Non-standard work timing: evidence from the Australian Time Use Survey*

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Abstract

Non-standard work is relatively common in Australia, with 63 per cent of weekday workers aged between 20 and 59 years working sometime outside 8am to 6pm. However, only 15 per cent of all working-time takes place outside standard hours. Workers in a range of service and manual industries, such as hospitality, health, mining and manufacturing, have high rates of work at non-standard times. Working long hours or part-time increases the chance of working at non-standard times, and there is some evidence that workers without post-school qualifications, in low-skill occupations and from non-English speaking backgrounds are disproportionately more likely to work at non-standard times.

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I Introduction

The standard model of working time can be roughly defined as a male breadwinner, working 35-40 hours per week, forty-eight weeks of the year, for around forty years of his life. Work takes place in the daylight hours and is spread evenly over the week, generally from Monday to Friday (Allan et al. 1998; Buchanan & Bearfield 1997; Burgess 1998).

Since the 1950s, the standard model has played a major role in shaping the labour market, taxation, superannuation and welfare systems in Australia. In light of recent labour market reforms, particularly the shift towards decentralised bargaining, there is a great deal of interest in working arrangements, and the implications of changing working arrangements for worker welfare. The standard model of working time has provided an important benchmark for research into emerging 'non-standard' working arrangements, such as long weekly hours, casual work and absenteeism. However, only a relatively small amount of research has been done on work outside standard hours, such as at night or on weekends, primarily because of a lack of relevant data (Burgess 1998).

This paper uses data from the most recent Australian Time Use Survey to examine the extent of work at non-standard times in Australia and the characteristics of those who work at non-standard times. Specifically, the paper aims to address three main questions:

(i) What is the standard working day in Australia?

(ii) How prevalent is work at non-standard times? How does Australia compare with other countries?

(iii) What factors affect the likelihood of working at non-standard times? What role do workers preferences and firm requirements play in determining work schedules? Is there evidence of a relationship between earnings potential and work at non-standard times?

The paper extends the existing literature on work at non-standard times in several ways. Firstly, it defines the standard working day in Australia based on observed worker

behaviour and provides a comprehensive description of the extent of work in the morning (5 am to 8 am), evening (6 pm to midnight) and at night (midnight to 5 am). Secondly, the paper provides a comparison of rates of non-standard work between Australia and other developed countries. Thirdly, findings from a multivariate regression analysis of the characteristics of non-standard times workers are presented. The Tobit model used in that analysis is an extension of the methods used in similar overseas studies, incorporating the amount of daily working time that takes place at non-standard times rather than simply a binary variable representing work at non-standard times. This makes use of the unique characteristics of time use data, and increases the robustness of the model to changes in the definition of standard and non-standard times.

The paper is organised as follows. Section II reviews previous research on work at non-standard times in Australia. Section III presents some theoretical background for the regression analysis. Section IV provides a discussion of the data source and outlines the Australian and international evidence on the extent of work at non-standard times. The regression model is discussed in section V, and results presented in section VI. The paper concludes in section VII.

II Previous Australian research on non-standard work timing

Existing research on work at non-standard times in Australia is mainly descriptive. Recent research, for example, finds that in 2000, around 55 per cent of employees worked during non-standard hours (defined by the ABS as working at some time between 7 pm and 7 am in the past four weeks) (ABS 2001). Other studies using irregular ABS data and smaller surveys of firms from the 1980s and 1990s show that around 6 per cent of workers work before 6 am, and 11 per cent work between 6 pm and midnight. Night work affects between 3 and 10 per cent of workers (Allan et al. 1998; Dawkins 1985).

Men are more likely than women to work at non-standard times of day such as early morning, evening and night. Night work is most common amongst trades and production workers, those in the mining, transport, manufacturing, recreational and personal services

industries, and public sector workers (Allan et al. 1998; Dawkins 1985). Workers in the service sector are twice as likely as others to work in the evening (Allan et al. 1998).

The inconsistency and irregularity of data on work timing makes it difficult to examine changes in timing patterns over time. Buchanan et al. (2001) summarise available ABS data and find that between 1983 and 2000 the proportion of the workforce working only between Monday and Friday has fallen slightly from 76 per cent to 73 per cent. Bittman and Rice (2002) use data from the Australian Time Use Surveys to examine changes in what they term 'unsociable' working hours between 1974 and 1997[1]. They find that the number of unsociable hours worked has increased by one hour per week for men and three hours per week for women. However, they do not control for increases in the average weekly hours over this time period, or differences in the population sampled in successive time use surveys.

Working time arrangements feature prominently in the Australia literature on enterprise bargaining. Changes to industrial relations institutions since the 1980s, particularly the rise of enterprise agreements, may have increased the potential for work at non-standard times. Examination of enterprise agreements has found that clauses relating to working hours are common and include changes (relative to previous awards or agreements) to start and finishing times, reduction or abolition of penalty rates and casual loadings and increasing the span of ordinary hours (that is, those for which overtime rates do not apply), sometimes to more than 12 hours (Charlesworth 1996; Heiler 1998).

There is a widespread belief amongst industrial relations researchers that changes to the regulatory environment have left workers with less control over working time arrangements: 'the changes are largely in the direction of 'employer-oriented flexibility' and a degradation of conditions for employees' (Campbell & Brosnan 1999, p. 384). In contrast, reform supporters claim that new working time arrangements have had a positive effect on worker welfare: 'flexible working hours are significant in positively influencing

[1] 'Unsociable' working hours are defined as hours other than between 9 am to 5 pm on weekdays.

the ability of an employee to be satisfied with their job, and balance their work and family responsibilities' (Reith 1999, pp. 224-225).

In summary, previous Australian research on work at non-standard times shows that it is common, and perhaps increasing in importance. However, there is no clear definition of a standard working day in Australia, and therefore what constitutes non-standard working arrangements. Adopting definitions of standard and non-standard hours of work that are consistent with similar research overseas could allow comparison of Australian and international working conditions. In addition, a deeper understanding of the characteristics of those who work at non-standard times could illuminate the debate about the effect on worker welfare of changes to working time arrangements.

