

Making a Molehill out of a Mountain – Spreading the Morning Peak with Flexible Working Hours

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1 ABSTRACT

Travel demand-management strategies are employed as cost-effective tools to ease peak-hour pressures. In this paper, we focused on the use of flexible working hours and measured its efficacy in spreading the morning peak demand using empirical data from the NSW Transport and Infrastructure's Sydney Household Travel Survey. The results indicated firstly, that the commute patterns of those with fixed hours during the morning showed striking similarity to those with flexible hours. This is largely because the required start times of those with fixed hours are already spread, effectively re-distributing travel outside the high demand period. This suggests that enforcing staggered start times is itself an effective tool in spreading peak hour demand. Among those workers with flexible hours, three-fifths arrived outside the 'super-peak' 8-9am period. This indicates a potential in dampening the sharp peak period if this flexible arrangement is extended to workers with fixed start times during this super-peak period. This paper makes simple calculations and assumes a 61% take-up of flexible hours based on revealed preferences to estimate this dampening effect, but it is expected that actual take-up would likely be influenced by other factors, many of which are qualitative and not easily assessable for this purpose.

2 INTRODUCTION

In major cities all over the world, including Sydney, there are growing capacity pressures on the road and public transportation networks, particularly during the morning peak. In the Sydney Greater Metropolitan Area (GMA), the largest demand is between 8.01am-9am during which time 9% of all motorised trips occur. Not only is demand highest during the morning peak, but the growth in demand in recent years was also highest at this time (TDC, 2009). With population increasing annually at about 1% (TDC, 2009), pressures on the network continue to grow. Without intervention, the result will be congestion on roads and crowding on public transport. Building new infrastructure (supply-side measures) are costly long-term solutions. Demand management strategies, however, offer more immediate and less expensive alternatives. (Battelino and Mendigorin 1999; Twiney and Rudd 2005). Incentives to travel during off-peak/shoulder periods could be monetary (e.g. variable tolling for the Sydney Harbour Bridge or reduced off-peak return train tickets) or alternative work arrangements, like teleworking or flexible work hours².

Of all motorised morning peak trips, over half are non-discretionary – 29% are commute/work-related trips and 23% are education/childcare trips. Because of the non-discretionary nature of these trips, they are probably less susceptible to monetary interventions. Given that there is less discretionary travel during this peak period, there is a need to look for effective methods of shifting essential travel. In this paper, we focus on flexible work hours, which have the potential to directly impact the morning peak-hour commute and 'make a molehill out of a mountain'.

¹ Opinions expressed in this paper are those of the authors and do not represent NSW Transport and Infrastructure.

² Flexi-time is a system where an employee's work hours are flexible within certain limits and the employee can 'build up' time and take a day off.

3 AIMS OF THIS PAPER

Using the Transport Data Centre's Sydney Household Travel Survey (NSW Transport and Infrastructure), we will empirically assess the commute to work of those with flexible hours to assess the potential of greater use of flexible working hours to spread the morning peak.

We will compare the characteristics of the workers and their commute trips, including

- departure time from home
- start time of work
- place of employment (eg CBD)
- mode choice
- reasons for departure time, including trip-chaining
- demographics

Comparisons will also be made for commuters with a fixed work location outside the home

- for those with fixed work hours and those with flexible work hours
- and for those with flexible work hours who travel outside the morning peak and those who travel during the morning peak.

The paper begins with a broad analysis of Sydney workers and their morning commute trips before focusing on commute trips of those with flexible work hours.

4 THE SYDNEY HOUSEHOLD TRAVEL SURVEY (HTS)

The HTS is the largest and most comprehensive source of personal travel data for the Sydney Greater Metropolitan Area (GMA). This area includes the Sydney and Illawarra Statistical Divisions and the Newcastle Sub-Statistical Division (Figure 1). Analysis included in this paper will explore morning peak trips across the entire GMA.

The HTS is the longest running household travel survey in Australia, having been running continuously since 1997. Detailed trip information for each day of the year, as well as socio-demographic information, is collected by face-to-face interview. For further details about the HTS, its scope, coverage and methodology, see TDC (2009).

