest for the 'other selected Australian cities', irrespective of mode.

Based on the PC survey, of all of the lengthy commutes from home to work undertaken by residents of the selected Australian cities during peak hour, 52 per cent have a priority mode of public transport, while for 47 per cent the priority mode was private vehicle and for 1 per cent it was active transport.

Figure 7.12 Productivity Commission *Community Survey* average commuting trip duration and prevalence of lengthy commutes by priority transport mode and place of residence, selected Australian cities, 2011



Notes: The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. A lengthy commuting trip is one with a commuting trip duration of 45 minutes or more. Where a commuting trip involves more than one transport mode, a priority mode has been allocated to the trip based on the BSA hierarchy (BSA 2014a, p.42). Nine priority modes were identified by BSA, simplified into three categories for presentation purposes in this chart, with 'other' mode excluded. Private vehicle includes car or similar, motorcycle, motor scooters. Public transport includes bus, train, tram, ferry, taxi and plane. Active transport includes walking and cycling. The PC's 'work from home' mode option was excluded, as no commuting trip is involved. The survey covers 24 Australian metropolitan areas and regional cities. Data is weighted to be representative of total in-scope population.

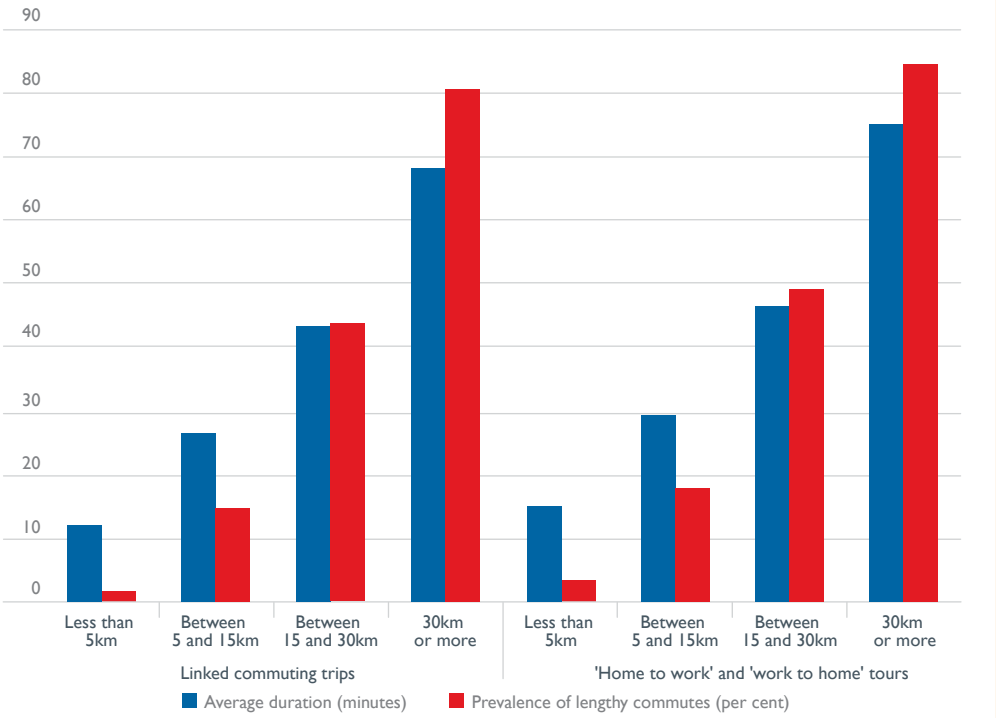
^ Based on sample of less than 100 responses, and should be used with caution.

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Neilsen, as an input to Productivity Commission (2011).

Trip distance

The average duration of a commute is closely related to the distance travelled—this was illustrated in Table 4.2, and has also been demonstrated by empirical studies, such as Turcotte (2005). Figure 7.13 extends the HTS results previously shown in Table 4.2 to include tour data, as well as trip data. Both the trip and tour durations tend to rise strongly with distance travelled, as does the prevalence of lengthy commuting trips and tours. Only 4 per cent of tours between home and work that are less than 5km take 45 minutes or more in travel time, compared to 85 per cent of tours that involve a road distance of 30km or more.

Figure 7.13 HTS average duration and prevalence of lengthy commutes by distance travelled, Sydney GMA, 2008–13



Notes: Distance travelled is the BSA derived road network distance between trip origin and trip destination. There were around 70 trips and 60 tours that were excluded from the analysis due to the trip origin/destination data not being able to be coded to a specific location. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Of the 837 700 lengthy tours between home and work undertaken by Sydney GMA residents on an average day, 41 per cent involved a road distance of more than 30km, while 38 per cent involved a road distance of 15 to 30km, 19 per cent involved a road distance of 5 to 15km and 2 per cent covered a road distance of less than 5km.

Commuting durations and distances are quite highly correlated, with a correlation coefficient of 0.73 for linked commuting trips and 0.72 for tours between home and work. Commuting durations and distances are a long way from being perfectly correlated, as the average speed will differ across individual commuting trips and tours.

Table 7.4 shows how average commuting distances and average speeds vary with place of residence and selected trip (tour) characteristics. The average road distance varies considerably by place of residence, being lowest for Inner Sydney and highest for Outer Sydney. Average speeds are lowest for those who reside in Inner Sydney and rise with distance from the CBD, reaching their maximum in the rest of the GMA. Commuting trips and tours that involve a CBD workplace tend to cover slightly more distance than those involving non-CBD workplaces, and involve significantly slower average travel speeds, reflecting the higher levels of traffic congestion in and around the CBD.

Table 7.4 HTS average distance and speed of commuting trips and tours by place of residence and selected trip characteristics, Sydney GMA, 2008–13

	Linked commuting trips		'Home to work' and 'work to home' tours	
	Average road distance (kilometres)	Average speed (kilometres per hour)	Average road distance (kilometres)	Average speed (kilometres per hour)
Place of residence				
Inner Sydney	8	16	10	15
Middle Sydney	12	21	14	21
Outer Sydney	19	33	22	32
Rest of GMA	15	41	19	40
Direction of travel				
Outward	15	29	17	28
Return	14	27	18	27
Time and day of travel				
Weekday peak	15	27	14	30
Weekday off-peak	14	29	15	30
Weekend	13	31	15	30
Place of work				
CBD	16	21	19	21
Other location	14	30	17	30
Stopovers				
Direct tours	na	na	16	28
Indirect tours	na	na	23	27

Notes: Inner, middle and outer rings defined based on Local Government Area (LGA) classification in Appendix A of BITRE (2012a). The CBD is defined as the City of Sydney Local Government Area. The assigned workplace is the address of the person's main job, or the address of another job if the main job was not attended on the travel day. Peak period is defined as trips arriving at their destination from 6.31 to 9.30am on weekdays and trips departing from 3.01 to 6.00pm on weekdays, while trips arriving/departing outside these timeslots are considered off-peak weekday trips (BSA 2014a). Road distance for each trip was derived by BSA based on the latitude and longitude co-ordinates of each trip origin and destination. Linked trips are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tours with a single linked trip are referred to as direct tours, while those with multiple linked trips are referred to as indirect tours. Tour road distance is an aggregate of the road travel distance for each contributing trip. Average speeds are derived from average road distances and average travel durations, and relate to the average speed across the whole trip/tour, and not to average speeds while in-vehicle. Data is weighted so as to be representative of total in-scope population. na=not applicable.

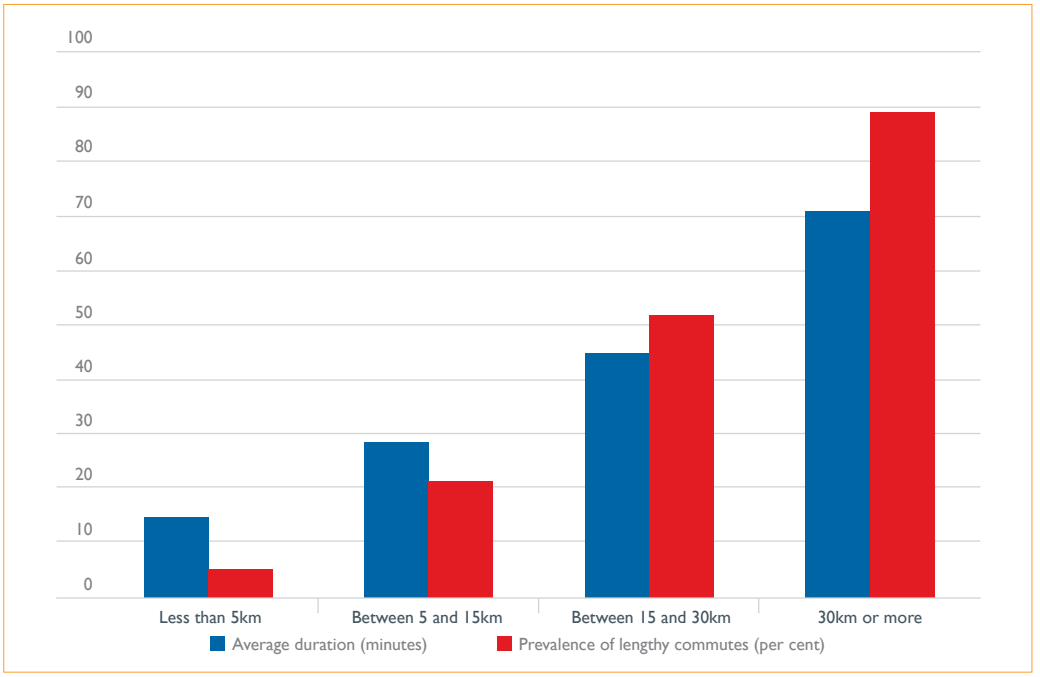
Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Average commuting distances and speeds do not vary much with the direction of travel. The average speed of linked commuting trips is somewhat slower in weekday peak periods than on weekends, but the average speed of 'home to work' and 'work to home' tours does not vary with the time and day of travel. Tours between home and work that involve a stopover for non-commuting purposes cover a longer average road distance than tours with no such stopovers, but there is little difference in the average travel speed of these two types of tours.

To see whether the patterns observed for the Sydney GMA translate to other areas, the VISTA 'home to work' and 'work to home' journey data for Melbourne and selected Victorian regional cities is presented in Figure 7.14. The results for the Victorian cities closely resemble the Sydney GMA tour results in Figure 7.13. Journey durations tend to rise strongly with distance travelled, as does the prevalence of lengthy commutes. Only 5 per cent of journeys between home and work that are less than 5km take 45 minutes or more in travel time, compared to 89 per cent of journeys that involve a road distance of 30km or more.

Of the 1.1 million lengthy journeys between home and work undertaken by residents of Melbourne and the selected Victorian regional cities on an average weekday, 33 per cent involved a road distance of more than 30km, while 42 per cent involved a road distance of 15 to 30km, 22 per cent involved a road distance of 5 to 15km and 3 per cent covered a road distance of less than 5km.

Figure 7.14 VISTA average journey duration and prevalence of lengthy commutes by road distance, Melbourne and selected Victorian regional cities, 2009–10



Notes: VISTA journey data based on 'home to work' and 'work to home' journeys undertaken on an average weekday. A journey may comprise one or more trips. Journey duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) journey duration of 45 minutes or more. Journeys to/from work with a main transport mode of other are excluded from the chart. Data relates to travel on an average weekday. The areas in scope of VISTA are metropolitan Melbourne, along with the regional cities of Geelong, Ballarat, Bendigo, Latrobe Valley and Shepparton. Data is weighted so as to be representative of total in-scope population

Source: BITRE analysis of *Victorian Integrated Survey of Travel and Activity* (VISTA) data for 2009–10, using VISTA's online tabulation software.

Place of work

People who work in the CBDs of our largest cities tend to have longer commuting durations and a higher prevalence of lengthy commutes than non-CBD workers (see Tables 4.2 and 4.3). This section takes a more in-depth look at the influence that a person's place of work has on commuting durations.

An issue that commonly arises when considering the relationship between lengthy commutes and place of work is the issue of fly-in fly-out (FIFO) workers. Box 7.1 provides information about the treatment of FIFO workers in each of this study's key datasets, and discusses the extent to which FIFO workers are contributing to this study's results.

Box 7.1 Fly-in fly-out (FIFO) workers and lengthy commutes

This study defines lengthy commutes based on trip duration, rather than trip distance. FIFO workers will typically be commuting long distances by air transport between their place of residence and place of work either on a:

- weekly basis—for example, a corporate manager who resides with their family in Melbourne but mainly works out of a Sydney office
- or around shifts—for example, a mining worker who lives in Perth but works at a Pilbara mine site.

FIFO workers are, in concept, within scope of the national HILDA-based lengthy commutes measure used in this study, so long as they have an average commuting trip duration of 45 minutes or more. The average commuting trip duration measure is derived by dividing the total time spent commuting to and from work in the reporting week by the number of weekly commuting trips (set equal to twice the usual number of days worked per week). FIFO workers may not have a particularly high ***average*** commuting trip duration, as once or twice a week they will undertake a very long duration commute between their home and workplace, but on the remaining work days their commuting trip duration may be very short (e.g. from employer-provided accommodation to mine site). Nevertheless, some FIFO workers will meet the lengthy commutes threshold, and be captured in the HILDA lengthy commutes data presented in this study.

FIFO workers cannot be identified in the HILDA dataset, as the survey does not collect data on transport mode or place of work. However, some results, such as the high commuting trip durations of workers employed in the Mining industry (see Figure 6.13 and Table 6.5), are likely to be influenced by FIFO workers.

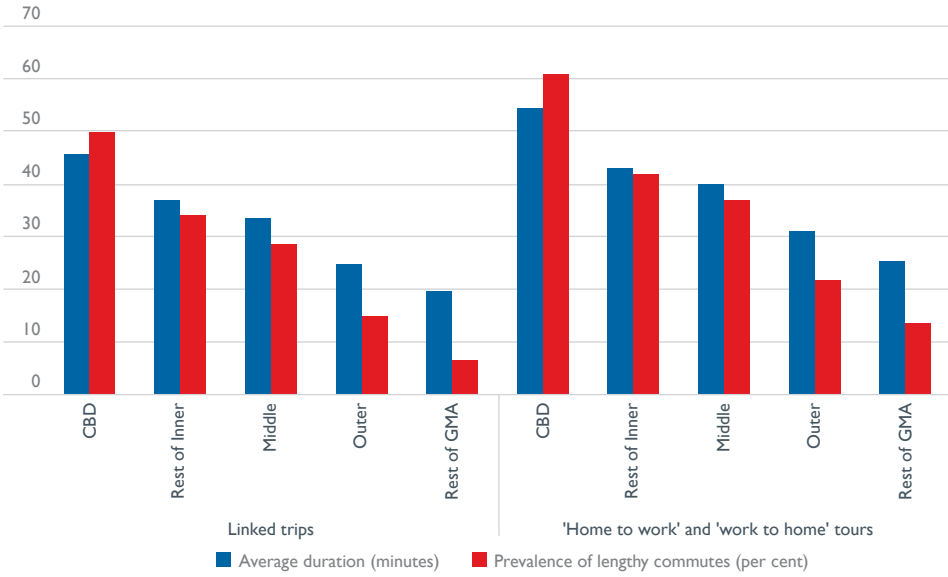
FIFO workers also lie within scope of the lengthy commutes measure derived from the PC's *Community Survey 2011*, so long as they report a peak hour commuting trip duration from home to work of 45 minutes or more. Analysis of the place of work and transport mode data for Perth residents identified a small number of FIFO workers, amounting to less than 1 per cent of the Perth sample who reported a non-zero commuting time. The majority of the identified FIFO workers reported a commuting time that exceeded the 45 minute threshold.

The NSW Bureau of Statistics and Analytics' *Household Travel Survey* (HTS) is focused on travel by residents of the Sydney GMA within the GMA. The HTS unit record file provided to BITRE does not contain any information on travel to locations outside NSW, and so will not generally capture long distance commutes by GMA-resident FIFO workers.

While FIFO workers are captured in the HILDA and PC survey data on lengthy commutes, they make up a very small fraction of the respective survey samples, and so will have limited impact on the overall results.

Figure 7.15 uses the HTS data for the Sydney GMA to summarise how commuting times vary with place of work, at a broad sectoral level. Both the trip and tour data show the same pattern of commuting times being highest for those who work in the CBD, and then declining with distance from the CBD, with commuting times being lowest for those who work in the rest of the GMA. About 60 per cent of 'home to work' and 'work to home' tours involving a CBD workplace take 45 minutes or more (one-way), compared to just 7 per cent of tours with a place of work in the rest of the GMA.

Figure 7.15 HTS average duration and prevalence of lengthy commutes by place of work, Sydney GMA, 2008–13



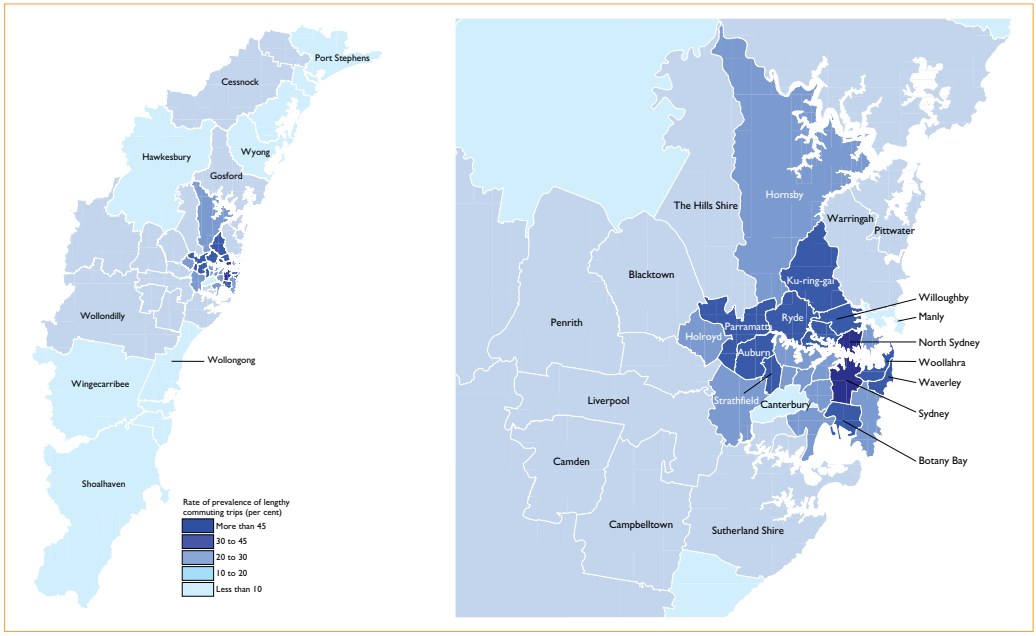
Notes: The CBD is defined as the City of Sydney LGA. Inner, middle and outer rings defined based on LGA of work using classification in Appendix A of BITRE (2012a). The assigned workplace is the address of the person's main job, or the address of another job if the main job was not attended on the travel day. Those with a place of work in the rest of NSW (outside the GMA) were excluded, due to a small sample size. Linked trips are journeys from one activity to another, ignoring changes in mode. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Map 7.1 maps the rate of prevalence of lengthy commuting trips by LGA of work. The prevalence of lengthy commutes is highest for those working in the City of Sydney LGA, and is also very high for those working in North Sydney. Other LGAs of work with a relatively high prevalence of lengthy commutes include the Middle sector LGAs of Ryde, Parramatta, Willoughby and

Auburn, and the Inner sector LGAs of Botany Bay and Waverley. It is the Illawarra and Lower Hunter LGAs which tend to have the lowest prevalence of lengthy commutes.

Map 7.1 HTS rate of prevalence of lengthy commuting trips for LGAs of work, Sydney GMA, 2008–2013



Notes: The assigned workplace is the address of the person's main job, or the address of another job if the main job was not attended on the travel day. Those with a place of work outside the GMA were excluded. Based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. Departure and arrival times are used to derive trip duration. A lengthy commuting trip is one with a (one-way) trip duration of 45 minutes or more. Commuting trip durations of more than 240 minutes were top-coded to 240 minutes. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

In terms of the number of people undertaking lengthy commuting trips of 45 minutes or more, there is a clear standout LGA of work. The City of Sydney LGA was the place of work for 232 100 lengthy commuting trips, which represents 37.2 per cent of all lengthy commutes identified in the Sydney GMA on an average day for the 2008–13 period. The other LGAs of work which had a substantial number of lengthy commuting trips were Parramatta (39 500), North Sydney (34 200) and Ryde (27 300).

Map 7.2 maps the rate of prevalence of lengthy commuting tours between home and work by the LGA of work. The prevalence of lengthy tours between home and work is highest for those working in the City of Sydney LGA, and is also very high for those working in North Sydney, the adjacent Willoughby LGA and nearby Hunters Hill. Other LGAs of work with a relatively high prevalence of lengthy commutes include Ryde, Parramatta, Waverley, Botany Bay, Auburn and Strathfield. LGAs of work in the Illawarra and Lower Hunter LGAs tend to have the lowest prevalence of lengthy commutes, while most outer suburban LGAs also have a relatively low prevalence of lengthy commuting tours. In Inner and Middle Sydney, the

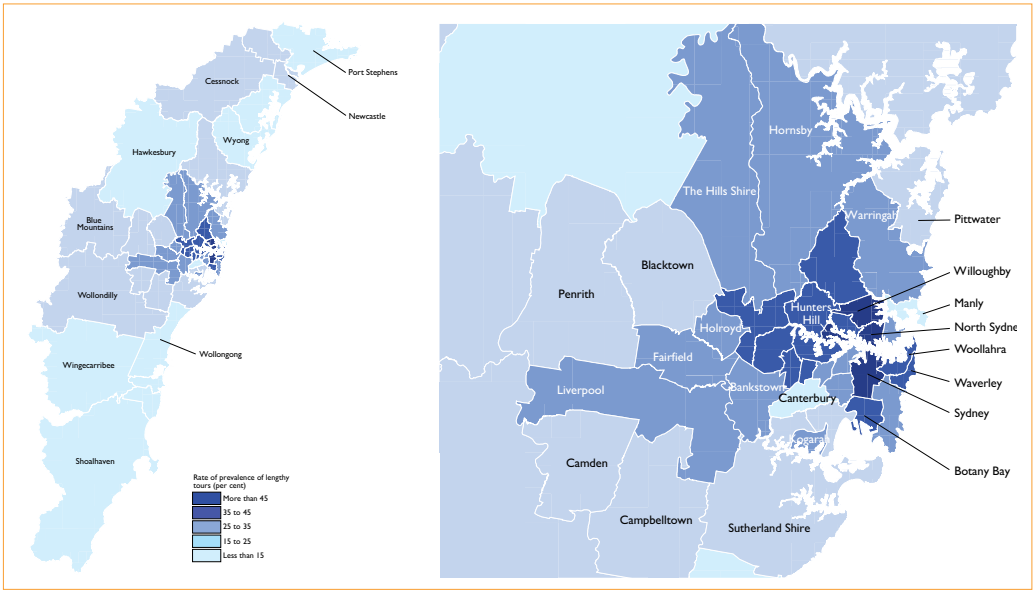
Manly and Canterbury LGAs stand out as having a much lower prevalence than the LGAs that surround them.

The City of Sydney LGA was the place of work for 287 900 lengthy tours, which represents 34.4 per cent of all lengthy tours between home and work identified in the Sydney GMA for an average day in the 2008–13 period. The other LGAs of work which had a substantial number of lengthy commuting tours were Parramatta (51 500), North Sydney (41 900) and Ryde (35 100).

Table 7.5 disaggregates the tour-based measures by sector of residence and sector of work for tours that are confined to the Sydney GCCSA. The first part of the table shows the proportion of all tours from 'home to work' and 'work to home' that fall into each category. The single largest category is tours within the Outer sector, which account for 31.6 per cent of all Sydney tours between home and work. Overall, tours for which the place of residence and place of work are both located in the home sector represent 61.7 per cent of all tours between home and work. Some of the sectoral combinations capture a very small number of tours—for example, there are very few tours between a home in the Inner sector and a place of work in the Outer sector.

The average commuting tour duration is longest for tours (outward or return) between a home in the Outer sector and a workplace in the Inner sector at 76 minutes. Tours from a Middle sector home to an Inner sector workplace also have a relatively long average duration of 52 minutes. While few people take tours between an Inner sector home and an Outer sector workplace, the average duration is high at 62 minutes. The average commuting tour duration is shortest for tours where the places of residence and work are located in the same sector, and particularly for tours with a place of residence and place of work in the Outer sector (28 minutes).

Map 7.2 HTS rate of prevalence of lengthy commuting tours for LGAs of work, Sydney GMA, 2008–2013



Notes: The assigned workplace is the address of the person's main job if the tour purpose was 'main job', or the specified address of another job if the tour purpose was 'other job'. Those with a place of work outside the GMA were excluded. Tour data is based on 'home to work' and 'work to home' tours with a tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commuting tour is one with a (one-way) trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

Table 7.4 HTS average tour duration and prevalence of lengthy commutes by sector of residence and sector of work, Sydney GCCSA, 2008–13

Place of residence	Place of work		
	Inner Sydney	Middle Sydney	Outer Sydney
	Proportion of 'home to work' and 'work to home' tours (per cent)		
Inner Sydney	16.8	2.9	1.0
Middle Sydney	11.3	13.3	3.5
Outer Sydney	8.6	11.0	31.6
	Average tour duration (minutes)		
Inner Sydney	35	44	62
Middle Sydney	52	31	42
Outer Sydney	76	49	28
	Prevalence of lengthy tours between home and work (per cent)		
Inner Sydney	29	47	68
Middle Sydney	64	22	36
Outer Sydney	88	52	18
	Proportion of all lengthy tours from 'home to work' and 'work to home' (per cent)		
Inner Sydney	13.1	3.6	1.9
Middle Sydney	19.4	7.8	3.4
Outer Sydney	20.5	15.3	15.1

Notes: Inner, middle and outer sectors defined based on LGA classification in Appendix A of BITRE (2012a). The assigned workplace is the address of the person's main job if the tour purpose was 'main job', or the specified address of another job if the tour purpose was 'other job'. Those who live or work in the rest of the GMA were excluded from the table as sample sizes did not permit such disaggregated analysis. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy tour is one with a (one-way) duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

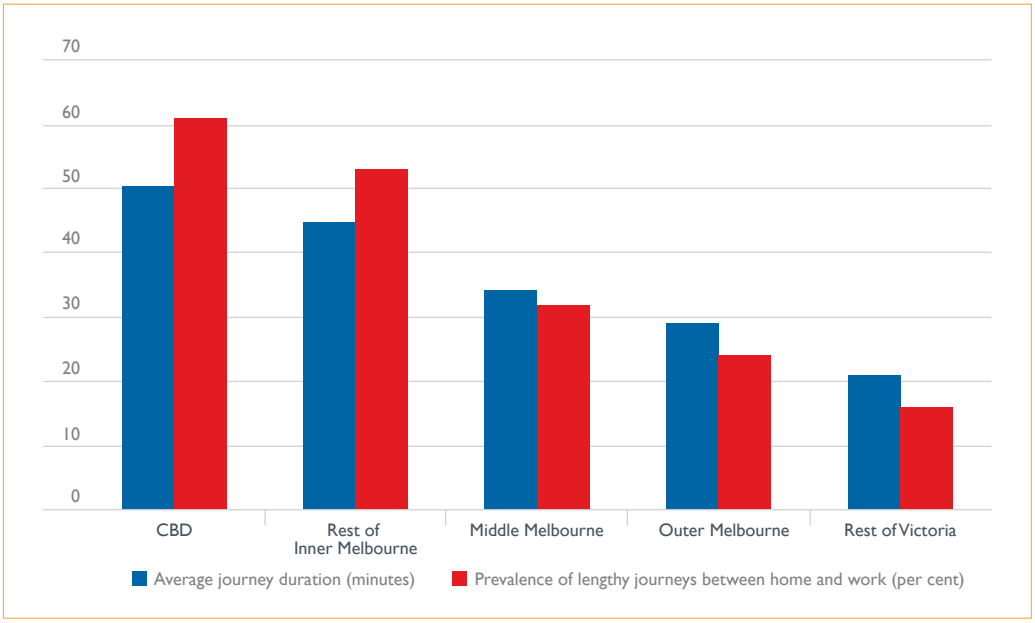
Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

The prevalence of lengthy commutes is highest for tours between an Outer Sydney residence and an Inner Sydney workplace (88 per cent). It is also relatively high for tours between a Middle Sydney residence and an Inner Sydney workplace (64 per cent) and for tours between an Inner Sydney residence and an Outer Sydney workplace (68 per cent). The prevalence of lengthy commutes is lowest for tours between an Outer Sydney residence and workplace (18 per cent) and for tours between a Middle Sydney residence and workplace (22 per cent).