III Theoretical framework

Hamermesh (1996; 1999) develops a model incorporating time-dependent utility maximising workers, and firms with time-dependent demand for labour. Equilibrium in this labour market for work at different times of the day occurs through equalising differences (Rosen 1986). Workers and firms are matched, and the terms of employment involve wage rates that reflect the non-pecuniary benefits or costs to the worker of working at particular times and productivity benefits to the firm of hiring labour at particular times of the day.

Hamermesh uses a simplified version of Wintson's (1982) model, where workers maximise their daily utility subject to a standard budget constraint based on income and consumption. The choice to work at each point in time depends on the marginal rate of substitution of consumption for leisure time and the time-varying wage rate:

$$\frac{(-\Delta U_{it} / \Delta L_t)}{(\Delta U_{it} / \Delta C_t)} \leq w_{it}$$

That is, a worker will only work at time t if the reduction in utility from less leisure time is equal to the increased utility from consumption of the wage earned by working at time t. The marginal utility of leisure and the marginal utility of consumption are assumed

to vary for each worker over times of the day, perhaps in line with personal characteristics such as family responsibilities or study commitments.

Hamermesh assumes that a majority of workers see work at non-standard times as inferior. Thus the wage paid for working at non-standard times will need to include some compensation for inferior nature of non-standard work to induce sufficient labour supply at non-standard times. As the wage paid for non-standard work increases compared to the average wage rate, more workers will be prepared to work at non-standard times.

Firms offer work at non-standard times if the addition to revenue from employing workers at non-standard times is greater than or equal to the wage paid to entice workers to work at non-standard times. The greater the wage premium, the fewer the number of firms who will find it profitable to offer work at non-standard times.

Equilibrium in the labour market for work at non-standard times occurs when the wage premium is such that the number of workers willing to work at each non-standard time equals the number of jobs offered at that time. The nature of the equilibrium is that, on average, workers with the least dislike of work at non-standard times work for the firms with the greatest productivity benefits from offering work at non-standard times.

Hamermesh's model allows some inferences to be made about the characteristics of workers and jobs at non-standard times. In general, the theory of equalising differences predicts that workers with higher incomes or greater capacity to earn higher incomes are able, as it were, to 'consume' better working conditions (Rosen 1986). To see this more clearly, it is helpful to think of the problem as a market for work at standard (superior) times of day. The cost of 'buying' work at standard times is the wage differential given up by not working at non-standard (inferior) times of day. As incomes increase, workers can afford to consume more work at standard times. In this case, workers with greater abilities or incomes could potentially be less likely to work at non-standard times. In addition, firms with the highest revenue gains from offering work at non-standard times are more likely to employ workers at non-standard times. Profit or productivity gains from

operating at non-standard times could be reliant on production technologies, consumer demand or the availability and cost of other inputs.

In summary, the limited theory on the timing of work over the day predicts that labour supply and demand factors are likely to play a role in determining work at non-standard times. In addition, if the assumption that work at non-standard times is viewed as inferior by a majority of workers is correct, we could expect to see workers with lower earnings potential disproportionately working at non-standard times, whilst those with higher earnings potential may be more likely to work during standard hours.

IV Data

This paper uses data from the most recent Australian Time Use Survey (TUS), conducted by the ABS in 1997. The survey involved persons over the age of 15 years in selected households filling in a time use diary for two consecutive days, detailing their activities over the day in five-minute intervals. Activities were then coded into 216 time use categories, including 14 relating to paid work.

The survey was conducted over four periods so that the results reflect approximately the correct number of weekdays, weekends and holidays, and seasonal variations in time use. The resulting diary day records were weighted by the ABS to reflect population benchmarks. The response rate was 84.5 per cent.

Work is defined in the following analysis as usual or extra hours in main or other job, plus work brought home. It does not include unpaid work in family business or farm, work breaks or meal breaks at work (except when the respondent was working whilst eating and work was indicated as the primary activity), time spent travelling to or from work, work related training, or job search. This definition was chosen because it coincides most closely with the traditional view of working time (that is, time spent working), excluding work-related travel. Other excluded categories represent only a small number of total work-related episodes of time use, thus have little impact on the overall results.

After selecting only episodes that include work (as defined above), start and finish times for each episode were used to construct 288 variables indicating whether or not a worker was working during each five minute interval of the day. These were then aggregated to generate variables indicating whether work was done during each hour of the day, the number of minutes (in five minute intervals) worked during each hour of the day, and the proportion of total daily working time that took place during each hour of the day.

The sample population used in the following analysis comprises employed persons aged between 20 and 59 years who worked at some time on their diary day. A small number of observations were removed because they contained incomplete information about weekly earnings.

Only weekdays are included in the analysis. While rates of non-standard work on weekends are quite high and the issue of non-standard work on weekends is important, it is not feasible to consider it here due to the small sample size of people working on weekends. Thus the analysis will concentrate on work on weekdays only[2]. This is analogous with the approach taken in comparable studies overseas (Callister & Dixon 2000; Hamermesh 1996).

The sample size used in the analysis is 4044 days containing at least one episode of work: 2402 for men and 1642 for women. The sample does not necessarily include two days for each person due to incomplete diaries and the fact that one diary day may be on a weekend. All estimates and regressions are weighted using the weights at the diary day level provided by the ABS.