The analyses presented in this paper are based on the 2007 estimates which represent nine years of pooled data collected from June 1999 to June 2008 weighted to the 30 June 2007 population. The total sample for this time period consists of 28,500 households, 82,500 individual respondents, 266,500 linked trips and 312,000 unlinked trips.

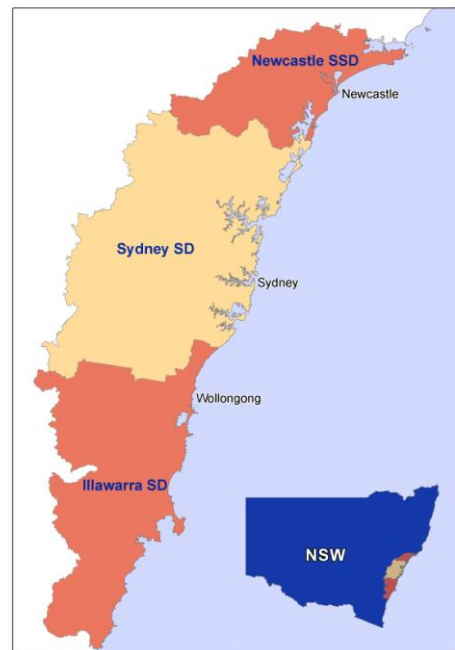


Figure 1 Sydney Greater Metropolitan Area (GMA)

As will be addressed in the next section, because the proportion of workers with flexible work arrangements is small (3%), it was necessary to pool nine years of data. Such pooling allowed us to focus on this segment of the population so that we could assess the impact of flexible work hours on the morning peak. There are obvious issues with pooling such a large dataset and using it to represent behaviour for a particular year. However, because the

focus of this paper is on flexible work hours, an arrangement that has been available for the nine years, the advantages outweigh the limitations that a larger sample brings.

5 DEMOGRAPHICS

5.1 Characteristics of Sydney workers³

In 2007, there were 2.7 million workers aged 15 or over in the Sydney GMA. Of those, 35% have fixed start and finishing times each day (967,000 workers) and 3% have flexible work hours (73,000). (See Table 1.)

Table 1⁴ Work schedule

Work schedule	Total number of workers	% of work schedule
Fixed start and finish times - same each day	967,000	35%
Flexitime	73,000	3%
Fixed start and finish times - each day can vary	463,000	17%
Rostered shifts	200,000	7%
Rotating shifts	72,000	3%
Variable hours ⁵	962,000	35%
Other	4,000	0%
Total	2,739,000	100%

Furthermore, of the 967,000 fixed-hour workers, 69% (663,000) have a fixed place of employment outside the home and went to work on an average weekday. Of the 73,000 flex-hour workers, 71% (52,000) have a fixed place of employment outside the home and went to work on an average weekday. Those who did not travel to work may have had a rostered day off, been ill, worked part-time, or been on leave. All subsequent analysis in this paper will focus on workers with a *fixed work location outside the home who travelled to work on their designated (weekday) travel day*.

5.2 Socio-demographic characteristics

Tables 2 and 3 identify types of workers who tend to have flexible work arrangements and also those who use this privilege. For the purposes of this paper, those who ‘use flex’ are those who arrived at work on an average weekday prior to 8.01am or after 9am. ‘Not using flex’ is defined as flex-time workers who arrived at work during what may be considered the super-peak of 8.01am-9am, where morning peak demand is at its highest.

Amongst the most notable differences across the groups are:

³ The HTS only asks work-related questions to residents aged 15 or over. ‘Worker’ includes people in full-time, part-time, casual and unpaid voluntary employment.

⁴ Figures in all tables have been rounded; however, totals, averages and percentages have been calculated from original unrounded data.

⁵ In the HTS, these are workers who consider themselves to have ‘variable hours’, meaning they could work different hours each day, but who do not consider their work arrangement to be either shiftwork or formalised flexitime. Although the concept of ‘variable’ work hours might include some flexibility in start and finish times, this definition differentiates these workers from flex-time workers. These workers are also more likely to be self-employed, casual, volunteers or be in full or part-time education. In this paper, these workers have been differentiated intentionally and excluded from the analysis.

