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Discussion Paper

Determining the labour force status of Aboriginal people using a multinomial logit model

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- identify and analyse the factors affecting Aboriginal and Torres Strait Islander participation in the labour force; and
- assist in the development of government strategies aimed at raising the level of Aboriginal and Torres Strait Islander participation in the labour market.

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ABSTRACT

It is well documented that Aboriginal people are less likely to be in employment and more likely to be unemployed or not in the labour force than are other Australians. The aim of this paper is to consider some of the reasons for these differences in the statistical framework of a multinomial regression equation. Using 1986 Census data, results are presented for males and females on the effect of Aboriginality, education, age, family characteristics and location of residence on the probability of being in full-time employment, part-time employment, unemployment or not in the labour force. Major results include the negative effect of Aboriginality on the probability of being in full-time employment and the positive effect of more education on the probability of being in full-time employment. This latter result was particularly strong for Aboriginal women. These results will provide an important benchmark for comparing results from a similar exercise using 1991 Census data.

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Foreword

In April 1992, Dr Anne Daly, Research Fellow at the Centre for Aboriginal Economic Policy Research (CAEPR), Australian National University, took up a concurrent half-time Australian Bureau of Statistics (ABS) Research Fellowship. The ABS objectives in providing Research Fellowships are to allow greater use of ABS data in academic research and to encourage the development of new techniques for the analysis of data. This latter objective, should occur, if at all possible, in collaboration with ABS staff.

This discussion paper presents the outcome from such a collaboration between Dr Daly and Bill Allen, Louise Aufflick, Ed Bosworth and Martin Caruso, a team of research officers working in the Statistical Support Section, ABS, Canberra, and is a result of a series of weekly meetings held in the first half of 1993 in which all participants contributed on both technical and general issues concerning the project. This paper, which uses the framework of a multinomial logit regression equation, is somewhat more statistical and technical than most of the CAEPR Discussion Papers. To match our normal style, a great deal of technical material has been presented in appendices rather than in the text. Earlier versions of the paper were presented as seminars at both CAEPR and the ABS.

The paper raises a number of very important issues concerning the determinants of Aboriginal labour market status, including factors such as level of education, location of residence, and Aboriginality. The active collaboration between CAEPR and ABS staff that is very evident in this discussion paper is very welcome and has, hopefully, been of mutual benefit to researchers from both organisations.

Jon Altman
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Labour force status, that is whether a person is employed full- or part-time, unemployed or outside the labour force, is an important indicator of economic wellbeing. Without income from employment, individuals become dependent on transfers from other sources, for example, within the family or from the state. It is the high level of unemployment among Aboriginal people with its associated dependence on income from the Federal Government which has been of particular concern to policy makers.[1]

This concern was recently addressed in the formulation of the Aboriginal Employment Development Policy (AEDP). One of the goals of the AEDP, launched by the Labor Government in 1987, was 'employment equity with other Australians, that is to increase the proportion of Aboriginal people aged 15 and above who are employed from 37% to around 60%' (Australian Government 1987: 3).

In the light of concern about the relatively low Aboriginal in employment rate, the purpose of this paper is to consider the determinants of labour force status for Aboriginal people. A multinomial logit model will be used to consider the main factors which determine whether a person is employed full- or part-time, unemployed or not in the labour force. The paper begins by presenting census evidence on the labour force status of Aboriginal people compared with relevant Australian totals. Some models are then presented which highlight the important determinants of labour force status.

The labour force status of Aboriginal and other Australians

Table 1 presents data on the labour force status of the Aboriginal population compared with all Australians as reported in each of the censuses between 1971 and 1991. In each year, Aboriginal men were less likely to be in employment than were Australian men in general. Unemployment was over three times higher among Aboriginal males than for the Australian male total over the 1971-86 period and they were also more likely to be outside the formal labour force. Perhaps the most dramatic feature of the figures on males reveals a decline in the percentage of Aboriginal men in employment by one-third, from 60.4 per cent in 1971 to 40.4 per cent in 1986. The proportion of men in the total population in employment also fell, but by a smaller 15 per cent, from 79.1 per cent to 66.9 per cent.

Between 1986 and 1991, there was a notable change in the trend of declining employment for Aboriginal males. In 1991, a larger percentage of Aboriginal males were in employment than in 1986, in contrast to the general picture for males. There had actually been a small decline in the

proportion of the Aboriginal male population who reported themselves as unemployed, while the general level of unemployment for Australian males rose from 6.6 per cent to 9.1 per cent.

Table 1. The Labour force status of the Aboriginal and total populations aged 15 years and over, 1971, 1976, 1981, 1986 and 1991.

	Males		Females	
	Aborigines Per cent	Total Per cent	Aborigines Per cent	Total Per cent
1971				
Employed	60.4	79.1	21.7	36.3
Unemployed	6.5	1.2	1.9	0.8
Total labour force	66.9	80.3	23.6	37.1
Not in labour force	33.1	19.7	76.4	62.9
1976				
Employed	56.2	76.1	25.1	41.6
Unemployed	12.6	3.2	5.1	2.2
Total labour force	68.8	79.3	30.2	43.8
Not in labour force	31.2	20.7	69.8	56.2
1981				
Employed	47.0	73.1	24.8	42.5
Unemployed	16.4	4.2	7.1	3.1
Total labour force	63.4	77.3	31.9	45.6
Not in labour force	36.6	22.7	68.1	54.4
1986				
Employed	40.4	66.9	22.7	42.3
Unemployed	22.7	6.6	11.8	4.5
Total labour force	63.1	73.5	34.5	46.8
Not in labour force	36.9	26.5	65.5	53.2
1991				
Employed	45.0	64.9	29.5	46.7
Unemployed	21.4	9.1	11.8	5.5
Total labour force	66.4	74.0	41.3	52.2
Not in labour force	33.6	26.0	58.7	47.8

Source: Tesfaghiorghis and Altman 1991; Table 6, 1991 Population Census.

These changes are surprising, given the deterioration in the general economic climate between 1986 and 1991 and the expectation that this would particularly affect a group such as Aboriginal males. The turnaround in the employment trend for Aboriginal males can probably be explained by the expansion of the Community Development Employment Projects (CDEP) scheme. Under this scheme, individuals can agree to forego their welfare entitlements which are then placed in a community

pool with additional funds for the administrative costs of the scheme and for investment in community projects. Participants then work part-time for the equivalent of their welfare entitlement.[2] In 1991, there were 18,000 participants in the scheme, equal to about a quarter of the Aboriginal labour force (Altman and Sanders 1991).

The trends in female employment differed from those of males. The proportion of women in employment rose over the period 1971-91, with particularly strong growth in the employment of Aboriginal women between 1986 and 1991. This increase was offset by a reduction in the proportion of women who considered themselves outside the labour force, but women appear to have also moved from this category into unemployment. Unemployment among Aboriginal women rose from 1.9 per cent of the Aboriginal female population in 1971 to 11.8 per cent in 1991. There was also a substantial increase in unemployment over the same period among the total female population, from 0.8 per cent to 5.5 per cent.

In summary, the census evidence shows that Aboriginal people were less likely to be in employment and more likely to be unemployed or outside the labour force than were Australians in general. The following section, based on 1986 data, will present the results of a formal model of labour force status which attempts to explain these differences. It is proposed to update this research when appropriate 1991 data become available. The results presented here will provide an important benchmark for measuring changes in the determinants of Aboriginal labour force status.

The determinants of labour force status

The purpose of this study is to investigate the determinants of labour force status for men and women aged 15-64 years. (For a full presentation of a formal model of the labour supply decision, see Killingsworth (1983)). Four possible outcomes have been identified: full-time employment (35 or more hours of work per week); part-time employment (1-34 hours a week); unemployment and 'not in the labour force' (NILF).

Nine independent variables were chosen for modelling on the basis of economic relevance and availability in the 1986 Census. These independent variables were used in regression equations for both sexes and fell into four broad areas: ethnicity; demographic factors; educational attainment and location of residence. They are summarised in Table 2 (see Appendix A for full details of the variables).

An important question for this study is whether Aboriginality in itself has an effect on labour force status or whether the lower employment rates of

Aboriginal people merely reflect their smaller stock of labour market skills. Any independent effect of Aboriginality on labour force status may reflect factors on either the supply or demand sides of the labour market. Aboriginal people who were identical in every other measured respect to comparable non-Aboriginal people may choose a different labour force status. Alternatively, factors on the demand-side of the labour market, for example discrimination in employment, may frustrate Aboriginal people in their attempts to achieve the labour force status which is most common among other Australians with the same set of measured characteristics. The results presented here will not, however, enable a distinction between the sources of any 'Aboriginal effect' on labour force status.

Table 2. The variables used to explain the labour force status of males and females, 1986.

Ethnicity	
ABORCAT	Indicates whether the respondent is an Aboriginal or a non-Aboriginal person.
Demographic	
AGE	Age in years.
DEPENDENT	The number of dependent children of a respondent.
MARITAL	Marital status of the respondent.
Geographical	
SECTION	This variable indicates whether the respondent was from a major, other urban or rural area.[a]
REMOTE	This variable divides Australia into a settled part where the labour market is well developed and an area where the labour market is less developed.[b]
Educational	
QUALIF	The level of qualification the respondent has attained.
ENGLISH	Respondent's ability to communicate in English.
ALS	The age of the respondent at leaving school.

a. These categories are derived from the section-of State variable in the Census. The three settlement size categories used here are defined as follows: an urban centre is 'one or more adjoining collection districts with urban characteristics and representing a population cluster of 1,000 or more people' (ABS 1986: 150). Major urban centres had over 100,000 inhabitants and other urban areas between 1,000 and 99,999 inhabitants. The rural category used here includes both ABS categories 'rural locality' and 'rural balance'. Localities include population clusters which can 'be expected to contain at least 200 people (but not more than 999) by the next census; have at least 40 occupied non-farm dwellings with a discernible urban street pattern; and have a discernible nucleus of population' (ABS 1986: 97). The rural balance includes all the collection districts not included elsewhere (ABS 1986: 132).

b. See Note 4 for a fuller explanation.

Source: 1986 Population Census.