Of all lengthy tours between home and work that occur within the Sydney GCCSA, the largest proportion relates to tours between an Outer Sydney residence and an Inner Sydney workplace (20.5 per cent), closely followed by tours between a Middle Sydney residence and an Inner Sydney workplace (19.4 per cent). There are also large numbers of lengthy tours occurring between an Outer Sydney residence and a Middle Sydney workplace (15.3 per cent of all lengthy tours between home and work), between an Outer Sydney residence and workplace (15.1 per cent), and between an Inner Sydney residence and workplace (13.1 per cent).

Figure 7.16 illustrates the relationship between commuting times and sector of work for residents of Melbourne and selected Victorian regional cities, based on the 2009–10 VISTA survey. It shows a very similar pattern to the HTS tour data in Figure 7.15, Average journey durations are at their highest for those who work in the Melbourne CBD (50 minutes), where 61 per cent of workers undertake commuting journeys of 45 minutes or more. Average journey durations (and the prevalence of lengthy commuting journeys) tend to decline with the distance of the workplace from the CBD, and are at their lowest for those who work outside of Melbourne.

Figure 7.16 VISTA average journey duration and prevalence of lengthy commutes by sector of work for residents of Melbourne and selected Victorian regional cities, 2009–10



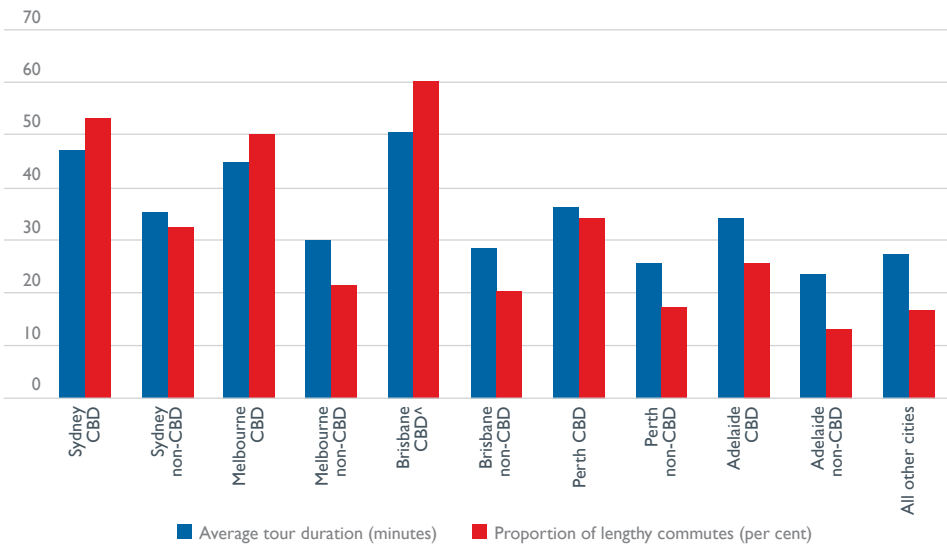
Notes: The CBD is defined as the City of Melbourne LGA. Inner, middle and outer rings defined based on LGA of work using classification in Appendix A of BITRE (2011), with Stonnington LGA classified entirely to Middle sector. Persons with a place of work outside Victoria excluded due to small sample size. VISTA journey data based on 'home to work' and 'work to home' journeys undertaken on an average weekday. A journey may comprise one or more trips. Journey duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy commute is one with a (one-way) journey duration of 45 minutes or more. Data relates to travel on an average weekday. The areas of residence in scope of VISTA are metropolitan Melbourne, along with the regional cities of Geelong, Ballarat, Bendigo, Latrobe Valley and Shepparton. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of *Victorian Integrated Survey of Travel and Activity* (VISTA) data for 2009–10, using VISTA's online tabulation software.

The City of Melbourne LGA was the place of work for 408 900 lengthy commuting journeys (including both outward and return journeys)[71], representing 35.9 per cent of all lengthy commuting journeys on an average weekday in Melbourne and the selected Victorian regional cities in 2009–10. The other LGAs of work which had a substantial number of lengthy commuting tours were the inner city LGAs of Port Phillip (67 100) and Yarra (56 300), and the middle suburban LGA of Monash (60 500).

Figure 7.17 summarises results from the PC *Community Survey* 2011 regarding the relationship between peak hour commuting times and place of work. For each of the five major capital cities, average commuting trip durations (and the prevalence of lengthy commutes) are considerably higher for those with a place of work in the CBD than for those with a place of work elsewhere in the city. However, average commuting trip durations are notably lower for those who work in the Perth and Adelaide CBDs than for those who work in the CBDs of the larger cities.

Figure 7.17 Productivity Commission *Community Survey* average commuting trip duration and prevalence of lengthy commutes by place of work, selected Australian cities, 2011



Notes: The CBD is defined as the central LGA in Sydney, Melbourne, Adelaide and Perth. The CBD was defined for Brisbane by BITRE based on postcodes and include the suburbs of Brisbane, South Brisbane, Spring Hill, Bowen Hills and Fortitude Valley. The PC *Community Survey* duration measure captures the journey to work travel time at 'peak hour' for the one-way journey from home to work, door to door using the normal route. Participants were advised that they should exclude time spent at any in-between destinations, such as day care, school, shopping or the gym. A lengthy commuting trip is one with a commuting trip duration of 45 minutes or more. The survey covers 24 Australian metropolitan areas and regional cities. Data is weighted to be representative of total in-scope population.

^ Based on sample of less than 100 responses, and should be used with caution.

Source: BITRE analysis of unit record data from PC *Community Survey* 2011. This data was collected by the consultants, AC-Nielsen, as an input to Productivity Commission (2011).

71 Note that this City of Melbourne LGA figure is expressed on a different basis (i.e. average weekday) to the lengthy commuting tours figure previously presented for the City of Sydney LGA (average day).

Use of key routes

The HTS collects information on whether respondents have used a selection of Sydney's key routes (including roads, bridges and tunnels) during their trip.[72] Table 7.5 presents information on the proportion of linked commuting trips that included travel on each of the selected routes, as well as the proportion of lengthy commuting trips that included travel on each of these routes, and the proportion of all linked commuting trips on these routes that exceeded the 45 minute threshold.

For 8.3 per cent of all linked commuting trips in the Sydney GMA, the respondent reported using one or more of the selected routes. Of the selected routes, the M4 was most commonly used for commuting purposes, followed by the M5. Just over 14 per cent of all lengthy commuting trips in the Sydney GMA involved use of one or more of the selected routes. Each of the selected routes made up a higher proportion of lengthy linked commuting trips than of total linked commuting trips. Consequently, the rate of prevalence of lengthy commutes was well above the GMA average of 26 per cent for all eight of the selected routes. The majority of commuting trips that used the M2, M5 and M7 took 45 minutes or more. However, only 35 per cent of commuting trips where the respondent reporting using the Sydney Harbour Bridge exceeded the 45 minute threshold.

Table 7.5 HTS proportion of commuting trips and lengthy commuting trips that used selected routes, Sydney GMA, 2008–13

Route	Proportion of all linked commuting trips that reported using this route (per cent)	Proportion of lengthy linked commuting trips that reported using this route (per cent)	Rate of prevalence of lengthy commutes on this route (per cent)
Sydney Harbour Bridge	1.2	1.6	35
Sydney Harbour Tunnel	0.7	1.4	47
M2	0.7	1.7	61
M4	3.2	5.5	44
M5	2.0	4.3	55
M7	1.0	2.1	55
M1 Eastern Distributor	0.8	1.5	50
Lane Cove Tunnel	0.5	1.0	50
Any of the above routes	8.3	14.4	45

Notes: Information was also collected on whether respondents used the Cross City Tunnel or the Military Road e-ramp, but results for these two routes have not been presented due to small sample sizes. Route information was collected for unlinked trips, but converted to a linked trip basis. A linked trip is a journey from one activity to another, ignoring changes in mode. Departure and arrival times are used to derive trip duration. A lengthy commuting trip is one with a (one-way) trip duration of 45 minutes or more. Data is weighted so as to be representative of total in-scope population.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

72 Note that interviewers only ask this question if it is judged to be appropriate to a particular trip.

Multivariate analysis

This chapter has presented bivariate analysis of the relationship between commuting times and a range of trip and tour characteristics. Given the inter-connectedness of many of these variables, there is value in undertaking multivariate regression analysis, in order to distinguish the relative importance of different trip (tour) characteristics in terms of their influence on commuting times in an Australian context. This section presents the results of regression analysis of commuting trip (and tour) duration and the probability of a lengthy commuting trip (tour), based on the HTS data for Sydney GMA residents for 2008–13. In addition to the trip and tour characteristics discussed in this chapter, a range of demographic and spatial control variables are included in the regression.[73]

While a significant number of multivariate regression analyses of commuting times have been undertaken internationally (see Chapter 6), transport mode is the only trip characteristic variable which is regularly included in such studies. An exception is Turcotte (2005) which undertakes regression analysis of average (round trip) commuting times as a function of place of residence, trip distance, transport mode, presence of stopovers, and whether the trip involved dropping off children or not. This model explained 47 per cent of the variation in round trip commuting times for Canada, which is a much higher explanatory power than achieved in any of the other regression studies reported in Table 6.4 (despite using a relatively narrow set of explanatory variables). This Canadian study—alongside the bivariate relationships identified to date in this chapter—suggest that trip characteristics may offer more potential than socio-economic variables for explaining variation in commuting times in Australia.

The HILDA-based multivariate regression analysis in Chapter 6 was restricted to socio-economic and spatial (place of residence) explanatory variables, as no trip characteristic information is collected in HILDA, and the model's explanatory power was low. The HTS unit record data provided to BITRE contains a fairly limited set of socio-economic variables (e.g. gender, occupation, work schedule), and when the set of explanatory variables is limited to just these socio-economic variables and the place of residence variables, the explanatory power of the HTS-based regressions are even lower than the HILDA-based regressions (with adjusted R-squared's of around 5–8 per cent). Fortunately, once trip characteristic information is included in the HTS-based regressions, the model's explanatory power improves considerably, as is illustrated in the remainder of this section.

With such a large number of independent variables, there is the potential for multicollinearity issues to arise. Such problems were minimised by excluding some (non-significant) variables and respecifying others. Nevertheless, some of the retained variables are highly correlated, with moderate to strong correlations between some of the place of work and place of residence variables, between the return direction variable and the time of day variables, and between some of the route pairs. Such multicollinearity issues may increase the standard errors of the relevant model coefficients and make it harder to interpret coefficients and their significance. We did not attempt to refine the model down to a more parsimonious specification, as one aim of the analysis was to identify which variables are insignificant predictors of commuting times in the Australian context.

In BITRE's HTS-based analysis for the Sydney GMA, the average commuting trip (tour) duration measure is a continuous variable and ordinary least squares regression is used. The lengthy

73 The range of demographic and socio-economic controls included in the regression is limited, as the HTS unit record file provided to BITRE contained only a limited number of such variables, so as manage risks relating to data confidentiality.

commuting trip (tour) measures are categorical variables and logistic regression was used to model the probability of an individual having an average commuting trip (tour) duration of 45 minutes or more.

Table 7.6 presents the results of the regression analysis for HTS linked commuting trips. The explanatory power of the regressions is high, at 76 per cent for the duration model and 71 per cent for the lengthy commutes model. This is considerably higher than the explanatory power of the regression performed in Turcotte (2005), reflecting the more extensive set of trip characteristic variables included in the HTS model. Thus, while socio-economic variables are only capable of explaining a relatively small proportion of the variation in commuting times (see Chapter 6), information on trip characteristics—such as trip distance, transport mode, day, time, direction, place of work and route—can explain the majority of the variation in commuting times for residents of the Sydney GMA.

The colour coding in the table identifies discrete sets of explanatory variables, such as mode, route, place of work, occupation and work schedule. Each of the sets of explanatory variables relating to trip characteristics was jointly significant in both the duration and lengthy commute models. The set of place of residence variables was also jointly significant in both models at the 95 per cent confidence level. However, the occupation and work schedule variable sets were not statistically significant in either model.

Much of the explanatory power of these regressions is due to a single trip characteristic, namely trip distance. A model that includes only trip distance (and the square of trip distance) as explanatory variables is capable of explaining around half of all variation in commuting trip duration. Both the distance variable and its square term are highly statistically significant in both regressions. Holding other factors constant, the predicted commuting trip duration tends to rise with commuting trip distance up to a distance of about 120km, at which point the predicted commuting trip duration starts to decline, reflecting higher travel speeds. Both the distance variable (positively signed) and its square term (negatively signed) are highly statistically significant in both regressions. While distance plays a dominant role, the transport mode, place of work and time of day variables are also highly significant predictors of commuting trip duration and the probability of undertaking a lengthy commute.

Table 7.6 Estimating the relationship between commuting times and trip characteristics for linked commuting trips by Sydney GMA residents, 2008–13

	Commuting trip duration		Lengthy commuting trip of 45 minutes or more	
Model information				
Model type	Ordinary least squares regression		Logistic regression	
Number of observations	17 631		17 631	
Adjusted R-squared	76.3 per cent		71.4 per cent[a]	
Explanatory variables	*Parameter estimate*	*Significance level*	*Parameter estimate*	*Significance level*
Intercept	8.841	***	–5.142	***
Trip characteristic explanatory variables				
Return direction (i.e. not outward trip)	0.417		–0.048	
Day and time (Ref=Weekday off-peak)				
Weekend	0.329		–0.155	
Weekday morning peak	1.580	***	0.386	***
Weekday afternoon peak	3.734	***	0.946	***
Priority transport mode (Ref=Vehicle driver)				
Vehicle passenger	–0.001		0.128	
Train	24.202	***	2.833	***
Bus	24.236	***	3.027	***
Ferry	30.343	***	3.312	***
Taxi	1.459		–0.198	
Walk	3.212	***	1.351	***
Bicycle	9.625	***	1.957	***
Other mode	24.440	***	3.947	***
Trip distance by road	1.471	***	0.248	***
Trip distance squared	–0.006	***	–0.001	***
Place of work (Ref=CBD)				
Rest of Inner sector (excluding CBD)	0.591		–0.127	
Middle sector	–0.736	**	–0.244	***
Outer sector	–5.769	***	–1.583	***
Rest of GMA	–4.667	***	–2.354	***
Rest of NSW	–8.924	***	–2.184	***
Unknown place of work	–5.272		–11.587	
Used specific routes (Ref=used none of these routes)				
Sydney Harbour Bridge	4.309	***	0.376	**
Sydney Harbour Tunnel	3.589	***	0.431	
M2	0.139		–0.037	
M4	–0.901		–0.218	*
M5	–1.859	***	–0.325	**

(continued)

	Commuting trip duration		Lengthy commuting trip of 45 minutes or more	
Explanatory variables	*Parameter estimate*	*Significance level*	*Parameter estimate*	*Significance level*
M7	–5.322	***	–0.399	*
M1 Eastern distributor	2.092	*	–0.025	
Cross City Tunnel	7.018	***	0.480	
Lane Cove Tunnel	–1.708		–0.796	**
Socio-economic and spatial control variables				
Place of residence (Ref=Inner)				
Middle	1.059	***	0.238	***
Outer	–0.362		–0.340	***
Rest of GMA	–4.545	***	–0.857	***
Female	0.662	***	0.128	**
Occupation (Ref=Professional)				
Manager	–0.467		0.096	
Technicians and trades worker	–0.279		–0.081	
Clerical and administrative worker	–0.137		–0.110	
Community and personal service worker	0.033		0.110	
Sales workers	0.300		0.182	
Labourer	–0.034		0.075	
Machinery operators and drivers	–0.463		0.060	
Occupation not stated	–8.526		–1.526	
Work schedule (Ref=Fixed start and finish times – same each day)				
Fixed start and finish times – each day can vary	0.018		–0.093	
Flexitime	–0.953		–0.067	
Rostered shifts	0.098		–0.043	
Rotating shifts	–0.797		–0.295	
Variable hours	0.312		0.001	
Other schedules	0.881		1.397	

Notes: Regression analysis is undertaken on a weighted basis and based on linked commuting trips. A linked trip is a journey from one activity to another, ignoring changes in mode. Departure and arrival times are used to derive trip duration. Trip characteristic variable specifications match those used earlier in this chapter. Wald tests used to test significance of logistic regression parameters. Ref=reference category for categorical variables.

* $p<0.10$ (i.e. 90 per cent confident the parameter estimate is significantly different from zero);

** $p<0.05$ (i.e. 95 per cent confident the parameter estimate is significantly different from zero);

*** $p<0.01$ (i.e. 99 per cent confident the parameter estimate is significantly different from zero).

[a] Nagelkerke's pseudo R-Squared is presented for the logistic regression model.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

There are a number of explanatory variables that do ***not*** have a statistically significant influence on commuting times (at the 95 per cent confidence level) in either regression model, namely:

- The occupation the person is employed in
- The person's work schedule
- Commuting trips operating in the return direction (from work to home) do not differ significantly from those operating in the outward direction
- Weekend commuting trips do not differ significantly from trips undertaken during off-peak periods on weekdays
- Trips where the priority transport mode is vehicle passenger or taxi do not differ significantly from trips where the priority mode is vehicle driver
- Trips involving a place of work in the Rest of the Inner sector and trips with an unknown place of work do not differ significantly from trips with a place of work in the CBD
- Commuting trips that make use of the M2, M4 or M1 Eastern distributor do not differ significantly from trips that make use of none of the specified routes.

The remaining discussion considers each of the statistically significant variables in Table 7.6 in turn. The significance levels, and signs of the significant variables, are generally consistent across the two models (with some exceptions, noted below).

Commuting trips undertaken during morning or afternoon peak periods on weekdays have a significantly higher duration and likelihood of qualifying as a lengthy commute than trips undertaken in weekday off-peak periods. This reflects the higher traffic congestion levels, and lower average speeds, occurring in these peak periods. In both models, the effect of the afternoon peak variable is of larger magnitude than the effect of the morning peak variable.

Compared to commuting trips with a priority transport mode of vehicle driver, trips by train, bus, ferry, walk, bicycle or 'other mode' have a significantly higher duration and probability of qualifying as a lengthy commute. Given that distance is controlled for in these regressions, the positive coefficients reflect the lower average speeds on these modes, relative to the reference category of vehicle driver (see Table 7.3). In both models, the magnitude of the coefficient is smaller for the walk and bicycle variables than for the train, bus, ferry and other mode variables.

Compared to those who work in the Sydney CBD, those who work in the Middle sector, the Outer sector, the rest of the GMA and the rest of NSW, all have a significantly lower commuting trip duration and probability of lengthy commutes. In both models, the magnitude of this effect is smaller for those who work in the Middle sector, than it is for those who work further away from the CBD.

In the model of commuting trip duration, if the respondent reported using the Sydney Harbour Bridge, the Sydney Harbour Tunnel or the Cross City Tunnel during their trip, this is associated with a significantly higher predicted duration (reflecting higher traffic congestion, and lower average speeds, given that distance is controlled for), while use of the M5 or M7 is associated with a significantly lower predicted duration (reflecting higher average speeds). In the lengthy commutes model, the route variables tend to be less significant. At the 95 per cent confidence level, use of the Sydney Harbour Bridge is associated with a higher lengthy commute probability, while use of the Lane Cove Tunnel or M5 is associated with a significantly lower probability of the trip qualifying as a lengthy commute.

In addition to the above-mentioned trip characteristic variables, a limited range of socio-economic and spatial control variables were also included in the regressions. Only the gender and place of residence variables proved to be statistically significant.

Compared to Inner sector residents, residents of Sydney's Middle sector have a significantly longer predicted commuting trip duration, while residents of the rest of the GMA have a significantly shorter predicted duration. The probability of lengthy commutes is significantly higher for Middle sector residents (compared to Inner sector residents), and is significantly lower for residents of Outer Sydney and the rest of the GMA.

Being female has a significant positive effect on commuting trip duration and the probability a trip is a lengthy commute (relative to the reference category of being male). This result differs from the HILDA regression results in Chapter 6 and the empirical literature which consistently reports that females have lower commuting trip durations, controlling for other socio-economic and spatial variables. The two sets of results can be reconciled, as none of the previous regression studies included gender as an explanatory variable alongside such an extensive range of trip characteristic variables as included in Table 7.6. The standard finding of shorter duration commutes of females (compared to males) may be able to be attributed to females travelling shorter distances, commuting on different days or times, using different modes or routes, or having different places of work. If this is the case, once such trip characteristics are controlled for, females will no longer have shorter commuting trip durations than males.

Table 7.7 presents the results of the regression analysis for HTS 'home to work' and 'work to home' tours. The tour-based model includes the same set of explanatory variables included in the trip-based model[74], as well as some additional explanatory variables capturing the number of linked trips within the tour, and whether the tour included a stopover for various non-commuting purposes (e.g. shopping, serve passenger, work-related business). The explanatory power of the regressions is high, at 74 per cent for the duration model and 71 per cent for the lengthy commutes model. This is considerably higher than the explanatory power of the tour-based regression performed in Turcotte (2005), reflecting the more extensive set of tour characteristic variables included in the HTS model.

Each of the sets of explanatory variables relating to trip characteristics was jointly significant in both the tour duration and lengthy commuting tour models, as was the set of place of residence variables. However, the occupation and work schedule variable sets were not statistically significant in either model.

Again, much of the explanatory power of these regressions is due to a single tour characteristic, namely tour distance. A model that includes only tour distance (and the square of tour distance) as explanatory variables is capable of explaining around half of all variation in the duration of tours between home and work. Both the distance variable and its square term are highly statistically significant in both regressions. While distance plays a dominant role, the transport mode, place of work, time of day and number of linked trips variables are also highly significant predictors of tour duration and the probability of undertaking a lengthy tour between home and work.

74 Note that many of the variables have been respecified so they relate to a tour, not a linked trip. For example, the road distance variable in Table 7.7 relates to the distance covered by the entire tour leg, which may consist of multiple linked trips. Similarly, the priority mode of a tour leg needs to be derived from the priority modes of the component linked trips using the BSA mode hierarchy.

Table 7.7 Estimating the relationship between commuting times and tour characteristics for tours between home and work by Sydney GMA residents, 2008–13

	'Home to work' and 'work to home' tour duration		Lengthy commuting tour of 45 minutes or more	
Model information				
Model type	Ordinary least squares regression		Logistic regression	
Number of observations	18 044		18 044	
Adjusted R-squared	74.1 per cent		70.9 per cent[a]	
Explanatory variables	***Parameter estimate***	***Significance level***	***Parameter estimate***	***Significance level***
Intercept	4.914	***	–5.371	***
Tour characteristic explanatory variables				
Return direction (i.e. from work to home)	0.983	***	0.180	**
Day and time (Ref=Weekday off-peak)				
Weekend	–0.716		–0.139	
Weekday morning peak	0.538		0.369	***
Weekday afternoon peak	2.882	***	0.798	***
Priority transport mode (Ref=Vehicle driver)				
Vehicle passenger	0.316		0.149	
Train	23.604	***	2.659	***
Bus	24.340	***	2.818	***
Ferry	28.898	***	2.717	***
Taxi	1.159		–0.130	
Walk	3.947	***	1.255	***
Bicycle	8.619	***	1.663	***
Other mode	24.908	***	3.620	***
Tour distance by road	1.233	***	0.206	***
Tour distance squared	–0.002	***	–0.001	***
Place of work (Ref=CBD)				
Rest of Inner sector (excluding CBD)	0.160		–0.149	*
Middle sector	–1.726	***	–0.344	***
Outer sector	–7.657	***	–1.593	***
Rest of GMA	–0.889		–1.999	***
Rest of NSW	–7.307	***	–2.351	***
Unknown place of work	55.529	***	4.163	***
Used specific routes (Ref=used none of these routes)				
Sydney Harbour Bridge	5.560	***	0.140	
Sydney Harbour Tunnel	4.649	***	0.784	***
M2	2.029		–0.035	
M4	–0.770		–0.307	**
M5	–1.726	**	–0.437	***
M7	–6.022	***	–0.356	
M1 Eastern distributor	1.376		–0.430	
Cross City Tunnel	4.530	**	0.358	

(continued)

	'Home to work' and 'work to home' tour duration		Lengthy commuting tour of 45 minutes or more	
Explanatory variables	*Parameter estimate*	*Significance level*	*Parameter estimate*	*Significance level*
Lane Cove Tunnel	–2.943		–0.772	**
Number of linked trips in tour leg	7.796	***	0.716	***
Stopovers (Ref=tour consists solely of commuting trips)				
Tour includes a work-related business trip	7.935	***	0.219	
Tour includes a social/recreation trip	2.599	***	0.217	
Tour includes a serve passenger trip	–1.764	***	0.080	
Tour includes a shopping trip	–4.521	***	–0.275	*
Tour includes an education trip	16.092	***	2.191	***
Tour includes a personal business trip	1.218		0.295	
Tour includes a trip for other purposes	–3.594	***	–0.285	
Socio-economic and spatial control variables				
Place of residence (Ref=Inner)				
Middle	1.813	***	0.239	***
Outer	0.096		–0.268	***
Rest of GMA	–10.897	***	–0.927	***
Female	0.754	***	0.142	**
Occupation (Ref=Professional)				
Manager	–0.885	**	0.043	
Technicians and trades worker	–0.371		–0.055	
Clerical and administrative worker	–0.193		–0.093	
Community and personal service worker	–0.501		0.090	
Sales workers	–0.235		0.194	*
Labourer	–0.515		0.074	
Machinery operators and drivers	–0.610		0.011	
Occupation not stated	–19.219	**	–2.011	
Work schedule (Ref=Fixed start and finish times – same each day)				
Fixed start and finish times – each day can vary	0.145		–0.022	
Flexitime	–0.839		–0.058	
Rostered shifts	0.076		–0.075	
Rotating shifts	–0.819		–0.237	
Variable hours	0.274		0.062	
Other schedules	0.691		2.285	**

Notes: Regression analysis is undertaken on a weighted basis. Tour data is based on 'home to work' and 'work to home' tours with an overall tour purpose of 'main job' or 'other job'. A tour may comprise one or more linked trips. Tour duration is an aggregate of the travel time for each contributing trip, and excludes time spent at stopovers. A lengthy tour is one with a (one-way) duration of 45 minutes or more. Tour characteristic variable specifications match those used earlier in this chapter. Wald tests used to test significance of logistic regression parameters. Ref=reference category for categorical variables.