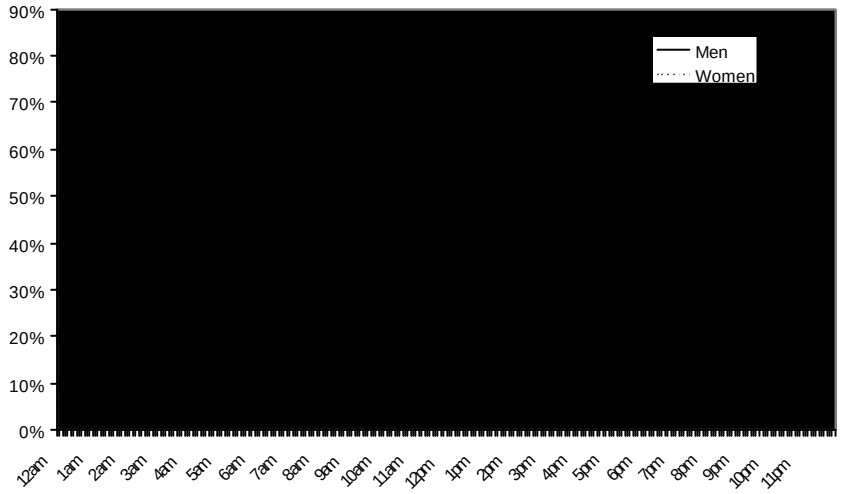
[2] Wald tests for pooling weekday and weekend data in the Tobit regressions in Section V rejected the hypothesis that the coefficients on explanatory variables for weekend days and weekdays were equal, therefore observations for weekend days could not be included in the sample. In addition, the sample size of employed persons working on weekends was small, precluding a separate analysis of non-standard work on weekends.

Two principal measures will be used to describe work timing patterns. The *proportion of workers working* is examined to determine the probability that a person is working at a particular time of day, given that they work at some time on that day. The *proportion of total working time* that takes place during a time period (such as between 9 am and 5 pm) is a measure of the concentration of work at particular times. This measure is most useful when comparing groups with different total daily work hours as it shows the relative importance of work at different times, regardless of total hours worked.

Note the distinction between worker and employed person: a *worker* is someone who worked at some time on their diary day; an *employed person* is someone who is classified as employed, but who may or may not have worked on their diary day.

Figure 1 shows the average work timing patterns of male and female workers on weekdays (Monday to Friday). Overall the distribution of work is what we would expect: most people are at work between 9 am and 5 pm and very small numbers work at night. However, the prevalence of work in the morning and evening is striking. Around 43 per cent of workers are working by 8 am, and 12 per cent of are still working after 8 pm.

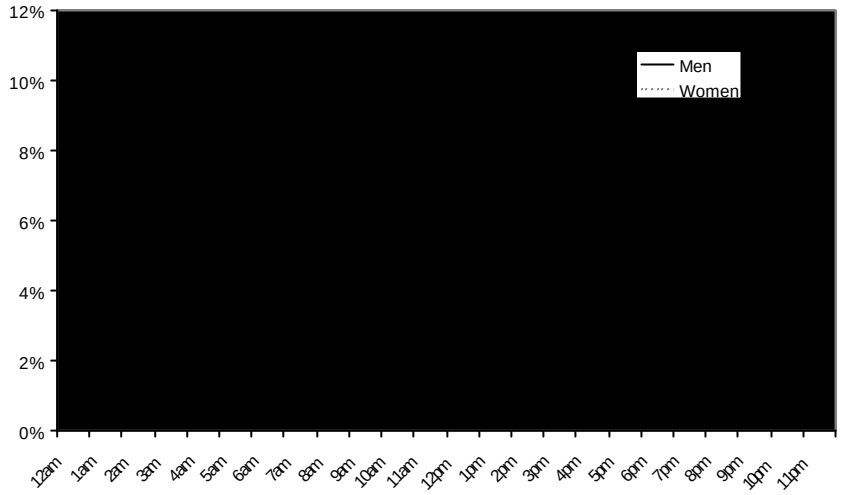
Figure 1 Proportion of workers working, weekdays, 1997



Men work longer hours than women on average and are therefore more likely to be working at each time during the day. Figure 2 shows the distribution of total working-time over the day for men and women. Women's work is concentrated between 9 am and 4 pm, whilst men spend a significantly larger proportion of time working in the early morning.

The dip in work in the middle of the day is mainly due to workers taking lunch breaks, however around 10 per cent of workers end work for the day between 12 pm and 2 pm. There is no significant difference in the amount of time spent working in the evening or at night.

Figure 2 Proportion of total working time, weekdays, 1997



The standard working weekday is defined for the purposes of this study as running from 8 am to 6 pm. This definition is adopted based on analysis of start and finish times of workers in the sample, whereby the most frequent starting time is between 8.00 am and 8.55 am and the most frequent finishing time is between 5.00 pm and 5.55 pm[3]. It also provides a definition of standard hours comparable with similar studies of Australian and New Zealand working time (Allan et al. 1998; Callister & Dixon 2001).

Based on this definition of standard hours and the definition of non-standard work used in previous studies, a number of classifications for non-standard work will be used to examine the extent and characteristics of non-standard work. 'Morning' is defined as the period between 5 am and 8 am. 'Evening' is defined as the period between 6 pm and midnight. 'Night' is defined as the period between midnight and 5 am.

Table 1 shows the extent of work at standard and non-standard times in Australia. Work at non-standard times is more common for men than for women. Morning work is

the most prevalent form of non-standard work, affecting 44 per cent of workers. However it only accounts for 5 per cent of all working time, indicating that many morning workers only work for a short period before 8 am. Evening work affects 31 per cent of workers and accounts for 8 per cent of working time. Night work is the least common form of non-standard working time.

Table 1 Extent of work at non-standard time, weekdays, 1997

	% of workers			% of working time		
	Women	Men	Total	Women	Men	Total
Standard (8 am-6 pm)	96	96	96	88	83	85
Morning (5 am-8 am)	27	55	44	3	7	5
Evening (6 pm-midnight)	25	34	31	8	8	8
Night (midnight-5 am)	3	7	6	1	2	2
Non-standard (6 pm-8 am)	47	75	63	12	17	15
Sample size	1642	2402	4044	1642	2402	4044

A range of international studies use surveys and time use data to provide estimates of the extent of work at non-standard times[4]. A general finding in the international literature is that whilst non-standard work is common, it accounts for only a small amount of total working time. This is confirmed by the Australian results presented above, which show that although 63 per cent of workers work at non-standard times, only 15 per cent of work is done outside 8 am to 6 pm. Indeed, less than 4 per cent of weekday workers work all their hours outside standard times.

