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LABOUR SUPPLY AND WELFARE PARTICIPATION IN AUSTRALIAN TWO-ADULT HOUSEHOLDS:

Accounting for Involuntary Unemployment and the 'Cost' of Part-time Work

by

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Abstract

We estimate a simultaneous discrete choice model for welfare participation and labour supply of two-adult households in Australia using the Income and Housing Costs Survey of 1994/1995. In this paper only unemployment-related welfare payments are considered. Welfare participation is assumed to have a positive indirect effect (through income) and a negative direct effect on utility. This approach allows for non-participation of eligible people. An earlier developed labour supply and welfare participation model is extended in this paper by adding employment equations to account for involuntary unemployment. In addition, a part-time penalty term is included in the utility function to allow for monetary or non-monetary costs of working part time and the number of discrete choices is increased. The first two extensions seem to improve the model's ability to simulate the correct distribution of actual labour supply. Without these extensions, labour force non-participation is underestimated and the number of people in part-time employment is overestimated.

The results indicate that there is evidence of a significant disutility associated with welfare participation for all specifications of the model. We also find that a change in the benefit withdrawal rate or the maximum benefit level does not seem to have a large effect on the actual labour supply of either adult.

JEL classification: J22, I18

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LABOUR SUPPLY AND WELFARE PARTICIPATION IN AUSTRALIAN TWO-ADULT HOUSEHOLDS: ACCOUNTING FOR INVOLUNTARY UNEMPLOYMENT AND THE 'COST' OF PART-TIME WORK

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INTRODUCTION

Although many papers have been written on the effects of different types of government benefit payments on labour supply, few include a possibly negative side effect of receiving benefits[1]. A reason for including this possibly negative effect might be that welfare recipients feel some embarrassment because of the social stigma involved in their accepting public assistance or there might be transactional costs associated with the receipt of welfare payments. This would discourage welfare participation.

Even fewer papers have allowed for involuntary unemployment at the same time as including welfare participation as an endogenous variable, except for Bingley and Walker (1997). However, the welfare scheme they study is an in-work transfer program for sole mothers, which is quite different from the Australian unemployment benefit system analysed here. Australia only has an unemployment assistance scheme, which is independent of previous work experience and earnings and provides benefits at a low level for an unlimited duration. Naturally, looking and being available for work is one of the prerequisites of being eligible for these unemployment benefits.

In this study, the more general term welfare participation is used for the acceptance of unemployment benefits only. Family payments are assumed to be taken up whenever the household is eligible for them and other welfare payments are not included. The purpose of this paper is to extend the simultaneous model of labour supply and welfare participation, estimated earlier (Kalb, 1999), by allowing for involuntary unemployment. Not allowing for involuntary unemployment means that all unemployed people are assumed to prefer not working and receiving welfare payments. As a result, in such a model part of the unemployment might be attributed to the welfare system, whereas it should be ascribed to a lack of labour demand. It is expected that distinguishing voluntary

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[*] I would like to thank Alan Powell for his helpful comments.

1 Examples of exceptions are Moffitt (1983), Ashenfelter (1983), Fraker and Moffitt (1988), Woittiez, Lindeboom and Theeuwes (1994), Charette and Meng (1994), Hagstrom (1996), Hoynes (1996), and Bingley and Walker (1997).

from involuntary unemployment will produce a larger estimated negative effect of welfare participation. The results from the previous study indicated that even without allowing for involuntary unemployment there was a significant negative effect of welfare participation on the utility level of households. The results from the updated model will be compared with the previous results.

In addition to involuntary unemployment, this paper also addresses the common overestimation of the number of people in part-time work by labour supply models. This is achieved by including part-time penalty terms in the utility function (following Van Soest, 1995).

The emphasis of the basic framework is on the separation of income into different categories and on a correct representation of net income at all levels of gross income, taking taxes and benefit reduction into account. This results in a highly nonlinear and non-convex budget constraint. Estimation of a continuous labour supply model for two persons, using this budget constraint, would be too complicated, so labour supply is discretized as in the previous version of the model. Following Van Soest (1995), we use a multinomial logit specification in the discrete choice model, which allows us to choose a relatively large number of labour supply points for both adults in the household. In this paper, we will extend the number of discrete labour supply points from seven to twelve, choosing five-hour intervals instead of the previous ten-hour intervals.

Section I briefly discusses the economic model. Section II describes the data. Section III contains the econometric details. The results are discussed in Section IV. First the estimated parameters are discussed and compared to the results of the more basic model, where special attention is given to the disutility or stigma parameter. Then, wage elasticities for some typical households and the simulated effects of an increase in the benefit level and a decrease in the maximum benefit withdrawal rate are presented. These results, when compared to the results using the more basic model indicate the sensitivity of the model to the manner in which unemployed persons are included in the model. Finally, in Section V some conclusions are presented.

I. THE ECONOMIC MODEL

By setting up the model in the familiar neoclassical way, starting from utility maximization under a budget constraint, a logical and consistent framework can be built to analyse labour supply (see for example Deaton and Muellbauer, 1980, or Killingsworth, 1983). We are interested in two-adult households (with or without dependent children), where the adults choose their labour supply and the household's participation in welfare to optimize its utility. A simple utility maximizing model could look as follows:

(1) $\max U(x, lhh_1, lhh_2, d_W)$

subject to:

$$T = lhh_1 + h_1$$

$$T = lhh_2 + h_2$$

$$x = \int_0^{h_1} g_1(t_1, h_2)dt_1 + \int_0^{h_2} g_2(h_1, t_2)dt_2 + n(y_1) + n(y_2) + n(B(hc))d_W$$

Or if the three restrictions are taken together, the budget constraint may be written:

(2)
$$x + \int_{T-lhh_1}^{T} g_1(t_1, T - lhh_2)dt_1 + \int_{T-lhh_2}^{T} g_2(T - lhh_1, t_2)dt_2 = \int_0^{T} g_1(t_1, T)dt_1 + \int_0^{T} g_2(T, t_2)dt_2 + n(y_1) + n(y_2) + n(B(hc))d_W$$

where:

$U(\ )$ is the utility function of a two-adult household,

lhh_1 and lhh_2 indicate the aggregate of leisure time and home production time per week of the husband and wife (married or de facto) respectively,

x indicates net income per week,

d_W indicates whether a household participates in welfare,

T is the total available time for each person in the household,

h_1 and h_2 are the hours of work of husband and wife,

$g_1(\ ,\ )$ and $g_2(\ ,\ )$ are the marginal wages of husband and wife,

y_1 and y_2 are the non-labour incomes of husband and wife

$B(hc)$ is the amount of benefit a household is eligible for given household composition hc,

$n(\ )$ is the amount of income after the deduction of taxes.

In this paper, the term ‘leisure’ is used to indicate both pure leisure time and home production time. The combination of leisure, income and welfare participation that delivers the highest utility to the household is regarded as the optimal choice. It is expected that utility increases with an increase in leisure and income and that it decreases with an increase in welfare participation. The disutility caused by welfare participation can be explained either by the existence of a stigma associated with welfare participation or by administrative and/or other costs of applying for welfare. This disutility might completely or partly offset the utility associated with the extra income, depending on the amount of extra income.

With regard to the assumption of free choice underlying this economic model, it should be noted that, in practice, it is often not known whether the observed labour

supply is the optimal labour supply or, alternatively, whether people are restricted in their labour supply choice by demand side factors[2]. In this paper, we use information on whether a non-working person is looking for part-time or full-time work, to determine whether someone is voluntarily or involuntarily unemployed. The observed hours are then updated so that they represent preferred hours rather than actual hours.

It would be interesting to generalize the above and analyse desired hours of work instead of actual hours of work or to allow for the restrictions in actual hours caused by the demand for labour. However, if a person works, it is assumed that the actual working hours equal their preferred hours, because no information on the preferences of working respondents is available.

II. THE DATA

The Survey of Income and Housing Costs 1994-95, released by the Australian Bureau of Statistics (ABS), has been used for the analysis. It has detailed income information for each person separately and for the household as a whole. This allows the budget constraint to keep its full complexity: a point of major importance given the aim of our study.

II.1. Selection Criteria for Inclusion in the Analyses

In this section, the selection criteria are discussed. First of all, the following criteria are applied:

- Only households that contain one income unit and consist of a head and a partner with or without dependants are included. For this group, it seems reasonable to adopt the assumption that the household takes joint decisions and maximizes a single utility function according to a common vision of the household's welfare.
- People of an age to be eligible for government paid age pensions are excluded. They are expected to behave differently from younger people.
- For the same reason of substantial differences, the self-employed and full-time students are also excluded.
- All people temporarily or permanently unable to work because of illness or disability are excluded from the analysis.
- People receiving a (military) service pension are not included, since these pensions are paid instead of age pension or in cases of disability.
- People who care for family members including a handicapped child and receive benefits for doing so, as well as people receiving a group of benefits not named anywhere else, are also excluded from the analysis.

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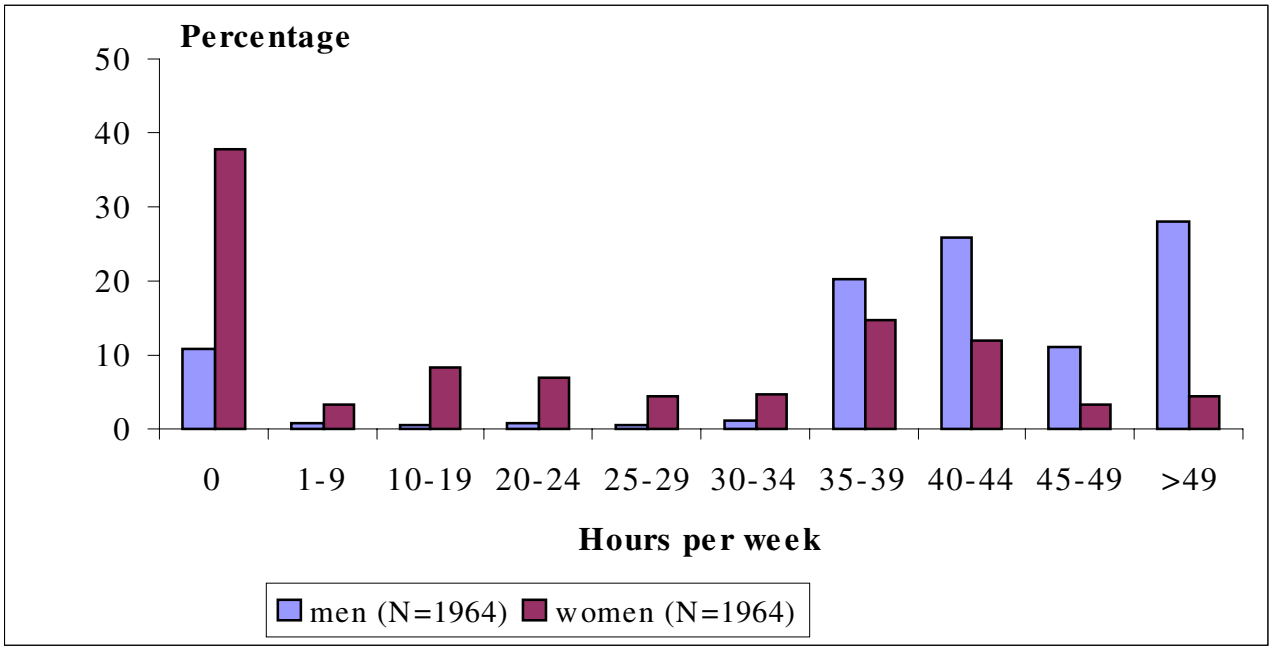
2 See for example, Laisney, Lechner, Van Soest and Wagenhals (1992), Bingley and Walker (1997) or Duncan, Giles and MacCrae (1999).

