YOUTH EDUCATION DECISIONS AND JOB-SEARCH BEHAVIOUR IN AUSTRALIA

by

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ABSTRACT

This thesis uses Australian unit-record data to examine two important aspects of labour supply behaviour. The first part of this thesis examines the participation decisions of Australian teenagers. Traditionally, the decision of whether to complete school or enter the labour force has been explained using personal characteristics, such as age and gender, and family background characteristics, such as parents' education. Chapter 2 extends this framework to consider whether neighbourhood characteristics provide information about these participation decisions over and above personal and family background characteristics. The results suggest that neighbourhood effects are present. Also within this framework, Chapter 3 considers whether government policy initiatives, designed to increase the proportion of Australian teenagers completing high school, achieved this aim. Again, the results suggest that this extension increases our understanding of teenage participation decisions.

The second part of this thesis investigates two aspects of job-search behaviour. Chapter 4 examines the factors that affect how teenagers look for work. An equilibrium search model is developed to explain why local labour market conditions may be important. The empirical analysis supports the model's implication that teenagers in high unemployment areas are more likely to use general search methods, such as a newspapers or employment agencies, which appear to be less successful on average. Chapter 5 considers whether reservation wage information helps to explain the unemployment duration of the individuals in a sample that covers a wider cross-section of the Australian labour market. Despite the importance of this variable in job-search models, it does not appear to explain unemployment duration experiences once background characteristics and previous labour market experience has been controlled for.

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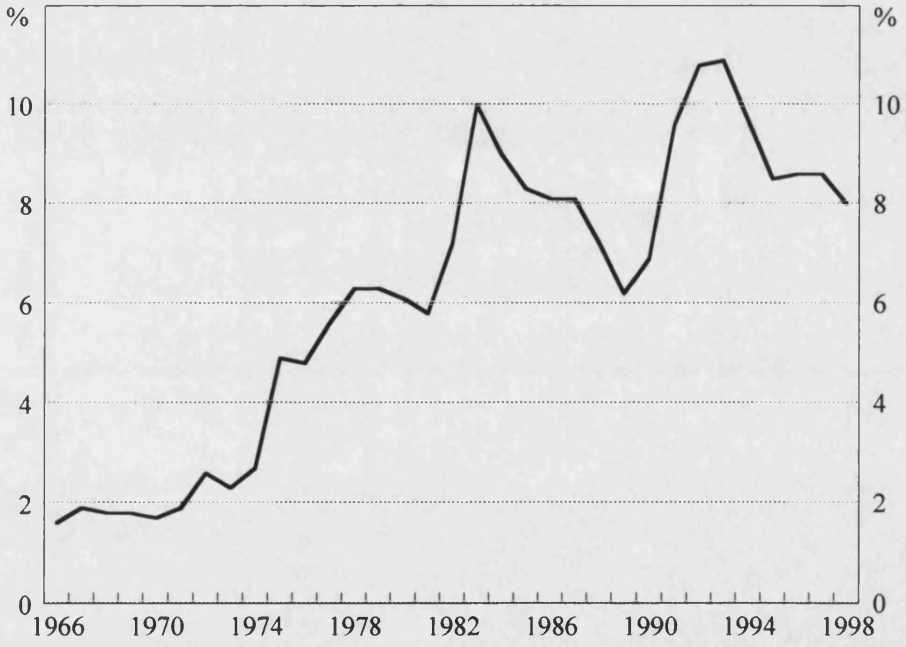
CHAPTER 1

SOME FACTS AND A SUMMARY

1 Introduction

The unemployment rate in Australia has risen substantially over the past three decades: it has increased from an average of less than 2 per cent in the late 1960s to an average of around 8 per cent in the 1980s and 1990s (Figure 1). Not surprisingly, estimates of the NAIRU for Australia have also increased substantially since the 1970s, with recent estimates of the NAIRU lying between 5½ and 7 per cent (Gruen, Pagan and Thompson, 1999).

Figure 1: Aggregate Unemployment Rate

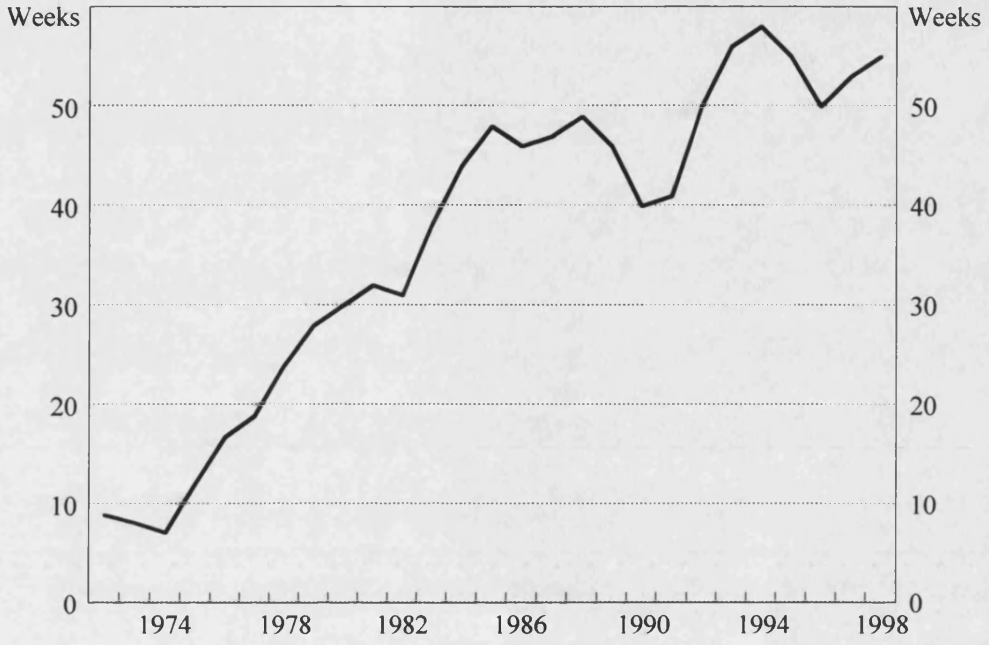


Source: ABS Cat. No. 6203.0 and ABS Cat. No. 6204.0

The rise in the aggregate unemployment rate has been associated with an increase in the average duration of unemployment (Figure 2). This increase in the proportion of long-term unemployment has been concentrated on some groups

more than others, in particular, teenagers, less-skilled workers, and people who previously worked in declining industries (Miller and Volker, 1987; Fahrer and Heath, 1992; Debelle and Swann, 1998; Strombach, Dockery and Ying, 1998).

Figure 2: Average Duration Of Unemployment



Source: ABS Cat. No. 6202.0 and ABS Cat. No. 6203.0

Recent research on neighbourhood-level data has indicated that unemployment has also become increasingly concentrated in low-socioeconomic areas (Hunter, 1995; Gregory and Hunter, 1995). The unemployment rate for the 10 per cent of neighbourhoods with the lowest socioeconomic ranking increased from just below 10 per cent in 1976 to around 40 per cent in 1991. The unemployment rate for the 10 per cent of neighbourhoods with the highest socioeconomic ranking increased marginally over this time, but remained below 10 per cent in 1991.

This thesis uses information about the participation and job-search decisions of individuals to understand the extent to which the level of the unemployment rate

in Australia can be explained by labour supply factors, rather than labour demand. The analysis concentrates on the extent to which the local environment affects the labour supply decisions and search effectiveness of Australian teenagers, the ability of government policy to influence teenagers' education decisions, and the role of the reservation wage in explaining the unemployment duration of a wider cross section of the Australian labour market.

Three of the four pieces of analysis that follow focus on the participation decisions and job-search behaviour of teenagers. Therefore, it is useful to provide some further information about the characteristics of the Australian teenage labour market before summarising the analysis and results in the subsequent chapters of this thesis.

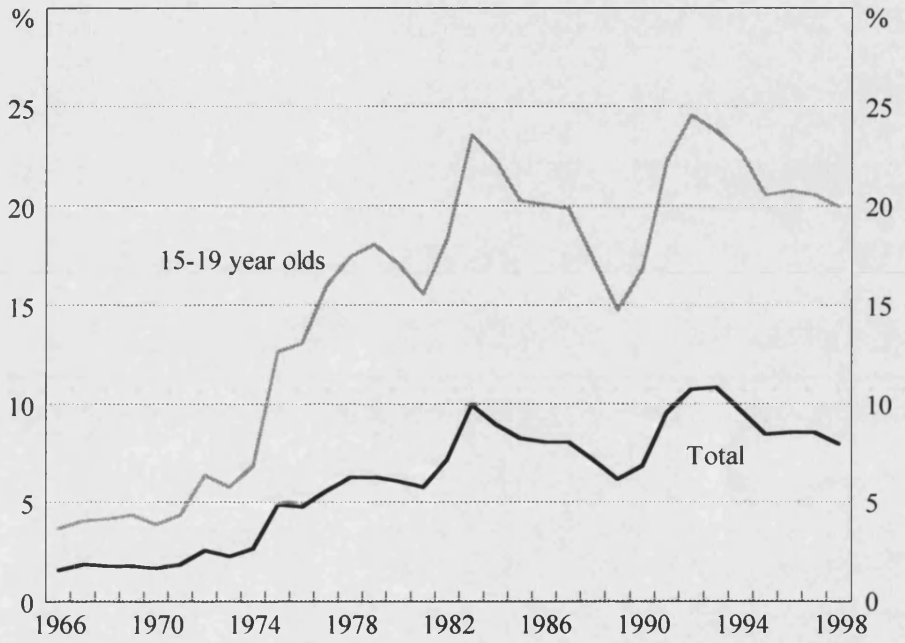
2 The Australian Youth Labour Market

The unemployment rate for teenagers in Australia has always been higher than the unemployment rate for adults (Figure 3). Traditionally, the high youth unemployment rate has been explained by a large number of teenagers experiencing relatively short spells of unemployment. Foster and Gregory (1982) find that in 1979-80 the rate of flow into the teenage unemployment pool was four to five times larger than the rate of flow into the 25 to 54 year-old unemployment pool. They also show that flows into the teenage unemployment pool are almost entirely accounted for by separations from full-time employment rather than entry from the outside the labour force.

However, high inflow rates only account for around half of the total teenage unemployment rate. It is also unlikely that changes in inflow rates over time can explain the rise in the teenage unemployment rate since the beginning of the 1970s. A more likely explanation of this rise is the increase in the average

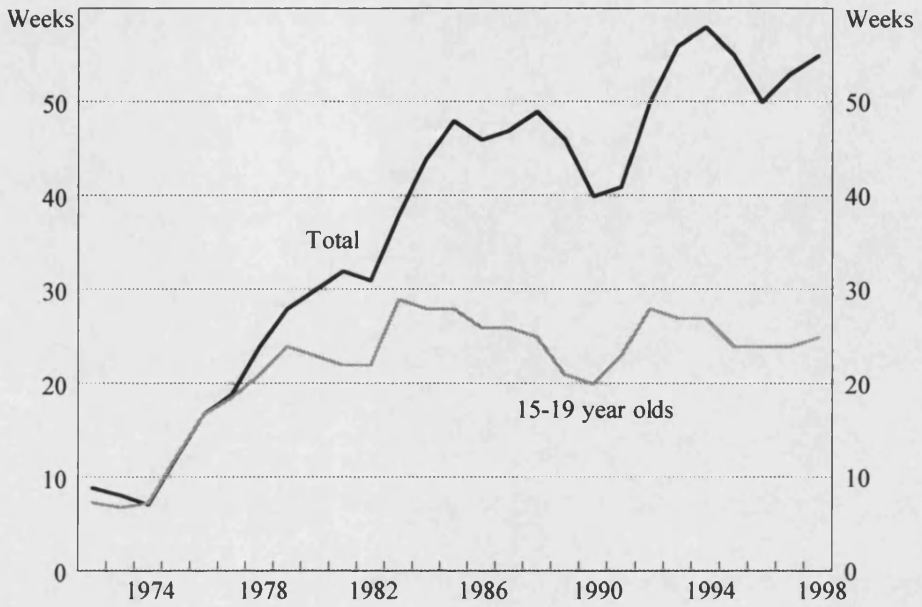
duration of unemployment for teenagers, which followed a similar path to aggregate average duration over this period (Figure 4). The duration of unemployment for teenagers will be capped by the length of time a teenager can be in unemployment before being reclassified into an older age group. This is likely to explain some of the levelling out of the average duration of teenage unemployment since the 1980s.

Figure 3: Unemployment Rates By Age



Source: ABS Cat. No. 6203.0 and ABS Cat. No. 6204.0

Figure 4: Average Duration Of Unemployment By Age



Source: ABS Cat. No. 6202.0 and ABS Cat. No. 6203.0

Although the teenage participation rate has fallen substantially, due to increased participation in full-time education (Figure 5), this has not offset falls in the full-time teenage employment-to-population ratio (Figure 6). In 1998, almost half of teenage unemployment could be attributed to teenagers who were not enrolled in full-time education and were looking for full-time employment.[1] This figure does not include a significant degree of underemployment, as roughly two-thirds of teenagers who work part time, and are not enrolled in full-time education, would prefer to work more hours.

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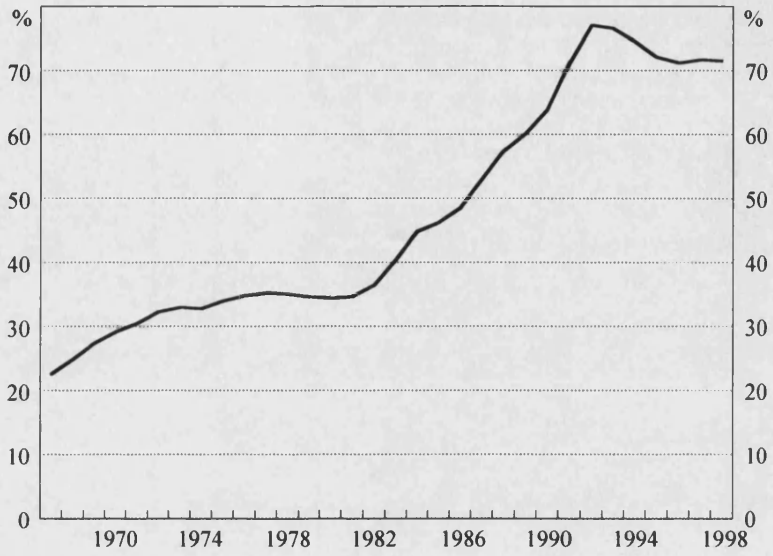
[1] See ABS Cat. No. 6203.0, *The Labour Force, Australia*, September 1998.

Figure 5: Total Year 12 Apparent Retention Rates[2]



Source: ABS Cat. No. 4221.0 and *Retention and Participation in Australian Schools*, DEET (1993)

The decline in the full-time employment-to-population ratio for teenagers has been offset to some extent by an increase in the part-time employment-to-population ratio. The part-time labour market is dominated by teenagers whose main activity is full-time education: by 1998, around 80 per cent of teenage part-time jobs were held by teenagers whose main activity was education. Teenagers in full-time education have been well placed to meet the increased demand for part-time labour, especially in relatively low-skilled service sectors such as retail trade. Around 90 per cent of unemployed teenagers looking for part-time work were in full-time education. Foster and Gregory (1982) show that even in 1979-80, flows between employment and outside-the-labour-force were dominated by part-time employment flows.

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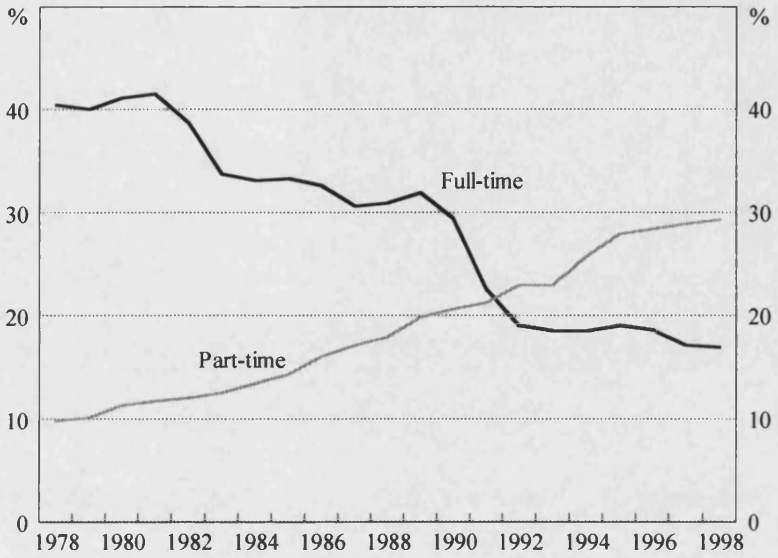
[2] Apparent retention rates are calculated as the number of students completing Year 12 (the final year of secondary school in Australia) in the given year divided by the size of the cohort that entered secondary school six years earlier, adjusted for factors such as interstate and overseas migration and grade repetition.

Figure 6: Employment To Population Ratios For 15-19 Year-Olds



Source: ABS Cat. No. 6203.0

The decline in the likelihood of finding full-time employment after leaving full-time education has probably been an important factor behind the marked increase in the number of teenagers attending full-time education, especially the number completing Year 12, the final year of high school. Estimates of what factors affect the teenage participation decision using time series data find evidence of a strong negative correlation between the proportion of teenagers staying in full-time education and the full-time employment to population ratio (Larum and Beggs, 1989; Lewis and Koshy, 1998). Although the proportion of Australian teenagers completing high school has trended upwards, it has plateaued in the 1990s at a level below the average of other industrialised countries, suggesting that there is room for improvement (Table 1).[3]

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[3] Note that these data will be affected by legal minimum leaving ages and differences in the way education systems are organised.

Table 1: Full-Time Retention Rates In Secondary Education By Age, 1992

At age 16		At age 17		At age 18	
Greater than 90 per cent		*Greater than 80 per cent*		*Greater than 50 per cent*	
Netherlands	97.3	Belgium	93.6	Germany	82.3
Belgium	97.2	Germany	92.8	Finland	79.7
Canada	96.3	Netherlands	90.8	Norway	77.2
Germany	95.3	Japan	90.2	Switzerland	74.2
Japan	95.1	France	87.2	Denmark	68.9
Norway	92.8	Sweden	87.0	Netherlands	67.9
Denmark	92.4	Norway	86.6	Sweden	59.6
France	92.1	Finland	85.8	France	58.6
United States	91.4	Switzerland	82.0		
		Denmark	80.1		
80 to 90 per cent		*60 to 80 per cent*		*20 to 50 per cent*	
Sweden	89.2	Canada	72.0	Belgium	49.8
Greece	88.4	United States	72.0	Canada	36.9
New Zealand	87.8	Ireland	70.2	Spain	35.5
Ireland	87.5	Spain	66.9	Ireland	33.1
Switzerland	85.2	New Zealand	65.7	New Zealand	20.8
		Greece	62.1	United States	20.6
Less than 80 per cent		*Less than 60 per cent*		*Less than 20 per cent*	
Australia	78.7	Australia	58.8	Turkey	19.8
Spain	75.6	UK	55.3	Greece	19.4
UK	75.3	Turkey	33.9	UK	18.7
Turkey	39.3			Australia	14.2
				Japan	1.8

Source: Centre for Education Research and Innovation, and OECD (1995).

3 Thesis Summary

3.1 Part 1: Aspects of School Leaving Decisions

The natural question that arises when looking at data for the youth labour market is why teenagers decide not to complete high school when their labour market prospects are so poor? The role of personal characteristics, such as age and gender, and family background characteristics, such as parents' education, have been examined previously in the Australian and international literature and have been found to be important. This thesis extends the basic framework previously applied, to ask whether local environment or government financial assistance have also had an impact on the education decisions of teenagers in Australia.

Chapter 2 examines whether characteristics of the local environment, or *neighbourhood effects*, can help explain school-leaving behaviour over and above personal and family background characteristics. An effort is also made to distinguish between exogenous and endogenous neighbourhood effects. Exogenous neighbourhood effects arise when neighbourhood characteristics affect individual behaviour directly, for example, role model effects. Endogenous neighbourhood effects arise when the behaviour of an individual is influenced by the behaviour of other individuals in the neighbourhood making the same decision, for example, peer group effects. Endogenous neighbourhood effects can also be thought of as examples of strategic complementarities, which introduces the possibility of multiple equilibria and a potentially important role for policy.

The results presented in Chapter 2 suggest that both types of neighbourhood effects are present in a teenager's schooling decision. While it is not possible to identify the channels through which they operate, several possible explanations

are discussed, including the role of job information provided by a local network of friends and relatives and role model effects.

Chapter 3 examines whether government policy initiatives, designed to increase the proportion of teenagers completing high school, have had the desired effect. In 1987, the Australian government introduced a new means-tested income support scheme which increased the level and coverage of financial assistance available to teenagers in their final two years of high school. Previous work has found that the introduction of this scheme, known as AUSTUDY, increased the number of eligible teenagers staying on at school by between 3 and 4 percentage points (Dearden and Heath, 1996). This analysis, however, neglected to consider the effect of changes made to unemployment benefit arrangements which occurred simultaneously, and which were also designed to encourage teenagers to stay at school.

In Chapter 3, the effects of these simultaneous policy changes are examined in a model in which teenagers can be observed in one of three outcomes: school, employment or unemployment. The most tractable method of estimating multinomial outcome models is the multinomial logit model. The results of estimating this model suggest that introducing AUSTUDY and reducing the availability of unemployment benefits increased the probability of teenagers completing high school and decreased the probability of being unemployed, although the probability of being employed fell by more. For individuals who completed high school after 1987, eligibility for AUSTUDY is estimated to have increased the probability of completing high school by between 8 and 10 percentage points.

The multinomial logit model, however, does not allow free estimation of any variance-covariance parameters. To do this, it is necessary to estimate a less

restricted model such as the multinomial probit model. Without information about characteristics of the outcomes which were *not* chosen, for example, the wage an individual would have received had they been employed, identification of a multinomial probit model will be fragile, that is, vastly different estimates of the variance-covariance parameters are consistent with the same likelihood value (Keane, 1992). In the current context, outcome-specific data are not available. This results in difficulty identifying variance-covariance parameters, although the marginal effects of different variables on behaviour do not change significantly. Consequently, there is very little to be gained by freely estimating variance-covariance parameters in this case.

3.2 Part 2: Aspects of Job-Search Behaviour

Descriptive evidence from Australian and international data strongly suggest that some methods of job-search, notably using friends and relatives and directly approaching employers, are more successful than others at generating acceptable job offers. Despite this, roughly two-thirds of unemployed Australian teenagers report that their main method of job-search is one of the less successful methods such as newspapers or employment agencies. Chapter 4 examines the factors which affect the job-search method choice of unemployed Australian teenagers.

First, an economic model of job-search method choice is developed by extending the equilibrium search framework of Pissarides (1990). The model assumes that individuals have two methods of finding work. The effectiveness of the first method, labelled the *general search method*, in generating job offers depends on aggregate labour market conditions and the amount of effort put into search by the individual. The general search method captures job-search methods such as looking at newspapers and registering with employment agencies. The effectiveness of the second job method, labelled the *local search method*, is

assumed to depend on local labour market conditions alone and cannot be affected by increasing search effort. This captures the idea that networks of friends and relatives are local in nature and that the ability of these networks to generate job offers only depends on the proportion of the network who are employed.

This model demonstrates that individuals will search harder using the general search method as the local unemployment rate rises. General equilibrium results are also derived and are demonstrated by considering the effects of an increase in the efficiency of the local search method and of an increase in the flow of benefits to being unemployed in a single neighbourhood.

The second task of Chapter 4 is to estimate which factors affect the main job-search method choices reported by Australian teenagers. The results suggest that receiving unemployment benefits is the most important determinant of job-search behaviour, but that local labour market conditions, background characteristics and unemployment duration also have an effect. The results are also interesting because they provide a possible explanation for the observed increase in the concentration of unemployment in some Australian neighbourhoods noted earlier.

In Chapter 5, a model of unemployment duration is estimated in which the role of the reservation wage is explicitly considered. Although job-search theory places emphasis on the role of reservation wages in determining the duration of unemployment, most empirical work investigating the factors which affect unemployment duration has not explicitly included the reservation wage. Based on a structural job-search model developed by Lancaster (1985), the relationship between unemployment and reservation wages is estimated, taking into account

possible biases introduced if there are omitted variables and/or the reservation wage varies with the duration of unemployment.

The results suggest that reservation wages do not help to explain unemployment duration once other personal and background characteristics are controlled for. One possible explanation is that the minimum wage rather than the reservation wage is the binding constraint on individuals finding work. While a significant proportion of job-seekers report reservation wages below the minimum, this does not appear to explain the insignificance of the reservation wage in the estimated relationship. A more plausible explanation is that the number of job offers received (and rejected) by the unemployed in Australia is small, indicating that more unemployed people are concerned with receiving a job offer in the first place rather than whether a given wage-offer is acceptable.

CHAPTER 2

THE INFLUENCE OF NEIGHBOURHOOD EFFECTS ON EDUCATION DECISIONS

1 Introduction

Traditionally, an individual's education decisions have been treated as a function of personal characteristics, the family environment and macroeconomic conditions. Recently, however, there has been an increase in the number of empirical studies analysing how the immediate environment affects behaviour above and beyond the effects of family background and macroeconomic conditions. The recent expansion in the empirical literature that looks at whether such neighbourhood effects exist has, in part, been driven by the availability of data allowing individuals to be located in relatively small geographic areas which can be thought of as neighbourhoods. Most of these data sources provide information about the experience of individuals living in inner city areas and the suburbs of major US cities. Comparable data from outside the US are not readily available.[4]

We use Australian data to examine the earliest education decision available to Australian teenagers: whether or not to complete high school. We combine unit record data from the Australian Youth Survey (AYS) with data on average neighbourhood characteristics from the 1991 Australian Census to create a data set of individuals, with information on their personal characteristics, family background and their immediate environment. Although the results are

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[4] One notable exception is Robertson and Symons (1996) who concentrate on peer group effects, using UK data.

interesting in their own right, they also have interesting implications for the existence of neighbourhood effects in a much wider context. One of the main problems facing the examination of neighbourhood effects using US data is that the locally funded nature of the US education system makes it difficult to distinguish between true neighbourhood effects and differential inputs into the schooling system. The distribution of funding across Australian secondary schools is relatively equitable, making it a useful comparison.