Table 2 shows that, by world standards, the rate of evening work in Australia seems to be high and the rate of night work is low. Compared with New Zealand, Australia has a much higher rate of work at non-standard times, primarily because Australian rates of evening work are almost double those in New Zealand. Night work is slightly more common in New Zealand, but the amount of total working time that is done in each period is similar for both countries.

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[3] This method is used by Harvey et al. (2000), who, amongst international studies of non-standard work timing, provide the only systematic method for defining standard working hours.

[4] Unfortunately in most cases the disparity in data sources and definitions of non-standard times in the international literature makes comparison with Australian findings difficult. In terms of definitions and data

Using a slightly different definition of non-standard and night, Australia has lower rates of non-standard work than the US, Canada, Finland and Sweden. Evening work rates are similar to those in Canada and Finland, whilst night work is less common in Australia than in the other four countries. Hamermesh (1999) shows that for the US, the rate of night work fell between the 1970s and early 1990s, and work on the fringes of the traditional working day increased in importance. The international data presented in Table 2 are between five and twelve years older than the Australian data. Thus international differences in night work may be reflective of the different periods examined, rather than any underlying differences in hours of work.

Table 2 Percentage of workers working at non-standard times on weekdays in Australia and selected countries

		Non-std	Evening	Night
		6pm-8am	6pm-12am	12am-5am
Australia	1997	63	31	6
New Zealand	1999	40	17	7
		6pm-6am	6pm-12am	12am-6am
Australia[a]	1997	37	31	10
United States	1985	45	27	12
Canada	1992	45	29	12
Finland	1986-87	43	29	11
Sweden	1990-91	42	24	14

Sources: Harvey 1996; Callister and Dixon 2001

a. These figures have been generated to enable comparison with Harvey's (1996) results. These definitions will not be used elsewhere in this paper.

V Regression model

(i) Model specification

The multivariate analyses of non-standard work in this section will use a Tobit model with left- and right-censoring to estimate the probability of working at non-standard times. The dependent variable is the number of minutes worked at the non-standard time during the day, given working at all on that day. Some workers do not work at all during non-standard times, so their minutes of work at non-standard time are treated as left-censored,

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used, Callister and Dixon (2001) and Harvey (1996) provide the most reliable estimates for comparison, as they use time use data and have the similar definitions for evening and night periods.

while some workers work for the entire non-standard period, and hence their observations are treated as right-censored.

The availability of time use data enables a Tobit model to be used in preference to the binary choice model used in previous studies[5], taking into account the amount of time worked at non-standard times. For example, using a probit model, a person who worked for five minutes in the evening is treated the same as a person who worked for three hours in the evening. Using a Tobit makes better use of the characteristics of the data and is more robust to changes to the definitions of standard and non-standard times[6].

The regression model is as follows:

$$y_i^* = F(a + X_i' b_i + W_i' g_i)$$

where:

$$y = \begin{cases} 0 \; if \;\; y^* \le 0 \\ y^* \; if \;\; 0 < y^* < m \\ 1 \; if \;\; y^* \ge m \end{cases}$$

and y is the number of minutes worked during a particular period (for example, between 5 am and 8am), which can vary between 0 (no time worked between 5 am and 8 am) and m (m = 180 representing those who work for the entire time period). X is a vector of personal and demographic characteristics, and W is a vector of job characteristics. A control is also included for total hours of work on the diary day.

The choice of independent variables was based on previous studies of the characteristics of non-standard time workers (Allan et al. 1998; Callister & Dixon 2001;

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[5] Hamermesh (1996) and Callister and Dixon (2001) estimate the impact of a variety of personal and job characteristics on the probability of working at non-standard times. Hamermesh uses a linear regression model (although states that a probit model would be more appropriate), whilst Callister and Dixon use a logit model. Both model the effects for men and women separately, with the dependent variable a zero-one variable indicating whether or not the worker worked during non-standard times.

[6] A probit model using the zero-one indicator variable was also used for comparison with the Tobit results. The results were similar, but the Tobit model was thought to be more appropriate given the additional information it incorporates.

Galarneau 1994; Golden 2001; Hamermesh 1996; Harkness 1999; Presser 1995). These can be broadly divided into personal characteristics (age, marital status, age of children, student status, ethnicity, geographical location, education) and job characteristics (industry, occupation, employment status, number of jobs, weekly income, weekly hours of work).

Age and age squared are included to control for both life cycle effects and as a proxy for experience. Age is given in five-year bands in the TUS, so was recoded to reflect the midpoint of each band. It is likely that work schedules are influenced by family and study commitments, so marital status, presence of children of preschool (0-4 years) and school (5-14 years) age, and whether or not a full-time student under the age of 25 years are included as explanatory variables.

Being a recently arrived immigrant and having poor English language skills are important determinants of labour market outcomes (Wooden & VandenHeuvel 1997). However, including dummies for birthplace and year of arrival in Australia did not seem to have a significant effect on the model. There was also a problem of collinearity, in that English language skills are correlated with year of arrival in Australia, and there is some correlation between birthplace and year of arrival. The final model includes a dummy variable for being born overseas and having a first language other than English.

Hamermesh (1996) found that US workers outside major urban areas were more likely to work at night than those in large cities. The only geographical information provided in the dataset is whether or not the respondent resided in a capital city, another major urban area, or in a rural area. These were included in the model.

Level of education was included in the model as a measure of earnings power, represented by a set of five dummy variables: did not finish high school; vocational qualification; diploma; degree. Year 12 qualifications is the omitted category.

Job characteristics were controlled for by the inclusion of dummy variables for being a multiple job holder, employer, self employed and weekly hours of work (7 variables). Ideally, wage rates or earnings should be included to test the earnings potential hypothesis

directly. Unfortunately, the income measure in the TUS includes all weekly cash income, such as salaries, profits, transfers and superannuation. Although these are potentially poor measures of earnings[7], weekly income and income squared are included, where the values are the midpoints of income bands reported in the survey.