- Roughly half of flex-time workers are in government administration and defence, compared with 5% of all workers. Understanding the current industry breakdowns will assist in targeting specific sectors that might potentially implement flexible work arrangements.
- A higher proportion of flex-time workers are ‘managers, administrators or professionals’, as compared to those with other work schedules. Conversely, a smaller proportion of flex-time workers are ‘tradespeople, technicians or labourers’ as compared to those with other work schedules. This implies that flexible work hours cater to certain occupations more so than others.
- Flex-time workers have higher salaries than their fixed-hour counterparts. This is likely due to the industry and occupation.
- A higher proportion of flex-time workers’ jobs are based in the Sydney CBD (29%) compared with all workers (21%) and fixed-time workers (19%). This is probably largely related to the industries in which they are employed.
- More male employees availed of their flexible work hours than female employees, though this was generally proportional to the number of male and female employees overall⁶.
- Household composition does not seem to be related to the type of work schedule or whether or not one availed of flexible work hours. This may seem counter-intuitive or even contrary to other literature, in that one might expect households with young children to be more apt to having flexible work hours and availing of them. However, perhaps these data suggest that flexible work schedules can cater to all types of households, not just those with young children. Furthermore, it is worth noting that the HTS data accounts for a 24-hour period and therefore tends to provide a picture of a ‘typical weekday’. Households with young children would have travel routines in place for a typical weekday. Yet, it might be on atypical days, like when a child is sick and alternative child-care arrangements need to be made, when families use flexible work arrangements. Such atypical days cannot easily be seen in the HTS data. Retrospective surveys accounting for a longer time-frame might be better placed to detect uncharacteristic occurrences. The Australian Bureau of Statistics (ABS, 2005) found that in the previous six months, nearly half of employees in paid employment used some form of work arrangement to care for another person (primarily their own young child). Over a third (36%) used flexible work hours to provide this care. Hypothetical surveys that are forward-looking might also focus on potential anomalies or unusual days that break from the routine. Almer *et al.*, (2003) found that workers *would be likely to adopt* flexible hours for family needs.

⁶ Golden (2008) found that in the US, “being female reduced the probability of having a flexible schedule by about 3-5%” (p92). Furthermore, Golden found that the effect was magnified when controlling for occupation, and was somewhat reduced when controlling for industry.

Table 2 Work-place socio-demographic characteristics of workers with fixed work locations outside the home

Characteristics	Type of worker	All workers	Fixed-hour workers	Flex-hour workers	Flex-hour workers who DID NOT USE flex	Flex-hour workers who USED flex
INDUSTRY	Manufacturing	13%	17%	8%	7%	9%
	Retail trade	15%	14%	3%	1%	4%
	Property & business services	14%	14%	11%	9%	13%
	Education	9%	10%	9%	11%	8%
	Health & community services	10%	9%	4%	6%	4%
	Finance & insurance	7%	8%	5%	5%	5%
	Government administration & defence	5%	3%	46%	54%	41%
	Other	27%	25%	14%	7%	17%
OCCUPATION	Managers, administrators, professionals	47%	38%	59%	60%	59%
	Tradespersons, technicians, labourers, related workers	16%	21%	4%	2%	6%
	Clerical, sales, service workers	33%	36%	35%	37%	34%
	Intermediate production, transport workers	4%	5%	1%	2%	1%
PERSONAL INCOME GROUP	<\$19,999	14%	11%	3%	2%	4%
	\$20,000 - \$34,999	21%	26%	8%	6%	10%
	\$35,000 - \$49,999	26%	31%	25%	23%	27%
	\$50,000 - \$64,999	14%	13%	27%	28%	27%
	>\$65,000	26%	18%	37%	41%	33%
	Mean income	\$55,000	\$48,000	\$65,000	\$69,000	\$63,000
	Median income	\$43,000	\$40,000	\$57,000	\$63,000	\$57,000
WORK LOCATION	Not in Sydney CBD	79%	81%	71%	70%	72%
	Sydney CBD	21%	19%	29%	30%	28%
BASE	All workers	1,554,000	663,000	52,000	21,000	32,000