Why should policy makers be interested in neighbourhood effects? If neighbourhood effects exist, the ability of families to move to different neighbourhoods, combined with barriers to such migration, eg housing prices, may benefit high income families, but not as much as they hurt low income families. Policy makers may need to intervene to ensure that positive externalities arising from the presence of neighbourhood effects are internalised. The subsequent increase in efficiency could increase welfare for all. In addition, equity considerations suggest that, "A system that allows the accidents of geography and birth to determine the quality of education received by an individual is inimical to the idea of equal opportunity in the market place".[5] The policy response will depend on the mechanisms through which neighbourhood characteristics influence education outcomes, as well as the strength of these neighbourhood effects.

The structure of this chapter is as follows. Section 2 discusses the existing empirical evidence about the factors that affect whether Australian teenagers decide to complete high school or not. Section 3 surveys the theoretical and empirical literature regarding the existence of neighbourhood effects, and the

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[5] Fernandez and Rogerson (1996) p. 136.

mechanisms through which they may operate. Section 4 provides information about the data in the Australian Youth Survey and its links to the 1991 Australian Census data, which are used in the subsequent analysis. Other practical considerations such as what defines a neighbourhood and which data are most appropriate for analysing the question at hand are also highlighted. Section 5 explores the existence and form of neighbourhood effects on the decision of Australian teenagers to leave school early. The results suggest that there are both significant exogenous and endogenous social effects influencing Australian teenagers' education decisions. Policy considerations and conclusions are drawn in Section 6.

2 Education Decisions of Australian Teenagers

The proportion of Australian teenagers completing high school has been steadily increasing through the 1970s and 1980s and has levelled off at a little over 70 per cent in the 1990s (Figure 5). Two approaches have been taken to understand the factors that influence the decision to complete high school or not. The first explains the aggregate retention rate as a function of other macroeconomic time series such as teenage unemployment rates. Larum and Beggs (1989) and Lewis and Koshy (1998) find that the aggregate Australian retention rate and the teenage full-time employment to population ratio are significantly negatively correlated, which is no surprise given that these two series are dominated by strong trends. Larum and Beggs (1989) also find a significantly positive relationship between the retention rate and the average government assistance paid to full-time high school students, although they suggest that this is driven by the increase in coverage, rather than increases in the level of payment to each individual.

In general, aggregate studies of this nature are unsatisfactory, as they cannot account for changes in sociological factors that have been shown to be important by analyses using individual level data. However, studies which include detailed information about family background and personal characteristics, are less able to capture the effects of changes in macro-economic conditions on participation decisions.

One of the most comprehensive examinations of teenage education decisions with Australian data is the analysis of Miller and Volker (1987, 1989) who use information about teenagers interviewed in the first wave of the Australian Longitudinal Survey (ALS) in 1985. They estimate a set of sequential binary logit equations for successive school continuation decisions, starting with the decision of whether or not to complete Year 10, usually the first year of school when a teenager could achieve the minimum school leaving age of 15 years. The final education decision in the sequence is the decision of whether or not to undertake tertiary education, given that the individual has already chosen to complete Year 12, the final year of high school. The unconditional probability of being observed at a given stage of education can be calculated as the product of the probabilities of choosing to continue at each of the earlier stages.

Miller and Volker consider an extensive array of explanatory variables. They control for macro-economic effects such as the state of residence and the teenage unemployment rates prevailing at the time the education decisions were made; socioeconomic background variables, which mainly includes parents' characteristics; and personal characteristics such as gender, the ability to speak English and the type of school attended. On balance they find that personal and family background characteristics are more important than macro-economic variables such as the teenage unemployment rate.

The results regarding the importance of family background obtained by Miller and Volker are consistent with earlier work, for example Rosier (1978). Teenagers with parents who have a university degree and/or higher occupational status are significantly more likely to complete high school than other teenagers. Both the educational attainment and occupational status of parents are likely to be a proxy for parents' income, which is not reliably available in the ALS. They may also reflect parental attitudes to education (Williams *et al.*, 1981).

Miller and Volker's results suggest that teenagers whose father was born in an English speaking country are less likely to complete high school than Australians who are at least second generation. Teenagers whose father was born either in a Mediterranean or South East Asian country are significantly more likely to complete high school. Teenagers from larger families are less likely to complete high school. The most probable explanation for this result is that larger families are less financially capable of supporting a working-age teenager in full-time education.

Miller and Volker also find that the personal characteristics of teenagers affect their education decisions, although these characteristics are also likely to reflect choices made by a teenager's parents on their behalf to some extent. Teenagers attending Catholic schools are 20 percentage points more likely to complete Year 12 than teenagers at government schools. The difference for teenagers attending other non-government schools is 38 percentage points. Teenagers whose first language is not English and report that their ability to speak English is poor are less likely to complete Year 10, but if they do choose to continue, this factor does not appear to affect future decisions.

Teenage education decisions are also found to be affected by factors outside the immediate family. It is especially important to control for the state and the

section of state of residence.[6] Variation across states can arise because education policy, for example school curriculae, are set at the state level, even though funding is allocated at the Federal level. There are also important differences in the patterns of labour demand across states and in different sections of states depending on whether they are urban or rural.

Miller and Volker's results show that state effects are important, and that they are consistent with aggregate differences in high school retention rates across states. The probability of completing high school in Queensland and the ACT is significantly higher, whilst the probability in Tasmania and the Northern Territory is significantly lower. Year 10 appears to be a more important decision point in NSW than other states as the conditional probability of completing Year 12, given that the decision to go on to Year 11 has been made, is much higher than for other states, although the unconditional probability of completing Year 12 is similar. Teenagers who spent most of their childhood in rural areas are around 10 percentage points less likely to complete high school than their city dwelling counterparts.

Finally, Miller and Volker consider the incentive effects of high teenage unemployment rates, measured at the time each decision was made. Aggregate teenage unemployment rates appear to have some effect on early education decisions but do not seem to be important at later stages.

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[6] Section of state is categorised as either capital city, other city, country town or rural area.

3 The Role of Neighbourhood Effects

Neighbourhood effects will exist when there are localised externalities present, that is the payoff to different decisions is affected by the behaviour and characteristics of the other people in the neighbourhood. The effects of such externalities on income distribution and other outcomes experienced by individuals has been examined extensively and this literature is analogous to the macroeconomic spillover literature (Durlauf; 1994, 1996a, 1996b).

A number of papers have gone beyond explaining what effect externalities have on outcomes and attempt to explain how these externalities arise. Struefert (1991) presents a theory of role models to explain why teenage education-decision making may be affected by neighbourhood composition. He assumes that children infer the returns to effort at school by examining the outcomes of adults in their neighbourhood, and base their education decisions on this information. Thus, the distribution of education across neighbourhoods can influence the education decisions of future generations.

Another model which may provide an insight into why there are externalities at the neighbourhood level is the social networks model of Montgomery (1991). This model assumes that the unemployed have different productivity levels, but that, without further information, they are observationally equivalent to potential employers. By introducing a social structure in which workers with similar productivity levels are more likely to associate with each other, it becomes possible for employers to increase the probability of hiring a high productivity worker by employing people recommended by current high productivity workers. By increasing information flows, social networks relieve adverse selection problems and increase efficiency. To the extent that social networks are localised, it is possible that some neighbourhoods will provide their job-seeking

residents with better job-information networks than others. For example, high unemployment areas are likely to have less active job-information networks which will decrease the probability of receiving job-offers and may decrease the incentives to leave school early.

These two models help explain how the composition of the neighbourhood may affect an individual's decisions. These spillovers can be described as exogenous neighbourhood effects. We are also interested in considering endogenous neighbourhood effects, where the propensity to leave school early is an increasing function of other teenagers' propensities to leave school early. One example of an economic model which uses this idea is Banerjee and Besley (1991) who model the importance of peer effects on education achievement. These endogenous effects are also implicit in the ethnographic evidence described in Akerlof (1997), which suggests that an individual's payoff to completing school can be severely diminished if peers do not also complete school. In the terminology of Cooper and John (1988) we are interested in the existence of strategic complementarities. The presence of endogenous neighbourhood effects raises the possibility of multiple equilibria across otherwise identical neighbourhoods and has interesting policy implications.

A rapidly growing literature has found empirical support for the existence of neighbourhood effects. Jencks and Mayer (1990) provide a detailed survey of the early literature. One of the best sources of data for looking at the influence of the neighbourhoods on education outcomes is the 1968 sample of the University of Michigan Panel Study of Income Dynamics (PSID) combined with the 1970 Census Fifth Count for Zip Codes. This provides a sample of young male heads of household who were 23 to 32 years-old in 1978 and who were living with at least one of their parents in one of 188 Standard Metropolitan Statistical Areas in

1968. The neighbourhood data consist of a number of socioeconomic indicators recorded by five digit zip code.

Two representative papers exploiting these data are Datcher (1982) and Corcoran, Gordon, Laren and Solon (1991). Both find strong intergenerational links between father's 1968 income and son's subsequent economic status. However, neither report a strong impact of neighbourhood variables on son's income over and above family background effects. Corcoran *et al.* (1991) conclude that a likely reason for these problems is the presence of measurement error and omitted variable bias.

Another interesting empirical paper, which finds evidence of neighbourhood effects, is Crane (1991). He proposes that the extremely bad outcomes observed in inner city areas of major US cities can be explained by epidemic or contagion effects which are triggered after some critical level of social problems is reached. After this point, outcomes in these neighbourhoods deteriorate rapidly as susceptibility to these problems increases. He tests this hypothesis by estimating a piecewise linear logit model using the Census Bureau's 1970 Public Use Microdata Samples where the observations are ranked by the proportion of the neighbourhood with professional or managerial jobs. His hypothesis is supported, as he finds significant differences in the estimated coefficients on the proportion of the neighbourhood with professional or managerial jobs, and the probability of dropping out of school is much higher than background characteristics suggest for teenagers in the lowest 5 per cent of the neighbourhood distribution defined in this way.

Case and Katz (1991) explicitly allow for the possibility of strategic interaction between agents in their analysis of the influence of neighbourhoods on the outcome of youths in low income neighbourhoods in inner city Boston. They

look at the influence of peer behaviour and the characteristics of older members of the neighbourhood on several outcome variables including teen pregnancy, drug abuse, church attendance, involvement in crime and drop out rates. After allowing for the endogeneity of their neighbourhood aggregates, as they are constructed from sample data, they find that there are significant neighbourhood effects, even after a large array of family background characteristics are taken into account. Interestingly, Case and Katz find that child behaviour is strongly influenced by similar behaviour of the neighbourhood adult population. High rates of neighbourhood crime bias children towards criminality, high neighbourhood church attendance biases children in other, more saintly, directions.

4 The AYS and Australian Neighbourhoods

The analysis in Section 5 of this chapter uses data from the AYS which covers the period from 1989 to 1994. The first wave, sampled in 1989, consists of 5,350 sixteen to nineteen year-olds. In each subsequent year, roughly 1,500 sixteen year-olds are interviewed for the first time, and all other panel members are re-interviewed where possible. Our sample includes teenagers who were in the final year of high school, or were in the same cohort but left school at an earlier stage. In this sample, the probability of leaving school early is 30 percent, which is consistent with aggregate retention rates over this period. Table 2 decomposes this sample by age and year.

Table 2: Summary Of Sample By Age And Year

Year\Age	16 years	17 years	18 years	Total
1989	121	563	–	684
1990	75	574	226	875
1991	60	557	199	816
1992	88	447	232	768
1993	61	429	165	655
1994	54	434	157	645

Extensive individual and family background information is collected in the AYS, including details of educational outcomes and labour market experience for both the respondent and the members of their household. Summary statistics for the sample of individuals who are still in school and for those who have left school are provided in Table 3. A more detailed description of the data is provided in Appendix A.

In general, males are less likely to complete school than females, as are teenagers who attend government schools. These differences are consistent with aggregate retention rate statistics. Teenagers who have left school have more siblings on average, which may reflect the increased financial constraints faced by families with more children. Teenagers who were born overseas, on the other hand, are more likely to complete school. Teenagers who were living with both parents when they were 14 are more likely to complete school than teenagers living with only one parent.

Table 3: Summary Statistics By Education Decision

Averages by group, standard errors in parentheses where appropriate

	In School	Left School
Personal background		
Male	0.46	0.58
Age	17.08 (0.55)	17.20 (0.57)
Number of siblings	1.96 (1.45)	2.17 (1.60)
Foreign born	0.13 (0.34)	0.08 (0.27)
English not first language		
English good	0.11 (0.31)	0.08 (0.27)
English poor	0.01 (0.11)	0.01 (0.08)
School		
Catholic	0.26 (0.44)	0.15 (0.36)
Other non-government	0.11 (0.32)	0.05 (0.21)
Parents' characteristics		
Father's occupational status @14	32.04 (24.22)	24.28 (21.79)
Mother's occupational status @14	20.89 (21.59)	16.42 (19.79)
Father not employed @14	0.05	0.06
Mother not employed @14	0.35	0.40
Father not present @14	0.12	0.24
Mother not present @14	0.02	0.13
Father has:		
Degree	0.20	0.09
Trade qualifications	0.17	0.18
Other post-secondary	0.11	0.09
Mother has:		
Degree	0.15	0.07
Trade qualifications	0.04	0.05
Other post-secondary	0.16	0.13

continued next page

Table 3: Summary Statistics By Education Decision *(continued)*		
	In School	**Left School**
Section of state		
Other capital city	0.17	0.18
Rural area	0.03	0.03
Country town	0.07	0.10
State		
Victoria	0.24	0.26
South Australia	0.10	0.10
Western Australia	0.11	0.11
Queensland	0.18	0.13
Tasmania	0.02	0.02
ACT	0.04	0.03
Neighbourhood		
Average personal income	5654.37 (1069.49)	5477.36 (931.20)
Proportion with graduate qualifications	0.14 (0.08)	0.12 (0.07)
Proportion with trade qualifications	0.14 (0.03)	0.14 (0.03)
Unemployment rate	0.11 (0.05)	0.12 (0.05)

Note: @14 indicates that the variable is the parent's characteristic when the respondent was 14 years-old

Unfortunately, parents' income is not well measured in the AYS. Child reported income figures are available, but the response rate is relatively low and the quality of the data is questionable. There is, however, detailed information about the occupational status of parents and their education levels, both of which are likely to be good proxies for income, especially permanent income. These variables are also likely to provide information about the parents' attitudes to education. Teenagers are more likely to complete high school if their parents have graduate qualifications and are employed in jobs with higher occupational status, which is measured as an index ranging from 0 to 100.

Most importantly for our purposes, the AYS provides detailed geographic information. As well as providing information about which state the respondent lives in and the section of state the respondent mainly lived in before they were 14 years old, the AYS allows individuals to be located by their geographic neighbourhood in most years. In 1989 and 1990 the information is recorded by 1986-defined collection districts (CD), which are small neighbourhoods containing, on average, 465 individuals. The postcode where the interview took place is available for re-interviewees in 1991 and for all people interviewed from 1992 to 1994. Postcodes are larger than CDs, but there is a mapping from 1986-defined CDs to 1991-defined postcodes.

The average postcode has 5,558 residents over the age of 15 years. The largest postcode has a population of 62,885; the smallest has less than a hundred residents. The distribution is highly skewed with 90 percent of postcodes having fewer than 15,131 residents. We have information on a range of neighbourhood characteristics at the postcode level from the 1991 Australian Census. The most important neighbourhood characteristics to include are those which can be justified by economic theory.

The theory of social networks suggests that variables which capture labour market status and the types of employment of neighbourhood residents would be important. Theories of role model effects would suggest that the most important variables for inclusion are those which capture the educational attainment and the subsequent earnings of neighbourhood residents. Based on these considerations, and taking into account the variables used to capture neighbourhood effects in earlier studies, the neighbourhood characteristics we have included are: the average level of personal income, the proportion of the neighbourhood with graduate and vocational qualifications, and the neighbourhood unemployment rate.

Neighbourhood characteristics differ across the two groups in ways which are consistent with differences in average family background characteristics: teenagers who come from neighbourhoods with higher average personal income or with a higher proportion of adults with graduate qualifications are more likely to complete high school.

The following analysis is restricted to major urban areas for two reasons.[7] The first is that the ABS introduces sampling error into small postcodes to ensure confidentiality. By excluding non-major urban areas, most postcodes which are affected by this will be excluded. The second reason is that the concept of the neighbourhood underlying the economic models above is related to physical proximity. Consequently, low density population areas, such as rural areas, do not conform easily to the concepts underlying our analysis.

The childhood postcode is defined as the postcode where the individual was interviewed when they were 16 years-old, as this is the earliest recorded neighbourhood information. The postcode information for 16 year-olds is missing in 1991, and these individuals are allocated their 17 year-old postcode from the subsequent interview. This is also done for the 17 year-olds in 1989 to increase the available sample.

Childhood postcodes are only defined if the children are living with one or both of their parents. This is standard practice in the literature, but may cause biases if the decision to move out from the family home is a function of the endogenous variable. For example, if children who leave school at 16 years-old are also more likely to move out then we under sample this group of children. It should be noted here, that respondents who reported that they had spent most of their life

until they were 14 years-old overseas or were married are also excluded from the analysis. This does not significantly affect any of the formal analysis.

5 An Empirical Model and Results

The purpose of our analysis is to estimate the effects of neighbourhood characteristics on education decisions. In particular, we look at whether or not Australian teenagers decide to complete high school. In Section 5.1 we develop the empirical model within the framework presented by Manski (1993, 1995) to formalise the different mechanisms through which neighbourhood effects could operate. In Section 5.2 we present the results of estimating this model ignoring neighbourhood effects. In Sections 5.3 and 5.4 we add neighbourhood variables and discuss their contribution to our understanding of teenage education decisions. In Section 5.5 we discuss potential objections to our interpretation that these results demonstrate the existence of neighbourhood effects.

5.1 A Common Framework

The model we estimate was originally discussed by Manski (1993, 1995) and can be summarised as follows:

$$y_i^* = \alpha + z_i'\beta + E(z \mid x_i)'\gamma + \delta E(y^* \mid x_i) + \varepsilon_i \qquad (1)$$

where:

- y_i^* is the underlying propensity to leave school before the final year of high school for individual *i*;

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[7] Major urban areas are defined as cities with greater than 100,000 in population.

- z_i are the personal and family background characteristics of individual *i*;

- x_i is the post code level neighbourhood of individual *i*;

- $E(z \mid x_i)$ are the average characteristics of the individuals in neighbourhood x_i;

- $E(y^* \mid x_i)$ is the probability of being an early school leaver in neighbourhood x_i; and

- ε_i is the error term which contains all the unobserved factors which affect individual *i*'s propensity to leave school before the final year.

In the context of the discussion above, $E(z \mid x_i)$ captures the exogenous neighbourhood effects, and $E(y^* \mid x_i)$ captures endogenous neighbourhood effects.

5.2 Individual Effects

We start our analysis by estimating the model assuming that neighbourhood effects are not important, that is assuming that $\gamma = \delta = 0$ in Equation 1. As discussed earlier, this specification has been considered in earlier literature and has been quite successful in explaining teenage education decisions (Miller and Volker, 1987). Because we do not observe the propensity to leave school early but the final decision, which is a binary variable, we estimate a probit model. The results are presented in Table 4.

Table 4: Estimation Results – Individual Effects

Number Of Observations: 4,401

	∂Pr/∂x	T-stat
Personal Background		
Male*	0.080	5.59
Age	0.093	6.48
Number of siblings	0.009	1.77
English not first language		
English good*	-0.080	-3.12
English poor*	-0.137	-2.09
Born overseas*	-0.077	-3.15
School		
Catholic*	-0.125	-7.32
Other non-government*	-0.170	-7.10
Parents' Characteristics		
Father's occupational status @14	-0.002	-3.51
Mother's occupational status @14	0.000	-0.26
Father not employed @14*	-0.017	-0.50
Mother not employed @14*	0.004	0.20
Father not present @14*	0.059	2.26
Mother not present @14*	0.443	10.84
Father has:		
Degree*	-0.055	-2.17
Trade qualifications*	0.020	0.95
Other post-secondary*	-0.039	-1.55
Mother has:		
Degree*	-0.091	-3.56
Trade qualifications*	0.019	0.52
Other post-secondary*	-0.025	-1.19

continued next page

Table 4: Estimation Results – Individual Effects *(continued)*

Number Of Observations: 4,401

	∂Pr/∂x	T-stat
Section of State		
Other capital city*	0.014	0.70
Rural area*	0.045	1.03
Country town*	0.026	0.99
State		
Victoria*	-0.025	-1.33
South Australia*	-0.048	-1.90
Western Australia*	-0.008	-0.32
Queensland*	-0.072	-3.35
Tasmania*	0.005	0.09
ACT*	-0.119	-3.32
Log Likelihood	-2256.8	
Pseudo R2	0.159	
Test overall significance	854.28	$\sim\chi^2(34)$

Note: Time dummies have been included, but have not been reported;
Dummy variables are denoted by an asterisk.

Because the probit model is non-linear, the estimated coefficients will provide information about the direction of the effect an independent variable has on the probability of leaving school early, but the magnitude of the effect depends on where the probability is evaluated. One way of presenting the estimates so that they are comparable is in marginal effects form. The marginal effect can be interpreted as the impact a one unit change in the explanatory variable will have on the probability of leaving school early, given that the probability is initially evaluated at the sample means. For dummy variables, marked with an asterisk, the reported marginal effect will be the change in the probability of being an early school leaver if the individual has that characteristic rather than the reference characteristic given by the omitted group. The results in Table 4 are expressed in marginal effects form.

Note that most of the variables have the expected effect. Males are 8 percentage points more likely to leave school early than females, and older cohort members are more likely to leave school early than younger ones, perhaps reflecting the effects of repeating earlier school years. Teenagers with more brothers and sisters are more likely to leave school early and this may reflect financial constraints.

Teenagers for whom English is not their first language are significantly more likely to complete high school, as are teenagers who were born overseas. These effects are independently significant. Consequently, teenagers who were born overseas and did not learn English as their first language are 15.7 percentage points more likely to complete high school if they judge themselves to speak English well, and are 21.4 percentage points more likely to stay on if they were born overseas and have poor English skills. This may reflect different attitudes to education, but may also reflect the relatively poor prospects these teenagers may face in the youth labour market. Teenagers who attend a government school are 12.5 percentage points more likely to leave school early than their counterparts attending a Catholic school and are 17 percentage points more likely to leave than teenagers at other non-government schools.

Parents' characteristics are also important for explaining the decision to leave school early. Teenagers with fathers who have higher status jobs are less likely to leave high school early. Teenagers from single parent families are significantly less likely to complete high school. Parents with degree qualifications are much more likely to have children who complete high school: degree qualified fathers and mothers decrease the chances of leaving by 5.5 and 9.1 percentage points respectively.

There is some indication that location has an influence on teenage decision making, as the section of state and state variables are jointly significant. If, however, the neighbourhood has some influence on a teenager's school leaving decision, this will not be captured fully by the variables we have included and will instead enter the error term. To see whether these errors vary systematically across neighbourhoods, we plot the actual and predicted probabilities of leaving school early against the proportion of the neighbourhood with graduate qualifications. Because individuals from neighbourhoods where there is a high proportion of adults with graduate qualifications are also more likely to come from families with graduate qualified parents, the actual and predicted probabilities of leaving school early will have a negative relationship with the proportion of adults in the neighbourhood with graduate qualifications. However, we are interested in whether the difference between these two probabilities varies systematically across neighbourhoods ranked by this variable.

For this heuristic measure of spatial correlation to be useful, it is necessary to smooth out the individual specific factors using the outcomes of individuals who should have similar behaviour. This is particularly important for obtaining an underlying actual probability of leaving school early for each individual, as only the actual decision is observed. The non-parametric smoothing procedure we use is *loess* (Cleveland, 1993).[8]

This procedure assumes that individuals can be ranked such that individuals who are closer in the ranking are also more similar in terms of the underlying behaviour of interest. We have ranked individuals by the proportion of the neighbourhood with graduate qualifications, as it corresponds well with our

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[8] We have used the *lowess* option in the STATA 5.0 command *ksm*.

intuition that teenagers from neighbourhoods with a high proportion of graduate qualified adults are also likely to have parents with graduate qualifications and are therefore likely to have similar school-leaving behaviour. The basic idea behind the *loess* smoothing procedure is to average the outcomes of a group of individuals, centred on each individual in turn, to obtain the expected outcome for the centre individual.

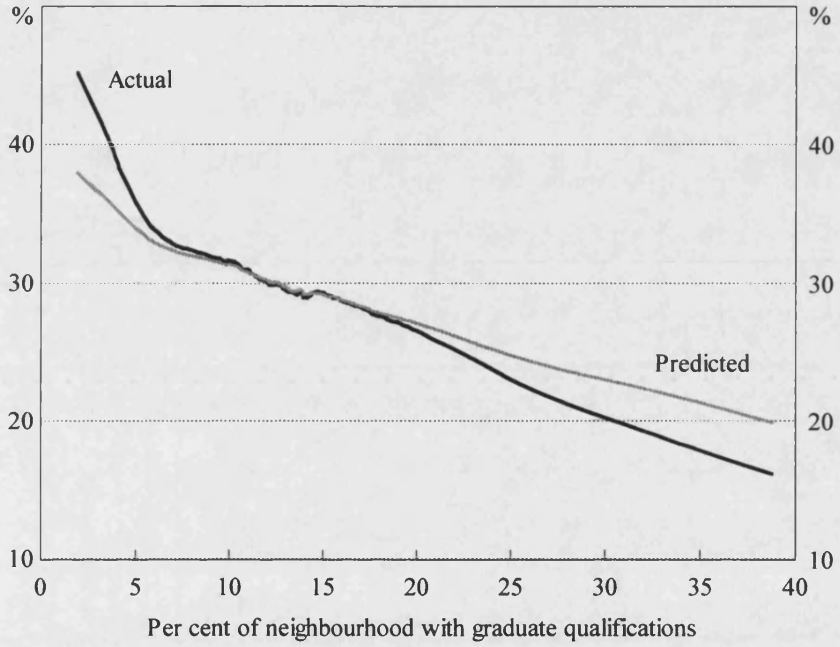
There are two ways in which the *loess* procedure smoothes out the individual specific factors using the outcomes on individuals who are 'close' in the ranking. The first is that a tricube weighting scheme is applied to 'close' individuals.[9] The tricube weighting function allocates the highest weight to the outcome of the individual in the centre of the chosen group, for whom the smoothed outcome is being calculated. The weights allocated to individuals on either side decline the further they are away in the ranking and are zero for individuals who are not defined to be 'close'. Smoother results are obtained when the number of individuals defined as 'close' increases or alternatively, the defined bandwidth is wider.

