Wage and Employment Rates in New Zealand from 1991 to 2001

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Abstract

This paper presents results for five separately estimated sets of employment and wage equations. The New Zealand working-age population is divided into sole parents, single men, single women, married men and married women. The results for the wage equations are as anticipated and similar to the results in other countries. A higher education level, living in a city and age (up to the early forties) increase the expected wage. Wages also differ significantly across industries and occupations. Employment follows the expected patterns as well, where women with children are less likely to be employed; education increases the employment probability; and living in remote areas decreases employment. In addition to the usual variables, unemployment affects the probability of employment negatively and a clear upward time trend is observed for sole parents, living with one's parents decreases the employment probability of singles but increases the probability for sole parents, and eligibility for the New Zealand Superannuation seems relevant in the employment decision.

JEL CLASSIFICATION J21
J31

KEYWORDS Wage rate; employment; joint model specification

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1 Introduction

This paper reports estimates of wage functions for a number of demographic groups in New Zealand, using pooled information from the 1991/92, 1992/93, 1993/94, 1994/95, 1995/96, 1996/97, 1997/98 and 2000/01 Household Economic Survey (HES). Similar to a number of other papers in this field, the main aim of estimating wage equations is to impute wage rates for those who are not currently working, so that they can be used in labour supply models.[1] This imputation of wage rates is complicated by the fact that wage equations should ideally contain variables, such as industry and occupation, which are not observed for non-workers (for the same reason that wage rates are not available). These variables are important determining factors of wage rates. This paper therefore follows the same approach as Creedy et al. (2001) to allow the use of these variables.

The availability of eight data sets covering a period of ten years, in which several changes occurred in New Zealand's economic situation and social policies (see for example Knutson, 1998), allow us to explore several interesting issues. For example, this long time span allows insights into changes over time, response to unemployment levels, the effect of changed work requirements for benefit recipients in 1998 and the increase in the age of eligibility for the New Zealand state pension from 60 to 65 years of age (gradually introduced from 1991 to 2000).

As in other articles, the estimation procedure corrects for the sample selection bias that would otherwise arise from the fact that only the wage rates of those currently working are observed. The approach of Creedy et al. (2001) is extended by estimating wage and employment (or selection) equations simultaneously, allowing for correlation between the unobserved components of the two equations, instead of using the standard Heckman procedure (Heckman, 1979), which is a two-step approach. The results using the two approaches are compared. There have been few studies estimating New Zealand wage functions, exceptions are Chiao and Walker (1992), who did not have good data, and Maloney (1997), whose equation had only a few explanatory variables. Earlier Australian wage functions were discussed for example by Miller and Rummery (1991), Murray (1996), Kalb (2000), Creedy et al. (2001) and Kalb and Scutella (2002). All these studies used the standard Heckman approach.

[1] Many tax policies are specially designed in an attempt to stimulate an increase in labour supply. There would therefore be little value in restricting analyses to those currently working, thereby excluding non-participants whose participation decision may be influenced by taxes and transfers. Labour supply analyses require an individual-specific budget constraint, so a wage rate must be assigned to non-workers.

An advantage of the New Zealand data over the Australian data used in Creedy et al. (2001) and Kalb and Scutella (2002) is that there is no censoring in the recorded hours of labour supply, which simplifies the estimation procedure. Furthermore, a longer period, including more recent years, is covered by the available data in New Zealand. That is, a period from 1991 to 2001 compared to a period from 1994 to 1998 in Australia.

The standard selection model is described briefly in section 2. The data are described in section 3. Estimates of the wage equations are reported in section 4. The approach of assigning wage rates to non-workers and the prediction of wage rates for some hypothetical individuals is discussed in section 5. Brief conclusions are in section 6.

2 The Statistical Model

The estimation of wage equations involves a system of two correlated equations, the first of which determines selection (employment) using a probit equation, while the second determines wage rates, conditional on employment. The correlation between the two equations accounts for the possible selection into work of those with higher wage rates. The wages of workers may therefore not represent the wages of non-workers.

First the selection equation, where each individual's observed employment outcome is regarded as being the result of an unobservable index of tendency to participate in the labour force and employability, E_i^* (based on the probability of someone's market wage being more than their reservation wage), which varies with observed personal characteristics, z_i. The variables included in z may include both supply and demand side variables. Hence:

$$E_i^* = z_i'\gamma + u_i \qquad (1)$$

where u_i is assumed to be independently distributed as N(0, 1)[2]. The realisation of E_i^* determines whether the individual is employed (E_i = 1), or unemployed or out of the labour force (E_i = 0), such that:

$$E_i = \begin{cases} 1 \text{ if } E_i^* > 0 \text{ occurring with prob. } \Phi\left(z_i'\gamma\right) \\ 0 \text{ if } E_i^* \le 0 \text{ occurring with prob. } 1 - \Phi\left(z_i'\gamma\right) \end{cases} \qquad (2)$$

where $\Phi\left(z_i'\gamma\right)$ is the standard normal distribution function evaluated at $z_i'\gamma$. The associated normal density function is denoted $\varphi\left(z_i'\gamma\right)$. The parameters of (2) can be consistently estimated by a standard probit model; see Maddala (1983).

Let w_i denote the logarithm of the wage rate and x_i a vector of characteristics of individual i. The regression model is written as:

$$w_i \Big|_{E_i=1} = x_i'\beta + \varepsilon_i \qquad (3)$$

The u_i from equation (1) and ε_i are assumed to be jointly normally distributed as N(0, 0, 1, σ_ε^2, ρ)[3]. In the first approach, equations (1) and (3) are estimated simultaneously, where

[2] As there is no information about the scale of E_i, the variance of u cannot be identified and is therefore set equal to unity. This is a standard procedure in Probit analyses and does not affect estimation of the other coefficients.

[3] The covariance between u_i and ε_i is thus $\rho\sigma_\varepsilon$.

$\varepsilon_i, u_i \sim N(0,\Sigma)$, with $\Sigma = \begin{bmatrix} \sigma_\varepsilon^2 & \rho\sigma_\varepsilon \\ \rho\sigma_\varepsilon & 1 \end{bmatrix}$.

An alternative, frequently used, approach is to include an additional term in the wage equation indicating the tendency to participate, which can also correct for this selection process without the need to estimate the wage and selection equation jointly (Heckman, 1979). This approach consists of two steps. In the first step, equation (2) is estimated, after which an estimate, $\hat{\lambda}_i$, of the inverse Mill's ratio for a working individual i is obtained using:

$$\hat{\lambda}_i = \frac{\varphi\left(z_i'\hat{\gamma}\right)}{\Phi\left(z_i'\hat{\gamma}\right)} \tag{4}$$

Then in the second step, in order to avoid selectivity bias, a correction term is added to (3):

$$w_i\Big|_{E_i=1} = x_i'\beta + \rho\sigma_\varepsilon\hat{\lambda}_i + \upsilon_i \tag{5}$$

Equation (5) takes into account the correlation between u_i and ε_i. It can be seen that the variance of υ_i, σ_i^2, is heteroscedastic, since:

$$\sigma_i^2 = \sigma_\varepsilon^2(1-\rho^2\delta_i) \tag{6}$$

where:

$$\delta_i = \lambda_i\left(\lambda_i + z_i'\gamma\right) \tag{7}$$

Efficient estimation of this model is carried out using the convenient two-step procedure of first estimating the probit model for the employment probability and calculating the predicted value for the inverse Mill's ratio, and then using the predicted Mill's ratio in the wage equation. Greene (1981) shows how to calculate the corrected standard errors.

We prefer to use the joint model as it makes the most efficient use of the available data. However, since the two-step approach has been used in many other studies, this paper presents both approaches to allow a comparison between the two sets of results to be made.

3 The Data

The data used in this analysis are taken from the 1991/92 to 2000/01 Household Economic Surveys collected by Statistics New Zealand. These surveys were released on a yearly basis from 1991/92 to 1997/98, but are currently undertaken only once every three years. The survey collects information on the sources and amounts of income received by persons resident in private dwellings throughout New Zealand, along with data on a range of characteristics for all individuals within the household. The individuals in each household are linked by a household number and family number. The survey is held continuously over the year with around 2000 individuals interviewed every quarter during the financial year, except for 1992/93 when over 3000 individuals were surveyed per quarter. In the surveys from 1991/92 to 2000/01, information is available for 68,711 individuals.

The details of hours worked are required for the calculation of wage rates, which is obtained for each individual as the ratio of total earnings to hours worked. Hence the following analysis ignores the possibility that individuals may obtain overtime premiums, or may work in more than one job at different wage levels

The majority of the data used as explanatory variables were recoded as zero-one dummy variables. To keep all the variables to a similar scale, all of the non-wage income variables were divided by 1000 while age was divided by 10. Any individuals with inconsistent observations on income from wages or salaries and hours worked, that is positive earnings for zero hours or zero earnings for positive hours, are excluded from the wage equation (as sensible wage rates cannot be calculated for them). However, these observations do remain in the selection equation assuming that we correctly observe whether or not they are working.

In the survey, individuals could name up to three ethnic groups with which they associate themselves. These three ethnic variables are recoded into one variable with the following categories for this analysis. Anyone who names Māori or a Pacific Islander group as one of the ethnic groups to which they belong is categorized as such. Those who do not name other ethnic groups are classified separately from those who also name alternative groups. Those who do not name Māori or a Pacific Islander group, but who associate themselves with ethnic groups other than the Pakeha (or European) group, are grouped into the other non-European category. This group is also subdivided into two groups if sufficient observations are available. One group which only names other non-European ethnic groups to describe their ethnicity and one group which also names the European group.

As the emphasis of the analysis is on obtaining results to be used in labour supply analysis for people of working age, individuals over 65 years (the current age of eligibility for New Zealand Superannuation) are excluded from the sample. In the earlier survey years, individuals would be eligible for the New Zealand Superannuation[4] at 60 years of age, but this was gradually increased to 65 years of age. This change during the survey period provides an opportunity to look at the effect of this change on the labour force participation of individuals aged between 60 and 64. Other groups which have been excluded are those with a disability and those in full-time education, because they are unlikely to participate in the labour force and the factors determining their participation decision would be quite different from other people of working age. Finally, the self employed are omitted from the sample, because their decision to work an additional hour has a less direct link to a wage rate for that additional hour than the link between wage rate and labour supply for the wage and salary earners.[5] In addition, the concepts of market wage and reservation wage underlying the selection equation in the wage model do not seem as relevant to the self employed as to wage and salary earners.

[4] This is a universal state-provided pension for all New Zealand residents over a certain age, which is not income tested. The age of eligibility changed over time in quarters of years. The data only report the age in full years, which means the eligibility for the superannuation is not certain for some individuals. In those cases where the eligibility is uncertain we represent eligibility by a value of 0.25 if the age of eligibility at the time of observation is for example 61.75 and the observed age is 61. Eligibility is represented by a value of 0.75 if the age of eligibility is for example 63.25 and the observed age is 63. For individuals who are eligible with certainty, that is the observed age is more than the age of eligibility, eligibility is represented by 1, whereas eligibility is represented by 0 for those individuals who are ineligible.