* p<0.10 (i.e. 90 per cent confident the parameter estimate is significantly different from zero);

** p<0.05 (i.e. 95 per cent confident the parameter estimate is significantly different from zero);

*** p<0.01 (i.e. 99 per cent confident the parameter estimate is significantly different from zero).

[a] Nagelkerke's pseudo R-Squared is presented for the logistic regression model.

Source: BITRE analysis of NSW Bureau of Statistics and Analytics *Household Travel Survey* pooled unit record dataset for July 2008 to June 2013 period.

While return commuting trips were not significantly different from outward commuting trips (see Table 7.6), Table 7.7 shows that return tours from work to home have a significantly longer duration than do outward tours from home to work, as well as a significantly higher probability of taking 45 minutes or more (at the 95 per cent confidence level). This is consistent with the bivariate analysis of the HTS tour data shown in Figure 7.1, and reflects the greater incidence of stopovers for non-commuting purposes on the return tour leg.

Weekend tours and weekday morning peak tours do not differ significantly in their duration from tours undertaken during off-peak periods on weekdays. However, tours undertaken during weekday afternoon peak periods are of significantly longer duration. The predicted probability of a lengthy tour is significantly higher for tours undertaken during either weekday morning or afternoon peak periods than it is for weekday off-peak periods (although the afternoon peak effect is of larger magnitude).

Tour legs for which the priority transport mode is vehicle passenger or taxi do not differ significantly from tour legs with a priority mode of vehicle driver. All of the other transport modes (i.e. train, bus, ferry, walk, bicycle, other) have a significantly longer tour duration and a higher probability of exceeding 45 minutes duration than do tour legs with a priority mode of vehicle driver. The magnitude of this effect is smaller for walk and bicycle tours than for train, bus, ferry and other modes (in both models).

At the 95 per cent confidence level, tour legs involving a place of work in the Rest of the Inner sector or in the Rest of the GMA do not have a significantly different duration from tour legs with a place of work in the CBD. Tour legs with a place of work in Sydney's Middle or Outer sectors or the rest of NSW have a significantly lower duration, while tour legs with an unknown place of work have a significantly higher duration. The key difference for the lengthy tour model is that the negative coefficient for the rest of the GMA variable is statistically significant, unlike in the duration model.

Tour legs that make use of the M2 or M1 Eastern distributor do not differ significantly from trips that make use of none of the specified routes. Tour legs that make use of the Sydney Harbour Bridge, Sydney Harbour Tunnel or Cross City Tunnel are of significantly longer duration (after controlling for other modelled variables), while tour legs that make use of the M5 or M7 are of significantly shorter duration. The likelihood of a lengthy tour leg between home and work is significantly higher for tour legs that make use of the Sydney Harbour Tunnel, and significantly lower for tour legs that make use of the M4, M5 or Lane Cove Tunnel.

The main additions to the HTS tour-based models are the variables relating to the number of linked trips and the purpose of stopovers undertaken within the tour leg. The greater the number of linked trips in a tour leg, the longer the predicted duration and the greater the likelihood that the tour leg takes 45 minutes or more. The variable capturing stopovers for personal business purposes is not significant in either model. However, all other stopover purpose variables are individually significant in the duration model, with work-related business stopovers, social/recreation stopovers and education stopovers having a significant positive effect on duration, while serve passenger, shopping and other stopovers have a significant negative effect on duration. In the lengthy tour leg model, only the education stopover variable is statistically significant at the 95 per cent confidence level—it has a positive effect on the likelihood that the tour leg takes 45 minutes or more.

Compared to Inner sector residents, residents of Sydney's Middle sector have a significantly longer predicted duration, while residents of the rest of the GMA have a significantly shorter predicted duration. The probability of a lengthy tour leg between home and work is significantly higher for Middle sector residents (compared to Inner sector residents), and is significantly lower for residents of Outer Sydney and the rest of the GMA.

Turning to the socio-economic control variables, being female has a significant positive effect on duration and the probability of a lengthy tour leg (relative to the reference category of being male). At the 95 per cent confidence level, those employed as managers and those with occupation not stated have a significantly lower duration than those employed as professionals, while those with an 'other' work schedule have a significantly higher probability of a lengthy tour leg than do those who work fixed start and finish times which are the same each day.

The key message from this section is that more than 70 per cent of the variation in the commuting time variables can be explained by reference to key trip characteristics, place of residence and socio-economic factors. Distance alone can explain about half of the variation in trip/tour duration. The other major explanators are transport mode, place of work, day and time of travel, and for tours, the number of linked trips (i.e. stopovers for non-commuting purposes) made within a tour. Place of residence and socio-economic factors play a relatively minor role in explaining variation in commuting times, as evidenced by the relatively low explanatory power of the HILDA-based regressions in Chapter 6, and the limited contribution of these variables to the explanatory power of Chapter 7's regressions.[75]

Summary

This chapter has built up a profile of the nature of lengthy commuting trips and tours, relying largely on HTS data for the Sydney GMA, but reinforced with evidence from the Victorian Government's VISTA survey 2009–10 and the Productivity Commission's *Community Survey* 2011.

Lengthy commuting trips by Sydney GMA residents between 2008 and 2013 had the following trip characteristics:

- 71 per cent of lengthy commuting trips occur in weekday peak periods, while 24 per cent occur in weekday off-peak periods and 5 per cent on weekends
- 52 per cent of lengthy commuting trips have a priority mode of public transport, while for 46 per cent the priority mode is private vehicle and for 2 per cent the priority mode is active transport
- 41 per cent of lengthy commuting trips involved a road distance of more than 30km, while 38 per cent involved a road distance of 15 to 30km, 19 per cent involved a road distance of 5 to 15km and 2 per cent covered less than 5km
- The City of Sydney LGA was the place of work for 232 100 (or 37 per cent of) lengthy commuting trips, while Parramatta, North Sydney and Ryde were also prominent places of work for lengthy commuting trips.

75 The results of the current section highlight an issue with the HILDA-based regressions in Chapter 6—they are potentially subject to omitted variable bias, as known predictors of commuting times (such as distance, place of work and transport mode) are necessarily omitted, due to these items not being collected in the HILDA survey. For omitted variable bias to exist, the omitted variables must be correlated with some of the included variables. Bias is created when the model compensates for the omitted factor by over- or under-estimating the effect of one of the included factors.

Tours between an Outer Sydney residence and an Inner Sydney workplace are the most common type of lengthy tour between home and work (with a 21 per cent share of within-GCCSA tours), followed by tours between a Middle Sydney residence and an Inner Sydney workplace (19 per cent). Lengthy commutes are more likely to occur on the return tour leg from work to home than on the outward tour leg, as people tend to make more stopovers for non-commuting purposes on their trip home. Two-thirds of lengthy tours by GMA residents involve a direct tour between home and work, while one-third involve an indirect tour, with intermediate stopovers.

Undertaking lengthy commutes can have a range of negative effects on individuals, impacting on their physical and mental health, family and social connections, and life satisfaction. There may also be benefits for those engaging in lengthy commutes, such as providing access to higher paid or more satisfying employment than is available closer to home. The next chapter provides a review of the literature on the costs and benefits of commuting, with a particular focus on the effects of long duration commutes.

CHAPTER 8
The direct effects of commuting

Key points

- Lengthy commuting has a significant negative impact on subjective overall life satisfaction, controlling for other relevant factors.
- Higher levels of overall job satisfaction, higher levels of satisfaction with the amount of free time a person has and higher levels of satisfaction with job flexibility are associated with a lower probability of being a lengthy commuter.
- People who feel rushed or pressed for time have a higher probability of being a lengthy commuter.
- People who spend more time on household errands, housework and outdoor tasks are associated with a higher probability of being a lengthy commuter.
- There does not appear to be a significant relationship between being a lengthy commuter and the amount of time a person spends playing with their own children or playing with other children.

Introduction

The aim of this chapter is to investigate the direct effects of lengthy commuting on a commuter's wellbeing. That is to say, to investigate the effects of the experience of commuting and the effects of using time for commuting. This does not include other, but equally important considerations like those that motivate lengthy commuting, such as improved income or career progression from the employment opportunities that are only available through lengthy commuting.

To explore these direct effects HILDA data from wave 12 is used to examine the association between lengthy commutes and a series of measure of subjective wellbeing and measures of time use. These measures are a far from exhaustive list of the direct welfare costs of lengthy commuting, however they do include a broad selection in various domains of welfare, specifically:

- four dimensions of satisfaction (i.e. self-reported overall life satisfaction, overall job satisfaction, satisfaction with flexibility and satisfaction with free time),
- feeling rushed or pressed for time and feeling tired, and
- time spent on selected 5 activities in a typical week (i.e. household errands, housework, outdoor tasks, playing with own children and playing with other people's children).

The chapter is organised as follows:

The chapter begins with a short literature review of national and international studies that have investigated the direct effects of lengthy commuting.

The next section firsts presents the welfare questions from the HILDA survey which will be analysed. This is followed by a description of the methods used in the analysis, specifically two sets of regressions.

The following section presents the results of the analysis, beginning with a comparison of the distribution of the various welfare measures by lengthy or not lengthy commuting status. This is followed by the regression results and interpretation.

Finally, concluding remarks are provided and some implications of the findings are indicated.

Literature review

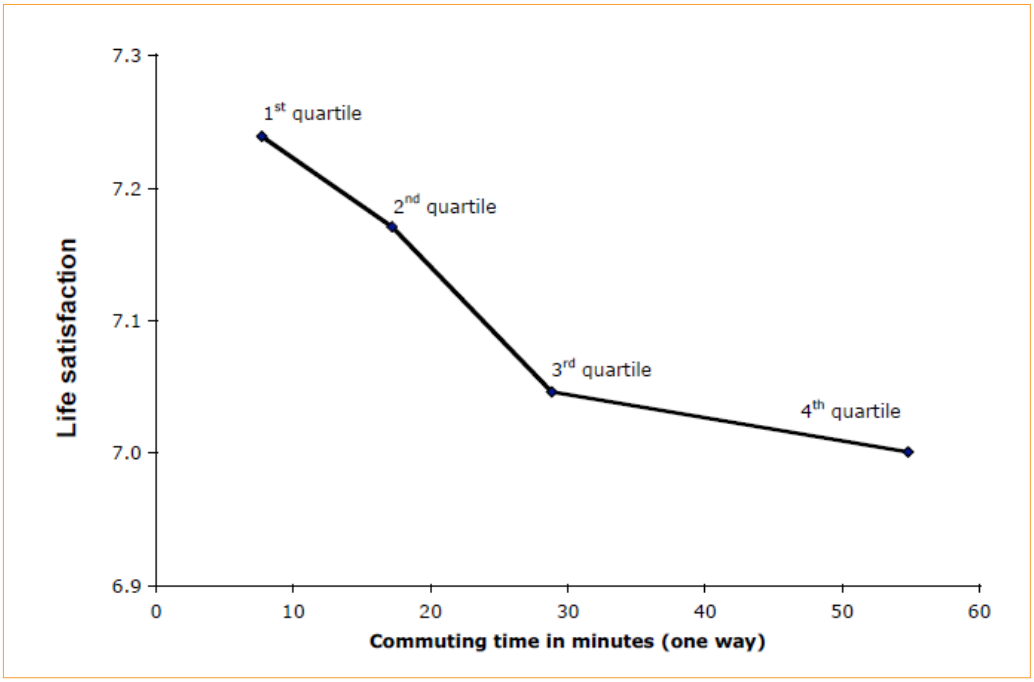
This section briefly explores existing literature related to lengthy commutes and personal welfare. Commuting time is generally negatively associated with overall life satisfaction (Krueger et al. 2008). The existing literature consistently finds that lengthy commuting is negatively related to life satisfaction (see for example Cassidy 1992, Stutzer and Frey 2008, Dickerson et al. 2014, Office for National Statistics 2014) and to wider measures of mental health and well-being (Roberts et al. 2009, Crabtree 2010, Roxby 2014).

Overall life satisfaction

- A study[76] in the UK examined the relationship between commuting to work (time spent commuting and method of travel) and life satisfaction using regression analysis, found that in most cases, the worst effects of commuting on personal well-being are experienced during journeys lasting between 61 and 90 minutes (Office for National Statistics 2014). This study showed that people travelling this length of time to work rated (after holding all else equal) their life satisfaction 0.17 points lower on a scale from 0-10 compared with those travelling only up to 15 minutes to work. Interestingly, the study also found that when the commute time reached three hours or more, the negative effects on personal well-being disappeared, suggesting that those with extremely long commutes have a different experiences to those travelling less time.
- In a German study, Stutzer and Frey (2008) found that people with long commutes reported lower life satisfaction than people with short commutes. They found that for each subsequent quartile of longer commuting time, a lower reported satisfaction with life. In their study, life satisfaction was 7.23 points, on average, for commuters who travel 10 minutes or less (the first quartile), while average satisfaction score was 6.99 points for commuting time more than 30 minutes (the fourth quartile), 0.24 points lower. This is shown in Figure 8.1.

76 The study used Annual Population Survey data from April 2012 to March 2013, all data weighted, non-respondents data were not included and results were statistically significant at the 5 per cent level (Office for National Statistics 2014).

Figure 8.1 Commuting time and average reported satisfaction with life, Germany, 1985–2003



Source: Stutzer and Frey (2008).

- Based on the UK Office for National Statistics data, Roxby (2014) reported that lengthy commutes between an hour and an hour and a half long had the most negative effect on personal well-being. Similarly, another study into commuting and personal well-being (using the same Office for National Statistics data) has also found that each minute added to a commute increases anxiety and decreases happiness and general well-being (Sedghi and Arnett 2014).
- Based on telephone interviews with 173 581 employed national adults (aged 18 and older), Crabtree (2010) found that US workers with lengthy commutes were likely to lower overall scores on the Gallup-Healthways Well-Being Index (i.e. life satisfaction). This study also showed that lower subjective well-being was present among full-time and part-time workers, after controlling for respondents' age, education, and income levels.

Contributors to overall life satisfaction

The following section reviews the effect of lengthy commuting on various contributors to overall life satisfaction, including job satisfaction, mental and physical health and work-life balance.

Literature suggest that, like life satisfaction, lengthy commuting is also negatively related to overall job satisfaction, satisfaction with flexibility and satisfaction with free time (Novaco et al. 1990, Stutzer and Frey 2004, Novaco and Gonzales 2009, Olsson et al. 2013, Martin and Licheron 2014).

In the UK, a study examined the relationship between commuting to work (time spent commuting and method of travel) and several aspects of personal well-being (using regression analysis) and found that in most cases, the worst effects of commuting on personal well-being are experienced during journeys lasting between 61 and 90 minutes (Office for National Statistics 2014). For example, people travelling this length of time to work rated (after holding all else equal):

- the sense that their daily activities are worthwhile 0.11 points lower on average than those travelling up to 15 minutes to work,
- their happiness levels 0.19 points lower than those travelling up to 15 minutes to work, and
- their anxiety levels 0.32 points higher on average than those travelling up to 15 minutes to work.

Commuting is also associated with stress. Perceived stress, while or immediately after commuting, has been found to increase with commuting time (Kageyama et al. 1998, Evans and Wener 2006, Gottholmseder et al. 2009). It has been reported that longer commuting times are associated with higher stress levels, particularly in full-time workers (Turcotte 2011).

Kageyama et al. (1998), who studied the short-term heart rate variability of 223 Japanese male white-collar workers in Tokyo Megalopolis (covariate analysis using the General Linear Model), found that workers commuting more than 90 minutes one-way had chronic stress, fatigue symptoms and the onset of heart disease.

Evans and Wener (2006), who studied a sample of 208 suburban rail commuters who took the train to Manhattan (New York), found that the greater the duration of the commute, the greater the levels of perceived stress. Similarly, Gottholmseder et al. (2009), using ordered logistic regression (controlling for personal and work-related characteristics), found that several dimensions of the commuting situation (such as impedance, control and predictability of commuting) significantly influence the perceived stress level.

Gottholmseder et al. (2009), using data from a 2005 survey of Austrian employees aged between 18 and 60 years and ordered logistic regression, found that an increase in commuting time of 1 min (at the mean) decreased the probability of feeling 'relaxed' or 'very relaxed' by 0.1 per cent, while an increase of one standard deviation (19 min) evaluated at the mean increased the probability of feeling 'stressed' by 2.2 per cent.

Using data from the 2010 General Social Survey (Canada), Turcotte (2011) found that 'of the full-time workers who took 45 minutes or more to travel to work, 36 per cent said that most days were quite or extremely stressful. In contrast, this was the case for 23 per cent of workers whose commuting time was less than 15 minutes' (ibid. p.34). The feeling of being trapped in a daily routine, feels rushed every day and no time for fun also increased with commuting time.

In Australia, the IBM Commuter Pain Survey[77] found that 81 per cent of commuters experienced travel stress and 41 per cent of drivers believed that traffic had negatively affected their health in 2011. Among those who believed that traffic has negatively affected their health, increased stress (77 per cent) and anger (52 per cent) were the primary symptoms (IBM 2011).

77 The 2011 IBM Australian Commuter Pain survey of over 1,500 commuters, aged 18-64 years, distributed throughout Sydney, Melbourne, Brisbane, Adelaide and Perth looked at differences in metropolitan commuting patterns and the effects roadway traffic and work, university and school performance have on a person's health and lifestyle. The data was weighted by age, sex and area to reflect the latest population estimates (IBM 2011).

In addition, people with very long commutes tend to feel more tiredness and less enjoyment during their working day than those with short commutes. For example, Hansson et al. (2011), using data from two Swedish cross-sectional population-based public health surveys (conducted in 2004 and 2008), examined the relationship of duration (one way) and mode of commuting with several health outcomes (e.g. especially perceived poor sleep quality, everyday stress, exhaustion or low vitality, mental health, self-reported health and absence from work due to sickness. They found that commuting was significantly associated with exhaustion, perceived poor sleep quality and low self-rated health.

In a similar study in the UK using the British Household Panel Survey, Jennifer et al. (2011) found that commuting created more psychological stress for women than men, after controlling for variables such as income and job satisfaction (cited in Wei 2015). This study also found that the negative stress of commuting was found at highest rates in women with preschool children compared to men with young children or single men and women without children.

As well as being associated with higher stress and less satisfaction, longer commuting times are also associated with spending less time socialising with family, friends and neighbours, and with not being a member of a sporting group or community organisation (Cassidy 1992, Flood and Barbato 2005, Martin and Licheron 2014). The intuition is that because long commuters tend to come home late, tired and worn out, without the physical or emotional energy to participate in family life, friendships or other relational activities.

Based on 2007 data, the Australian Work and Life Index, which is a national survey of work–life outcomes amongst working Australians that measures perceptions of work–life interaction, including both work-to-life and life-to-work interactions, found that workers with long and very long commute times have the worst outcomes in terms of work-life balance (Pocock 2007).

Some studies have found that parents spend less time with their children as commuting time increases and this is not uncommon in Australia. For example, Flood and Barbato (2005) found that over 10 per cent of working parents spend more time commuting than they do with their children.

In addition, commuting time has also been found to increase feelings of not having enough time for family and friends. In a Canadian study, Turcotte (2011) found that 79 per cent of people who had commuting times of less than 15 minutes said they were satisfied or very satisfied with their balance between work and family life and this proportion declined as commuting time increased—reaching 65 per cent among full-time workers who took 45 minutes or more to get to work. This study also found that 43 per cent of full-time workers who took less than 15 minutes to travel to the office felt that they had worries about not spending enough time with family and friends and this proportion increased to 55 per cent of people who took more than 45 minutes to travel to work.

Research also shows that length of commuting has a negative impact on social satisfaction. Delmelle et al. (2013) examined the relationship between commuting times and social satisfaction in the city of Vienna (Austria). After controlling for various residential and transportation factors and using multivariate regression analysis, they found that long commute (one-way commutes of 30 minutes or longer) had a significant negative effect on social satisfaction outcomes.

Long commute to work and spending most of working time in transport is the most unpleasant activity of the day, hence affecting the level of satisfaction with transport (Stutzar and Frey 2008). Commuting stress is also associated with driving on congested roadways or strains in public transport, and this stress affects health, both physical and mental (Novaco and Gonzales

2009). In addition, the choice of transport mode of commuting, congestion and noise on the roads are also associated with the commuting stress (Gottholmseder et al. 2009). However, this aspect is out of scope in this study and we are unable to analyse.

Method

Data

The data in this chapter is sourced from wave 12 of the HILDA survey (Continuing Person Questionnaire or CPQ) from two sections ('C' and 'K') and HILDA Self Completed Questionnaire (SCQ) from one section ('B'). The first dealt with here relates to overall life satisfaction, which is the principle measure used here to analyse the welfare effects of lengthy commuting.

Before respondents are asked about their overall life satisfaction, they are first asked questions about their satisfaction with other domains of their life, one of which will also be used in the following analysis.

The other domains of satisfaction are satisfaction: the home in which live, employment opportunities, financial situation, feeling safe, feeling part of your local community, health, neighbourhood and the amount of free time. These satisfaction measures are scored using a scale (between 0 and 10) on a written showcase. Of these domains, the satisfaction with free time question is used in this study

As an example of the domain specific questions, Figure 8.2 shows the wording used to measuring subjective satisfaction, along with the specific wording of the 'free time' domain.

Figure 8.2 Extract from HILDA person questionnaire that is relevant to estimating amount of free time

K13 I am now going to ask you some questions about how satisfied or dissatisfied you are with some of the things happening in your life. I am going to read out a list of different aspects of life and, using the scale on SHOWCARD K13**, I want you to pick a number between 0 and 10 that indicates your level of satisfaction with each. The more satisfied you are, the higher the number you should pick. The less satisfied you are, the lower the number.**

h **The amount of free time you have?** ☐

Note: Only relevant question is included and intervening questions are omitted to keep the presentation concise. However, these are mentioned in the text earlier.

Source: Extract from HILDA survey wave 12 Continuing Person Questionnaire (CPQ), available from <www.melbourneinstitute.com/hilda/doc/questionnaires/q12.html>.

After this question, respondents are asked about their overall life satisfaction, in the form shown below in Figure 8.3.

Figure 8.3 Extract from HILDA person questionnaire that is relevant to estimating life satisfaction

K14 All things considered, how satisfied are you with your life? Again, pick a number between 0 and 10 to indicate how satisfied you are.

Enter number from 0 to 10 ☐

Source: Extract from HILDA survey wave 12 Continuing Person Questionnaire (CPQ), available from <www.melbourneinstitute.com/hilda/doc/questionnaires/q12.html>.

The life satisfaction variable is ordinal, the respondents are asked to choose a number between 0 (totally dissatisfied with life) and 10 (totally satisfied with life).

In addition, respondents are asked some questions about how satisfied or dissatisfied they are with different aspects of their main job. These questions are based on total pay, job security, type of work, work hours, flexibility available to balance work and non-work commitments and overall job satisfaction. In this study, only two questions analysed are shown below in Figure 8.4.

Figure 8.4 Extracts from HILDA person questionnaire that are relevant to estimating satisfaction with flexibility and job satisfaction

C35 I now have some questions about how satisfied or dissatisfied you are with different aspects of your job. (Again I remind you that we are only interested here in your main job.)

If not currently employed, also read out:
These questions refer to the most recent job you were working in.

Looking at SHOWCARD C35, **please pick a number between 0 and 10 to indicate how satisfied or dissatisfied you are with the following aspects of your job. The more satisfied you are, the higher the number you should pick. The less satisfied you are, the lower the number.**

e	**The flexibility available to balance work and non-work commitments?**	☐	99
f	**All things considered, how satisfied are you with your job?**	☐	99

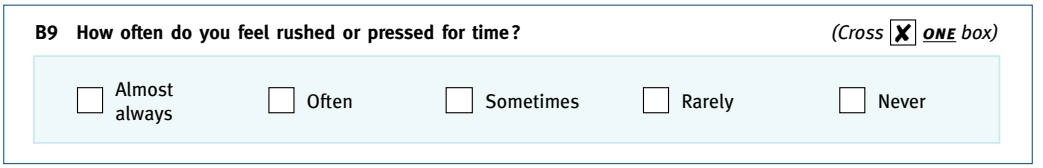
Note: Only relevant questions are included and intervening questions are omitted to keep the presentation concise.

Source: Extract from HILDA survey wave 12 Continuing Person Questionnaire (CPQ), available from <www.melbourneinstitute.com/hilda/doc/questionnaires/q12.html>.

As with the other satisfaction responses these are ordinal as the respondents are asked to choose a number between 0 and 10 to indicate how satisfied or dissatisfied they are with the aspects of their job. The more satisfied they are, the higher the number they pick, while the less satisfied they are, the lower the number

This chapter also uses another question on subjective welfare: 'How often do you feel rushed or pressed for time?' The framing of this question is shown in Figure 8.5.

Figure 8.5 HILDA survey question on feeling rushed or pressing for time from self-completion questionnaire



Source: Extract from HILDA Self Completed Questionnaire (SCQ).