The second step of the *loess* procedure is to perform a weighted least squares regression of outcomes on the ranking variable for samples centred on each individual in turn. The final smoothed outcome will be the predicted value of the outcome variable for each centre individual. The actual smoothed probability of leaving school early for each individual will effectively be a weighted sample proportion. The smoothed actual and predicted probabilities of leaving school early are graphed against the proportion of the neighbourhood with graduate qualifications in Figure 7.

Figure 7 shows that a systematic difference between the smoothed actual and predicted probabilities of leaving school early does exist: the individual effects model is under-predicting the probability of being an early school leaver in less educated neighbourhoods and over-predicting this probability for more educated neighbourhoods.

Figure 7: Smoothed Probability Of Leaving School Early

Individual Effects Only



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9 For a full description of the tricube weighting function, see the Methods and Formulas section of the *ksm* command in the STATA reference manual.

5.3 Reduced Form

If we take expectations of Equation 1, conditional on the individual's neighbourhood we obtain $E(y^* \mid x_i)$ as a linear function of $E(z \mid x_i)$. Substituting this out we obtain Equation 2:

$$y_i^* = \frac{\alpha}{(1-\delta)} + z_i'\beta + \frac{E(z \mid x_i)'(\gamma - \delta\beta)}{(1-\delta)} + \varepsilon_i \qquad (2)$$

Given personal characteristics and family background variables, we can test for the presence of neighbourhood effects by testing the significance of average neighbourhood characteristics in a standard probit framework. We will not be able to identify the coefficients γ and δ, and therefore, we cannot distinguish between endogenous and exogenous neighbourhood effects in this reduced form specification. The results from estimating Equation 2 are presented in the first two columns of Table 5.

In general, the size and significance of the marginal effects of personal characteristics and family background variables do not change noticeably. The variables which are most affected by the presence of the neighbourhood variables are, not surprisingly, the section-of-state and state variables. The neighbourhood variables indicate that an individual is more likely to leave school early if the proportion of people in the neighbourhood with vocational qualifications is higher, and to a lesser extent, if the neighbourhood unemployment rate is higher.

Table 5: Estimation Results

Number Of Observations: 4,401

	Reduced form		Structural form	
	∂Pr/∂x	T-stat	∂Pr/∂x	T-stat
Neighbourhood				
Average personal income	0.000	0.39	0.000	-0.43
Proportion with graduate qualifications	0.001	0.31	0.015	2.28
proportion with trade qualifications	0.014	3.02	0.016	3.41
Unemployment rate	0.005	1.52	0.001	0.23
Endogenous effect	–	–	0.021	2.36
Personal Background				
Male*	0.081	5.65	0.080	5.60
Age	0.092	6.43	0.092	6.40
Number of siblings	0.009	1.85	0.008	1.73
English not first language				
English good*	-0.072	-2.76	-0.072	-2.75
English poor*	-0.129	-1.94	-0.126	-1.89
Born overseas*	-0.076	-3.12	-0.075	-3.08
School				
Catholic*	-0.120	-6.96	-0.119	-6.94
Other non-government*	-0.161	-6.48	-0.160	-6.46
Parents' Characteristics				
Father's occupational status @14	-0.002	-3.48	-0.002	-3.47
Mother's occupational status @14	0.000	-0.29	0.000	-0.27
Father not employed @14*	-0.016	-0.45	-0.012	-0.36
Mother not employed @14*	0.004	0.18	0.003	0.14
Father not present @14*	0.060	2.30	0.061	2.32
Mother not present @14*	0.445	10.82	0.444	10.79
Father has:				
Degree*	-0.052	-2.04	-0.052	-2.01
Trade qualifications*	0.016	0.79	0.017	0.84
Other post-secondary*	-0.045	-1.78	-0.046	-1.83
Mother has:				
Degree*	-0.083	-3.22	-0.087	-3.39
Trade qualifications*	0.017	0.49	0.018	0.49
Other post-secondary*	-0.025	-1.17	-0.026	-1.22

Table 5: Estimation Results *(continued)*

Number Of Observations: 4,401

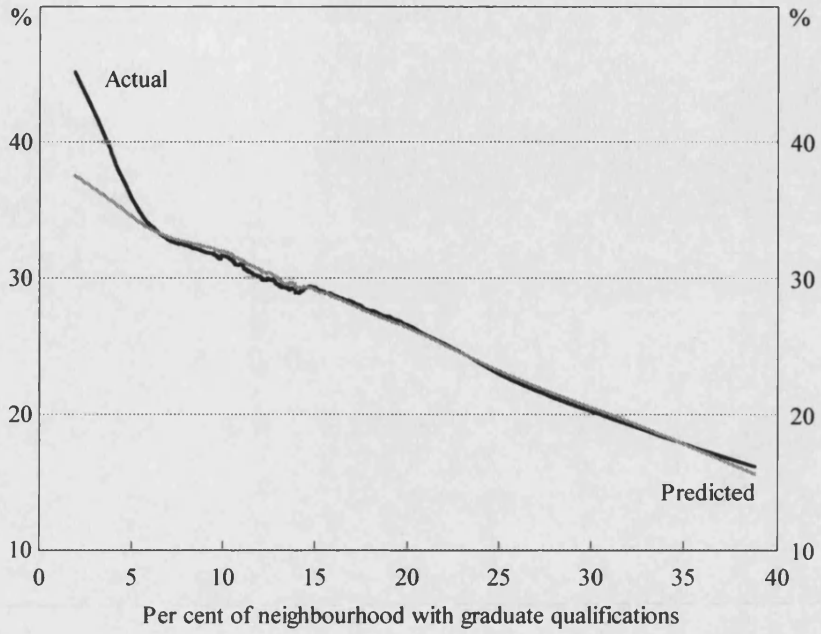
	Reduced form		Structural form	
	∂Pr/∂x	T-stat	∂Pr/∂x	T-stat
Section of State				
Other capital city*	-0.005	-0.22	-0.001	-0.07
Rural area*	0.025	0.57	0.028	0.63
Country town*	0.008	0.29	0.010	0.39
State				
Victoria	0.001	0.05	-0.004	-0.17
South Australia	-0.037	-1.32	-0.053	-1.86
Western Australia	-0.008	-0.29	-0.010	-0.33
Queensland	-0.045	-1.79	-0.048	-1.89
Tasmania	0.043	0.79	0.015	0.27
ACT	-0.087	-2.19	-0.095	-2.40
Log Likelihood	-2249.2		-2246.41	
Pseudo R2	0.162		0.163	
Test overall significance	869.44	$\sim\chi^2(38)$	874.99	$\sim\chi^2(39)$

Note: Time dummies have been included in estimation but are not reported;
Dummy variables are indicated by an asterisk.

Figure 8 compares the smoothed actual probability of leaving school early with the smoothed probability of leaving school early predicted by the reduced form estimation. Including neighbourhood effects has reduced the systematic error between the predicted and actual probabilities of leaving school early, although the reduced form model is still under-predicting the probability of leaving school early for the less educated neighbourhoods. Thus, there appears to be some support for the Crane hypothesis of epidemic effects in low status neighbourhoods.

Figure 8: Smoothed Probability Of Leaving School Early

Reduced Form



There are several possible explanations for the importance of the proportion of the neighbourhood with vocational qualifications. Our preferred explanation is that it captures the extent and usefulness of the job-information network available to a teenager contemplating leaving school early. To the extent that vocationally trained adults are aware of jobs which offer opportunities to early school leavers, teenagers with access to this network will have higher expected benefits of leaving school early than teenagers in neighbourhoods without a high proportion of vocationally trained adults.

Another related possibility is that the proportion of vocationally trained adults represents the level of local labour demand, and therefore the probability of an early school leaver securing a job. For this effect to be operating, it would be necessary to argue that the proportion of vocationally trained adults is a better proxy for the local demand for unskilled labour than the local unemployment rate. This is not an unreasonable hypothesis, however, the distinction between

these two channels cannot be resolved in the current setting, especially given the problems of multicollinearity which are likely to be present (see below).

The final possibility is that there is a role model effect, similar to the model presented by Struefert (1991). In this model the probability of leaving school early increases as the number of high earning, highly educated role models in the neighbourhood decreases. This model is based on the underlying assumption that the returns to completing high school and undertaking further education are higher than they are for leaving school before the completion of Year 12. This is true in Australia (Gregory and Vella, 1996). However, Dockery and Norris (1996) present evidence that suggests the returns to completing an apprenticeship are also high in Australia. If a teenager's information set includes a large number of adults receiving relatively high returns to their vocational training and if there are relatively few adults to demonstrate the returns to graduate education, this will naturally bias them towards leaving school early to find an apprenticeship. Roughly 40 per cent of early school leavers in the AYS give starting an apprenticeship as the main reason for leaving school.

5.4 Structural Form

In order to separately estimate exogenous and endogenous neighbourhood effects, it is necessary to ensure that these effects are identified in the empirical model and that the endogenous neighbourhood effect variable can be suitably measured. The formal identification of the two effects requires that some identifying assumptions about the parameters in Equation 1 are made. In particular, it is possible to separately identify all the underlying parameters if at least one exclusion restriction is imposed on the γ vector. The fact that the coefficient on the endogenous neighbourhood effect, δ, can be recovered if this restriction is imposed can be seen by considering Equation 2. The exclusion

restriction, combined with the estimate of β, allows δ to be recovered from the composite coefficient on the neighbourhood variable.

Technically, δ is over-identified in our empirical model, as there is more than one exclusion restriction implicit in our choice of included neighbourhood characteristics. In this case, δ can be estimated as long as a suitable measure of the endogenous neighbourhood effect can be found. If we had sufficient observations in each neighbourhood, we could estimate Equation 1 using sample estimates of $E(y^* \mid x_i)$. Due to the small number of observations per neighbourhood however, we must use information from individuals in 'similar' neighbourhoods to calculate a sample estimate, $\hat{E}(y^* \mid x_i)$. The *loess* smoothing technique discussed earlier can also be used for this purpose. Because $\hat{E}(y^* \mid x_i)$ is calculated from the sample, it is potentially correlated with the error for each individual in that neighbourhood.[10] This is a side effect of the very feedback structure that we are trying to capture.

We try to solve this problem by finding suitable instruments for $\hat{E}(y^* \mid x_i)$. A good instrument should be correlated with the average probability of early school leaving in the neighbourhood, but should not affect the individual's decision to leave school early. We choose the average number of siblings in the neighbourhood as an instrument, because it will be correlated with the average probability of peers leaving school early, but will not have an effect on the individual's decision beyond this. Again, the small number of individuals in

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[10] This is independent of the fact that we have smoothed over neighbourhoods, although smoothing lowers the correlation between the endogenous variable and the error term.

each neighbourhood requires that the *loess* technique be used to obtain a smoothed sample average of the number of siblings in the neighbourhood.

The results of estimating Equation 1, instrumenting $\hat{E}(y^* \mid x_i)$ with the smoothed average number of siblings are presented in the final two columns of Table 5. The estimated marginal effects of the variables capturing personal characteristics and family background do not change noticeably. The proportion of the neighbourhood with trade qualifications has remained positive and significant and the marginal effect is comparable to that estimated in the reduced form specification. The variable included to capture the endogenous effects, $\hat{E}(y^* \mid x_i)$ is positive and significant.

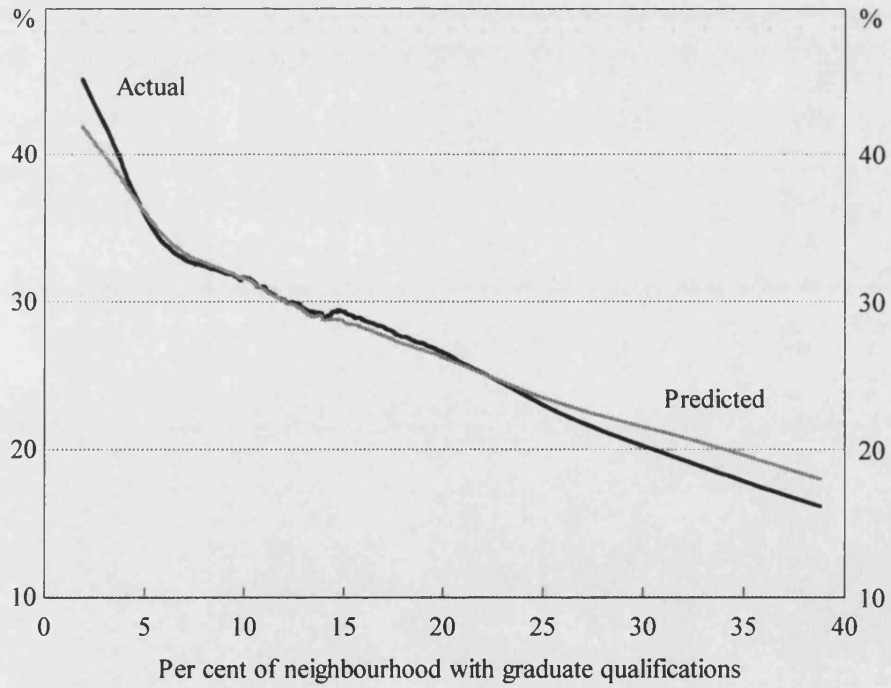
However, the estimated marginal effects and significance of the other neighbourhood composition variables change markedly. The local unemployment rate changes from being marginally significant to being insignificant and the marginal effect of the proportion of the neighbourhood with graduate qualifications, which had a perverse sign in the reduced form regression, has become larger and significant. To some extent this is expected if the reduced form parameters were capturing both neighbourhood effects.

When estimating the structural form, excluding the proportion of the neighbourhood with graduate qualifications and the local unemployment rate, the endogenous effect variable is estimated to have a marginal effect of 0.4 of a percentage point with a t-statistic of 1.23. The proportion of the neighbourhood with vocational qualifications has a marginal effect of 0.8 percentage points and remains significant. This confirms the intuition that the significance of the proportion of graduate qualifications in the neighbourhood is spurious, but also makes it difficult to assess the importance of endogenous neighbourhood effects.

Another way of checking whether endogenous effects matter, is to look at the difference between the smoothed actual probabilities of leaving school and the smoothed probabilities predicted from the structural form model. Figure 9 provides further support for the Crane hypothesis of epidemic effects in low status neighbourhoods because the inherently non-linear nature of the endogenous neighbourhood variable has improved the ability of the model to predict the probability of teenagers leaving school early in less educated neighbourhoods. Although this specification has reduced the difference between actual and predicted smoothed probabilities at the low end of the education distribution, these differences have increased slightly at the upper end of the distribution relative to the reduced form specification.

Figure 9: Smoothed Probability Of Leaving School Early

Structural Form



In summary, it appears that neighbourhood effects do influence a teenager's decision of whether or not to complete high school. Neighbourhood composition

affects this decision through the proportion of the neighbourhood with vocational qualifications. There is also some evidence for the presence of endogenous neighbourhood effects. Although multicollinearity problems make it difficult to separate the two effects, the structural form model appears to be better at explaining actual school leaving behaviour over the whole distribution of neighbourhoods than the reduced form model. It is also apparent that these neighbourhood effects are dominated by personal characteristics and the immediate family. Before concluding, however, we briefly consider possible objections to our interpretation of the results as demonstrating the existence of neighbourhood effects.

5.5 Have we Really Found Neighbourhood Effects?

One common objection to the empirical analysis of neighbourhood effects is that the neighbourhood composition variables may just be picking up omitted individual level variables such as parents' attitudes. We have two responses to this objection. The first is that omitted background variables are more likely to be correlated with the large number of included background variables than with neighbourhood variables.

The second response is that the mechanisms by which such effects are supposed to occur are difficult to specify. Our interpretation can only be affected by an omitted variable which is positively correlated with the proportion of the neighbourhood with vocational training, as a negatively correlated variable would induce negative bias which serves to strengthen our case. It is difficult to imagine an omitted individual level variable which increases the probability of a teenager leaving school early and is more highly correlated with the proportion of vocationally trained adults in the neighbourhood than with any individual level variables.

To the extent that the neighbourhood characteristics that have been included are correlated with excluded neighbourhood characteristics, the conclusion that neighbourhood effects are present is not affected. The presence of such a correlation, however, might affect the consistency of the results with the mechanisms through which neighbourhood characteristics might influence individual behaviour proposed in Section 5.3. However, as already mentioned, the analysis presented in this chapter can only ever establish the existence of neighbourhood effects. Further research is required to find evidence of specific mechanisms.

Another concern that has been expressed about interpreting the results in Table 5 as neighbourhood effects is the possibility of endogenous sorting. This will arise if there are omitted variables, such as school quality, which directly affect the probability of leaving school early, but also have an indirect effect through location decisions made by families on the basis of school quality, which change the composition of the neighbourhood. Thus, the omitted variable will be correlated with the neighbourhood composition variables which we have treated as exogenous. Again, we have two responses.

The first is that we would expect an omitted variable which causes families to sort to be more correlated with the endogenous neighbourhood effect (Evans, Oates and Schwab, 1992). We have instrumented for this variable, albeit for different reasons. Second, to the extent that the unobserved variable affecting the location decision of families is more highly correlated with the proportion of the neighbourhood with graduate qualifications than with the proportion of the neighbourhood with vocational training, we would expect the positive bias to be greater for this variable. This effect is not apparent in the results presented in Table 5.

6 Conclusion

This paper examines the factors which affect a teenager's decision to leave school early. In particular, we are interested in whether higher rates of early school leaving in some neighbourhoods is the result of families with characteristics which discourage school completion tending to live together, or whether the neighbourhood has an independent effect. We find that, although personal characteristics and family background variables explain much of the distribution of early school leaving behaviour across neighbourhoods, these variables are not enough.

We find evidence of exogenous neighbourhood effects. Specifically, we find that a larger proportion of vocationally trained adults in the neighbourhood increases the probability of a teenager leaving school early, even when the qualifications of each parent have been controlled for. We suggest that the most plausible explanation for the presence of this effect is that this variable is a proxy for the extent and usefulness of local job-information networks which may affect the balance of costs and benefits to these teenagers of staying on at school. We also find some evidence for the presence of endogenous neighbourhood effects which arise when the schooling decisions of other teenagers in the neighbourhood affect an individual's decision.

Distinguishing between endogenous and exogenous neighbourhood effects is interesting because the policy implications of these two types of effects are quite different. Theoretical results suggest that endogenous feedback mechanisms, such as endogenous neighbourhood effects, can lead to multiple equilibria even for initially identical neighbourhoods. One-off expenditures that reduce the rate of early school leaving may have long-run benefits if the endogenous feedback mechanism pushes the neighbourhood to a new equilibrium. In contrast, policies

that attempt to affect school decisions by changing neighbourhood composition may have to be ongoing if endogenous sorting in future periods pushes the equilibrium neighbourhood configuration back to its old equilibrium.

It is also important to bear in mind that while the analysis in this paper argues that neighbourhood effects influence teenage education decisions, we have only suggested possible mechanisms through which exogenous neighbourhood effects operate. Further research is necessary.

If the job-information network story is correct, direct search methods, such as using family and friends for information or approaching employers directly, should be more commonly used in neighbourhoods where the proportion of vocationally trained adults is higher. Chapter 4 of this thesis examines the factors which affect the job-search decisions of unemployed Australian teenagers, and finds that the local unemployment rate rather than the proportion of vocationally trained adults is important. While this does not directly support the job-information network explanation put forward above, it also does not provide evidence against it, to the extent that teenagers leaving school early move directly into jobs. Information about search methods is only available in the AYS for unemployed job-seekers. Another potentially fruitful direction for further research is to incorporate different types of education into the Struefert model to distinguish between vocational training and more academic post-school qualifications.

APPENDIX A: DATA FROM THE AYS AND 1991 AUSTRALIAN CENSUS

1 The Australian Youth Survey (AYS)

The AYS is used in Chapters 2 to 4 of this thesis. The original sample contained 5,350 16 to 19 year-olds in 1989. In each subsequent year, this sample was reinterviewed where possible, and a new cohort of 16 year-olds was added. The final wave of the survey was interviewed in 1994. Table 6 summarises the main activities of respondents of different ages.

Table 6: Main Activity By Age At The Time Of Interview, 1989-1994

Per Cent Of Total Age Group In Parenthesis

	Main Activity at the time of interview				
Age	School	Employed	Unemployed	Other Study	Other
16	6 705 (84.3)	812 (10.2)	303 (3.8)	60 (0.8)	78 (1.0)
17	4 644 (61.9)	1 894 (25.3)	598 (8.0)	206 (2.7)	155 (2.1)
18	1 253 (17.4)	3 915 (54.3)	1 058 (14.7)	747 (10.4)	233 (3.2)
19	144 (2.2)	4 348 (66.1)	1 057 (16.1)	777 (11.8)	253 (3.8)
20–24	23 (0.2)	9 788 (73.5)	1 745 (13.1)	1 047 (7.9)	705 (5.3)

At the first interview individuals are asked about a large list of background characteristics. These include personal characteristics such as gender, place of birth and information about the respondent's parents. Respondents are asked whether each of their parents were present in the household when they were 14. If a parent was present, further questions are asked about whether the parent was employed, the nature of their employment and their education level.

At the first interview, individuals are also asked about their current circumstances. At subsequent interviews information about current

circumstances is updated and questions about the time since the previous interview are also asked.

The following variables take the value one when the characteristic is present and zero otherwise:

- personal characteristics: male, married, born overseas;
- parent's characteristics: parent not present in the household when the respondent was 14, parent not employed when the respondent was 14 (given that they were present in the household);
- parent's education: has a degree, has a trade qualifications, has other post school qualifications (omitted category: parent has completed high school or less);
- section of state: other city, rural area, country town (omitted category: capital city);
- state: Victoria, South Australia, Western Australia, Queensland, Tasmania, ACT (omitted category: New South Wales; Northern Territory dropped due to too few observations); and
- school/work experience: left school in Year 10 or earlier, receives unemployment benefits or the Job Search Allowance (used in Chapter 4).

The following variables are discrete variables:

- age (in years), number of siblings;

- parent's occupational status is measured as the socioeconomic status of the respondent's parent when the respondent was 14. If the parent was not present in the household or was not employed the index is set to zero; and

- years since leaving school and current unemployment duration (in weeks) (used in Chapter 4).

The language proficiency variables are defined as:

- *English good* takes the value one if the respondent does not have English as a first language, but regards their proficiency as 'very good' or 'good'; and

- *English poor* takes the value one if the respondent does not have English as a first language and regards their proficiency as 'fair', 'poor' or 'very poor'.

The omitted category contains respondents who speak English as their first language.

The school variables are defined as:

- *Catholic* takes the value one if the respondent is currently studying at a Catholic high school, or whose last school before they left was a Catholic high school;

- *Other non-government* takes the value one if the respondent is currently studying at a non-government, non-Catholic high school, or whose last school before they left was an 'other non-government' school.

The omitted category contains respondents whose current or last school was a government high school.

The AYS provides detailed geographic information that allows individuals to be located by their geographic neighbourhood in most years. In 1989 and 1990 the information is recorded by 1986-defined collection districts (CD), which are small neighbourhoods containing, on average, 465 individuals. The postcode where the interview took place is available for re-interviewees in 1991 and all people interviewed from 1992 to 1994. Postcodes are larger than CDs, but there is a mapping from 1986-defined CDs to 1991 defined postcodes.

2 The Australian Census - 1991

Information about the neighbourhood where an individual lives can be obtained from the 1991 Australian Census. Information about the average characteristics of an individual's neighbourhood is used in Chapters 2 and 4.

The neighbourhood variables are defined as:

- *Average personal income* is the average personal income of the respondent's post code measured in 1976 Australian dollars[11];

- *Unemployment rate* is the unemployment rate of the respondent's post code;

- *Proportion with graduate qualifications* is the proportion of the respondent's post code who recorded having a higher degree, a degree, a graduate diploma, or an undergraduate diploma; and

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[11] To convert to 1991 Australian dollars, this number should be multiplied by 3.333.

- *Proportion with trade qualifications* is the proportion of the respondent's post code who recorded having skilled vocational training or basic vocational training.

The omitted education category is the proportion of the respondent's post code with high school education or less.

CHAPTER 3

FINANCIAL ASSISTANCE AND THE SCHOOL LEAVING DECISION

1 Introduction

In the 1986-87 Budget, the Australian government introduced a new student income support initiative to address the twin problems of rising youth unemployment and the low level of high school completion rates. The scheme, known as AUSTUDY, is essentially a means-tested income support scheme for full-time students in higher education and for secondary school students in the final two years of school. It replaced a number of earlier income support schemes for full-time students and was accompanied by changes to income support arrangements for unemployed teenagers. The policy changes resulted in a dramatic increase in the availability and amount of income support for full-time students, particularly those in the final two years of secondary school. At the same time, there was also a substantial reduction in the amount and availability of income support for unemployed teenagers.

This chapter uses data on individuals who were making school leaving decisions before and after the change in government policy to see whether the aim of increasing the number of teenagers choosing to stay at school through these initiatives was achieved. To do this, we develop an economic model to explain what factors will affect the probability of observing any given individual either in employment, in unemployment or at school.

Previous empirical work has estimated the effect of AUSTUDY within a 'natural experiment' framework, using the means-tested nature of AUSTUDY to identify a control group of individuals whose behaviour was not affected by its

introduction. This analysis finds that eligibility for AUSTUDY does increase the probability of an individual completing high school. However, it does not take into account the possibility that the control group was affected by simultaneous changes that were made to the administration of unemployment benefits.

In this chapter we consider the effects of the two policy changes, personal characteristics and family background on the observed outcomes of teenagers who were either in the final year of high school, or would have been if they had stayed on. Taking the incentive effects of changing the level and availability of unemployment benefits into account requires unemployment and employment to be considered as separate outcomes. The most appropriate framework for analysing this question, therefore, is the multinomial outcome framework.

The most straight-forward way of estimating a three outcome model is to use a multinomial logit specification. The results from this estimation confirm the importance of personal characteristics and family background in determining the outcomes of teenagers. Changes in policy also appear to have an important role in increasing the number of teenagers completing high school. Eligibility for unemployment benefits and AUSTUDY appears to increase the probability of teenagers completing school by between 8 and 10 percentage points. Interestingly, eligibility for unemployment benefits and AUSTUDY is estimated to decrease the probability that teenagers will be employed and slightly increases the probability that they will be unemployed. These results suggest that teenagers choosing not to complete school are taking a gamble on the labour market, and that when the disincentives to being unemployed increase, it is the teenagers who have a better chance of finding work who are choosing to complete high school.