The choice of other variables used in the analysis has taken into account the factors which human capital theory suggests should be important in determining labour force status and the results of earlier studies of Aboriginal employment and unemployment (see Miller (1987, 1989, 1991); Ross (1991); Jones (1990, 1991); Daly (1993)). Education has been included in two forms; age on leaving school and level of qualification. Additional education is expected to raise the probability of employment (and therefore reduce the probability of being unemployed or NILF).

Additional work experience is also predicted to have a positive effect on the probability of employment through most of an individual's working life. It is difficult to accurately measure an individual's work experience from the information collected in the census, as the census focuses on the current period and contains no information on past labour force experience. Many studies, such as this one, have approximated work experience with current age, minus the age on leaving school (Mincer 1974). This assumes that individuals have spent all their adult life in employment, however, this is an inappropriate assumption for Aboriginal people. Rather than use this standard approximation of labour force experience with the associated interpretation of the coefficient as measuring the effect of work experience and on-the-job training on the probability of being in a particular labour force category, age has been included. Age captures not only the effects of labour market experience on labour force status, but also broader life cycle effects. This variable has the additional advantage of being truly exogenous, that is, determined independently of the model.[3]

An additional measure of skill which has been included in this analysis is the ability to communicate in English. Other studies (Jones 1990, 1991; Daly 1993) have found that poor English skills reduced the probability of being in employment.

Many studies of the determinants of labour force status and income have included family characteristics as important control variables (Hill 1979). An individual's marital status is likely to effect their range of employment opportunities and their motivation. The effects will differ between the sexes where family responsibilities are allocated according to conventional patterns. It is expected that the number of dependent children will have a positive effect on the probability of females being NILF. The predicted sign for males is not so clear. Additional children may encourage a greater search effort to find employment or, by raising welfare entitlement, reduce the incentives to find employment.

Location has been shown to be an important determinant of labour force status for Aboriginal people (Tesfaghiorghis 1991; Daly 1991, 1993). Two measures of location were used in this analysis. The first is the section-of-

State variable used by the Australian Bureau of Statistics (ABS) which divides Australia into three categories according to settlement size. The second variable has been constructed to broadly capture the differences between parts of Australia where a fully developed labour market is operating ('settled') and remote areas where opportunities for paid employment are limited and more Aboriginal people are likely to be living a traditional lifestyle.

A stratified random sample of 1986 Census data, created by the ABS, was used for the analysis. The data consisted of about 25,000 Aborigines and 25,000 non-Aborigines, giving a total of about 50,000 observations. Aboriginal people were therefore over-represented and the sample should not be taken as representative of the Australian population as a whole. Observations with missing values were removed before modelling was undertaken which slightly reduced the number of observations to just under 50,000. It should be noted that the 1986 Census imputed values for the missing values of marital status, age and sex and that imputed values could not be distinguished from non-imputed values.

The statistical model

As the dependent variable was not continuous, ordinary linear regression was inappropriate and it was necessary to use a technique appropriate for a dependent variable with only four possible values. Multinomial logit regression was chosen, as the four possible outcomes needed to be treated as categorical, rather than ordinal. The inclusion of the NILF category meant that the outcomes could not be ordered by the number of hours worked.

Logistic regression can be best explained in the case where the dependent variable has two possible values. For example:

-Employed
-Not Employed

In this case the following would be modelled

P = no. of people employed/relevant sub-population.

However this lies between 0 and 1 and still not between the required -infinity and +infinity. To overcome this problem, a logit transformation is applied,

$$\text{logit } P = log(P/(1-P)).$$

This is also known as the log odds. Logit P becomes the dependent variable and the modelling performed is known as logistic regression. However, there are four possible values for the dependent variable in this example so the model is extended to multinomial logistic regression. Here a similar proportion is used, that is,

P_i = number of people in labour force category i/relevant sub-population, where i takes on one of four values.

P_1 = proportion of people employed full-time,
P_2 = proportion of people NILF,
P_3 = proportion of people employed part-time,
P_4 = proportion of people unemployed.

The logit transformation becomes

$$\text{logit } P_i = log(P_i / P_4),$$

where $P_4 = 1 - P_1 - P_2 - P_3$.

The model then becomes

$$\text{logit } P_i = b_0 + b_1X_1 + b_2X_2 + ... + e_i,$$

where b_i are the coefficients, X_j the variables and e_i the error term which approximates a multivariate normal distribution (see Hosmer and Lemeshow (1989) and Agresti (1984) for fuller discussions).

Variables were added to the model sequentially in order of importance (forward model selection) until the addition of further variables did not greatly improve the model. This was done using the procedure Proc Catmod in the computer package SAS.

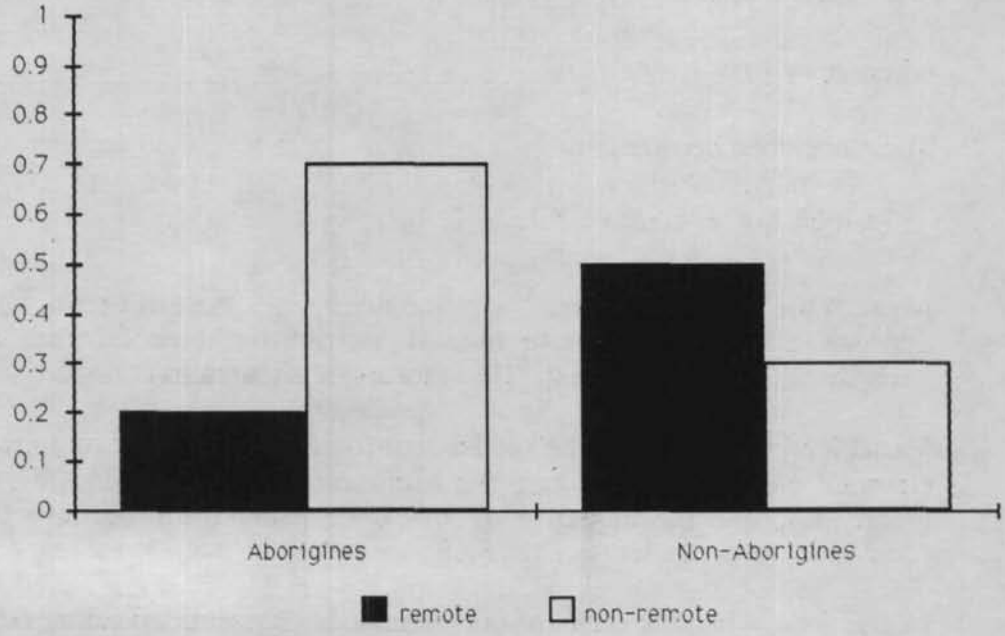
Interactions, when the effect of one variable is different depending on the level of another variable, were also considered in the model fitting procedure. These are important, for if not taken into account the results may be misleading. Only two-way interactions were included as the model selection process did not indicate that higher order interactions were appropriate. Interactions have been indicated in the text by an * between the two variable names.

Figure 1 illustrates, by way of synthetic example, the situation where there is an interaction between ABORCAT and REMOTE. The interaction shows that for Aborigines, there was an increased probability of full-time

employment in non-remote areas, but for non-Aborigines there was a lower probability of full-time employment in non-remote areas.

Models were fitted to 90 per cent of the data so that the adequacy of the final model fitted could be checked on the remaining 10 per cent. Results are presented for two regression equations in Appendix B; those including only the main effects, and the preferred model for each sex which included significant interaction terms. Both the female and male models were validated on the 10 per cent sample. Appendix C contains details of a test of model quality.

Figure 1. Illustrative example of the effect of an interaction term on the probability of being in full-time employment.



The results

The coefficients in logistic regression models measure relative probabilities.[5] In 1986, among the variables which were predicted to increase the likelihood of full-time employment for females (relative to the likelihood of being unemployed) were:

i Having no dependants. The values of the coefficients of the DEPT*AGE and DEPT*SECTION interactions were negative (that is, the effect was reduced for people who were older) but were not large enough to remove this effect.

ii Having a further educational qualification. The ABORCAT*QUALIF interaction means that an Aboriginal woman with a further educational qualification had a greater likelihood of being in full-time employment than a non-Aboriginal woman. This was the only outcome for which this event occurred.

In 1986, an increased likelihood of full-time employment for males (relative to the likelihood of being unemployed) was predicted for those:

i Leaving school after the age of 16. This was less important the older the individual (the result of the ALS*AGE interaction).

ii Possessing an educational qualification. This was not as important for males as for females, though a higher education qualification still increased the likelihood of being employed full-time. The absence of an ABORCAT*QUALIF interaction in the model for males means that Aboriginal males and non-Aboriginal males benefited from further education to a similar extent.

The regression coefficients can then be used to calculate the probability of people being in a particular labour force category given their characteristics. As Table 3 shows, Aboriginal males and females were less likely to be in full-time employment and more likely to be unemployed or NILF than were other Australians. Compared to the average non-Aboriginal male in the sample, the probability of the average Aboriginal male being in full-time employment was 32 percentage points lower (0.40 compared with 0.72). The probability of the average Aboriginal male being unemployed was 16 percentage points higher than for the average non-Aboriginal male and there was the same difference in the probability of being NILF. The average male in each group had the same relatively small probability (7 per cent) of being in part-time employment.

Table 3. The predicted probabilities of being in a particular labour force category by Aboriginality, males and females, 1986.

	Aboriginality	
	Aboriginal	Non-Aboriginal
Males		
Full-time	0.40	0.72
Part-time	0.07	0.07
Unemployment	0.23	0.07
NILF	0.30	0.14
Females		
Full-time	0.16	0.34
Part-time	0.09	0.18
Unemployment	0.11	0.06
NILF	0.63	0.42

Source: Appendix B, Tables B1 and B2.

There was also a large difference in the predicted probabilities of being in full-time employment for the average Aboriginal and non-Aboriginal female. The probability was 18 percentage points higher for non-Aboriginal than for Aboriginal females. Non-Aboriginal females were twice as likely to be in part-time employment as Aboriginal females. The smaller proportion of Aboriginal females in employment contrasted to the larger predicted proportions in the unemployed and NILF categories than other Australian females.