Finally, although the model is only indicative of the correlates of work at non-standard times rather than a structural model of supply and demand influences, occupation (8 variables) and industry (16 variables) characteristics are included to control for demand side influences.

In the absence of any clear functional form for heteroskedasticity in the model, White-corrected standard errors were calculated. Therefore standard errors and hypothesis tests for individual variables are robust for the presence of heteroskedasticity. In addition, the data contain up to two diary days for each individual in the sample. Although it is reasonable to assume that the errors are independently generated for each person, errors will potentially be correlated between the two diary days of the same person. Robust standard errors calculated assume that errors are independent between individuals in the sample, but not between two diary days of the same person[8].

The regressions use only data for workers (people who worked at some time on diary day). Therefore the results show the probability of working at non-standard times, conditional on working at all.

(ii) Model evaluation

For men and women separately, three regressions were estimated for minutes worked at non-standard hours (6 pm to 8 am) and for each non-standard time period (morning (5 am to 8 am), evening (6 pm to midnight) and night (midnight to 5 am)). Tests for pooling the

[7] Main source of cash income was reported as: wages or salaries 85 per cent; profits from own business or partnership 11 per cent; government benefits 2 per cent; superannuation or other investment income 1 per cent; other income 1 per cent.

[8] Robust standard errors were calculated using the robust cluster(*var*) command in STATA version 7.

data rejected the hypotheses that the coefficients from female and male models were equal, so running separate regressions for women and men is justified.

Table 3 shows the actual and predicted likelihood of working at each non-standard time of day, and the percentage of correct predictions for men and women. Two types of predicted probability are shown. The first is the predicted probability of working at the non-standard time calculated at the mean value of all independent variables. This is the probability that a person with the average characteristics of the whole sample will work more than zero minutes at the non-standard time. The second calculation is the mean predicted probability of working at the non-standard time for all people in the sample. This is the proportion of people in the sample for whom the model predicts minutes worked at the non-standard time are greater than zero. The percentage of correct predictions compares the models' predictions of the likelihood of working non-zero minutes at the non-standard time with the actual observation of work at non-standard times for each person in the sample.

Table 3 Model predictions

		Actual probability Pr(y>0)	Predicted probability at mean[a]	Mean predicted probability[b]	% correctly predicted
Non-standard (6pm-8am)	Men	0.7460	0.7027	0.7899	79.6
	Women	0.4683	0.4250	0.3892	69.7
Morning (5am-8am)	Men	0.5520	0.5581	0.5884	72.7
	Women	0.2667	0.2195	0.1338	78.0
Evening (6pm-midnight)	Men	0.3443	0.3169	0.2113	75.8
	Women	0.2479	0.2164	0.1128	79.4
Night (midnight-5am)	Men	0.0729	0.0503	0.0022	92.4
	Women	0.0311	0.0002	0.0031	96.9

a. $\Pr(y > 0) = \Pr(y > 0 \mid \bar{x}_i)$

b. $\Pr(y > 0) = \frac{1}{N} \sum_{i=1}^{N} \Pr(y_i > 0 \mid x_i)$

Overall, the model evaluated at the mean values for the sample under-predicts the likelihood of working at non-standard times slightly. The mean predicted probabilities show that the model overpredicts the likelihood of the most frequent outcome occurring. For example, around 75 per cent of men in the sample work at non-standard times overall, while the model predicts that $y > 0$ for almost 79 per cent of the sample. In contrast, around 75 per cent of women do not work in the evening, while the model predicts around

88 per cent of the sample will not work in the evening. This tends to distort the percentage of correct predictions, whereby the percentage of correct predictions is higher when the actual probabilities of each outcome are not close to 50 per cent.

The models are particularly poor-performing in predicting the probability of night work. Around 7 per cent of men and 3 per cent of women in the sample work at night, but the models vastly under-predict the likelihood of any person in the sample working at night. However, when the probability of night work is calculated at the sample mean, the result for men is much closer to the actual probability. As the marginal effects reported in the next results section are calculated at the sample mean, the results of the night work model for men were retained. However, even at the sample mean, the model for women predicts that only 0.02 per cent of women will work at night. Thus the results for night work for women were discarded and the discussion of night work in the next section is for male workers only.

VI Results

Table 4 shows the results of regressions of personal and job characteristics on the number of minutes worked in the morning, evening, at night, and at non-standard times in general (that is, outside 8am-6pm). The marginal effects reported in Table 4 reflect the change in the probability of working during the non-standard time period associated with a change in each explanatory variable, evaluated at the sample mean:

$$\text{Marginal effect} = \frac{\partial(\Pr(y^* > 0 \mid \overline{x}_i))}{\partial x}$$

Due to the nature of the data, all variables except age, age squared, income, income squared, and daily hours of work are dummy variables. For dummy variables, the marginal effects reflect the change in the probability of working at non-standard times associated with a change from zero to one in the dummy variable, holding all other variables constant at their mean values, compared with the comparison category:

$$\text{Marginal effect} = \frac{\partial(\Pr(y^* > 0))}{\partial x_k} = \left[\Pr(y^* > 0 \mid \overline{x}_{-k}, x_k = 1)\right] - \left[\Pr(y^* > 0 \mid \overline{x}_{-k}, x_k = 0)\right]$$

where x_k is a dummy variable and $\overline{x}_{-k}$ is the mean of all other variables.

The overriding impression from the results is that the determinants of work at non-standard times vary depending on the time of day under analysis, and that the determinants are different for women and men.

Moreover, the simple model presented does not provide a structural account of the influence of demand and supply factors on work schedules. Nevertheless, some general remarks can be made about the relative impact of various factors on the likelihood of working at non-standard times.