While a multinomial logit model is straight forward to estimate, this comes at the expense of restrictive assumptions about the structure of the variance-covariance matrix. In order to allow free estimation of variance-covariance parameters, it is necessary to use an alternative specification such as the multinomial probit model. We find, however, that although the estimated multinomial probit model is formally identified, the identification of the variance-covariance parameters is fragile, that is, vastly different estimates of the variance-covariance parameters are consistent with the same likelihood value. The source of this problem is that when the explanatory variables only capture individual characteristics and no outcome specific characteristics, the coefficient estimates can change to accommodate different variance-covariance parameters (Keane, 1992). This makes the multinomial probit model an expensive method, in terms of time and effort, for very little practical reward, in empirical work where the data only have information about the individuals, and not the outcomes.

The rest of this chapter is set out as follows. Section 2 discusses the details of the changes to education and labour market policy that have occurred in Australia since the 1970s, and discusses the 'natural experiment' analysis of Dearden and Heath (1996). In Section 3 we develop a simple multinomial outcome model which explicitly models the changes to incentives which were intended to occur as a result of the policy change. The data are discussed in Section 4 and Section 5 presents the results of estimating multinomial outcome models. Section 5.1 focuses on the multinomial logit model and Section 5.2 discusses the multinomial probit model. Final conclusions are drawn in Section 6.

2 Teenage Labour Market And Education Policy

From 1974 until the mid-1980s, a major focus of Australia's education policy was to ensure equal access to tertiary education. This was signaled in 1974 when

fees for tertiary education were abolished. At the same time, means-tested income for full-time students was provided by the Tertiary Education Allowance Scheme (TEAS) and Secondary Allowance Scheme (SAS).

SAS was paid to parents and the real value of the maximum payment was very low. This did not vary greatly over the 12 years the scheme was in operation (Dearden and Heath, 1996). The number of secondary students receiving SAS was also quite low. In 1977, coverage was only 2 per cent of the relevant student cohort. The proportion of students receiving SAS remained below 5 per cent until 1983 and peaked at 15 per cent in 1986. TEAS was paid to eligible full-time higher-education students directly and was more generous than SAS, but the level of both allowances was substantially lower than the non-means-tested benefit paid to unemployed teenagers.

By the mid-1980s, it was apparent that there were several problems with the focus of education policy in general and with several institutional aspects of SAS in particular. Despite the abolition of tertiary education fees, there had not been a significant change in the demographic make-up of higher-education participants. Students from financially constrained and disadvantaged families continued to be the ones who did not complete secondary school and thus were precluded from benefiting from the provision of free tertiary education. In an extensive survey of low-income families, Braithewaite (1987) looked at the effectiveness of SAS. He found that the number of eligible families taking advantage of SAS payments was surprisingly low and that the relatively high level of unemployment benefits acted as a disincentive to completing secondary school.

These issues were clearly in the minds of policy makers when the introduction of AUSTUDY was announced in the 1986-87 Budget. The Minister for

Employment and Industrial Relations, introduced the policy initiative in the following way:

"The significant increases in allowances being implemented by the Government provide a much stronger incentive for young people to study and secure qualifications which will help them find and keep employment. The scheme with its much improved allowances for students will remove the disincentive to study which arose from the fact that the unemployment benefit outstripped the basic rates of education allowances for young people."

The introduction of AUSTUDY involved substantial real increases in the level of income support provided to students, particularly secondary-school students, and the benefit is generally received by the student, not their parents. This brought payments made to eligible 16 and 17 year-olds into line with the Job Search Allowance (JSA), a new form of unemployment benefit payments payable to unemployed youth (Dearden and Heath, 1996). The JSA was no longer universally paid to all unemployed 16 and 17 year-olds but, like AUSTUDY, was now means-tested on parents' income. Those eligible to receive JSA also had to wait 13 weeks after leaving school before they could receive any payment. From September 1990, the level of unemployment benefit paid to 18 to 19 year-olds living at home was also lowered to bring the maximum benefits into line with AUSTUDY rates.

In addition, AUSTUDY had a more generous means-test than SAS, and was advertised widely to raise awareness as a part of the 'Priority One' education policy initiative. The combined effect was that the proportion of students receiving AUSTUDY increased to well over 30 per cent. The AYS provides some extra information about whether the introduction of AUSTUDY has influenced the decisions of teenagers.

Of respondents attending school in 1990 and 1991, 43 per cent said that they had decided to complete Year 12 before they entered high school at the age of 12 or 13 years. A further 28 percent said that they had made the decision to continue in Year 10, this year or last year. This suggests that there are a significant number of teenagers making their education decisions relatively late in their time at high school and therefore, that there is some potential for AUSTUDY to influence their education decisions. In 1990, 10 to 15 per cent of teenagers receiving AUSTUDY said that they would not stay at school if they were not eligible.

A further sign of the shifting focus of education policy, was the reintroduction of tertiary fees via a Higher Education Contribution Scheme (HECS), from which part of the cost of tertiary study is recouped in the form of a delayed payment collected through the taxation system when the student enters the labour market. This allowed some of the funding that would otherwise have gone to tertiary education to be redirected towards supporting students from low-income families. The introduction of HECS was also motivated by a desire to expand the capacity of the tertiary sector (Chapman, 1997).

The main features of AUSTUDY are that it is means-tested on parents' income and that the amount payable depends on the child's adjusted family income (AFI). This AFI takes into account the number of dependent children under the age of 16 in the family. The amount that is payable and the rate of abatement are also affected by the number of other 'eligible siblings' – namely, brothers and sisters aged 16 or over in full-time education. If the student receives AUSTUDY, their parents are no longer permitted to receive family allowance for that child or other social security payments associated with supporting the child. There is also a limit on the amount of income students can earn from part-time work and if this is exceeded, the student loses $1 per annum of support for every

$2 per annum earned over the limit. A more detailed description of the administrative details of the means test are provided in Dearden and Heath (1996).

The changes in government policy that were implemented in 1987 were significant and had explicit aims. Despite this, there has been very little empirical assessment of whether the changes which were made achieved their goal of increasing the proportion of teenagers completing high school. Dearden and Heath (1996) investigate this question in two ways. The first method is a two stage estimation procedure. In the first stage, information about whether teenagers in school after 1987 were receiving AUSTUDY or not is used to estimate the probability of being eligible for AUSTUDY using probit estimation. Using the results from the first stage estimation, the probability of being eligible is predicted for individuals in the pre-1987 period and for those who had left school in the post-1987 period.

The second stage regression estimates the probability of completing high school, using the predicted probability of being eligible for AUSTUDY as an explanatory variable. It is important to ensure that the predicted eligibility variable is identified, that is that there is at least one variable in the eligibility equation which is not likely to affect school continuation decisions independently. Eligibility for AUSTUDY is based on a means-test and on the number of eligible siblings. Most factors which could be used to control for the effects of the means-test, for example, family size or parent's education, on eligibility are likely to have an independent effect on the schooling decision (Miller and Volker, 1987; Dearden, 1995). Dearden and Heath (1996) use the number of siblings in the household over 15 years-old as an instrument, as it will be highly correlated with the number of eligible teenagers and is unlikely to have an independent effect once the number of siblings is controlled for.

The number of children in the household aged 15 years and over is significant in the first stage regression and increases the probability of being eligible by around 2.5 percentage points for each extra sibling over 15 years-old. The probability of being eligible for AUSTUDY has a significantly positive effect on the probability of continuing on to do Year 11 and Year 12. The estimate of the marginal effect suggests that a one percentage point increase in the probability of being eligible increases the probability of continuing high school by around 2 percentage points for an 'average' individual in the sample.

The two stage estimation results are extended to a 'natural experiment' framework by identifying a control group of individuals whose school leaving behaviour is not likely to be affected by the introduction of AUSTUDY. The obvious control group are teenagers who will not be eligible for AUSTUDY because of the means-test. Dearden and Heath (1996) define the control group as the 50 percent of individuals who have the lowest predicted probability of being eligible for AUSTUDY. Given that around 30 per cent of teenagers in school receive AUSTUDY, this cut-off point is somewhat conservative. The estimated effects of eligibility on the school decision will also be conservative as the treatment group will contain teenagers who are essentially unaffected by the introduction of AUSTUDY.

The factors which affect the school continuation decision are estimated for the control group and this provides a policy-free baseline estimate. The policy-free behaviour of all individuals in the treatment group can be predicted from these estimates. The effect of policy can then be estimated by calculating the extent to which the differences between actual and policy-free behaviour of the treatment group differ in the pre-1987 and the post-1987 periods. The procedure is essentially a difference-in-differences approach to a problem expressed in a natural experiment framework.

Using this method, the introduction of AUSTUDY is estimated to have increased the probability of continuing high school by around 4 percentage points for the treatment group. This is an average marginal effect calculated for the treatment group as a whole. The estimated marginal effect increases as the group for which it is calculated is restricted to individuals who are predicted to be 'more eligible'.

3 Teenage Labour Market And Education Outcomes

The main failure of Dearden and Heath (1996) is that it does not consider the impact of changes in the unemployment benefit system which occurred simultaneously with the introduction of AUSTUDY. To do this, it is necessary to increase the number of possible outcomes to include employment and unemployment. Random utility models provide the most natural framework for analysing such a multinomial outcome model.

Assume that the value to individual j of being in one of the three outcomes can be written as a linear combination of observable characteristics and a random shock:

$$V_{ij} = X_j'\beta_i + \varepsilon_i \text{ for } i \in \{\text{employed (E), unemployed (U), in school (S)}\} \quad (3)$$

To help with notation, let S_j be an indicator variable which takes the value one when individual j is observed at school, and zero otherwise. Similarly, let E_j and U_j indicate whether individual j is employed or unemployed. Given that the outcomes are mutually exclusive, these indicator variables will sum to unity.

We can write the probability that individual j is observed at school as:

$$\Pr(S_j = 1) = \Pr(\{V_{Sj} > V_{Ej}\} \cap \{V_{Sj} > V_{Uj}\})$$

$$= \Pr\left(\left\{X_j'\beta_S + \varepsilon_{Sj} > X_j'\beta_E + \varepsilon_{Ej}\right\} \cap \left\{X_j'\beta_S + \varepsilon_{Sj} > X_j'\beta_U + \varepsilon_{Uj}\right\}\right)$$

$$= \Pr\left(\left\{X_j'\beta_S - X_j'\beta_E > \varepsilon_{Ej} - \varepsilon_{Sj}\right\} \cap \left\{X_j'\beta_S - X_j'\beta_U > \varepsilon_{Uj} - \varepsilon_{Sj}\right\}\right)$$

$$= \Pr\left(\left\{a_{Ej} > w_{Ej}\right\} \cap \left\{a_{Uj} > w_{Uj}\right\}\right) \qquad (4)$$

where $a_{Ej} = X_j'\beta_S - X_j'\beta_E$

$$a_{Uj} = X_j'\beta_S - X_j'\beta_U$$

$$w_{Ej} = \varepsilon_{Ej} - \varepsilon_{Sj}$$

$$w_{Uj} = \varepsilon_{Uj} - \varepsilon_{Sj}$$

It is possible to follow a similar process to write down the probability of being in either of the other two states in terms of the limit variables, a_{Ej} and a_{Uj}, and the error terms, w_{Ej} and w_{Uj}.

$$\Pr(E_j = 1) = \Pr\left(\left\{V_{Ej} > V_{Sj}\right\} \cap \left\{V_{Ej} > V_{Uj}\right\}\right)$$

$$= \Pr\left(\left\{-a_{Ej} > -w_{Ej}\right\} \cap \left\{a_{Uj} - a_{Ej} > w_{Uj} - w_{Ej}\right\}\right) \qquad (5)$$

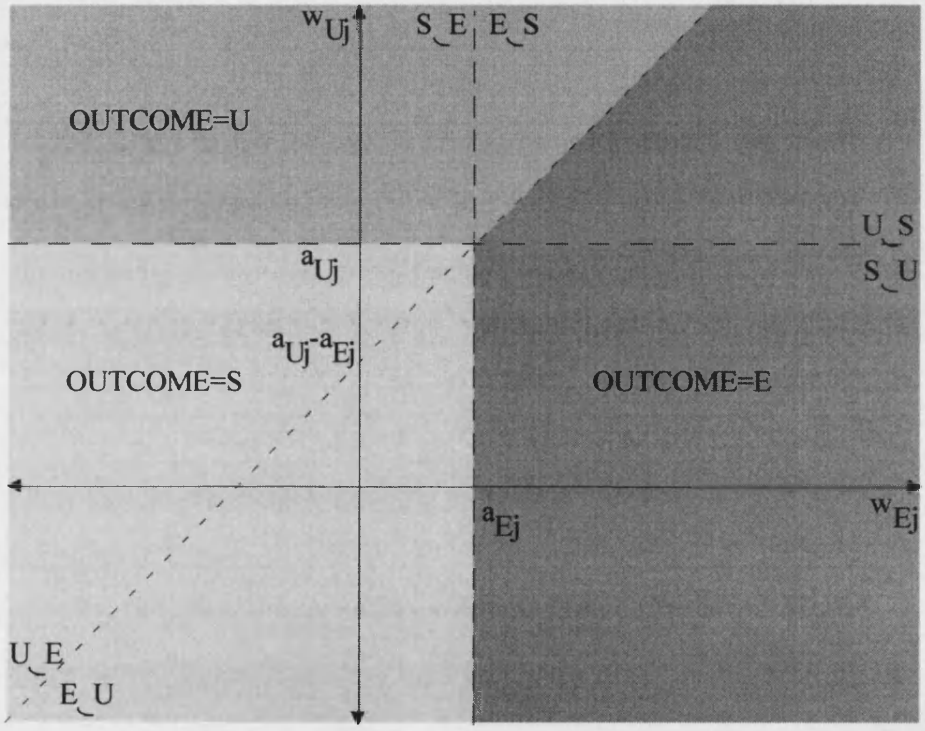
$$\Pr(U_j = 1) = \Pr\left(\left\{V_{Uj} > V_{Sj}\right\} \cap \left\{V_{Uj} > V_{Ej}\right\}\right)$$

$$= \Pr\left(\left\{-a_{Uj} > -w_{Uj}\right\} \cap \left\{a_{Ej} - a_{Uj} > w_{Ej} - w_{Uj}\right\}\right) \qquad (6)$$

The three dimensional outcome problem can be represented in two dimensional space (Figure 10). In this figure the axes are the error terms, w_{Ej} and w_{Uj}, which represent the unmeasured factors affecting the individual's outcome. Given their

definitions, a high draw of w_{Ej}, for example, suggests that the unmeasured factors influencing individual *j* increase the probability of their being observed in employment, all else equal. The three broken lines in Figure 10 represent the locus of points along which individual *j* will be indifferent between two of the three alternatives. On either side of these lines, individual *j* is more likely to be observed in one or other state, as indicated.

Figure 10: Representation Of A Three Outcome Model



Assuming a joint probability density function for the error terms w_{Ej} and w_{Uj}, *f(w)*, it is possible to determine the probability of observing an individual in any of the three states, given values of a_{Ej} and a_{Uj}. In particular, we can write the probability that a teenager *j* completes school as:

$$\Pr(S_j = 1 \mid X_j; \beta, \Sigma) = \int_{-}^{a_{Ej}} \int_{-\infty}^{a_{Uj}} dF(w) \qquad (7)$$

where:

- β are the parameter vectors $\beta_S, \beta_E, \beta_U$;
- Σ is the underlying variance-covariance matrix of the errors, $\varepsilon_S, \varepsilon_E, \varepsilon_U$; and
- *F(w)* is the cumulative distribution function of *f(w)*.

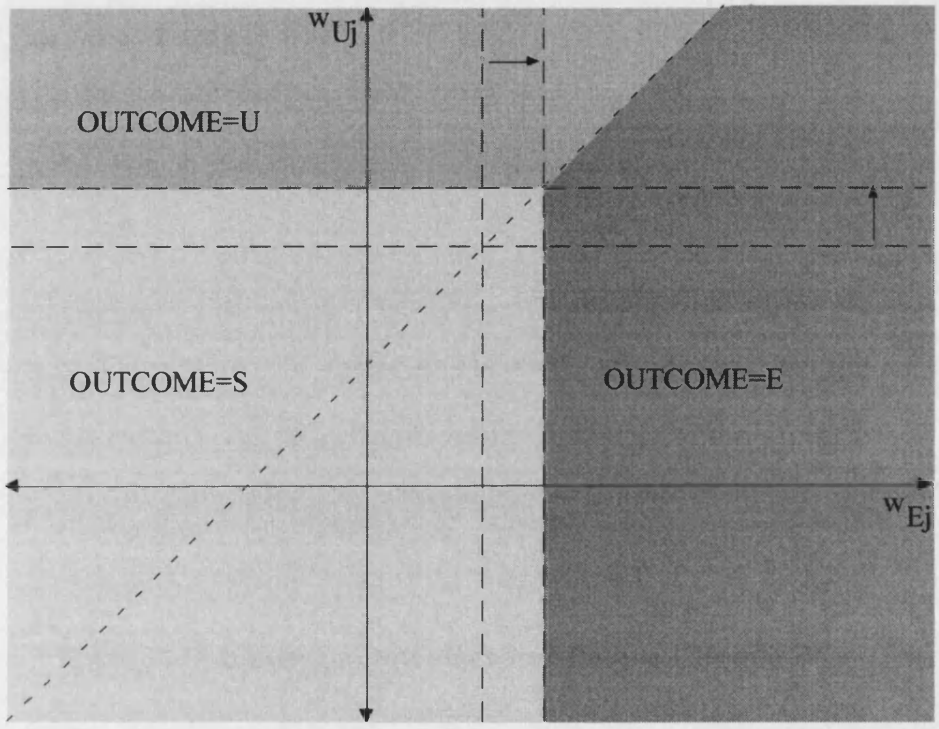
Similar expressions for the probability of being observed in either unemployment or employment can be derived from the appropriate normalisation.

Before dealing with assumptions about probability distributions and the details of estimation, it is useful to discuss how we would expect the introduction of AUSTUDY and changes to the administration of unemployment benefits to affect an individual's observed outcome. There are three regimes to consider. The first is the pre-1987 regime in which no-one is eligible for AUSTUDY and everyone is eligible for unemployment benefits. For convenience, this regime will be referred to as *PRE87*. The second regime includes all individuals who were eligible for both AUSTUDY and unemployment benefits after 1987. The third regime includes all individuals who are eligible for neither after 1987. These two regimes will be referred to as *ELIGIBLE* and *INELIGIBLE* respectively.

The change in incentives for an individual moving from *PRE87* to *ELIGIBLE*, that is someone for whom AUSTUDY becomes available, is equivalent to an equal increase in a_{Ej} and a_{Uj}. This is represented in Figure 11. Assuming that

the joint probability distribution of w_{Ej} and w_{Uj} does not change, the net result is that the probability of observing an individual in school increases, and the probabilities of observing an individual in employment or unemployment decrease.

Figure 11: Change In Outcomes For People Eligible Post-1987

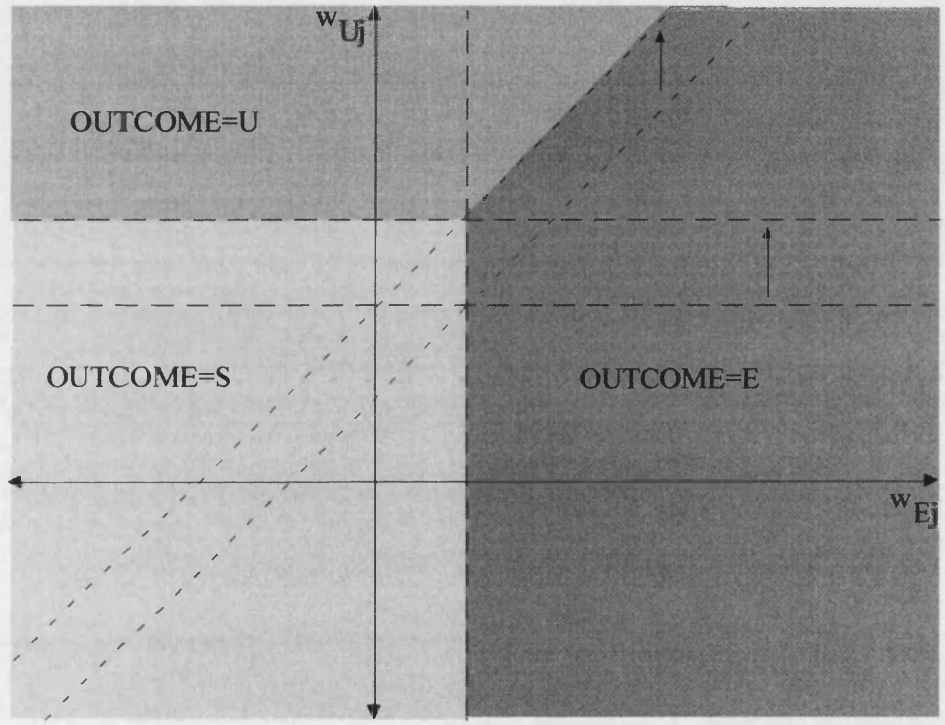


An individual moving from *PRE87* to *INELIGIBLE*, that is someone for whom unemployment benefits become unavailable, can be characterised as experiencing an increase in the level of a_{Uj}. This is represented in Figure 12. The net result of this change is that the probability of an individual being observed in unemployment decreases, and the probabilities of observing them either in employment or school increase.

Given that the level of unemployment benefits fell after 1987, this effect will be present to a lesser degree for individuals moving from *PRE87* to *ELIGIBLE*. The

probability of being observed in school will still increase unambiguously and the probability of being observed in unemployment will fall. However, the effect on the probability of observing the individual in employment will be ambiguous. If the effect of the falling level of unemployment benefits dominates, the probability of observing an individual who becomes *ELIGIBLE* in employment could rise.

Figure 12: Change In Outcomes For Ineligible People Post-1987



The analysis of Dearden and Heath (1996) can be defended by arguing that there are very few individuals who are *INELIGIBLE* due to the means-test, who do not already decide to complete school. For these individuals, the values of a_{Ej} and a_{Uj} are so high that there is very little probability of observing them in either unemployment or employment and the effect of increasing these values through the policy initiatives is small. Another way of thinking about this in terms of the structure above, is that for most individuals who are *INELIGIBLE*, the shocks

which would be required to observe that individual in employment or unemployment are very large and occur with very low probability.

4 Data Sources and Definitions

The data used in this paper are essentially the same as the data used by Dearden and Heath (1996). The post-1987 data are from the AYS which is described in more detail in Appendix A. The pre-1987 sample consists of individuals who were interviewed in the Australian Longitudinal Survey (ALS). This survey was run from 1985 to 1989 and tracks a nationally representative sample of individuals who were 16 to 25 years-old when the sample was established in 1985. For the purposes of this paper we restrict our sample to teenagers who were in Year 12 or would have been in Year 12 had they stayed at school. Because the ALS did not interview new cohorts of 16 year olds each year, the data required to obtain a representative sample are not available by 1987. To extend the pre-1987 data set, we use information about what respondents were doing in 1984 to obtain an extra year of data. The information and question structure of the ALS is essentially the same as for the AYS.

A summary of the activities of the individuals in our sample, by year, is provided in Table 7. The changes in the composition of the sample generally reflect changes in composition at the aggregate level.

The focus of the following analysis is on how eligibility for AUSTUDY and unemployment benefits affects outcomes. We aim to assess the impact of eligibility by estimating the marginal effects of being in one of the three regimes identified in Section 3 on the probability of being observed in different outcomes, after controlling for personal and family background characteristics. Policy is captured in the following analysis by two indicator variables. The first takes the

value zero in the pre-1987 period and one if the individual is *ELIGIBLE*, that is eligible for both AUSTUDY and unemployment benefits after 1987. The second indicator variable captures individuals who are *INELIGIBLE* by taking the value zero in the pre-1987 period and one if the individual is not eligible in the second period.

Table 7: Teenage Labour Market And Education Outcomes

Proportions in parentheses

Year	School	Employment	Unemployment	Total
1984	322 (45.5)	302 (42.7)	83 (11.7)	707
1985	432 (48.9)	342 (38.7)	109 (12.3)	883
1986	334 (48.6)	296 (43.0)	58 (8.4)	688
1989	680 (51.1)	502 (37.6)	151 (11.3)	1333
1990	820 (66.9)	318 (26.0)	87 (7.1)	1225
1991	841 (71.7)	251 (21.4)	81 (6.9)	1173
1992	930 (82.2)	145 (12.8)	56 (5.0)	1131
1993	889 (85.3)	118 (11.3)	35 (3.4)	1042
1994	809 (83.4)	114 (11.8)	47 (4.9)	970

Before 1987, AUSTUDY was not available and eligibility for unemployment benefits was not affected by family background, as there was no means-test on parents' income. From this point of view, eligibility for all the individuals in the pre-1987 sample was the same. The proportion of unemployed teenagers in the pre-1987 sample who actually received unemployment benefits was 61.4, 74.3 and 86.2 per cent in each year from 1984 to 1986. The fact that not all unemployed individuals received benefits may reflect the fact that these individuals had enough private income to be ineligible for benefits, but still considered themselves to be unemployed. Alternatively, there may be incomplete take up of unemployment benefits.

After 1987, eligibility for AUSTUDY and unemployment benefits (or JSA) was affected by means-tests on parents' income. These are similar enough that we assume that the receipt of one benefit implies eligibility for the other. Table 8 provides information about the proportion of individuals in the sample receiving AUSTUDY and unemployment benefits, if they were in school or unemployment respectively. Roughly one-third of students in Year 12 receive AUSTUDY. On average around half of unemployed teenagers who would have been in Year 12 receive unemployment benefits. This proportion is higher in periods of high unemployment, which highlights the importance of controlling for macroeconomic conditions either by including aggregate unemployment rates or more generally, year indicator variables.

Table 8: Proportion Of Teenagers Receiving Benefits

Year	Proportion of School Attenders Receiving AUSTUDY	Proportion of Unemployed Receiving Benefits
1989	34.0	22.5
1990	32.2	48.3
1991	33.5	61.7
1992	34.1	71.4
1993	35.3	65.7
1994	32.6	48.9

An important assumption underlying the definition of whether an individual is *ELIGIBLE* or *INELIGIBLE* is that individuals who are eligible actually receive transfer payments. The pre-1987 evidence suggested that while take-up rates of unemployment benefits were high, they were not complete. In 1990 respondents to the AYS were asked whether they had applied for AUSTUDY, and the reasons for not applying if they had not. Roughly 75 per cent of respondents had not applied, and of these, two thirds did not apply because they or their parents earned too much for them to be eligible. Twenty percent of 16 year-olds

responded that they did not know why they had not applied, hadn't got around to it or didn't know what AUSTUDY was. For 17 year-olds and older age groups, the proportion with this response fell to 6 per cent. This suggests that the assumption of complete take up of AUSTUDY by eligible teenagers is not unrealistic.