The effects of selected independent variables on the labour force status of males and females are summarised in Tables 4, 5, 6 and 7. The tables show the additional effect of a change in one of the independent variables on the probability of being included in a particular labour force category. The effect of changes in the independent variables are measured relative to either the average Aboriginal or non-Aboriginal person. The tables can therefore be interpreted as in the following example from Table 4; the probability of being in full-time employment for an Aboriginal male was 15 percentage points less than the probability of the average male in the sample being in full-time employment. However, the probability of being in full-time employment for an Aboriginal male with a higher qualification and all the other characteristics of the average Aboriginal male, was 35 percentage points higher than the probability for the average Aboriginal male in the sample.

Table 4 shows that Aboriginality had a negative effect on the probability of full-time employment for both males and females. While more than half

(0.55) of the males in the sample were predicted to be employed full-time, the average Aboriginal male had a lower probability, of 0.40. The average Aboriginal female also had a lower probability of full-time employment compared with the average female in the sample; 0.16 compared with 0.25. A higher qualification or a diploma increased the probability of being in full-time employment for males and females, regardless of Aboriginality.

Table 4. Factors effecting the probability of being in full-time employment for Aboriginal and other Australians, 1986.

	Males		Females	
Probability of average member of sample being employed full-time	0.55		0.25	
Aboriginal	-0.15		-0.09	
Non-Aboriginal	0.15		0.09	
Change in probability compared with the average for each group[a]				
	Aboriginal	Non-Aboriginal	Aboriginal	Non-Aboriginal
Higher qualification	0.35	0.14	0.52	0.16
Diploma	0.26	0.12	0.22	0.08
Left school >16	0.11	0.09	0.12	0.10
Never married	-0.09	-0.08	0.06	0.11
No dependants	-0.01	0.01	0.07	0.07
Major urban area	0.11	0.02	0	0
Other urban area	-0.01	0.03	0.01	-0.03

a. The figures can be interpreted in the following way taking the effect on the probability of being in full-time employment for Aboriginal females as an example. The probability of being in full-time employment for an Aboriginal female was 9 percentage points lower than for the average woman in the sample. However, the probability of being in full-time employment for an Aboriginal woman with a higher qualification and all the other characteristics of the average Aboriginal female, was estimated to be 52 percentage points higher than for the average Aboriginal female in the sample; that is 0.68 compared with 0.16 (see Table 3).

Source: Appendix B, tables B1 and B2.

Both Aboriginal and non-Aboriginal males who had never been married were less likely to be in full-time employment than the respective average male. Living in a major urban area increased the probability of full-time employment for Aboriginal males by 11 percentage points.

Perhaps the most dramatic findings revealed by Table 4 are those relating to the effect of educational qualifications on the probability of Aboriginal females being in full-time employment. A higher qualification raised the probability of full-time employment by 52 percentage points. In contrast to

the result for males, both Aboriginal and non-Aboriginal females who had never been married were more likely to be in full-time employment than was the average female in each sample. Females with no dependent children were also more likely to be in full-time employment.

Table 5. Factors effecting the probability of being unemployed for Aboriginal and other Australians, 1986.

	Males		Females	
Probability of average member of sample being unemployed	0.15		0.09	
Aboriginal	0.08		-0.02	
Non-Aboriginal	-0.08		0.02	
Change in probability compared with the average for each group[a]				
	Aboriginal	Non-Aboriginal	Aboriginal	Non-Aboriginal
No qualification	0.01	0.03	0.04	-0.04
Left school <15	0.02	0.01	0.02	-0.06
Left school 15-16	0.02	0.01	0.06	-0.06
Married	-0.06	-0.02	0.01	-0.07
Other marital status	0.02	0.01	0.03	-0.05
One dependant	0	0	0.05	-0.05
Two-three dependants	0	0	0.02	-0.06
Four or more dependants	0.01	0.02	0.05	-0.05
Rural area	0.01	0.01	0.06	-0.06

a. The figures can be interpreted in the following way taking the effect on the probability of being unemployed for Aboriginal males as an example. The probability of being unemployed for an Aboriginal male was 8 percentage points higher than for the average male in the sample. However, the probability of a married Aboriginal male with all the other characteristics of the average Aboriginal male being in full-time employment, was estimated to be 6 percentage points lower than for the average Aboriginal male in the sample; that is 0.17 compared with 0.23 (see Table 3).

Source: Appendix B, tables B1 and B2.

Table 5 presents the changes in the probability of being unemployed for males and females. Aboriginality increased the probability of males falling into this category, but decreased the probability of females falling into this category. The largest effect reported in Table 5 was the effect of marriage on reducing the probability of unemployment. Having no qualifications, leaving school before the age of 17 years and living in a rural area all raised the probability of an Aboriginal male falling into the unemployed category. These variables had similar effects for the non-Aboriginal males in the sample. The factors which were identified as increasing the

probability of an Aboriginal female being unemployed, also had a negative effect on the probability of a non-Aboriginal female being unemployed.

Table 6 relates to changes in the probability of being in part-time employment for males and females. Those with higher levels of qualifications, particularly women, were more likely to be in part-time employment than the average person. Both males and females with no dependent children were less likely to be in part-time employment.

Table 6. Factors effecting the probability of being employed part-time, Aboriginal and other Australians, 1986.

	Males		Females	
Probability of average member of sample being unemployed	0.07		0.13	
Aboriginal	0.0		-0.04	
Non-Aboriginal	0.0		0.04	
Change in probability compared with the average for each group[a]				
	Aboriginal	Non-Aboriginal	Aboriginal	Non-Aboriginal
Higher qualification	0.02	0.02	0.04	0.05
Diploma	0	-0.01	0.06	0.06
Left school 17+	0.01	0	0.03	0.04
Never married	-0.01	0.01	0	-0.02
No dependants	-0.01	-0.01	-0.01	-0.02
Major urban	-0.02	0	0	0.01
Other urban	-0.01	-0.01	-0.01	0.01

a. The figures can be interpreted in the following way, taking the effect on the probability of being in part-time employment for Aboriginal males as an example. Compared with the average Aboriginal male in the sample, the probability of being in part-time employment for an Aboriginal male living in a major urban area with all the other characteristics of the average Aboriginal male, was estimated to be 2 percentage points lower; that is 0.05 compared with 0.07 (see Table 3).

Source: Appendix B, tables B1 and B2.

Table 7 considers the factors most likely to change the probability of being outside the labour force. Both Aboriginal and non-Aboriginal males were more likely to be NILF than their respective averages if they had low levels of education, four or more dependent children or lived in a rural area. Females, both Aboriginal and non-Aboriginal, who left school before the age of 15 or who were widowed, separated or divorced, had a particularly high probability of being NILF.

Table 7. Factors effecting the probability of not being in the labour force, Aboriginal and other Australians, 1986.

	Males		Females	
Probability of average member of sample being unemployed	0.22		0.53	
Aboriginal	0.08		0.10	
Non-Aboriginal	-0.08		-0.10	
Change in probability compared with the average for each group[a]				
	Aboriginal	Non-Aboriginal	Aboriginal	Non-Aboriginal
No qualification	0.03	0.05	0.05	0.06
Left school <15	0.11	0.13	0.11	0.17
Left school 15-16	-0.10	-0.03	-0.05	0.01
Married	-0.05	-0.04	0.03	0.01
Other marital status	0.05	0.05	0.08	0.07
One dependant	-0.03	-0.03	0.02	0.0
Two-three dependants	-0.02	-0.04	0.05	0.03
Four or more dependants	0.03	0.03	0.01	0.01
Rural area	0.04	0.01	0.05	0.01

a. The figures can be interpreted in the following way, taking the effect on the probability of being NILF for Aboriginal males as an example. Compared with the average Aboriginal male in the sample, the probability of being NILF for an Aboriginal male who left school before the age of 15, and had all the other characteristics of the average Aboriginal male, was estimated to be 11 percentage points higher; that is 0.41 compared with 0.30 (see Table 3).

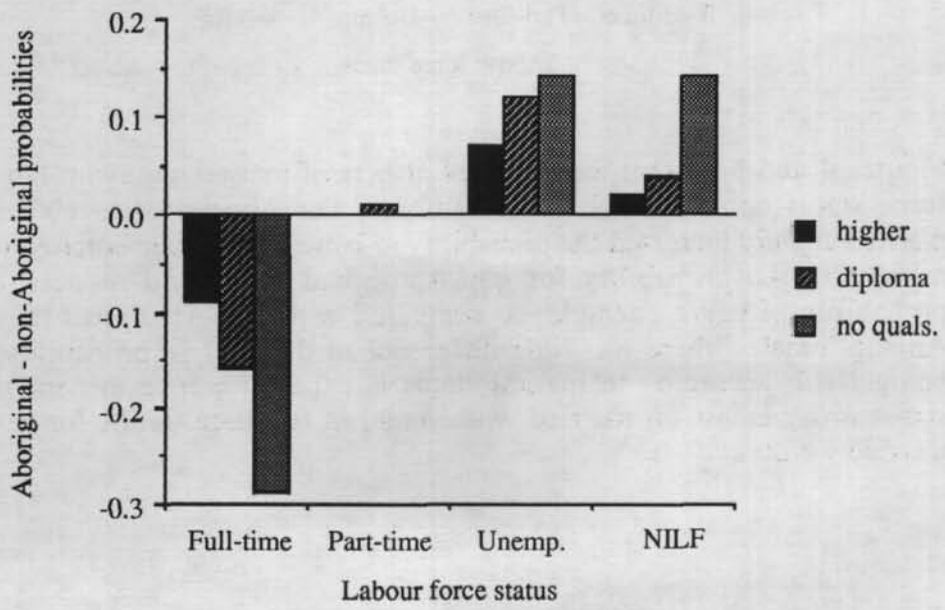
Source: Appendix B, tables B1 and B2.

Figures 2 to 7 compare in graphical form, the different effects of selected independent variables on the labour force status of Aboriginal people with the effects on other Australians. A negative value indicates that the probability of an Aboriginal person with the characteristic of interest (for example having a higher degree) being in the relevant labour force category was less than for a non-Aboriginal person with the same characteristic. A positive value means that the probability of an Aboriginal person with the characteristic of interest being in the particular labour

force category was greater than for non-Aborigines with the same characteristic. Three comparisons have been selected; level of qualifications, marital status and location of residence by section-of-State.