After the above selection process, a data set of 1964 households is left for analysis. Missing values or outliers (which may be measurement errors) result in the deletion of a few additional households in subsequent analyses. First, some values for wage income seem unrealistically small when compared to the corresponding hours worked. In Australia there is no Federal or state minimum wage covering all employees. Each award has its own minimum wage. Therefore, across states, occupations and industries, minimum wage levels vary. In addition, not all workers are covered by an award. In the estimation of the wage equation all persons earning less than $4 per hour are excluded (the same selection is used to estimate the labour supply equation). Second, all households that had a weekly income of less than $150 are also excluded. Some observations may be wrongly excluded because it is possible that some households live off their savings temporarily. In the final labour supply analysis 1914 cases remain.

II.2. Variables used in the Analyses

Figure 1 gives an overview of the sample frequency distribution of (categorized) male and female working hours in the selected samples. The difference between men and women is obvious and as expected. Relatively more women work part time and more men work full time (especially over 45 hours per week) in both samples. Table 1 gives summary statistics of the variables, which are used in the analyses.

Figure 1: Labour Supply of Males and Females



The background characteristics used to specify preferences in the utility function are listed below.

Table 1: Summary Statistics for the Income and Housing Cost Survey 1994/1995 (N=1964)

	men	women
Variable	**%**	**%**
Hours worked		
• 0	11.0	37.7
• 1-9	0.8	3.5
• 10-19	0.5	8.5
• 20-24	0.8	6.9
• 25-29	0.6	4.5
• 30-34	1.2	4.7
• 35-39	20.2	14.6
• 40-44	25.8	11.9
• 45-49	11.2	3.4
• >49	28.2	4.3
voluntarily unemployed	4.0	33.9
looking for part-time work	0.2	1.2
looking for full-time work	6.8	2.7
State of residence		
• New South Wales	21.4	
• Victoria	21.8	
• Queensland	18.1	
• South Australia	10.9	
• Western Australia	13.9	
• Tasmania	7.0	
• Territories	6.9	
Residence of household in capital city	59.9	
Participation in welfare of household	6.2	
Migrant	28.3	26.2
Recent migrant	2.2	3.1
Non-English speaking background	9.1	9.7
Last year, principal source of income came from work	89.0	65.0
Education		
• No qualifications	42.9	58.4
• Basic vocational qualification	1.9	6.5
• Skilled vocational qualification	27.2	11.3
• Diploma	10.7	9.8
• University degree	17.3	14.1
Youngest child in household is 0	8.9	
Youngest child in household is between 1 and 5	26.5	
Youngest child in household is between 6 and 11	18.0	
Youngest child in household is between 12 and 14	6.4	

	Mean	
Variable	**men**	**women**
Number of children in household	1.35	
Unemployment benefits in household	10.70	
Mortgage debt of household	33162.76	
Non-labour income	22.57	14.69
Wage income	652.42	280.37
All income	694.85	316.40
Age	39.35	36.77
Number of months worked during last 7 months	5.41	3.91

Age is exactly known for those under 25 and those over 54 years of age, while the ages between 25 and 54 are known in five-year intervals. The midpoint values of each category are used. Younger and older persons are expected to have a higher preference for leisure.

Education is divided into the following categories:

- no qualifications
- basic vocational qualifications
- skilled vocational qualifications
- associate or undergraduate diploma
- higher or bachelor degree or postgraduate diploma

Education is expected to increase the preference for work, because time and money have been invested in human capital. Apart from the financial rewards, one would also expect a high-skill job to be more interesting than a low-skill job and hence more desirable.

The *number of dependent children* in each household is calculated by adding the number of dependent children from 0 to 24 years old. This variable is expected to be especially important for the female adult in the households. Children are likely to increase the value of time at home, which is reflected in a higher preference for leisure in the model.

The survey records the *age of the youngest dependent child under 15 years of age* in the household. The effect of dependent children in the household is likely to be bigger when young children are present.

The value of the *outstanding mortgage* is the only information available on debts or assets in the data. The aim is to capture at least part of the life cycle effect. However, it should be realized that at the moment of the decision to buy a house and take out a mortgage, this decision is probably influenced by labour supply now and by the prospects of labour supply in the future. Our cross-sectional data does not allow us to specify a model that would take this possible endogeneity of the outstanding mortgage into account. Therefore, it is modelled as having an effect on preferences. This is justified by the fact that once a mortgage has been taken out, the decision is not easily reversed. Given this fact, at the moment of our cross-section the outstanding mortgage is a given rather than a choice in most cases.

Variables expected to be relevant to the wage rate are described below.

Age and Age^2, because age reflects the experience people are likely to have

had in the labour market. If the interest were in the separate effects of schooling and experience, this would not be an adequate specification (Mincer, 1974; Rosenzweig, 1976). However, here the goal is to impute a wage rate for the non-workers and the separate effects are not so important.

Education, which is expected to determine the wage level to a great extent.

Three dummy variables are used to identify *migrants* in general; *recent migrants*, that is those who arrived in 1991 or later; and migrants from a *non-English speaking background*. The latter is an approximation, since the countries of birth were not grouped by language. Migrants originating from Northern America and migrants from Europe and USSR (of which a large proportion comes from the UK) are not included in the non-English speaking group, whereas migrants from Oceania and Antarctica[3] are, although this category includes New Zealand.

To approximate *recent work experience* and make an allowance for the difference between those who are likely to have worked in the previous year and those who are unlikely to have done so, we assign the value one to a dummy variable indicating that the principal source of income in the previous year was from wages and salaries or from one's own business (but zero otherwise). In addition, the number of months during which the respondent was employed in the seven months preceding the interview is included as an indicator of recent work experience.

State of residence indicates the state or territory. Unfortunately, the Northern Territory and the Australian Capital Territory are categorized as one group, which is a disadvantage for the estimation of the wage equation, as the job markets in these two regions differ considerably. A variable indicating whether the household lives in or outside a capital city is also available.

Other important variables in the analysis are noted below.

Non-labour income (excluding the unemployment benefit) is constructed by adding all income from investments, rents and dividends to superannuation payments, compensation payments and other regular income.

The *wage rate* is calculated by dividing *weekly income from wages and salaries* by the number of 'hours worked'. The exact number of hours is observed up to 50 hours per week. For people working 50 or more hours a week only the maximum possible wage rate is known.

Participation in welfare payments is represented by a dummy variable, which is one when the household receives unemployment benefits.

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3 This is how the Australian Bureau of Statistics has defined the categories of immigrants.

III. ECONOMETRIC SPECIFICATION

In Section I an economic model was introduced that serves as a starting point for the specification of an econometric model. Computational restrictions and available data, however, limit the econometric models that might be successfully estimated. In the following sections, possible options are discussed.

III.1. Specification of a Labour Supply and Welfare Participation Model

Dealing with a Nonlinear and Non-convex Budget Constraint

Including taxes and benefits for two persons in the budget constraint produces a highly nonlinear constraint. Looking at the benefit and tax regimes of 1994/95[4] leads us to expect many kinks in the budget constraint. Since we prefer to keep the representation of taxes and benefits as close to reality as possible, a complex budget constraint cannot be avoided. In the case where one only considers one potential worker at a time, the labour supply estimation can already be quite complex[5]. The complexity is even greater in the case where households with two potential workers are analysed, subject to their joint budget constraint.

Restricting the number of possible working hours to a limited set of discrete values (as is done by many authors facing the same problem), appears an attractive solution. For this limited set of hours, one can calculate the level of utility that each possible combination of hours would generate, according to the specified utility function. An additional advantage of the discrete approach is that quasi-concavity does not have to be imposed before using maximum likelihood methods to estimate the model, as would be necessary in the case of continuous labour supply for some utility functions (see Van Soest, Kapteyn and Kooreman, 1993).

Instead of being defined on a continuous set of working hours [0,T], in the discrete choice case the budget constraint is defined on a discrete set of points $h_1 \in A=\{0,dh_{11},dh_{12},...,dh_{1m}\}$ and $h_2 \in B=\{0,dh_{21},dh_{22},...,dh_{2k}\}$ on the interval [0,T][6]. Using these sets, the net income $x(h_1,h_2)$ is calculated for all $(m+1)\times(k+1)$ combinations of h_1 and h_2 (where m+1 is the number of discrete points for h_1 and k+1 is the number of discrete points for h_2). By increasing the number of different hours in the choice set, the quality of the representation improves. However, the computational load also increases, so a compromise between quality and computational feasibility is necessary. In addition to this discrete choice of hours, participation in welfare is a choice variable as well. This choice variable can only take two different values: unity for participation and zero for non-participation, so $d_W \in C = \{0,1\}$. For all working hours where households are still eligible for a

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4 For an overview of the basic rules, see Appendix A.

5 See e.g. Burtless and Hausman (1978), Hausman (1979), Hausman (1985) or Moffitt (1986) for a continuous labour supply approach with a nonlinear (non-convex) budget constraint.