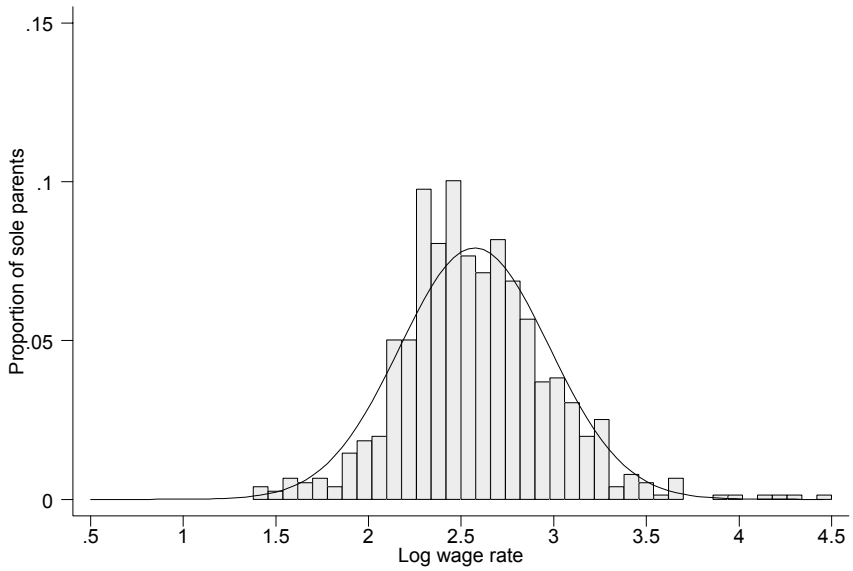
[5] In the surveys used, there were 18,548 persons under 16 years of age, 3,476 people either at school or studying full-time, 715 individuals were permanently unavailable for work, 7,542 individuals were over the age of sixty-five and there were 4,720 self-employed persons.

The eight surveys were pooled and the sample was divided into five demographic groups.[6] These are sole parents, single females without dependents, single males without dependents, married females and married males. Summary tables of sample characteristics are provided for each demographic group in Table A.2 in the Appendix. It was not possible to estimate separate equations for sole mothers and sole fathers, given the small number of sole fathers in the sample[7].

Examples of distributions of the logarithms of observed hourly wage rates for the five demographic groups are shown in Figures 1 to 5. These are based on 2001 wages for workers. The histograms suggest that the wage distributions are approximately lognormal, although the distributions of the logarithm of the wages are slightly more peaked than the corresponding normal distributions with the same mean and variance. Individuals reporting wage rates more than 50 per cent below the relevant minimum wage at the time[8] or greater than $100 an hour are considered outliers and were omitted from the wage equation. A total of 227 observations were excluded for this reason. As expected, the graphs show that the modal wage rate is higher for married men and women than for singles. The difference between men and women is less pronounced.

Besides the information in the HES data sets, we used information on quarterly unemployment rates by gender from the second quarter of 1996 and yearly information up to that time. The unemployment rates are used to create a time-dependent unemployment measure for each observation.

Figure 1 – Log hourly wage rates for sole parents, December 2001 wages



[6] All wage rates are increased to the values they would have had in the last quarter of 2001 using quarterly indices derived from average weekly earnings and all income from other sources is inflated with the appropriate consumer price index to obtain the value it would have had in the last quarter of 2001.

[7] There were 257 male sole parents, compared with 1886 females.

[8] See the Appendix table A.1 for the minimum wage details over the survey period.

Figure 2 – Log hourly wage rates for single females without dependents, December 2001 wages

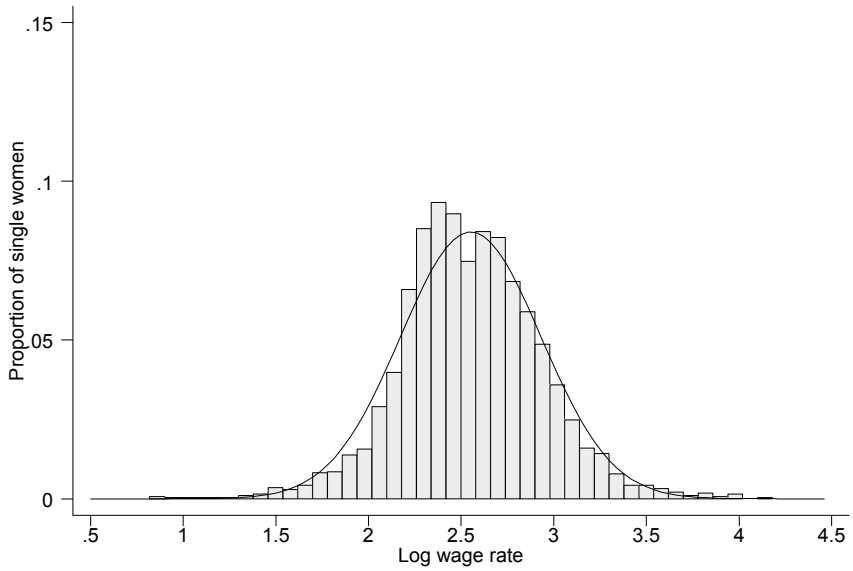


Figure 3 – Log hourly wage rates for single males without dependents, December 2001 wages

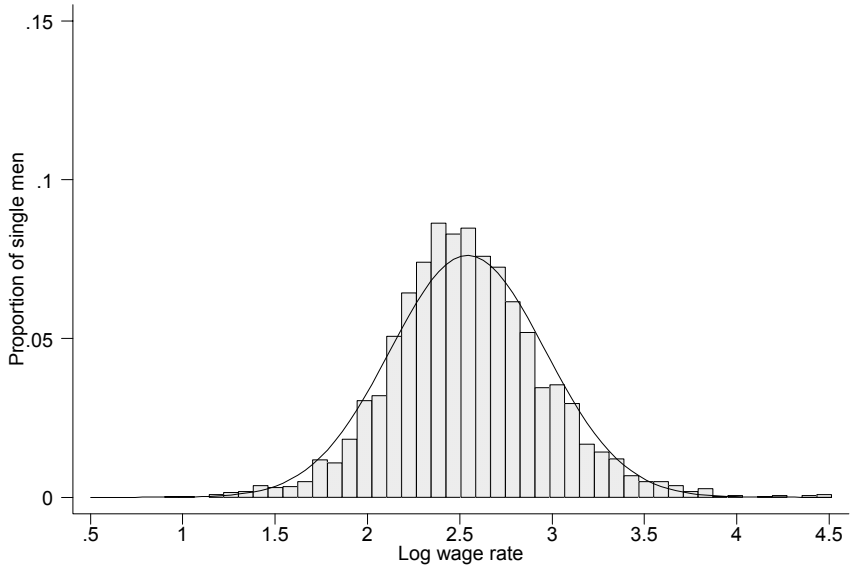


Figure 4 – Log hourly wage rates for married females, December 2001 wages

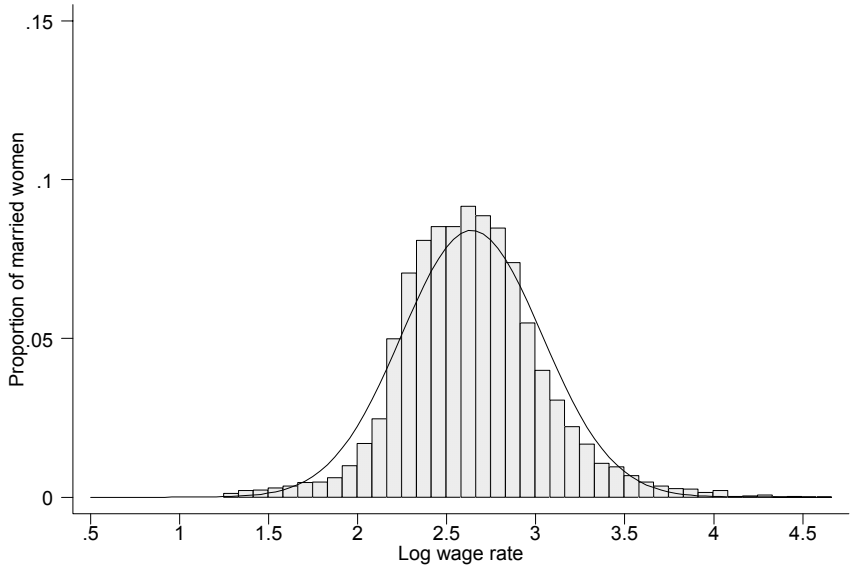
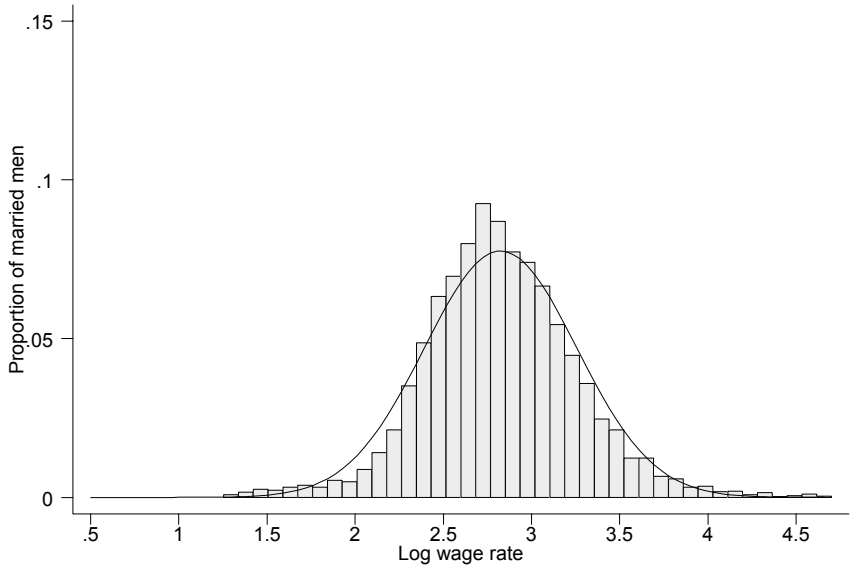


Figure 5 – Log hourly wage rates for married males, December 2001 wages



4 Empirical Results

4.1 Estimation results

This subsection presents the main empirical results. The results for the joint models of selection equations and wage equations are reported for each demographic group in Tables 1, 2 and 3. Tables A.4 to A.6, containing the results using the two-step Heckman approach, can be found in the appendix. The sample sizes are, for married women, married men, single women, single men and sole parents respectively 12294, 10528, 4279, 4691 and 2166. The inverse Mill's ratio has the expected sign for all groups except

sole parents, that is, for most groups the parameter is significant and positive. The inverse Mill's ratio is negative for sole parents. However, its value is very small and insignificant. The interpretation of negative inverse Mill's ratios in this context was discussed by Ermisch and Wright (1994)[9].