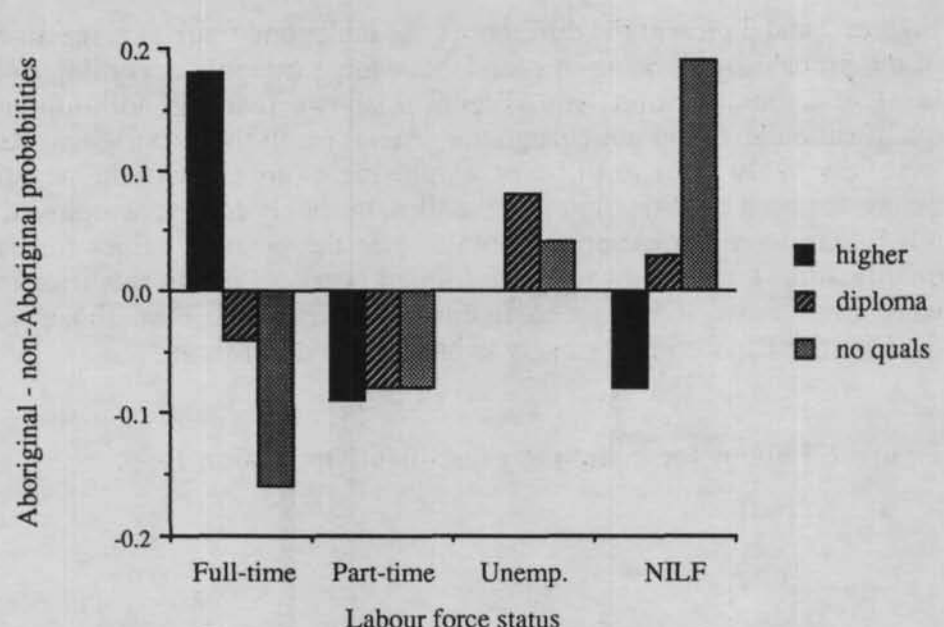
Figures 2 and 3 present the differences, for males and females respectively, of the probability of being in each labour force category according to the level of a qualification held. Figure 2 shows that the addition of a qualification level did not change the general result that Aboriginal males were less likely to be in full-time employment (apparent in the negative values for each qualification level) and more likely to be unemployed or NILF than were non-Aboriginal males (see the positive values for each qualification level). However, Aboriginal people with no qualifications were even more likely to be unemployed or NILF than those with qualifications and even less likely to be employed full-time.

Figure 2. Labour force status by qualifications, males, 1986.



The differences reported in Figure 3 for females show that higher educational qualifications had a particularly strong positive effect on the probability of Aboriginal women being in full-time employment and reduced the probability of them being in the NILF category. Higher educational qualifications, however, did not increase the relative probability of Aboriginal women being in part-time employment.

Figure 3. Labour force status by qualifications, females, 1986.



Figures 4 and 5 present the different affects of marital status on labour force status combined with Aboriginality. For Aboriginal men, being married slightly increased the probability of being in full-time employment relative to the probability for non-Aboriginal males and reduced the probability of being unemployed compared with non-Aboriginal males. Among females, there was little difference in the relative probability of being NILF according to marital status but the difference in part-time status was greatest for married women and in full-time status, for never married women.

Figure 4. Labour force status by marital status, males, 1986.

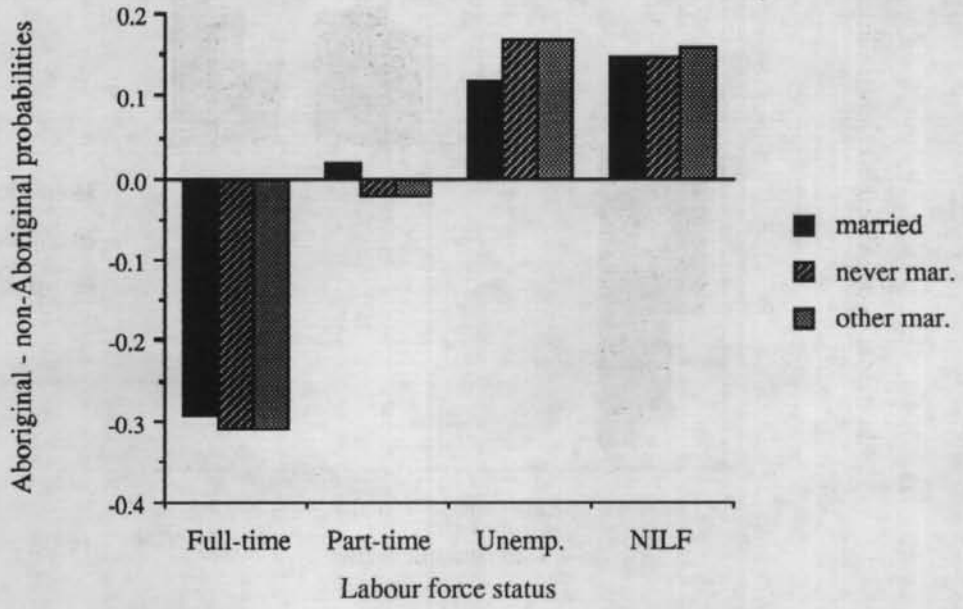


Figure 5. Labour force status by marital status, females, 1986.

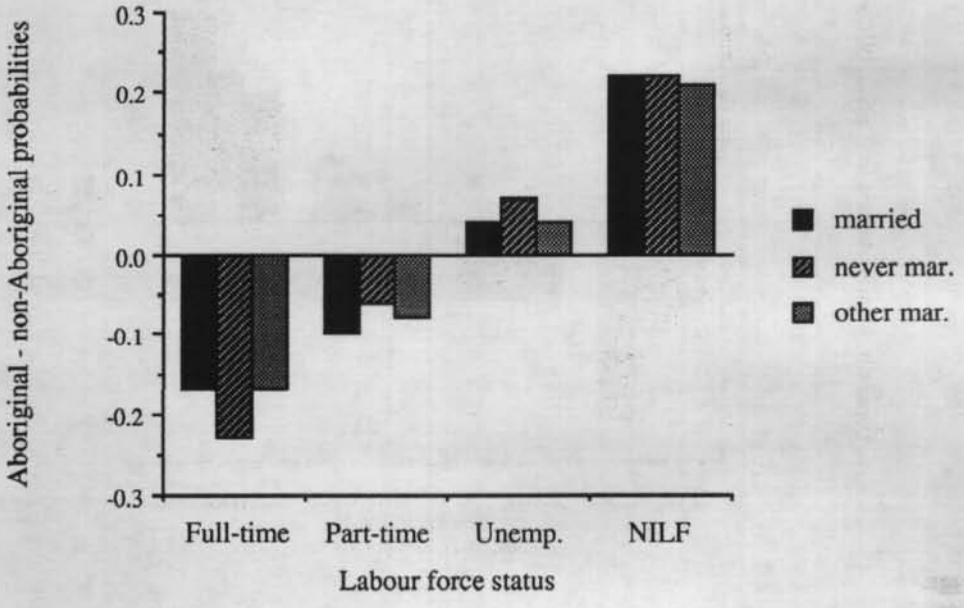


Figure 6. Labour force status by section-of-State, males, 1986.

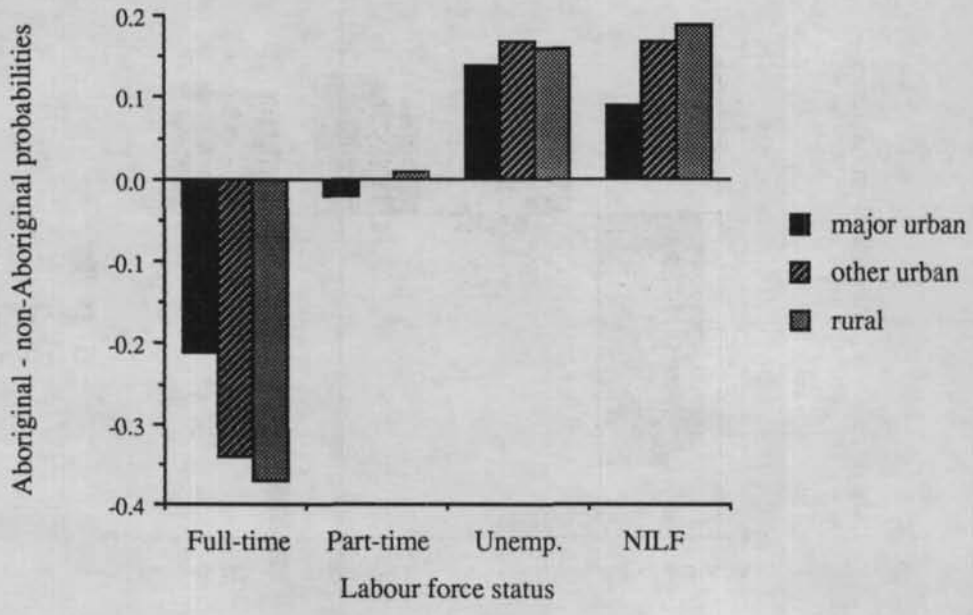
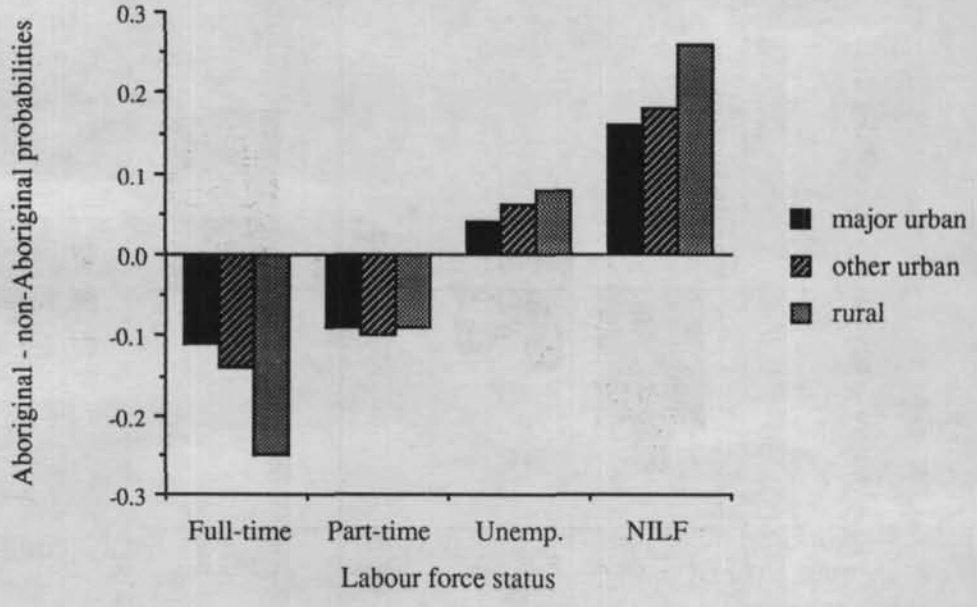


Figure 7. Labour force status by section-of-State, females, 1986.