Table 3 Person/household socio-demographic characteristics of workers with fixed work locations outside the home

Person/ Household Characteristics	Type of worker	All workers	Fixed-hour workers	Flex-hour workers	Flex-hour workers who DID NOT USE flex	Flex-hour workers who USED flex
GENDER	Male	53%	50%	52%	50%	53%
	Female	47%	50%	48%	50%	47%
HOUSEHOLD TYPE	Adult living alone	9%	9%	11%	10%	11%
	Married couple only	21%	21%	24%	25%	24%
	Married couple with child(ren) 15+	21%	22%	21%	21%	20%
	Married couple with child(ren) 0-14	22%	21%	23%	23%	23%
	Married couple with child(ren) 0-14 & 15+	9%	8%	6%	5%	6%
	One adult with child(ren) 15+	6%	7%	7%	9%	7%
	One adult with child(ren) 0-14	2%	2%	1%	1%	1%
	One adult with child(ren) 0-14 & 15+	2%	2%	0%	0%	1%
	Group households & Other	9%	9%	7%	7%	8%
	AGE GROUP	15-19	6%	4%	1%	0%
20-24		10%	11%	5%	6%	5%
25-34		23%	24%	24%	24%	24%
35-44		26%	25%	29%	31%	27%
45-54		23%	23%	32%	30%	33%
55-64		10%	11%	9%	9%	9%
65+		2%	2%	0%	0%	1%
Mean age		38.9	39.1	40.9	40.7	41.0
Median age		39	39	41	41	41
BASE	All workers	1,554,000	663,000	52,000	21,000	32,000

6 ANALYSIS OF THE COMMUTE TO WORK

6.1 Departure and arrival times

Sydney workers with fixed work hours have a median *required start* time of 8.30am (Table 4). There is a fair amount of variability in this start time, as the inter-quartile range (IQR, or middle 50% of values) has a 90-minute range. Nearly half (46%) of fixed-time workers are required to start work during the super-peak between 8.01am-9am. A sizeable percentage (23%) are required to start in the pre-peak shoulder (7.01am-8am) while a small proportion (5%) are required to start in the post-peak shoulder (9.01am-10am).

Actual arrival times of those with fixed hours followed their required start times quite closely. These workers arrived at work at 8.20am on average (median value), with an IQR of 85 minutes, slightly narrower than the IQR of 90 minutes for required start times. This suggests that required start times, are effectively enforcing the actual arrive times. Because *required*

start times of workers with fixed hours are already spread, this demonstrates that required start times have the effect of distributing demand in the morning peak period.

Sydney workers with flexible work arrangements can generally start as early as 7am (median early start time) and as late as 9.30am (median late start time). Workers with flexible hours also tended to arrive at work at 8.30am (median value; IQR=72 minutes).

Interestingly, the differences and spread of the required start times of those with fixed work hours resulted in a work arrival time distribution that was similar to those with flexible work hours. This observation will be revisited in later discussion.

Table 4 Actual and required start times by work schedule⁷

	Fixed-hour workers	Flex-hour workers	All workers
	median (IQR)	median (IQR)	median (IQR)
Required start time	8.30am (IQR = 90 min)	N/A	N/A
Earliest start time	N/A	7.00am (IQR = 30 min)	N/A
Latest start time	N/A	9.30am (IQR = 30 min)	N/A
Actual arrival time at work	8.20am (IQR = 85 min)	8.30am (IQR = 72 min)	8.30am (IQR = 95 min)
Actual departure time from home	7.37am (IQR = 94 min)	7.40am (IQR = 85 min)	7.45am (IQR = 100 min)

The actual departure time from home was also similar for fixed-time and flex-time workers. Fixed-hour workers had a median departure time from home of 7.35am compared to 7.40am for flex-hour workers. In fact, as Table 4 illustrates, the actual departure times from home and arrival times at work for those with fixed work hours are correspondingly similar to those with flexible work hours. Although in general, there seems to be slightly *less* variability (shown by the IQR) amongst those with flexible working hours. This result is validated by Palma *et al.* (1997) who found that the daily commuting schedules for those with flexible and fixed working hours in Brussels, a city of one million residents, were rather similar.