Table 1 – Joint Wage and Selection Model: Married Women and Men

	Wage equation				Selection equation			
	Married men		Married women		Married men		Married women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
age/10	0.5104	16.74	0.2569	8.73	1.2803	10.33	1.1491	11.13
Age sq./100	-0.0592	-16.16	-0.0297	-8.34	-0.1717	-11.44	-0.1671	-12.95
Education (reference group is less than school cert.)								
School certific.	0.0879	6.32	0.0668	5.44	0.3402	6.54	0.3179	8.57
bursary	0.1539	4.09	0.1974	5.37	0.8469	5.90	0.4941	4.45
Voc./trade cert.	0.1041	2.79	0.2469	6.52	0.8526	6.00	0.6449	5.59
Bach. Deg/dipl.	0.1382	2.32	0.2629	4.46	1.0607	4.01	0.4246	2.10
Post-grad. qual.	-0.1135	-1.23	0.4187	4.16	0.3450	0.83	1.1105	2.88
part deg/other	0.1062	2.30	0.2770	6.16	0.6298	3.56	0.7459	5.15
Pgrad*age/10	0.1205	5.68	-0.0170	-0.70	0.0995	1.08	-0.0504	-0.56
Bach*age/10	0.0297	2.12	0.0000	0.00	-0.1033	-1.80	0.0629	1.27
Voc/med*age/10	0.0015	0.18	-0.0269	-3.18	-0.0939	-3.19	-0.0300	-1.19
Nr of children					-0.0195	-1.00	-0.0646	-3.97
Age of youngest child								
0					-0.0920	-1.18	-1.5844	-25.35
1 to 3					-0.1083	-1.64	-1.1239	-21.85
4 to 5					-0.1486	-1.84	-0.8134	-12.84
6 to 9					-0.1479	-2.10	-0.4217	-7.66
Over 9					-0.1677	-2.26	-0.1593	-2.68
Ethnicity (reference group is European)								
Māori/Pacif.Isl.	-0.0178	-0.64	-0.0223	-0.84	-0.3525	-3.50	0.1168	1.34
Māori/Pac.only	-0.0754	-3.55	-0.0502	-2.44	-0.2891	-4.16	0.0277	0.45
Other non-Eur.	-0.2015	-3.54	-0.2732	-2.12	-0.2997	-1.44	-0.4296	-1.19
Other n.E. only			-0.1248	-2.11			0.1926	1.07
Pgr/bac*ma/pa	0.0049	0.08	-0.2013	-3.26	0.1808	0.61	-0.1238	-0.56
Pgr/bac*other	0.1435	2.49	0.0966	1.57	-0.3044	-1.56	-0.1005	-0.58
voc/med*ma/pa	0.0088	0.31	-0.0878	-2.88	-0.0509	-0.49	-0.1778	-1.90
Voc/med*other	0.0807	1.30	0.1552	2.45	-0.0288	-0.13	0.0951	0.52
Industry (reference group is services)								
agriculture	-0.0672	-2.77	0.0279	0.87				
Mining/quarry	0.1707	3.56	0.1681	0.88				
Manufacturing	0.0639	4.88	0.0478	3.10				
Elec./gas/water	0.1354	4.88	0.0577	0.92				
construction	-0.0135	-0.72	-0.0007	-0.02				
trade	-0.1111	-7.86	-0.0617	-5.09				
transport	0.0416	2.00	0.0353	1.43				
finance/real est.	0.1355	8.93	0.0707	5.35				
communication	0.0617	2.96	0.0526	1.67				
other	0.0093	0.29	0.0622	1.83				

[9] Miller and Rummery (1991) found a positive value for women and a negative value for men. They also review results found in previous Australian studies. They do not distinguish between single and married men and women. Murray (1996) found a positive value for mothers (single and married) and Kalb (2000) found a positive value for married women and a negative (insignificant) value for married men.

Table 1 – continued

	Wage equation				Selection equation			
	Married men		Married women		Married men		Married women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Occupation (reference group is elementary occupations)								
manager	0.2930	15.96	0.3493	17.17				
professional	0.2587	12.74	0.3833	19.56				
associate prof.	0.2643	13.33	0.3191	15.09				
clerks	0.1274	5.37	0.2574	14.40				
Sales workers	0.1139	5.35	0.0680	3.75				
agr./fish. wrk.	-0.0280	-0.95	-0.0069	-0.18				
Trades workers	0.1173	6.19	0.1083	3.30				
plant/mach.wrk	0.0604	3.28	0.0316	1.30				
Elig. NZ super					-0.7402	-8.17	-0.3099	-3.26
Other inc./1000					-0.1614	-4.98	-0.1388	-4.89
Characteristics of partner								
wage inc./1000					-0.0739	-1.20	-0.0511	-3.17
employed					0.6492	15.01	0.6954	18.77
School certific.					0.1991	4.41	0.0300	0.69
bursary					0.2432	3.98	0.0701	1.29
Voc./trade cert.					0.1232	2.54	0.0019	0.05
Bach. Deg/dipl.					0.0818	1.05	-0.1912	-3.67
Post-grad. qual.					-0.2657	-2.27	-0.4025	-5.52
part deg/other					0.1079	0.87	-0.0514	-0.52
Elig. NZ super					-0.0046	-0.04	-0.1480	-2.44
Māori/Pacif.Isl.	-0.0407	-1.57	0.0304	1.09	-0.1078	-1.06	0.0308	0.34
Māori/Pac.only	-0.0771	-4.35	0.0058	0.33	-0.2287	-3.65	0.0413	0.73
Other non-Eur.	0.0856	0.84	0.0372	0.19	-0.0775	-0.19	-0.6884	-1.17
Other n.E. only	-0.1442	-3.26	-0.1411	-2.83	-0.1501	-0.80	-0.6351	-4.00
Region (reference group is Auckland)								
North North isl	-0.0835	-6.64	-0.0931	-7.49	-0.2345	-4.86	-0.1111	-2.86
Central N. isl	-0.1103	-8.21	-0.0744	-5.62	-0.2333	-4.44	-0.0286	-0.68
Wellington	0.0423	3.31	0.0325	2.58	-0.0984	-1.81	0.1269	3.01
Canterbury	-0.0859	-6.37	-0.0712	-5.26	-0.1249	-2.20	-0.0274	-0.63
South island	-0.0911	-6.78	-0.0954	-7.14	-0.1712	-3.06	-0.0324	-0.75
Year (trend)	0.0018	0.69	0.0079	3.11	0.0223	2.09	0.0123	1.51
Unempl. rate	-0.0061	-1.70	0.0008	0.16	-0.0351	-2.49	-0.0212	-1.43
constant	1.5735	20.29	1.7486	21.66	-1.3547	-4.56	-1.6161	-6.42
Correlation[a]	0.3120	0.22,0.40	0.2807	0.21,0.35	Nr of obs.	10528		12294
Sigma[a]	0.3639	0.36,0.37	0.3352	0.33,0.34	Nr of			
Mill's ratio[a]	0.1135	0.08,0.15	0.0941	0.07,0.12	cens.obs	2081		5076
Log likelihood					-7245.30		-8779.27	
Restricted Log likelihood [b]					-10128.46		-11872.76	
Pseudo-R^2 [c]					0.28		0.25	

Notes a: Instead of a z-value a 95% confidence interval is given.

b: The restricted model consists of a wage equation with a constant and sigma and a selection equation with a constant only.

c: Pseudo R^2 is calculated by $1 - \frac{\log \text{likelihood} / (N - \text{number of parameters})}{\text{restricted log likelihood} / (N - 3)}$.

Table 2 – Joint Wage and Selection Models, Single Men and Women

	Wage equation				Selection equation			
	Single men		Single women		Single men		Single women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
age/10	0.6892	17.65	0.5485	16.03	0.7782	6.82	0.9747	8.11
Ages sq./100	-0.0818	-14.95	-0.0638	-14.04	-0.1196	-7.78	-0.1410	-9.11
Education(reference group is less than school cert.)								
School certific.	0.0790	3.74	0.0925	4.41	0.5570	9.40	0.5827	9.17
bursary	0.1141	2.84	0.0955	2.47	0.7711	6.33	1.0253	7.97
Voc./trade cert.	0.1735	3.90	0.1173	2.80	1.0230	7.19	1.0304	6.90
Bach. Deg/dipl.	0.0340	0.47	0.0503	0.91	0.4215	1.58	0.8025	3.43
Post-grad. qual.	0.1337	1.08	0.0227	0.23	0.2524	0.52	0.7144	1.39
part deg/other	0.1469	2.70	0.1173	2.44	0.8809	4.58	0.9228	5.10
Pgrad*age/10	0.0672	2.05	0.0838	3.43	0.1815	1.43	0.1545	1.25
Bach*age/10	0.0684	3.13	0.0515	3.53	0.1116	1.35	0.0525	0.82
Voc/med*age/10	0.0045	0.39	0.0126	1.35	-0.0786	-2.15	-0.0545	-1.65
Ethnicity (reference group is European)								
Māori/Pacif.Isl.	0.0183	0.57	-0.0070	-0.24	-0.3771	-3.79	-0.1190	-1.04
Māori/Pac.only	-0.0484	-1.78	-0.0460	-1.77	-0.5688	-8.28	-0.4701	-6.22
Other non-Eur.	0.1799	1.62	-0.0955	-1.37	0.3182	0.57	-0.3550	-1.54
Other n.E. only	-0.0800	-1.31			0.2516	1.03		
Pgr/bac*ma/pa	-0.0200	-0.18	-0.0754	-1.15	0.7686	1.37	0.5963	1.66
Pgr/bac*other	0.0739	0.76	0.1009	1.17	-1.0607	-3.09	0.2014	0.57
voc/med*ma/pa	-0.0241	-0.58	-0.0086	-0.21	0.1018	0.78	-0.0568	-0.40
Voc/med*other	-0.1043	-1.17	-0.0448	-0.46	-0.7471	-2.23	-0.0996	-0.28
Industry (reference group is services)								
agriculture	-0.0161	-0.47	-0.0029	-0.06				
Mining/quarry	0.1353	1.33	0.2428	1.72				
Manufacturing	0.0608	3.17	0.0138	0.64				
Elec./gas/water	0.2305	4.32	0.0459	0.57				
construction	0.0078	0.30	-0.0293	-0.48				
trade	-0.0541	-2.63	-0.0613	-3.90				
transport	0.0527	1.66	0.1354	3.82				
finance/real est.	0.0902	3.81	0.0452	2.62				
communication	0.1163	3.44	-0.0466	-1.31				
other	0.0775	1.51	0.0778	1.70				
Occupation (reference group is elementary occupations)								
manager	0.2528	9.14	0.3438	10.47				
professional	0.2276	7.87	0.3280	10.63				
Associate prof.	0.2441	9.34	0.2738	8.71				
clerks	0.1453	5.17	0.2060	7.32				
Sales workers	0.0435	1.75	0.0640	2.23				
Agr./fish. wrk.	-0.0655	-1.79	0.0069	0.12				
Trades workers	0.0644	2.95	0.1186	2.44				
plant/mach.wrk	0.0478	2.11	0.0553	1.53				
Elig. NZ super					-0.9071	-4.61	-0.5125	-3.90
Other inc./1000					-1.4714	-6.29	-0.8644	-5.14
Live w. parents					-0.2377	-4.87	-0.1605	-2.74