Figures 6 and 7 illustrate the effect of section-of-State of residence on the labour force status of Aboriginal males and females relative to other Australians. Aboriginal people who lived in the rural section-of-State were even less likely to be employed full-time and even more likely to be NILF compared to non-Aboriginals in other locations. These results were the same for both males and females. For non-Aboriginals, in 1986, there was very little difference in employment probability between the different locations. For Aboriginals, both male and female, those who lived in a major urban area were more likely to be employed full-time and were less likely to be unemployed or NILF.

Summary and conclusions

Over the period 1971-91, Aboriginal people were less likely to be employed and more likely to be unemployed or outside the labour force than were other Australians. The purpose of this paper has been to explain the source of some of these differences in a formal regression framework. The results form a benchmark for undertaking a similar exercise using 1991 Census data. Aggregate data from the 1991 Census show that employment trends since 1986 have differed between Aboriginal people and the Australian population in general. An analysis such as this using 1991 data would help explain these aggregate differences.

The results show that there are a number of important factors that contribute to these differences in labour market outcomes. Perhaps the most striking result is the effect of educational attainment on labour force status. Educated Aboriginal people were more likely to be in full-time employment and less likely to be unemployed or NILF than were the less educated. The effect of tertiary qualifications was particularly marked for Aboriginal females, for whom these qualifications increased the probability of being in full-time employment to an even greater extent than for non-Aboriginal females.

Demographic variables such as marital status and the number of dependent children had different effects on the labour force status of males and females. While males who had never been married were less likely to be in full-time employment, females who had never been married were more likely to be in full-time employment. Married women, particularly non-Aborigines, were more likely to be employed part-time than were other women.

A third important influence on labour force status was the location of residence. Aboriginal people were less likely to be in full-time employment and more likely to be NILF if they lived in a rural area. While the results did not find a significant difference in labour force status for

women living in remote parts of Australia compared with settled Australia, there was some evidence that the probability of males being unemployed was higher in remote Australia than elsewhere.

The results reported here show that even after holding a wide range of other factors constant, Aboriginality had an independent effect on labour force status. It reduced the probability of being in full-time employment for males and raised the probability of being unemployed. The probability of an Aboriginal female with the average characteristics of the whole sample having a full-time or part-time job was lower than for a comparable non-Aboriginal female. This was offset by the much higher probability of being unemployed or NILF. The results presented here do not indicate the sources of these differences but show that they include factors not modelled explicitly here.

The replication of this exercise on 1991 Census data could reveal some interesting changes from the results reported here for 1986. There have been important changes in the labour market, especially for Aboriginal people, over this period. The CDEP scheme has expanded dramatically from 4,000 participants in 1986 to 18,000 in 1991. The usual determinants of labour force status (for example, educational attainment and labour force experience) are not relevant to inclusion in the scheme. Rather, Aboriginality is the selection criteria, thus many of the relationships presented here may no longer be in evidence. For example, educational attainment may no longer appear as an important predictor of labour force status and the effect of Aboriginality may be increasingly important. Instead of having a negative effect on the probability of being in employment, Aboriginality may increase this probability. Individuals who were otherwise identical according to the measured criteria, may be more likely to be in part-time employment if Aboriginal (that is involved in the CDEP scheme) but unemployed if non-Aboriginal.

This study has raised a number of important issues concerning the determinants of Aboriginal labour force status. It emphasises the important effects of education and location of residence on the labour force status of Aboriginal people. It also shows that Aboriginality in itself plays a major role in determining labour force status. The expansion of a scheme like the CDEP scheme for which Aboriginality is a key selection criteria for participation, could change the direction of the effect of Aboriginality on employment status. It also raises the issue of the appropriateness of existing labour force categories as a means of describing the true position of many Aboriginal people.

Notes

1. The terms 'Aboriginal' and 'Aborigines' will be used throughout this paper to describe both the Aboriginal and Torres Strait Islander populations of Australia.

2. A fuller discussion of the CDEP scheme is presented in Sanders (1988); Altman and Sanders (1991); Morony (1991); and Altman and Daly (1992).

3. The Box-Tidwell transformation was used to detect a departure from linearity. This test adds a term of the form $x\ln(x)$ and if the coefficient for this variable is significant then there is evidence of a departure from linearity (Weisberg 1985). The results of this test showed that the relationship was not linear. An age squared variable was therefore added to the model to capture the non-linear nature of the relationship between age and labour force status.

4. Settled Australia includes the south-eastern coastal strip and the area around Perth, while the remaining areas are classified as remote. For a more detailed description and discussion of this geographical division see Taylor (1991) and Daly (1992).

5. The coefficients for a particular labour force category (see Appendix B) are a function of the probability of being in that category divided by the probability of being unemployed. The interpretation of the coefficients of different variables is described by the following (totally synthetic) example:

   Suppose, when investigating the effect of having a trade diploma on labour force status, the following coefficients are predicted:

Labour Force Category	Intercept	Trade Diploma
Full-time employment	-0.3	0.7
NILF	0.5	-0.2
Part-time employment	-0.9	0.4

   Then, in the absence of a trade diploma, the model predicts that

   $\log(P_{FT} / P_{U/E}) = -0.3 - 0.7 = -1.0$

   i.e., $P_{FT} / P_{U/E} = \exp(-1.0) < 1$

   thus, $P_{FT} < P_{U/E}$,

   where *FT* stands for full-time employment and *U/E* stands for unemployed.

   However, if a trade diploma is present,

   $\log(P_{FT} / P_{U/E}) = -0.3 + 0.7 = 0.4$

   i.e., $P_{FT} / P_{U/E} = \exp(0.4) > 1$

   thus, $P_{FT} > P_{U/E}$.

   In other words, the positive coefficient of having a trade diploma associated with full-time employment illustrates that having a trade diploma increases the probability of being in a particular labour force category relative to the probability of being unemployed. When there is more than one explanatory variable, and particularly when there are interactions, the situation becomes more complicated, though the same general principle holds.

The coefficients are converted into probability values using the formula

$$P_i = \frac{e^{\text{logit}P_j}}{1 + \sum_{1}^{3} e^{\text{logit}P_j}}.$$

Appendix A

It was necessary to collapse some of the categories available in the Census to enable the modelling to be carried out within ABS resource constraints. The variables for which this was necessary are indicated here. Details of independent variables used in the logistic regressions:

ABORCAT - Aboriginal and Torres Strait Islander indicator:
- Aboriginal or Torres Strait Islander (ATSI)
- non-ATSI

AGE - treated as continuous (Age ranging from 15 to 64 years)

MARITAL - marital status:
- NEVER married
- MARRIED
- OTHER (i.e. divorced, separated, widowed)

DEPT - number of dependent children, this was collapsed for the analysis into:
- NONE
- 1
- 2 to 3
- 4 plus

The educational independent variables are:

QUALIF - qualifications:
- no qualifications
- diploma - eg trade
- tertiary

ALS - age left school, collapsed for the analysis into:
- 1 (did not go to school or left <15)
- 2 (left 15-16)
- 3 (left school at >16)
- 4 (still at school)

ENGLISH - standard of English:
- GOOD
- BAD

The geographic independent variables are:

SECTION - section-of-State:
- 0 (major urban)
- 1 (other urban)
- 2 (rural, includes migratory)

REMOTE - divides Australia into a settled part where the labour market is well developed and an area where the labour market is less developed:
- 0 (not remote)
- 1 (remote)

Appendix B

The models contain the following variables, in order of entrance into the model (A*B refers to the interaction between the variables A and B):

Females	Drop in Likelihood Ratio
INTERCEPT	(56935)[a]
AGE, AGE^2	10557
ABORCAT	1793
DEPT	1196
ALS	801
AGE*DEPT	310
MARITAL	277
MARITAL*ALS	363
QUALIF	289
SECTION	88
ABORCAT*SECTION	77
ENGLISH	39
DEPT*SECTION	82
AGE*ALS	55
SECTION*ENGLISH	30
ABORCAT*QUALIF	41

Males	Drop in Likelihood Ratio
INTERCEPT	(55075)[a]
AGE, AGE^2	13173
ABORCAT	2401
ALS	1384
AGE*ALS	550
MARITAL	464
QUALIF	388
ENGLISH	113
SECTION	86
ALS*SECTION	90
REMOTE	48
MARITAL*REMOTE	46
ABORCAT*REMOTE	47
ENGLISH*SECTION	37
DEPT	38
AGE*DEPT	94
REMOTE*DEPT	51

a. The initial value of the likelihood ratio.

Tables B1-B4 present the coefficients estimated for males and females. Tables B1 and B2 are the preferred estimates including interaction terms and Tables B3 and B4 present the results without interaction terms. The tables should be read in the following way in conjunction with the variables listed in Appendix A: For each variable, there are three coefficients measuring the log odds for a particular labour force category compared with being unemployed. The first relates to full-employment, the second to NILF and the third to part-time employment.