For the question 'feeling rushed or pressing for time', respondents are asked to give a response by crossing out one of the five possible answers and the answers are: 'Almost always', 'Often', 'Sometimes', 'Rarely' and 'Never'.

Analytical methods

We begin the analysis with a comparison of the distribution of the various welfare measures by lengthy or not lengthy commuting status. We then use an ordered logistic regression on subjective overall life satisfaction which tests the effect of being a lengthy commuter. This is followed by a series of logistic regressions which estimate the probability of being a lengthy commuter, based on the model used in Chapter 6. Each of these regressions tests the association between lengthy commuting one of the other indicators of welfare (satisfaction with flexibility, free time, feeling rushed or pressed for time, and time spent on selected six activities in a typical week; household errands, housework, outdoor tasks, playing with own children).

As mentioned earlier, the measure of overall subjective life satisfaction is ordinal, in that 10 is better than 0. Because we only observe the values given by a person and not the threshold between values, we do not know where that threshold lies or in fact whether the distance on the scale is consistent between values. For this reason an ordered regression, which does not assume a consistent scale, is most appropriate. An ordered regression model is also applied to estimate the effects of commuting on the perceived stress level, due to the ordinal nature of the stress variables (e.g. very stressed, stressed, relaxed and very relaxed) (Gottholmseder et al. 2009).

The variables included in ordered logistic regression model have been chosen to reflect other international studies of life satisfaction and commuting time, most specifically the study by Dickerson et al. (2014), which was based on data from the British Household Panel Survey. Two differences from this formulation are that the present study does not contain a variable for regular saving, as no sufficiently analogous variable is available in the HILDA dataset, and that this model does not include education variables, as these were not found to be significant for either males or females.

The series of logistic regressions test the significance of the other variables of interest on lengthy commutes using logistic regression to estimate the probability of an individual being a lengthy commuter. These use reduced for model developed from the logistic regression specification in chapter 6. The reduced form variables were chosen through backwards selection (i.e. removing those variables which were not individually statistically significant). As such, some variable which on their own were not significant, but which were part of significant groups of variables have been removed. Each of the welfare indicators is separately added to the reduced form model. This indicates, controlling for other factors we know to be related to lengthy commuting, the relationship between the added welfare measure and lengthy commuting.

This method been chosen over the alternative but more robust method of developing a complete model for each variable as developing such a model would requires a complete study of each welfare measure itself. This cursory approach only controls for factors known to influence the probability of being a lengthy commuter, without an in depth understanding of the factors which influence the welfare measure itself. This leads to a more cautious discussion of the results which we limit to the significance and direction of the effect.

Results

Descriptive analysis

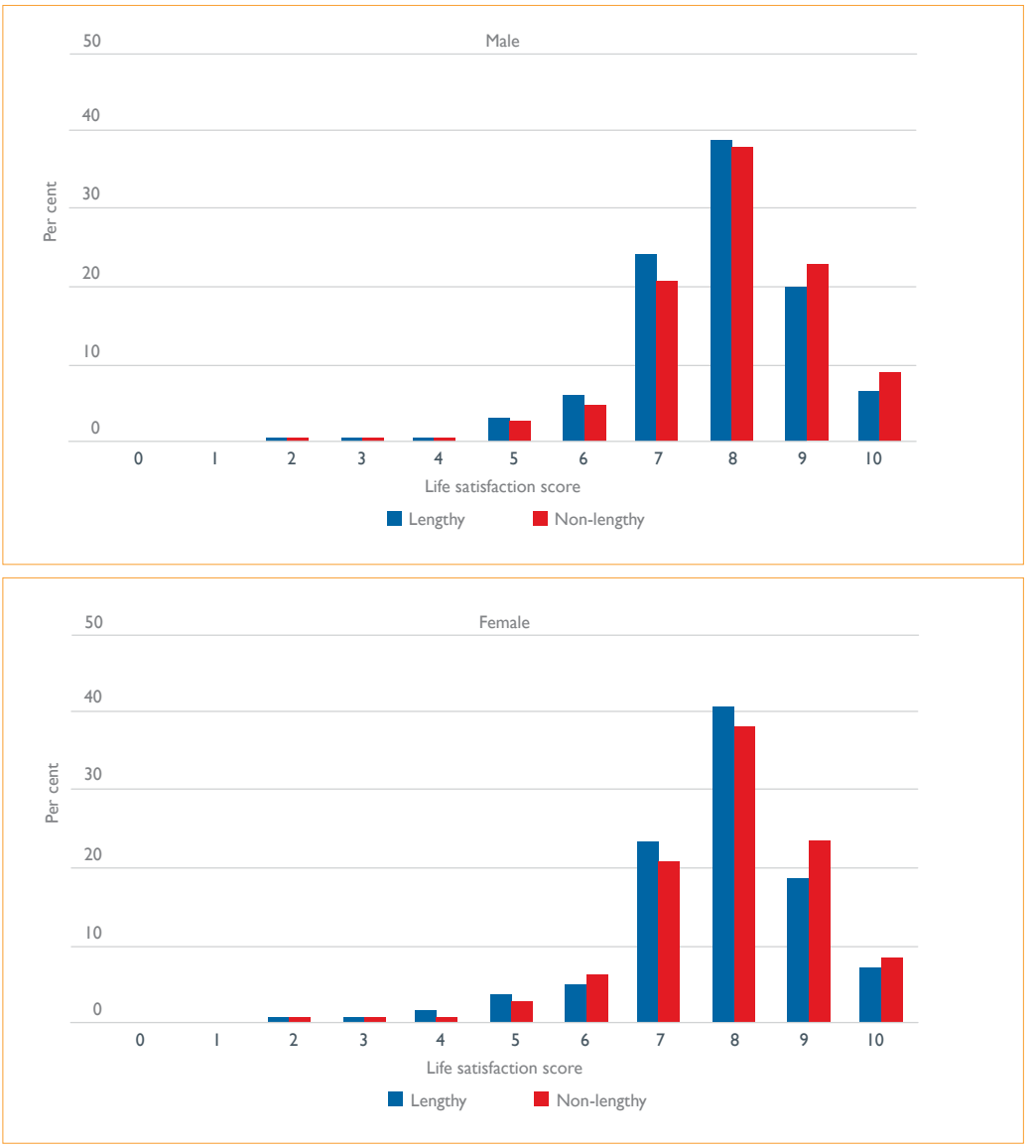
Overall life satisfaction

Below we considers the distribution of objective overall life satisfaction scores of non-lengthy and lengthy commuters found in wave 12 of the HILDA survey. The distributions of males and females are shown separately as they have different distributions of scores across the entire population. Further, Roberts et al. (2011), who examined the effects of commuting time on the psychological health of men and women using data from the British Household Panel Survey, observed that commuting had a detrimental effect on the psychological health of females, but not males, which also suggests that the distributions should be examined separately.

Figure 8.6 illustrates the distribution of self-reported overall life satisfaction for male and female lengthy and non-lengthy commuters. The distribution is highly concentrated around higher scores, with majority of the responses with a score of 8. This is a consistent theme in self-assessed overall life satisfaction across western countries (e.g. Cassidy 1992, Krueger et al. 2008, Stutzer and Frey 2008, Dickerson et al. 2014, Office for National Statistics 2014).

Further, it can also be seen from the Figure 8.6 that the distribution of responses differs slightly between male and female non-lengthy commuters. Irrespective of sex, there are marked differences the distributions of life satisfaction between lengthy and non-lengthy commuters, with there being fewer lengthy commuters reporting scores of 9 or 10 and more reporting scores of 8 or below. This suggests that many lengthy commuters are less satisfied with their life overall than non-lengthy commuters.

Figure 8.6 Distribution of self-reported overall life satisfaction by lengthy and non-lengthy commuters, by sex



Notes:

1. Distribution of life satisfaction is presented as a percentage using weighted data.
2. The respondents were asked to give a response score on a 11-point scale, where the lowest value (0) is labelled 'Totally dissatisfied with life' and the highest value (10) is labelled 'Totally satisfied with life'.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Like the distribution of scores for overall life satisfaction the distributions of scores for overall job satisfaction and satisfaction with free time are highly skewed, with the majority of the responses at the top end the distribution for both lengthy and non-lengthy commutes (Table 8.1 and Table 8.3), while the distribution of the satisfaction with flexibility data is less skewed, but again the majority of the lengthy and non-lengthy commutes report relatively high values (Table 8.2). Dickerson et al. (2014) also found similar pattern on the distribution of the leisure time of respondents.

Using a survey conducted in a UK city region to analyse the effect of commuting time and mode of transport on self-reported job satisfaction (ordered probit estimation), Crawley (2014) found a significant and positive relationship between age and self-reported job satisfaction for lengthy commuters. On the other hand, Martin and Lincheron (2014), in a cross-sectional survey in Luxembourg using simultaneous ordered probit regressions, found non-significant relationship between age and job satisfaction due to commuting. They also found presence of children tended to be positively related to job satisfaction.

Table 8.1 Distribution of overall job satisfaction by sex, lengthy and non-lengthy commutes, 2012

Score	Lengthy commutes			Non-lengthy commutes		
	Male	Female	Total	Male	Female	Total
	Per cent					
0	0.4	0.0	0.2	0.2	0.1	0.1
1	0.2	0.6	0.4	0.4	0.3	0.3
2	0.7	0.4	0.5	0.6	0.6	0.6
3	1.3	1.4	1.4	1.7	1.0	1.3
4	1.7	2.3	1.9	1.8	1.8	1.8
5	5.3	5.5	5.4	4.8	4.9	4.9
6	7.7	9.4	8.4	7.2	7.2	7.2
7	23.2	19.6	21.7	21.5	18.9	20.2
8	33.4	34.2	33.8	32.3	32.2	32.2
9	20.7	17.7	19.4	21.3	22.2	21.8
10	5.4	8.8	6.9	8.3	10.6	9.5

Note: The respondents are asked to choose a number between 0 and 10, where the more satisfaction, the higher the number and the less satisfaction, the lower the number.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 8.2 Distribution of satisfaction with flexibility by sex, lengthy and non-lengthy commutes, 2012

Score	Lengthy commutes			Non-lengthy commutes		
	Male	Female	Total	Male	Female	Total
			Per cent			
0	0.7	0.9	0.8	0.7	0.6	0.7
1	0.7	0.9	0.8	0.8	0.7	0.7
2	2.1	2.8	2.4	2.1	1.8	2.0
3	3.3	3.1	3.2	2.5	1.9	2.2
4	2.9	3.6	3.2	3.3	2.8	3.1
5	7.9	7.6	7.8	7.7	7.8	7.7
6	7.7	6.4	7.2	7.6	7.8	7.7
7	14.4	15.9	15.0	15.7	14.1	14.9
8	24.9	23.6	24.4	23.2	23.0	23.1
9	19.8	18.5	19.2	18.2	19.0	18.6
10	15.5	16.8	16.0	18.2	20.6	19.4

Note: The respondents are asked to choose a number between 0 and 10, where the more satisfaction, the higher the number and the less satisfaction, the lower the number.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 8.3 Distribution of satisfaction with free time by sex, lengthy and non-lengthy commutes, 2012

Score	Lengthy commutes			Non-lengthy commutes		
	Male	Female	Total	Male	Female	Total
			Per cent			
0	1.2	1.9	1.5	0.9	1.1	1.0
1	1.8	2.6	2.1	1.6	2.1	1.9
2	4.8	6.5	5.5	3.7	5.2	4.4
3	7.7	8.2	7.9	5.9	5.7	5.8
4	7.9	8.6	8.2	6.5	6.9	6.7
5	14.3	12.6	13.6	12.2	13.2	12.7
6	15.8	16.4	16.0	14.5	13.0	13.7
7	22.0	19.9	21.1	21.2	20.6	20.9
8	13.8	13.2	13.6	18.7	17.9	18.3
9	6.3	5.9	6.2	7.7	8.0	7.9
10	4.3	4.2	4.3	7.1	6.3	6.7

Note: The respondents are asked to choose a number between 0 and 10, where the more satisfaction, the higher the number and the less satisfaction, the lower the number.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Tables 8.1 to 8.3 also show that male lengthy commuters are more satisfied with overall job, flexibility and free time than female lengthy commuters. For example, among male and female lengthy commuters who gave ratings between 6 and 10:

- 82.8 per cent of men and 80.4 per cent are women are satisfied with their job overall,
- There is little difference between men and women in their satisfaction with flexibility (74.6 per cent and 74.7 per cent, respectively), and
- 58.0 per cent are men and 55.4 per cent women are satisfied with their free time.

Many commuters in paid work feel rushed or pressed for time (Table 8.4), with more than 47 per cent of lengthy commuters and 42 per cent of non-lengthy commuters reporting that they feel rushed or pressed for time 'Almost always' or 'Often'. Nearly 42 per cent of lengthy commuters and 43 per cent non-lengthy commuters 'Sometimes' feel rushed or pressed for time. Only 11 per cent of lengthy commuters 'Rarely' or 'never' feel rushed or pressed for time, while for non-lengthy commuters is just over 15 per cent.

Table 8.4 Distribution of feeling rushed or pressed for time by sex, lengthy and non-lengthy commutes, 2012

Categories	Lengthy commutes			Non-lengthy commutes		
	Male	Female	Total	Male	Female	Total
	Per cent					
Almost always	8.4	13.8	10.7	6.5	11.1	8.9
Often	35.2	38.1	36.4	28.5	38.0	33.3
Sometimes	43.0	39.8	41.7	45.9	39.5	42.7
Rarely	12.3	8.0	10.5	17.8	10.6	14.1
Never	1.1	0.4	0.8	1.3	0.7	1.0

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Table 8.5 shows that lengthy commuters spent more time on household errands, outdoor tasks and playing with their own children and less time on looking after other children and volunteer or charity work than non-lengthy commuters. However, both lengthy and non-lengthy commuters spent a very similar amount of time on housework. In a typical week on average, lengthy commuters spent 8.47 hours, while non-lengthy commuters spent 8.36 hours.

Table 8.5 Time spent on selected activities in a typical week (hours) by sex, lengthy and non-lengthy commuters, 2012

Activity	Time spent in a typical week (hours)		
	Male	Female	Total
	Lengthy commutes		
Household errands[1]	4.07	5.10	4.48
Housework[2]	6.38	11.58	8.47
Outdoor tasks[3]	4.54	2.22	3.62
Playing with own children[4]	6.02	6.85	6.35
Looking after other people's children[5]	0.35	0.61	0.45
	Non-lengthy commutes		
Household errands[1]	3.03	4.05	3.52
Housework[2]	5.31	11.67	8.36
Outdoor tasks[3]	3.90	2.20	3.09
Playing with own children[4]	4.43	7.18	5.74
Playing with other children[5]	0.44	0.93	0.68

Note: The responded are asked to put total time (in hours) spend on each of these activities in a typical week.

1 Household errands, such as shopping, banking, paying bills, and keeping financial records (but do not include driving children to school and to other activities).

2 Housework, such as preparing meals, washing dishes, cleaning house, washing clothes, ironing and sewing.

3 Outdoor tasks, including home maintenance (repairs, improvements, painting etc.), car maintenance or repairs and gardening.

4 Playing with your children, helping them with personal care, teaching, coaching or actively supervising them, or getting them to child care, school and other activities.

5 Looking after other people's children (aged under 12 years) on a regular, unpaid basis.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Among lengthy commuters, men only spent more time on outdoor tasks, while women spent more time on the other five activities (see Table 8.5). Both lengthy and non-lengthy female commuters spent more time on housework and playing with their own children. This is likely to be a result of women having greater responsibilities for day-to-day household tasks, such as childcare and housework, which makes women more sensitive to longer commuting times (Roberts et al. 2011).

Based on the HILDA Longitudinal Survey (wave 2), Flood and Barbato (2005) examined the impact of commuting on personal and social life in terms three dimensions: personal and social relationships, perceptions of time pressure and time satisfaction, and the monetary value of time spent. They found that 'among full-time workers, people who socialise several times a week have significantly shorter commuting times (three hours and 54 minutes per week) than the people who socialise two or three times a month (four hours and 30 minutes per week)' (ibid, p.30).

Subjective overall life satisfaction model

Table 8.6 presents the results of the ordered logistic regression on subjective overall life satisfaction in order to evaluate whether lengthy commuting has a statistically significant effect (indicated by significance level) and whether that effect is negative or positive (reflected in the parameter estimate). While larger parameter estimates do indicate an effect of greater magnitude, they are not accurately comparable between the models for males and females.

The results show that lengthy commuting has a significant and negative effect on reported overall life satisfaction for both men and women. To better illustrate the estimated effect of lengthy commuting the estimated probability of having a given life satisfaction for a representative male and female are shown in Figure 8.7. The differences may appear small, however as we do not know a person's subjective scale of life satisfaction - for example how large the difference between a 7 and an 8 on an individual's rating, and whether this is the same as the difference between a 5 and a 6 – and so the magnitude of the effect is not able to be directly evaluated.

The adjusted pseudo R-squared, which is used to evaluate the explanatory power of the model, indicates that the model explains around 4.2 percent of the variation in total life satisfaction for men and 3.7 per cent for women. While similarly low levels of explanatory power are not uncommon in cross sectional models on person level characteristics, it does suggest that the results should be interpreted cautiously.

Table 8.6 Subjective overall life satisfaction model

Model Information				
Model Type	Logistic Regression		Logistic Regression	
Base number of observations	3134		3016	
Adjusted R-squared	4.2 per cent[1]		3.7 per cent[2]	
Explanatory variables	**Male**		**Female**	
	Parameter estimate	**Significance level**	**Parameter estimate**	**Significance level**
Age	-0.1377	***	-0.0724	***
Aged squared	0.00166	***	0.000848	***
Ln(Gross personal financial year income)[3]	0.2342	***	0.0697	***
Child(ren) resident in household (Ref= no children)	0.0122	***	-0.2669	***
Married or has defacto partner (Ref=not married and no defacto partner)	0.9347	***	0.5705	***
Usual weekly hours worked	-0.00077	***	-0.01430	***
Lengthy commute of 45 minutes or more (Ref= commute of less than 45 minutes)	-0.1896	***	-0.3010	***

Note: All parameter estimates (for both Male and Female) are statistically highly significant ($p<0.001$).

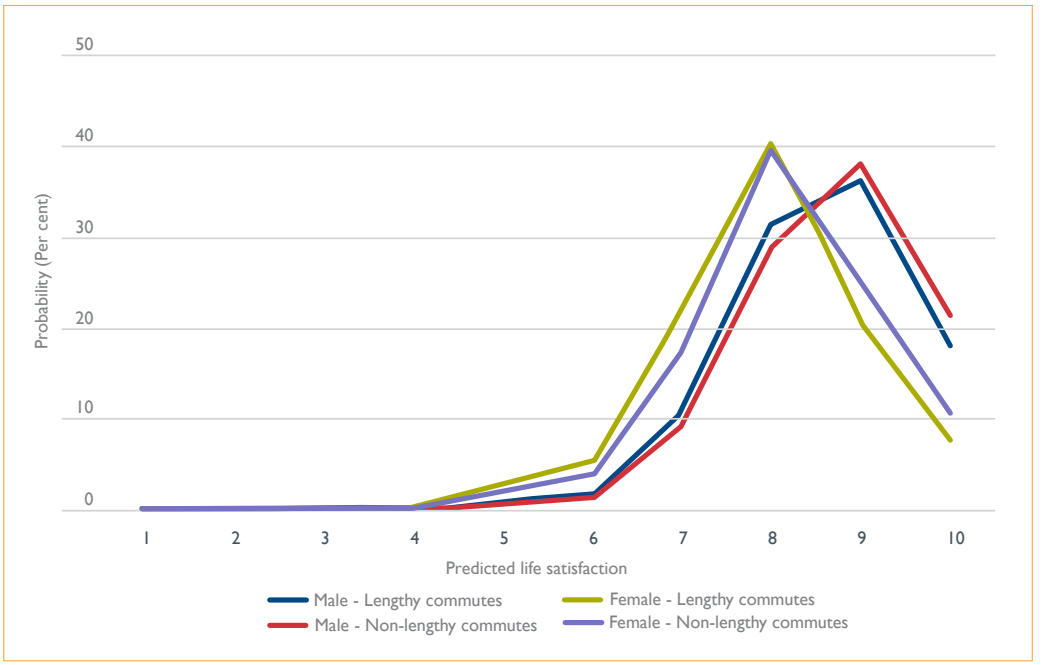
1 This figure represents Nagelkerke's pesudo R-Squared.

2 This figure represents Nagelkerke's pseudo R-Squared.

3 The imputed version of the income measure was used in the regression.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Figure 8.7 Predicted life satisfaction for representative male and female, lengthy and non-lengthy commute



Note: Estimated life satisfaction score ranged from 0 (Totally dissatisfied with life) to 10 (Totally satisfied with life).

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The subjective wellbeing measure shown is for a person of the given sex aged 40, earning $65 000 per year, is married or with a de facto partner, is living in a household with children and is working 38 hours a week. Table 8.7 shows the summary statistics of the variables used.

In terms of the other variables, the model indicates a significant u-shaped relationship between age and overall life satisfaction (in line with other studies of subjective life satisfaction such as Dickerson et al. (2014)). The minimum life satisfaction occurs at around 41 years for males and 43 years for females. The specification of income implicitly assumes a diminishing marginal utility of wealth and is significant and positive and this indicates that higher incomes do increase overall life satisfaction. Having children resident in the household improves overall life satisfaction for males but decreases overall life satisfaction for females. For both sexes having a partner improves overall life satisfaction and higher usual weekly hours worked reduces overall life satisfaction.

Table 8.7 Summary statistics for Subjective Overall Life Satisfaction model

Variable	Mean	Std. Dev.	Minimum	Maximum
Male				
Overall life satisfaction	7.91	1.22	1.00	10.00
Age	44.27	11.59	18.00	86.00
Gross personal financial year income ($'000)	83.70	58.36	0.06	733.23
Child(ren) resident in household	0.47		0.00	1.00
Married/defacto partner	0.93		0.00	1.00
Usual weekly hours worked	43.32	12.11	2.00	160.00
Lengthy commute of 45 minutes or more	0.26		0.00	1.00
Female				
Overall life satisfaction	7.90	1.21	2.00	10.00
Age	43.88	11.51	15.00	83.00
Gross personal financial year income ($'000)	49.75	33.97	0.20	733.23
Child(ren) resident in household	0.43		0.00	1.00
Married/defacto partner	0.85		0.00	1.00
Usual weekly hours worked	33.05	12.38	2.00	90.00
Lengthy commute of 45 minutes or more	0.19		0.00	1.00

Note: These data is based on the number of people who responded to all of the questions and had a positive crosssectional weight.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Other welfare measures reduced form model

In order to get a rough measure of the relationship between lengthy commuting and other welfare measures we use the following set of logistic regressions based on a reduced form of the model shown in Chapter 6. The primary use of these regressions is to test the statistical significance of the relationship and where there is a significant relationship, the direction as shown by the parameter estimate.

The model information, parameter estimates, and significance of the reduced form model, without the addition of any test variables are presented in Table 8.8. It also shows the parameter estimates and significance of each variable added to this reduced form model. The explanatory power of the regressions is low (10.9 per cent), slightly lower than the lengthy commute complete model which was 11.6 per cent (refer Table 6.5). However, all explanatory variables are statistically highly significant ($p<0.001$), except female ($p<0.05$).

Table 8.8 Probability of lengthy commuting (reduced form)

Model Information		
Model Type		Logistic Regression
Base number of observations		8694
Adjusted R-squared		10.9 per cent[1]
Explanatory variables	*Parameter estimate*	*Significance level*
Intercept	-2.1991	***
Female (Ref=Male)	-0.1155	**
Age	0.0502	***
Aged squared	-0.00063	***
Foreign born (Ref=Australian born)	0.2539	***
Gross personal financial year income[2]	0.00159	***
Other schedule (including on call and split-shift)	-0.8923	***
Occupation		
Professionals	0.2253	***
Industry		
Mining	1.0212	***
Electricity, gas, water and waste services	0.9056	***
Construction	0.826	***
Information, media and telecommunications	0.9495	***
Financial and insurance services	0.8208	***
Professional, scientific and technical services	0.6499	***
Administrative and support services	0.632	***
Public administration and safety	0.5065	***
City of residence		
Brisbane	-0.4176	***
Perth	-0.5433	***
Adelaide	-0.6213	***
Rest of Australia	-0.903	***
Reside in a non-urban area[3]	0.3822	***
Remoteness class of residence		
Outer regional	-0.3979	***
Remote and very remote	-0.9276	***

1 This figure represents Nagelkerke's pseudo R-Squared.

2 The imputed version of the income measure was used in the regression.

3 Urban refers to ABS' section of state categories 'major urban' and 'other urban' which captures urban centres with populations of 1000 or more. Non-urban refers to the remaining section of state categories (i.e. bounded localities and rural balance.)

*** $p<0.001$

** $p<0.05$.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The addition to the model of each test variable did not significantly alter the parameter estimates for the reduced form model at the 95 per cent level is discussed further below.

Table 8.9 shows that the parameter estimates (coefficient) for lengthy commutes. The negative and significant parameter estimates for overall job satisfaction, satisfaction with flexibility and satisfaction with free time suggest that higher levels of satisfaction are associated with a lower probability of being a lengthy commuter.

The negative and significant parameter estimate for 'Feeling rushed or pressed for time' suggests that feeling rushed or pressed for time more often in associated with a higher probability of being a lengthy commuter.

Table 8.9 Satisfaction, feeling and activities with lengthy commutes

Explanatory variables	Parameter estimate	Significance level
Satisfaction		
Overall job satisfaction	-0.03881	**
Satisfaction with flexibility	-0.04408	***
Satisfaction with free time	-0.09046	***
Feeling		
Feeling rushed or pressed for time	-0.12969	***
Activities		
Household errands	0.05826	***
Housework	0.01330	***
Outdoor tasks	0.03348	***
Playing with own children	0.00338	NS
Playing with other children	-0.01792	NS

*** $p<0.001$

** $p<0.05$

NS Not significant.

Source: BITRE analysis of HILDA survey unit record data for wave 12. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

In terms of activities, the significant and positive parameter estimates suggest more time spent on household errands, housework and outdoor tasks is associated with a higher probability of being a lengthy commuter. However neither time spent playing with own children or playing with other children has any significant association with lengthy commuting.

Discussions

Overall the direct effects of lengthy commuting appear to be unambiguously negative. Lower overall life satisfaction, lower overall job satisfaction, lower satisfaction with free time and lower satisfaction with job flexibility are all associated with lengthy commuting.