6 0, dh_{11}, dh_{12}, etc represent the discrete values that labour supply can take.

benefit, an additional value for the net income $x(h_1,h_2)$ has to be calculated. So net income x is dependent on labour supply and wage rates of both adults, on non-labour income, on household composition and on participation in benefits (d_W). Wage rates, non-labour income and household composition are exogenous in this model. The model becomes:

(3) $$\max U(x, lhh_1, lhh_2, d_W)$$

subject to:

(4) $$(x, lhh_1, lhh_2, d_W) \in BC(w_1, w_2, y_1, y_2, hc)$$

where:

$$BC(w_1,w_2,y_1,y_2,hc) = \{(x,T-h_1,T-h_2,d_W);(h_1,h_2,d_W)\in \mathcal{A}\times\mathcal{B}\times\mathcal{C} \text{ and } x = w_1h_1 + w_2h_2 + y_1 + y_2 + B(hc, w_1h_1 + w_2h_2 + y_1 + y_2)d_W - \tau(B.d_W, w_1h_1 + y_1, w_2h_2 + y_2, hc)\},$$

w_1 and w_2 are the gross wage rates of husband and wife,

BC is the set of discrete points h_1, h_2 and d_W plus the net income x which is calculated for each of the points h_1, h_2 and d_W,

$\mathcal{A}$, $\mathcal{B}$ and $\mathcal{C}$ are the sets of discrete points from which values can be chosen for h_1, h_2 and d_W,

B is the amount of benefit, for which the household is eligible, given household composition and income,

τ is the tax function that indicates the amount of tax to be paid.

A likelihood function can be formed using the above utility function. The contribution of each household to the likelihood function is the probability that its stated hours and welfare participation status result in an optimal utility for the household of interest when compared with all other possible choices for hours and welfare participation. This probability looks as follows:

(5) $$\Pr(U(x((lhh_1, lhh_2, d_W)_r),(lhh_1,lhh_2,d_W)_r,\varepsilon_r) \geq U(x((lhh_1, lhh_2, d_W)_s),(lhh_1, lhh_2, d_W)_s,\varepsilon_s) \text{ for all } s)$$

where:

r stands for the combination h_1, h_2 and d_W that is preferred,

s stands for all (k+1)×(m+1) possible combinations that can be made, given the discrete choice sets for hours worked and participation in welfare,

ε_r and ε_s represent error terms.

Adding an error term to the utility function prevents contributions to the likelihood in any data point from becoming zero. It allows for optimization errors made by the household. Choosing an extreme value specification for the error term in (5) results in a multinomial logit model (see Maddala, 1983).

The likelihood contribution further consists of the probability of employment for those who are not voluntarily unemployed. The employment equation is a probit with the probability of finding employment as the dependent variable. Independent variables are education, age, recent work experience, state of residence, ethnicity. Employment equations are included to take the demand side of the labour market into account, so that preferred labour supply can be more accurately estimated. Note that the employment equation can only be included in the likelihood function for those who want to be employed. Although involuntary unemployment has now been taken into account, people who are employed are still assumed to be working at their preferred hours. In addition, it is assumed that if only one person is involuntarily unemployed then the other person does not adjust their labour supply, but works the number of hours selected in the overall preferred combination.

The log likelihood contribution for households where both adult members are working or voluntarily unemployed looks as follows:

$$\ln L = U_{i'j'k'} - \ln\left(\sum_{i,j,k} \exp(U_{ijk})\right) + d_1\left[d_{1e}\Phi(X_{1e}\beta_{1e}) + (1-d_{1e})(1-\Phi(X_{1e}\beta_{1e}))\right] + d_2\left[d_{2e}\Phi(X_{2e}\beta_{2e}) + (1-d_{2e})(1-\Phi(X_{2e}\beta_{2e}))\right] \quad (6)$$

where:

i indicates the husband's labour supply;

j indicates the wife's labour supply;

k indicates welfare participation. $k \in \{0,1\}$, where 0 stands for non-participation and 1 for participation in welfare;

i', j', k' are the preferred states (combination r in equation 5);

U_{ijk} is the level of utility derived from the state where the husband has labour supply i, the wife has labour supply j and the household has welfare participation k;

d_i is 1 if person i is working or involuntarily unemployed, d_i is 0 otherwise;

$d_{ie} = 1$ if person i is employed, 0 otherwise;

Φ represents the normal cumulative density function;

X_{ei} is a vector of variables explaining employment of person i;

β_{ei} is a vector of parameters indicating the effect of characteristics on person i.

Expression (6) denotes the probability that the utility in the preferred combination of hours and welfare participation is higher than the utility in any other situation. In addition to this probability, the employment probability is also part of the likelihood for those who are working or involuntarily unemployed.

The option of receiving welfare is only available when certain income requirements are fulfilled. This means that in most cases the household can only

receive welfare payments when the number of working hours is sufficiently low. The participation in welfare according to the model above is assumed to be a voluntary decision together with the number of hours worked. However, the choice can be limited by a restriction in labour supply.

In the case where there is involuntary unemployment, the likelihood contribution changes. First of all, instead of actual hours we will use information on whether respondents, who are looking for work, want to work part time (less than 35 hours) or full time (35 hours or more). This is a range of worked hours rather than an exact number, which means we have to sum over the probabilities of discrete points falling within this range. Secondly, if the household is eligible for welfare at its actual hours, an additional term for the probability of welfare participation, conditional on the restricted labour supply, is added to the model. This will further assist in identifying the 'stigma' effect.

Three new variables $h_1^*, h_2^*, \text{and } d_W^*$ are defined, to distinguish actual labour supply and welfare participation from desired labour supply and welfare participation. The actual net income x* is defined by $x\left(h_1^*, h_2^*, d_W^*\right)$.

The likelihood contribution now becomes:

$$\ln L = \ln\left(\sum_{\substack{h_{1r}\in PLS_1 \\ h_{2r}\in PLS_2 \\ d_{Wr}\in WP}} \exp\left(U\left(h_{1r}, h_{2r}, d_{Wr}\right)\right)\right) - \ln\left(\sum_{i,j,k} \exp(U_{ijk})\right) +$$

(7)

$$d_1\left[d_{1e}\Phi(X_{1e}\beta_{1e}) + (1-d_{1e})(1-\Phi(X_{1e}\beta_{1e}))\right] +$$

$$d_2\left[d_{2e}\Phi(X_{2e}\beta_{2e}) + (1-d_{2e})(1-\Phi(X_{2e}\beta_{2e}))\right] +$$

$$d_3\left[d_W^* \ln\left[P\left(d_W^*=1\middle|h_1^*, h_2^*\right)\right] + (1-d_W^*)\ln\left[P\left(d_W^*=0\middle|h_1^*, h_2^*\right)\right]\right]$$

where

PLS_i={all discrete labour supply points of 35 hours or more} if the preference is for full-time work, PLS_i={all discrete labour supply points of more than 0 and less than 35 hours} if part-time work is preferred, and $PLS_i=\{h_i^*\}$ if person i is working or voluntarily unemployed;

WP={0} if at the preferred hours of work there is no welfare eligibility or if there is no actual welfare participation ($d_W = 0$), in all other cases WP={0,1};

d_3 = 1 if the household is eligible for welfare participation at the actual hours worked, 0 otherwise;

$P(d_W^*)$ is a binomial logit, defined as follows:

$$P\left(d_W^* = 1 \middle| h_1^*, h_2^*\right) = P\left(U\left(x_1, h_1^*, h_2^*, 1, \varepsilon_1\right) > U\left(x_0, h_1^*, h_2^*, 0, \varepsilon_0\right)\right) \text{ and}$$
$$P\left(d_W^* = 0 \middle| h_1^*, h_2^*\right) = P\left(U\left(x_0, h_1^*, h_2^*, 0, \varepsilon_0\right) > U\left(x_1, h_1^*, h_2^*, 1, \varepsilon_1\right)\right).$$

The first term in equation (7) contains less information than in equation (6), because for those involuntarily unemployed it is only known whether they want to work part time or full time (the exact number of hours is unknown) and the decision on welfare participation is often unknown as well. However, this is partly compensated by those households who are eligible for welfare participation at their actual hours worked. For these households, we know whether the household prefers to participate in welfare given the actual hours worked. The last term in equation (7) represents this additional information on the ranking of preferences. The probability in the first and last term in (7) are both based on the same utility function.

Specification of the Utility Function

For the sake of convenience the utility function used here is the translog specification (following Van Soest, 1995), to which a dummy term is added for participation in welfare[7]. This is in line with the approach of other papers on labour supply and welfare participation, in which it is also assumed that the disutility from welfare participation is separable from the utility from leisure and goods.

Many models have had the problem of overpredicting part-time hours. Van Soest (1995) suggests that this may be caused by not taking into account the fact that the demand for part-time workers is low. He suggests a simple approach to account for this lower demand by including specific constant terms for part-time hours in the utility function, which penalizes the choice of part-time labour supply. This approach is also taken here. The utility derived from leisure, income and welfare participation can be written as:

$$\begin{aligned} U(x, h_1, h_2, d_W) = {} & \beta_x \ln(x) + \beta_1 \ln(80 - h_1) + \beta_2 \ln(80 - h_2) + \alpha_{xx} (\ln(x))^2 + \\ & \alpha_{11} (\ln(80 - h_1))^2 + \alpha_{22} (\ln(80 - h_2))^2 + 2\alpha_{x1} \ln(x) \ln(80 - h_1) \\ & + 2\alpha_{x2} \ln(x) \ln(80 - h_2) + 2\alpha_{12} \ln(80 - h_1) \ln(80 - h_2) + \\ & \gamma_1(h_1) + \gamma_2(h_2) - \varphi d_W \end{aligned} \tag{8}$$

where α.., β., and φ are preference parameters that have to be estimated; the total endowment of time (T) is chosen to be equal to 80 hours per week; and

7 Only participation and non-participation are distinguished. The amount of participation, as could be expressed by measuring the value of the benefit received, is not taken into consideration as far as its direct effect on the utility is concerned.

$\gamma_1(h_1)$ and $\gamma_2(h_2)$ are functions that take on a different value at each of the discrete part-time labour supply points — they are zero when the relevant person is not working or working full time. The different values at part-time hours have to be estimated.

This translog utility function has a simple form, and heterogeneity of preferences is easy to include. A disadvantage of this functional form is that utility is not automatically quasi-concave. However, if the two conditions outlined in Van Soest (1995) are fulfilled at a data point, then U is quasi-concave at that point. In a model with continuous hours of labour supply, these conditions would have had to be imposed a priori to guarantee coherency, as has been mentioned earlier. In the approach taken here, these two conditions can be tested at all data points after estimation of the parameters.

To account for differences in preferences between households, the parameters β, α, γ and φ can be made dependent on household and individual characteristics. For the moment it is assumed that no unobserved heterogeneity is present in the preferences and only β_1 and β_2 depend on personal and household characteristics (see section II.2). Simple linear specifications are chosen.