Table B1. Analysis of individual parameters for males.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
INTERCEPT	FT	-1.2837	0.0300	18.2700	0.0001
	NILF	3.9090	0.2778	198.0100	0.0001
	PT	-0.5098	0.4207	1.4700	0.2256
AGE	FT	0.1055	0.0131	64.7100	0.0001
	NILF	-0.2331	0.0131	317.77	0.0001
	PT	-0.0221	0.0186	1.4100	0.2349
AGESQU	FT	-0.0010	0.0002	36.0800	0.0001
	NILF	0.0035	0.0002	399.1000	0.0001
	PT	0.0004	0.0002	3.2200	0.0726
ABORCAT	FT - AB	-0.7469	0.0463	260.7600	0.0001
	NILF - AB	-0.1268	0.0557	5.1900	0.0227
	PT - AB	-0.4598	0.0677	46.1600	0.0001
ALS	FT - at school	-0.0396	0.1837	0.0500	0.8294
	NILF - at school	1.2598	0.1347	87.4800	0.0001
	PT - at school	0.5861	0.2186	7.1900	0.0073
	FT - <15	0.5267	0.1696	9.6500	0.0019
	NILF - <15	-1.7106	0.1298	173.6600	0.0001
	PT - <15	-0.6270	0.2041	9.4400	0.0021
	FT - 15-16	1.4073	0.1941	52.5700	0.0001
	NILF - 15-16	-0.5754	0.1692	11.5600	0.0007
	PT - 15-16	0.7574	0.2386	10.0800	0.0015
AGE*ALS	FT - at school*AGE	0.0009	0.0044	0.0400	0.8426
	NILF - at school*AGE	-0.0259	0.0036	52.200	0.0001
	PT - at school*AGE	-0.0122	0.0054	5.1500	0.0232
	FT - <15*AGE	-0.0060	0.0043	1.9300	0.1642
	NILF - <15*AGE	0.0342	0.0037	86.0300	0.0001
	PT - <15*AGE	0.0182	0.0052	12.0100	0.0005
	FT - 15-16*AGE	-0.0264	0.0054	24.0700	0.0001

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Table B1. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
	NILF - 15-16*AGE	0.0042	0.0052	0.6700	0.4120
	PT - 15-16*AGE	-0.0171	0.0067	6.4100	0.0114
MARITAL	FT - MARRIED	0.5441	0.0460	139.700	0.0001
	NILF- MARRIED	-0.0331	0.0515	0.4100	0.5208
	PT - MARRIED	0.4154	0.6925	35.9800	0.0001
	FT - NEVER	-0.2927	0.0451	39.6100	0.0001
	NILF - NEVER	0.0564	0.0518	1.1900	0.2763
	PT - NEVER	-0.1806	0.0731	6.1000	0.0135
QUALIF	FT - DIP	0.2093	0.0871	5.7800	0.0162
	NILF - DIP	0.0053	0.1151	0.0000	0.9632
	PT - DIP	-0.0214	0.1053	0.0400	0.8391
	FT - HIGHER	0.4716	0.1488	10.0400	0.0015
	NILF - HIGHER	-0.0399	0.1976	0.0400	0.8399
	PT - HIGHER	0.6251	0.1709	13.3700	0.0003
ENGLISH	FT - BAD	-0.5941	0.1045	32.3100	0.0001
	NILF - BAD	0.2263	0.0757	8.9400	0.0028
	PT - BAD	-0.3983	0.1890	4.4400	0.0351
SECTION	FT - MAJOR	0.3168	0.1357	5.4500	0.0196
	NILF - MAJOR	-0.1442	0.1144	1.5900	0.2075
	PT - MAJOR	0.0381	0.2381	0.0300	0.8728
	FT - OTHER	-0.3674	0.1973	3.4700	0.0626
	NILF - OTHER	0.3106	0.1322	5.5200	0.0188
	PT - OTHER	-0.6237	0.3713	2.8200	0.0930
ALS*SECTION	FT - MAJ*AT SCH.	-0.1949	0.0898	4.7200	0.0299
	NILF - MAJ*AT SCH.	0.0148	0.0840	0.0300	0.8600
	PT - MAJ*AT SCH.	-0.0138	0.1369	0.0100	0.9196
	FT - MAJ*<15	0.0765	0.0836	0.8400	0.3606
	NILF - MAJ*<15	0.0489	0.0731	0.4500	0.5030

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Table B1. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
	PT - MAJ*<15	0.1093	0.1405	0.6100	0.4365
	FT - MAJ*15-16	-0.0050	0.0820	0.0000	0.9500
	NILF - MAJ*15-16	-0.164	0.0801	4.1900	0.0406
	PT - MAJ*15-16	-0.2445	0.1292	3.5800	0.0584
	FT - OTH*AT SCH.	0.0622	0.0749	0.6900	0.4058
	NILF - OTH*AT SCH.	-0.0617	0.0686	0.8100	0.3680
	PT - OTH*AT SCH.	0.2729	0.1304	4.3800	0.0365
	FT - OTH*<15	-0.0325	0.0909	0.1300	0.7204
	NILF - OTH*<15	-0.1302	0.0942	1.9100	0.1668
	PT - OTH*<15	-0.0026	0.1386	0.0000	0.9851
	FT - OTH*15-16	0.1622	0.0890	3.3200	0.0683
	NILF - OTH*15-16	-0.0677	0.0913	0.5500	0.4583
	PT - OTH*15-16	0.1789	0.1474	1.4700	0.2249
REMOTE	FT - REMOTE	-0.0500	0.0539	0.8600	0.3534
	NILF - REMOTE	-0.0612	0.0625	0.9600	0.3274
	PT - REMOTE	-0.1154	0.0814	2.0100	0.1563
MARITAL*REMOTE	FT - MAR*REM	0.0466	0.0448	1.0800	0.2988
	NILF - MAR*REM	-0.1965	0.0493	15.9100	0.0001
	PT - MAR*REM	-0.0813	0.0670	1.4700	0.2247
	FT - NEV*REM	-0.0984	0.0403	5.9500	0.0147
	NILF - NEV*REM	0.0740	0.0424	3.0400	0.0814
	PT - NEV*REM	-0.0611	0.0624	0.9600	0.3282
ABORCAT*REMOTE	FT - REM*AB.	0.1192	0.0458	6.7700	0.0093
	NILF - REM*AB	-0.0824	0.0549	2.2600	0.1332
	PT - REM*AB	-0.1796	0.0668	7.2300	0.0072
ENGLISH*SECTION	FT - BAD*MAJ	0.0414	0.1206	0.1200	0.7315
	NILF - BAD*MAJ	-0.3277	0.1005	10.6400	0.0011

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Table B1. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
	PT - BAD*MAJ	-0.2401	0.2157	1.2400	0.2656
	FT - BAD*OTH	-0.1418	0.1901	0.5600	0.4558
	NILF - BAD*OTH	0.4169	0.1272	10.7500	0.0010
	PT - BAD*OTH	-0.2071	0.3575	0.3400	0.5624
DEPT	FT - NONE	0.2245	0.1041	4.6500	0.0310
	NILF - NONE	-0.7420	0.1149	41.7100	0.0001
	PT - NONE	-0.2200	0.1560	1.9900	0.1586
	FT - 1	-0.0328	0.1236	0.0700	0.7906
	NILF - 1	-0.0230	0.1253	0.0300	0.8541
	PT - 1	-0.0042	0.1728	0.0000	0.9808
	FT - 2-3	-0.3819	0.1205	10.0500	0.0015
	NILF - 2-3	0.2892	0.1164	6.1700	0.0130
	PT - 2-3	0.1129	0.1684	0.4500	0.5028
AGE*DEPT	FT - NONE*AGE	-0.0065	0.0031	4.3800	0.0363
	NILF - NONE*AGE	0.0168	0.0033	25.8400	0.0001
	PT - NONE*AGE	0.0023	0.0045	0.2700	0.6048
	FT - 1*AGE	0.0013	0.0040	0.1100	0.7370
	NILF - 1*AGE	0.0013	0.0041	0.0900	0.7584
	PT - 1*AGE	0.0050	0.0054	0.8800	0.3494
	FT - 2-3*AGE	0.0102	0.0038	7.3100	0.0069
	NILF - 2-3*AGE	-0.0058	0.0038	2.3400	0.1262
	PT - 2-3*AGE	-0.0010	0.0053	0.0300	0.8520
REMOTE*DEPT	FT - NONE*REM	0.0955	0.0440	4.700	0.0301
	NILF - NONE*REM	-0.0004	0.0481	0.0000	0.9928
	PT - NONE*REM	0.0733	0.0648	1.2800	0.2585
	FT - 1*REM	0.0181	0.0505	0.1300	0.7199
	NILF - 1*REM	0.0010	0.0538	0.0000	0.9851
	PT - 1*REM	-0.0975	0.0690	2.0000	0.1577
	FT - 2-3*REM	0.0088	0.0435	0.0400	0.8401
	NILF - 2-3*REM	0.0552	0.0460	1.4400	0.2297
	PT - 2-3*REM	-0.0291	0.0605	0.2300	0.6312

TABLE B2. Analysis of individual parameters for Females.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability values
INTERCEPT	FT	-1.4665	0.4099	12.8000	0.0003
	NILF	1.4128	0.3425	17.0200	0.0001
	PT	-2.5467	0.4475	32.3900	0.0001
ABORCAT	FT	-0.3351	0.1348	6.1800	0.0130
	NILF	-0.1491	0.1471	1.0300	0.3107
	PT	-0.4086	0.1503	7.3900	0.0066
AGE	FT	0.1190	0.0184	41.9200	0.0001
	NILF	-0.0396	0.0160	6.1300	0.0133
	PT	0.1209	0.0202	35.9700	0.0001
AGESQU	FT - AB	-0.0011	0.0002	21.4200	0.0001
	NILF - AB	0.0012	0.0002	31.7400	0.0001
	PT - AB	-0.0010	0.0003	14.1100	0.0002
DEPT	FT - NONE	0.8612	0.1280	45.2800	0.0001
	NILF - NONE	-1.2639	0.1233	105.0100	0.0001
	PT - NONE	-0.0701	0.1541	0.2100	0.6491
	FT - 1	-0.0566	0.1520	0.1400	0.7097
	NILF - 1	0.4824	0.1284	14.1200	0.0002
	PT - 1	0.1905	0.1684	1.2800	0.2580
	FT - 2-3	-1.0230	0.1674	37.3600	0.0001
	NILF - 2-3	0.7476	0.1342	31.0400	0.0001
	PT - 2-3	-0.2524	0.1743	2.1000	0.1475
ALS	FT - AT SCHOOL	-0.4075	0.2981	1.8700	0.1717
	NILF - AT SCHOOL	0.5153	0.2102	6.0100	0.0142
	PT - AT SCHOOL	0.8675	0.2988	0.8430	0.0037
	FT - <15	-0.3551	0.2628	1.8300	0.1766
	NILF - <15	-0.8655	0.1867	21.4800	0.0001
	PT - <15	-0.9154	0.2673	11.7300	0.0006