Occupation and industry are by far the most important determinants of work at non-standard times. Overall, industry changes the likelihood of work at non-standard times by 11 to 68 per cent for women, and 4 to 41 per cent for men, whilst occupation changes the likelihood by 11 to 33 per cent for women and 4 to 32 per cent for men.

In Australia, there seems to be no clear distinction between service and non-service industries in terms of work schedules. Whilst service industries such as hospitality, recreational services and health have high rates of non-standard work, so do some manual industries such as manufacturing, mining, transport and construction.

It is feasible to link the high rates of non-standard work timing in these industries with production or consumer demand characteristics. For example, the manufacturing and mining industries are highly capital intensive and users of continuous production methods, and also have high rates of work at various non-standard times of day.

Service industries with high rates of non-standard work are those which are more likely to have consumer demand at non-standard times, such as hospitality, health and personal services. Although far from conclusive, this lends weight to the argument that labour demand factors are important determinants of work schedules.

Table 4 Marginal effects of explanatory variables on probability of working at non-standard times, weekdays, 1997

Variable (*Comparison category shown in italics*)		Non-standard (6pm-8am)				Morning (5am-8am)			
		Men		Women		Men		Women	
		ME	p-value	ME	p-value	ME	p-value	ME	p-value
Age		-0.0114	0.200	0.0216	0.130	-0.0211*	0.071	0.0105	0.386
Age^2/100		0.0136	0.208	-0.0301*	0.099	0.0284*	0.059	-0.0106	0.494
Married		0.0029	0.928	-0.0710**	0.041	-0.0072	0.839	0.0071	0.820
Youngest child 0-4 years		-0.0147	0.663	0.0293	0.662	-0.0074	0.863	-0.0296	0.578
Youngest child 5-14 years		-0.0195	0.437	-0.0569	0.179	0.0363	0.275	-0.1150**	0.001
Location	Other urban	0.0261	0.325	-0.0783**	0.044	0.0115	0.709	-0.0466	0.143
(Capital city)	Rural	0.0142	0.642	-0.0245	0.531	0.0928**	0.008	-0.0124	0.760
Born NES country		0.0711**	0.034	0.0502	0.361	-0.0065	0.881	0.0012	0.997
Full-time student under 25 years		0.2411**	0.035	0.1559	0.257	0.0716	0.761	-0.0581	0.579
	Did not finish HS	0.0596	0.102	-0.0352	0.564	0.0999**	0.024	0.0278	0.568
Education	Vocational	0.0227	0.520	-0.0380	0.535	0.0818*	0.051	-0.0186	0.686
(Year 12)	Diploma	0.0312	0.501	-0.0755	0.301	0.0071	0.897	-0.0639	0.215
	Degree	-0.0179	0.711	-0.1479**	0.041	-0.0660	0.235	-0.0632	0.203
Employment status	Employer	-0.0856**	0.034	-0.0095	0.887	-0.1537**	0.010	-0.0394	0.559
(Employee)	Self employed	0.0116	0.737	0.0499	0.454	-0.0308	0.475	0.0731	0.277
Multiple job holder		0.0503	0.183	0.1262**	0.009	0.0884*	0.051	-0.0192	0.660
	1-15 hours	0.0782	0.404	0.1615*	0.071	-0.0970	0.483	-0.1244*	0.063
	16-24 hours	0.0657	0.472	0.0680	0.351	0.0059	0.974	-0.1008**	0.046
Weekly hours	25-34 hours	0.1127*	0.051	0.1433**	0.043	-0.0592	0.492	0.0301	0.580
(40 hours)	35-39 hours	0.0048	0.897	-0.0454	0.294	-0.0037	0.926	-0.0114	0.784
	41-48 hours	0.0467	0.192	-0.0290	0.577	-0.0174	0.692	-0.0096	0.838
	49+ hours	0.0596*	0.072	0.1512**	0.003	0.0085	0.828	0.0109	0.821
Weekly income/100		0.0192	0.260	0.0176	0.514	0.0271	0.221	0.0106	0.677
Weekly income^2/10000		-0.0008	0.509	-0.0023	0.251	-0.0015	0.329	-0.0017	0.415
	Manager	0.0096	0.820	0.2059**	0.031	0.0858	0.132	-0.0010	0.988
	Professional	-0.0053	0.911	0.1908**	0.003	-0.0180	0.759	0.0785	0.101
	Assoc professional	0.0620	0.218	0.0460	0.382	0.0717	0.246	0.0429	0.366
Occupation	Tradesperson	0.0861**	0.037	-0.0585	0.482	0.2129**	0.000	0.0013	0.989
(Intermediate service)	Advanced service	-0.0706	0.433	-0.1910**	0.000	-0.0159	0.879	-0.1156**	0.007
	Intermediate prodn	0.1496**	0.000	0.2677**	0.004	0.2703**	0.000	0.1431*	0.085
	Elementary service	0.1445**	0.039	0.1954**	0.000	0.1299	0.154	0.1999**	0.000
	Labourer	0.2027**	0.000	0.2569**	0.000	0.3189**	0.000	0.3332**	0.000
	Agriculture	-0.0531	0.428	0.0459	0.734	0.1269	0.154	0.2152	0.142
	Mining	0.2848**	0.000	0.3400	0.106	0.1803	0.174	0.6816**	0.000
	Manufacturing	0.0727	0.133	0.1478**	0.051	0.1404**	0.037	0.2815**	0.004
	Utilities	0.1208	0.349	-0.1935	0.351	0.1973**	0.046	0.1120	0.637
	Construction	-0.0220	0.656	0.1830	0.105	0.1316**	0.050	0.3637**	0.013
	Wholesale	-0.0846	0.153	0.1057	0.242	0.0766	0.353	0.1832*	0.067
	Retail	-0.0395	0.502	-0.0075	0.915	-0.0328	0.683	0.0442	0.595
Industry	Hospitality	0.2560**	0.000	0.3932**	0.000	0.0162	0.902	0.1554	0.111
(Business services)	Transport	0.0444	0.434	0.1941*	0.088	0.1303*	0.074	0.1969	0.155
	Communication	0.0500	0.442	0.0500	0.617	0.0755	0.326	0.2810**	0.050
	Finance	0.0311	0.686	0.0069	0.933	-0.0342	0.691	0.0908	0.288
	Government	-0.0453	0.485	-0.0497	0.492	0.1050	0.196	-0.0162	0.862
	Education	0.0115	0.826	0.0428	0.506	0.0072	0.934	0.1198	0.161
	Health	-0.0183	0.804	0.2466**	0.000	0.0130	0.891	0.3422**	0.000
	Recreation	0.1138	0.130	0.2725**	0.030	0.0800	0.424	0.1842	0.135
	Personal services	0.1346*	0.076	0.0254	0.769	0.0806	0.335	0.1778	0.164
Daily hours of work		0.0812**	0.000	0.0768**	0.000	0.0761**	0.000	0.0450**	0.000
Sample size		2402		1642		2402		1642	
Log likelihood		-11593.3		-5351.0		-7831.8		-2897.2	