However there appears to be some complexity related to transport mode which unfortunately is not able to be assessed using the HILDA survey. If lengthy commutes are undertaken on transport modes where the person is a passenger they may find the experience comparatively non-stressful or even relaxing. As shown in Chapter 4, this is the case for 22.4 per cent of lengthy commuters.This is echoed in other studies which have included mode and suggests that controlling for how a person travels is an important, but missing consideration in measuring the direct effect of commuting. For example, Gottholmseder et al. (2009) found that the choice of transport mode of commuting, congestion and noise on the roads were associated with the commuting stress.

Similarly, our cursory investigation suggests that lengthy commuting does not have a detrimental impact on the amount of time spent doing other activities, such as household errands, housework, outdoor tasks or playing with children. In fact, it suggests that people who are lengthy commuters spend more time on household errands, housework and outdoor tasks.

Conclusion

The aim of this chapter is to investigate the direct effects of lengthy commuting on a commuter's wellbeing, which include four dimensions of satisfaction (i.e. self-reported overall life satisfaction, overall job satisfaction, satisfaction with flexibility and satisfaction with free time), feeling rushed or pressed for time and feeling tired, and time spent on selected activities (i.e. household errands, housework, outdoor tasks, playing with own children and playing with other people's children) in a typical week.

The results show that lengthy commuting has a significant negative impact on subjective overall life satisfaction, controlling for other relevant factors. In addition, higher levels of overall job satisfaction, higher levels of satisfaction with the amount of free time a person has and higher levels of satisfaction with job flexibility are associated with a lower probability of being a lengthy commuter.

The results also show that people who feel rushed or pressed for time have a higher probability of being a lengthy commuter. In addition, people who spend more time on household errands, housework and outdoor tasks are associated with a higher probability of being a lengthy commuter.

Interesting results can also be reported for activities, particularly there does not appear to be a significant relationship between being a lengthy commuter and the amount of time a person spends playing with their own children or playing with other children.

The next chapter (Chapter 9) will investigate the persistence of lengthy commutes over time using the HILDA survey data.

CHAPTER 9
Persistence of lengthy commutes over time

Key points

- Lengthy commuting is a mostly temporary situation.
- For most lengthy commuters, a stint of lengthy commuting will only last around 1 year. For around 1 in 10, it will last five or more consecutive years.
- Lengthy commuting needs to be understood in the context of a person's life cycle and the characteristics of lengthy commuters change during their stint of lengthy commuting.
- The most important factors associated with longer or shorter lengthy commuting stints are; sex, age, employment and place of residence.

Introduction

This chapter investigates whether lengthy commuting is a permanent or temporary state, the typical duration of stints of lengthy commuting and the factors which influence this duration. This is an important consideration in the context of the previous chapter which showed that lengthy commuting generally reduces overall life satisfaction and other measures of welfare. Commuters being locked into lengthy commuting provide a more compelling case for government intervention than commuters transiting through lengthy commuting as they move through their life cycle.

In this chapter we first briefly discus the data used in the analysis and present our best estimates of the distribution of lengthy commuting stint durations. We then attempt to identify factors which influence the duration of a lengthy commuting stint. This is related to the analysis presented in Chapter 6, but contains an extra level of complexity. In Chapter 6 we described the characteristics of people observed to be lengthy commuters at a given point in time. However, characteristics associated with lengthy commuting in Chapter 6 could have that association either because:

- the characteristic is associated with a higher chance of having a lengthy commuting stint at all, and/or
- the characteristics are associated with a longer stint, and thus a higher chance of being observed in that period.

The focus of this chapter are those characteristics that could be associated with a longer stint and so an analysis of the same factors discussed in Chapter 6 is carried out using only lengthy commuters.

The analysis is further complicated by the changing characteristics of lengthy commuters over time. While people may remain lengthy commuters for a number of years, they often change in many other important characteristics, often associated with typical changes we observe over a person's life. These include changing jobs (and so their industry and occupation), marrying or divorcing, having children and/or changing address. This dynamism means that we can identify factors which are predictors of longer lengthy commuting stints both at the beginning of the stint and retrospectively. We can assess this question looking forward over a person's lengthy commuting stint, or looking backward over the stint in retrospect. In looking forward, the characteristics of a lengthy commuter at the beginning of their lengthy commuting stint are used, while in looking back, the characteristics of a lengthy commuter at the end of their stint are used, bearing in mind that this can be substantially different. As well as indicating characteristics associated with lengthy commuting this section highlights that people change their characteristics over time. This shows us that behaviour like lengthy commuting should always be contextualised as part of other dynamic factors in people's lives and forms part of wider life cycle trends.

Lengthy commuting stint durations

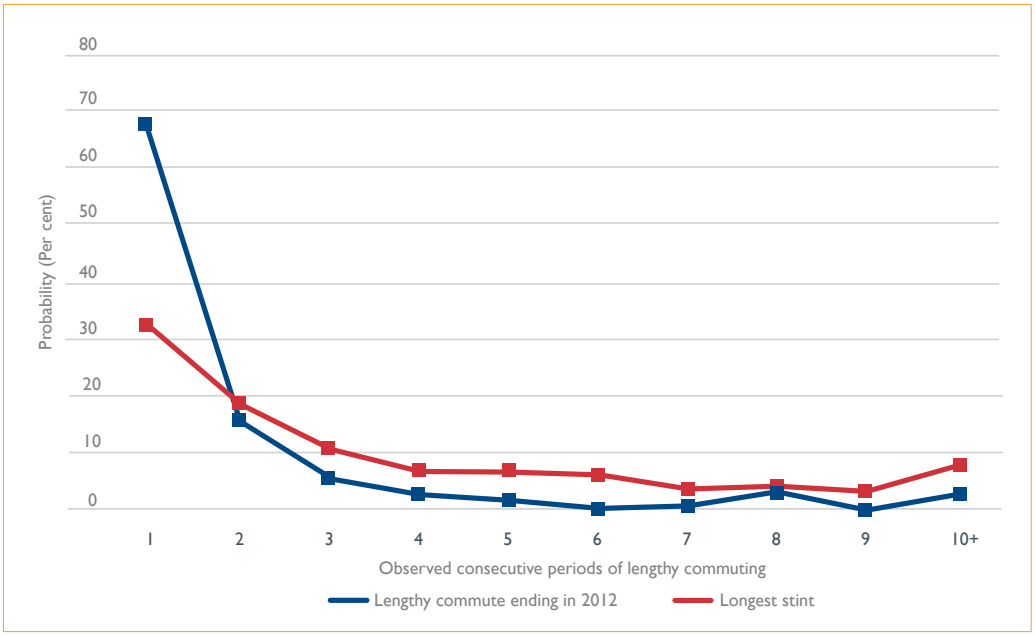
To estimate the distribution of lengthy commuting stint durations we have used data drawn from the HILDA survey and use a panel of persons who were identified as lengthy commuters at any time between 2002 and 2012, a panel of eleven years. This result in a panel that is unevenly censored[78] and where there can be no more than eleven observed periods. There are occasions where participants drop out of the sample, which can be accounted for using longitudinal weighting, as well as some question specific non-response, which cannot.

Our best estimate of the usual distribution of lengthy commutes is shown below in Figure 9.1 by the series 'Lengthy commute ending in 2012'. This series has been constructed of consecutive yearly observations by considering only those stints of lengthy commuting which ended in 2012 – that is to say, a person was a lengthy commuter in 2011 but not in 2012. Further, any person who was unable to be identified as a lengthy commuter in any period was eliminated from the panel, based on the assumption that such missing information was randomly distributed. This is intended to reduce the bias in the remaining weighted panel to a minimum. The remaining censoring occurs where an individual has a stint of 10 or more periods of lengthy commuting, which are included in an aggregate category. Although minimising the bias, this process reduces the number of observations to only 428, far too few for further analysis.

In order to investigate who is more likely to have a lengthy commute we have also constructed a series of each person's longest observed stint of lengthy commuting. Again any person who was unable to be identified as a lengthy commuter in any period was eliminated from the panel. However, rather than stints ending in 2012, this series includes the longest observed stint for each individual in the panel. This series is also shown in Figure 9.1, and contains 6396 observations of 1,998 persons. Although it is possible to have eleven observed periods in this series they have been combined with those who have ten periods in Figure 9.1 to make them comparable with the series Lengthy commute ending in 2012.

78 Strictly right censored, meaning that the length of the stint is not known for some commuters.

Figure 9.1 The persistence of lengthy commutes



Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne)..

Further, Figure 9.1 also shows that most people will not be observed commuting for more than 45 minutes or more per trip in more than one consecutive year. However a significant proportion of people, around 1 in 10, will be observed for five or more consecutive years. This implies that while for the vast majority of lengthy commuters (at least 92 per cent), lengthy commuting will be a temporary phenomenon, for many will be experienced for several years.

Characteristics associated with longer stints

In this section we investigate which characteristics are associated with a longer rather than a shorter stint. To do this we use the series for the longest observed lengthy commuting stint in order to have sufficient observations for a meaningful analysis.

A consequence of using the longest stint series is that there is relatively more censoring in the panel, or more specifically, uneven censoring. This makes the most common duration analysis techniques such as survival analysis problematic. Instead we use two relatively simple logistic regressions to predict the probability of being observed as a lengthy commuter, with a reference state of having ended a stint of lengthy commuting. The regression analysis essentially indicates the most significant predictors of having a longer stint of lengthy commuting.

The logistic regressions, presented in Table 9.1, model the probability of a period being in a given state. In this case the two states are:

1 = A period of lengthy commuting.

0 = The end period - The period after a stint of lengthy commuting (where the person is not a lengthy commuter).

The longer the stint, the more observed periods of lengthy commuting with a person's characteristics there will be relative to the same characteristics for the end period. Where there is censoring, no end period exists and so the results are biased towards false negatives. In the start regression, the characteristics used are those of the person at the beginning of their lengthy commuting stint, while in the end regression, the characteristics used are those of the person in their last observed period of lengthy commuting. Thus we see the effects of changes in characteristics during stints, but not the effects of changes in characteristic between being a lengthy commuter and not being a lengthy commuter, which are examined in Chapter 10. While this method tells us little about the absolute magnitude of the effects, it does indicate which characteristics are statistically significant and whether they are associated with longer (positive coefficient) or shorter (negative coefficient) lengthy commuting stints.

Some characteristics are statistically significant in both periods, while others are only significant in one period. Where the characteristics tend to change (such as the industry of employment), being significant in one period rather than another may reflect changes that occur during the lengthy commuting stint. Following the presentations of the models and their coefficients the discussion includes a brief exploration of where changes in characteristics during stints have influenced the regression results.

Table 9.1 shows that females have a lower probability than males of having a longer lengthy commuting stint. This is in line with the reduced probability of being observed as a lengthy commuter in a single time period seen in Chapter 6.

The older a person is when they begin their stint, the higher the probability of a longer stint. Aged squared is also statistically significant and negative, but the combination with age has no turning point inside the lifetime of person in the sample, suggesting that there is a diminishing marginal effect to age.

Being a home owner is statistically significant at the 90 per cent level of confidence as a characteristic at the starts of a stint and at the 95 level of confidence as a characteristic at the end of a stint. In both cases the positive coefficient indicates that being a home owner increases the chance of having a longer stint of lengthy commuting relative to a shorter stint.

Table 9.1 Estimating who among lengthy commuters is more likely to have longer stints of lengthy commuting, Australia, 2001– 2012

	Individual continued a lengthy commuting stint (Start characteristics)		Individual continued a lengthy commuting stint (End characteristics)	
Model information	Logistic			Logistic
Model type	regression			regression
Number of observations	6221			6112
Adjusted R-squared	4.9 per cent[a]			8.9 per cent[a]
Explanatory variables	**Parameter estimate**	**Significance level**	**Parameter estimate**	**Significance level**
Constant	0.2957		0.1639	
Female (Ref=male)	-0.2361	***	-0.0942	
Age	0.0401	**	-0.0006	
Age squared	-0.0005	**	0.0001	
Child(ren) resident in household (Ref=no children)	0.0750		-0.0602	
Foreign born (Ref=Australian born)	0.1114		0.0467	
Home owner (Ref=not home owner)	0.1270	*	0.1755	**
Highest educational qualification (Ref=Year 11 or below education)				
Bachelor degree or higher qualification	0.1687		0.0692	
Advanced diploma, diploma or certificate III/IV	0.0985		0.0582	
Year 12 education	0.0443		0.0376	
Gross personal financial year income[b] ($'000)	0.0003		0.0094	
Employed part-time (Ref=employed full-time)	-0.1540	*	0.0791	
Work schedule (Ref=regular daytime schedule)				
Evening shift	-0.2632		-0.4563	*
Night shift	-0.2094		-0.2143	
Rotating shift	0.1137		-0.3123	**
Irregular shift	-0.1744		-0.2393	*
Other schedule (including on-call and split-shift)	-0.2344		-0.1801	
Self-employed (Ref=employee)	0.0235		-0.1713	
Occupation (Ref=labourers)				
Managers	0.1529		-0.1159	
Professionals	0.0724		0.0482	
Technicians and trades workers	0.2408	*	0.2713	*
Community and personal service worker	0.0160		0.0824	
Clerical and administrative workers	0.1327		0.1833	
Sales workers	-0.0297		0.0165	
Machinery operators and drivers	-0.0733		-0.0434	

(continued)

	Individual continued a lengthy commuting stint (Start characteristics)		Individual continued a lengthy commuting stint (End characteristics)	
Explanatory variables	Parameter estimate	Significance level	Parameter estimate	Significance level
Industry (Ref=Retail trade)				
Agriculture, forestry and fishing	-0.2776		-0.2159	
Mining	0.2415		0.0285	
Manufacturing	0.0190		0.0627	
Electricity, gas, water and waste services	-0.0467		-0.3127	
Construction	-0.2126		-0.1477	
Wholesale trade	-0.2268		-0.3348	
Accommodation and food services	-0.0486		0.0537	
Transport, postal and warehousing	-0.1828		-0.1426	
Information media and telecommunications	0.3316		0.2647	
Financial and insurance services	0.2364		0.3258	*
Rental, hiring and real estate services	0.4312	*	-0.1381	
Professional, scientific and technical services	0.3664	**	0.0735	
Administrative and support services	-0.0115		0.0149	
Public administration and safety	0.2397		0.1564	
Education and training	0.0529		0.0025	
Health care and social assistance	-0.0882		-0.0191	
Arts and recreation services	-0.3647		-0.1789	
Other services	0.0214		0.0165	
City of residence (Ref=Sydney)				
Melbourne	-0.0956		-0.0254	
Brisbane	-0.1772		-0.0901	
Perth	-0.4179	***	-0.2982	*
Adelaide	-0.3193	**	-0.2002	
Rest of Australia	-0.5192		-0.3907	***
Reside in non-urban area[c] (Ref=urban)	0.0093		-0.0583	
Remoteness class of residence (Ref=Major cities)				
Inner regional	0.1256		0.2332	**
Outer regional	-0.1004		-0.0483	
Remote and very remote	-0.0087		0.0268	

Notes: Regression analysis is undertaken on a weighted basis. With the exception of the income variable, socio-economic variable specifications match those used earlier in this chapter. Wald tests used to test significance of logistic regression parameters. Ref=reference category for categorical variables.

* p<0.10 (i.e. 90 per cent confident the parameter estimate is significantly different from zero);
** p<0.05 (i.e. 95 per cent confident the parameter estimate is significantly different from zero);
*** p<0.01 (i.e. 99 per cent confident the parameter estimate is significantly different from zero).

a. Nagelkerke's pseudo R-Squared is presented for the logistic regression model.

b. The imputed version of the income measure was used in the regression, so that the maximum number of observations would be retained.

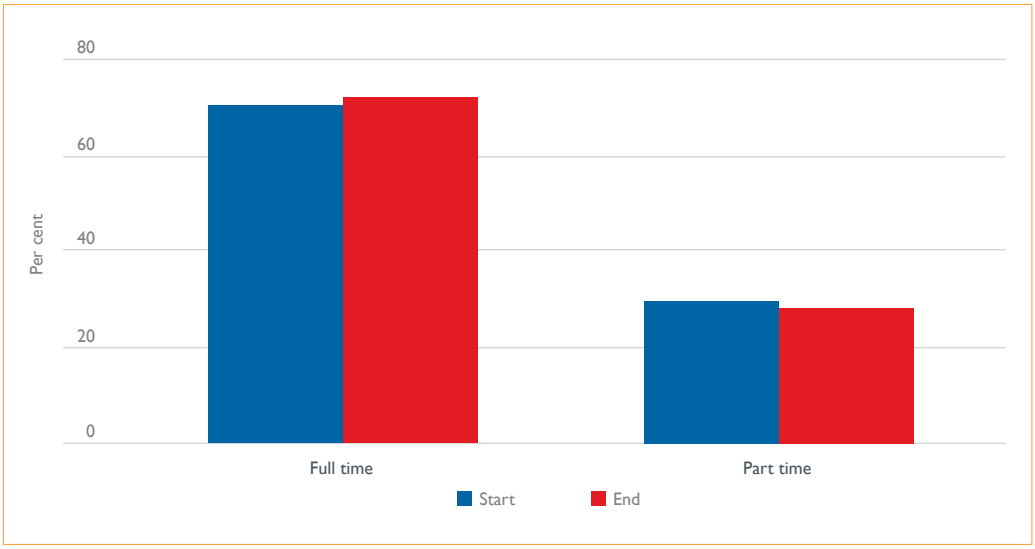
c. Urban refers to the ABS' section of state categories 'major urban' and 'other urban' which capture urban centres with populations of 1000 or more. Non-urban refers to the remaining section of state categories (i.e. bounded localities and rural balance).

Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The results indicate that those with a Bachelor degree or higher qualification are more likely to have longer commuting stints relative to other qualification levels. Similarly, at either the start or end of a stint, those who are employed part time are more likely to have a short stint relative to those who are employed full time and those who are employed as Technicians and trades workers are more likely to have longer commuting stints relative to those employed in other occupations.

In terms of changing characteristics, the results indicate that being employed part time is more significant at the beginning of a stint compared with the end of a stint. During lengthy commuting stints a significant proportion of those who are initially employed part time transition to full time work, as shown in Figure 9.2 below. This helps explain why being employed part time at the end of the stint is not as statistically significant, if only because the sample size is smaller as there are fewer people employed part time.

Figure 9.2 Comparison of the proportion of lengthy commuters by full time and part time at the start and at the end stints, Australia



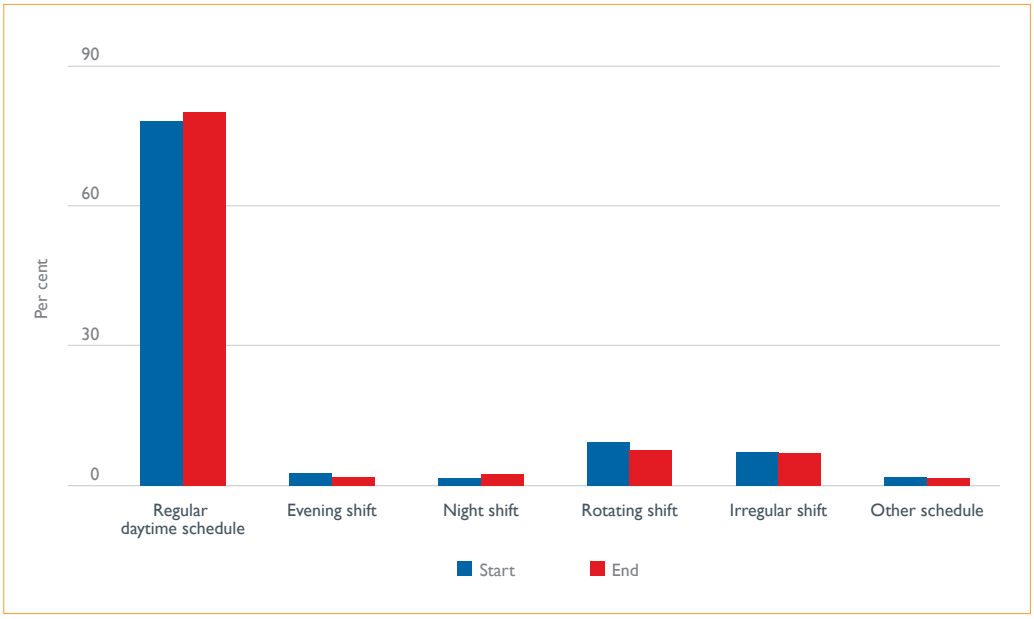
Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The work schedule a person has at the end of their lengthy commuting stint appears to be an important factor in the duration of their stint. Relative to other shift types, being on the Evening shift, a Rotating shift (at a 95 per cent confidence level) or an Irregular shift (at a 90 per cent confidence level) decrease the chances of having a longer lengthy commute stint. Over the duration of the lengthy commuting stints there is a shift from each of these schedules and an overall trend in favour of a regular daytime schedule, as shown in Figure 9.3.

In terms of industries, those who initially work in Rental, hiring and real estate services (at a 90 per cent confidence level) or Professional, scientific and technical services (at a 95 per cent confidence level) are more likely to have longer stints rather than shorter stints. There is considerable change away from both of these industries over the duration of lengthy commuting

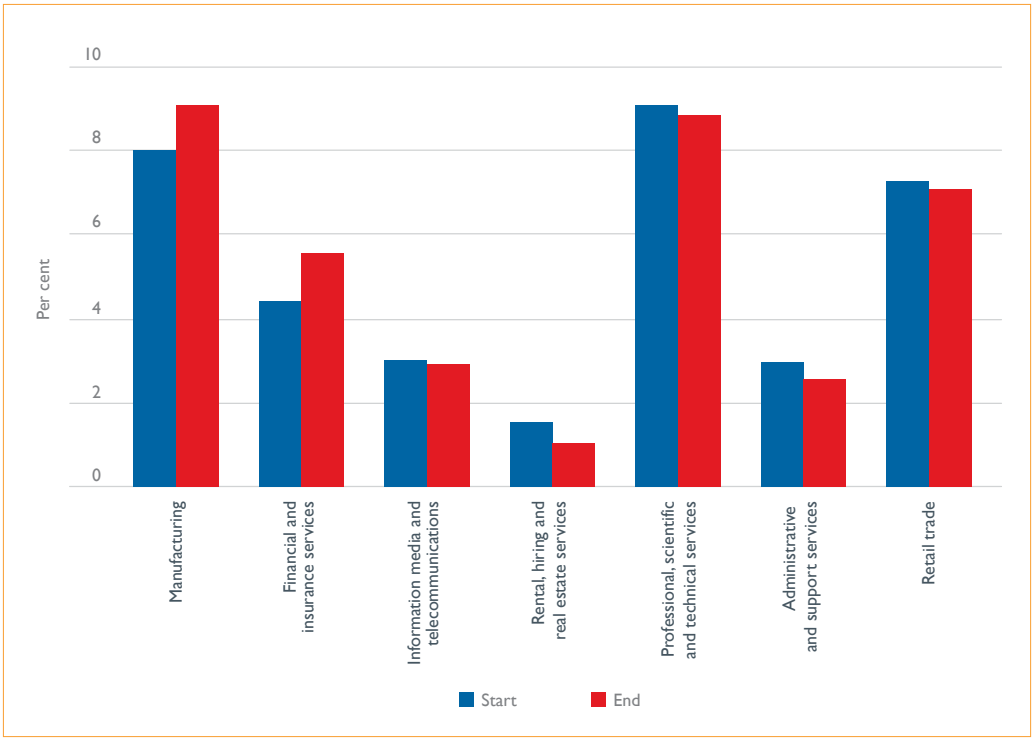
stints. Similarly, being employed in the Financial and insurance services and Information media and telecommunications industries at the end of a lengthy commuting stint is associated with a higher probability of a longer stint of lengthy commuting. The shifts in the proportion of employed in these industries and other selected industries can be seen in Figure 9.4.

Figure 9.3 Comparison of the proportion of lengthy commuters by work schedule at the start and at the end stints, Australia



Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

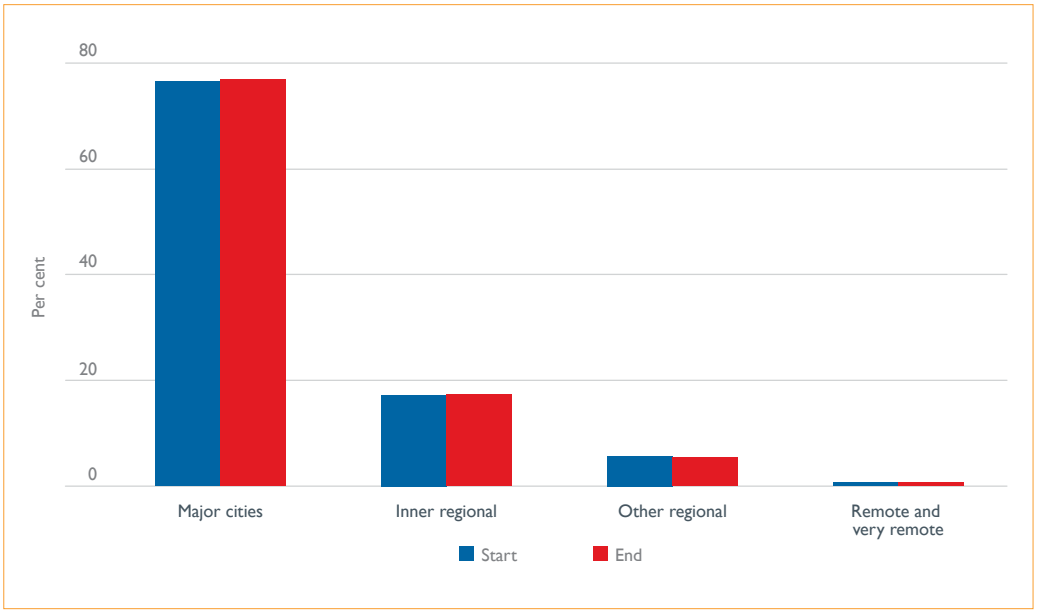
Figure 9.4 Comparison of the proportion of lengthy commuters by selected industries at the start and at the end stints, Australia



Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne)..

Over the duration of stints there is a tendency to move from Outer regional, Remote and Very remote regions and a tendency to move to Inner regional areas and Major cities. Living in Inner regional Australia at the end of a stint appears to increase (at the 90 per cent significance level) the likelihood that the stint will be longer, relative to living in other areas. These changes are shown in Figure 9.5 below.