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TABLE B2. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability values
	FT - 15-16	0.5776	0.3065	3.5500	0.0594
	NILF - 15-16	-0.4701	0.2450	3.6800	0.0551
	PT - 15-16	-0.1290	0.3157	0.1700	0.6829
AGE*DEPT	FT - NONE*AGE	-0.0189	0.0043	19.6100	0.0001
	NILF - NONE*AGE	0.0207	0.0040	26.5300	0.0001
	PT - NONE*AGE	-0.0052	0.0048	1.2100	0.2709
	FT - 1*AGE	-0.0018	0.0052	0.0120	0.7276
	NILF - 1*AGE	-0.0110	0.0045	5.8800	0.0153
	PT - 1*AGE	-0.0038	0.0055	0.4700	0.4930
	FT - 2-3*AGE	0.0294	0.0056	27.5400	0.0001
	NILF - 2-3*AGE	-0.0085	0.0048	3.1600	0.0756
	PT - 2-3*AGE	0.0185	0.0057	10.4000	0.0013
MARITAL	FT - MARRIED	0.3125	0.0912	11.7600	0.0006
	NILF - MARRIED	0.3133	0.0630	24.7400	0.0001
	PT - MARRIED	0.4802	0.0922	27.1400	0.0001
	FT - NEVER	-0.1640	0.1330	1.5200	0.2173
	NILF - NEVER	-0.1285	0.0842	2.3300	0.1270
	PT - NEVER	-0.0807	0.1323	0.3700	0.5420
ALS*MARITAL	FT - AT SCH.*MAR	0.1239	0.1191	1.0800	0.2982
	NILF - AT SC*MA	-0.1794	0.0895	4.0200	0.0451
	PT - AT SCH*MA	0.0150	0.1218	0.0200	0.9021
	FT - <15*MAR	-0.0621	0.1682	0.1400	0.7119
	NILF<15*MAR	0.3548	0.1154	9.4600	0.0021
	PT - <15*MAR	0.2057	0.1674	1.5100	0.2191
	FT - 15-16*MAR	0.0762	0.1000	0.5800	0.4461
	NILF - 15-16*MAR	0.2728	0.0737	13.7100	0.0002
	PT - 15-16*MAR	0.3186	0.1025	9.6500	0.0019

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TABLE B2. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability values
	FT - AT SCH*NEV	0.1702	0.1395	1.4900	0.2224
	NILF - AT SC*NEV	-0.2839	0.0925	9.4200	0.0022
	PT - AT SC*NEV	-0.2500	0.1417	3.1100	0.0777
	FT - <15*NEV	-0.2651	0.1174	5.1000	0.0240
	NILF - <15*NEV	0.2653	0.0966	7.5500	0.0060
	PT - <15*NEV	-0.1590	0.1216	1.7100	0.1909
	FT - 15-16*NEV	0.1644	0.1532	1.1500	0.2832
	NILF - 15-16*NEV	-0.4127	0.1139	13.1300	0.0003
	PT - 15-16*NEV	0.0003	0.1570	0.0000	0.9983
QUALIF	FT - DIP	0.0141	0.1435	0.0010	0.9215
	NILF - DIP	-0.1180	0.1559	0.5700	0.4491
	PT - DIP	0.0951	0.1606	0.3500	0.5537
	FT - HIGHER	0.6490	0.2603	6.2200	0.0127
	NILF - HIGHER	-0.0546	0.2856	0.0400	0.8483
	PT - HIGHER	0.3441	0.2905	1.4000	0.2361
SECTION	FT - MAJOR	-0.1063	0.1490	0.5100	0.4756
	NILF - MAJOR	-0.3638	0.1293	7.9100	0.0049
	PT - MAJOR	-0.6018	0.1837	10.7300	0.0011
	FT - OTHER	0.5428	0.2371	5.2400	0.0221
	NILF - OTHER	0.5280	0.2110	6.2600	0.0123
	PT - OTHER	0.3659	0.2891	1.6000	0.2056
ABORCAT*SECTION	FT - AB*MAJ	0.1993	0.0440	20.4700	0.0001
	NILF - AB-MAJ	0.0710	0.0416	2.9100	0.0879
	PT - AB*MAJ	0.0295	0.0502	0.3500	0.5561
	FT - AB*OTH	0.0095	0.0487	0.0400	0.8448
	NILF - AB*OTH	-0.0699	0.0459	2.3200	0.1274

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TABLE B2. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability values
	PT - AB*OTH	-0.1081	0.0541	4.0000	0.0455
ENGLISH	FT - BAD	-0.2589	0.1328	3.8000	0.0512
	NILF - BAD	-0.1058	0.1136	0.8700	0.3516
	PT - BAD	-0.4770	0.1578	9.1400	0.0025
AGE*ALS	FT -at school*AGE	0.0042	0.0079	0.2900	0.5900
	NILF - at school*AGE	-0.0098	0.0059	2.8100	0.0938
	PT - at school*AGE	-0.0233	0.0079	8.7100	0.0032
	FT - <15*AGE	0.0185	0.0071	6.7700	0.0093
	NILF - <15*AGE	0.0214	0.0054	15.3700	0.0001
	PT - <15*AGE	0.0266	0.0072	13.7300	0.0002
	FT - 15-16*AGE	-0.0001	0.0088	0.0000	0.9880
	NILF - 15-16*AGE	0.0040	0.0075	0.2800	0.5961
	PT - 15-16*AGE	0.0143	0.0090	2.5000	0.1139
DEPT*SECTION	FT - NONE*MAJ	0.1474	0.0637	5.3600	0.0207
	NILF - NONE*MAJ	0.0150	0.0625	0.0600	0.8102
	PT - NONE*MAJ	0.0250	0.0735	0.1200	0.7341
	FT - 1*MAJ	0.0054	0.0690	0.0100	0.9372
	NILF - 1*MAJ	0.0505	0.0658	0.5900	0.4427
	PT - 1*MAJ	0.1133	0.0818	1.9200	0.1662
	FT - 2-3*MAJ	0.1079	0.0721	2.2400	0.1344
	NILF - 2-3*MAJ	0.1465	0.0643	5.1800	0.0228
	PT - 2-3*MAJ	0.1388	0.0779	3.1800	0.0748
	FT - NONE*MAJ	0.0320	0.0735	0.1900	0.6639
	NILF - NONE*OTH	-0.0907	0.0628	2.0900	0.1482
	PT - NONE*OTH	-0.1318	0.0830	2.5200	0.1121
	FT - 1*OTH	-0.1762	0.0690	6.5200	0.0107
	NILF - 1*OTH	0.1227	0.0610	4.0400	0.0445

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TABLE B2. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability values
	PT - 1*OTH	0.0512	0.0717	0.5100	0.4749
	FT - 2-3*OTH	-0.0859	0.0691	1.5400	0.2141
	NILF - 2-3*OTH	-0.1236	0.0581	4.4600	0.0346
	PT - 2-3*OTH	-0.0548	0.0738	0.5500	0.4582
SECTION*ENGLISH	FT - BAD*MAJ	-0.3752	0.1468	6.5300	0.0106
	NILF - BAD*MAJ	-0.3628	0.1271	8.1500	0.0043
	PT - BAD*MAJ	-0.7037	0.1810	15.1100	0.0001
	FT - BAD*OTH	0.6134	0.2351	6.8100	0.0091
	NILF - BAD*OTH	0.5184	0.2085	6.1800	0.0129
	PT - BAD*OTH	0.5026	0.2872	3.0600	0.0801
ABORCAT*QUALIF	FT - DIP*AB	-0.1432	0.1435	1.0000	0.3181
	NILF - DIP*AB	-0.1005	0.1559	0.4200	0.5191
	PT - DIP*AB	-0.0982	0.1605	0.3700	0.5406
	FT - HIGHER*AB	0.4451	0.2595	2.9400	0.0862
	NILF - HIGHER*AB	0.0362	0.2849	0.0200	0.8988
	PT - HIGHER*AB	0.2889	0.2896	1.0000	0.3185

Table B3. Analysis of individual parameters for males (main effects only).

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
INTERCEPT	FT	-0.9098	0.2278	15.9600	0.0001
	NILF	4.1693	0.2374	308.5300	0.0001
	PT	-0.1008	0.3261	0.1000	0.7572
ABORCAT	FT	-0.6658	0.0273	596.3200	0.0001
	NILF	-0.2373	0.0317	55.9700	0.0001
	PT	-0.5723	0.0419	186.2400	0.0001
AGE	FT	0.1054	0.0116	82.3900	0.0001
	NILF	-0.2477	0.0120	426.1800	0.0001
	PT	-0.0157	0.0164	0.8600	0.3537
AGESQU	FT - AB	-0.0012	0.0002	54.7200	0.0001
	NILF - AB	0.0036	0.0002	491.6000	0.0001
	PT - AB	0.0004	0.0002	2.6600	0.1031
ALS	FT - at school	0.0314	0.0528	0.3500	0.5523
	NILF - at school	0.5424	0.0491	121.9200	0.0001
	PT - at school	0.0777	0.0717	1.1800	0.2783
	FT - <15	0.1236	0.0455	7.3900	0.0066
	NILF - <15	-0.6330	0.0452	196.4900	0.0001
	PT - <15	-0.2367	0.0624	14.4000	0.0001
	FT - 15-16	0.4745	0.0569	69.5200	0.0001
	NILF - 15-16	-0.3808	0.0615	38.2900	0.0001
	PT - 15-16	0.1996	0.0775	6.6300	0.0100
MARITAL	FT - MARRIED	0.5887	0.0413	203.5700	0.0001
	NILF - MARRIED	-0.0128	0.0487	0.0700	0.7922
	PT - MARRIED	0.3863	0.0624	38.3800	0.0001
	FT - NEVER	-0.3208	0.0425	56.8700	0.0001
	NILF - NEVER	0.0215	0.0503	0.1800	0.6690
	PT - NEVER	-0.2058	0.0673	9.3600	0.0022