Although the assumption that individuals receiving benefits are eligible for both AUSTUDY and unemployment benefits is useful for individuals who are observed in school or unemployment, no information about eligibility is directly available for individuals observed in employment after 1987. As an approximation, we predict the probability of being *ELIGIBLE* for employed teenagers from a probit model of eligibility estimated using the observed benefit receipt of all the unemployed and individuals in school in the post-1987 sample. Employed individuals whose probability of being eligible is greater than 50 percent are deemed to be *ELIGIBLE.*

The control variables which are included are a standard set of individual and family background characteristics. A summary of the mean characteristics for teenagers in each of the three outcomes is presented in Table 9. Interestingly, one of the most distinct differences between employed and unemployed teenagers is that employed teenagers are more likely to have working parents with higher status jobs on average. A more detailed description of the data used is given in Appendix A.

Table 9: Summary Statistics by Observed Outcome

Averages by group, standard errors in parentheses where appropriate

	Employment	Unemployment	School
Personal background			
Male	0.56	0.55	0.48
Age	17.29 (0.70)	17.40 (0.70)	17.15 (0.62)
Foreign Born	0.08	0.10	0.14
ESL: English spoken well	0.05	0.07	0.09
ESL: English spoken poorly	0.01	0.02	0.02
Attend(s/ed) a government school	0.83	0.83	0.70
Number of siblings	2.39 (1.56)	2.53 (1.85)	2.16 (1.53)
Parents' characteristics			
Father's occupational status @14	27.32 (21.68)	21.77 (2.39)	32.21 (23.59)
Mother's occupational status @14	15.53 (19.45)	13.05 (19.19)	19.86 (21.79)
Father not employed @14	0.04	0.09	0.04
Mother not employed @14	0.45	0.49	0.39
Father not present @14	0.14	0.21	0.12
Mother not present @14	0.03	0.06	0.02
Father has:			
Degree	0.07	0.10	0.17
Trade qualifications	0.20	0.13	0.17
Other post school qualifications	0.07	0.06	0.10
Secondary education	0.43	0.40	0.36
Mother has:			
Degree	0.06	0.05	0.14
Trade qualifications	0.06	0.04	0.05
Other post school qualifications	0.12	0.11	0.15
Secondary education	0.64	0.64	0.56

Note: @14 indicates that the variable is the parent's characteristic when the respondent was 14 years-old

5 Estimation Issues and Results

The purpose of this section is to estimate the model outlined in Section 3 of this chapter. All that is required to implement this model is for an assumption to be made about the joint probability distribution for the underlying errors and

consequently the joint probability distribution of the errors w_{Ej} and w_{Uj}. Having made this assumption, the likelihood function can be written as:

$$l(\beta,\Sigma)=\prod_{j=1}^{N}\Pr(S_j=1\mid X_j;\beta,\Sigma)^{S_j}\Pr(E_j=1\mid X_j;\beta,\Sigma)^{E_j}\Pr(U_j=1\mid X_j;\beta,\Sigma)^{1-E_j-S_j} \quad (8)$$

where N is the total number of individuals in the sample.

Section 5.1 discusses estimation of the multinomial logit model. From a practical point of view, this model is the most straight forward to estimate and provides an excellent starting point from which to explore less restricted models. Section 5.2 discusses estimation of the multinomial probit model which permits the estimation of more free parameters at the cost of being more time and computer intensive.

5.1 Multinomial Logit Estimation

The multinomial logit model is the most straight forward multinomial outcome model to estimate. This model has the advantage that the cumulative distribution function used to evaluate the probabilities used in the likelihood function can be expressed in closed form and is therefore straightforward to compute. Another computational advantage of the multinomial logit model is that global convergence is guaranteed.

The multinomial logit specification defines the probability of individual j being observed in school as:

$$\Pr(S_j=1)=\frac{e^{X_j'\beta_S}}{\sum_{i\in\{S,E,U\}}e^{X_j'\beta_i}} \quad (9)$$

The probability of being observed in each of the other two outcomes is defined similarly and the sum of the three probabilities will be one, as required. However, the coefficients will not be uniquely identified without a further restriction. The standard restriction for multinomial logit models is to assume that the vector of coefficients for one alternative, known as the base category, is normalised to zero. The normalised coefficients are then interpreted as the effect of a given characteristic on the probability of being observed in a given outcome, relative to its effect on the probability of being observed in the base category. For example, if the base category is schooling, a positive coefficient on *age* for employment indicates that older teenagers in the sample are more likely to be observed in employment than in school, all else being equal.

However, computational ease comes at the cost of implied restrictions on the variance-covariance matrix, which may not be satisfactory from the point of view of the economics. In particular, the multinomial logit specification assumes that the variance-covariance matrix of the underlying errors is an identity matrix, thus implicitly assuming that all the possible outcomes are perfectly substitutable for each other. This assumption, also known as the Independence of Irrelevant Alternatives (IIA), is difficult to justify *a priori*, in the current circumstances. For example, it is plausible that shocks increasing the likelihood that an individual leaves school for employment could be positively correlated with shocks which increase the likelihood of observing an individual in unemployment.

Despite the restrictive assumptions, multinomial logit estimation provides a good first pass at the problem. At the very least, the multinomial logit provides good starting values for more computationally intensive multinomial probit model, discussed in Section 5.2 and provides a feel for the data.

Because multinomial choice models are non-linear functions of their coefficients, the estimated coefficients provide information about the direction of the effect, but not about its size. The size will depend on the values taken by all the independent variables. For this reason, the results of estimating the multinomial logit model presented in Table 10 are expressed in terms of the marginal effect a given variable has on the probability of being observed in a particular outcome, given that all other variables are set to their mean value. In terms of Equation 9, this can be written as:

$$\left.\frac{\partial \Pr(S_j=1)}{\partial x}\right|_{x=\bar{x}} = \Pr(S_j=1)\Big|_{x=\bar{x}}\left(\sum_{i\in\{S,E,U\}}(\beta_S-\beta_i)\Pr(i_j=1)\Big|_{x=\bar{x}}\right) \qquad (10)$$

The coefficients on dummy variables can be interpreted as the change in the probability of observing a given outcome if the value of the dummy variable is changed from zero to one. Dummy variables are indicated by an asterisk. For example, in Table 10, being male increases the probability that the individual will be observed in employment by 4.8 percentage points. For continuous variables such as *age*, the coefficient is interpreted as the increase in the probability of observing the outcome if the explanatory variable increases by one unit. Therefore, an individual who is one year older than average will be 7.7 percentage points more likely to be observed in employment.

Table 10: Estimation Results

Number of observations: 9,152

	Employment		Unemployment		School	
	∂Pr/∂x	t-stat	∂Pr/∂x	t-stat	∂Pr/∂x	t-stat
Eligibility						
ELIGIBLE (post-1987)*	-0.314	-15.59	-0.017	-1.55	0.331	14.60
INELIGIBLE (post-1987)*	-0.150	-8.44	-0.041	-3.80	0.191	9.30
Personal background						
Male*	0.048	5.27	0.010	2.09	-0.059	-5.74
Age	0.077	10.26	0.033	8.70	-0.110	-13.08
Foreign Born*	-0.054	-3.02	-0.016	-1.69	0.070	3.59
ESL: English spoken well*	-0.122	-5.45	-0.022	-1.93	0.144	5.96
ESL: English spoken poorly*	-0.205	-3.65	-0.000	-0.01	0.205	3.57
Attend(s/ed) a government school*	0.121	10.48	0.024	3.70	-0.146	-11.41
Number of siblings	0.011	3.59	0.004	2.53	-0.014	-4.34
Parents' characteristics						
Father's occupational status @14	-0.001	-3.78	-0.001	-5.21	0.002	6.08
Mother's occupational status @14	-0.000	-1.19	-0.000	-1.18	0.001	1.68
Father not employed @14*	-0.046	-1.76	0.015	1.34	0.031	1.11
Mother not employed @14*	-0.007	-0.49	-0.004	-0.46	0.011	0.67
Father not present @14*	-0.010	-0.44	-0.007	-0.60	0.017	0.66
Mother not present @14*	0.051	1.50	0.041	2.62	-0.092	-2.44
Father has:						
Degree*	-0.116	-4.46	0.010	0.71	0.107	3.73
Trade qualifications*	-0.013	-0.60	-0.024	-2.08	0.036	1.54
Other post school qualifications*	-0.070	-2.83	-0.021	-1.53	0.092	3.30
Secondary education*	-0.016	-0.81	-0.008	-0.81	0.024	1.10
Mother has:						
Degree*	-0.086	-3.16	-0.023	-1.52	0.109	3.63
Trade qualifications*	0.033	1.19	-0.004	-0.24	-0.029	-0.93
Other post school qualifications*	-0.024	-1.02	-0.004	-0.034	0.028	1.07
Secondary education*	0.002	0.09	0.007	0.76	-0.009	-0.43

Note: Section of state and state of residence and time dummies have been included, but have not been reported; Dummy variables are indicated by an asterisk.

The marginal effects of the eligibility indicators are large and significant. These coefficients provide information about how the probability of being observed in a given outcome would be affected by being either *ELIGIBLE* or *INELIGIBLE*, rather than in the pre-1987 sample. As such, they can be interpreted as the effect of introducing AUSTUDY, in the case of *ELIGIBLE*, and the effect of removing unemployment benefits, in the case of *INELIGIBLE*. In most cases the direction of the effects correspond to the changes represented in Figures 11 and 12.

Individuals in the post-1987 sample are more likely to complete high school and are less likely to be unemployed than those in the earlier sample. Teenagers who are *ELIGIBLE* are less likely to be employed than *PRE87* teenagers, which suggests that the effect of introducing AUSTUDY is stronger than the effect of decreasing the level of unemployment benefits which are available. However, contrary to the prediction of the model outlined in Section 3, *INELIGIBLE* individuals are less likely to be observed in employment than *PRE87* individuals.

One explanation for this is that the leaving school is seen as a gamble on finding work, and the lack of access to unemployment benefits if the gamble does not pay off inclines individuals who would otherwise have had a good chance of being employed towards completing high school. Another possibility is that these indicator variables are picking up trend changes in participation and unemployment rates. However, this explanation can be discounted as these effects are captured by the inclusion of time dummies.

The impact of both changes in policy on behaviour can be assessed by comparing the *ELIGIBLE* and *INELIGIBLE* individuals, without reference to the pre-1987 sample. This can be calculated as the difference in the marginal effects of being *ELIGIBLE* and *INELIGIBLE* as presented in Table 10. This calculation suggests that being *ELIGIBLE* increases the probability of completing high school by 14.0

percentage points and of being unemployed by 2.4 percentage points, and reduces the probability of being observed in employment by around 16.4 percentage points.

Intuition and the results presented earlier from Dearden and Heath (1996) suggest that the estimated marginal effects of eligibility on the probabilities of being observed in either employment or school are larger than would be expected. One possible explanation for the magnitude of the calculated marginal effects is that they are evaluated at the average characteristics of the entire sample. If we are interested in understanding how a given group would have responded to the availability of benefits, it is not clear that the average characteristics of the whole sample is the correct place to evaluate the marginal effect.

The questions we are interested in addressing are:

- How would the predicted probabilities of *ELIGIBLE* teenagers change if they did not have access to AUSTUDY and unemployment benefits?

- How would the predicted probabilities of *INELIGIBLE* teenagers have been affected if these benefits had been made available?

To answer these questions, we calculate the probability of correctly predicting the actual outcome of each individual in the post-1987 sample, first assuming that the individual is *ELIGIBLE* and then assuming that they are *INELIGIBLE.* Differencing these predicted probabilities provides information about the marginal effect of being eligible for *both* AUSTUDY and unemployment benefits, rather than neither, for each individual.

To summarise these effects, we average the probabilities predicted under both assumptions and their differences for different groups. First we split the post-

1987 sample by observed outcome, because we are interested in how the availability of benefits would have affected the probability of observing actual outcomes. Each of these three groups is split further by whether the individual was actually *ELIGIBLE* or *INELIGIBLE*. Consequently, there are six groups of individuals for which the average probability of correctly predicting observed outcomes is calculated under these two assumptions (Table 11). For each group, one of the average predicted probabilities will be the probability that they are observed in their actual situation, and the other will be a counterfactual. The actual scenario has been made bold.

Table 11: Average Probability Of Choosing Observed Outcome

For individuals in the post-1987 sample

	Assuming that all individuals are:		
Observed Group	*ELIGIBLE*	*INELIGIBLE*	Difference
Employed			
ELIGIBLE	**0.210** **(0.45)**	0.394	-0.184
INELIGIBLE	0.182	**0.344** **(0.75)**	-0.162
Unemployed			
ELIGIBLE	**0.140** **(0.80)**	0.091	0.049
INELIGIBLE	0.128	**0.085** **(0.66)**	0.043
In School			
ELIGIBLE	**0.803** **(0.76)**	0.706	0.097
INELIGIBLE	0.839	**0.750** **(0.65)**	0.079

Note: Bold entries indicate the actual predicted probabilities rather than probabilities evaluated under the counterfactual scenario;
Numbers in parentheses are the proportions of the relevant groups with predicted probabilities of being higher than the random probability.

In general, the higher the probability of correctly predicting the actual outcome, the better is the predictive power of the model. However, the predicted probability of observing an outcome will also be higher, the higher the random probability of observing that outcome. Therefore, each predicted probability should be compared with the random probability, which is given by the proportion of the sample in each outcome. To provide some metric of the quality of the predictions, the proportion of individuals with predicted probabilities above the random probability has been included for each actual scenario in parentheses. In general, the model appears to be adding predictive power.

Table 11 confirms the general result that being *ELIGIBLE,* rather than *INELIGIBLE,* increases the probability of observing teenagers in unemployment and school, and decreases the probability of observing them in employment. If AUSTUDY had been taken away from teenagers who were receiving AUSTUDY and completing school, these calculations suggest that they would have been 9.7 percentage points less likely to complete school. In the reverse situation, if teenagers who were completing school but were not eligible for AUSTUDY were to receive it, their predicted probability of completing school would increase by 7.9 percentage points. This model, therefore, suggests that the effect of both the policy changes is roughly twice as large as was predicted by Dearden and Heath (1996), although it should be noted that their estimates were conservative.

The effect of being *ELIGIBLE* appears to have had the least effect on the behaviour of unemployed teenagers: the probability of correctly predicting that unemployed teenagers are unemployed increases by between 4 and 5 percentage points. This suggests that there are relatively few teenagers in the unemployment pool who are affected by the means-test. This adds weight to the results of

Dearden and Heath (1996) which are essentially estimated with this assumption imposed.

Eligibility for AUSTUDY and unemployment benefits appears to have the largest impact on the predicted behaviour of employed individuals: it decreases the probability of observing an individual in employment by around 17 percentage points. Changes in government policy appear to have had the largest impact on the employment/school margin rather than on unemployment outcomes.

The rest of the results in Table 10 show that the personal background and family characteristics that have been included are also important for explaining the outcomes of Australian teenagers, consistently with earlier literature and other analysis in this thesis. Males are 4.8 percentage points more likely to be employed and 5.9 percentage points less likely to be in school than females. Older members of a cohort are more likely to have left school. Teenagers who would have been in Year 12 and are one year older than the sample average, are 7.7 percentage points more likely to be in employment and 3.3 percentage points more likely to be unemployed.

Individuals who were born overseas are more likely to complete Year 12 and are significantly less likely to be employed than members of their cohort who were born in Australia. In addition, teenagers whose native language is not English are also significantly more likely to stay and school and are less likely to be employed. The fact that these effects are stronger for poor English speakers suggests that these teenagers face poor labour market prospects and use school as a means of improving their skills.

Teenagers who attended government schools are 12.1 percentage points more likely to be employed and 2.4 percentage points more likely to be unemployed than teenagers from the same cohort who are enrolled in Catholic or other non-government schools. As before, teenagers with more siblings are less likely to complete school.

Parents' characteristics are also important determinants of teenagers' education and labour market outcomes. In general, teenagers whose parents have higher status occupations and are better educated are more likely to complete high school and are less likely to be either employed or unemployed. Interestingly, parents' education appears to affect the probability of observing the individual in school or in employment, whereas occupational status also affects the probability of observing a teenager in unemployment. This suggests that there is some financial element in the probability of observing that someone is unemployed, as this is captured in the occupational status index, but is imperfectly approximated by educational attainment.

5.2 Multinomial Probit Estimation

An alternative to the multinomial logit specification is the multinomial probit model. By assuming that the underlying errors are joint normally distributed, and consequently that the error terms w_{Ej} and w_{Uj} are joint normally distributed, it is possible to allow free estimation of some variance-covariance parameters. Although there are three parameters in the variance covariance matrix of w_{Ej} and w_{Uj}, only two of these parameters are free to be estimated. The loss of one free parameter arises because the estimated coefficient parameters can only be estimated relative to the parameters in the variance-covariance matrix. Identifying the coefficient parameters requires that the variance-covariance

matrix be normalised, which reduces the number of free variance-covariance parameters by one.

The trade-off for being able to freely estimate variance-covariance parameters is that the cumulative distribution function of a joint normal does not have a closed form solution. The three outcome model considered here requires that the cumulative distribution function of a bivariate normal distribution be evaluated. In general, the evaluation of cumulative distribution functions of multivariate normal variables will require simulation techniques.[12] In the case of a bivariate normal, however, the cumulative distribution function can be evaluated by numerical integration.[13] Estimation of the multinomial probit model requires significantly more computational effort that the multinomial logit model. The rest of this section discusses the results of estimating the multinomial probit model using numerical integration techniques, and examines whether the extra effort is rewarded by economic insights which could not be made by estimating the multinomial logit model.

In general, parameter estimates for the multinomial probit model failed to converge. In order to understand the reasons for this, the model was estimated with a relatively high tolerance for the convergence criterion of three decimal places.[14] The estimated marginal effects for all the control variables are very

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[12] Originally, we intended to estimate the multinomial probit model using the Geweke-Hajivassiliou-Keane (GHK) algorithm to simulate the probabilities in the likelihood function. Details of this simulation method are presented in Appendix B. However, problems of obtaining convergence for the multinomial probit, discussed below, were more severe for this method.

[13] In what follows, the *cdfbvn* command in GAUSS is used to evaluate the cumulative density of a bivariate normal distribution for given parameter vectors.

[14] The maximum likelihood estimation performed here was done using the GAUSS routine *optmum*.

close to those presented in Table 10. The estimated marginal effects of being either *ELIGIBLE* or *INELIGIBLE,* rather than in the pre-1987 sample, on the probability of being observed either in school or in employment are also similar in magnitude to those estimated by multinomial logit (Table 12). The marginal effect of being *ELIGIBLE* on the probability of being observed in unemployment is closer to zero, but was statistically insignificant in the multinomial logit results.

Table 12: Marginal Effects Of Being *ELIGIBLE* and *INELIGIBLE*

Estimated with a multinomial probit model

		Employment	Unemployment	School
Numerical Integration (tolerance = 3)	*ELIGIBLE*	-0.331	-0.006	0.337
LL=-6480.39	*INELIGIBLE*	-0.154	-0.035	0.189
Numerical Integration (tolerance = 5)	*ELIGIBLE*	-0.339	-0.003	0.342
LL=-6479.09	*INELIGIBLE*	-0.158	-0.032	0.190

Note: Tolerance is given in terms of the number of decimal places, and LL is the log likelihood function.

The maximum likelihood estimation procedure has been set up to estimate two free elements of the lower Choleski decomposition of the variance-covariance matrix, rather than the free parameters in the variance-covariance matrix themselves. Neither of these parameters are statistically significant. The corresponding variance-covariance matrix of the error terms w_{Ej} and w_{Uj} is presented in Equation 11. The final term in this equation expresses the variances and covariance of w_{Ej} and w_{Uj} in terms of the variances and covariances of the underlying errors.

$$\text{var cov} = \begin{bmatrix} 1 & -0.967 \\ -0.967 & 5.638 \end{bmatrix} = \begin{bmatrix} \sigma_S^2 + \sigma_E^2 - 2\sigma_{ES} & \sigma_S^2 - \sigma_{ES} - \sigma_{US} + \sigma_{EU} \\ \sigma_S^2 - \sigma_{ES} - \sigma_{US} + \sigma_{EU} & \sigma_S^2 + \sigma_U^2 - 2\sigma_{US} \end{bmatrix} \quad (11)$$

The variance of w_{Uj} is large relative to the variance of w_{Ej} which has been normalised to one for the purposes of identification and the covariance between w_{Ej} and w_{Uj} is negative. In order to attribute signs and relative magnitudes of these estimated parameters to underlying variances and covariances, it would be necessary to make three further identifying restrictions. Without doing this explicitly, it is possible to infer that the relationships between the elements of the variance covariance matrix are consistent with σ_U^2 being relatively large and with σ_{EU} being relatively large and negative. The magnitude of σ_S^2 cannot explain the signs and relative magnitudes in Equation 11, because it is present in all three terms. Also, it can be argued that the signs and magnitudes of σ_{ES} and σ_{US} cannot be used to explain the differences in the estimated parameters because they affect the estimated parameters in the same way, which is not consistent with the fact that they have opposite signs.

This suggests that it is relatively difficult to explain why a teenager is observed in unemployment with the available information. This is consistent with the fact that there are relatively few unemployed teenagers in the sample, which generally makes it more difficult to find strong correlations between observed behaviour and personal characteristics. A large negative correlation between the shocks affecting the probability of being observed in employment and unemployment is also consistent with intuition. It is straight forward to find unobserved characteristics such as the presence of local information networks, which are discussed at length in the following chapter, which would increase the probability of observing a teenager in employment and decrease the probability of observing a teenager in unemployment simultaneously.

We attempted to estimate these parameters more accurately by decreasing the tolerance of the convergence criterion to five decimal places. However, after 20,000 iterations, the estimates had not converged, there had been very little improvement in the log likelihood value and the estimated marginal effects had not changed significantly (Table 12).[15] However, the estimated elements of the β matrix and of the Choleski decomposition did change considerably (Equation 12). The associated variance-covariance matrix of the parameter vector is not invertible.

$$\text{var cov} = \begin{bmatrix} 1 & -1290 \\ -1290 & 197789100 \end{bmatrix} \tag{12}$$

Another way of demonstrating these results is to compare the distribution of the probabilities of correctly predicting observed outcomes, estimated by multinomial logit, and multinomial probit at the two different tolerance levels (Figure 13). These histograms are strikingly similar despite apparently large differences in the magnitude of the variance-covariance parameters.

These results are indicative of identification problems, although the model estimated above is formally identified. Keane (1992) noted that even in formally identified multinomial probit models, identification would be an issue if the explanatory variables only contain information about the individual and not information specific to the different outcomes. An alternative statement of this requirement is that there needs to be at least one exclusion restriction in the coefficient vector for each alternative.

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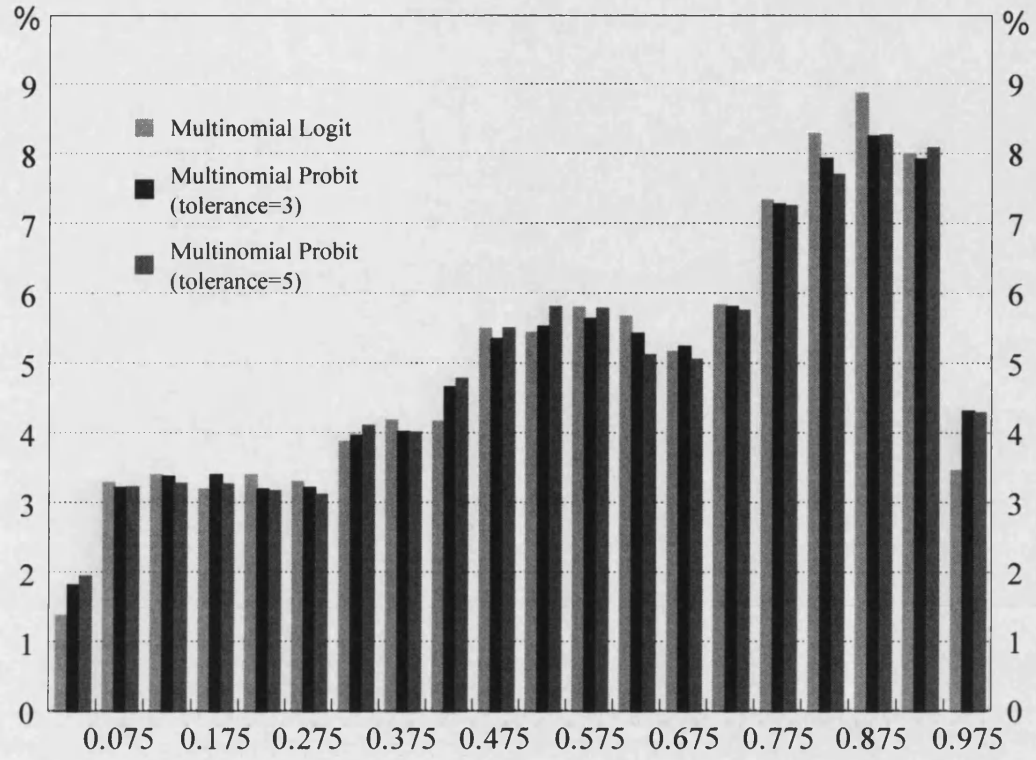
[15] Estimating 20,000 iterations took around two weeks, to give some indication of the time required to estimate a multinomial probit model with three outcomes and 9,152 observations using numerical integration methods.

Figure 13: Distribution Of The Probabilities Of Correctly Predicting Outcomes



The source of this identification problem is that, in the absence of exclusion restrictions, changes in the estimated variance-covariance parameters can be accommodated by changes in the estimated coefficient parameters. This behaviour is apparent in the two sets of estimates generated by numerical integration methods, as the estimated coefficient vector varies markedly as the variance-covariance parameters vary, even though the marginal effects do not vary significantly.[16] For the question being addressed here, it is not possible to know what the characteristics of the unchosen alternatives are, making it difficult to fulfil this requirement. For example, it is not possible to know how much an individual would be earning if they are not observed to be working. The

[16] A more detailed discussion of this effect is provided in Keane (1992).

conclusion of this section, therefore, is that for this particular empirical question, there is very little added value, in terms of our understanding of the behaviour of individuals, from estimating a multinomial probit model.

6 Conclusions

The aim of this analysis was to understand the impact that changes in government policy can have on the behaviour of teenagers who are making decisions about whether or not to complete high school. In 1987 the Australian government introduced a means-tested payment for teenagers in their final two years of high school and introduced a means-test for unemployment benefits for teenagers. The combined effect of these changes was intended to increase the proportion of teenagers completing high school and to decrease the number of unemployed teenagers by changing the financial incentives that they faced.