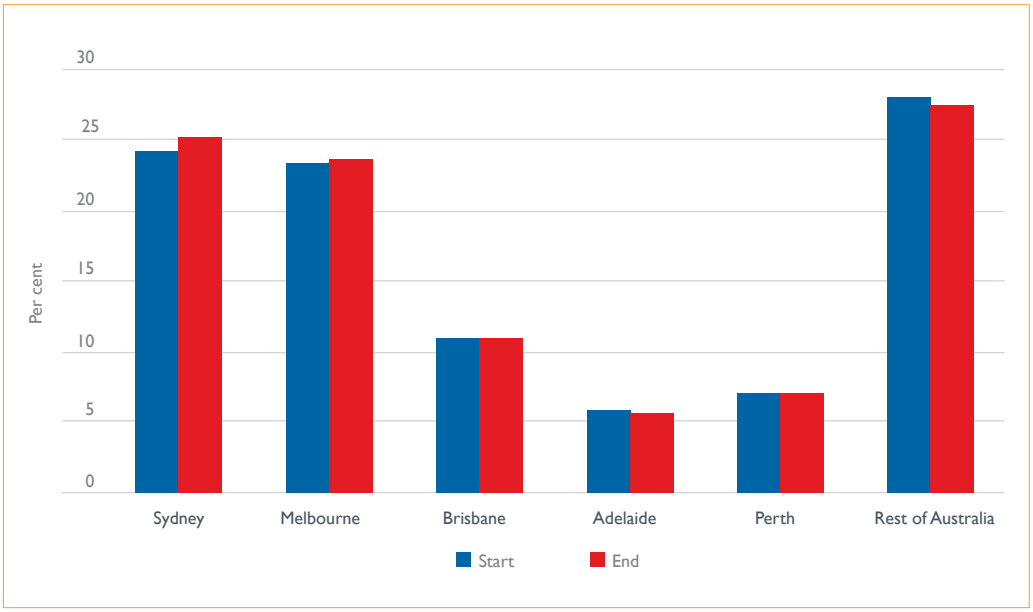
Figure 9.5 Comparison of the proportion of lengthy commuters by remoteness class of residence at the start and at the end stints, Australia



Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Living in Perth, Adelaide, or in the Rest of Australia at either the start or end of a stint are associated with lower chances of having a longer stint relative to Sydney, Melbourne or Brisbane. Over the duration of a stint people tended to move to Sydney or Melbourne and away from Adelaide and the Rest of Australia. Figure 9.6 below illustrate these trends.

Figure 9.6 Comparison of the proportion of lengthy commuters by city of residence at the start and at the end stints, Australia



Source: BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). BITRE analysis of HILDA Survey, Wave 2 (2002) to Wave 12 (2012). The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Conclusion

This chapter has investigated whether lengthy commuting is a permanent or temporary state, the typical duration of temporary stints of lengthy commuting and the factors which influence this duration. In the first section we have shown that lengthy commuting is a temporary phenomenon and that most stints of lengthy commuting are less than two years in length. However, a small proportion of people do undertake lengthy commutes for several consecutive years.

As we have seen in the previous section lengthy commuting needs to be contextualised in the life cycle of an individual, as during their stint of lengthy commuting many things in their life will change. People's lives are inherently dynamic and a static picture of lengthy commuting does not allow us to fully understand its place in people's lives. Many of the characteristics that are associated with longer stints of lengthy commuting – such as living in larger cities, working in certain industries or occupations – are characteristics that frequently change, even during a lengthy commuting stint. Similarly many factors which are associated with shorter stints – part time or full time employment and work schedule are also dynamic even during a stint of lengthy commuting. The short duration of most lengthy commuting stints and people's constant change over their working lives indicates that there is a need for a more in-depth investigation into the process of adaption away from lengthy commuting, which is the subject of the following chapter.

CHAPTER 10
Adaptation

Key points

- This chapter investigates the changes that occur with the transition from lengthy commuting and attempts to identify any patterns of adaption.
- Leaving employment appears to be most related to lifecycle factors or involuntary changes and does not appear to be used as a way of adapting to lengthy commuting times.
- There is strong evidence to suggest that changing jobs or changing residence are ways in which Australians seek to reduce or eliminate lengthy commutes. While lengthy commuting is not associated with an increased probability of changing jobs, those who are lengthy commuters and do change jobs, tend to choose jobs which reduce their commuting time. Similarly, lengthy commuters do not appear more likely to change residence. However, those that do, tend to have lower commuting time, suggesting that the nature of the move is different and that moving house could be a way in which Australians reduce their commuting times.
- There is no evidence to suggest that stopping lengthy commuting on average leads to a reduced income, although it does appear to reduce future income growth.
- There is some evidence to suggest that those who stopped lengthy commuting but remained employed work more hours than they would if they were lengthy commuters.
- Lengthy commuters do not appear more likely to change residences, however when they do they tend to have lower commuting times. This suggests that changing residence may also be a way individuals reduce their commuting times.

Introduction

This chapter analyses the transition from being a lengthy commuter to not being a lengthy commuter. The objective is to investigate the changes that occur with this transition and to identify any patterns of adaption whereby individuals make changes to reduce or eliminate lengthy commutes.

Adaption is most often used in the literature to describe psychological or behavioural changes which a person may make in order to continue lengthy commuting but with fewer negative consequences. For example, we may observe individuals changing commuting modes, vehicles, or commuting schedule to cope with traffic congestion to reduce psychological stress. In this sense, the adaptations are a function of the available coping resources (Novaco and

Gonzales 2009). According to this view, drivers and transport users adjust to conditions in the transportation environment in order to enhance their well-being. This has been described in terms of a hierarchy where 'adaptation occurs at different levels of analysis, ranging from "high level" trip and travel mode decisions to "low level" vehicle control behaviors that maintain safety margins' (ibid. p.36).

The focus of this paper is at the higher level of the hierarchy, on decisions such as changing job or changing residence which reduce commuting time below a fixed threshold. The threshold we use is consistent with the definition of a lengthy commute used elsewhere in this report and is a forty five minute single trip to or from the place of work. We investigate the changes that take place between periods where we observe an individual's commuting time above this threshold and where we observe that their commuting time is below this threshold.

Concept and time periods

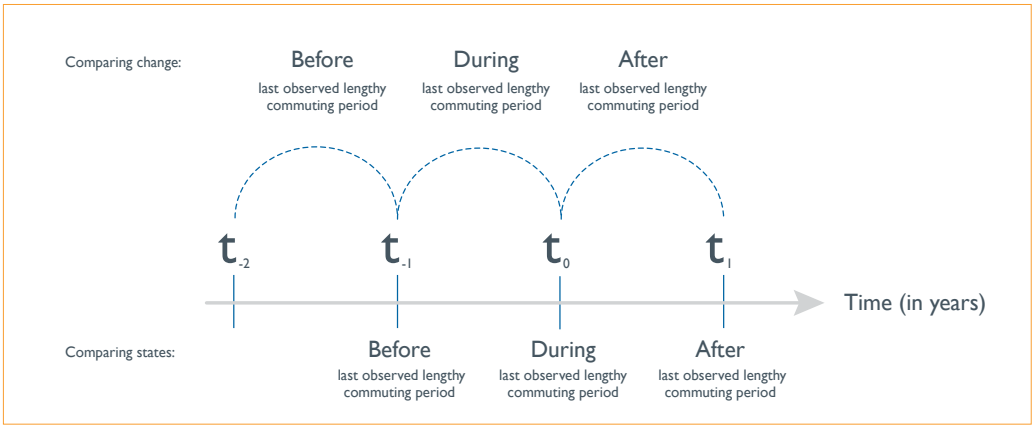
One of the complicating factors in investigating the transition from lengthy commuting is the fact that in a lifetime there can be many transitions in and out of lengthy commuting as it is defined here. Not only is it possible to have multiple stints during a lifetime, it is also possible, because of the threshold of forty five minutes set in this report, that a person whose commute time is close to the threshold may naturally vary above and below the threshold in the normal course of events without making any changes to their behaviour. For this reason, in order to best capture a person's most important transition this chapter focuses on the transition from an individual's last observed period of lengthy commuting. This is based on the assumption that of all the observed transitions in our panel, the last observed is most likely to reflect a permanent transition away from lengthy commuting.

The central challenge in understanding a transition among such a select population subgroup is to establish an appropriate benchmark. Lengthy commuters, and specifically those in their last observed period of lengthy commuting, are significantly different from the general population. This makes establishing a valid reference necessary.

In order to establish a reference population we use the same pool of individuals in prior time periods. This restricts the sample to those whose last observed period of lengthy commuting was observed in HILDA waves 3 to 11 as, to capture transitions, the sample only includes individuals who were also interviewed in the period before and the period after their last observed lengthy commuting period.

The central analysis of this chapter uses a sample of 1418 individuals from the HILDA survey whose last observed lengthy commuting periods was between wave 3 (around 2003) and wave 11 (around 2011). Where appropriate these are compared with a benchmark for the entire relevant population or to the entire panel, in which case details of the comparison group used will be provided in a footnote. The time frames and references used for this analysis are illustrated in Figure 10.1.

Figure 10.1 Conceptual diagram of time periods used



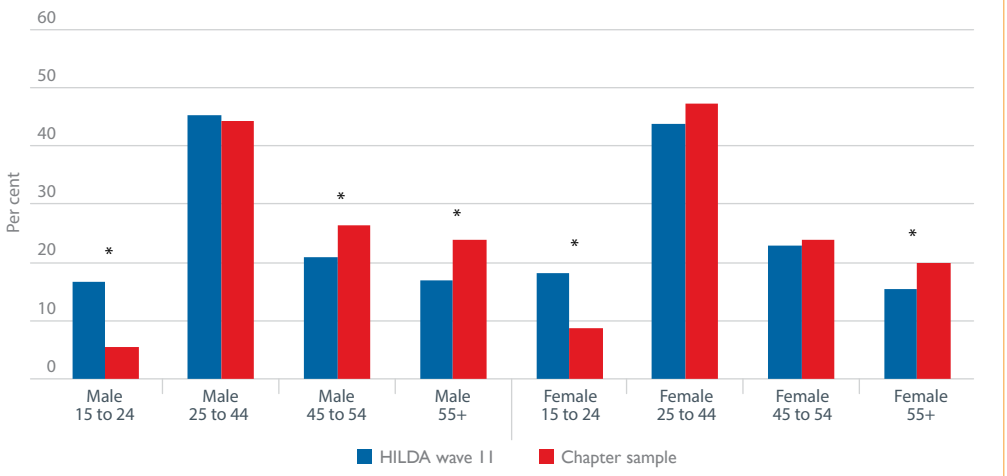
To benchmark change, for example between being a lengthy commuter and not being a lengthy commuter, we compare to the change from earlier periods. To benchmark states, for example to the period after the last observed lengthy commuting period, we use the periods before and/or during the last observed period of lengthy commuting.

Key characteristics of the sample

As there are significant differences between the chapter sample and employed persons more broadly (as there are between lengthy commuters and non-lengthy commuters), the key characteristics of the chapter sample is outlined in the following section. These focus on characteristics shown in the preceding chapters to be related to lengthy commuting (specifically Chapters 6 and 8). This allows for the later analysis and results to be viewed in the context of the specific group of lengthy commuters represented by the chapter sample.

The age distribution of the chapter sample is somewhat different to the general population of employed persons, approximated here by employed persons in wave 11 of the HILDA survey. As shown in Figure 10.2, there is a concentration in the ages in the centre of the distribution. The difference in the age profile is driven by there being significantly fewer people in the chapter sample who are in the 15 to 24 age range than in the population of employed persons in wave 11.

Figure 10.2 Age profile by sex of chapter sample at last observed period of lengthy commuting[a] and HILDA wave 11[b], employed persons[79]



[a] Unless otherwise specified all estimates provided have been weighted using the responding person balanced panel longitudinal weights included in HILDA release wave 12.

[b] The responding person cross sectional weights for wave 11 (included in wave 12) have been used to weight the wave 11 series.

* Statistically significant difference between series at 95 per cent confidence level.

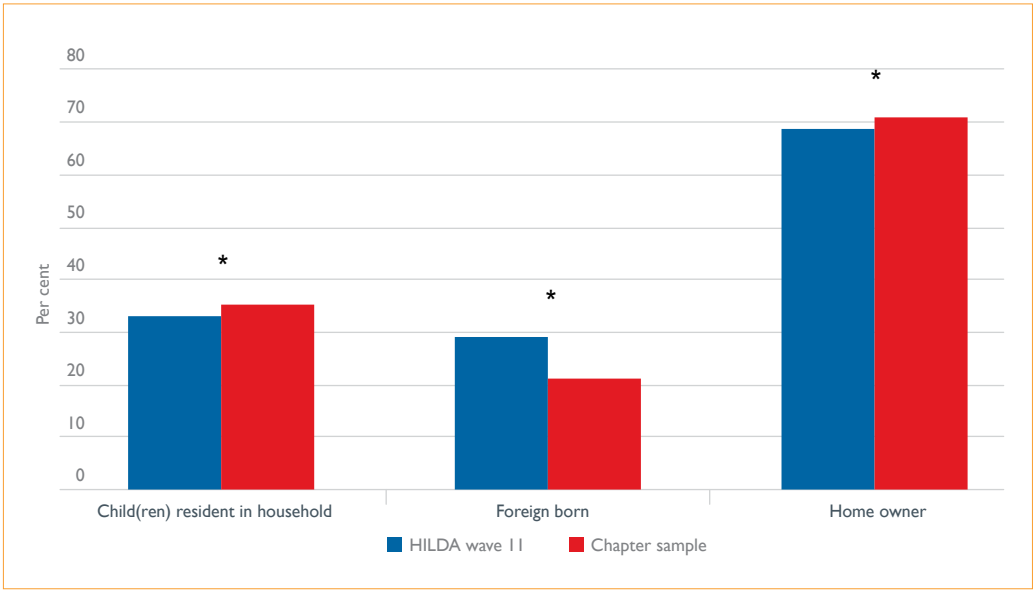
Source: BITRE analysis of HILDA survey waves 3 to 11 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Despite the difference in age profile, there is no significant difference in the education levels of the chapter sample and the employed population more generally, again approximated by HILDA wave 11 employed persons. There are, however, significant differences in other key characteristics known to be important in lengthy commuting. There are significantly more households with resident children in the chapter sample, as would be expected given the differences in the age profile. Fewer were born overseas, and, as might be expected given the lower proportion of 15 to 24 year olds, a higher proportion of home owners. These comparisons are shown below in Figure 10.3.

These differences provide context to the following analysis which focuses on the differences in and between time periods for the same group of lengthy commuters rather than to other groups such as employed persons or non-lengthy commuters.

79 All statistical tests in this chapter have been carried out at the 95 per cent confidence level. Wald confidence limits have been used for proportions between 25 per cent and 75 per cent. For proportions below 25 per cent or above 75 per cent Clopper-Pearson (exact) confidence limits have been used.

Figure 10.3 Key characteristics of chapter sample at last observed period of lengthy commuting and HILDA wave 11,[80] employed persons



* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 3 to 11 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Analysis

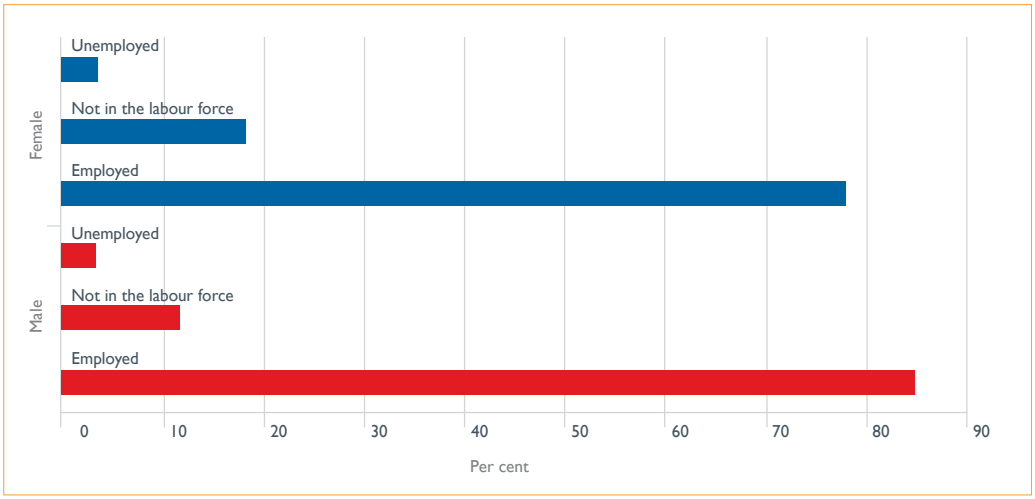
The following section investigates the transition from lengthy commuting across two domains and a number of subdomains. We first discuss employment, beginning with an overview of the employment status in the year after the last observed period of lengthy commuting. This is followed by a short discussion of the factors associated with ending a lengthy commute and leaving employment. We then proceed to a longer discussion on the factors associated with ending a lengthy commute but continuing in employment. This includes an investigation on changes in part time and full time status, income and hours. The final section investigates the relationship between changing residence and ending a lengthy commute.

Employment

The vast majority of both men and women continue in employment after their last observed lengthy commuting period, although the proportion of women is around five per cent lower than for men. Correspondingly, significantly more women leave the labour force than do men (10 per cent compared with 6 per cent respectively), while around the same proportion of either sex become unemployed (around 3.5 per cent). These employment flows are shown in Figure 10.4.

80 The cross sectional weights for wave 11 (included in wave 12) have been used to weight the wave 11 series

Figure 10.4 Employment status after last observed period of lengthy commuting



Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

The distinction between the categories of 'Not in the labour force' and 'Unemployed' presented above rests on the strict definition of unemployed.[81] As the flows to employment from either state are large and depend on the sub-group of the population in question (Thomson and Kapuscinski 2014), it would be misleading to assume that all those not in the labour force either do not want work or are not seeking work. For this reason, although these distinctions are presented above the following analysis will not make a distinction between 'Not in the labour force' and 'Unemployed', and will instead combine the categories into a single state of 'not employed'.

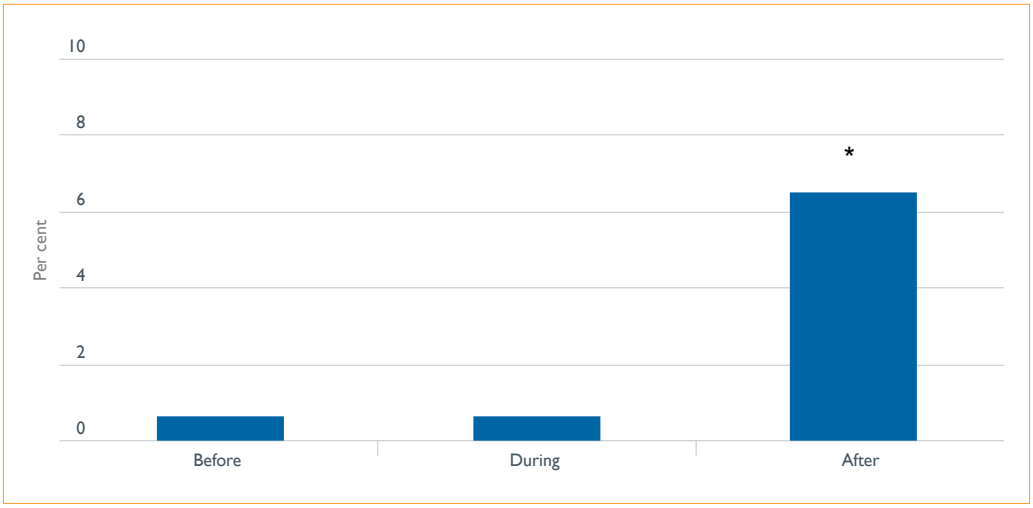
Ending lengthy commuting due to leaving employment

As seen above, a large proportion of individuals were not employed at the interview following their last observed period of lengthy commuting. There are many possible factors for this change, however they can be broadly grouped into adaption (leaving employment in order to stop lengthy commuting) or other unrelated changes. Of the factors investigated, none directly pointed to leaving employment as a form of adaption. Instead involuntary non-employment and life cycle factors appear most important in transitions from lengthy commuting out of employment.

Retiring from the workforce is one of the significant reasons people stop lengthy commuting. A small proportion of people did retire in the year leading up to being observed as a lengthy commuter, and around the same small proportion retired the year before. In both cases, this small proportion returned to employment as lengthy commuters. The proportion who retired in the year leading up to the interview in each period is shown below in Figure 10.5.

81 For the strict definitions used in the HILDA survey, see ABS Labour Statistics: Concepts, Sources and Methods, 2001 (ABS 2001).

Figure 10.5 Life event in the past year: Retired from workforce before, during or after last observed period of lengthy commuting



* Statistically significant difference between the after series and either the before or during series.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

We can see from the figure above that the largest change occurred in the period after the last observed lengthy commuting period, where around 6 per cent of people retired in the year leading up to their interview. This is unsurprising, as the proportion who return to work after retiring is generally small (in this case around 0.7 per cent, as shown in the before and during periods in Figure 10.5), so by definition a lengthy commuter who retires is more likely to do so in the last observed period. It may in fact be more surprising that the proportion is only around 6 per cent; however this reflects the age profile of the chapter sample, where there are proportionally fewer people of retirement age than in the general population.

There remains the possibility that retirement is brought forward by lengthy commuting. The statistically significant difference between the average age of retirement in the chapter sample and employed persons more generally, as approximated by those who retired in waves 2 to 12 of the HILDA survey,[82] supports this proposition. The average age of retirement in the year after the last observed period of lengthy commuting is around 59 years, while the average age in waves 3 to 11 of the HILDA survey is around 61 years. This suggests that there may be a relationship between lengthy commuting and early retirement worth further investigation.

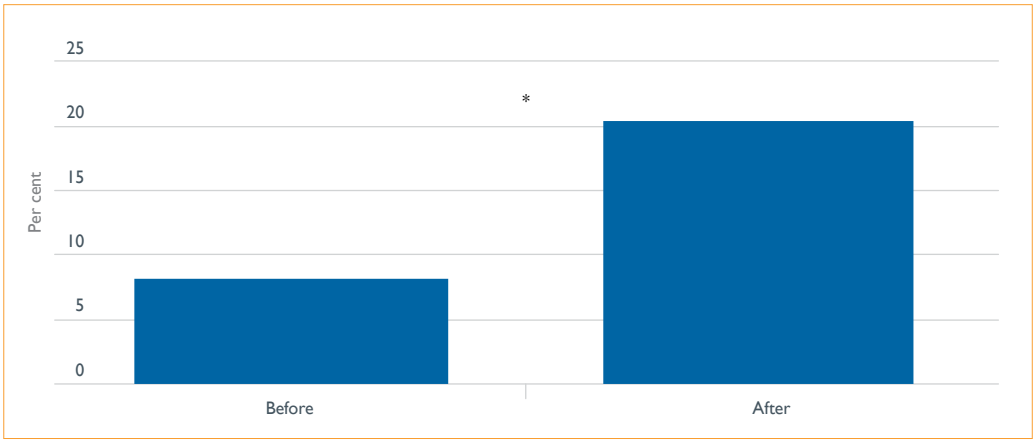
Being dismissed or made redundant is also associated with stopping lengthy commuting. In the year after the last observed lengthy commuting period a high proportion (around 20 per cent) of those who left employment responded that they had been dismissed in the year before they were interviewed.[83] This was not significant for those who remained employed in both periods. As shown in figure 10.6 below this contrasts with around 8 per cent in the year before the last

82 The responding person cross sectional weights for each wave included in the HILDA wave 12 release have been used in this series.

83 As noted above, most people who were dismissed or made redundant and who were not employed did not meet the definitions of being unemployed.

observed lengthy commuting period (all persons were employed in the last observed lengthy commuting period). While the difference is significant for the comparison within the same group across time periods, it is not significantly different from the frequency found in waves 3 to 11 of the HILDA survey[84] among those employed at the time of the previous interview but not employed at the time of interview in which the question is asked. While it is difficult to see involuntary separation from employment as a form of adaption the high proportion of respondents who reported being dismissed or made redundant in the year after a lengthy commuting stint suggests some value in further investigation into lengthy commuting and involuntary separation from employment more generally.

Figure 10.6 Not employed persons dismissed or made redundant before or after last observed period of lengthy commuting



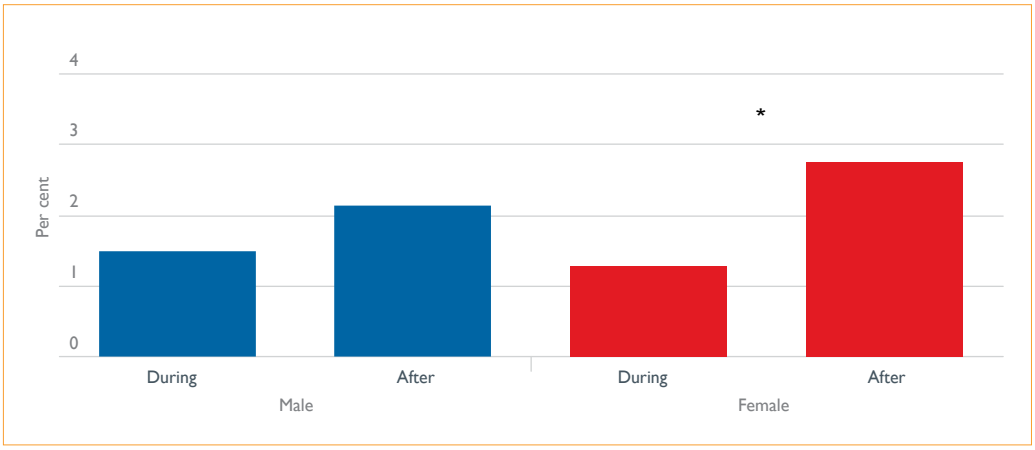
* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Regardless of whether they are or are not lengthy commuters one of the major reasons women leave employment is to raise young children. In line with this, in the year before the last observed lengthy commuting period a significantly higher proportion of women reported having given birth to or adopted a new child in the year prior to being interviewed. As shown in Figure 10.7 below, the difference was not statistically significant for men.

84 Responses have been weighted using the responding persons cross sectional weights included in HILDA wave 12, for each respective wave from wave 3 to wave 11.