III.2. Unobserved Wages

Like other researchers in this area, we have to deal with unobserved market wages for people who are not working. The wage equation is estimated separately and estimated wages are used as if they represented the true values of the unobserved wages[8]. To correct for a possible selection bias as a result of only observing wage rates for those gainfully employed, the Heckman correction term for participation is included in the wage equation (Heckman, 1979). Once all the parameters of the wage equation are estimated, estimated wage rates for the non-participants can be imputed using the wage equation with the estimated correction term for the non-participants.

The best way to deal with unobserved wages is to incorporate them into the likelihood function and estimate wages and labour supply simultaneously. However, this is computationally more difficult and it is not attempted often[9]. We leave this for future research.

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8 Van Soest (1995) uses this approach and points out that most of the papers in a special issue on Taxation and Labor Supply in Industrial Countries of the *Journal of Human Resources* (Moffitt, 1990) follow this approach as well.

9 Exceptions are, for example, Fraker and Moffitt (1988), Gerfin (1993) and Murray (1996).

IV. Results from the Estimation of the Labour Supply Model

In this section, the focus is on the labour supply equation; the results from the labour force participation, wage and employment equations are presented in Appendix B. Labour supply and welfare participation are estimated using imputed wage values for the non-workers as described in the previous section.

For the estimation of the labour supply model an additional 16 records are lost, because the observations on the household's welfare participation and their calculated eligibility are contradictory. The remaining data sets consist of 1898 households.

IV.1. Discussion of the Results

Table 2 gives the parameter estimates of the translog specification of the utility function for a model with seven discrete labour supply points for men and twelve points for women. The location of the points is defined in a footnote to the table.

Three alternative specifications of the model in Table 2 are presented in Table C.1 in appendix C[10]. The effects of different characteristics on the preference for leisure of both adults in the household are the first results to be discussed. The significance and direction of the effects seem to be quite similar in the different specifications. In the following we use the term 'basic model' for the model without involuntary unemployment and part-time constants. The basic model has seven labour supply points for men and women. The term 'extended model' is used for the model accounting for involuntary unemployment and including part-time constants. The number of female discrete labour supply points has been extended to twelve.

To begin with the parameterized preference for leisure for the male adult, a significant negative effect[11] is found when the number of children in the household increases and when the age of the man increases. A negative effect is further observed for households facing a higher mortgage and for households where the man has a higher level of education. The only characteristic that seems to have a significant positive effect on the preference for leisure is age squared, which combined with the linear effect of age means that the preference for leisure decreases for men up to 37 years of age after which it increases with age[12].

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10 They include a basic model that does not take involuntary unemployment or the 'cost' of part-time work into account and has seven discrete labour supply points for each person, a model that only accounts for involuntary unemployment, and a model that accounts for involuntary unemployment and increases the number of discrete labour supply points for women to twelve.

11 This indicates a lower preference for leisure and thus a larger taste for work.

12 In the basic model, the minimum is at an age of 39 years (see the first column in Table C.1).

Table 2: Estimated Parameters of the Labour Supply Model with voluntary unemployment and part-time penalty terms[a]

	Estimated coefficient	t-ratio		Estimated coefficient	t-ratio
β_x (income)	32.9891	3.28	α_{xx}	-1.4576	-3.04
β_1 (male leisure):			α_{11}	-0.6499	-2.07
Constant	8.8906	1.41	α_{22}	-1.2792	-3.41
Number of children	-0.5198	-4.82	α_{1x}	-0.1101	-0.40
Age of youngest child			α_{2x}	-0.9809	-3.18
• 0	-0.1216	-0.31	α_{12}	0.4846	2.27
• 1- 5	0.4155	1.41			
• 6 - 11	0.1850	0.59	men pt penalty 1-9 hrs	-1.8818	-6.05
Age man/10	-2.1483	-2.80	men pt penalty 10-19 hrs	-2.8896	-8.44
Age2 man/100	0.2903	3.12	men pt penalty 20-29 hrs	-2.5771	-12.71
Mortgage/10 000	-0.0856	-4.04	women pt pen. 1-4 hrs	-3.3781	-14.17
Education men (no qual.)			women pt pen. 5-9 hrs	-2.5486	-16.48
• basic vocational	0.2254	0.34	women pt pen. 10-14 hrs	-2.1425	-15.88
• skilled vocational	-0.4987	-2.34	women pt pen. 15-19 hrs	-1.5656	-14.36
• diploma	-0.3834	-1.28	women pt pen. 20-24 hrs	-1.2134	-12.24
• degree	-1.1330	-3.95	women pt pen. 25-29 hrs	-1.5442	-12.96
Education women(no qual.)			women pt pen. 30-34 hrs	-1.3332	-11.44
• basic vocational	0.1264	0.34			
• skilled vocational	-0.4265	-1.49	φ (stigma effect)	1.9462	7.24
• diploma	-0.2571	-0.85			
• degree	-0.4706	-1.63			
β_2 (female leisure):					
Constant	24.8090	3.54			
Number of children	0.3909	3.64			
Age youngest child					
• 0	3.8612	9.31			
• 1- 5	2.4918	9.05			
• 6 - 11	0.1676	0.60			
Age woman/10	-1.4802	-1.91			
Age^2 woman/100	0.2916	2.90			
Mortgage/10 000	-0.0521	-2.88			
Education women(no qual.)					
• basic vocational	-0.7570	-2.33			
• skilled vocational	-0.6713	-2.59			
• diploma	-0.8902	-3.12			
• degree	-2.1528	-7.76			
Education man (no qual.)					
• basic vocational	0.5030	0.84			
• skilled vocational	-0.0582	-0.29			
• diploma	0.3101	1.11			
• degree	0.2035	0.79			

[a] Seven discrete points of labour supply are distinguished for each man: 0 hours for non-participants, 5 hours for people working from 1 to 9 hours, 15 hours for people working from 10 to 19 hours, 25 hours for people working from 20 to 30 hours, 35 hours for people working from 30 to 40 hours, 45 hours for people working from 40 to 49 hours and 55 hours for people working more than 49 hours. Twelve discrete points of labour supply are distinguished for each woman: 0 hours for non-participants, 2 hours for people working from 1 to 4 hours, 7 hours for people working from 5 to 9 hours, 12 hours for people working from 10 to 14 hours, 17 hours for people working from 15 to 19 hours, 22 hours for people working from 20 to 24 hours, 27 hours for people working from 25 to 29 hours, 32 hours for people working from 30 to 34 hours, 37 hours for people working from 35 to 39 hours, 42 hours for people working from 40 to 44 hours, 47 hours for people working from 45 to 49 hours and 55 hours for people working more than 49 hours.

As one would expect, the preference for leisure of the female adult seems to be much higher than that of her male partner, at least as far as this is reflected in the size of the constant term of β_2. A significant negative effect is observed for women in households with higher mortgage obligations and for women with higher education levels. Compared to the basic model the effects are somewhat stronger and have a more logical ordering in the extended model. In the basic model, basic vocational education has an unexpectedly strong negative effect on the preference for leisure. A minimum preference for leisure is observed around 25 years of age (29 years in the basic model).

All variables related to children have a significant positive effect on the preference for leisure, except for children between six and 11 years old. As one would expect, and as is seen in many other studies (Australian examples are Eyland, Mason and Lapsley, 1982 and Ross, 1986), having a newborn child or a child between one and five years of age has a large positive effect on the female preference for leisure. Children of primary school age, however, do not seem to affect the mother's preference for leisure.

Besides the linear terms, there are also quadratic terms involved in the translog utility function. Taking the first derivative with respect to leisure time of men, the following expression for the marginal utility of leisure for men is obtained:

$$U_1 = \frac{\beta_1 + 2\alpha_{11}\ln(lhh_1) + 2\alpha_{12}\ln(lhh_2) + 2\alpha_{1x}\ln(x)}{lhh_1}$$

Similar expressions can be formulated for the leisure time of women and for net income. From this formula and the results in Table 2, we can conclude that in both models couples seem to enjoy having leisure time together. If one of the two persons has more leisure time, the marginal utility of leisure of the other person also increases. There seems to be no significant effect of income on the marginal utility of the husband's leisure time or vice versa, but there is for the wife's leisure time. This is an interesting result given that our definition of leisure time also includes home production time and given that women are likely to do most of the home production. It seems less utility is derived from the wife's leisure (read home production) when income is higher. This indicates that goods bought in the market, when income increases, may substitute home produced goods. Thus, net income and female leisure time seem to be exchangeable. More income means that the marginal utility for female leisure is lower and more female leisure means a lower marginal utility of income.

The part-time constants are all negative and significant as expected. Three different constants are estimated for men and seven constants for women. The constants are mostly larger negative for men than for women, possibly because fewer part-time jobs may be available in typical male occupations than in female occupations. Only the constant for men in the lowest category (1-9 hours) is

smaller than the constants for women and it is also smaller than the other constants for men. This might be explained by the fact that men already have a very low preference for working such a small amount. Even for women all the constants are negative and significant. Although women seem more likely to work part time, the penalty for the shortest hours seems substantially larger negative than for the other categories, indicating jobs in that category may be more scarce.

The last parameter in Table 2 is the stigma/cost parameter associated with receipt of welfare payments. The results indicate that there is a positive and significant effect. This means that participating in welfare lowers the utility level of the household. Welfare payments are not just 'free' income for which no work has to be done, but they have a negative side effect attached to them when received by a household. Thus, there is a threshold that people need to overcome before applying for unemployment benefits. The threshold is higher when this estimated parameter is higher. It does not mean that people will not apply for welfare, but it does indicate that applying for welfare is not as attractive as some people seem to think. These results lead one to expect that some households would not take up the benefits for which they are eligible, especially when low amounts of benefits are involved[13] (as observed in the real world).

To explore the economic significance of the 'stigma' value found and compare the values in the different specifications of the model, utility levels for a reference household are calculated and the differences between several situations are compared with the estimated size of the 'stigma' effect (see Table 3). The reference household consists of a man and a woman, each aged 30 years, without children. Both persons have the lowest educational level and there is no outstanding mortgage. We examine household income levels around the maximum benefit level. Using the estimated parameters from the extended model it is found that an exogenous increase of $60 in non-labour weekly income, which raises total weekly income from $230 to $290, is insufficient to offset the disutility arising from participation in welfare; that is, to a first approximation, the stigma effect in monetary terms is not less than $60 per week for the household in this example. The increase in income would only result in a rise in utility of about 1.7 units, whereas the stigma effect is –1.95 units.

The other two models accounting for involuntary unemployment show a similar result, although it should be noted that in these models the utility is even slightly higher for people working a low number of hours than for people who are not working. Only in the most basic model, it is found that a similar increase of $60 in non-labour weekly income, is predicted to be sufficient to offset the disutility arising from participation in welfare. However, a $30 increase in income

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13 Duclos (1997) has estimated a welfare participation model based on the same idea. He assumes that people will only apply for benefits when the benefit entitlement outweighs the 'cost' of participation.

to $260 would not be sufficient. The latter increase in income would only result in a rise in utility of about 0.52 units compared to –0.64 units for the stigma effect.