This question has been addressed in earlier work by Dearden and Heath (1996), although they did not consider the effect of changes to the administration of unemployment benefits. The analysis here extends the analysis of Dearden and Heath (1996) by allowing teenagers to be observed in one of three outcomes: employment, unemployment or school. In the first stage of this analysis we use a multinomial logit model to estimate the effects of policy changes on the probability of being observed in school, employment or unemployment.

The results from estimating this model indicate that the policy changes in 1987 did affect the probability of observing teenagers in different outcomes. Being eligible for unemployment benefits and AUSTUDY, rather than being ineligible for either, is estimated to increase the probability of completing high school by between 8 and 10 percentage points. The estimated effect of the policy change is roughly double the effect estimated by Dearden and Heath (1996). Interestingly,

being eligible rather than ineligible also increases the probability of being unemployed by between 4 and 5 percentage points and decreases the probability of being employed by between 16 and 19 percentage points.

The increase in the proportion of teenagers completing high school was achieved by decreasing the probability of being employed rather decreasing the probability of being unemployed, as would be expected from a model such as the one outlined in Section 3. One explanation for this result is that teenagers who decide not to complete high school are taking a gamble on the labour market, and it is the teenagers who would have had the best chances of obtaining work who are most likely to complete high school in response to increased incentives to staying in school and the increased costs of unemployment.

The last section of this paper considered estimating the effects of policy changes using a multinomial probit model to allow for the free estimation of variance-covariance parameters which is not permitted in the multinomial logit model. The estimated marginal effects and the probability of correctly predicting the observed outcome are not significantly changed by allowing for the extra parameters to be estimated. This arises because, although the model is formally identified, identification will be fragile in the absence of exclusion restrictions in the estimated coefficient matrix. In the context of multinomial probit models, exclusion restrictions require the data to contain information about the different alternatives. Given the nature of the problem, namely that the available data only contain information on individuals, there is no benefit in estimating a multinomial probit model.

APPENDIX B: SIMULATED MAXIMUM LIKELIHOOD ESTIMATION

The following description of the simulated maximum likelihood approach to estimating a multinomial probit is based on Börsch-Supan and Hajivassiliou (1992). The aim is to evaluate the probability of a certain outcome being observed that is continuous in the parameters, so that standard maximum likelihood algorithms can be applied. The basic procedure is as follows:

- rewrite the problem in terms of univariate errors using a Choleski decomposition of the variance-covariance matrix;

- draw a set of univariate errors with the appropriate distributions and constraints applied for each individual;

- evaluate the probability of observing the outcome given these errors and the parameter vector, and average across draws;

- apply standard maximum likelihood optimisation algorithms to determine a new set of parameters that increase the likelihood.

In what follows, the example of an individual who is observed in school, as developed in Section 3 will be continued. The simulation of the probability of being observed in unemployment or employment is a straight forward transformation of this procedure given that the error terms which need to be simulated can be expressed as linear combinations of the error terms simulated for the case where an individual is observed in school.

The first step towards simulating the probability of observing that an individual is in school is to re-write the problem in terms of univariate standard normal

variables. Assuming $\begin{bmatrix} w_E \\ w_U \end{bmatrix} \sim N(0, \Sigma^*)$, and that the lower Choleski factor of Σ^* is L, we know that $w = \begin{bmatrix} w_E \\ w_U \end{bmatrix} = \begin{bmatrix} l_{EE} & 0 \\ l_{EU} & l_{UU} \end{bmatrix} \begin{bmatrix} \omega_E \\ \omega_U \end{bmatrix} = L\omega$

where $\begin{bmatrix} \omega_E \\ \omega_U \end{bmatrix} \sim N(0, I)$.

Consequently, we can re-write the probability of observing that an individual is in school in terms of standard normal variables as:

$$\Pr(S_j = 1) = \Pr(\{a_{Ej} > w_{Ej}\} \cap \{a_{Uj} > w_{Uj}\})$$

$$= \Pr(\{a_{Ej} > l_{EE}\omega_{Ej}\} \cap \{a_{Uj} > l_{EU}\omega_{Ej} + l_{UU}\omega_{Uj}\})$$

$$= \Pr\left(\omega_{Ej} < \frac{a_{Ej}}{l_{EE}}\right) \Pr\left(\omega_{Uj} < \frac{a_{Uj} - l_{EU}\omega_{Ej}}{l_{UU}}\right)$$

$$= \Phi\left(\frac{a_{Ej}}{l_{EE}}\right) \Phi\left(\frac{a_{Uj} - l_{EU}\omega_{Ej}}{l_{UU}}\right)$$

The first component of this probability is a straight forward evaluation of a cumulative standard normal function. The second component, however, depends on the data, parameters and a truncated standard normal variable, ω_{Ej}. A variable following this truncated normal distribution can be simulated from a variable following a standard uniform distribution using the inverse transform theorem. This theorem states that when an inverse cumulative distribution function is applied to a uniformly distributed random variable, the resulting variable will be distributed with the probability density function associated with the cumulative distribution function used.

The cumulative distribution function of a standard truncated normal variable is:

$$G(\omega)=\frac{\Phi(\omega)-\Phi(a_{lower})}{\Phi(a_{upper})-\Phi(a_{lower})}$$

where a_{upper} and a_{lower} are the upper and lower bounds of the truncation; and

$$\omega \sim N(0,1).$$

Therefore, a standard truncated normal random variable, ω, can be derived from a standard uniform random variable, η, as:

$$\omega = G^{-1}(\eta)=\Phi^{-1}\left(\eta\left(\Phi\, a_{upper} - \Phi\, a_{lower}\right)+\Phi(a_{lower})\right)$$

In order to simulate the probability accurately, it is necessary to draw a set of $r=1,...,R$ replications for each individual from a standard uniform distribution, using a different seed for each individual to ensure that the shocks experienced by each individual are different. This set of standard uniform variables, η_{Er}, remains the same for each parameter draw to ensure that there is not extra variation introduced. Consequently, there will be $r=1,...,R$ evaluations of a truncated standard normal variable for each individual j, for each new parameter vector:

$$\omega_{Erj}=\Phi^{-1}\left(\eta_{Er}\left(\Phi\left(\frac{a_{Ej}}{l_{EE}}\right)-\Phi(-\infty)\right)+\Phi(-\infty)\right)=\Phi^{-1}\left(\eta_{Er}\Phi\left(\frac{a_{Ej}}{l_{EE}}\right)\right)$$

Finally, these probabilities are averaged across the R replications, resulting in the following simulated likelihood function contribution from individuals observed in school:

$$\tilde{l}(\beta,\Sigma)=\prod_{S_j=1}\Pr(j=S\mid X_j;\beta,\Sigma)$$

$$= \frac{1}{R} \sum_{r=1}^{R} \prod_{S_j=1} \Phi\left(\frac{a_{Ej}}{l_{EE}}\right) \Phi\left(\frac{a_{Uj} - l_{EU}\omega_{Erj}}{l_{UU}}\right)$$

This procedure has been implemented for multinomial probit models in GAUSS and is available on request.

CHAPTER 4

JOB-SEARCH METHODS, NEIGHBOURHOOD EFFECTS AND THE YOUTH LABOUR MARKET

7 Introduction

Survey data suggest that around one-third of teenagers successfully find work through friends and relatives, one-third find work by directly contacting employers and the remaining third use indirect methods such as newspapers or employment agencies. In contrast, less than 10 per cent of unemployed teenagers report that they are using friends and relatives as their main job-search method and two thirds report that they are mainly using an indirect method of search. This chapter examines what factors affect the way teenagers look for work in order to explain why we observe this behaviour.

To this end, a model of job-search behaviour is developed in which there are two job-search methods available. The first is a general job-search method whose success depends on aggregate labour-market conditions and the search effort chosen by the individual. The second is a local job-search method which only depends on local labour-market conditions. This characterisation is motivated by the possibility, raised in Chapter 2, that information networks provided by friends and relatives are local in nature. Modelling the interaction of individuals, their neighbourhood and the aggregate labour market also provides an opportunity to explore the possibility that local job-information networks help to explain the unequal distribution of unemployment across Australian neighbourhoods as documented by Gregory and Hunter (1995).

Finally, this paper estimates the factors which affect the search methods chosen by Australian teenagers. Our sample includes teenagers who were looking for work, but were not enrolled in full-time education and who were respondents to the AYS. Data on individuals from the AYS allow us to control for individual characteristics, past education experience, family background and the characteristics of the neighbourhood the teenager is living in.

We find that the receipt of unemployment benefits is the single most important variable for explaining the method reported as the main search method. Unemployment benefit recipients are almost 20 percentage points more likely to report that the government employment agency, the CES, is their main job search method and are significantly less likely to report either newspapers or direct search methods.[17] There is some evidence that individuals who have a longer duration of unemployment are more likely to report newspapers as their main job-search method. This is consistent with the possibility that unemployed teenagers begin their job search by focussing on methods that have proved more successful for other teenagers, but switch to alternative search methods if a job offer is not secured after some period.

Respondents whose parents are better educated and/or have higher status occupations are more likely to search using friends and relatives or directly contacting employers in preference to searching in the newspaper or through the CES. Respondents who left school in Year 10 or earlier and/or attended a

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[17] The Commonwealth Employment Service (CES) was the main employment service available to the unemployed through the sample period being considered here, and was administered by the Federal Government. In 1998, it was replaced by Centrelink and a competitive employment services market known as the Jobs Network.

government school are more likely to report that the CES is their main method of search.

Finally, there is evidence that higher neighbourhood unemployment rates decrease the probability of using direct search methods and increase the probability of using the CES as the main method of search. This relationship can be explained if the effectiveness of direct search methods depends on the quality local job information networks, measured as the proportion of the neighbourhood who are employed. The importance of local job-information networks may help explain the increasing concentration of unemployment in some neighbourhoods documented by Gregory and Hunter (1995). If a neighbourhood experiences a negative employment shock, for example the closure of a local employer, the initial increase in unemployment may be amplified by a fall in the search effectiveness of the unemployed in the local area due to the decrease in the quality of local job-information networks.

The rest of the paper is organised as follows. Section 2 provides some summary information about the search methods used in the youth labour market in Australia and reviews the international evidence on the effectiveness of different job-search methods. After discussing why friends and relatives would be a more successful method than other available search methods, this section briefly reviews the current empirical evidence for which factors affect the way individuals choose to search. Section 3 develops an economic model that explains an individual's choice of job-search method and discusses the general equilibrium implications of modelling search behaviour in this way.

Section 4 provides a detailed description of the data. Section 5 lays out the econometric model explaining the job-search method choice of an unemployed individual and presents the estimation results. Section 6 concludes by

summarising the results and examining their contribution to our understanding of the youth labour market in Australia.

8 Job-Search Behaviour: What Do We Know Already ?

8.1 Which Search Methods are Most Effective?

Table 13 summarises the job-search methods reported by Australian teenagers who were respondents to the AYS. Information about which methods of search proved successful is derived from the responses of teenagers who were employed at the time of the interview and had obtained their job in the year prior to the interview. These responses are summarised in column 1. The number of respondents who have been employed continuously over the year since their previous interview is also included in the second last row of the table.

Roughly one-third of teenagers found their job through friends and relatives, one-third through contacting employers directly, and the final third through indirect search methods such as newspapers and the CES. This information is consistent with the successful methods reported by teenagers for the 12 months to July 1998, although the proportion using direct employer contact is slightly larger and the reported use of newspapers and the CES is correspondingly lower.[18]

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[18] ABS Cat. No. 6245.0, *Successful and Unsuccessful Job Search Experience*. It should also be noted that the CES was replaced by Centrelink and a competitive employment services market, the Job Network, during the period covered by the survey. All services which replace the CES have been classified as the CES here for the purposes of comparison with the older survey data.

Table 13: Job-Search Methods

16 To 19 Year-Olds

	Used to obtain current job	Currently used by unemployed
Government program	438 (6%)	–
CES	671 (10%)	801 (27%)
Newspapers/media	1 209 (18%)	1 219 (40%)
Friends and relatives	2 228 (33%)	171 (6%)
Direct employer contact	1 929 (28%)	686 (23%)
Other	370 (5%)	145 (5%)
Total	6 845	3 022
Same job as last year	4 126	–
Total	10 971	–

Note: 'Other' includes unions, unemployed persons groups, private agencies, advertising and other.

Respondents to the AYS who reported that their main activity was looking for work were asked to list all the search methods they were using and, if more than one method was reported, to identify the main job-search method.[19] For comparison, the main job-search methods of these unemployed teenagers are summarised in column 2 of Table 13.

The most striking difference between the employed and the unemployed is that the unemployed are much less likely to report that friends and relatives are their main search method than the employed are to have used this method successfully.[20] The proportion of unemployed teenagers reporting that their main

[19] Thus, teenagers looking for work, who are enrolled in full-time education are not included in this sample.

[20] Around one-third of the employed respondents moved directly into their current job from an earlier job. The differences observed in Table 13 could perhaps be explained if the job-search behaviour of on-the-job searchers was significantly different from that of individuals who are not already employed. An examination of the data suggests that this is not the case.

search method is either newspapers or the CES is significantly higher than the proportion of employed teenagers who gained jobs through this method.

This is consistent with evidence about the success of different job-search methods used by 15 to 26 year-olds who were respondents to the first wave of the Australian Longitudinal Survey (ALS) in 1985. Miller and Volker (1987) show that respondents using the CES or newspapers are less likely to leave unemployment than those using friends and relatives or direct employer contact. Jobs obtained through the CES are also less successful if success is measured by the duration of employment.

Information about the search effort applied to different job-search methods and the success of such effort in terms of the number of job offers received is available for the US and the UK. Analysis of these data provides further evidence that friends and relatives and direct employer contact are the two most successful job-search methods.

Holzer (1988) finds that 16 to 23 year-old males from the 1981 Youth Cohort of the National Longitudinal Survey for the United States who were unemployed the month before the interview date, spend more hours searching through friends and relatives and direct employer contact than through state employment agencies or newspapers. They also receive more job offers from these direct search methods. Holzer also shows that job offers generated through friends and relatives have an 81 per cent probability of being accepted, which is much higher than the acceptance rate for offers generated by any other method.

Jones (1989) presents similar evidence for the UK using a sample of unemployed people collected by the Economist Intelligence Unit in September 1982. He finds that there is some decline in the total hours spent on search as the duration of

unemployment lengthens and that this is particularly noticeable for the number of hours spent using friends and relatives.

Jones also estimates the effects of hours spent using different search methods on measures of success such as the number of job offers received and the number of interviews obtained. He finds that hours spent using friends and relatives has no effect on the number of interviews received, but increases the number of offers received. While this supports Holzer's finding that the probability of obtaining an acceptable offer using friends and relatives is very high, it makes it difficult to interpret the effect of spending more hours searching on the final outcome.

Another of Jones' results which is difficult to interpret is that the number of hours spent using a government employment agency decreases the number of interviews and the number of offers. This suggests that the hours spent using different types of search may be proxies for omitted personal or background characteristics which are important. More time spent using newspapers is found to increase the number of interviews, but not the number of offers.

Overall, the evidence suggests that employment agencies and newspapers are relatively unsuccessful job-search methods, compared with using friends and relatives or direct employer contact. The question then arises: why do unemployed teenagers use job-search methods which are apparently less successful?

Assuming that these job seekers are acting in their own best interests, there are two explanations for this behaviour. One is that job-search methods which proved more successful, on average, for employed teenagers are tried first and when they do not result in an acceptable job offer, alternative job-search methods are pursued. If this is the explanation, we would expect to see that teenagers with

longer durations of unemployment are less likely to use direct search methods. The second possibility is that some individuals are living in environments or have characteristics which make it optimal to choose indirect job search methods, even though they are less successful on average. Before addressing this question more directly, it is useful to consider why direct methods would be more successful.

Motivated by the stylised fact that direct methods appear to be more successful than indirect methods, Montgomery (1991) develops a model of imperfect information to explain why this might be the case. His model assumes that employers cannot observe the quality of potential employees and that, without further information, employers will offer all potential employees a real wage equal to the average productivity of the unemployment pool.

Montgomery also assumes that there is a social structure within which high productivity workers are more likely to associate with each other than with low-productivity workers. In this environment, one way for firms to increase the probability of hiring a high productivity worker is to offer jobs to potential employees who are recommended by current high-productivity workers.

The net gain arises because both the employer and the potential employee have better information about each other, increasing the probability that there will be a successful match. This process has also been argued less formally by Rees (1966) who suggests that employed individuals will only refer capable workers to ensure that their own reputation is not affected. These incentives will reinforce the mechanism described in the Montgomery model.

8.2 *What Factors Affect the Choice of Job-Search Method?*

Although the Montgomery model explains why friends and relatives will be a successful method of job search, it does not suggest that this method will increase the chances of finding an acceptable job for all the unemployed. In fact, the model relies on the fact that the unemployed are not homogenous in two respects. First, for imperfect information to be an issue, potential workers must have different productivity levels when they are matched to a given job. The second way in which the unemployed are not homogeneous, is that some are connected to more useful social networks than others.

McGregor (1983) considers the possibility that the job-information network provided by friends and relatives is local in nature. This implies that the effectiveness of friends and relatives as a job-search method would be highly dependent on local neighbourhood characteristics. In particular, he argues that information about jobs is more likely to come from employed people and consequently that there will be less useful job information in high unemployment neighbourhoods. The expected probability of obtaining a job offer using information from friends and relatives in high unemployment areas is also likely to be lower as there will be more competition for any available jobs.

McGregor (1983) proceeds to test his hypothesis, that local labour market conditions affect job-search behaviour, using a sample of males who were unemployed in Glasgow in 1976. He finds that when personal characteristics are controlled for, neighbourhood unemployment rates do not influence the probability that friends and relatives are used for search. Although this is a disappointing result, there are several technical reasons why these estimates should be treated with caution. First, the unemployment rates are presented in

high, medium, and low bands and second, the estimation technique does not take proper account of the nature of the data being used.[21]

Schmitt and Wadsworth (1993) find that the most important determinant of job-search method choice is the unemployed person's previous occupational status, using a sample of unemployed male benefit recipients in Great Britain who were interviewed in the General Household Survey between 1979 and 1982. The other consistently important variables are the duration of unemployment and a dummy for the 50 to 65 year-old age group. Unfortunately however, the use of personal contacts is not available as a separate category in this study, but is subsumed in 'other' job-search methods.

Crockett (1994) analyses the factors which affect job-search effort, measured as the number of search methods reported by respondents to the 1985 wave of the ALS. He finds that state unemployment rates and the benefit-to-income ratio both have a negative effect of the number of job-search methods reported. Even though these factors are significant, the estimated elasticities are small.

Jones (1989) estimates the relationship between search effort, measured as the number of hours used on different search methods and individual characteristics. He finds that being male increases the number of hours spent searching through all methods except newspapers, that older individuals are less likely to spend time searching through government employment agencies and individuals with technical qualifications spend more time directly approaching employers. A more

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[21] The dependent variable used by McGregor (1983) takes the value one if the individual is using friends and relatives as a search method and zero otherwise. McGregor (1983) uses a linear probability model to estimate the proposed relationship rather than a method designed to deal with dependent variables of this type, such as logit or probit.

puzzling result is that individuals from high unemployment areas spend less time searching through government employment agencies or newspapers. Holzer (1988) examines the factors which affect the probability that an individual will use different search methods, but the results are only marginally significant at best.

9 A New Model of Job-Search Method Choice

In this section, we develop an economic model to formalise the way in which characteristics of the local environment can affect the job-search behaviour of unemployed individuals. This is done by extending the job-search model developed by Pissarides (1990) to allow individuals to have access to two different search methods with characteristics reflecting the differences between the indirect and direct search methods discussed above.

The first job search method, labelled the general search method, captures search methods such as newspapers and employment agencies, which provide general job information. The probability that the general job search method will create a match between an unemployed worker and an unfilled vacancy is assumed to be a function of aggregate labour market conditions and the search effort of the individual. Thus, the general search method is equivalent to the form of search described in the search intensity model of Pissarides (1990).

The second job search method, labelled the local search method, is designed to capture job-search methods, such as information from friends and relatives or direct employer contact. The effectiveness of these methods is assumed to be influenced by conditions in the local labour market, but not by the amount of effort applied by the job seeker. This implicitly assumes that the job-information network provided by friends and relatives is confined to the local area, and that

the employed neighbourhood residents receive job information at a fixed rate, which the job seeker cannot influence.

In Section 3.1 we consider the individual's job-search method choice and the steady state of the local labour market, taking aggregate labour market conditions as given. The first order condition of the individual's problem provides a basis for the empirical model estimated in Section 5. In Section 3.2, we introduce the labour-demand decision of firms and look at the aggregate labour market in steady state, assuming that all neighbourhoods are identical. Finally, in Section 3.3, we examine the effects on individual and aggregate outcomes of improving the effectiveness of the local search method and of increasing the flow of benefits to being unemployed in a single neighbourhood. This allows us to compare this model with the framework of Pissarides (1990) and to understand the interaction of individuals, neighbourhoods and the aggregate labour market.

9.1 The Local Environment

Introducing a local search method, which is dependent on local labour market conditions, requires assumptions to be made about the way the labour force is divided into neighbourhoods. We assume that the labour force is evenly distributed across $n=1,...,N$ neighbourhoods and that the labour force in each neighbourhood is normalised to one. We assume that the proportion of neighbourhood n who are unemployed is denoted u_n and consequently, that the proportion of neighbourhood who are employed is $1-u_n$.

The aggregate unemployment rate is defined as:

$$u = \frac{\sum_{n=1}^{N} u_n}{N} \tag{13}$$

Individuals choose the optimal level of search effort given information about their local labour market and the aggregate labour market. This decision will be affected by the probability of matching a job, the value of the job, the costs of searching for work, and the value of being unemployed.

The probability of finding a job through the local search method for an unemployed person in neighbourhood n is assumed to be a decreasing function of local unemployment:

$$f_n = f(u_n) = \frac{\delta}{u_n} \tag{14}$$

where δ is a measure of the efficiency of the local search method. This particular functional form has been chosen for algebraic convenience.

The probability of finding a job through the general search method will depend on the state of the aggregate labour market and the search effort applied by the individual. Following Pissarides (1990), the number of job matches generated when the number of unemployed in the aggregate economy is Nu, the average search effort of the unemployed is c, and the aggregate number of vacancies is Nv can be expressed by the matching function $H(cNu, Nv)$. The parameter c can also be thought of as a technology parameter of this matching function that captures the average search effectiveness of the unemployed.

The probability of an unemployed person with search effort c_n matching a vacancy can be expressed as the search effort of the individual relative to the average, multiplied by the probability that an unemployed person with average search effort makes a match (Equation 15). The second equality in Equation 15 can be obtained by making the assumption that the matching function exhibits constant returns to scale:

$$p_n = \frac{c_n}{c} \bullet \frac{H(Ncu, Nv)}{Nu} = c_n H\left(1, \frac{Nv}{Ncu}\right) = c_n h(\theta) \qquad (15)$$

where

- c_n is the search effort chosen by an individual in neighbourhood n;
- $\theta = v/cu$ is the degree of labour market tightness, or the extent to which demand for labour exceeds supply;
- Nv is the stock of vacancies in the economy;
- Ncu is the stock of unemployment measured in search effort units; and
- c is the average level of search effort in the economy, defined as:

$$c = \frac{\sum_{n=1}^{N} u_n c_n}{\sum_{n=1}^{N} u_n} \Rightarrow Ncu = \sum_{n=1}^{N} u_n c_n \qquad (16)$$

Another factor which affects the individual's decision about how hard they should search using the general search method, is the balance between the costs

and benefits of being unemployed. We assume that the net flow of benefits to being unemployed for an individual in neighbourhood n can be represented by a function $\sigma(c_n; z_n)$, where z_n represents the exogenous flow of income and other benefits received by an unemployed individual in neighbourhood n. To conform to our priors that search effort is costly and to ensure that there is an interior solution to the individual's choice problem, the derivatives of this function are signed: $\sigma_c(c_n; z_n) < 0$; $\sigma_{cc}(c_n; z_n) < 0$; and $\sigma_z(c_n; z_n) > 0$.

An unemployed individual in neighbourhood n will choose c_n to maximise the present discounted value of being unemployed, U_n. The following equations describe the relationship between the present discounted value of being unemployed, U_n, and the present discounted value of being employed, E_n, for an individual in neighbourhood n:

$$\begin{aligned}(1+r)U_n &= \sigma(c_n; z_n) + (f_n + p_n)E_n + (1 - f_n - p_n)U_n \\ (1+r)E_n &= w + sU_n + (1-s)E_n\end{aligned} \tag{17}$$

where

- r is the discount rate;
- w is the wage rate received by employed individuals;[22] and
- s is the exogenous separation rate from employment.

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[22] At this stage the wage is assumed to be the same across neighbourhoods. This assumption is justified below.

The present discounted value of being in either of the two labour force states can be thought of as the flow of benefits from being in that state currently, plus the expected value of future labour market experience. This expected value will be the probability of remaining in the current state multiplied by the present discounted value of remaining, plus the probability of changing state multiplied by the present discounted value of being in the alternative state. By substituting out E_n and re-organising Equation 17, the present discounted value of being unemployed can be written as:

$$U_n = \frac{(r+s)\sigma(c_n;z_n)+(f\ u_n\ +c_n h\ \theta\ )w}{r(r+s+f(u_n)+c_n h(\theta))} \tag{18}$$

An important side condition that is required to ensure that the unemployed are willing to look for work in the first place is that the wage is greater than the net flow of benefits of being unemployed.

The first order condition for an individual choosing search effort to maximise the present discounted value of unemployment will be:

$$\frac{\partial U_n}{\partial c_n} = \frac{(r+s)\sigma_c(c_n;z_n)+h(\theta)w}{r(r+s+f\ u_n\ +c_n h\ \theta\ )} - \frac{(r+s)\sigma(c_n;z_n)+(f\ u_n\ +c_n h\ \theta\ )w}{r(r+s+f\ u_n\ +c_n h\ \theta\ )^2} \bullet h(\theta) = 0$$

$$\Rightarrow (r+s+f(u_n)+c_n h(\theta)) \bullet \sigma_c(c_n;z_n)+(w-\sigma\ c_n;z_n\ ) \bullet h(\theta) = 0 \tag{19}$$

where θ, z_n, w, r, s and u_n are taken as given by the individual. The condition that $\sigma_{cc}(c_n;z_n) < 0$, ensures that the solution to this first order condition will be an interior maximum.