Table 2 – Continued

	Wage equation				Selection equation			
	Single men		Single women		Single men		Single women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Region (reference group is Auckland)								
North North isl	-0.0918	-4.77	-0.0746	-4.13	-0.2774	-4.43	-0.2174	-3.23
Central N. isl	-0.0834	-4.09	-0.0988	-5.30	-0.2842	-4.24	-0.0135	-0.19
Wellington	-0.0212	-1.13	0.0351	2.16	-0.1182	-1.72	0.0335	0.49
Canterbury	-0.0811	-4.15	-0.0790	-4.35	0.0045	0.06	-0.1048	-1.43
South island	-0.0623	-3.28	-0.1144	-6.21	-0.1915	-2.83	-0.1295	-1.76
Year (trend)	0.0034	0.90	0.0083	2.38	0.0113	0.84	-0.0047	-0.34
Unempl. rate	-0.0064	-1.23	0.0090	1.43	-0.0297	-1.65	-0.0617	-2.46
constant	1.1182	11.41	1.1303	11.64	-0.3980	-1.36	-0.7083	-2.11
Correlation[a]	0.3937	0.18,0.57	0.3906	0.20,0.55	Nr of obs.	4691		4279
Sigma[a]	0.3301	0.32,0.35	0.2880	0.28,0.30	Nr of	1474		1461
Mill's ratio[a]	0.1300	0.06,0.20	0.1125	0.06,0.17	cens.obs.			
Log likelihood					-3357.84		-2614.05	
Restricted Log likelihood [b]					-4736.79		-4043.03	
Pseudo-R^2 [c]					0.28		0.34	

Notes a: Instead of a z-value a 95% confidence interval is given.

b: The restricted model consists of a wage equation with a constant and sigma and a selection equation with a constant only.

c: Pseudo R2 is calculated by $1 - \dfrac{\log\text{likelihood}/(\text{N} - \text{number of parameters})}{\text{restricted log likelihood}/(\text{N} - 3)}$

Table 3 – Joint Wage and Selection Models, Sole Parents

	Wage equation		Selection equation	
	Coef.	z-value	Coef.	z-value
woman	-0.2104	-5.05	-0.0385	-0.39
age/10	0.1830	1.38	1.1312	4.02
Age sq./100	-0.0250	-1.47	-0.1556	-4.23
Education (reference group is less than school cert.)				
School certific.	-0.0669	-1.75	0.4041	4.92
bursary	0.0186	0.14	0.4286	1.36
Voc./trade cert.	-0.0504	-0.37	0.5586	1.73
Bach. Deg/dipl.	-0.1994	-0.73	1.2767	1.63
Post-grad. qual.	-0.4273	-0.85	-1.5948	-1.07
part deg/other	-0.0584	-0.40	0.4093	1.14
Pgrad*age/10	0.1701	1.52	0.5880	1.72
Bach*age/10	0.0774	1.13	-0.0957	-0.47
Voc/med*age/10	0.0208	0.62	0.0621	0.74
Nr of children			-0.0825	-2.23
Age of youngest child				
0			-1.5800	-8.82
1 to 3			-1.1164	-8.98
4 to 5			-0.9182	-7.11
6 to 9			-0.6141	-5.84
Over 9			-0.3830	-3.49

Table 3 – Continued

	Wage equation		Selection equation	
	Coef.	z-value	Coef.	z-value
Ethnicity (reference group is European)				
Māori/Pacif.Isl.	-0.0011	-0.02	-0.0924	-0.72
Māori/Pac.only	-0.0221	-0.52	-0.2176	-2.55
Other non-Eur.	0.0441	0.34	-0.5945	-2.04
Pgr/bac*ma/pa	0.0374	0.21	-0.5981	-1.32
Pgr/bac*other	-0.1301	-0.60	0.1989	0.34
voc/med*ma/pa	0.0673	0.89	-0.2719	-1.52
Voc/med*other	-0.0216	-0.10	0.5881	0.98
Industry (reference group is services)				
agriculture	-0.0715	-0.73		
Manufacturing	0.0983	1.91		
Elec./gas/water	0.3698	1.84		
construction	0.1520	1.64		
trade	-0.0167	-0.47		
transport	0.1775	1.82		
finance/real est.	0.1266	2.70		
communication	0.1618	1.90		
other	0.1492	1.40		
Occupation (reference group is elementary occupations)				
manager	0.3217	4.81		
professional	0.4110	7.13		
Associate prof.	0.3394	5.58		
clerks	0.2022	3.86		
Sales workers	0.0683	1.35		
Agr./fish. wrk.	-0.0287	-0.28		
Trades workers	0.0283	0.34		
plant/mach.wrk	0.0657	0.98		
Elig. NZ super			-0.3797	-0.47
Other inc./1000			0.1897	0.55
Live w. parents			0.2238	1.71
Region(reference group is Auckland)				
North North isl	-0.0577	-1.50	-0.2252	-2.45
Central N. isl	-0.0992	-2.57	-0.0384	-0.40
Wellington	-0.0388	-0.94	-0.0743	-0.70
Canterbury	-0.0720	-1.75	-0.0323	-0.30
South island	-0.0455	-1.02	-0.1434	-1.28
Year (trend)	-0.0120	-1.52	0.0462	2.37
Unempl. rate	-0.0197	-1.43	-0.0038	-0.11
constant	2.5031	7.60	-1.8147	-2.81
Correlation[a]	-0.1600	-0.45,0.16	Nr of obs.	2166
Sigma[a]	0.3309	0.31,0.35	Nr of censored obs.	1409
Mill's ratio[a]	-0.0530	-0.16,0.05		
Log likelihood			-1347.18	
Restricted Log likelihood [b]			-1798.08	
Pseudo-R^2 [c]			0.22	

Notes a: Instead of a z-value a 95% confidence interval is given.

b: The restricted model consists of a wage equation with a constant and sigma and a selection equation with a constant only.

c: Pseudo R^2 is calculated by $1 - \frac{\log \text{likelihood} / (\text{N} - \text{number of parameters})}{\text{restricted log likelihood} / (\text{N} - 3)}$.

The interpretation of coefficients in the wage model is not as straightforward as in a simple linear regression. The effect of a one-unit change in a characteristic is calculated by using the following formula: [exp(relevant coefficient) – 1]×100%. For example, a married woman with a postgraduate degree is expected to be offered a wage rate, which is about 52 per cent higher than for a married woman without post secondary qualifications[10].

Personal Characteristics

The coefficients more or less display the expected variation of wage with age, that is, wage rates generally increase with age up to people's early forties, after which they decline with age[11]. A similar pattern is observed for Australia (Kalb and Scutella, 2002). The effect is weakest for sole parents. The age effect is also more pronounced for singles and married men than for married women. A similar pattern is found for the probability of employment in the different groups, where the probability of employment is highest around 35 years old.

There are considerable differences in wage rates between occupations and educational qualifications. Wage rates of managers, professionals, and associate professionals are highest, followed by clerks. Agriculture or fishery workers seem to have the lowest wages although they are not significantly lower than for the elementary occupations. Wage rates also tend to increase with the level of educational qualification across all groups. The model includes education levels and an interaction term of the two university levels and the medium-level and vocational education with age. Generally, people educated at university level have the highest wages. This higher wage level is not so obvious at a young age but the difference with other education levels increases with age, indicating a steeper age-earnings profile and a later peak in the wage level for more highly educated individuals.

This effect is not present for married women and sole parents, which may be explained by the different career path of women with children. Women with children have often left the labour force temporarily or worked part time while their children were young. The effect of education on wages seems much lower for sole parents than for the other groups. As expected, individuals with higher education levels are also more likely to be employed. This effect is most obvious for women, followed by single men. Singles and married men with medium level education are more likely to participate when they are young, but as they grow older their employment rates drop more than the employment rates of the lower and higher educated groups. With the introduction of the interaction term of age and education nearly all education wage effects are negative for sole parents and the interaction term is positive and larger for people with higher education levels, indicating a more rapidly increasing wage with age. However, none of these effects is significant. The participation in employment of sole parents with a postgraduate degree is at first lower but increases with age. At about the age of 40 the ranking of the different education levels is as expected.

Comparing the wage rates in the different industries the effects are less clear than for occupation or education, but mining and quarrying seems to pay higher wages for most groups (although the effect is not always significant, possibly due to the small proportion of some groups working in the mining industry). Electricity, Gas and Water pay higher wages as does the Finance and real estate industry. However, it is not the same industry that pays the highest wage relative to an individual's other characteristics (such as age or

[10] In this example: [exp(0.4187)-1] ×100% =52.0% for married women.

[11] This increase and decrease in wage rates is not actually observed over a person's lifecycle, but is the result of the cross sectional nature of the data where different age cohorts are observed at one point in time.

education) in all five groups. Examining the lowest paying industry there is less ambiguity. The Trade industry pays the lowest wage across all groups, although the difference is insignificant for sole parents.

Ethnicity affects wage rates to some extent for all groups apart from sole parents. People from European descent earn the highest wages, followed by the Māori and Pacific Islander population. The slight negative effect for this group is only significant (or close to significance) for those who name this ethnic group as the only group to which they belong. Other non-European groups receive the lowest wages. This is only significant for married men and women who name a non-European other group as one of more ethnic groups to which they belong. For men no distinction can be made between those who belong to non-European other groups only and those who belong to the European group as well, because of the small size of the latter group. Employment rates are also lowest amongst this latter group for married women and sole parents. For the groups of married men and singles, those from Māori and Pacific Islander descent are least likely to be employed. Examining the interaction of ethnic group (grouping the two Māori/Pacific Islander groups together and the two other Non-European groups) and education level (university and medium level, including vocational, bursary and other degrees, versus the lower levels), it is clear that wage and employment patterns differ across the ethnic groups by education. With regard to the wage rate, married women from Māori/Pacific Islander descent seem to benefit less from education than the other groups, whereas those from non-European descent seem to benefit more. To a much lesser extent the latter also appears true for married men. None of the effects is significant for the other three demographic groups. The effects on employment are not as clear. The only clearly significant effect is observed for single men from other non-European background who are more likely to be employed when they have a higher or medium education level. Finally, the partner's ethnicity seems to have some effect[12]. Men with Māori or other non-European partners and women with other non-European partners seem to have lower wages. The probability of employment of men with Māori partners is lower. The probability of employment of women with other non-European partners is lower as well. Basically, all partners from non-European descent seem to affect the probability of employment negatively although not significantly. Women with Māori/Pacific Islander partners are, if anything, more likely to be employed.