If the male partner can earn $260 per week by working 40 hours, this would be preferred over not working and receiving the same mount in benefits. The female preference for leisure is higher, but according to the model, she would still prefer working 20 hours to participation in welfare. Having children makes working a less attractive option for women, while male preferences for leisure seem to decrease somewhat if they have children. Women with children need an additional $30 per week to make working 20 hours preferable over not working and being on welfare.

In the basic model, $260 per week earned through 30 hours of work by the male partner would result in the same utility level as not working and receiving the same amount in benefits. As before, the female preference for leisure is much higher than the male preference for leisure. Even an additional $30 per week would not make working 20 hours per week preferable over not working and being on welfare. Having children makes working an even less attractive option for women, while male preferences for leisure seem to decrease somewhat if they have children.

From this example, it is clear that the size of the stigma parameter is relevant in terms of changing the preferred options. On several occasions, the difference in utility levels between the different options open to the household is smaller than the size of the stigma parameter. This means that adding the stigma term can change preferences from being on welfare to not being on welfare. According to the model, men prefer working full-time to receiving welfare and women without children prefer working part-time to receiving welfare even if no extra income is earned by working. It should be noted, however, that the part-time penalty parameters (which are not included in Table 3) mean that in practice people will be unlikely to work part time although they might prefer it.

Similar significant results have also been found in other studies. In Hoynes (1996), a significant stigma effect of participation in welfare on the utility level of two-adult households in the US can also be seen. In the same study, in an alternative specification, the stigma parameter has been made dependent on personal characteristics. However, none of these variables is estimated to have a significant effect. Moffitt (1983) found a strongly significant stigma effect for female heads in the US. He also analysed the relation between the amount of benefits received and this effect and found no significant relationship. This seems to indicate that welfare recipience *per se* has a negative effect on utility, which is invariant with respect to the amount received.

Table 3: Utility Levels (Excluding the 'Stigma' Effect) for Some Typical Households[a]

Without children

Situation (x, h1, h2)[b]	Utility			
	basic[c]	inv. 7[d]	inv. 7&12[e]	extended[f]
230, 30, 0	64.94	191.23	169.09	187.51
260, 30, 0	65.46	192.18	170.11	188.43
290, 30, 0	65.94	193.01	171.00	189.21
260, 0, 0	66.10	191.96	170.15	189.69
260, 20, 0	65.76	192.23	170.26	188.95
260, 40, 0	65.01	191.88	169.71	187.72
260, 0, 20	64.63	190.23	167.97	188.11
260, 0, 30	63.66	189.08	166.69	187.00
260, 20, 20	64.37	190.57	168.16	187.45
290, 0, 20	65.18	191.15	168.94	188.94

Two children, the youngest between one and five

Situation (x, h1, h2)	Utility			
	basic	inv. 7	inv. 7&12	extended
310, 30, 0	79.26	205.42	183.71	201.57
340, 30, 0	79.69	206.09	184.43	202.19
370, 30, 0	80.08	206.70	185.07	202.73
340, 0, 0	80.08	205.58	185.14	203.13
340, 20, 0	79.89	206.03	184.45	202.59
340, 40, 0	79.35	205.93	184.17	201.64
340, 0, 20	77.72	203.07	181.16	200.76
370, 0, 20	78.17	203.75	181.88	201.34
For comparison, the estimated stigma effect:	-0.64	-1.83	-2.02	-1.95

[a] The typical household consists of a man and a woman of 30 years of age. Both persons have the lowest education level and there is no outstanding mortgage.

[b] x stands for net household income, h1 represents the hours worked by the man and h2 represents the hours worked by the woman.

[c] basic stands for the model that does not take involuntary unemployment into account and which has seven discrete labour supply points for each person.

[d] inv. 7 stands for the model that takes involuntary unemployment into account and which has seven discrete labour supply points for each person.

[e] inv. 7&12 stands for the model that takes involuntary unemployment into account and which has seven discrete labour supply points for each man and twelve discrete labour supply points for each woman.

[f] extended stands for the model that takes involuntary unemployment into account and includes part-time penalty terms. The model has seven discrete labour supply points for each man and twelve discrete labour supply points for each woman.

Hagstrom (1996) estimates labour supply and welfare (food stamp) participation jointly for married couples, also in the US. He does not have an explicit stigma parameter, but there is evidence of several variables that have a negative effect on welfare participation. Assets and other income decrease welfare participation, which Hagstrom explains by the positive relationship of assets with the stigma of receiving food stamps. Smith (1997), however, estimates a non-significant stigma coefficient. Compared to the other articles, the percentage of people participating in the welfare programme is relatively high in his data. This might be partly explained by the fact that his US data consist of lone mothers only. The stigma or costs involved with welfare might be of less importance to them because they have children to care for and working might just not be an option for them. Bingley and Walker (1997) investigate the 'stigma' effect of an in-work benefit, Family Credit, rather than the out-of-work benefits for lone mothers in the UK. They find that the average utility loss from Family Credit participation is equivalent to the utility loss associated with a reduction in income of £5.91 per week (compared to average Family Credit benefits of £25 per week).

The translog utility function is not automatically regular. Therefore, one needs to check for quasi-concavity after estimation in the way that is explained in Section III.1. It is found that the first condition is fulfilled for both specifications in 100 per cent of the cases in all specifications. The second condition is fulfilled for 99.42 per cent of the cases in the extended model (99.16 per cent for the basic model, 100.00 per cent for the model only accounting for involuntary unemployment and 77.12 per cent for the last model[14]). From the above results, it can be concluded that the utility function is quasi-concave in a vast majority of the cases in the model presented in Table 2.

IV.2. Uncompensated Wage Elasticities

One way of illustrating the implications of the results found here, is to calculate elasticities. Ninety per cent confidence intervals are calculated for each elasticity of interest by using simulation techniques. Parameter values for our labour supply model are drawn from a multivariate normal distribution with the vector containing our point estimates as its mean and the variance-covariance matrix of the parameter estimates as its variance. We draw 10,000 independent sets of parameter values and calculate the implied elasticities. The width of the resulting range of elasticity values indicates how accurate the elasticities are that can be calculated from the model. Own-wage and cross-wage elasticities are calculated for both adults in six different typical households. The typical households studied are couples without children and couples with two children

14 It is interesting to note that the percentage of cases that are quasi-concave is even lower if the number of male labour supply point is increased to twelve (especially if part-time penalty parameters are included). The low number of observations in the male low-hours categories might be the cause.

(where the youngest is between one and five years) on three different wage rate levels (low, average and high). A low wage is defined here as a gross wage rate of $8 per hour for men and $6.67 per hour for women. Average wage rates are defined as respectively $15 and $13 per hour. 'High' wages are defined as $22.67 for men and $20 for women. The results are reported in Tables 4 (basic model) and 5 (extended model).

It is clear from Table 4 that the own-wage elasticities at low wage levels are in most instances higher in absolute terms than in the cases with higher wages. It interesting to note that for low wage rates (and low hours) male elasticities are also high, which is an unusual finding. A similar observation can be done in Table 5, although the elasticities are lower in the extended model. Fraker and Moffitt (1988) find that own-wage elasticities for female heads of households decrease with an increase in the wage rates. Thus, the above higher wage elasticities for males earning lower wage rates seem to be similar to what they find for female heads. Men with children seem to be somewhat less affected by this drop in the elasticity levels.

In the lower-wage households, the cross-wage elasticities are also positive for the basic model, which is unusual. However, one can imagine that households on low income are highly likely to be eligible for unemployment benefits. This implies that the marginal tax rate can drop considerably with an increase of family income above the level where benefits are still payable. This drop could encourage someone to increase working hours when the gross wage rate of the partner increases, since it would result in an increase in his or her own net wage rate. However, this theory does not hold in the extended model where cross-wage elasticities are all negative.

The elasticity values for average and high wage rates in Tables 4 and 5 are reasonably in line with those found in the literature. In most other research, elasticities are calculated for average persons or households. Values range from negative values (Blundell, 1997) to values of 0.15 (Van Soest, 1995). In overviews by McElroy (1981) and Killingsworth (1983: 119-25), it can be seen that the variation found in different studies is even larger. In the current study, the own-wage elasticities for both men and women at average and higher wages are much lower than for the low-wage earners. The cross-wage elasticities are negative for all people on average and high wages. The extended model shows larger negative cross-wage elasticities than the basic model.

Female own-wage and cross-wage elasticities tend to be higher than the male elasticities[15]. This can however be partly explained by the fact that women work fewer hours. When the expected number of working hours for women

15 This is also commonly found in other studies. See, for example, Wales and Woodland (1976, 1977), Killingsworth (1983), Van Soest (1995), Hagstrom (1996), Hoynes (1996) and Blundell (1997).

Table 4: Labour Supply and Welfare Participation Elasticities[a] (basic model)

	male lab. supply elasticity			female lab. supply elasticity			Welfare part. elasticity		
	Q50[b]	**Q5**	**Q95**	**Q50**	**Q5**	**Q95**	**Q50**	**Q5**	**Q95**
Low wage family[c] no children									
	E(h1)d = 39.06			E(h2) = 24.11			E(dW) = 0.14		
Wage1	0.319	0.203	0.475	0.168	0.072	0.286	-2.436	-2.727	-2.157
Wage2	0.088	0.040	0.151	0.734	0.604	0.864	-1.433	-1.670	-1.217
Low wage family, two children, where the youngest is between 1 and 5 years old									
	E(h1) = 33.52			E(h2) = 7.08			E(dW) = 0.35		
Wage1	0.241	0.148	0.352	0.184	0.129	0.246	-1.242	-1.404	-1.082
Wage2	0.010	0.001	0.022	0.495	0.438	0.560	-0.180	-0.219	-0.148
Average wage family[e] No children									
	E(h1) = 43.22			E(h2) = 34.36			E(dW) = 4.32 10^{-3}		
Wage1	0.077	0.049	0.109	-0.082	-0.137	-0.033	-3.045	-3.361	-2.724
Wage2	-0.075	-0.100	-0.054	0.386	0.312	0.465	-2.189	-2.479	-1.925
Average wage family, two children, where the youngest is between 1 and 5 years old									
	E(h1) = 42.82			E(h2) = 14.99			E(dW) = 3.85 10^{-2}		
Wage1	0.205	0.147	0.276	0.009	-0.075	0.096	-3.015	-3.362	-2.665
Wage2	0.008	-0.006	0.024	0.811	0.726	0.897	-1.066	-1.242	-0.907
High wage family[f] no children									
	E(h1) = 43.24			E(h2) = 38.47			E(dW) = 2.27 10^{-4}		
Wage1	0.088	0.068	0.111	-0.065	-0.113	-0.026	-3.004	-3.343	-2.669
Wage2	-0.089	-0.120	-0.064	0.261	0.210	0.320	-2.570	-2.902	-2.260
High wage family, two children, where the youngest is between 1 and 5 years old									
	E(h1) = 44.99			E(h2) = 20.20			E(dW) = 3.38 10^{-3}		
Wage1	0.080	0.059	0.104	-0.212	-0.290	-0.137	-3.292	-3.670	-2.916
Wage2	-0.050	-0.069	-0.034	0.697	0.627	0.768	-1.481	-1.743	-1.250

[a] All elasticities are calculated for a typical household with the following characteristics: both adults are 35 years old, have a skilled vocational qualification and do not have a mortgage. Other non-labour income is 10 dollars per week for both persons.