This first order condition is the most important relationship for understanding the job-search behaviour of individuals. Implicit differentiation of Equation 19

shows that the level of search effort chosen and hence the probability of reporting that the main method of search is a general search method, increases as the local unemployment rate rises and falls as the flow of benefits to being unemployed or the efficiency of the local search method increases. Other comparative static results are straightforward to derive and correspond to the partial equilibrium results presented in Pissarides (1990), Table 4.1.

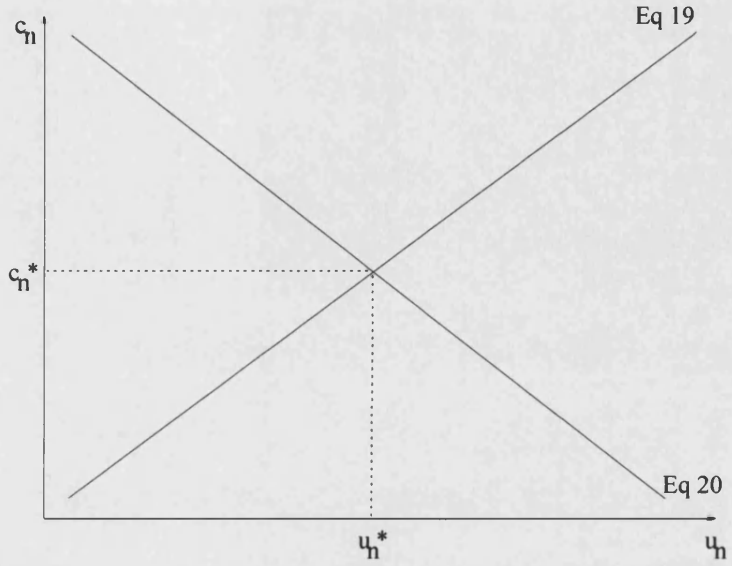
Equation 19 defines the behaviour of individuals in a given neighbourhood and will, therefore, be important for interpreting the results presented in Section 5. Defining a steady state condition for the local unemployment rate will enable us to tie down the local equilibrium. The local labour market will be in steady state when the flows into and out of the local unemployment pool are equal. This condition can be written as:

$$\begin{aligned} \dot{u}_n &= s(1-u_n) - (f\ u_n\ + c_n h\ \theta\ )u_n \\ &= s(1-u_n) - \delta + c_n h(\theta) u_n = 0 \\ \Rightarrow u_n &= \frac{s-\delta}{s+c_n h(\theta)} \end{aligned} \tag{20}$$

where $s > \delta$ is required for steady state local unemployment to be non-zero.

Equations 19 and 20 provide us with two equations for the two local endogenous variables, c_n and u_n, as functions of aggregate variables and exogenous parameters. A local equilibrium is guaranteed by the fact that the equilibrium unemployment rate condition is a decreasing function of local search effort (Figure 14).

Figure 14: Local Equilibrium



9.2 The Aggregate Labour Market

To understand equilibrium in the aggregate labour market, it is necessary to introduce three further relationships. The first defines the aggregate steady-state unemployment rate. The second condition summarises the labour demand of firms in the economy. Finally, the third condition describes the wage setting behaviour in the economy.

9.2.1 Steady State Unemployment

Aggregate unemployment is in steady state when the flows into and out of the unemployment pool offset each other so that the unemployment rate remains constant. This concept is directly analogous to steady-state unemployment in local labour markets and can be derived simply by aggregating the local labour market flows:

$$\dot{u} = s(N - Nu) - \sum_{n=1}^{N} (f\, u_n + c_n h\, \theta)\, u_n = 0$$
$$\Rightarrow u = \frac{s - \delta}{s + ch(\theta)} \tag{21}$$

The only difference between this steady state relationship and the standard aggregate steady state relationship used in the job-search literature is the presence of the local matching efficiency parameter, δ, which lowers the steady state unemployment rate.

9.2.2 Labour Demand

Following Pissarides (1990), labour demand is characterised in this framework by a firm's decision of whether or not to open a vacancy. We assume for simplicity that the production function displays constant returns to scale and that the only input is labour. This implies that the marginal product of labour is constant and is represented by A.

Analogously to the worker's problem, the firm's behaviour is determined by the present discounted value of having a filled job, J, and the present discounted value of holding a vacancy open, V (Equation 22). As before, the present discounted value of these assets will be equal to the flow of income in the current period plus the expected value of the next period. This expected value will be a weighted average of the two asset values, where the weights depend on the probability of a job match being destroyed for assessing the value of a filled job, and the probability of a job match being made in the case of assessing the value of holding open a vacancy.

$$(1+r)J = A - w + sV + (1-s)J$$

$$(1+r)V = -\gamma_0 + \left(\frac{\sum_{n=1}^{N} (f\, u_n + c_n h\, \theta)u_n}{Nv} \right) J + \left(1 - \frac{\sum_{n=1}^{N} (f\, u_n + c_n h\, \theta)u_n}{Nv} \right) V \qquad (22)$$

$$= -\gamma_0 + \left(\frac{\delta}{v} + \frac{h(\theta)}{\theta} \right) J + \left(1 - \frac{\delta}{v} - \frac{h(\theta)}{\theta} \right) V$$

where A is the constant marginal product of labour;

w is the wage paid to each worker; and

γ_0 is the fixed cost per period of having a vacancy open.

Assuming that there is free entry of firms, the present discounted value of holding a vacancy open must be equal to zero. From the vacancy equation this implies that:

$$J = \frac{\gamma_0}{\left(\frac{\delta}{v} + \frac{h(\theta)}{\theta} \right)} \qquad (23)$$

By substituting this into the equation describing the value to the firm of a filled job, setting the present discounted value of vacancies to zero and rearranging, we obtain the following labour demand function:

$$cu(r+s)\gamma_0\theta = (A-w)(\delta + cuh\,\theta) \qquad (24)$$

If there was no local job matching method, that is $\delta = 0$, this labour demand condition would be the same as the condition derived in Pissarides (1990). It is interesting to note that the introduction of local matching means that firms take

account of the average level of search intensity in the aggregate unemployment pool as well as the wage and aggregate labour market tightness, which are the only two factors relevant to the firm's decision in the standard model. To ensure incentive compatibility, it is important that wages are set so that the return to the firm to filling a job, *A-w*, exceeds the costs of holding open a vacancy.

9.2.3 Wage Bargaining

The standard assumption about wage bargaining in the job search literature is that there is a Nash bargain between firms and workers. The result is that the surplus of matching a worker and a vacancy is divided between the two parties according to their relative bargaining strengths (Pissarides,1990; Mortensen and Pissarides, 1999). Consequently:

$$w = \beta(E - U + J - V) \tag{25}$$

where β is the relative bargaining strength of the workers.

There are two reasons to find an alternative solution to this bargaining process for our purposes. The first is that in a framework where individuals are not homogeneous, the wage generated by the Nash bargaining solution will vary depending on which neighbourhood the unemployed worker comes from. This introduces the possibility of strategic behaviour by firms and individuals which unnecessarily complicates the structure of the model given our objectives.

The second issue with the standard Nash bargaining solution is that it is a bargain over the total surplus generated by the match, despite the fact that the costs of search and the costs of holding a vacancy open have already been sunk. This is unsatisfactory as only the surplus generated by the match after the sunk costs

have been spent can be held back and bargained over. Within this framework, the surplus is the marginal product of labour, A, and the wage outcome will be:

$$w = \beta A \tag{26}$$

This can also be derived as the outcome of a bargaining process under specific conditions.[23]

9.3 General Equilibrium

In this section we combine the behaviour of individuals and firms, to obtain some general equilibrium results. In particular, we consider a situation in which all neighbourhoods start with the same flow of benefits to being unemployed, which implies that all individuals start choosing the same search effort and that the unemployment rate in all neighbourhoods is the same. We compare this equilibrium with the equilibrium in Pissarides (1990) and examine the effects of increasing the efficiency of the local search method and of increasing the flow of benefits to being unemployed in one neighbourhood.

Assuming that $z_n = z$, $u_n = u$ and $c_n = c$, and substituting out the wage using Equation 26, we can summarise the equilibrium of this model with three equations:

$$\left(r + s + \frac{\delta}{u} + ch(\theta)\right) \bullet \sigma_c(c;z) + (\beta A - \sigma\ c;z\ ) \bullet h(\theta) = 0 \tag{19}$$

---

[23] The original discussion of how this may be the outcome of a bargaining process is in Binmore, Rubenstein and Wolinsky (1986) and Wolinsky (1987). A more recent discussion in the context of job-search models can be found in Mortensen and Pissarides (1999).

$$u = \frac{s-\delta}{s+ch(\theta)} \tag{21}$$

$$cu(r+s)\gamma_3\theta - (1-\beta)A(\delta + cuh\,\theta) = 0 \tag{24}$$

These three equations represent the job-search effort condition, the steady state unemployment condition and the aggregate demand for labour condition, and can be solved for the three endogenous variables, c, u, and θ. One of the important differences between this system of equations and the system of three equations derived by Pissarides (1990), is that introducing the local search method has also introduced the unemployment rate u into the job-search effort condition and the aggregate demand for labour. This means that where the job-search effort condition and aggregate labour demand can be used to solve for c and θ in the Pissarides (1990) framework, it is not possible to recursively solve the system of equations above in this way.

The three equation system can be reduced to a two equation system using the Equation 21 to eliminate u:

$$\left(s^2 + r(s-\delta) + sch(\theta)\right)\sigma_c(c;z) + (s-\delta)(\beta A - \sigma\, c;z\,)h(\theta) = 0 \tag{27}$$

$$(s-\delta)(r+s)\gamma_3 c\theta - (1-\beta)As(\delta + ch\,\theta) = 0 \tag{28}$$

The relationships between search effort, c, and labour market tightness, θ, defined by these relationships are established in Propositions 1 and 2.

Proposition 1

Assuming that $z_n = z$, $u_n = u$ and $c_n = c$, job-search effort will be an increasing function of labour market tightness.

Proof

Implicitly differentiating the job-search effort choice with respect to aggregate labour market tightness using Equation 27, gives us the following expression:

$$\left.\frac{\partial c}{\partial \theta}\right|_{Eq\,27} = \frac{-h'(\theta)\left((s-\delta)(\beta A - \sigma\, c; z\,) + sc\sigma_c(c;z)\right)}{\sigma_{cc}(c;z)\left(s^2 + r(s-\delta) + sch(\theta)\right) + \delta h(\theta)\sigma_c(c;z)} \tag{29}$$

Knowing that $\sigma_c(c;z)$ and $\sigma_{cc}(c;z)$ are negative and that the condition for an interior solution to the steady state unemployment equation, $s > \delta$, is satisfied, allows us to sign the denominator of this expression as being unambiguously negative. The numerator can be signed by noting that the last term is a part of Equation 27:

$$sc\sigma_c(c;z) + (s-\delta)(\beta A - \sigma\, c; z\,) = -\frac{\left(s^2 + r(s-\delta)\right)\sigma_c(c;z)}{h(\theta)} > 0 \tag{30}$$

Consequently, $\left.\frac{\partial c}{\partial \theta}\right|_{Eq\,27} > 0$ ∎

Proposition 2

The elasticity of aggregate labour market tightness, which is determined by firm's demand for labour, to the average level of search effort is negative one.

Proof

This proposition can be shown by implicitly differentiating aggregate labour market tightness with respect to average search intensity in Equation 28.

$$\left.\frac{\partial\theta}{\partial c}\right|_{Eq\,28} = \frac{-((s-\delta)(r+s)\gamma_0\theta-(1-\beta)Ash(\theta))}{(s-\delta)(r+s)\gamma_0 c-(1-\beta)Asch'(\theta)}$$

$$= -\frac{\theta}{c}\bullet\frac{(s-\delta)(r+s)\gamma_0\theta-(1-\beta)Ash(\theta)}{(s-\delta)(r+s)\gamma_0\theta-(1-\beta)Asch'(\theta)\theta} \qquad (31)$$

$$= -\frac{\theta}{c}$$

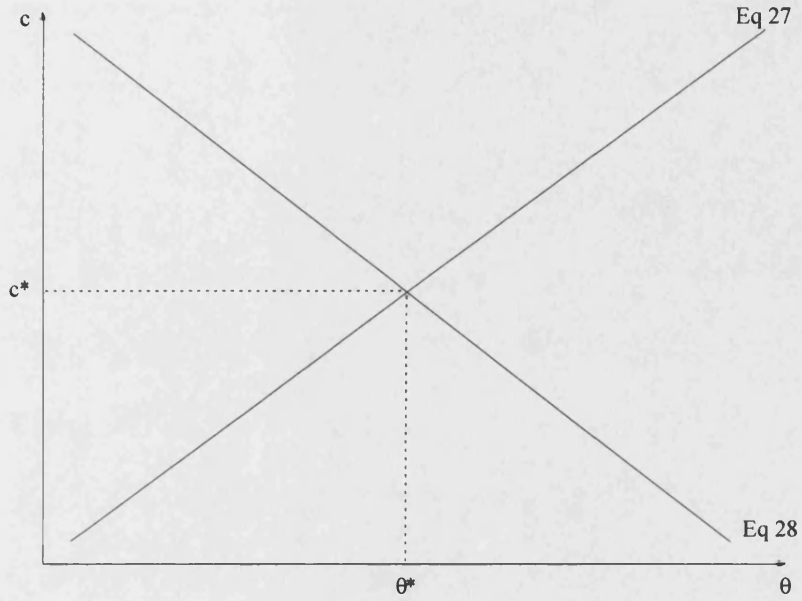
$$\Rightarrow \frac{\partial\theta/\theta}{\partial c/c} = -1 \qquad (32)$$

The numerator and denominator of the final term in line two cancel when it is noted that the function $h(\theta)$ is homogenous of degree one.∎

The search effort of individuals, c, is an increasing function of labour market tightness, and the labour demand of firms is a decreasing function of the average search effort of individuals, ensuring that an equilibrium exists (Figure 15).

A second important difference between the current model and the Pissarides (1990) framework is the relationship between labour market tightness and average job-search effort. Pissarides (1990) finds that firms increase the number of vacancies in response to an increase in the average level of search effort in the economy, whereas Proposition 2 shows that the relationship is negative. The difference between the aggregate labour demand functions obtained from the two models arises due to a combination of different wage setting rules and the introduction of the local search method.

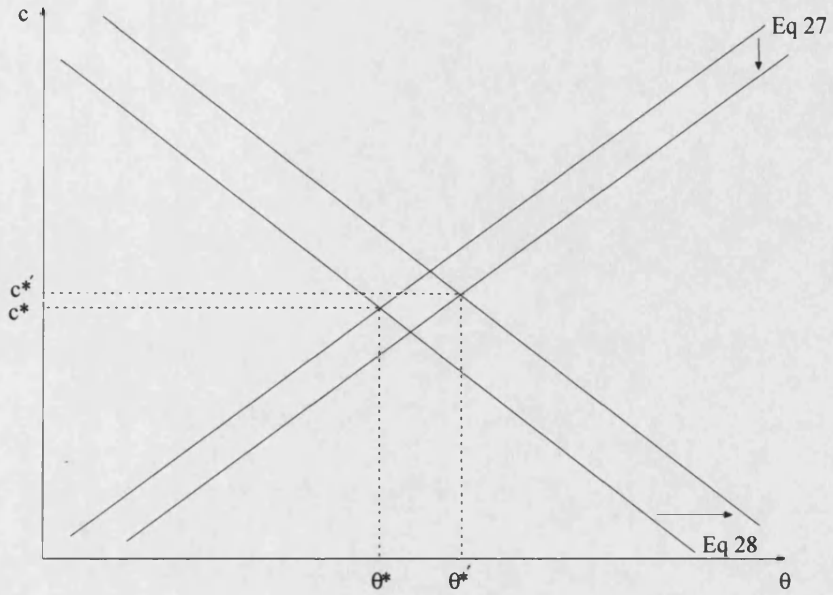
Figure 15: Aggregate Labour Demand And Search Intensity



In the current framework, the average level of search effort enters the labour demand equation due to the presence of the local search method: if $\delta=0$, the average search effort would cancel from this equation. As search effort increases, firms can achieve the same probability of matching by opening less vacancies. In the Pissarides (1990) framework, the average level of search effort enters the labour demand function through the firm's share of the surplus from the Nash bargain which depends on the costs of search. If search effort increases, the costs of searching increase, the surplus generated by the match falls and the firm must open more vacancies to generate the same surplus.

Another way of understanding the effect of introducing a local search method is to examine an increase in the effectiveness of the local search method. Using Equations 27 and 28, the effect of increasing the efficiency of the local search method is illustrated in Figure 16.

Figure 16: An Increase In Local Search Method Efficiency



Given the level of labour market tightness, the average level of search intensity will fall in response to an increase in the efficiency of the local search method (Equation 27). The incentive for an individual to search using the general search method falls if the chances of obtaining work with no costly effort rises. For a given level of search effort, the probability of firms filling vacancies will increase (Equation 28) if local matching is more efficient. This results in a shift out of the aggregate labour demand schedule. The combination of these two effects leads to an unambiguous increase in aggregate labour market tightness.

Proposition 3

The average level of search intensity will increase and the aggregate unemployment rate will decrease in response to an increase the efficiency of the local search method.

Proof

The proof requires the three aggregate conditions to be totally differentiated. See Appendix C for details. ∎

Intuitively, an increase in the effectiveness of the local search method will decrease the average time taken to fill an open vacancy. Firms will respond to this by opening more vacancies. The resulting increase in labour market tightness will increase the benefits of putting more effort into search through the general search method. Although this is offset to some extent by the decreased incentive to search harder because the probability of finding a job through the local search method increases, the overall effect is that the average level of search effort increases. The combined effect of increased search effort and labour market tightness is a fall in the unemployment rate. The overall effect of increasing the effectiveness of the local search method is beneficial to the efficient operation of the labour market.

Another interesting comparative static exercise to consider is how a change in one neighbourhood will affect the aggregate economy, given that all neighbourhoods start in an equilibrium in which $u_n = u$, $c_n = c$ and $z_n = z$. This can be characterised as an increase in the flow of benefits accruing to individuals in neighbourhood one, $\Delta z_1 > 0$.

In the previous comparative static exercise it was possible treat the model as a description of an aggregate labour market. Tracking the effect of a change in the flow of benefits to being unemployed in one neighbourhood requires the neighbourhood structure of the economy to be considered explicitly. To reduce the dimensionality of the problem, we assume that there are two neighbourhoods. The neighbourhood where the change occurs is labelled neighbourhood one and

the other *N-1* neighbourhoods are aggregated and labelled neighbourhood two. The labour market can then be characterised by six equations:

$$\left(s+r+\frac{\delta}{u_i}+c_i h(\theta)\right)\sigma_c(c_i;z_i)+(s-\delta)(\beta A-\sigma\, c_i;z_i\,)h(\theta)=0 \quad \text{for i=}\{1,2\} \quad (33)$$

$$u_i=\frac{s-\delta}{s+c_i h(\theta)} \quad \text{for i=}\{1,2\} \quad (34)$$

$$cu(r+s)\gamma_3\theta-(1-\beta)A(\delta+cuh\,\theta\,)=0 \quad (35)$$

$$cu-\frac{c_1u_1}{N}-\frac{(N-1)c_2u_2}{N}=0 \quad (36)$$

There are six endogenous variables:

- u_1 the unemployment rate in the neighbourhood where the shock occurs;
- c_1 the search effort applied to the general search method by individuals in the neighbourhood where the shock occurs;
- u_2 the unemployment rate in the unaffected neighbourhoods;
- c_2 the search effort applied to the general search method in the other neighbourhoods;
- θ aggregate labour market tightness; and
- cu the level of unemployment measured in search effort units.

This system of six equations can be reduced to a system of three equations by substituting out the local unemployment rates using Equation 34 and substituting out the aggregate unemployment rate measured in search effort units using Equation 36. The three remaining endogenous variables are c_1, c_2 and θ.

Proposition 4

The effect of an increase in the flow of benefits to being unemployed in neighbourhood one will decrease the level of search effort in neighbourhood one, increase the aggregate level of labour market tightness and increase the search effort in the other neighbourhoods. The unemployment rate in neighbourhood one will rise and the unemployment rate in all other neighbourhoods will fall.

Proof

The effect of a change in the flow of benefits to being unemployed in neighbourhood one can be calculated by totally differentiating the reduced system of three equations. Details are provided in Appendix C. ∎

The direct effect of increasing the flow of benefits to being unemployed on residents of neighbourhood one is that the incentives to search for work fall. Given that the labour demand condition has not shifted and that the individuals from neighbourhood one are competing less for existing vacancies, there is in an increase in the incentives for all job seekers to search harder. This indirect effect will result in an overall increase in labour market tightness. The direct effect of a rise in the flow of benefits to being unemployed, dominates in neighbourhood one, so the local unemployment rate will rise there, whereas the unemployment rate in neighbourhood two will fall.

As might be expected, the effect of a change in the behaviour of individuals in one neighbourhood on the aggregate labour market depends on the size of the neighbourhood relative to the aggregate. As the size of the neighbourhood decreases, or alternatively the number of neighbourhoods increases, the effect of a change in the flow of benefits to being unemployed in neighbourhood one on aggregate variables decreases.

Proposition 5

As the size of a neighbourhood decreases relative to the aggregate, or alternatively, $N \to \infty$, only local variables are affected by a change in the flow of benefits to being unemployed in that neighbourhood.

Proof

Details of the proof are provided in Appendix C. ∎

10 Data and the Basic Framework

The data used for the following analysis are from the AYS. The sample includes all 16 to 19 year-olds who report unemployment as their main activity at the time of their interview and who provide information on all the variables used in the estimation. The restriction of the sample to teenagers ensures that the age composition of the sample does not vary significantly over time. The results presented below do not rely on restricting the sample in this way.

The dependent variable used in the following analysis indicates which search methods are chosen by individuals in the sample as their main search method. Given the information in Table 13, we restrict the choice set to include three possible search methods: 'direct employer contact' or 'friends and relatives'

(taken as one category); visiting the CES; and searching in newspapers. Sample sizes do not permit us to consider 'friends and relatives' as a separate job-search method.

A set of control variables, similar to what has been used to explain other aspects of teenage decision making and behaviour in previous chapters, has been used to explain main job-search method choice of teenagers. Table 14 summarises the mean values of these variables and a more detailed discussion of the data is provided in Appendix A. For comparison, the average characteristics of teenagers who obtained employment in the survey year and report their successful job search method have also been included. Based on our observation that direct search methods are more successful than the CES or newspapers, we would expect that characteristics which are more prevalent in the employed sample would also be associated with an increased probability that an unemployed teenager would choose a direct search method.

There is a slightly higher proportion of males in the unemployed sample. The employed sample come from families where the parents have higher skill levels on average, as indicated by the higher proportion of parents with graduate and trade qualifications. Parents of the employed sample also have higher average occupational status and a higher probability of being employed. Members of the employed sample are also more likely to have been living with both parents when they were 14 years-old. Employed teenagers in the sample are less likely to have left school in Year 10 or earlier and are less likely to have attended a government high school.

Table 14: Summary Statistics by Labour Force Status

Averages by group, standard errors in parenthesis where appropriate

	Sample of unemployed*	Sample of employed
Personal background		
Male	0.52	0.51
Age	17.93 (0.99)	17.90 (0.99)
Married	0.06	0.04
Number of siblings	2.42 (1.76)	2.29 (1.57)
Parents' characteristics		
Father's occupational status @14	22.89 (22.84)	28.26 (23.08)
Mother's occupational status @14	14.95 (20.20)	17.95 (20.89)
Father not employed @14	0.08	0.04
Mother not employed @14	0.45	0.38
Father not present @14	0.22	0.15
Mother not present @14	0.05	0.04
Father has:		
Degree	0.10	0.12
Trade qualifications	0.13	0.18
Other post school qualifications	0.08	0.09
Secondary education	0.34	0.37
No qualifications	0.35	0.24
Mother has:		
Degree	0.08	0.09
Trade qualifications	0.04	0.05
Other post school qualifications	0.13	0.14
Secondary education	0.56	0.58
No qualifications	0.19	0.14
School/work experience		
Attended government school	0.79	0.74
Left school in year 10 or earlier	0.30	0.26
Years since leaving school	1.57 (1.13)	1.56 (1.00)
Current unemployment duration**	29.18 (31.13)	9.94 (14.45)
Receives unemployment benefits	0.53	0.04
Neighbourhood		
Average personal income	17.27 (3.01)	17.88 (3.31)
Unemployment rate	12.85 (4.81)	11.75 (4.31)
Per cent with vocational qualifications	14.51(2.99)	14.95 (3.11)
Per cent with post graduate qualifications	10.67 (6.40)	11.45 (6.65)

Notes: @14 indicates that the variable takes the characteristic of the parent when the respondent was 14 years-old;
* these are the average characteristics of those unemployed individuals used in the following estimation, i.e. 2,284 observations;
** this is the length of the previous unemployment spell for the employed.

Perhaps the most marked difference between the two samples is the average unemployment experience. The current duration of unemployment has been included in the analysis to capture the possibility that the effectiveness and availability of different search methods may change over the course of a spell of unemployment. To ensure that this is not picking up some measure of the time spent in the labour force, the number of years since leaving school has also been included in the specification. The unemployed sample have experienced an average incomplete duration of unemployment of 29 weeks, whereas the employed sample experienced an average completed duration of unemployment of 10 weeks.

A dummy variable which indicates whether the individual receives unemployment benefits or the Job Search Allowance (JSA) is included to control for the fact that receipt of this benefit will affect the costs of unemployment. Roughly half the unemployed report that they receive unemployment benefits or the Job Search Allowance. A very small percentage of the employed report that they are also receiving benefits which is possible if they are earning a sufficiently small amount.

As already discussed, another potentially important influence on the job search behaviour of individuals is their local environment. Neighbourhood characteristics have been controlled for using the same set of variables that are used in Chapter 2. Of special interest, given the model developed in Section 3, is the local unemployment rate which can be thought of as a proxy for the effectiveness of local job-information networks. The neighbourhood composition variables tell a similar story to the family background characteristics. On average, respondents in the employed sample come from neighbourhoods where the unemployment rate is lower, and the average skill level, measured as the

proportion of the adult population with vocational or graduate qualifications, is higher.

11 Estimation Framework and Results

The dependent variable for the analysis below indicates which of the three possible job-search methods is reported as the *main* job-search method by the unemployed respondent. Because the choices of main job search method are mutually exclusive and exhaustive, it is necessary to use an estimation technique which imposes this restriction. Following the discussion in Chapter 3, the results presented in Table 15 are the marginal effects estimated from a multinomial logit model. It should be noted that section of state, state and year indicators were included in the estimation, but have not been reported to minimise the volume of results. For each choice, the first column presents the marginal effects calculated at the sample averages and the second presents the t-statistics.