Figure 10.7 Births/Adoption of new child, before, during or after last observed period of lengthy commuting by sex



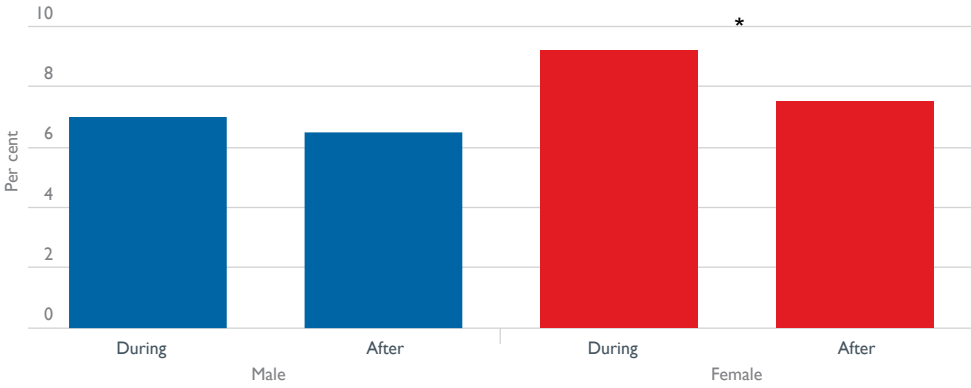
* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

In terms of health, there were no significant differences in reporting a serious injury to self in the year leading up to being interviewed in any period. For women there was a significant difference for reporting a serious injury/illness to family member before or after last observed period of lengthy commuting in the year prior to being interviewed, however this is negatively associated with stopping lengthy commuting. Women were more likely to report a serious injury/illness to family member than men before and during the last observed lengthy commuting period, however both have similar rates of reporting after. These differences are illustrated below in Figure 10.8.

Overall, with the exception of the lower average retirement age there is little evidence to support leaving employment as response to the negative effects of lengthy commuting. The strong associations relate more to life cycle or involuntary changes. Having said this, as in the case of retirement, the earlier average retirement age after the last observed lengthy commuting period warrants further investigation.

Figure 10.8 Serious injury/illness to family member before or after last observed period of lengthy commuting by sex



* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Ending a lengthy commute but continuing in employment

Intuitively, we would expect more adaption among those who stopped lengthy commuting but were employed in the following period. This could be through changing workplace or changing residence. The limited data on place of work and place of residence in the unconfidentialised HILDA data makes direct observation of this type of adaption difficult. What we can most easily observe are flows between jobs and residences in terms of volume of change.

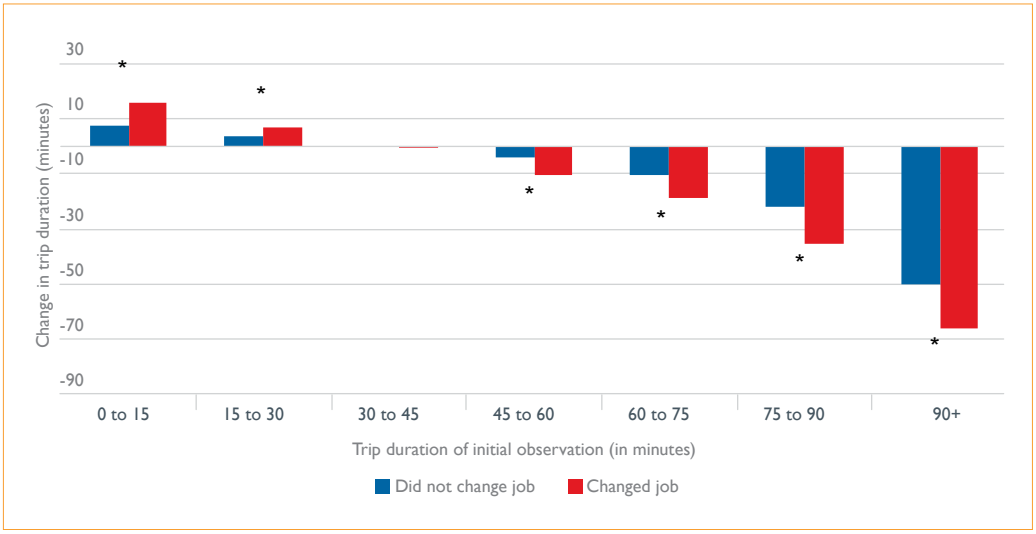
The volume of change we observe does not suggest that changing job is used to reduce lengthy commuting. Among those employed in the period after the last observed lengthy commuting period there were not significant differences in the proportion who reported either changing jobs or changing occupations in the year before being interviewed. Overall around one in five individuals changed job in either period, which highlights how dynamic the population is but does not suggest that individuals changed jobs more often to avoid lengthy commutes.

The quality of the job changes does differ, although this can easily be missed as average commuting times have increased over the duration of the HILDA study and *on average* commuting time *increases* after a change in job. Across the entire panel, from 2002 to 2012 the average yearly change in commuting time for individuals who did not report changing jobs in-between interviews was an increase of around 25 seconds per trip. For those who reported changing jobs in-between interviews the average change in commuting time was an increase of around 70 seconds per trip.[85]

85 Based on paired tests of the change trip duration between yeas of commuters in waves 2 to 12 of the HILDA survey. Responses have been weighted using the responding person balanced panel longitudinal weights included in the HILDA wave 12 release.

This average change, which is fairly small in absolute terms (although not zero), is the result of commuters tending to converge from both shorter commutes and longer commutes to commutes of around 30 to 45 minutes. This behaviour, consistent with the idea of a travel time budget (see Chapter 1, p.16), can clearly be seen if we categorise the panel according to the trip duration in the initial observation. This is shown below in Figure 10.9.

Figure 10.9 Change in trip duration waves 2 to 12 by duration in initial observation and whether changed job since last interview



* Statistically significant difference between series at 95 per cent confidence level.

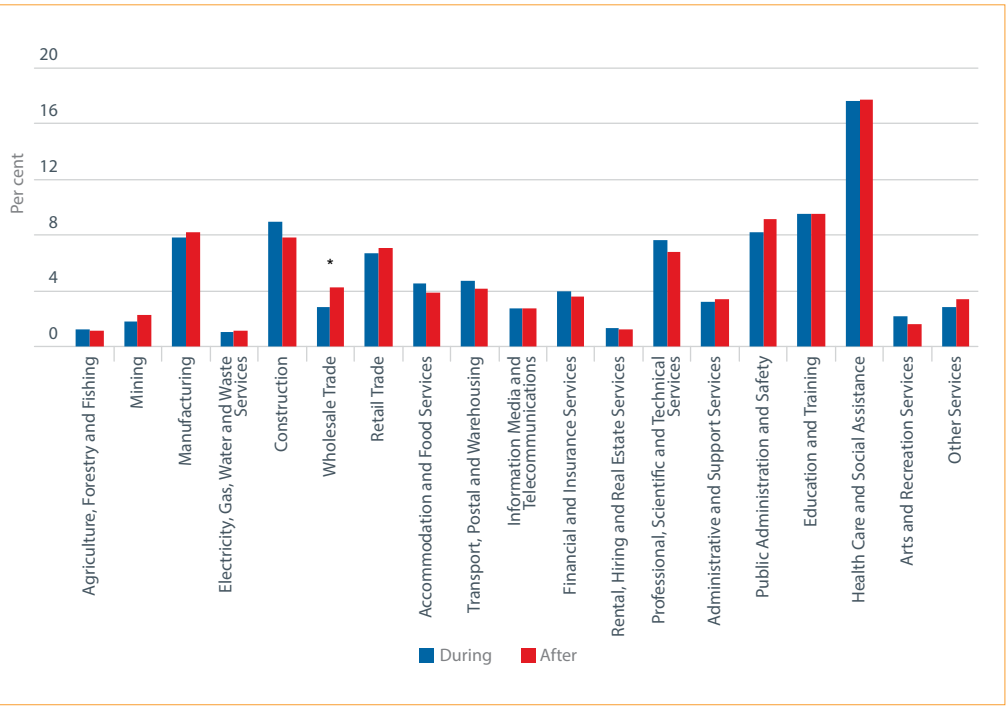
Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Regardless of whether the individual changed jobs those with initial commuting trip of less than 30 minutes tended to increase their commuting time, while those with greater than 45 minutes tended to decrease their commuting time. There was no statistically significant change for those who had an initial commuting trip of between 30 and 45 minutes. This convergence towards the 30 to 45 minute category suggest a travel time budget or of around an hour, in line with Marcetti's constant.

This pattern is amplified for those who changed jobs. Those who had an initial commuting trip of less than 30 minutes and changed jobs tended to increase their commuting time more than the respective group who did not change jobs. Similarly those with commutes of 45 minutes or more tended to decrease their commuting time more if they changed job compared with not changing job. This strongly suggests that the quality of the job changes for those who commute for 45 minutes or more are associated with lower commuting times and that changing jobs may be a way individuals avoid lengthy commutes. This raises the question of whether this qualitative change in the nature of the job corresponds with other qualitative changes, including as industry, occupation, part time full time status, income and hours.

Beginning with industry, there is little evidence that the reduction in commuting time corresponds with a change in industry of employment. The very similar distributions of employment by industry at the last observed lengthy commute and the period after are shown below in Figure 10.10. The only significant difference is that slightly more are employed in the wholesale trade industry after the last observed lengthy commuting period.

Figure 10.10 Distribution of industry of employment during and after last observed period of lengthy commuting



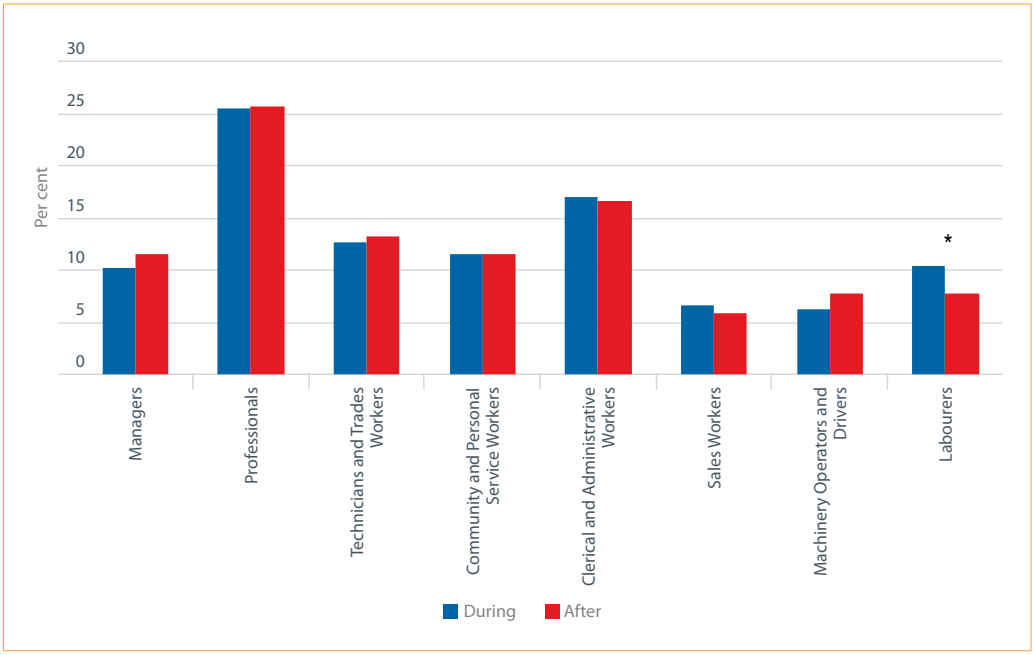
* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

As with industry, the distribution of occupations is very similar, with the only significant difference being a decrease in the proportion who were employed as labourers, as can be seen below in Figure 10.11.

The subsample of individuals who changed jobs was too small and the variation in responses too high to draw meaningful conclusions about changes in working arrangements or reasons for changing jobs.

Figure 10.11 Distribution of occupation of employment during and after last observed period of lengthy commuting



* Statistically significant difference between series at 95 per cent confidence level.

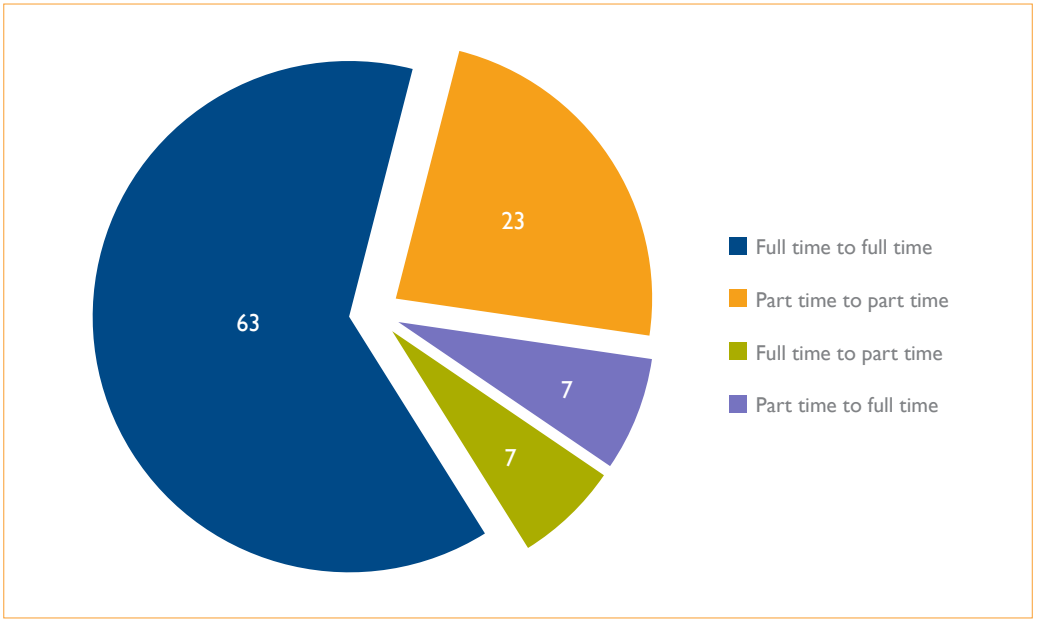
Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

Part time and full time employment status

Related to the 'churn' we see in the proportion of individuals who change jobs there is considerable change in full time/part time status between any two periods. Again, there is no significant difference in the volume of change into or between part time and full time status between any of the periods examined in this chapter. However, there are some significant differences in income and hours worked for some flows into and between full time/part time status that will be discussed further below.

To provide context to this discussion, Figure 10.12 below shows proportional flows of people employed in both periods between and into full time and part time employment.

Figure 10.12 Change in full time/ part time status during and after the last observed lengthy commuting period, per cent



Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

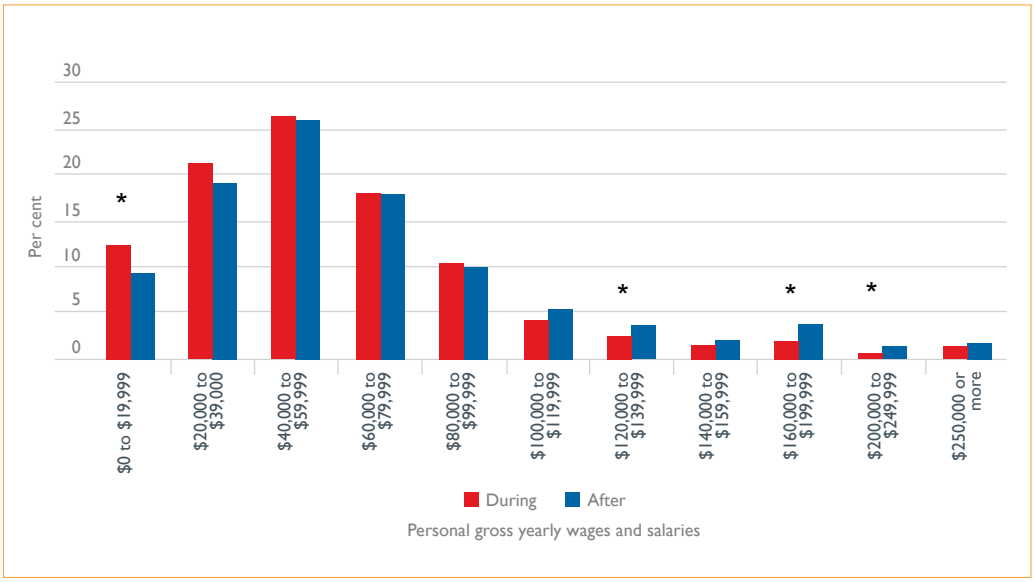
While there are no significant differences in the flows between states there are two significant differences in the reasons for working part time hours rather than full time hours between the last observed lengthy commuting period and the period after. Only around 8 per cent in the last observed lengthy commuting period responded that they prefer the job and part time hours are a requirement of the job, while around 14 per cent responded this way in the period after. Interestingly, more responded that they work part time hours to care for a disabled or elderly relative in the last observed lengthy commuting period than in the flowing period.

Income

This section builds on the analysis in Chapters 6 and 8 which touched on the relationship between lengthy commuting and income. In terms of lengthy commuters observed at a given point, lengthy commuters did earn more although controlling for all other factors income did not appear significant (Chapter 6). Here we investigate whether income is reduced by ending lengthy commuting. This would provide some evidence that individuals would accept a lower income in order not to undertake a lengthy commute. However this section is able to provide another perspective on this relationship. Lengthy commuting may be related to expected future income rather than current actual income, in which case the effect would not be observable in the analysis carried out in the preceding chapters. Here we can observe the direct change in income between ending a lengthy commuting stint and the following period of employment.

The real income distribution for those with a positive income during the last observed lengthy commuting period and the period after are very similar. Incomes were higher in real terms in the period after than in the last observed lengthy commuting period, as can be seen by the shift to the right in Figure 10.13. This suggests that people do not take a pay cut to end lengthy commuting.

Figure 10.13 Income distribution during and after last observed lengthy commute period, persons reporting a positive income[86]



* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

While it does not appear that individuals ending a lengthy commute take a pay cut, there is evidence of an effect on real annual income growth. For workers who were employed full time in both periods the average difference in real annual income growth was around 5 percentage points higher[87] in the year up to the last observed lengthy commute period compared with the year up to the observation after the last observed lengthy commute period.

Labour market conditions changed significantly between 2002 and 2012 in a way that might cause later years on average to have lower income growth than earlier years. However the observations cover the entire period and the two measurements are only one year apart, making it unlikely to be a reflection of changing labour market conditions.

86 Real income show in 2012 dollars.
87 Paired test on the difference in the change in income for each individual.

In terms of other financial effects, there was no significant difference in the proportion of people who reported a major improvement in their financial situation (for example winning the lottery or receiving an inheritance) in the previous year in either the last observed lengthy commuting period or the period after. Twice as many people responded that there had been a significant worsening in their finances (for example becoming bankrupt) in the previous year in the period after the last observed lengthy commuting period (3 per cent to 6 per cent). This is not significant when considering people who were employed in both periods, suggesting that this may be due to a loss of employment more generally rather than a specific effect of stopping lengthy commuting.

There is no evidence here to suggest individuals accept a lower income in order not to undertake a lengthy commute. However there is some evidence of differences in the rates of income growth between the last observed period of lengthy commuting and the following period which may suggest that lengthy commuting is motivated by expected future income rather than actual current income.

Hours

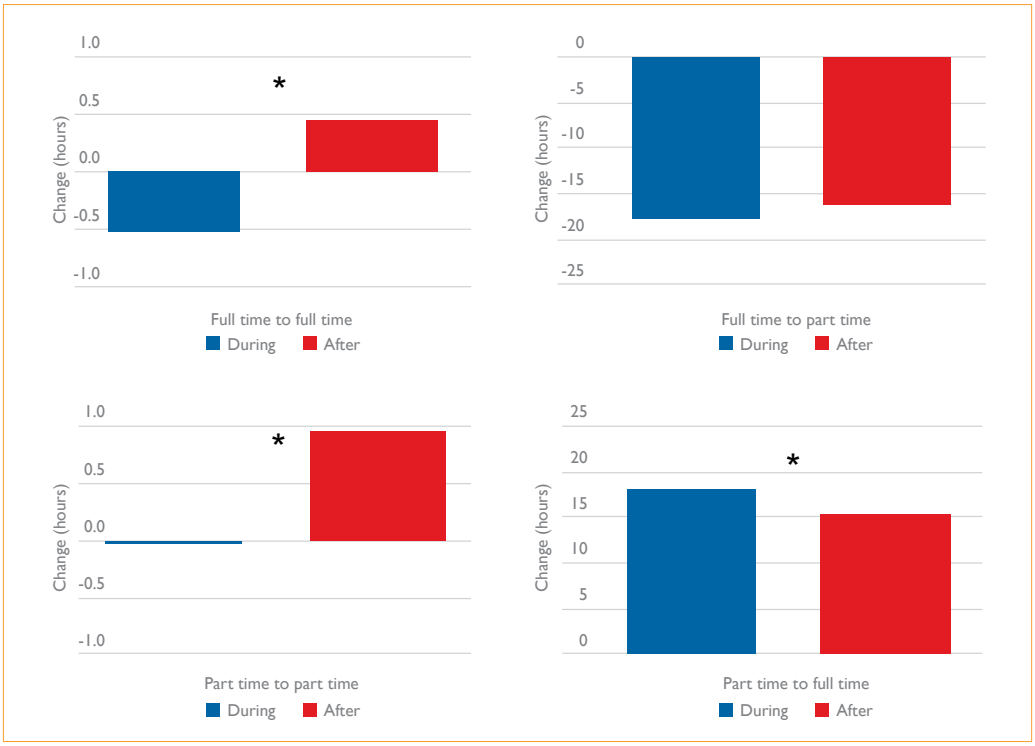
Ending lengthy commuting has a relationship to hours worked, although that relationship does not suggest that changing the volume of hours is a way of avoiding a lengthy commute. There is some limited evidence to suggest changing work schedule is associated with the end of the last observed lengthy commuting period.

For those who worked in both periods, changes in working hours between the last observed lengthy commuting period and the period after are most easily categorised depending on the transitions in full time part time status. These changes can be seen below in Figure 10.14.

Individuals who did not change part time/full time status between the last observed lengthy commuting period and the prior period worked more hours on average than did those in the last observed lengthy commuting period and the period after.

Those who moved from full time to part time work into the last observed lengthy commuting period worked fewer hours on average than did those who moved from full time to part time work into the period after. The difference between the average hours worked of the two groups is around an hour and a half. This does suggest that time spent commuting may reduce time spent working for part time employed persons. Given the fixed time constraints that often motivate part time work, such as beginning and end of school hours, this trade-off is not surprising. The difference between individuals who moved from part time to full time work is not statistically significant.

Figure 10.14 Change in hours of work during and after last observed period of lengthy commuting by change of full time-part time status



* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

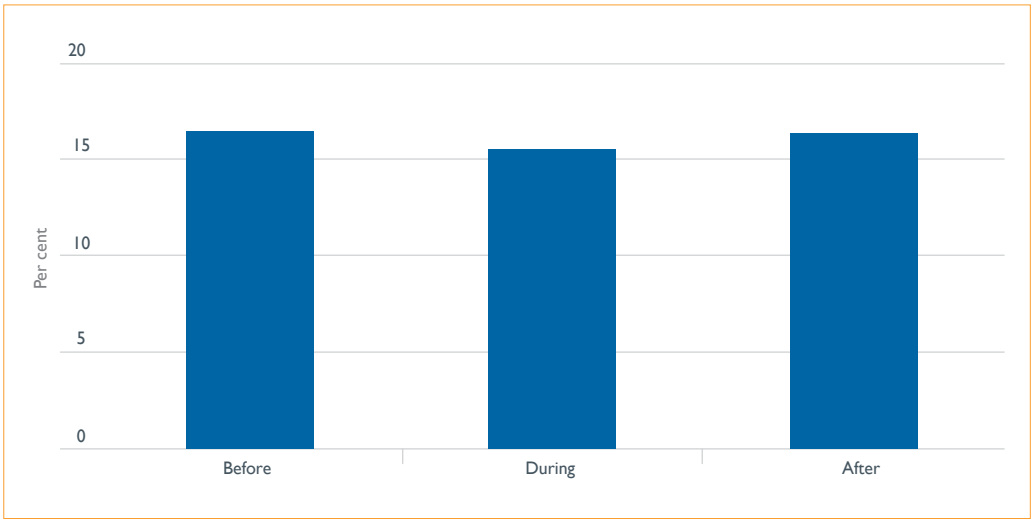
There was also a slight increase in the proportion of people working in what we describe as 'Other schedules', which include on-call and split-shift. These are in contrast to a regular daytime schedule, evening shift, night shift, rotating shift or an irregular shift. The difference, though statistically significant, is very small, with around 2 per cent of people employed in 'other schedules' in the last observed lengthy commuting period compared with around 4 per cent in the period after.

In general, this agrees with the literature and the results presented in chapter 6 in that it suggests that there is some trade-off between hours worked and time spent commuting. The evidence that after ending a lengthy commute people generally work more than they would otherwise supports other evidence that longer commutes reduce working time. There is no strong evidence to suggest that people change hours of work to avoid a lengthy commute.

Changing residence

One of the methods of adapting to a distant job is changing residence. Around 15 per cent of the chapter sample reported changing residence in the previous year regardless of the period in which they were interviewed. There were no statistically significant differences in the proportion who changed residence before, during or after the last observed lengthy commuting period, as shown in figure 10.15 below. There is also no significant difference when considering only those who were employed in each period. As is the case with changing jobs, there appears to be little difference in the volume of change in residence with respect to lengthy commuting.

Figure 10.15 Changed residence before, during and after last observed period of lengthy commuting



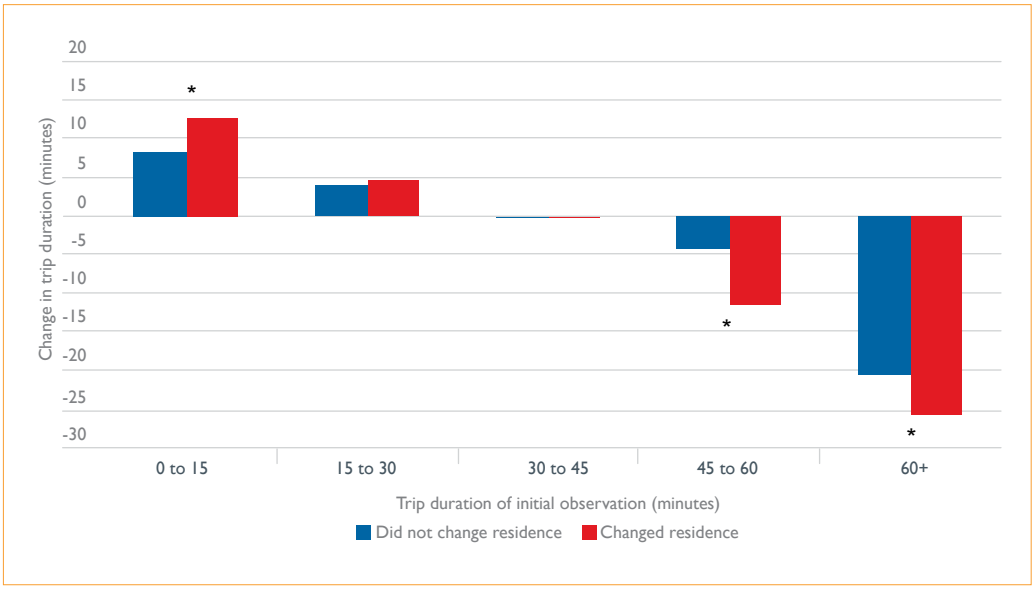
Note: No statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

As we saw in the section on changing jobs, the difference in commuting behaviour depends on the initial situation. Across the entire panel from wave 2 to wave 12, when we break an individual's change in trip duration between periods into categories, based on the trip duration in the initial observation period, a clear pattern emerges, as shown below in Figure 10.16.