Table 4 (continued)

Variable (*Comparison category shown in italics*)		Evening (6pm-midnght)				Night (midnight-5am)	
		Men		Women		Men	
		ME	p-value	ME	p-value	ME	p-value
Age		0.0051	0.614	0.0092	0.448	-0.0068	0.128
Age²/100		-0.0074	0.553	-0.0161	0.306	0.0076	0.174
Married		0.0185	0.588	-0.0612*	0.051	-0.0049	0.757
Youngest child 0-4 years		0.0122	0.749	0.0225	0.629	-0.0011	0.949
Youngest child 5-14 years		-0.0231	0.453	0.0187	0.594	-0.0131	0.367
Location	Other urban	0.0087	0.776	-0.0542*	0.079	0.0009	0.945
(Capital city)	Rural	-0.0623*	0.084	0.0018	0.958	-0.0132	0.420
Born NES country		0.0715*	0.093	0.0505	0.246	0.0217	0.216
Full-time student under 25 years		0.4067**	0.009	0.1356	0.253	0.0383	0.494
	Did not finish HS	-0.0063	0.884	-0.0182	0.702	0.0217	0.300
Education	Vocational	-0.0145	0.724	0.0105	0.823	0.0110	0.579
(Year 12)	Diploma	0.0586	0.266	0.0104	0.847	0.0103	0.704
	Degree	0.0298	0.565	-0.0426	0.383	0.0010	0.970
Employment status	Employer	0.0265	0.512	0.0473	0.458	-0.0422**	0.022
(Employee)	Self employed	0.0946**	0.016	0.0238	0.672	-0.0015	0.944
Multiple job holder		0.0231	0.565	0.1495**	0.000	0.0155	0.454
	1-15 hours	0.2225**	0.033	0.2827**	0.001	0.0111	0.803
	16-24 hours	0.1485	0.203	0.1476**	0.022	0.0028	0.944
Weekly hours	25-34 hours	0.2428**	0.001	0.1311**	0.022	-0.0160	0.594
(40 hours)	35-39 hours	0.0075	0.875	-0.0251	0.511	-0.0216	0.238
	41-48 hours	0.0876*	0.055	0.0070	0.877	-0.0019	0.914
	49+ hours	0.1117**	0.004	0.1632**	0.001	0.0183	0.306
Weekly income/100		0.0079	0.654	0.0150	0.504	-0.0008	0.936
Weekly income²/10000		-0.0004	0.771	-0.0013	0.421	0.0004	0.582
	Manager	-0.0329	0.509	0.2483**	0.006	-0.0177	0.461
	Professional	0.0036	0.946	0.1112**	0.013	-0.0165	0.466
	Assoc professional	0.0220	0.679	0.0056	0.898	0.0149	0.615
Occupation	Tradesperson	-0.0804	0.106	-0.0421	0.605	0.0181	0.439
(Intermediate service)	Advanced service	-0.0481	0.630	-0.1223**	0.003	-0.0433*	0.062
	Intermediate prodn	-0.0298	0.596	0.1314	0.139	0.0651**	0.017
	Elementary service	0.0524	0.419	0.0750	0.208	0.1538**	0.006
	Labourer	-0.0069	0.915	0.0404	0.530	0.1123**	0.001
	Agriculture	-0.0834	0.257	-0.0781	0.469	-0.0447**	0.032
	Mining	0.4096**	0.001	-0.2186**	0.000	0.1449*	0.053
	Manufacturing	0.0183	0.736	-0.0386	0.538	-0.0153	0.446
	Utilities	-0.0985	0.615	-0.2208**	0.000	0.0041	0.948
	Construction	-0.0937*	0.075	-0.0439	0.596	-0.0508**	0.008
	Wholesale	-0.1135**	0.043	-0.0247	0.759	-0.0415*	0.086
	Retail	-0.0063	0.901	-0.0156	0.792	-0.0214	0.325
Industry	Hospitality	0.4090**	0.000	0.3106**	0.000	0.0327	0.370
(Business services)	Transport	0.0273	0.675	0.0590	0.540	-0.0278	0.189
	Communication	0.0608	0.447	-0.0721	0.433	-0.0214	0.436
	Finance	0.0807	0.319	-0.0206	0.764	-0.0213	0.579
	Government	-0.1171*	0.092	-0.0575	0.299	-0.0274	0.310
	Education	-0.0267	0.612	-0.0374	0.457	0.0343	0.361
	Health	-0.0380	0.587	0.0185	0.705	-0.0314	0.292
	Recreation	0.1146	0.184	0.1255	0.184	-0.0007	0.987
	Personal services	0.1605**	0.040	-0.0487	0.470	0.0017	0.963
Daily hours of work		0.0706**	0.000	0.0438**	0.000	0.0083**	0.003
Sample size		2402		1642		2402	
Log likelihood		-5906.3		-3083.1		-1379.0	

Notes: No results are shown for women for night work as the model is not a good fit; p-values shown are for the underlying coefficients; ** indicates that underlying coefficient is significant at 95% confidence level; * indicates that underlying coefficient is significant at 90% confidence level. Variations in work timing patterns by occupation seem to be related to both the nature of work in those occupations and the skill level or earnings potential.