Female sole parents have significantly lower wage rates than male sole parents, but do not appear less likely to be employed. Comparing the size of the coefficient with the difference in the constant terms in the wage equations for married or single men and women, there appears to be little difference between the reference group single man and woman. The constant term for married women is even higher than for men.

External characteristics

New Zealand displays clear regional differences in wage and employment rates. People living in the two major cities of Auckland and Wellington are paid higher wages than people living outside these cities. For couples and single women, Wellington pays the highest wages. This latter effect is comparable to the effect of living in Canberra in Australia, given that both cities house the federal government and a large proportion of the population work in government jobs, which are generally well paid. The highest employment rates are found in Auckland, except for married and single women, who are more likely to participate when living in Wellington. Employment rates in the north of the North Island are the lowest of all regions amongst all groups. These results are in line with

[12] Scobie and Gibson (2002) include a similar variable in their model and Gibson and Scobie (2001) include a variable in their savings model indicating the proportion of the household who are from Maori/Pacific Islander descent. There seems to be a difference between households with different shares of ethnic groups.

those of Maré, Mawson and Timmins (2001), where it is found that the North Island, and in particular the region of Northland, is deprived. Deprivation is measured by nine different components; three of these components are related to income and employment.

Over the ten-year survey period unemployment has fluctuated considerably. The results show that the level of unemployment has affected the probability of employment, with married men and singles affected most and sole parents least, but that unemployment has not affected wage rates significantly (although the sign is negative for men and sole parents). The models also include a yearly time trend to examine changes over time. The inclusion of quarterly unemployment rates should take out most of the effect of business cycle changes. Sole parents seem to have increased their labour force participation over the ten years of the study, which is reflected in higher employment rates in the later survey years[13]. There is also some evidence of an increase in the employment rates for couples and for an increase in wage rates of single and married women over this time period.

Household characteristics

The selection equation of the model includes some family composition variables which are not expected to influence the wage equation. Important variables for married women and sole parents are the number of children and the age of the youngest child. As expected, the presence of more children reduces labour force participation and thus the probability of employment; and the presence of younger children has a larger effect than the presence of older children. Even for married men, some negative effects are found, although the effects are larger and significant only for older children. Compared to the effects for women (most sole parents are women), the effects for men are small and much less significant.

For married men and women, information on the partner's characteristics is included in the selection equation. A partner's employment has a positive effect on the person's own employment, but the higher the partner's wage income, the lower the effect. The latter counteracting effect is only significant for women. A partner's education decreases a woman's employment probability only if it is a university degree, whereas for men, the partner's higher education level mostly only increases the employment probability unless the partner has a postgraduate degree. The effects for women seem larger.

The presence of other (non-labour) income in the household decreases the probability of employment for all groups except sole parents. For singles and sole parents, we also use an indicator of whether they are still living with their parents. Singles who live with their parents are less likely to be employed whereas sole parents living with their parents are more likely to be employed (although only at the 10 per cent significance level). This may indicate that the presence of their own parents could be a valuable source of childcare for sole parents, enabling them to work outside the home.

Policy-related variables

A final variable of interest in the selection equation is the eligibility indicator for the New Zealand Superannuation scheme. In the period from April 1992 to April 2001 the age of eligibility increased from 60 to 65. Comparing employment rates over time for those between 60 and 65, it becomes clear that employment rates have increased considerably for this group over the time period in this study. This can also be seen in Statistics New Zealand (2002) and indicates the importance of the Superannuation in the retirement

[13] Between 1991 and 2001, the percentage of women in the labour force has increased (Statistics New Zealand, 2002).

decision of New Zealanders. Hurnard (2003) notes that only 40 per cent of middle-aged couples had private or employer sponsored superannuation at a low median value of 30,000 dollars. We control for these private savings through the "other income" variable in the models. The importance of the Superannuation is confirmed by the significance of the eligibility indicator in the selection equation. Those who are eligible are much less likely to be employed. Similar results are documented in Maloney (2000, 2002) and Hurnard (2003), who all used more aggregated data than are used for this study. For married women, even the partner's eligibility is relevant. Some support for this result is also found in Hurnard (2003). Few sole parents are in the age group that is eligible and as a result the indicator is not significant for this group.

Another policy change with the potential to change labour force participation was the introduction of a part-time work requirement in April 1997 followed by a more extensive (part-time) work requirement in February 1999 for individuals on the Domestic Purposes Benefit and the Widows Benefit.[14] These work requirements depend on the age of the youngest child. In an alternative specification of the models, indicators were introduced for individuals observed after the first quarter of 1999, who may have been affected by the policy. None of the variables relating to this policy was, however, significant and these variables have therefore been dropped from the final version of the model. The Department of Labour and Ministry of Social Development (2001) note some problems with the implementation of this new policy and in addition, the number of individuals affected by the change in policy in the data is relatively small. This may explain the lack of effect. Wilson (2000) and Wilson and Ball (2001) seem to find an effect of the policy change on the propensity of Domestic Purposes Benefit recipients to declare earnings (this could partly be a reporting issue). They use administrative data from the Department of Work and Income payments system, which have information on a much larger number of relevant individuals than the HES data set.

Knutson (1998) notes the high rate of births amongst teenagers in New Zealand. This is comparable to the situation in the US, where a relatively large proportion of sole parents are teenage mothers. Comparing the employment rates of individuals who had a child as a teenager compared with those who did not, shows a much lower employment rate for those who had children as a teenager. However, an indicator for teenage births included in the selection equations is not significant for any of the groups. This may be caused by the fact that those who have children as a teenager, have many other characteristics which make them less likely to be employed. That is, the teenage birth is not causing the low employment rate but is being caused by the same factors that cause low employment rates.

Standard error and correlation

Finally, the estimated standard error (σ_ε) has a similar size over all the demographic groups. It is largest for married men, indicating that for these groups a larger proportion of the differences in wage rates has not been explained by the variables included in the equation. The standard error is smallest for single women. However, the differences between groups are rather small.

The correlation coefficient between the wage and selection equations in the models is relatively high for most groups, indicating that it is necessary to account for the correlation between the two equations. Using a two-step method to estimate the wage and selection equation results in similar outcomes, although the mill's ratio is somewhat different in the two approaches for singles and married men. The estimated correlation for these groups,

[14] See Department of Labour and Ministry of Social Development (2001) for more details about this change.

using the two-step approach, seems unrealistically high (particularly for singles). The next section will explore the differences in predicted wage rates using the alternative methods.

4.2 Marginal effects

This subsection provides selected examples of the extent to which people's wage rates may change given a change in their observable characteristics.

Consider first the impact of postgraduate qualifications on the wage rates of individuals. A typical 30-year old sole parent with a postgraduate degree is expected to be offered a wage rate which is about 8.7 per cent higher than for those without post secondary qualifications[15]. Single females without dependents and married men of 30 years old with postgraduate qualifications can expect a wage that is about 30 per cent higher, while single males without dependents or married females with a postgraduate qualification receive a wage of around 40 per cent higher. Sole parents thus experience the lowest effect from education on wage levels, which may be explained by their higher probability of withdrawing temporarily from the labour market, while having young children.

Second, consider the impact of living in the north of the North Island on the wage rate of individuals. Wage rates are lower across all five demographic groups compared to individuals residing in Auckland. Sole parents experience the smallest effect on their wage rates a 5.6 per cent decrease by living in the north of the North Island. All other groups have wage rates which are between 7.2 and 8.9 per cent lower than in Auckland.

Finally, consider the impact of age on the wage rates of individuals. To calculate the age effect for the lowest education groups (school certificate or less than school certificate), we need to take into account the coefficients of age and age squared. In addition, the effect depends on the starting age. The effect for married men is an increase of 16.8[16] per cent for a ten-year increase in age from 25 to 35 years and a 3.7 per cent increase for a ten-year increase from 35 to 45 years. This reflects the turnaround point in people's early forties, from an increasing wage rate with age to a decreasing wage rate with age. This turnaround point occurs in the early forties for all lower educated groups. For a married man with a postgraduate degree the percentage wage increase from 25 to 35 years is 31.7 per cent and from 35 to 45 years it is 17.0 per cent[17]. The maximum wage rate is expected in the early fifties. Except for married women, the age-earnings profiles are steeper for higher educated people and the maximum wage rate occurs at an older age.

5 Wage Predictions

5.1 Derivation of the predicted wage

This section describes how a wage rate may be assigned to unemployed individuals. In the simple case where the selection and wage equations contain a common set of

[15] This value is calculated by using the following formula: [exp(relevant coefficients) – 1]×100%. The relevant coefficients are the education level coefficients and the interaction terms of education and age. In this example: [exp(0.4187-3 ×0.017)-1] ×100% =44.4% for a 30-year old married woman.

[16] The formula used in this calculation is [exp(coefficient of age + coefficient of age squared+2*(age at start/10)*(coefficient of age squared)) – 1]×100%. In this example: [exp(0.5104-6*0.0592)-1] ×100% =16.8%.

[17] The formula used in this calculation is [exp(coefficient of age + coefficient of age*education level+ coefficient of age squared+2*(age at start/10)*(coefficient of age squared)) – 1]×100%. In this example: [exp(0.5104+0.1205-6*0.0592)-1] ×100% =31.7%.

variables, consider first the conditional mean log-wage rate, for an individual with given characteristics. For those who are employed, this is given by:

$$E\left(w_i \middle| _{E_i=1}\right) = x_i'\hat{\beta} + \hat{\rho}\hat{\sigma}_\varepsilon\hat{\lambda} \qquad (8)$$

Imputed wage rates for those who are unemployed can be obtained using the expression:

$$E\left(w_i \middle| _{E_i=0}\right) = x_i'\hat{\beta} - \hat{\rho}\hat{\sigma}_\varepsilon \frac{\varphi\left(z_i'\hat{\gamma}\right)}{1-\Phi\left(z_i'\hat{\gamma}\right)} \qquad (9)$$

The use of the conditional mean log-wage is perhaps the most obvious choice for the predicted wage. It is also possible, for example, to take a random draw, for each individual, from the relevant conditional distribution. Indeed, in labour supply analyses there is no necessity to be restricted to using observed wage rates for those employed in the sample period: it would also be possible to take random draws from the relevant conditional distributions.