[b] Q50 indicates the median value of the elasticity, Q5 indicates the fifth percentile and Q95 indicates the ninety-fifth percentile.

[c] The husband has a wage rate of $8 per hour and the wife has a wage rate of $6.67 per hour.

[d] E(h1) indicates the expected value of hours worked by men for the typical household. Similar expressions are used for the hours worked by women and the probability of welfare participation.

[e] The husband has a wage rate of $15 per hour and the wife has a wage rate of $13 per hour.

[f] The husband has a wage rate of $22.67 per hour and the wife has a wage rate of $20 per hour.

Table 5: Labour Supply and Welfare Participation Elasticities[a] (extended model)

	male lab. supply elasticity			female lab. supply elasticity			Welfare part. elasticity		
	Q50[b]	**Q5**	**Q95**	**Q50**	**Q5**	**Q95**	**Q50**	**Q5**	**Q95**
Low wage family[c] no children									
	E(h1)d = 42.06			E(h2) = 24.77			E(dW) = 0.04		
Wage1	0.124	0.051	0.235	-0.203	-0.266	-0.136	-3.183	-3.695	-2.654
Wage2	-0.065	-0.092	-0.032	0.459	0.372	0.553	-1.682	-1.973	-1.394
Low wage family, two children, where the youngest is between 1 and 5 years old									
	E(h1) = 37.64			E(h2) = 9.82			E(dW) = 0.17		
Wage1	0.100	0.002	0.248	-0.081	-0.162	0.001	-1.909	-2.215	-1.614
Wage2	-0.023	-0.039	-0.005	0.476	0.410	0.542	-0.374	-0.450	-0.304
Average wage family[e] No children									
	E(h1) = 40.54			E(h2) = 27.49			E(dW) = 1.47 10^{-3}		
Wage1	0.031	0.001	0.068	-0.254	-0.318	-0.194	-2.538	-2.874	-2.200
Wage2	-0.158	-0.202	-0.120	0.281	0.228	0.335	-1.516	-1.750	-1.285
Average wage family, two children, where the youngest is between 1 and 5 years old									
	E(h1) = 41.56			E(h2) = 14.81			E(dW) = 1.58 10^{-2}		
Wage1	0.096	0.049	0.154	-0.317	-0.396	-0.239	-2.728	-3.097	-2.355
Wage2	-0.058	-0.078	-0.041	0.524	0.451	0.599	-0.854	-1.006	-0.716
High wage family[f] no children									
	E(h1) = 38.48			E(h2) = 27.89			E(dW) = 1.88 10^{-4}		
Wage1	0.034	-0.000	0.069	-0.211	-0.277	-0.151	-2.034	-2.401	-1.668
Wage2	-0.172	-0.228	-0.126	0.225	0.179	0.272	-1.342	-1.634	-1.055
High wage family, two children, where the youngest is between 1 and 5 years old									
	E(h1) = 41.43			E(h2) = 15.80			E(dW) = 2.21 10^{-3}		
Wage1	0.017	-0.017	0.051	-0.369	-0.445	-0.295	-2.257	-2.658	-1.857
Wage2	-0.099	-0.133	-0.072	0.396	0.324	0.465	-0.796	-1.002	-0.612

[a] All elasticities are calculated for a typical household with the following characteristics: both adults are 35 years old, have a skilled vocational qualification and do not have a mortgage. Other non-labour income is 10 dollars per week for both persons.

[b] Q50 indicates the median value of the elasticity, Q5 indicates the fifth percentile and Q95 indicates the ninety-fifth percentile.

[c] The husband has a wage rate of $8 per hour and the wife has a wage rate of $6.67 per hour.

[d] E(h1) indicates the expected value of hours worked by men for the typical household. Similar expressions are used for the hours worked by women and the probability of welfare participation.

[e] The husband has a wage rate of $15 per hour and the wife has a wage rate of $13 per hour.

[f] The husband has a wage rate of $22.67 per hour and the wife has a wage rate of $20 per hour.

(E(h2)) is examined, it can be seen that the expected hours increase with the wage rates. This is as expected given the values for own-wage elasticities. For women with children the own wage elasticity increases from low to average wages and decreases again from average to high wages. This might be caused by the home child care allowance which provides all carers of dependent children (mostly women) with a basic allowance of $30 per week irrespective of their partners' income. The allowance is withdrawn at a rate of 25 per cent for individual income over $5.43 per week. This might be a disincentive for women on low wages in particular to work more hours.

Households with and without dependent children can also be compared. Female labour supply drops dramatically with the presence of children. This is in line with the parameter estimates of the labour supply model in Table 2 and with results from other research. In the households with higher wages, men seem to increase their labour supply slightly when children are present. Men with low wages, however, seem to have lower working hours and households participate more often in welfare when children are present. However, comparing the results of the extended and the basic model, it can be seen that the expected number of hours worked for men on low wages with children is higher in the extended model than in the basic model. This indicates that at least part of the lower hours may be explained by the higher probability of (involuntary) unemployment, rather than a higher preference for leisure.

The elasticity of welfare participation has the expected sign in all cases. It is clear that it is much more responsive to male than female wage rates in the cases where women only work few hours. An increase of the woman's wage rate in these instances has little impact on the welfare participation decision, since her additional income contribution is only small. Therefore, the increase might not be sufficient to become independent of welfare. It is also obvious from Tables 4 and 5 that families with adults on low market wages are more likely to participate in welfare than others are. For households with the highest wage rates, the expected welfare participation is extremely low.

IV.3. Goodness of Fit and Policy Simulations

The final analysis in this study compares the actually observed levels of labour supply and welfare participation to those predicted by the basic and the extended model (see Table 6). The probabilities of being in each of the categories of labour supply and welfare participation are used. We are interested in the predicted actual hours worked, therefore we use the part-time penalty parameters in the utility function and the probability of employment[16] to take demand side factors into account in the calculations.

16 The model including a variable for recent work experience is chosen.

Table 6: Actual and Expected Labour Supply and Welfare Participation

	Men					Women				
				using extended model					using extended model	
Hours	Actual	Exp.I[a]	Exp.II[b]	Pol. Sim.1[c]	Pol. Sim.2[d]	Actual	Exp. I	Exp. II	Pol. Sim.1	Pol. Sim.2
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
Non-welfare participants										
0	75	11.4	99.1	96.3	97.4	605	328.2	688.9	683.6	687.2
1 - 9	7	20.4	7.2	7.2	7.2	58	300.3	50.2	49.9	50.2
10 - 19	8	64.6	6.9	6.9	6.9	158	276.1	137.5	136.4	137.1
20 - 29	23	177.4	23.0	22.9	23.0	218	275.7	197.3	195.8	196.6
30 - 39	415	348.8	495.7	492.9	494.9	371	252.5	337.1	335.4	336.3
40 - 49	714	533.4	598.7	595.7	597.8	287	204.6	325.4	324.4	325.0
≥ 50	539	625.1	567.1	564.8	566.4	84	143.7	61.3	61.2	61.2
Welfare participants										
0	108	21.9	92.5	100.1	94.6	106	53.2	82.4	90.0	84.6
1 – 9	5	37.4	3.3	4.5	3.4	5	45.3	4.6	5.2	4.7
10 - 19	1	35.9	1.2	1.6	1.3	3	14.9	7.7	8.8	8.1
20 - 29	2	17.9	0.8	1.2	1.1	3	3.1	4.3	5.4	5.0
30 - 39	0	2.6	1.8	3.0	3.0	0	0.4	1.1	1.8	1.7
40 - 49	1	0.9	0.6	0.8	0.7	0	0.0	0.1	0.3	0.3
≥ 50	0	0.3	0.2	0.3	0.3	0	0.0	0.0	0.0	0.0

[a] Expected numbers using the model without involuntary unemployment and with 7 discrete labour supply points.

[b] Expected numbers using the model accounting for involuntary unemployment and including part-time penalty terms. The model includes 7 discrete labour supply points for men and 12 discrete labour supply points for women. The probability of employment given that a person desires to work is taken into account.

[c] Expected numbers calculated after a 10 per cent increase in the unemployment benefit level (the model in Exp II is used).

d Expected numbers calculated after a 10 per cent decrease in the highest deduction rate of earned income from benefits, that is from 100 per cent to 90 per cent (the model in Exp II is used).

In the basic model, the number of people working part-time hours from one to 29 hours is overpredicted. Many other models have also overpredicted part-time hours. Van Soest (1995) suggests that this may be caused by not taking into account the fact that the demand for part-time workers is low, so there are restrictions in the hours of work on offer. It is clear from Table 6 that including part-time penalty parameters helps to get predicted numbers closer to the actual numbers.

The introduction of an employment equation to account for involuntary unemployment also helps to predict worked hours correctly, since it introduces the influences of the demand side in the labour market. The number of predicted labour force non-participants by the extended model is closer to the actual number than the number predicted by the basic model.

The expected number of welfare participants and the actual number of welfare participants are similar in the basic model. There is, however, a striking difference between the expected and the actual hours worked by men in households on welfare. Looking at the unemployment benefits rules this might not be so surprizing as thought at first sight. At zero or low hours of labour supply, people normally have lower preferences for leisure and the first $30 of income does not have any impact on benefit payments. The next $40 is deducted from the benefits at a rate of 50 per cent and after that any additional earnings are deducted on a dollar for dollar basis. Given that one participates in welfare, working a low number of hours is likely to be optimal, since the marginal preference for leisure and the marginal tax rate are likely to be low at that level of labour supply. After the first few hours the deduction rate in the benefit scheme increases to 100 per cent, so working more hours then becomes a less attractive alternative. In reality, jobs with low hours are scarce, so households (especially their male adult members) might be restricted in their labour supply and not be able to work at all.