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Table B3. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
QUALIF	FT - DIP	0.2419	0.0865	7.8200	0.0052
	NILF - DIP	-0.0268	0.1132	0.0600	0.8132
	PT - DIP	-0.0088	0.1044	0.0100	0.9331
	FT - HIGHER	0.4243	0.1475	8.2800	0.0040
	NILF - HIGHER	0.0610	0.1933	0.1000	0.7525
	PT - HIGHER	0.6089	0.1689	12.9900	0.0003
ENGLISH	FT - BAD	-0.4598	0.0682	45.5000	0.0001
	NILF - BAD	0.1123	0.0616	3.3300	0.0681
	PT - BAD	-0.1356	0.0880	2.3800	0.1232
SECTION	FT - MAJOR	0.2192	0.0364	36.2400	0.0001
	NILF - MAJOR	0.1189	0.0416	8.1700	0.0043
	PT - MAJOR	0.1564	0.0558	7.8500	0.0051
	FT - OTHER	-0.1225	0.0320	14.7000	0.0001
	NILF - OTHER	-0.1078	0.0354	9.3000	0.0023
	PT - OTHER	-0.2612	0.0503	26.9500	0.0001
REMOTE	FT - REMOTE	-0.0034	0.0298	0.0100	0.9083
	NILF - REMOTE	-0.1307	0.0324	16.3200	0.0001
	PT - REMOTE	-0.2750	0.0466	34.8600	0.0001
DEPT	FT - NONE	0.0501	0.0382	1.7200	0.1900
	NILF - NONE	-0.2059	0.0441	21.7600	0.0001
	PT - NONE	-0.1236	0.0581	4.5200	0.0335
	FT - 1	0.0150	0.0444	0.1100	0.7362
	NILF - 1	-0.0497	0.0494	1.0100	0.3144
	PT - 1	0.1036	0.0646	2.5700	0.1087
	FT - 2-3	-0.0658	0.0397	2.7400	0.0977
	NILF - 2-3	0.1400	0.0433	10.4600	0.0012
	PT - 2-3	0.0673	0.0579	1.3500	0.2455

TABLE B4. Analysis of individual parameters for females (main effects only).

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
INTERCEPT	FT	-2.3902	0.2926	66.7400	0.0001
	NILF	1.5412	0.2552	36.4600	0.0001
	PT	-3.3402	0.3317	101.4000	0.0001
ABORCAT	FT	-0.5603	0.0328	291.9500	0.0001
	NILF	-0.1163	0.0307	14.3400	0.0002
	PT	-0.6018	0.0371	262.7300	0.0001
AGE	FT	0.1536	0.0160	92.4000	0.0001
	NILF	-0.0610	0.0142	18.3400	0.0001
	PT	0.1466	0.0178	67.4500	0.0001
AGESQU	FT - AB	-0.0017	0.0002	54.4500	0.0001
	NILF - AB	0.0016	0.0002	59.0100	0.0001
	PT - AB	-0.0013	0.0003	28.4200	0.0001
DEPT	FT - NONE	0.2861	0.0476	36.1400	0.0001
	NILF - NONE	-0.5938	0.0463	164.6600	0.0001
	PT - NONE	-0.3428	0.0565	36.8200	0.0001
	FT - 1	-0.0838	0.0510	2.7000	0.1002
	NILF - 1	0.1218	0.0454	7.2100	0.0073
	PT - 1	0.1135	0.0562	4.0800	0.0435
	FT - 2-3	-0.1954	0.0497	15.4400	0.0001
	NILF - 2-3	0.4783	0.0432	122.6000	0.0001
ALS	PT - 2-3	0.3497	0.0527	44.2500	0.0001
	FT - AT SCHOOL	0.0714	0.0816	0.7700	0.3811
	NILF - AT SCHOOL	0.4592	0.0624	54.2200	0.0001
	PT - AT SCHOOL	0.2720	0.0838	10.5500	0.0012
	FT - <15	0.1259	0.0686	3.3700	0.0663
	PT - <15	-0.1522	0.0711	4.5800	0.0324
	NILF - <15	-0.2885	0.0514	31.4600	0.0001

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Table B4. Continued.

Effect	Parameter	Estimate	Standard Error	Chi-square	Probability value
	FT - 15-16	0.4740	0.0780	36.9300	0.0001
	NILF - 15-16	-0.3661	0.0636	33.1500	0.0001
	PT - 15-16	0.1650	0.0826	3.9900	0.0459
MARITAL	FT - MARRIED	0.2695	0.0480	31.4500	0.0001
	NILF - MARRIED	0.5166	0.0440	137.5800	0.0001
	PT - MARRIED	0.6282	0.0529	141.2600	0.0001
	FT - NEVER	0.0121	0.0520	0.0500	0.8160
	NILF - NEVER	-0.3333	0.0472	49.8100	0.0001
	PT - NEVER	-0.1795	0.0606	8.7700	0.0031
QUALIF	FT - DIP	0.1650	0.0974	2.8700	0.0902
	NILF - DIP	-0.0838	0.1019	0.6800	0.4109
	PT - DIP	0.1875	0.1035	3.2800	0.0701
	FT - HIGHER	0.2884	0.1549	3.4700	0.0626
	NILF - HIGHER	-0.0354	0.1638	0.0500	0.8287
	PT - HIGHER	0.1257	0.1644	0.5800	0.4446
SECTION	FT - MAJOR	0.2665	0.0407	42.9100	0.0001
	NILF - MAJOR	0.0332	0.0375	0.7800	0.3760
	PT - MAJOR	0.1378	0.0450	9.3700	0.0022
	FT - OTHER	-0.0818	0.0407	4.0300	0.0448
	NILF - OTHER	-0.0220	0.0358	0.3800	0.5387
	PT - OTHER	-0.1591	0.0460	11.9400	0.0006
ENGLISH	FT - BAD	-0.4753	0.0851	31.1800	0.0001
	NILF - BAD	-0.3357	0.0669	25.1800	0.0001
	PT - BAD	-0.6916	0.0996	48.2100	0.0001

Appendix C

Model quality

Each combination of the predictor variables yields different predicted LFS probabilities. These combinations are referred to as 'populations'. It is possible to investigate the quality of the models by comparing predicted probabilities with observed probabilities (for fuller discussions of the issue of model quality and testing in the context of multinomial logit see Cramer and Ridder (1991); Andrews, Klem, Davidson et al. (1981); Hosmer and Lemeshow (1980); and Albert and Harris (1987)).

If the predicted probabilities differ greatly from the observed probabilities for a given population, then the model tends to misclassify people with that particular combination of explanatory variables. The closer the two probabilities, the lower the chance of misclassification (Lesaffre and Albert, 1989).

Suppose (in some fictional case) there were two unemployed 24-year old Aboriginal males with no dependants, no qualifications, who left school before the age of 15, who had never married, and who lived in a remote rural area. Suppose there were also two males with identical characteristics who had part-time employment. Then the observed probabilities are:

$p_{FT} = 0$ $p_{PT} = 0.5$ $p_{NL} = 0$ $p_{U/E} = 0.5$

If the probabilities predicted by the model were:

$p_{FT} = 0.08$ $p_{PT} = 0.4$ $p_{NL} = 0.12$ $p_{U/E} = 0.4$

Then there is a small chance that the LFS of a person with corresponding characteristics would be incorrectly predicted by the model.

If, however, the probabilities predicted by the model were:

$p_{FT} = 0.38$ $p_{PT} = 0.2$ $p_{NL} = 0.32$ $p_{U/E} = 0.1$

Then the chance of incorrect prediction would be very large.

The models explained 72 per cent of the male populations (73 per cent of the female populations) with no chance of misclassification. In the remaining 28 per cent (27 per cent), at least one observation was misclassified per population.

Returning to the previous example, suppose that the values predicted by the model were:

$p_{FT} = 0.08$ $p_{PT} = 0.4$ $p_{NL} = 0.12$ $p_{U/E} = 0.4$

In this case, predicted cell frequencies would be:

$n_{FT} = 0.32$ $n_{PT} = 1.6$ $n_{NL} = 0.48$ $n_{U/E} = 1.6,$

which becomes:

$n_{FT} = 0$ $n_{PT} = 2$ $n_{NL} = 0$ $n_{U/E} = 2,$

with rounding, given that there are 4 observations in the population.

In this case, there would be no misclassification; the model is accurate for this population.

Now suppose the predicted probabilities were:

$p_{FT} = 0.38$ $p_{PT} = 0.2$ $p_{NL} = 0.32$ $p_{U/E} = 0.1$

Predicted cell frequencies would be:

$n_{FT} = 1.52$ $n_{PT} = 0.8$ $n_{NL} = 1.26$ $n_{U/E} = 0.4$,

which rounds to:

$n_{FT} = 2$ $n_{PT} = 1$ $n_{NL} = 1$ $n_{U/E} = 0$,

so two observations were misclassified; the model is 50 per cent accurate for the population.

Poor results were deemed to occur whenever one or more observations in a population was misclassified.

The poor results for males are distributed as follows:

Aboriginal	65.9
Non-Aboriginal	34.1
Full-time employment	17.0
NILF	27.5
Part-time employment	18.5
Unemployed	37.0
No dependants	27.6
1 dependant	19.6
2-3 dependants	22.4
4+ dependants	30.5
Left school <15	33.3
Left school 15-16	37.9
Left school 17+	19.6
Still at school	9.1
Diploma	15.3
Higher education	2.9
No qualification	81.8
Major urban	28.8
Other urban	33.6
Rural and migratory	37.6

For example, the model misclassifies more Aboriginal males than non-Aboriginal males, and the bulk of misclassifications occur for males with no qualifications, as opposed to those having higher qualifications or diplomas.

The poor results for females are distributed as follows:

Aboriginal	45.5
Non-Aboriginal	54.5
Full-time employment	29.3
NILF	14.8
Part-time employment	31.7

Unemployed	24.2
No dependants	28.2
1 dependant	25.7
2-3 dependants	24.9
4+ dependants	21.3
left school <15	22.0
left school 15-16	25.7
left school 17+	24.9
still at school	21.3
Diploma	25.7
Higher education	6.8
No qualification	67.5
Major urban	41.8
Other urban	29.4
Rural and migratory	28.7

For example, more non-Aboriginal females are misclassified than Aboriginal females, the reverse of the result for males.

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