6.2 Analysis of arrival times by work schedule

Figure 2 illustrates the proportions of commute trips arriving at work in the morning by 30-minute intervals for all workers, those with flexible work hours, and those with fixed work hours. The graph also shows the *required* start time for fixed-hour workers (as compared to the *actual* arrival time).

For all four datasets featured in the graph, the general trend is for the proportion of trips to gradually increase from 5am, reaching the highest proportion during the 8.01am-8.30am interval, slightly dipping but remaining high in the 8.31am-9am before tapering off. For all workers in general, fixed hour and flex-hour workers in particular, the demand is consistently highest in what we have so far called the “super-peak” period of 8.01-9am. Commute trips occurring outside this hour might be attributed to the various work schedules.

Figure 2 demonstrates the striking similarity in the arrival times of workers with fixed hours and those with flexible work hours. This is somewhat counter-intuitive until it is understood that, as previously mentioned, the *required*, and therefore the *actual* start times of those with fixed hours are in fact already spread. This effectively results in a distribution of demand outside the super-peak. The main difference with these fixed-hour workers compared to those flex-hour workers, though, is that these start times are imposed rather than chosen. Of those workers with fixed hours, 60% arrived outside the 8.01-9am super-peak. This

⁷ For workers who went to work on their travel day and have fixed work locations outside the home.

suggests that enforcing staggered start times is an effective tool in spreading peak hour demand.

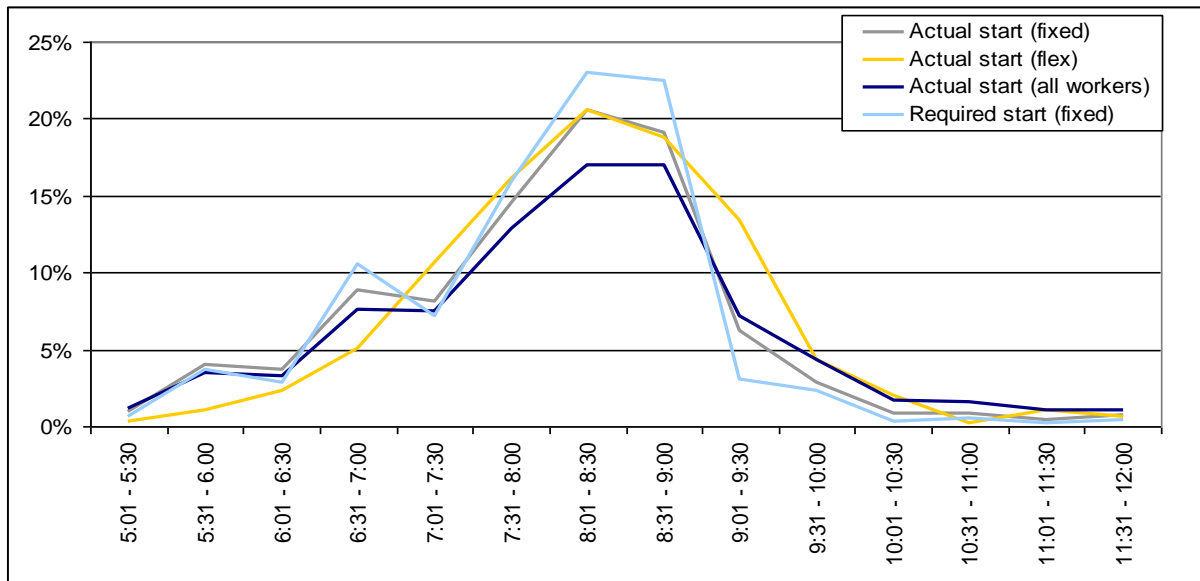


Figure 2 *Actual* morning arrival time at work by work-schedule (all modes) and *required* arrival time (for fixed-hour workers) for workers with fixed work locations outside the home

Among those workers with flexible hours, 39% arrived in the high demand 8.01-9am period leaving a substantial three-fifths travelling outside this period. One quarter (27%) of flex-hour workers arrived at work in the pre-shoulder period of 7.01-8am, while 18% arrived in the post-shoulder period of 9.01-10am period.