In the present context, the expression in (9) cannot be used without modification because some variables used in the estimation of the wage functions are not available for non-workers. In addition to the wage rate, neither the occupation nor the industry of non-workers is known. Although these variables could not be included in the selection equations, they were included in the wage equations because of their demonstrated importance in wage determination. An alternative predictor for non-workers is simply (9) with the dummy variables for occupation and industry replaced by the sample proportions in the different categories. Since it is likely, that the distribution across occupations differs between the employed and the unemployed workers, extraneous information on unemployment rates within the various occupation and industry groups are used to assign proportions within occupation and industry groups to the non-workers (see Table A.3). For a complete discussion of this approach see Creedy et al. (2001).

5.2 Predicted wages

In this subsection, we present an overview of the predicted wages, using the approach from the previous subsection assigning the average occupation and industry characteristics for the unemployed (see Table A.3). Table 4 shows the average predicted wage by employment status and education level. For those who are employed the average observed wages are presented as well. Average predicted wages and average observed wages are close to each other in the different education groups for all demographic groups. For married women and single women, the difference between the observed and predicted wage is somewhat larger, because for this group a larger proportion of the observed wages were too low to be included in the wage model.[18] When these observations are excluded, the predicted average wage is close to the observed average wage.

Comparing average predicted wages over the whole sample we find clear differences between participants and non-participants. As expected the predicted wages are lower for those who are currently unemployed. This is even true for sole parents (although to a much smaller extent) who did not suffer from selectivity problems, which indicates that the characteristics of participants and non-participants are different. An explanation of this smaller selectivity problem for sole parents is that the reason for non-employment of sole

[18] In the labour supply model, observed wages that are too low (less than half the minimum wage) will be replaced by the imputed wage.

parents is different from the reasons in the other groups. Responsibility for a young child and the difficulty of combining care for a young child with employment may be the main reason of non employment for sole parents. This should not affect a sole parent's expected wage rate, whereas in the other groups other (unobserved) factors may impede employment and wage levels at the same time. Comparing the average wages across the demographic groups confirms expectations that married men have the highest wage levels. Married women and sole parents have higher wage levels than singles, where single women obtain the lowest wage levels.

Table 4 – Average predicted wage and observed wage[a] in 2001 dollars by education level and participation in employment

	Married men	Married women	Single men	Single women	Sole parents
Non employed					
No qualification	11.60	10.49	9.59	9.54	13.27
School certificate	12.23	11.06	9.17	9.62	12.49
Bursary	13.24	11.44	9.76	9.25	14.92
Vocational/trade certif.	12.99	11.87	11.49	10.86	14.49
Bachelor degree/diploma	15.48	13.69	12.37	11.15	15.25
Post graduate qualification	18.27	15.01	14.67	13.10	17.79
Part degree/other	13.13	12.33	10.63	10.81	13.93
All non employed	12.45	11.23	9.99	9.80	13.43
Employed					
No qualification	14.83	12.46	11.96	11.70	12.36
	14.44	12.77	12.12	11.36	12.44
School certificate	16.93	14.14	12.02	12.49	12.17
	16.90	14.32	11.87	12.32	12.30
Bursary	19.51	15.02	12.96	12.62	15.35
	19.40	14.92	12.97	12.63	14.66
Vocational/trade certif.	18.26	16.17	15.17	14.63	15.46
	18.06	16.63	14.86	14.45	15.21
Bachelor degree/diploma	23.48	19.56	18.20	16.46	18.04
	24.56	20.62	18.05	16.50	18.30
Post graduate qualification	27.75	21.91	22.33	20.79	23.57
	28.11	21.45	22.45	21.32	26.05
Part degree/other	19.50	16.98	14.58	14.47	15.07
	18.97	17.69	14.49	14.39	15.75
All employed	18.52	15.19	13.91	13.79	14.22
	18.49	15.51	13.81	12.25	14.18

Note a: Wages are only observed for employed individuals. The first number represents the average predicted wage and the second number represents the average observed wage.

In addition to the average predicted wages presented above, as a further illustration, we provide some examples of predicted wages obtained when unemployed hypothetical individuals are assigned the average occupation and industry characteristics for the unemployed (see Table A.3). The two different approaches used in estimation also result in somewhat different predictions for singles and married men, although the relative wage rate levels remain similar. In the next stage of the project, we will use the imputed values obtained from the jointly estimated model.

In the following examples, we look at hypothetical individuals living in Auckland in 2001, who are not eligible for the New Zealand Superannuation. Consider first a hypothetical female unemployed sole parent with the following characteristics: aged 23 years; with a

certificate; partly from Māori/Pacific Islander descent; with no other income unit income; not living with her parents; with one dependent child at the age of three; and a current female unemployment rate of 5.1 per cent. The predicted or imputed wage obtained using the distribution over industry and occupation groups for unemployed individuals (see Table A.3) is found to be $12.48 per hour using the joint estimation approach and $12.41 using the two-step estimation approach.

Second, consider a hypothetical unemployed single female without children; aged 19 years; from European descent; with a certificate; with $400 of other income; not living with her parents; and a current female unemployment rate of 5.1 per cent. The imputed hourly wage is found to be $8.98 for the joint model ($6.70 in the two-step model).

Third, consider a hypothetical unemployed single male without children; aged 28 years; with a certificate; from Māori/Pacific Islander descent; living with his parents; no other income; and a current male unemployment rate of 5.4 per cent. The imputed wage is $11.31 for the joint model ($9.65 in the two-step model).

Fourth, consider a hypothetical unemployed married female: aged 35 years; with six dependent children, where the youngest child is 4 years old; from European descent; without educational qualifications; partner has postgraduate degree and is employed at a wage of $1000 per week; no other income; and a current female unemployment rate of 5.1 per cent. The basic imputed wage is $12.40 per hour in the joint model ($12.28 in the two-step model).

Finally, consider a hypothetical unemployed married male: aged 33 years; with two dependent children where the youngest is two years of age; from European descent; without qualifications; partner has a certificate and is currently employed at $800 dollars per week; no other income; and a current male unemployment rate of 5.4 per cent. The basic hourly rate is $12.40 per hour in the joint model ($10.63 in the two-step model).

From the above results, it is clear that the groups where the estimated correlation is quite different between the two alternative specifications also display the largest difference between the imputed wage rates using the alternative models. As a result of the very strong correlation between wage rates and employment probabilities estimated in the two-step model for singles and married men, the two-step model predicts wage rates at a rather low level for non-working singles and married men.

6 Conclusion

This paper has reported estimates of wage equations for New Zealand workers, using pooled data from the Household Economic Surveys between 1991/92 and 2000/01. Selection bias was taken into account by using the alternative methods of estimating wage and selection equations simultaneously and in two steps using the Heckman approach, in both cases allowing for correlation between the two equations. The effects of all the variables are similar in both approaches, but the estimated correlation differs for singles and married individuals, resulting in somewhat different predicted wages depending on the approach.

The results for the wage equations are as expected for the usual characteristics, with education and age (up to the early forties) increasing the expected wage. People over 43 to 45 experience decreasing wages with increasing age. Except for married women, people at higher education levels have more steeply increasing wages and the maximum wage rate occurs at an older age. From the models, it is also clear that occupation and industry affect the level of the wage. People working in managerial, professional or associate professional positions are clearly paid more than people in other occupations and people in elementary occupations and agriculture or fishery workers are paid the least. Individuals living in the two main cities of Auckland and Wellington are paid more than people living elsewhere. The ethnicity variable shows that people from different ethnic groups are affected in different ways, individuals from European descent are paid higher wages than individuals from Māori or Pacific Islander descent, who are again paid more than individuals from the remaining ethnic groups.

The long time period for which data were available, allows a time trend to be estimated. The effect of business cycle changes was taken into account to some extent by including national unemployment rates in the model. It is found that changes took place for some groups over time and that unemployment rates do not seem to affect wage levels. Wage rates for married and single women have increased over time to some extent.

Employment rates are affected by the usual characteristics as well, that is, women with younger or more children are less likely to be employed; individuals living in cities; more highly educated individuals; European New Zealanders, except for married women; and men married to a partner with a medium-level education are more likely to be employed. Individuals with more income from other sources, with a partner on a higher wage income, with a partner with a postgraduate degree, and individuals from other non-European backgrounds (and Māori and Pacific Islander descent to a lesser extent) are less likely to be employed. The highest probability of employment occurs around the age of 35 years.

In addition to the usual characteristics include in wage models, some other variables were included. First, the gradual change in the age of eligibility for New Zealand Superannuation from 60 to 65 years during the survey allowed us to examine the influence of eligibility for the Superannuation while controlling for several other characteristics. An individual's own eligibility plays a significant role in the decision to participate, whereas for women the partner's eligibility is also important although to a lesser extent than their own eligibility. This effect is insignificant for sole parents, which may be explained by the smaller proportion of sole parents in the age group for which this change took place. No evidence was found for the effect of the changed work requirements for Domestic Purposes Benefit recipients or for the effect of teenage births

on employment rates. Secondly, time trends were included and show that employment rates for sole parents increased over time and decreased with the unemployment rate for married men, and single women and men. Finally, including a dummy variable for singles and sole parents that indicates whether they are living with their parent(s) shows that singles are less likely to be employed when living with their parents, whereas sole parents are more likely to be employed when living with their parents. This may indicate the existence of childcare opportunities provided by the grandparents.

The process of assigning a wage rate to non-workers, needed in the context of labour supply analysis, was examined with special attention given to dealing with the situation where the wage equation includes variables that are not available at an individual level for the unemployed (such as occupation and industry). For these two characteristics, annual distributions over the categories were used for the unemployed instead of individual observations. These annual aggregate observations on industry and occupation, based on the value for these characteristics in their previous job (excluding the unemployed who have never had a job), were used in the imputation. On average, non-workers have lower wages than the workers, even for sole parents, where there is no evidence of selection bias. In this latter case, it is the difference in characteristics between the two groups that is causing the difference in average wages.

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Appendix: Additional Tables

Summary statistics for the various demographic groups are shown in Table A.2. Many variables are dummy variables taking (0, 1) values, the tables show the proportions in each category for these variables.