Although low-skilled workers of both sexes (intermediate production, elementary service and labourers) are more likely to work at non-standard times, supporting the earnings power hypothesis, so are some more highly skilled workers such as male tradespersons, and female managers and professionals.

For example, men in manual occupations (tradesperson, production workers and labourers) have a high probability of work in the morning, whereas service workers of similar skill level have no greater probability of morning work than average. It is possible that this reflects the outdoor nature of work in some of these occupations, thus requiring daylight operation. However, even within this result, there is evidence that skill level is important: the marginal probability of morning work increases as skill level falls, from 21 per cent for tradespersons, to 27 per cent for production workers, and 32 per cent for labourers.

For both men and women, working more than 49 hours per week increases the probability of working at non-standard times, by 6 per cent and 15 per cent respectively. Most of this extra work seems to take place in the evening: women who work long hours are 16 per cent more likely, and men 11 per cent more likely, to work in the evening than 40-hours workers.

Somewhat surprisingly, working part-time also increases the likelihood of working in the evening. Part-time women are 13 to 28 per cent more likely to work in the evening than 40-hours workers, whilst for men, part-time work increases the likelihood of evening work by between 22 and 24 per cent. However, part-time work does not necessarily increase non-standard work at all times of the day. For instance, women who work part-time are 7 to 10 per cent less likely to work in the morning than those who work 40 hours per week.

In general, personal characteristics seem to play only a small role in determining work at non-standard times. Family has no effect on work at non-standard times for men, and only a small effect for women. Women with school-age children are over 11 per cent less likely to work in the morning than those without. Married women are 6 per cent less

likely to work in the evening, and 7 per cent less likely to work at non-standard times overall than single women[9].

Being a male full-time student dramatically increases the likelihood of working during the evening by over 40 per cent, which is consistent with the preferences of students for work at times that do not conflict with study (or do not require early mornings!).

Overall, male multiple job holders are not more likely to work at non-standard times than men with only one job. However, they are 9 per cent more likely to work in the morning. In contrast, women with more than one job tend to work in the evening, and have 13 per cent more chance overall of working at non-standard times than single job holders.

Male employers are 15 per cent less likely to work in the morning and 4 per cent less likely to work at night than employees, while self employed men tend to work in the evening. Employment status has no effect on the probability of work at non-standard times for women.

There is no clear evidence of a direct relationship between work at non-standard times and weekly income. This is possibly because of the inferior nature of the data on weekly income, as discussed above. However, the hypothesis that workers with higher earnings potential 'buy' themselves more agreeable work schedules, whilst those with low earnings potential work at non-standard times to take advantage of wage premiums is partially supported by the results.

As discussed above, workers in low-skilled occupations are significantly more likely to work at non-standard times. There is also a weak negative relationship between education

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[9] It is highly probable that work timing patterns for married workers depend in part on the work timing patterns of their partners. However, the TUS provided no information on the employment status of workers' partners. Although all members of each household were surveyed, theoretically enabling information about partners' employment status and non-standard work patterns to be incorporated into the analysis, in reality, missing data (such as the partner being absent or not filling in the diary correctly) made this impractical for this paper.

level and the probability of working at some non-standard times. In addition, workers from non-English speaking backgrounds seem to be concentrated in jobs requiring work outside standard hours.

Education is more important in determining work timing patterns for men than women. Education level is negatively related to the probability of morning work for men, with those who did not finish high school 10 per cent more likely to work in the morning than Year 12 graduates. In addition, men with low levels of education are concentrated in jobs that have a high likelihood of working at some time outside standard hours overall. However, for evening and night work, there is no evidence of a relationship. If anything, evening work is positively correlated with education level for men.

For women, the results are less conclusive. Overall, women with a degree are almost 15 per cent less likely to work at non-standard times than those without any post-school qualifications. Women who did not finish high school are concentrated in industries and occupations that have high rates of morning work. Again, there is no significant relationship between evening work and education level.

Workers from non-English speaking countries are more likely to work at non-standard times, perhaps reflecting their poorer labour market outcomes, and thus lower earnings potential. Men from non-English speaking countries are 7 per cent more likely to work at non-standard times overall and in the evening in particular, and are concentrated in occupations and industries that increase their chance of working at night. Women from non-English speaking countries are significantly more likely to work in occupations and industries with high rates of work at non-standard times.

VII Conclusion

Using data from the 1997 Australian Time Use Survey, the standard weekday can be defined as the hours between 8 am and 6 pm. On average, 96 per cent of Australian workers work at some time during standard hours on weekdays. Work outside standard hours is relatively common, with 44 per cent of weekday workers aged between 20 and 59

years working in the early morning, 31 per cent in the evening, and 6 per cent at night. However, only 15 per cent of all working time takes place outside standard hours. Australia's rates of work at non-standard times are higher than in New Zealand, but lower or comparable to those in some North American and European countries.

There is no clear definition of a 'non-standard hours worker'. The characteristics of those who work at non-standard times vary depending on gender and the time of day under consideration. Morning and night work are common for relatively low-skilled workers in manual occupations and industries. Evening work affects a broader subsection of the workforce, and is prevalent for workers who work part-time or very long weekly hours.

In general, demand-side factors such as industry and occupation of employment appear to have the greatest influence on non-standard work. Personal characteristics, such as family and age, have little effect, and the results show that women are more likely than men to be influenced by marital status or the age of children.

There is some support for a negative relationship between earnings potential and the probability of work at non-standard times, especially for male workers. Education has a direct effect on the likelihood of working at some non-standard times, and workers with low levels of education tend to be concentrated in occupations and industries with a higher probability of work at non-standard times. Workers from non-English speaking countries also have a higher likelihood of working at non-standard times.

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