Some simple calculations project a dampening of the peak if fixed-hour workers (who currently arrive during the super-peak) were able to adopt flexible work hours. Assuming the same 61% take-up of actual flex-hour workers and overall distribution of flex-hour work trips, the proportion of commute trips arriving during the super-peak would theoretically reduce from 40% to 17%. The reduction in commute trips during this period is estimated to be over 40%. The proportion of pre-shoulder trips would rise from 23% to 33% while the percentage of post-shoulder trips would increase from 10% to 16%⁸.

6.3 Reasons for departure time

In the HTS, workers who went to work are asked for their reasons for departing at the time they did. This can provide insight on whether work schedules are influencing this behaviour. Table 5 shows that the most prevalent reason for commuters departing at a particular time was because it was the 'latest departure time to arrive on time'. As expected, those with fixed work hours cite this reason almost twice as often as those with flexible work hours.

Roughly one in ten workers attributed their departure time to the avoidance of traffic delays. Flex-hour workers who used flex were slightly more likely to cite this reason (14%). This conscious decision made by the commuter to avoid peak periods is evidence of peak

⁸ The authors emphasise that these are very simple calculations which assume maximum take-up and the same behaviour shown by those with flexible hours. This assumption is supported by the actual socio-demographic similarities of fixed-hour and flex-hour workers. However, these simple calculations do not account for different industries, some of which would not be able to accommodate flexible work arrangements. Recognising that the actual take-up will of course vary, the figures nonetheless provide indications of the extent of the dampening of the peak-hour demand.

spreading. This phenomenon is described by Hounsell (1994) as “active” peak spreading, eg when a traveller makes a deliberate decision to re-time their departure in order to avoid congestion.

Those with flexible work hours were more likely to say that they ‘prefer an early start/finish’ (14%), compared to all workers. This indicates that flexible work hours are being used by individuals to attend to non-work demands. Albion (2004) found that amongst employees, a positive attitude towards flexible work arrangements as a means of achieving work-life balance was a predictor of actually using flexible work arrangements. Golden (2008) suggests that these preferences relate to the different stages of one’s life cycle. For example, working parents might need to juggle their family needs with their work responsibilities. Some parents might prefer to start and finish work early so that they can be home by the time the school day finishes. Indeed, the Australian Bureau of Statistics (2005) found that in New South Wales, of the carers who were in the workforce, 4% had permanently modified their usual start or finish times to care for someone.

Work demands can also be met with flexible work hours. Compared to fixed-time workers (8%) and all other workers (9%), flex-time workers (12%) were slightly more likely to note that their departure time from home was so that they could ‘start early to do extra work’.

Table 5 Reasons for departure time from home for workers with fixed work locations outside the home⁹

Work schedule	All workers	Fixed-hour workers	Flex-hour workers	Flex-hour workers who DID NOT USE flex	Flex-hour workers who USED flex
Latest departure time to arrive on time	60%	64%	37%	39%	36%
Other activities on way to work	15%	14%	15%	15%	15%
Avoid traffic delays	12%	11%	12%	9%	14%
Start early to do extra work	9%	8%	12%	16%	10%
Delayed from planned/normal time	4%	4%	5%	3%	6%
Carpool/lift arrangements	4%	5%	3%	2%	4%
Prefer early start/finish	3%	3%	14%	14%	14%
Other ¹⁰	9%	7%	19%	16%	21%

6.4 Mode of travel to work from home

Table 6 shows the (priority)¹¹ mode used to travel from home to work. All workers are most likely to drive to work, with flex-hour workers driving slightly less. Pressures on the road network are aggravated during peak periods in the day, particularly during the morning commute.