Welfare participation is underestimated in the extended model (5.3 per cent instead of 6.2 per cent). However, the introduction of the part-time penalty parameters and the employment equations to account for involuntary unemployment has improved the distribution of welfare participants over the number of hours worked.

The goodness of fit of the basic and the extended model can be further summarized by calculating the expected hours worked and welfare participation. We find that the expected welfare participation is equal to 6.2 per cent in the basic model and 5.3 per cent in the extended model. The expected hours worked by men is 40.79 hours and 40.23 respectively, and the expected hours worked by women is 20.56 hours and 19.57 hours respectively.

Similar expected values are calculated after implementing a policy change in the extended model. We use the original expected values from the extended model as the benchmark in our policy simulations. After simulating an increase in the maximum benefit level by 10 per cent, the expected values for the extended model have increased to 5.9 per cent, whereas labour supply has decreased to 40.08 hours and 19.52 hours. A decrease in the highest withdrawal rate for earned income by 10 percentage points from 100 per cent to 90 per cent produces expected values of: 5.5 per cent, 40.20 hours and 19.56 hours. In the above simulations, it is assumed that the probability of employment remains the same after the policy change. The simulations using the basic model (see Kalb 1999), resulted in somewhat larger effects for these policy changes, although they were

still quite small. However, this is an indication that changes in the specification of the model can be relevant for the predicted outcome of policy changes.

The 10-percentage point decrease in withdrawal rates does not seem to have much effect on labour supply. These results are similar to those of Moffitt (1983), Fraker and Moffitt (1988), Hoynes (1996), Hagstrom (1996) and Keane and Moffitt (1996). A 10 per cent increase in the benefit level has more effect, although still not a very large one. Moffitt (1983), Fraker and Moffitt (1988), Hoynes (1996) and Hagstrom (1996) find larger effects for this change as well. Comparing their results to those of the present study is hard since the percentage change in the benefit level is different for all the studies cited. The population which Moffitt (1983), Fraker and Moffitt (1988), and Keane and Moffitt (1996) used in their studies is different from our population as well, so that the welfare participation rates in their samples are much higher than those in our sample. Hoynes (1996) and Hagstrom (1996) have a reasonably comparable sample of two-adult households with only slightly higher participation rates in welfare. Overall, it can be concluded that the model estimated here seems to dictate similar behaviour patterns with respect to changes in deduction rates and maximum benefit levels as the models estimated in the above articles.

V. CONCLUSION AND FURTHER WORK

In this paper, we estimated a simultaneous labour supply and welfare participation model with Australian data (Survey of Income and Housing Costs 1994-95) allowing for a direct negative effect from welfare participation on the utility level. Welfare participation choice is an important issue when one is interested in the effect of changes in welfare payments. Several specifications are compared, extending the basic model by accounting for involuntary unemployment, increasing the number of labour supply points and by introducing part-time penalty parameters in the utility function. The 1994 data is quite suitable to estimate this extended model.

First, the introduction of an employment equation in the model accounts for involuntary unemployment. For non-working respondents in the Survey of Income and Housing Costs 1994-95 it is known whether they were looking for part-time employment, looking for full-time employment or not looking for employment. This identifies those who are out of the labour force and those who are unemployed. In addition, it gives an indication of desired labour supply. Second, the introduction of part-time penalty parameters improved the prediction of the number of people working part-time by accounting for monetary or non-monetary costs of part-time work, like for example the fact that part-time jobs are scarce and therefore difficult to find. The underprediction of labour force non-participants and the overprediction of the number of part-time workers in the basic model have been largely fixed by these two extensions.

Increasing the number of labour supply points seemed less important. It appeared that increasing the number of points in an area in which few observations

lie, reduced the percentage of cases that fulfilled the two conditions necessary for quasi-concavity. Therefore, we choose a specification with seven labour supply points for men and twelve labour supply points for women, because the latter's hours are more evenly spread over the possible range of hours.

The labour supply estimates are mostly consistent with the existing literature and so are the estimated elasticities. The elasticities in the basic model are larger than those in the extended model, but the patterns in both specifications are similar. The additional parameter to measure disutility from welfare participation together with the introduction of the welfare participation choice into the model means that the model allows for households that are eligible for welfare, but are not taking up their benefits. It is found that this parameter is significant in both a statistical and an economic sense. The estimated effect is larger in the extended model. According to simulations with the extended model, men would prefer working full time to receiving welfare even if they do not receive extra income.

Using the estimated model to simulate policy changes can give some insight into the implications of the model. From the simulations performed in this study, it can be seen that neither changing the benefit level nor a change in the withdrawal rate of the benefits seem to have a large effect on labour supply. These results are similar to the results found using US data. The policy simulations with the extended model provide somewhat smaller effects than the policy simulations with the basic model. Accounting for involuntary unemployment and the cost of part-time employment seems relevant with respect to predicting the effect of policy changes.

The model could be further extended to account for unobserved heterogeneity. The multinomial logit is computationally convenient, but has the potential disadvantage that the error terms in the model can only be interpreted as optimization errors and do not reflect random preferences. So first, an extension of the model, to allow for unobserved heterogeneity in some of the parameters, could deal with this. Second, the wage equation and labour supply equation could be estimated simultaneously, integrating out unobserved wages, thus taking the wage prediction uncertainty into account. The potential gain of these two extensions is uncertain and expected to be less than the extensions introduced in this paper[17].

17 See for example Van Soest (1995).

Since only couples with or without children are part of this study, the overview is restricted to this group.

Job Search Allowance and Newstart Allowance[18]

Maximum rate for couples with children	$132.65 per week per person
Maximum rate for couples without children:	
Per person over 20 years of age	$132.65 per week
Per person between 18 and 20 years of age	$120.75 per week
Per person younger than 18 years of age	$109.20 per week
Income test: free area (0 % reduction)	$0.00-$30.00 per week per couple
50 % reduction of benefit	$30.00-$70.00 per week per couple
100 % reduction of benefit	more than $70.00 per week per couple
Extra free area for earnings per person	$25.00 per week per person

Basic Family Payment

For families with children younger than 16 years old, or children of 16 or 17 years old, who are dependent students, or children of 18 to 24 years old, who are from disadvantaged families.

Not paid if annual income is over $60,000 for a household with one dependent child. For each additional child an extra $3000 per year may be earned.

Rate:

1 child	$10.65 per week
2 children	$21.30 per week
3 children	$31.95 per week
4 children	$46.15 per week
each additional child	+ $14.20 per week

There is no tax on the basic family payment.

Additional Family Payment

Maximum rate	
For children under 13 years of age	$32.10 per week per child (no tax)
For children between13 and 15 years of age	$45.30 per week per child (no tax)
For children over 15 years of age	$17.00 per week per child (no tax)
Income test: free area	$0.00-($409.45+$11.97*number of dependent children) per week
50 % reduction	more than ($409.45+$11.97*number of dependent children) per week

No tax payable.

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18 Information on several allowances and rebates in 1994/1995 was obtained from a spreadsheet developed by Gerry Redmond, Social Policy Research Centre, University of New South Wales.

Tax Rates

Tax free area	$0.00-$103.56 per week
20 %	$103.57-$396.99 per week
34 %	$397.00-$728.77 per week
43 %	$728.78- $958.90 per week
47 %	more than $958.90 per week

Tax Rebates

For a dependent spouse with children:

Home child care allowance (instead of previous tax rebate)

Maximum rate	$30.00 per week
Income test: free area	spouse earns less than $5.43 per week
25 % reduction	spouse earns more than $5.43 per week

No tax payable.

For a dependent spouse without children:

Maximum rate	$23.22 per week (on taxable income of main earner)
Income test: free area	spouse earns less than $5.41 per week
25 % reduction	spouse earns more than $5.41 per week

For beneficiaries:

Maximum rate	$5.37 per week
Income test: free area	income of couple is less than $180.97 per week
12.5 % reduction	income of couple is more than $180.97 per week

For low-income earners (individual assessment)

Maximum rate	$2.88 per week
Income test: free area	individual earns less than $396.99 per week
4% reduction	individual earns more than $396.99 per week

Medicare Rates

Levy rate	1.4%
Free area	$409.76 + (number of children) * $40.27
Phase-in percentage	20%

Appendix B: TABLES OF THE PARTICIPATION, WAGE AND EMPLOYMENT EQUATIONS

Table B.1: A Probit Model of the Labour Force Participation of Men and Women

	Men		Women	
	Parameter	t-ratio	Parameter	t-ratio
Constant	-1.9759	-2.61	-1.2918	-1.81
Number of children (no children)				
• number = 1-2	0.4501	1.78	-0.1994	-0.74
• number > 2	0.3931	1.32	-0.1404	-0.47
Age of youngest child (no/older children)				
• youngest child 0	-0.3671	-1.13	-1.3975	-4.46
• youngest child 1-5	-0.6864	-2.39	-0.4163	-1.52
• youngest child 6-11	-0.5978	-2.11	0.2027	0.72
• youngest child 12-14	-0.8008	-2.43	-0.0260	-0.09
(outstanding mortgage)/10000	0.0795	4.17	0.0218	1.78
(other non-labour income)/1000	0.4096	2.41	0.2079	0.71
(wage income of partner)/1000	-0.4253	-1.84	-0.2336	-3.12
Participation of partner (dummy variable)	0.3925	2.37	0.5666	4.04
State (New South Wales)				
• Victoria	-0.1185	-0.72	-0.2906	-1.98
• Queensland	0.0474	0.28	-0.2860	-1.88
• South Australia	-0.4139	-1.83	-0.1400	-0.77
• West Australia	-0.0400	-0.22	-0.2646	-1.56
• Tasmania	0.1674	0.68	0.0504	0.26
• Territories	0.2318	0.72	0.2295	1.05
Living in capital city (dummy variable)	0.0741	0.61	0.1237	1.17
Age/10	0.5693	1.46	0.0206	0.05
$(Age/10)^2$	-0.0848	-1.81	-0.0290	-0.54
Migrant (dummy variable)	-0.1024	-0.74	-0.0083	-0.06
Recent migrant (dummy variable)	0.5131	1.55	-0.1465	-0.54
Non-English speaking background (dummy var.)	-0.0346	-0.17	-0.1302	-0.63
Work experience previous year (dummy variable)	1.3325	10.67	1.0903	9.97
Number of months worked of the last seven	0.2799	14.35	0.3580	18.69
Education (no qualification)				
• basic vocational qualification	-0.1463	-0.34	0.0345	0.18
• skilled vocational qualification	0.0823	0.60	-0.0235	-0.16
• diploma	0.0136	0.07	0.3920	2.08
• degree	0.4061	2.24	0.4910	3.26
loglikelihood	-306.760		-430.563	
ln(L(0)) [a]	-678.379		-1301.587	
Adjusted pseudo-R^2 [b]	0.54		0.66	
		Predicted Participation		
Actual participation	No	yes	No	yes
no	141	74	656	85
yes	35	1741	79	1144

[a] Ln(L(0)) is the maximum log likelihood function when all parameters except the Constant are set to zero.