Information about the occupation and industry in the previous job for those who were unemployed in 1991 and 2001, taken from Tables 3D and 3E in the Labour Statistics Database of the International Labour Organisation, were used to construct the proportions given in Table A.3. In predicting wage rates, information was used from yearly data available from 1991 to 2001

Table A.1 – Minimum wage rates between 1991 and 2001

Time period	minimum wage in $/hour for those	
	20 years of age and over	under 20 years of age
1991 to April 1994	6.125	n.a.
April 1994 to April 1995	6.125	3.680
April 1995 to April 1996	6.250	3.750
April 1996 to April 1997	6.375	3.825
April 1997 to April 2000	7.000	4.200
April 2000 to April 2001	7.550	4.550
	18 years of age and over	under 18 years of age
April 2001 to April 2002	7.700	5.400

Table A.2 – Sample Proportions

	married men	married women	single men	single women	sole parent
Wage rate	16.6717	13.6917	12.5087	12.3698	12.8699
Employment rate	0.8023	0.5871	0.6858	0.6586	0.3495
Woman					0.8809
age/10	4.1733	4.0455	3.0525	3.4993	3.4556
Age squared/100	18.7218	17.7186	10.9483	14.5989	12.7884
No qualification	0.2861	0.3261	0.3123	0.2998	0.4603
School certificate	0.1402	0.2141	0.1929	0.1849	0.2036
Bursary	0.0862	0.1167	0.1733	0.1774	0.0753
Vocational/trade certificate	0.3171	0.2139	0.1921	0.1657	0.1602
Bachelor degree/diploma	0.1068	0.0845	0.0810	0.1094	0.0392
Post-graduate qualification	0.0447	0.0259	0.0269	0.0320	0.0148
Part degree/other qualification	0.0190	0.0187	0.0215	0.0308	0.0226
Year (trend)	4.7623	4.7534	4.6176	4.6116	4.6330
Māori/Pacific Islander and another ethnic group	0.0247	0.0245	0.0401	0.0367	0.0623
Māori/Pacific Islander is only group named	0.1312	0.1214	0.1450	0.1365	0.3176
Other non-European and another ethnic group	0.0004	0.0013	0.0021	0.0009	0.0203
Other non-European is only group named	0.0297	0.0294	0.0226	0.0229	0.0189
Industry					
Agriculture	0.0568	0.0306	0.0830	0.0227	0.0357
Mining/quarry	0.0070	0.0004	0.0031	0.0014	0.0000
Manufacturing	0.2501	0.1312	0.2565	0.1210	0.1057
Electricity/gas/water	0.0226	0.0039	0.0121	0.0043	0.0040
Construction	0.0747	0.0125	0.0824	0.0078	0.0211
Trade	0.1545	0.1850	0.1996	0.2339	0.1929
Transport	0.0475	0.0276	0.0423	0.0245	0.0172
finance/real estate	0.1075	0.1377	0.0951	0.1558	0.0898
Other services	0.2146	0.4411	0.1772	0.3900	0.4967
Communication	0.0162	0.0137	0.0134	0.0142	0.0145
Other	0.0484	0.0163	0.0354	0.0245	0.0225
Occupation					
Manager	0.1994	0.1002	0.0799	0.0759	0.0647
Professional	0.1414	0.1988	0.0945	0.1689	0.1823
Associate professional	0.1140	0.0859	0.0995	0.0983	0.0885
Clerks	0.0478	0.2652	0.0746	0.2935	0.1849
Sales workers	0.0771	0.1888	0.1156	0.2356	0.2523
Agriculture/fishery worker	0.0451	0.0224	0.0755	0.0170	0.0330
Trades workers	0.1541	0.0194	0.1946	0.0170	0.0357
plant/machine worker	0.1527	0.0538	0.1464	0.0500	0.0700
Elementary occupations	0.0619	0.0639	0.1166	0.0429	0.0885
Region					
North North island	0.1734	0.1768	0.1686	0.1517	0.2114
Auckland	0.2905	0.2859	0.2935	0.3092	0.2710
Central north island	0.1372	0.1392	0.1349	0.1246	0.1731
Wellington	0.1396	0.1380	0.1426	0.1603	0.1173
Canterbury	0.1257	0.1253	0.1162	0.1278	0.1173
South island	0.1336	0.1349	0.1441	0.1264	0.1099
Number of children	1.1354	1.0896			1.7890

Table A.2 – continued

	married men	married women	single men	single women	sole parent
Age of youngest child is 0	0.0775	0.0743			0.0960
Age of youngest child is 1 to 3	0.1567	0.1469			0.2770
Age of youngest child is 4 to 5	0.0647	0.0612			0.1279
Age of youngest child is 6 to 9	0.1014	0.0969			0.2004
Age of youngest child is > 9	0.0662	0.0644			0.1251
Other non-labour income/1000	0.0700	0.0783	0.0230	0.0333	0.0189
Living with parents			0.3873	0.2933	0.0697
Wage income of partner/1000	0.2970	0.6483			
Employment of partner	0.6140	0.7860			
Partner's education					
No qualification	0.3199	0.3181			
School certificate	0.2147	0.1324			
Bursary	0.1207	0.0803			
Vocational/trade certificate	0.2120	0.3053			
Bachelor degree/diploma	0.0857	0.1036			
Post-graduate qualification	0.0269	0.0425			
part degree/other qualification	0.0201	0.0177			
Partner: Māori/Pacif. Isl. and another ethnic group	0.0270	0.0227			
Partner: Māori/Pacif. Isl. is only group named	0.1324	0.1201			
Partner: Other non-Eur. and another ethnic group	0.0014	0.0006			
Partner: Other non-Eur. is only group named	0.0307	0.0285			
Eligibility of partner for NZ superannuation	0.0270	0.1033			
Eligibility for NZ superannuation	0.0540	0.0432	0.0252	0.0567	0.0060
Unemployment rate	8.5376	7.7773	8.6153	7.8641	7.8931
Had oldest child as teenager	0.0196	0.0279			0.1150
Observed after 1999 (work requirement)		0.1084			0.0937
Work requirement *age youngest is 0 to 4		0.0261			0.0402
Work requirement *age youngest is 5 to 6		0.0061			0.0083
Work requirement *age youngest is 7 to 13		0.0163			0.0337
Work requirement *age youngest is 14 to18		0.0050			0.0115
Part-time work requirement		0.2202			0.2059
Part-time work req. * age youngest child 14 to 18		0.0107			0.0222
Number of observations	10528	12294	4691	4279	2166
Number of observations in wage equation	8447	7218	3217	2818	757

Table A.3 – Occupation and Industry Proportions: Unemployed

Category	1991	2001
Industry Division		
Agriculture, hunting, fishing and forestry	0.1044	0.1192
Mining/quarrying	0.0040	0.0033
Manufacturing	0.2148	0.1325
Electricity/gas/water	0.0046	0.0022
Construction	0.0978	0.0635
Wholesale and retail trade, restaurants, hotels	0.2155	0.2194
Transport and storage	0.0261	0.0273
communication	0.0261	0.0273
Finance, insurance, real estate, business services	0.0562	0.0880
Other services	0.1778	0.1927
Other	0.0687	0.1225
Occupational Group		
Legislators, administrators and managers	0.0426	0.0549
Professionals	0.0476	0.0561
Technicians and associate professionals	0.0653	0.0860
Clerks	0.1157	0.0998
Service sales workers	0.1611	0.2207
Agriculture and fishery workers	0.1121	0.1297
Trades workers	0.1462	0.0823
Plant and machine operators and assemblers	0.1540	0.1110
Elementary occupations	0.1540	0.1608

Table A.4 – Two-Step Wage and Selection Model: Married Women and Men

	Wage equation				Selection equation			
	Married men		Married women		Married men		Married women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
age/10	0.5494	16.36	0.2633	8.91	1.2366	9.94	1.1821	11.39
Age sq./100	-0.0644	-15.65	-0.0305	-8.53	-0.1663	-11.04	-0.1710	-13.18
Education (reference group is less than school cert.)								
School certific.	0.0983	6.79	0.0686	5.57	0.3334	6.39	0.3118	8.39
Bursary	0.1706	4.44	0.2002	5.44	0.8419	5.84	0.4876	4.38
Voc./trade cert.	0.1204	3.16	0.2502	6.60	0.8552	6.02	0.6424	5.56
Bach. Deg/dipl.	0.1520	2.51	0.2655	4.50	1.1023	4.12	0.4255	2.09
Post-grad. qual.	-0.1188	-1.27	0.4224	4.18	0.3287	0.79	1.0555	2.74
part deg/other	0.1174	2.50	0.2808	6.23	0.6202	3.50	0.7451	5.14
Pgrad*age/10	0.1249	5.80	-0.0171	-0.70	0.0999	1.09	-0.0401	-0.45
Bach*age/10	0.0294	2.08	0.0000	0.00	-0.1195	-2.06	0.0608	1.22
Voc/med*age/10	0.0003	0.04	-0.0271	-3.20	-0.0965	-3.28	-0.0304	-1.20
Nr of children					-0.0186	-0.94	-0.0715	-4.35
Age of youngest child								
0					-0.0786	-1.00	-1.5586	-24.76
1 to 3					-0.1014	-1.51	-1.1055	-21.30
4 to 5					-0.1388	-1.70	-0.8256	-12.91
6 to 9					-0.1167	-1.64	-0.4392	-7.89
Over 9					-0.1537	-2.05	-0.1865	-3.11
Māori/Pacif.Isl.	-0.0259	-0.92	-0.0221	-0.83	-0.3522	-3.49	0.1178	1.35
Māori/Pac.only	-0.0860	-3.96	-0.0516	-2.51	-0.2907	-4.20	0.0346	0.56
Other non-Eur.	-0.2150	-3.73	-0.2758	-2.14	-0.2998	-1.46	-0.4340	-1.20
Other n.E. only			-0.1235	-2.09			0.1819	1.02
Pgr/bac*ma/pa	0.0157	0.24	-0.2001	-3.24	0.2229	0.75	-0.1278	-0.58
Pgr/bac*other	0.1440	2.48	0.0959	1.56	-0.3339	-1.72	-0.0877	-0.50
voc/med*ma/pa	0.0142	0.49	-0.0875	-2.87	-0.0419	-0.41	-0.1775	-1.89
Voc/med*other	0.0861	1.37	0.1555	2.45	-0.0335	-0.15	0.1115	0.61
Industry (reference group is services)								
Agriculture	-0.0681	-2.81	0.0284	0.89				
Mining/quarry	0.1704	3.57	0.1710	0.90				
Manufacturing	0.0632	4.82	0.0484	3.14				
Elec./gas/water	0.1331	4.80	0.0574	0.92				
Construction	-0.0139	-0.74	0.0005	0.01				
Trade	-0.1115	-7.89	-0.0612	-5.05				
Transport	0.0425	2.05	0.0359	1.45				
finance/real est.	0.1357	8.92	0.0712	5.38				
communication	0.0618	2.98	0.0529	1.68				
other	0.0088	0.27	0.0627	1.85				
Occupation (reference group is elementary occupations)								
manager	0.2945	16.12	0.3517	17.28				
professional	0.2596	12.82	0.3844	19.63				
Associate prof.	0.2648	13.40	0.3208	15.18				
clerks	0.1295	5.48	0.2587	14.49				
Sales workers	0.1154	5.45	0.0692	3.81				
Agr./fish. wrk.	-0.0269	-0.92	-0.0057	-0.15				
Trades workers	0.1186	6.29	0.1092	3.33				
plant/mach.wrk	0.0608	3.33	0.0330	1.35				
Elig. NZ super					-0.7700	-8.40	-0.3020	-3.14
Other inc./1000					-0.1233	-3.72	-0.1412	-4.85