⁹ Percentages do not add to 100% because respondents can provide more than one reason.
¹⁰ ‘Other’ reasons mentioned included ‘to get parking’ and ‘to avoid public transport delays/crowding’. Figures for these reasons could not be reported because they were not categorised in the same manner in previous waves of the HTS. Figures reported in this paper reflect nine years of pooled data.
¹¹ Trips to work are considered a ‘linked trip’ possibly consisting of multiple trip legs. A linked trip is a journey from one activity to another, excluding change of mode. Where a linked trip is comprised of unlinked trips that use more than one mode, a priority mode is allocated to a hierarchy. For more details, see TDC (2009).

Those with flexible work hours are more likely to travel to work by train or bus, which can be attributed to the higher proportion working in the CBD. Demands on the rail network are also highest during peak periods.

Table 6 Mode to travel to work from home for workers with fixed work locations outside the home

Work schedule	All workers	Fixed-hour workers	Flex-hour workers	Flex-hour workers who DID NOT USE flex	Flex-hour workers who USED flex
Vehicle driver	63%	62%	49%	47%	51%
Vehicle passenger	8%	8%	5%	5%	6%
Train	15%	16%	30%	33%	28%
Bus	7%	7%	10%	9%	10%
Walk only	6%	6%	3%	5%	2%
Other	2%	2%	2%	1%	2%
Total	100%	100%	100%	100%	100%

6.5 Distance and duration details of the morning commute

As the analysis becomes more detailed, we narrow our focus to those who used flexible work arrangements (eg arrived at work before 8.01am or after 9am) as compared to those who arrived during the super-peak (8.01am-9am).

We examined whether the ‘take-up’ of flexible working conditions had an impact on one’s journey time (see Table 7). No significant differences¹² were found in the journey time of those who used their flexible work arrangements compared to those who did not. These findings replicate those in Brussels where the willingness of modifying departure time in order to reduce travel time was studied (Palma *et al*, 1997). Palma *et al*. found that when respondents shifted their departure time, their arrival time shifted by a comparable amount, suggesting that travel time savings are not the primary reasons for adjusting departure times. They also investigated the *willingness* to change departure times in order to save travel time. Car drivers travelling long distances were most willing to change their departure times.

Furthermore, in Sydney in 2007, both flex-time workers, who availed of flex and those who did not, travelled for roughly 40 minutes. Journey times were shorter when travelling by private vehicle (30 minutes) than by public transport (over 55 minutes, including wait time). There is therefore insufficient evidence to suggest that journey times for arrivals at work outside the super-peak (between 8.01am-9am), are shorter. The HTS may not be a sensitive enough instrument to pick up on such differences.

It was further hypothesised that the distance¹³ travelled from home to work might be different between these two groups, which might therefore contribute to the lack of differences in journey time. On average, workers with flexible work arrangements travel 18 kms to work. Those travelling by public transport tend to live slightly further away from work (21 km). There were no statistical differences between the two groups of flexible workers in terms of the distance they travelled to work from home.

¹² Analysis involved the use of independent sample t-tests. These were constructed using data that were weighted but *normalised* to execute proper statistical tests of significance particularly when comparing means.

¹³ Trip distances are calculated based on origin/destination x,y coordinates and the actual road network.

Table 7 Distance and duration of commute trip by mode, for flex-hour workers with fixed work locations outside the home

	Mode	All flex-hour workers who travelled from home to work	Flex-hour workers who DID NOT USE flex	Flex-hour workers who USED flex
Duration (min)	All modes	40.6	40.1	40.9
	Private vehicle	30.2	29.7	30.6
	Public transport	57.7	56.4	58.7
Distance (km)	All modes	18.4	17.3	19.3
	Private vehicle	17.8	16.6	18.6
	Public transport	21.3	20.2	22.1

6.6 Trip chaining

Overall, the majority of workers with flexible hours (78%) travelled straight from home to work without making stops along the way. Of the 22% who did make a stop on their trip to work, two-thirds (68%) ultimately arrived at work outside the 8.01am-9am peak.