[b] This is calculated by $(1 - \frac{\ln L/(T-K)}{\ln L(0)/(T-1)})$, where k is the number of independent variables.

Table B.2: Estimated Wage Equations for Men and Women[a]

	Men		Women	
	Parameter	t-ratio[b]	Parameter	t-ratio
Constant	1.9202	9.78	1.4387	7.63
State (New South Wales)				
• Victoria	-0.0469	-1.39	-0.0281	-0.82
• Queensland	-0.0466	-1.45	-0.0408	-1.18
• South Australia	-0.0796	-2.29	-0.0968	-2.81
• West Australia	-0.0619	-1.62	-0.0360	-0.91
• Tasmania	0.0230	0.57	-0.1254	-3.59
• Territories	0.1258	2.64	0.0687	1.51
Capital city (dummy variable)	0.0755	3.05	0.0593	2.51
Age/10	0.2557	2.88	0.3657	3.94
$(Age/10)^2$	-0.0290	-2.64	-0.0417	-3.29
Migrant (dummy variable)	-0.0323	-1.18	-0.0387	-1.19
Recent migrant (dummy variable)	0.0359	0.40	-0.0065	-0.06
Non-English speaking background (dummy var.)	-0.0296	-0.76	-0.0217	-0.48
Work experience previous year(dummy variable)	0.0992	1.23	0.1751	2.80
Number of months worked of the last seven	0.0013	0.14	0.0242	2.38
Education (no qualifications)				
• basic vocational qualification	0.0825	0.95	-0.0336	-0.95
• skilled vocational qualification	0.0155	0.63	0.0783	2.30
• diploma	0.0939	2.52	0.2315	5.87
• degree	0.2346	6.96	0.2799	8.29
Correction term	-0.0899	-0.82	0.1549	2.11
Variance	0.3954	28.45	0.3644	27.66
Number of observations	1711		1193	
loglikelihood	-882.47		-521.12	
Loglikelihood with only the constant	-948.47		-616.47	

[a] The dependent variable is log(hourly wage rate). The equation is estimated by interval regression, because for people working more than 49 hours per week the exact number of working hours is not known. As a result, the wage rate for these people is not exactly known. It is only known to be below a certain value, which is the weekly income from wages and salaries divided by 50 (the minimum hours worked in this category).

[b] The values for these t-ratios are an overestimate of the real values, as the extended formula for the covariance matrix to account for the estimation of the Heckman term P was not used.

Table B.3: Estimated Employment Equation for Men and Women (Probit model)[a]

	includes recent work experience		excludes recent work experience	
	estimated coefficient	**t-value**	**estimated coefficient**	**t-value**
men:				
constant	-1.7728	-2.36	-1.2695	-1.96
age	0.6945	1.79	1.2368	3.75
age squared	-0.0781	-1.64	-0.1506	-3.75
basic vocational	0.3375	0.88	0.2702	0.83
skilled vocational	0.3761	2.75	0.5296	4.47
diploma	0.3874	1.92	0.5199	2.96
university	0.6245	3.18	0.6927	4.32
Victoria	0.1259	0.76	0.0285	0.21
Queensland	0.0577	0.35	0.1020	0.70
South Australia	-0.1399	-0.76	-0.1474	-0.93
Western Australia	0.1746	0.92	0.1143	0.71
Tasmania	0.2801	1.16	0.0163	0.09
territory	0.6583	2.03	0.8641	2.84
capital city	0.1397	1.15	0.2401	2.34
migrant	-0.2100	-1.44	-0.1843	-1.47
recent migrant	0.3117	0.94	-0.2253	-0.77
NESB	-0.0919	-0.45	-0.3892	-2.30
work exp. past 7 months	1.9088	15.48		
women:				
constant	-2.0389	-2.19	-0.5472	-0.67
age	1.2379	2.39	0.9132	1.99
age squared	-0.1493	-2.17	-0.1000	-1.63
basic vocational	0.1105	0.39	0.0390	0.16
skilled vocational	-0.1795	-0.91	-0.1307	-0.75
diploma	0.0715	0.30	0.2445	1.14
university	0.2139	0.95	0.2165	1.18
Victoria	-0.0461	-0.23	0.0120	0.07
Queensland	-0.1391	-0.66	0.0884	0.48
South Australia	-0.0185	-0.07	0.1069	0.48
Western Australia	-0.0313	-0.14	0.0541	0.28
Tasmania	0.4505	1.24	0.3280	1.12
territory	1.2372	2.10	1.2994	2.75
capital city	0.2181	1.46	0.3317	2.53
migrant	0.0622	0.28	-0.0354	-0.19
recent migrant	-0.7964	-2.55	-1.0042	-3.67
NESB	-0.5024	-1.93	-0.4826	-2.16
work exp. past 7 months	1.5967	10.96		
log likelihood	-518.45		-707.30	

APPENDIX C: ALTERNATIVE LABOUR SUPPLY MODELS

Table C.1: Estimated Parameters of the Labour Supply Model

	no invol. unempl. 7 discrete points[a]		**involuntary unempl. 7 discrete points[a]**		**involuntary unempl. 7&12 discrete points[b]**	
	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio
β_x (income)	2.3816	0.54	28.3919	2.69	29.3968	2.73
β_1 (leisure men)						
Constant	6.2485	1.20	20.1023	3.04	19.7677	2.97
Number of children	-0.4466	-5.01	-0.5780	-5.38	-0.6012	-5.59
Age of youngest child						
• 0	-0.3936	-1.24	-0.0543	-0.14	-0.0435	-0.11
• 1- 5	0.2543	1.05	0.4642	1.59	0.4798	1.64
• 6 - 11	0.0135	0.05	0.2588	0.83	0.2806	0.90
Age man/10	-2.1354	-3.39	-2.1587	-2.79	-2.1215	-2.73
Age^2 man/100	0.2743	3.56	0.2954	3.14	0.2905	3.07
Mortgage/10 000	-0.1119	-6.04	-0.0828	-3.96	-0.0821	-3.93
Education man (no qual.)						
• basic vocational	0.0682	0.13	0.1649	0.26	0.2110	0.32
• skilled vocational	-0.7155	-4.07	-0.4516	-2.13	-0.4462	-2.10
• diploma	-0.5577	-2.20	-0.3405	-1.14	-0.3294	-1.10
• degree	-0.8177	-3.34	-1.1031	-3.85	-1.0748	-3.75
Education woman(no qual.)						
• basic vocational	0.2340	0.79	0.1236	0.34	0.1323	0.37
• skilled vocational	-0.1178	-0.50	-0.4222	-1.48	-0.4175	-1.46
• diploma	-0.0084	-0.03	-0.2291	-0.75	-0.2305	-0.75
• degree	-0.2999	-1.18	-0.4752	-1.62	-0.4753	-1.63
β_2 (leisure women):						
Constant	15.7542	2.97	23.1755	3.40	8.6521	1.24
Number of children	0.5708	5.03	0.4610	4.14	0.4410	3.91
Age youngest child						
• 0	4.2108	8.44	4.2205	8.86	4.4177	8.91
• 1- 5	2.4010	8.18	2.4140	8.42	2.5418	8.67
• 6 - 11	-0.1157	-0.41	-0.0305	-0.11	-0.0341	-0.12
Age woman/10	-1.7920	-2.32	-1.5010	-1.94	-1.3597	-1.74
Age^2 woman/100	0.3119	3.09	0.2865	2.85	0.2699	2.65
Mortgage/10 000	-0.0496	-2.82	-0.0424	-2.43	-0.0420	-2.37
Education woman(no qual.)						
• basic vocational	-0.8107	-2.55	-0.8054	-2.52	-0.7845	-2.41
• skilled vocational	-0.4654	-1.79	-0.6301	-2.44	-0.6327	-2.41
• diploma	-0.6947	-2.50	-0.7738	-2.78	-0.6982	-2.47
• degree	-1.6604	-6.39	-1.8218	-6.98	-1.7582	-6.66
Education man (no qual.)						
• basic vocational	0.2212	0.38	0.5644	0.95	0.5491	0.90
• skilled vocational	-0.1335	-0.67	-0.0747	-0.38	-0.0491	-0.24
• diploma	0.2824	1.01	0.3134	1.12	0.3457	1.21
• degree	0.3991	1.56	0.2951	1.16	0.2569	1.00

Table C.1 (continued)

	no invol. unempl. 7 discrete points		involuntary unempl. 7 discrete points		involuntary unempl. 7&12 discrete points	
	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio
α_{xx}	0.6501	3.43	-0.9585	-1.87	-0.9770	-1.86
α_{11}	-0.9441	-3.10	-2.6697	-7.65	-2.5354	-7.25
α_{22}	-0.4078	-1.30	-0.5983	-1.81	1.1895	3.50
α_{1x}	0.2264	1.15	0.1337	0.46	0.0721	0.25
α_{2x}	-0.8071	-3.94	-1.2634	-4.14	-1.2395	-3.97
α_{12}	0.4975	2.69	0.4437	2.07	0.4883	2.25
φ (stigma effect)	0.6394	4.15	1.8270	6.99	2.0172	7.43

[a] Seven discrete points of labour supply are distinguished for each person: 0 hours for non-participants, 5 hours for people working from 1 to 9 hours, 15 hours for people working from 10 to 19 hours, 25 hours for people working from 20 to 30 hours, 35 hours for people working from 30 to 40 hours, 45 hours for people working from 40 to 50 hours and 55 hours for people working more than 49 hours.

[b] Seven discrete points of labour supply are distinguished for each man as above in note a. Twelve discrete points of labour supply are distinguished for each woman: 0 hours for non-participants, 2 hours for women working from 1 to 4 hours, 7 hours for women working from 5 to 9 hours, 12 hours for women working from 10 to 14 hours, 17 hours for women working from 15 to 19 hours, 22 hours for women working from 20 to 24 hours, 27 hours for women working from 25 to 29 hours, 32 hours for women working from 30 to 34 hours, 37 hours for women working from 35 to 39 hours, 42 hours for women working from 40 to 44 hours, 47 hours for women working from 45 to 49 hours and 55 hours for women working more than 49 hours.

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