This pattern shows a trend from both lower trip durations and higher trip durations towards around 30 to 45 minutes. In a way very similar to changing jobs, having changed residence is associated with a larger increase in trip duration for those individuals whose trip was less than 30 minutes and a larger decrease in trip duration for those individuals whose trip was greater than 45 minutes, relative to those who did not change residence. The effect is significant for each of the categories show in the figure above, but is of a smaller magnitude to changing jobs.

Figure 10.16 Change in trip duration waves 2 to 12 by duration in initial observation and whether changed residence since last interview



* Statistically significant difference between series at 95 per cent confidence level.

Source: BITRE analysis of HILDA survey waves 2 to 12 unit record data. The HILDA survey was initiated, and is funded, by the Australian Government through the Department of Social Services (DSS). Responsibility for the design and management of the survey rests with the Melbourne Institute of Applied Economic and Social Research (University of Melbourne).

We can conclude from this that although lengthy commuting does not seem to increase the likelihood of changing residence it does affect the qualities of a change in residence. The result is that those who have a commuting trip of more than 45 minutes will on average have a reduced commuting time when they move. This suggests that changing residence may be used as a means of reducing commuting time.

Conclusion

In this chapter we have investigated the changes that occur with the transition from lengthy commuting and attempted to identify any patterns of adaption.

For those who leave employment it appears more likely that is related to lifecycle factors or involuntary changes, rather than being a form of adaption. Foremost these include retiring, being involuntarily separated from employment and, for women, having children.

For those who remained employed, there is strong evidence to suggest that changing jobs or residence are ways that Australians seek to reduce or eliminate lengthy commutes. While it does not appear that stopping lengthy commuting is associated with changing jobs, it does appear to have an effect on the nature of that change in that commuting times appear to be lower than would otherwise be the case. Other changes which we might expect to be associated with this, such as a corresponding change in industry or occupation of employment have not been found.

There is no evidence to suggest that stopping lengthy commuting on average leads to a reduced income, although it does appear to reduce future income growth. This is despite the observation that those who stopped lengthy commuting but remained employed generally appear to work more hours than they would if they were lengthy commuters.

Finally, while lengthy commuters do not appear more likely to change residences, those that do tend to have lower commuting times. This strongly suggests that the nature of the move is different and that moving house could be a way in which Australians reduce their commuting times.

In this chapter, we have also highlighted some areas deserving of further research. This includes the link between commuting and early retirement, an area in which we have not been able to venture an explanation. Areas that would benefit from improved data collection include the actual spatial aspects of changes in jobs and changes in residence, as well as the information on the mode of transport.

CHAPTER 11
Conclusions

One major contribution of this report is that it shows how the Marchetti's constant works in the context of the Australian transport system and urban form. What is the Marchetti's constant? Cesare Marchetti was an Italian physicist who studied journey times and noticed that human beings will only devote around an hour and ten minutes (the constant) to travel. Subsequent work suggests that this has been the case since the Stone Age indicating that it is deeply embedded in the human makeup.

As Marchetti predicted, travel times rise with the size of cities until they reach a limit of around 35 minutes for a one way journey. After that, the perceived costs for the journey rise steeply. Indeed, this report shows that commutes longer than 45 minutes are perceived as unambiguously lessening wellbeing. This has important implications for the transport system and city structures. Commuting times do not expand indefinitely with city size. Once the Marchetti's constant has been reached, the average commuting time stabilises. Sydney is the exemplar of this. It is the largest city in Australia and has the longest commuting times. However, after reaching 35 minutes ten years ago there has been little change (Table 4.3). Interestingly, all parts of the city have an average commute time of between 31 and 37 minutes. This opens the question of how cites adapt to the operation of the Marchetti's constant.

Previous BITRE commuting studies for Sydney, Brisbane, Melbourne and South-East Queensland (BITRE 2010, 2011, 2012a, 2013a, 2013b) have shown that one of the main adaption mechanisms is changes in city structure. Once the CBD jobs fall outside the constant, jobs in the suburbs grow and indeed the earlier reports showed that the number of jobs in the suburbs has grown faster in terms of absolute numbers than jobs in the CBDs. This has led to an increase in cross suburban commuting rather than the radial commuting that has characterised earlier urban transport systems. This is changing. As Australia's economy globalises, the growth in high agglomeration jobs in the CBD is accelerating. This has led to greatly increased housing demand within a 35 minute commuting time of the inner city which has manifested itself in the largest apartment building program in Australia's history.

This report also shows how individuals adapt to the constant. One of the key mechanisms of economic growth in Australia, as in other countries, is greater division of labour. In other words, production is broken down into a series of ever more specialised steps and hence ever more specialised jobs. One of the consequences of this is that the search for a job that fits an individual's speciality takes longer than if there were a high proportion of generalist jobs. Chapter 7 of this report shows that. For those with more than baseline skills, there is an incentive to travel up to the constant in order to maximise the choice of jobs. The more specialist and high skilled the job the longer individuals are prepared to travel to do it. This is why a high proportion of those who undertake lengthy commutes has higher skills and are well

renumerated for commuting longer than the constant. As an aside, if the relationship between skills and salaries stays constant, we would expect commuting times to rise.

This report shows that many of those that who do undertake lengthy commutes do so only for a short period before reducing their travel times mainly by changing jobs or changing residence location. This suggests that average commuting times above the constant are perceived as being very costly for individual wellbeing.

This brings the focus onto transport networks. In much of the public discourse, poor transport systems are said to result in people (mainly in the outer suburbs) 'travelling hours to work'. This report shows that it is a myth. The true costs of poorly functioning transport networks is that because the average commute tops out at 35 minutes, poor transport reduces people's access to a jobs and thus reduces division of labour. At a personal level, poor transport systems reduce range of goods and services consumers have access to further reducing economic growth.

The report also showed that the operation of Marchetti's constant is influenced by transport mode. Continuing the Sydney example, the dominant commuting mode is light passenger vehicle (67%). Commuting times by this mode show remarkably little variation across the whole Sydney metropolitan area ranging from 25-27 minutes. This suggests that the Marchetti's constant for this mode may be around this level.

Around 5 per cent of commuters in Sydney walk or cycle to work (active travel). The commuting time for this group is again remarkably constant, varying from 15 to 17 minutes across Sydney. This suggests that the constant for this group is much lower.

Mass transit commuting times are much longer and display greater variability. Inner Sydney mass transit users have a commuting time of 46 minutes. Those from the outer suburbs have an average commute time of 77 minutes. This suggests that the constant may be much longer for mass transit than for light passenger vehicle travel.

What are the take home messages from the report?

1. Commuting times rise from regional areas to cities and with the size of the city.
2. They do not keep rising, reaching a ceiling at 35 minutes.
3. Commuting longer than 35 minutes imposes high costs on perceived individual wellbeing and most people who undertake lengthy commutes do so because they are well compensated.
4. Changing city structure is the main way commuting times are kept at 35 minutes.
5. Individuals also adapt mainly be changing jobs or changing residence.

Abbreviations and acronyms

AASHTO	American Association of State Highway and Transportation Officials
ABS	Australian Bureau of Statistics
ANZSCO	Australian and New Zealand Standard Classification of Occupations
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BSA	Bureau of Statistics and Analytics (previously known as TDC)
Cat.	Catalogue
CBD	Central Business District
CPQ	Continuing Person Questionnaire
DSS	Department of Social Services
FIFO	Fly-in fly-out
GCCSA	Greater Capital City Statistical Area
GMA	Greater Metropolitan Area
HILDA	Household Income and Labour Dynamics in Australia
HTS	Household Travel Survey
IRSAD	Index of Relative Socio-economic Advantage and Disadvantage
km	Kilometre
km/h	Kilometre per hour
LGA	Local Government Area
MIAESR	Melbourne Institute of Applied Economic and Social Research
NSW	New South Wales
OECD	Organisation of Economic Co-operation and Development
PC	Productivity Commission
PQ	Person Questionnaire
SCQ	Self-completion questionnaire
SD	Statistical Division
SEIFA	Socio-economic Indexes for Areas
UK	United Kingdom
VISTA	Victorian Integrated Survey of Travel and Activity
vktpp	Vehicle kilometres travelled per person

References

Ahmed A and Stopher P R 2014, Seventy Minutes Plus or Minus 10 - A Review of Travel Time Budget Studies, Transport Reviews, 34(5), pp. 607-625.

American Association of State Highway and Transportation Officials (AASHTO) 2013, Commuting departure time and trip time, Commuting in America 2013—The national report on commuting patterns and trends, Brief 11, AASHTO, October.

Australian Bureau of Statistics (ABS) 2001, Labour Statistics. Concepts, Sources and Methods, 2001, Cat. 6102.0, ABS, Canberra.

Australian Bureau of Statistics (ABS) 2008, How Australians use their time, 2006, Cat. 4153.0, ABS, Canberra.

Australian Bureau of Statistics (ABS) 2015a, Regional Population Growth, Australia, Cat. 3218.0, Released 31 March 2015, ABS, Canberra.

Australian Bureau of Statistics (ABS) 2015b, Labour force, Australia, April 2015, Cat. 6202.0, ABS, Canberra.

Benito A and Oswald A 2000, Commuting in Great Britain in the 1990s, University of Warwick economic research papers, Number 560.

Buchanan J, Baldwin S and Wright S 2011, Understanding and improving labour mobility: a scoping paper, Discussion Paper, National Vocational Education and Training Research and Evaluation Program, Department of Education, Employment and Workplace Relations, Canberra, 44 pages.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2011, Population growth, jobs growth and commuting flows in Perth, Research Report 119, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2011, Population growth, jobs growth and commuting flows in Melbourne, Research Report 125, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2012a, Population growth, jobs growth and commuting flows in Sydney, Research Report 132, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2012b, Traffic growth in Australia, Research Report 127, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2013a, Population growth, jobs growth and commuting flows in South East Queensland, Research Report 134, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2013b, Population growth, jobs growth and commuting flows—a comparison of Australia's four largest cities, Research Report 142, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014a, Long-term trends in urban public transport, Information Sheet 60, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014b, Saturating daily travel, Information Sheet 61, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014c, Yearbook 2014—Australian Infrastructure Statistics, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2015a, Australia's commuting distance: cities and regions, Information Sheet 73, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2015b, Traffic and congestion cost trends for Australian capital cities, Information Sheet 74, BITRE, Canberra.

Bureau of Statistics and Analytics (BSA) 2013, Household Travel Survey 2011/12—November 2013 release, Technical documentation, accessed 4th February 2015 from <www.BSA.nsw.gov.au/Statistics/HTS/default.aspx#top>.

Bureau of Statistics and Analytics (BSA) 2014a, Household Travel Survey report: Sydney 2012/13, BSA, Sydney, December.

Bureau of Statistics and Analytics (BSA) 2014b, Household Travel Survey (HTS) Database documentation, August 2014 version.

Cassidy T 1992, Commuting-Related Stress: Consequences and Implications, Employee Counselling Today, 4, pp. 15-21.

Cervero R 1989, Jobs housing balancing and regional mobility, Journal of the American Planning Association, 55, pp. 136–150.

Crabtree S 2010, Wellbeing Lower Among Workers With Long Commutes, Gallup, Released on 13 August 2010, Retrieved from http://www.gallup.com/poll/142142/ wellbeing-lower-among-workerslong-commutes.aspx, Assessed 15 September 2015.

Dargay J and Hanly M 2003, A panel data exploration of travel to work, Paper presented at the European Transport Conference, Strasbourg, France, October 2003.

Delmelle E C, Haslauer E and Prinz T 2013, Social satisfaction, commuting and neighborhoods, Journal of Transport Geography, 330, pp. 110-116.

Department of Education 2014, Geographic labour mobility research study, Submission to the Productivity Commission, March 2014, 32 pages. Assessed 29 October 2015 from http://www.pc.gov.au/data/assets/pdf_file/0004/135184/ subdr060-labour- mobility.pdf

Dickerson A, Hole A R and Munford L A 2014, The relationship between well-being and commuting revisited: Does the choice of methodology matter? Regional Science and Urban Economics, 49, pp. 321–329.

Evans G W, Wener R E 2006, Rail Commuting Duration and Passenger Stress, Health Psychology, 25, pp. 408-412.

Flood M and Barbato C 2005, Off to work—Commuting in Australia, Discussion Paper Number 78, The Australia Institute, April.

Giminez-Nadal J and Molina J 2014, Commuting time and labour supply in the Netherlands—a time use study, Journal of Transport Economics and Policy, 48, Part 3, pp. 409–26.

Giminez-Nadal J and Molina J 2015, Commuting time and household responsibilities: evidence using propensity score matching, IZA Discussion Paper Number 8794, January.

Gottholmseder G, Nowotny K, Pruckner GJ and Theurl E 2009, Stress perception and commuting, Health Economics, 18, pp. 559–576.

Groot S, de Groot H and Veneri P 2012, The educational bias in commuting patterns: micro-evidence for the Netherlands, Tinbergen Institute, Discussion Paper, Number 2012-080/3.

Guiliano G 1998, Information technology, work patterns and intra-metropolitan location: a case study, Urban studies, 35, pp. 077–95.

Guiliano G and Small K 1993, Is journey to work explained by urban structure?, Urban Studies, 30, pp. 1485–1500.

Hanson S and Johnstone I 1985, Gender differences in work trip length: explanations and implications, Urban Geography, 6(3), pp. 193–219.

Hansson E, Mattisson K, Björk J, Östergren P-O and Jakobsson K 2011, Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden, BMC Public Health, 14 pages.

Harsman B and Quigley J 1998, Education, job requirements and commuting: an analysis of network flows, University of California Transportation Centre, Working Paper Number 378.

Hayes C 2008, HILDA standard errors—a users guide, HILDA Project Technical Paper, Series, No. 2/08, February, MIAESR, The University of Melbourne.

IBM 2011, IBM Commuter Pain Survey announcement: Major Findings Document for Australian cities, Australian major findings fact sheet, 8 pages.

Ironmonger D and Norman P 2007, Travel Behaviour of Women, Men and Children: What Changes and What Stays the Same? Presented at the IATUR 29th Annual Conference 17-19 October 2007 Washington DC, USA.

Jennifer R Hodgson R and Dolan P 2011, It's driving her mad: Gender differences in the effects of commuting on psychological health, Journal of Health Economics, 30, pp. 1064-1076.

Kageyama T, Nishikido N, Kobayashi T, Kurokawa Y, Keneko T and Kabuto M 1998, Long commuting time, extensive overtime, and sympathodominant state assessed in terms of short-term heart rate variability among male white-collar workers in the Tokyo megalopolis, Industrial Health, 36, pp. 209-217.

Krueger AB, Kahneman D, Fischler C, Schkade D, Schwarz N and Stone AA 2008, Time use and subjective wellbeing in France and the U.S, Social Indicators Research, 93(1), pp. 7–18.

Kylstra C 2014, 10 Things Your Commute Does to Your Body, Published in the Times, February 26, 2014.

Lee B S and Mcdonald J F 2003, Determinants of commuting time and distance for Seoul residents: the impact of family status on commuting of women, Urban Studies, 40, pp. 1283–1302.

Lyons G and Chatterjee K 2008, A human perspective on the daily commute: Costs, benefits and trade-offs. Transport Reviews, 28(2). pp. 181-198.

Madden J F and White M J 1980, Spatial Implications of Increases in the Female Labor Force: A Theoretical and Empirical Synthesis, Land Economics, 56(4), pp. 432-446.

Martin L and Licheron J 2014, Commuting and well-being at work: An empirical analysis in the cross-border region of Luxembourg, First draft - January 2014, CEPS/INSTEAD – Luxembourg.

McKenzie B and Rapino M 2011, Commuting in the United States 2009, American Community Survey Reports, ACS–15, U.S. Census Bureau, Washington DC.

McQuaid R and Chen T 2012, Commuting times - The role of gender, children and part-time work, Research in Transportation Economics, 34(1), pp. 66-73.

Melbourne Institute of Applied Economic and Social Research (MIAESR) 2014, Families, incomes and jobs, Volume 9—A statistical report on waves 1 to 11 of the Household, Income and Labour Dynamics in Australia survey, MIAESR, The University of Melbourne.

Milakis D, Cervero R, van Wee B and Maat K 2015, Do people consider an acceptable travel time? Evidence from Berkely, CA, Journal of Transport Geography, (44), pp. 76–86.

Milthorpe F 2007, Consistency in daily travel time—an empirical assessment from Sydney travel surveys, Paper presented to 30th Australasian Transport Research Forum, 25–7 September, Melbourne.

Milthorpe F and Daly A 2010, Comparison of trip and tour analysis of Sydney Household Travel Survey data, Paper presented to Australasian Transport Research Forum 2010, 29 September–1 October, Canberra,

Mokhtarian P and Chen C 2002, TTB or Not TTB, That is the Question: A Review and Analysis of the Empirical Literature on Travel Time (and Money) Budgets. Institute of Transportation Studies and Department of Civil and Environmental Engineering, University of California, Davis.

Newman P and Jennings I 2008, Modeling Cities on Ecosystems (Chapter 5), In: Cities as sustainable ecosystems: principles and Practices, Island Press House, Washington DC, USA

Novaco R W and Gonzales O I 2009, Commuting and well-being, In: Technology and Psychological Well-Being, Amichai-Hamburger Y (Ed.), pp.174–205, New York: Cambridge University Press.

Novaco R W, Stokols D and Milanesi L 1990, Objective and subjective dimensions of travel impedance as determinants of commuting stress, American Journal of Community Psychology, 18, pp. 231-257.

Office for National Statistics 2014, Commuting and personal well-being, 2014, Article released on 12 February 2014, 25 pages.

Öhman M and Lindgren U 2003, Who is the long-distance commuter? Patterns and driving forces in Sweden, European Journal of Geograpphy, Assessed on 23 March 2015. <http://dx.doi.org/10.4000/cybergeo.4118>

Olsson L E, Garling T, Ettema D, Friman M and Fujii S 2013, Happiness and satisfaction with work commute, Social Indicators Research, 111, pp. 55–263.

Organisation of Economic Co-operation and Development (OECD) 2010, LMF 2.6: Time spent travelling to and from work, OECD Family Database, OECD, Paris.

Peters P, de Wilde R, Clement B, Peeters P 2001, A constant on the move? Travel time, virtual mobility and constant travel time budgets (cited in van Wee et al. 2002 and 2006).

Pocock B, Skinner N and Williams P 2007, Work–life in Australia: Outcomes from the Australian Work and Life Index (AWALI) 2007, Hawke Research Institute for Sustainable Societies, University of South Australia, Adelaide, 54 pages.

Productivity Commission (PC) 2011, Performance benchmarking of Australian business regulation: Planning, zoning and development assessments, Research Report, PC, Canberra.

Productivity Commission (PC) 2014, Geographic Labour Mobility, Research Report, PC, Canberra.

Punpuing S 1993, Correlates of commuting patterns: a case-study of Bangkok, Thailand, Urban Studies, 30(3), pp. 527–46.

Rapino M and Fields A 2013, Mega commuters in the U.S.—Time and distance in defining the long commute using the American Community Survey, United States Census Bureau Working paper 2013–03.

Regional Australia Institute 2013, The costs and benefits of geographic labour mobility: A regional perspective, Submission to Productivity Commission Inquiry into Geographic Labour Mobility, 29 August 2013, 24 pages.

Roberts J, Hodgson R and Dolan P 2011, It's driving her mad: gender differences in the effects of commuting on psychological well-being, Journal of Health Economics, 30, pp. 1064-1076.

Rouwendal J 1988, Search theory spacial labor markets and commuting, Journal of Urban Economics, 43, pp. 1-22.

Rouwendal J 2004, Search Theory and Commuting Behavior, Growth and Change, 35(3), pp. 391-418.

Roxby P 2014, How does commuting affect wellbeing? Retrieved from http://www.bbc.co.uk/news/health-26190236, Assessed 19 August 2015.

Sandow E and Westin K 2010, Preferences for commuting in sparsely populated areas, Journal of Transport and Land Use, 2, pp. 87–107.

Schafer As and Victor D G 2000, The Future Mobility of the World Population, Transportation Research Part A, 34(3), pp. 171-205.

Sedghi A and Arnett G 2014, How does commuting affect wellbeing? The Guardian, 12 February 2014, Retrieved from http://www.theguardian.com/news/, Assessed 19 August 2015.

Shaz K and Corpuz G 2008, Serving passengers—are you being served?, Paper presented to 4th annual PATREC research forum, 2nd October.

Shen Q 2000, Spatial and social dimensions of commuting, Journal of the American Planning Association, 66(1), pp. 68-82.

So K S, Orazem P F and Otto D M 2001, The effects of housing prices, wages and commuting time on joint residential and job location choices, American Journal of Agricultural Economics, 83(4), pp. 1036-1048.

Statistics Canada 2011, Commuting to work: results of the 2010 General Social Survey, in Canadian Social Trends, Cat. No. 11–008, Statistics Canada.

Stopher P and Zhang Y 2011, Travel time expenditures and travel time budgets - Preliminary findings, Institute of Transport and Logistics Studies, University of Sydney, Working Paper, ILTS-WP-11-04, 14 pages.

Straszheim M 1975, The demand for housing attributes and the choice of neighbourhood', in An econometric analysis of the urban housing market, National Bureau of Economic Research, Chapter 7, pp. 78–115.

Strathman J, Dueker K and Davis J 1994, Effects of household structure and selected travel characteristics on trip chaining, Transportation, 21, pp. 23–45.

Stutzer A and Frey BS 2004, Stress that Doesn't Pay: The Commuting Paradox, Discussion Paper No. 1278, Institute for the Study of Labor (IZA), Bonn, Germany, 42pp.

Stutzer A and Frey BS 2008, Stress that Doesn't Pay: The Commuting Paradox, The Scandinavian Journal of Economics, 110, pp. 339-366.

Sultana S 1005, Effects of married-couple dual-earner households on metropolitan commuting: Evidence from the Atlantic metropolitan area, Urban Geography, 26(4), pp. 328-352.

Summerfield M, Freidin S, Hahn M, Li N, Mundy L, Watson N, Wilkins E and Wooden M 2014, HILDA user manual—Release 13, MIAESR, The University of Melbourne.

Taylor B and Mauch M 1998, Gender, race and travel behaviour: an analysis of household-serving travel and commuting in the San Francisco Bay Area, Women's travel issues: Proceedings from the second national conference, October 1996, U.S. Department of Transportation.

Thomson K and Kapuscinski C A 2014, Experimental estimates of Indigenous employment from administrative data, Australian Journal of Labour Economics, 17(2), pp. 39-161.

Toole-Holt L A 2004, A Comparative Analysis of Travel Time Expenditures in the United States, These, Master of Science in Civil Engineering, Department of Civil and Environmental Engineering, College of Engineering, University of South Florida, 138 pages.

Toole-Holt L, Polzin S and Pendyala R 2005, Two Minutes per Person per Day each Year: An Exploration of the Growth in Travel Time Expenditures, Presented at the 84th Transportation Research Board Annual Meeting, January 2005, 20 pages.

Trendle B and Sui J 2007, Commuting patterns of Sunshine Coast residents and the impact of education, Australasian Journal of Regional Studies, 13(2), pp.221–30.

Turcotte M 2005, The time it takes to get to work and back, in General Social Survey on Time Use—Cycle 19, Cat. No. 89–622-XIE, Statistics Canada.

Turcotte M 2011, Commuting to work: Results of the 2010 General Social Survey, Component of Statistics Canada, Catalogue no. 11-008-X, Canadian Social Trends, Statistics Canada, pp. 25-36.

Vaddepalli S 2004, An analysis of the characteristics of long and short commuters in the United States, Master's thesis, Accessed 20th April 2014 from <scholarcommons.usf.edu/etd/1279/>.

van den Berg G and Gorter C 1996, Job search and commuting time, Research Memorandum 1996-1, Applied Labour Economics Research Team, Vrije University, Amsterdam, The Netherlands, 34 pages.

Van Ham M and Hooimeijer P 2009, Regional differences in spatial flexibility: long commutes and job-related migration intentions in the Netherlands, Applied Spatial Analysis, 2, pp. 129–46.

van Ommeren J, van den Berg G J and Corter C 1998, Estimating the marginal willingness to pay for commuting, Research Memorandum 1998-46, Applied Labour Economics Research Team, Vrije University, Amsterdam, The Netherlands, 25 pages.

van Wee B, Reitveld P and Meurs H 2002, A constant travel time budget? In search for explanations for an increase in average travel time, Research Memorandum 2002-31: Faculty of Economic Sciences, Business Administration and Econometrics, Free University of Amsterdam, (available from ideas.repec.org/p/dgr/vuarem/2002-31.html).

van Wee B, Rietveld P and Meurs H 2006, Is average daily travel time expenditure constant? In search of explanations for an increase in average travel time, Journal of Transport Geography, 14, pp. 109–122.

VicHealth 2012, VicHealth Indicators Survey 2011—Selected findings, Victorian Health Promotion Fund, Melbourne, October.

Victorian Department of Transport 2009, Victorian Integrated Survey of Travel and Activity (VISTA-07), Department of Transport, Melbourne, accessed 12 February 2015 from <www.dtpli.vic.gov.au/transport/research-anddata/statistics/ victorian-integrated-survey-of-travel-and-activity#data>

Wachs M, Taylor B D, Levine N and Ong P 1993, The changing commute: a case study of the jobs-housing relationship over time, Urban Studies, 30(10), pp. 1711–1729.

Wang F 2001, Explaining intraurban variations of commuting by job proximity and workers' characteristics, Environment and Planning B: Planning and Design, 28(2), pp. 169–182.

White M J 1988, Location Choice and Commuting Behavior in Cities with Decentralized Employment, Journal of Urban Economics, 24, pp. 129-152.

Wilkins R, Warren D and Hahn M 2009, Time spent travelling to and from work, Families, incomes and jobs, Volume 4—A statistical report on waves 1 to 6 of the HILDA survey, pp. 202–204, MIAESR, The University of Melbourne.

Williams I N 2012, A comparative study of commuting patterns and trends in Great Britain, Ireland and the US, Presented at the European Transport Conference 2012, Association for European Transport and Contributions, Glasgow (Scotland), 8-10 August 2012, 18 pages.

bitre

www.bitre.gov.au

ISBN 1978-1-925401-39-4