Table A.4 – continued

	Wage equation				Selection equation			
	Married men		Married women		Married men		Married women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Partner								
wage inc./1000					-0.0464	-0.71	-0.0422	-2.51
employed					0.6258	14.02	0.7027	18.72
School certific.					0.2114	4.62	0.0426	0.97
bursary					0.2685	4.36	0.0834	1.52
Voc./trade cert.					0.1489	3.04	0.0031	0.09
Bach. Deg/dipl.					0.1112	1.41	-0.1874	-3.55
Post-grad. qual.					-0.2191	-1.86	-0.3867	-5.24
part deg/other					0.1393	1.11	-0.0536	-0.54
Māori/Pacif.Isl.	-0.0429	-1.63	0.0302	1.08	-0.1110	-1.08	0.0349	0.39
Māori/Pac.only	-0.0843	-4.66	0.0056	0.31	-0.2268	-3.63	0.0435	0.77
Other non-Eur.	0.0857	0.83	0.0363	0.18	-0.0272	-0.06	-0.6730	-1.14
Other n.E. only	-0.1477	-3.29	-0.1825	-0.90	-0.1456	-0.79	-0.6280	-3.97
Elig. NZ super					0.0014	0.01	-0.1440	-2.35
Region (reference group is Auckland)								
North North isl	-0.0888	-6.91	-0.0939	-7.54	-0.2224	-4.61	-0.1020	-2.63
Central N. isl	-0.1154	-8.42	-0.0746	-5.62	-0.2136	-4.08	-0.0191	-0.45
Wellington	0.0405	3.12	0.0327	2.59	-0.0993	-1.83	0.1330	3.15
Canterbury	-0.0888	-6.47	-0.0716	-5.28	-0.1111	-1.96	-0.0237	-0.55
South island	-0.0940	-6.88	-0.0955	-7.14	-0.1457	-2.61	-0.0239	-0.56
Year (trend)	0.0024	0.90	0.0079	3.12	0.0193	1.81	0.0125	1.53
Unempl. rate	-0.0069	-1.89	0.0006	0.13	-0.0371	-2.62	-0.0197	-1.33
constant	1.4898	17.86	1.7295	21.32	-1.2602	-4.24	-1.7044	-6.76
Correlation	0.4856		0.3141		Nr of obs.	10528		12294
sigma	0.3716		0.3366		Nr of cens.obs	2081		5076
Mill's ratio	0.1804	6.50	0.1057	7.69				

Table A.5 – Two-Step Wage and Selection Model: Single Men and Women

	Wage equation				Selection equation			
	Single men		Single women		Single men		Single women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
age/10	0.7393	14.72	0.6608	11.89	0.7417	6.51	0.9416	7.80
Age sq./100	-0.0893	-12.39	-0.0800	-10.33	-0.1155	-7.53	-0.1380	-8.87
Education (reference group is less than school cert.)								
School certific.	0.1064	3.93	0.1509	4.93	0.5547	9.36	0.5849	9.20
bursary	0.1482	3.21	0.1817	3.52	0.7671	6.28	1.0176	7.90
Voc./trade cert.	0.2171	4.13	0.2045	3.72	1.0129	7.13	1.0299	6.90
Bach. Deg/dipl.	0.0537	0.71	0.1087	1.69	0.4583	1.72	0.8414	3.63
Post-grad. qual.	0.1518	1.17	0.0680	0.60	0.2253	0.46	0.6599	1.26
part deg/other	0.1842	3.04	0.1966	3.31	0.8796	4.57	0.9281	5.12
Pgrad*age/10	0.0723	2.10	0.0974	3.46	0.1849	1.44	0.1600	1.27
Bach*age/10	0.0724	3.16	0.0591	3.60	0.0955	1.16	0.0407	0.65
Voc/med*age/10	0.0018	0.15	0.0097	0.96	-0.0776	-2.12	-0.0543	-1.64
Māori/Pacif.Isl.	0.0010	0.03	-0.0161	-0.50	-0.3652	-3.66	-0.1298	-1.13
Māori/Pac.only	-0.0774	-2.37	-0.0952	-2.95	-0.5656	-8.23	-0.4704	-6.22
Other non-Eur.	0.1910	1.63	-0.1279	-1.70	0.3709	0.66	-0.3457	-1.50

Table A.5 – continued

	Wage equation				Selection equation			
	Single men		Single women		Single men		Single women	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
Other n.E. only	-0.0690	-1.07			0.2623	1.06		
Pgr/bac*ma/pa	0.0174	0.15	-0.0213	-0.28	0.8051	1.43	0.5809	1.62
Pgr/bac*other	0.0245	0.23	0.1244	1.31	-1.0810	-3.15	0.1995	0.56
voc/med*ma/pa	-0.0147	-0.34	-0.0004	-0.01	0.1101	0.84	-0.0571	-0.40
Voc/med*other	-0.1360	-1.43	-0.0565	-0.53	-0.7441	-2.22	-0.0907	-0.26
Industry (reference group is services)								
agriculture	-0.0158	-0.47	-0.0059	-0.13				
Mining/quarry	0.1367	1.35	0.2468	1.70				
Manufacturing	0.0588	3.06	0.0157	0.73				
Elec./gas/water	0.2274	4.26	0.0484	0.61				
construction	0.0062	0.24	-0.0300	-0.49				
trade	-0.0553	-2.69	-0.0615	-3.97				
transport	0.0517	1.63	0.1358	3.78				
finance/real est.	0.0908	3.82	0.0451	2.58				
communication	0.1163	3.46	-0.0462	-1.29				
other	0.0764	1.48	0.0768	1.67				
Occupation (reference group is elementary occupations)								
manager	0.2583	9.40	0.3443	10.75				
professional	0.2293	7.92	0.3278	10.96				
Associate prof.	0.2476	9.48	0.2743	8.99				
clerks	0.1459	5.20	0.2062	7.70				
Sales workers	0.0461	1.86	0.0665	2.44				
Agr./fish. wrk.	-0.0640	-1.76	0.0106	0.19				
Trades workers	0.0669	3.09	0.1162	2.47				
plant/mach.wrk	0.0499	2.23	0.0556	1.62				
Elig. NZ super					-0.9700	-4.84	-0.4408	-3.35
Other inc./1000					-1.2192	-5.50	-0.8690	-5.01
Live w. parents					-0.2658	-5.44	-0.2037	-3.49
Region (reference group is Auckland)								
North North isl	-0.1028	-4.90	-0.0901	-4.38	-0.2811	-4.49	-0.2167	-3.22
Central N. isl	-0.0958	-4.28	-0.0985	-4.81	-0.2858	-4.26	-0.0064	-0.09
Wellington	-0.0259	-1.31	0.0365	2.01	-0.1239	-1.81	0.0212	0.31
Canterbury	-0.0803	-3.93	-0.0863	-4.26	0.0161	0.21	-0.1116	-1.52
South island	-0.0692	-3.42	-0.1232	-5.99	-0.1867	-2.76	-0.1361	-1.85
Year (trend)	0.0038	0.96	0.0080	2.09	0.0107	0.80	-0.0017	-0.12
Unempl. rate	-0.0077	-1.42	0.0042	0.58	-0.0304	-1.69	-0.0574	-2.29
constant	0.9956	7.98	0.8730	6.21	-0.3133	-1.07	-0.6714	-1.99
Correlation	0.6414		0.8544		Nr of obs.	4691		4279
sigma	0.3519		0.3372		Nr of			
Mill's ratio	0.2257	3.34	0.2882	4.15	cens.obs	1474		1461

Table A.6 – Two-Step Wage and Selection Model: Sole Parents

	Wage equation		Selection equation	
	Coef.	z-value	Coef.	z-value
woman	-0.2107	-5.07	-0.0391	-0.40
age/10	0.1871	1.41	1.1106	3.96
Age sq./100	-0.0254	-1.50	-0.1529	-4.17
Education (reference group is less than school cert.)				
School certific.	-0.0660	-1.73	0.4050	4.94
bursary	0.0195	0.15	0.4396	1.40
Voc./trade cert.	-0.0492	-0.36	0.5703	1.77
Bach. Deg/dipl.	-0.1983	-0.72	1.2497	1.59
Post-grad. qual.	-0.4302	-0.86	-1.6589	-1.11
part deg/other	-0.0572	-0.39	0.4308	1.20
Pgrad*age/10	0.1711	1.53	0.5990	1.74
Bach*age/10	0.0775	1.13	-0.0886	-0.43
Voc/med*age/10	0.0209	0.62	0.0592	0.71
Nr of children			-0.0824	-2.21
Age of youngest child				
0			-1.5707	-8.76
1 to 3			-1.1183	-9.00
4 to 5			-0.9275	-7.22
6 to 9			-0.6026	-5.72
Over 9			-0.3769	-3.42
Māori/Pacif.Isl.	-0.0013	-0.02	-0.0898	-0.70
Māori/Pac.only	-0.0229	-0.54	-0.2165	-2.54
Other non-Eur.	0.0433	0.34	-0.5876	-2.02
Pgr/bac*ma/pa	0.0371	0.20	-0.5961	-1.32
Pgr/bac*other	-0.1305	-0.60	0.1925	0.33
voc/med*ma/pa	0.0672	0.89	-0.2709	-1.52
Voc/med*other	-0.0206	-0.10	0.5969	0.99
Industry (reference group is services)				
agriculture	-0.0715	-0.73		
Manufacturing	0.0983	1.91		
Elec./gas/water	0.3704	1.84		
construction	0.1523	1.64		
trade	-0.0169	-0.47		
transport	0.1777	1.83		
finance/real est.	0.1266	2.70		
communication	0.1618	1.90		
other	0.1494	1.40		
Occupation (reference group is elementary occupations)				
manager	0.3217	4.81		
professional	0.4113	7.13		
Associate prof.	0.3397	5.59		
clerks	0.2026	3.87		
Sales workers	0.0686	1.35		
Agr./fish. wrk.	-0.0282	-0.27		
Trades workers	0.0284	0.34		
plant/mach.wrk	0.0659	0.98		
Elig. NZ super			-0.5603	-0.65
Other inc./1000			0.1661	0.50
Live w. parents			0.2129	1.63

Table A.6 – continued

	Wage equation		Selection equation	
	Coef.	z-value	Coef.	z-value
Region (reference group is Auckland)				
North North isl	-0.0581	-1.51	-0.2265	-2.46
Central N. isl	-0.0994	-2.57	-0.0392	-0.41
Wellington	-0.0390	-0.95	-0.0761	-0.71
Canterbury	-0.0720	-1.75	-0.0329	-0.30
South island	-0.0454	-1.02	-0.1384	-1.23
Year (trend)	-0.0120	-1.52	0.0458	2.35
Unempl. rate	-0.0197	-1.43	-0.0041	-0.12
constant	2.4919	7.56	-1.7756	-2.75
Correlation	-0.1504		Nr of obs.	2166
sigma	0.3306		Nr of cens.obs.	1409
Mill's ratio	-0.0497	-0.91		