For those workers with flexible hours who trip-chained, Table 8 shows their activity immediately prior to arriving at work. On the whole, these workers tended to ‘serve passengers’ (drop off or accompany someone) on their way to work. This is consistent with the growing trend in recent years of parents dropping off their children at school or childcare. (van der Ploeg, et al, 2008; Shaz and Corpuz, 2008). Serving passengers (many of whom would have fixed start times at school) on their way to work is one of the main factors dictating arrival time at work; as previously shown in Table 5, 15% of *all* workers indicated that they left home at a certain time because of activities they needed to perform on the way to work.

On their way to work, a high proportion of flex-hour workers ‘shop’, which includes buying a take-away coffee/meal or newspaper. Many who arrived before or after the peak also perform work-related business activities before arriving at the office.

Table 8 Activity engaged in on the way to work, for flex-hour workers who trip-chained and have fixed work locations outside the home

	Flex-hour workers who DID NOT USE flex	Flex-hour workers who USED flex
Work related business	3%	18%
Shopping	15%	32%
Personal business/services	7%	3%
Social/recreation	12%	10%
Serve passenger	63%	38%
Total	100%	100%

7 SUMMARY AND DISCUSSION

Palma *et al.* (1997) suggest that “Under normal travel conditions, commuters settle into a habitual set of departure times and associated schedule delays and are averse to changes.” (p 140). The HTS measures a 24-hour travel period and cannot look at an individual’s variability over a longer period of time; however, the large sample compensates for this. The

fact that Sydney residents with fixed and flexible work hours behave so similarly in their morning commute tends to support the theory that departure time habits are strong.

There may also be other factors, exogenous to those detected by the HTS, that influence one's regular departure time from home and hence the take-up of flexible work hours. Such factors could be other family members' schedules, retail hours, school hours, daylight hours, or negative attitudes towards flexible work hours (which could be perceived barriers to career development (Albion, 2004) or a lack of organisational support (Almer, *et al.*, 2003)). Caring for family members might be a regular part of one's schedule for which people have already adapted their typical work hours. On the other hand, irregular or unforeseen occurrences could influence one's departure time. By their very nature, flexible work arrangements are more accommodating of these types of events.

Despite the fact that the take-up of flexible work hours is already high (61% arrived at work outside the super-peak period), the addition of other forms of flexible work arrangements could further reduce the morning peak. For example, an employee taking up the 48/52 leave scheme, in which an employee effectively buys an additional four weeks of holiday and their reduced salary is spread over the entire year, would make 20 fewer morning commute trips in a year. Another extension of flexible work hours that would lessen the demand on the network (and would not financially disadvantage an employee), is in the form of compressed work weeks. With compressed work weeks, one works full-time hours over four days or two weeks' worth over nine days. Rather than potentially spreading the peak, compressed work weeks have the capability of reducing all commute trips by 10%-20%. Over a 12-year period, Zhou and Winters (2008) found an increasing participation rate in compressed work weeks, reaching over 20% in 2005 in Washington state. They found that the take-up for compressed work weeks was higher for those living further from work, thus having an even greater impact on reducing demand on the network and have the added benefit of reducing greenhouse gas emissions.

8 CONCLUSIONS

We have empirically demonstrated that by choice, 61% of flex-time workers arrive at work outside the super-peak period of 8.01am-9am. Granted, flex-time workers' commute behaviour seem to mirror those of fixed-time workers. The difference is that fixed-time workers are *required* to commute during the heightened peak. Simple calculations have shown that if flexible work hours were to be extended to fixed-hour workers (who are currently required to arrive at work during the super-peak), then peak-spreading would be achieved. Furthermore, the impact, under certain assumptions, does not appear to be insubstantial. These calculations assume a 61% take-up of flexible hours; but it is expected that actual take-up would likely be influenced by other factors, many of which are qualitative and not easily assessable for this purpose.

Furthermore, there is already a degree of variability of required start times at work amongst fixed-hour workers, which already contributes to peak spreading. Prescribed staggered start times outside the peak could therefore be given consideration, where appropriate, for different employment sectors to maximise this effect. Such measures, along with other strategies, like teleworking or carpooling, will have an even greater combined impact on making a molehill out of a mountain of the morning commute.

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