Gender and age are both important for explaining the observed job-search behaviour of unemployed teenagers. Males are 4.9 per cent more likely to choose direct methods, and are 6.8 per cent more likely to choose the CES than females. Because the predicted probabilities must sum to unity, this implies that females are 11.6 per cent more likely than males to use newspapers as their main job-search choice. Older teenagers are more likely to use direct methods and are less likely to use the CES.

Table 15: Estimation Results

Number Of Observations: 2,284

	Direct methods		CES		Newspapers	
	∂Pr/∂x	t-stat	∂Pr/∂x	t-stat	∂Pr/∂x	t-stat
Personal background						
Male*	0.049	2.37	0.068	3.45	-0.116	-5.28
Age	0.036	2.20	-0.056	-3.74	0.020	1.16
Married*	-0.069	-1.49	-0.061	-1.46	0.129	2.81
Number of siblings	-0.004	-0.74	0.007	1.35	-0.003	-0.44
Parents' characteristics						
Father's occupational status @14	0.001	1.75	-0.001	-1.14	-0.000	-0.53
Mother's occupational status @14	0.000	0.21	-0.000	-0.44	0.000	0.22
Father not employed @14*	0.106	2.41	-0.012	-0.30	-0.093	-1.88
Mother not employed @14*	0.067	2.06	0.016	0.52	-0.083	-2.43
Father not present @14*	0.007	0.17	0.049	1.23	-0.057	-1.23
Mother not present @14*	0.055	0.89	-0.087	-1.60	0.032	0.50
Father has:						
Degree*	-0.022	-0.42	0.087	1.68	-0.065	-1.17
Trade qualifications*	-0.008	-0.19	0.066	1.57	-0.058	-1.21
Other post school qualifications*	-0.027	-0.55	0.058	1.20	-0.031	-0.59
Secondary education*	-0.016	-0.42	0.075	2.11	-0.059	-1.47
Mother has:						
Degree*	0.096	1.81	-0.081	-1.55	-0.015	-0.25
Trade qualifications*	0.054	0.86	-0.128	-2.13	0.074	1.11
Other post school qualifications*	0.080	1.81	-0.151	-3.56	0.071	1.49
Secondary education*	0.029	0.80	-0.086	-2.80	0.058	1.53
School/work experience						
Attended government sch*	-0.025	-0.94	0.062	3.19	-0.037	-1.28
Left in year 10 or earlier*	0.006	0.19	0.044	2.48	-0.050	-1.39
Years since leaving school	0.006	0.42	0.024	1.85	-0.030	-1.92
Current unemployment duration	-0.000	-1.24	-0.000	-0.96	0.001	1.96
receive unemployment benefits	-0.106	-4.45	0.192	8.41	-0.086	-3.38
Neighbourhood						
Average personal income	-0.025	-3.37	0.007	1.03	0.018	2.23
Unemployment rate	-0.011	-3.35	0.005	1.54	0.006	1.83
Per cent with voc. qualifications	-0.006	-1.24	0.005	1.13	0.001	0.17
Per cent with grad. qualifications	0.005	1.39	-0.001	-0.42	-0.003	-0.92

Note: Section of state and state of residence and time dummies have been included, but have not been reported; Dummy variables are indicated by an asterisk.

Parents' characteristics have some effect on observed job-search behaviour. Unemployed teenagers are more likely to use direct methods and are less likely to use the CES as the occupational status of their parents' jobs, especially their father's job, increases. If either parent was not employed when the respondent was 14 years old, the respondent is more likely to use direct search methods and less likely to use newspapers. The effects of parents' education are difficult to interpret. More educated mothers however, generally have children who are more likely to use direct search methods and are less likely to use the CES.

Education and employment histories of the individual are also important. Respondents who attended government schools and/or left school in Year 10 or earlier are significantly more likely to use the CES as their main job-search method. The combined effect of having both these characteristics is to increase the probability of choosing the CES by 10.6 percentage points.

Teenagers who have been in the labour force for longer are more likely to be searching through the CES and are less likely to be using newspapers. Having controlled for the years since leaving school it is interesting that current unemployment duration significantly increases the probability that newspapers are reported as the main job-search method and decreases the probability of using direct search methods. This provides some limited support for the hypothesis that the unemployed are less likely to be observed using direct methods because the expected benefits of these methods diminish over the duration of unemployment.

Perhaps the most important single variable for explaining the choice of main job-search method is the indicator for unemployment benefit receipt. Individuals receiving unemployment benefits are almost 20 percentage points more likely to use the CES as their main method of job search. One explanation for this is that individuals receiving unemployment benefits are required to demonstrate that

they are looking for work and registering with the CES offers an easy way of doing this. However, even if this were the case, it would not necessarily imply that the CES would be reported as the *main* method of search.

Although receiving unemployment benefits would be expected to increase the flow of benefits to being unemployed all else being equal, unemployment benefits in Australia are subject to a means-test. Therefore, individuals who receive benefits are likely to come from more financially constrained backgrounds and the net effect of these two financial considerations could easily be that benefit recipients have lower flows of income while unemployed on average. In light of this, another explanation for the significant effect of benefit receipt on the probability of using the CES is that eligible individuals have a lower flow of benefits to being unemployed on average. Following the model outlined in Section 3, this would lead eligible individuals to search harder, increasing the probability that they are observed using indirect methods. However, this explanation also implies that the probability of observing that newspapers are the main method of job-search should be higher for eligible individuals. In fact teenagers receiving unemployment benefits are less likely to be observed using newspapers by around 8.6 percentage points.

The two explanations for the significance of the effect of benefit receipt on job-search behaviour are not inconsistent, and there is likely to be some truth in each. However, the argument for the work-test explanation is perhaps the most consistent with the effects of eligibility on the probability of choosing other job-search methods.

Two neighbourhood characteristics appear to be important. As hypothesised, a higher local unemployment rate decreases the probability that an unemployed teenager will choose direct search methods. An increase in the local

unemployment rate of one per cent will decrease the probability of using direct search methods by 1.1 percentage points. The marginal effect of a one percentage point increase in the local unemployment rate on the probability of using either the CES or newspapers is around 0.5 of a percentage point. Consequently, the degree of competition for jobs at a local level and the lack of access to a local job-information network, as proxied by the local unemployment rate, can help explain why unemployed teenagers are less likely to be observed using direct search methods although they have proved to be the most successful methods of finding work for employed teenagers.

The other significant neighbourhood characteristic is the average level of personal income. Given that we have controlled for an extensive array of background characteristics as well as the proportion of the neighbourhood with either academic or vocational post-school training, it is puzzling that coming from a neighbourhood with higher average personal income seems to reduce the use of direct methods. Since high income is likely to be correlated with unobserved characteristics measuring success, the average level of personal income in the neighbourhood might have been expected to have the opposite effect.

12 Conclusions

Australian and international evidence suggests that the most effective job search methods are direct methods such as using family and friends for information or directly contacting employers. Over 60 per cent of Australian teenagers obtain their jobs using these methods, whereas only 30 per cent of unemployed Australian teenagers report these direct methods as their main method of job search.

We find that the single most important characteristic for explaining the job-search method choices of Australian teenagers is whether they receive unemployment benefits. Receiving benefits increases the probability of a teenager using the CES as the main job-search method by almost 20 percentage points and decreases the probability of using direct methods or newspapers by around 10 percentage points each. Due to the means-tested nature of these benefits, this variable may be picking up unmeasured family characteristics. However, the fact that the CES offers a relatively easy way for benefit recipients to demonstrate that they are looking for work is likely to be a more significant factor.

Personal characteristics and family background are also important for understanding how unemployed teenagers search for work. In general, unemployed individuals with more highly skilled or better educated parents are more likely to use direct methods than to use the CES. Males are more likely to use direct methods or the CES than newspapers as their main job-search activity. Older unemployed teenagers are also more likely to use direct methods than the CES. Individuals who attended government school or left school in Year 10 or earlier have a significantly higher probability of using the CES and a significantly lower probability of using newspapers.

One reason why unemployed teenagers may not be using job-search methods which appear to be more effective for teenagers who actually found work, is that these methods have been tried and their possibilities exhausted. This is supported by the finding that unemployed individuals with longer unemployment durations were significantly more likely to use newspapers as their main job-search method and were less likely to use direct search methods.

Another interesting finding is that the local environment, especially the state of the local labour market, is important for explaining job-search method choice. Higher local unemployment rates decrease the probability that an unemployed teenager will use direct search methods, and increase the probability that they will use the CES. These results are consistent with the economic model developed in Section 3, which highlights the importance of local job-information networks and local labour market conditions for explaining job-search behaviour.

An interesting implication of these results is that they help to explain the recently documented evidence that unemployment has become increasingly concentrated in low-socioeconomic status neighbourhoods (Gregory and Hunter, 1995). An adverse labour demand shock in one neighbourhood will raise the local unemployment rate and lower the probability that individuals in that neighbourhood will obtain work through friends and relatives or direct employer contact. This increases the incentives for people in these areas to search using general search methods such as newspapers or employment agencies, but their overall probability of finding work could easily fall despite this. Thus, the effects of an exogenous shock can be magnified within neighbourhoods if job-information networks are local in nature and provide an effective means of finding employment. If this is an important part of the explanation for the increasing concentration of unemployment in low-socioeconomic areas, it suggests that it is important for government policy to improve the effectiveness of general search methods in these areas. Steps in this direction have already been taken with recent changes to the operation of employment agencies in Australia.

APPENDIX C: DETAILS OF PROOFS

1 Details of the Proof of Proposition 3

Write the total differential system as:

$$[Z_c \quad Z_\theta \quad Z_u]\begin{bmatrix} dc \\ d\theta \\ du \end{bmatrix} = Z_\delta d\delta$$

where:

$$Z_c = \begin{bmatrix} \sigma_{cc}\left(r+s+\dfrac{\delta}{u}+ch(\theta)\right) \\ -h(\theta)u \\ u\theta(\, r+s\,\gamma_0-1-\beta\, Ah'\,\theta\,) \end{bmatrix}$$

$$Z_\theta = \begin{bmatrix} (c\sigma_c+A\beta-\sigma)h'(\theta) \\ -cuh'(\theta) \\ cu(\, r+s\,\gamma_0-1-\beta\, Ah'\,\theta\,) \end{bmatrix}$$

$$Z_u = \begin{bmatrix} -\sigma_c\dfrac{\delta}{u^2} \\ -(s+ch\,\theta\,) \\ c\theta(\, r+s\,\gamma_0-1-\beta\, Ah'\,\theta\,) \end{bmatrix}$$

$$Z_\delta = \begin{bmatrix} -\dfrac{\sigma_c}{u} \\ 1 \\ (1-\beta)A \end{bmatrix}$$

In order to apply Cramer's Rule it is useful to sign the component determinants:

$$|Z_c \quad Z_\theta \quad Z_u| = [(r+s)\gamma_3 - (1-\beta)Ah'(\theta)]\times$$
$$\left[cus\sigma_{cc}\left(r+s+\frac{\delta}{u}+ch(\theta)\right)-h(\theta)us(c\sigma_c+A\beta-\sigma)\right]<0$$

$$|Z_\delta \quad Z_\theta \quad Z_u| = -(r+s)c\gamma_3\left[\sigma_c\left(s+\frac{\delta}{u}+ch(\theta)\right)-h(\theta)(A\beta-\sigma)\right]-$$
$$s(1-\beta)Ah'(\theta)(A\beta-\sigma)<0$$

$$|Z_c \quad Z_\delta \quad Z_u| = \sigma_{cc}\left(r+s+\frac{\delta}{u}+ch(\theta)\right)(c\theta(r+s)\gamma_3+(1-\beta)As)+\sigma_c\theta\gamma_3(r+s)\frac{\delta}{u}+$$
$$\sigma_c s\theta(r+s\ \gamma_3-1-\beta\ Ah'\ \theta)<0$$

$$|Z_c \quad Z_\theta \quad Z_\delta| = -(r+s)\gamma_3 c\left[\sigma_c\left(s+\frac{\delta}{u}+ch(\theta)\right)+(A\beta-\sigma)h(\theta)\right]-$$
$$s(1-\beta)Ah'(\theta)(A\beta-\sigma)>0$$

Applying Cramer's Rule and knowing the signs of the component determinants allows us to sign the relevant total derivatives.

$$\frac{dc}{d\delta}=\frac{|Z_\delta \quad Z_\theta \quad Z_u|}{|Z_c \quad Z_\theta \quad Z_u|}>0$$

$$\frac{d\theta}{d\delta}=\frac{|Z_c \quad Z_\delta \quad Z_u|}{|Z_c \quad Z_\theta \quad Z_u|}>0$$

$$\frac{du}{d\delta}=\frac{|Z_c \quad Z_\theta \quad Z_\delta|}{|Z_c \quad Z_\theta \quad Z_u|}<0$$

2 Details of the Proof of Proposition 4

The system of three differential equations can be characterised as:

$$\begin{bmatrix} X_{c_1} & X_{c_2} & X_\theta \end{bmatrix} \begin{bmatrix} dc_1 \\ dc_2 \\ d\theta \end{bmatrix} = X_{z_1} dz_1$$

Assuming for simplicity that $\sigma_{cz} = 0$:

$$X_{c_1} = \begin{bmatrix} \dfrac{\delta h(\theta)\sigma_c(c_1;z_1) + (s-\delta)\sigma_{cc}(c_1;z_1)\left(r+s+c_1h(\theta)+\delta\dfrac{s+c_1h(\theta)}{(s-\delta)}\right)}{(s-\delta)} \\ 0 \\ \dfrac{(2h(\theta)c_1+s)\theta(\, r+s\,\gamma_3 - 1-\beta\, Ah'\,\theta\,)}{N(s-\delta)} \end{bmatrix} = \begin{bmatrix} X_{11} \\ 0 \\ X_{31} \end{bmatrix}$$

$$X_{c_2} = \begin{bmatrix} 0 \\ \dfrac{\delta h(\theta)\sigma_c(c_2;z_2) + (s-\delta)\sigma_{cc}(c_2;z_2)\left(r+s+c_2h(\theta)+\delta\dfrac{s+c_2h(\theta)}{(s-\delta)}\right)}{(s-\delta)} \\ \dfrac{(N-1)(2h(\theta)c_2+s)\theta(\, r+s\,\gamma_3 - 1-\beta\, Ah'\,\theta\,)}{N(s-\delta)} \end{bmatrix} = \begin{bmatrix} 0 \\ X_{22} \\ X_{32} \end{bmatrix}$$

$$X_\theta = \begin{bmatrix} \dfrac{sc_1\sigma_c(c_1;z_1) + (s-\delta)(A\beta - \sigma\, c_1;z_1\,)h'(\theta)}{(s-\delta)} \\ \dfrac{sc_2\sigma_c(c_2;z_2) + (s-\delta)(A\beta - \sigma\, c_2;z_2\,)h'(\theta)}{(s-\delta)} \\ \left(\dfrac{2c_1^2h(\theta) + 2(N-1)c_2^2h(\theta) + s(c_1 + N-1\, c_2)}{N(s-\delta)}\right)((r+s)\gamma_3 - (1-\beta)Ah'(\theta)) \end{bmatrix} = \begin{bmatrix} X_{13} \\ X_{23} \\ X_{33} \end{bmatrix}$$

$$X_{z_1} = \begin{bmatrix} h(\theta)\sigma_z(c_1;z_1) \\ 0 \\ 0 \end{bmatrix}$$

Signing the determinants required to apply Cramer's rule:

$$\left|X_{c_1} \quad X_{c_2} \quad X_\theta\right| = X_{11}[X_{22}X_{33} - X_{23}X_{32}] + X_{31}[0 - X_{13}X_{22}] > 0$$

$$\begin{vmatrix} X_{z_1} & X_{c_2} & X_\theta \end{vmatrix} = h(\theta)\sigma_z(c_1;z_1)[X_{22}X_{33} - X_{23}X_{32}] < 0$$
$$\begin{vmatrix} X_{c_1} & X_{z_1} & X_\theta \end{vmatrix} = X_{11}[0-0] + X_{31}[h\,\theta\,\sigma_z\,c_1;z_1\,X_{23} - 0] > 0$$
$$\begin{vmatrix} X_{c_1} & X_{c_2} & X_{z_1} \end{vmatrix} = X_{11}[0-0] + X_{31}[0 - h\,\theta\,\sigma_z\,c_1;z_1\,X_{22}] > 0$$

The signs of the total differentials of the endogenous variables with respect to a change in z_1 are therefore:

$$\frac{dc_1}{dz_1} = \frac{\begin{vmatrix} X_{z_1} & X_{c_2} & X_\theta \end{vmatrix}}{\begin{vmatrix} X_{c_1} & X_{c_2} & X_\theta \end{vmatrix}} < 0$$

$$\frac{dc_2}{dz_1} = \frac{\begin{vmatrix} X_{c_1} & X_{z_1} & X_\theta \end{vmatrix}}{\begin{vmatrix} X_{c_1} & X_{c_2} & X_\theta \end{vmatrix}} > 0$$

$$\frac{d\theta}{dz_1} = \frac{\begin{vmatrix} X_{c_1} & X_{c_2} & X_{z_1} \end{vmatrix}}{\begin{vmatrix} X_{c_1} & X_{c_2} & X_\theta \end{vmatrix}} > 0$$

Noting that:

$$\theta X_{33} - c_1 X_{13} = \frac{(r + s\,\gamma_0 - 1 - \beta\,Ah'\,\theta)}{N(s-\delta)} \times$$
$$\left(2c_1^2 h(\theta) + 2(N-1)c_2^2 h(\theta) + s(c_1 + N - 1\,c_2) - 2c_1^2 h(\theta) - sc_1\right)$$
$$= \frac{(r + s\,\gamma_0 - 1 - \beta\,Ah'\,\theta)}{N(s-\delta)}\left(2(N-1)c_2^2 h(\theta) + s(N-1)c_2\right) > 0$$

the sign of the effect of a change in the flow of benefits to the unemployed in neighbourhood one on the unemployment rates of neighbourhoods one and two, can be evaluated as:

$$\frac{1}{u_1(s+c_1 h\ \theta\ )}\frac{du_1}{dz_1} = -h(\theta)\frac{dc_1}{dz_1} - c_1 h'(\theta)\frac{d\theta}{dz_1}$$

$$= -\frac{h(\theta)h(\theta)\sigma_z(c_1;z_1)[X_{22}X_{33} - X_{23}X_{32}]}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|} - \frac{c_1 h'(\theta)h(\theta)\sigma_z(c_1;z_1)X_{31}X_{22}}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|}$$

$$= \frac{-h'(\theta)h(\theta)\sigma_z(c_1;z_1)[\theta X_{22}X_{33} - \theta X_{23}X_{32} - c_1 X_{31}X_{22}]}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|}$$

$$= \frac{-h'(\theta)h(\theta)\sigma_z(c_1;z_1)[-\theta X_{23}X_{32} + X_{22}(\theta X_{33} - c_1 X_{31})]}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|} > 0$$

$$\frac{1}{u_2(s+c_2 h\ \theta\ )}\frac{du_2}{dz_1} = -h(\theta)\frac{dc_2}{dz_1} - c_2 h'(\theta)\frac{d\theta}{dz_1}$$

$$= -\frac{h(\theta)h(\theta)\sigma_z(c_1;z_1)X_{31}X_{23}}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|} - \frac{c_1 h'(\theta)h(\theta)\sigma_z(c_1;z_1)X_{31}X_{22}}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|}$$

$$= \frac{-h'(\theta)h(\theta)\sigma_z(c_1;z_1)[\theta X_{31}X_{23} - c_2 X_{31}X_{22}]}{\left|X_{c_1}\quad X_{c_2}\quad X_\theta\right|} < 0$$

3 Details of the Proof of Proposition 5

As $N \to \infty$:

$X_{31} \to 0$

$$X_{32} \to \frac{(2h(\theta)c_2 + s)\theta(\ r + s\ \gamma_0 - 1 - \beta\ Ah'\ \theta\ )}{(s-\delta)} > 0$$

$$X_{33} \to \frac{(2h(\theta)c_2 + s)c_2(\ r + s\ \gamma_0 - 1 - \beta\ Ah'\ \theta\ )}{(s-\delta)} > 0$$

Consequently,

$$\left|X_{c_1} \quad X_{z_1} \quad X_\theta\right| = X_{11}[0-0]+0\times[h_{.}\theta_{.}\sigma_{z_{.}}c_1;z_{1_{.}}X_{23}-0]=0$$
$$\left|X_{c_1} \quad X_{c_2} \quad X_{z_1}\right| = X_{11}[0-0]+0\times[0-h_{.}\theta_{.}\sigma_{z_{.}}c_1;z_{1_{.}}X_{22}]=0.$$

Therefore,

$$\frac{dc_2}{dz_1} = \frac{\left|X_{c_1} \quad X_{z_1} \quad X_\theta\right|}{\left|X_{c_1} \quad X_{c_2} \quad X_\theta\right|} = 0$$

$$\frac{d\theta}{dz_1} = \frac{\left|X_{c_1} \quad X_{c_2} \quad X_{z_1}\right|}{\left|X_{c_1} \quad X_{c_2} \quad X_\theta\right|} = 0$$

$$\frac{1}{u_1(s+c_1h\,\theta)}\frac{du_1}{dz_1} = -h(\theta)\frac{dc_1}{dz_1} - c_1h'(\theta)\times 0 > 0$$

$$\frac{1}{u_2(s+c_2h\,\theta)}\frac{du_2}{dz_1} = -h(\theta)\times 0 - c_2h'(\theta)\times 0 = 0$$

The effects can be summarised as:

$$\frac{dc_1}{dz_1}<0,\ \frac{dc_2}{dz_1}=0;\ \frac{du_1}{dz_1}>0;\ \frac{du_2}{dz_1}=0;\ \frac{d\theta}{dz_1}<0;\ \frac{dcu}{dz_1}=0.$$

CHAPTER 5

RESERVATION WAGES AND THE DURATION OF UNEMPLOYMENT

1 Introduction

The average duration of unemployment in Australia has increased significantly since the 1960s (Figure 2). Despite its importance for understanding the rise in Australia's aggregate unemployment rate, there has been relatively little empirical investigation of its causes. To the extent that the Australian literature has addressed this issue, the focus has been on explaining the probability of leaving unemployment rather than on the factors which directly affect unemployment duration. In particular, the role of minimum wages, either as legal minima that influence firm behaviour, or as minimum acceptable wages to job seekers, has not been analysed in depth.

This paper investigates the factors affecting the duration of unemployment using data on individual Australian job seekers. These data, which come from the Survey of Employment and Unemployment Patterns (SEUP), allow us to assess the influence of a comprehensive array of personal characteristics. Importantly, the data set provides job seekers' responses concerning their minimum acceptable (or reservation) wage. The reservation wage is a central feature of basic job-search theory and its availability allows us to specify an empirical model closely tied to theory. Although previous Australian studies have investigated unemployment duration using data on individuals, the reservation wage has only been included in these studies in an *ad hoc* manner, to the extent that it has been considered directly at all.

We find that the reservation wage does not appear to affect the duration of unemployment in general. The binding constraint for job seekers is more likely to be that they receive very few job offers. Descriptive evidence suggests that one reason for this may be that minimum wages are pricing some job seekers out of the market. However, more research is required to properly understand the role of minimum wages. Non-wage aspects of employment, such as the type of occupation, also appear to have a role to play in explaining job seeker behaviour. There is evidence that the reservation wage affects the duration of unemployment of females. However, supporting evidence suggests that this result is likely to be influenced by females who are marginally attached to the labour force rather than unemployed *per se*, and for whom family considerations such as child care costs are an important factor.

The rest of the paper is organised as follows: in Section 2 we briefly review current evidence regarding which factors affect unemployment duration in Australia. This also provides an opportunity to motivate the approach taken in this paper. In Section 3 we discuss the data used and consider descriptive evidence for the role played in job-search behaviour by the reservation wage. We derive an empirical model of unemployment duration from job-search theory in Section 4. In Section 5, we present the results and consider whether the estimation issues highlighted in Section 4 are of practical concern. Finally, Section 6 concludes.

2 The Australian Evidence

As there are relatively few cross-section or longitudinal data sets available, most Australian studies of unemployment have been based on macroeconomic data. In general, studies which have used data on individuals have estimated models which explain the probability of leaving unemployment, either after a given

duration of unemployment or over a fixed period of time. The probability of leaving unemployment, indirectly provides information about the characteristics which are likely to affect an individual's duration of unemployment. To date, only Miller and Volker (1987) have directly investigated those factors which affect unemployment duration using individual level data.

The most frequently used empirical model for investigating unemployment at the individual level explains the probability of leaving unemployment given the duration of unemployment already experienced. This framework, also known as the hazard model, has been used by Brooks (1986), Miller and Volker (1987) and Chapman and Smith (1992) to look at the youth labour market. It has also been used by Aungles and Stewart (1986) to look at the behaviour of job seekers registered with the Commonwealth Employment Service (CES) in the Brisbane metropolitan area and by Stromback, Dockery and Ying (1998) to look at a large cross-section of Australian job seekers surveyed in the SEUP.

In general, these studies find that among the general population, older people are less likely to leave unemployment than younger people, but when the analysis is restricted to the youth labour market, unemployed youth in their early twenties are more likely to exit unemployment than unemployed teenagers. Work experience and the level of education increase the probability of leaving unemployment, as does being married. To the extent that the duration of unemployment affects the probability of exiting unemployment, the effect appears to be restricted to the very short term. Chapman and Smith (1992) also find that a higher reservation wage reported at the beginning of the unemployment spell is associated with a lower probability of leaving unemployment, although the marginal effect is relatively small.

This framework uses job-search theory to suggest the variables which should be included in an econometric model however, the estimated parameters cannot be directly related back to the theory, and in this sense this analysis is essentially 'reduced form'. In this respect it is noteworthy that none of the studies referenced above simultaneously estimated the probability of leaving unemployment after a given duration of unemployment and reservation wages, as might be suggested by theory. It is also likely that the results are affected by the functional forms which are assumed for the different components of the hazard model.

The second indirect approach to understanding those factors which affect unemployment duration is to model transitions between labour market states between two points in time. This method has been used by Brooks and Volker (1985), who focus on the youth labour market, and Strombach, Dockery and Ying (1998). The effects of different characteristics on the probability of moving out of unemployment are consistent with the results obtained by studies referenced above.

Brooks and Volker (1985) investigate the probability that an individual will either stay in unemployment, exit unemployment for full-time work or exit unemployment for part-time work. The reservation wage and duration of unemployment are included as explanatory variables. Across different specifications, one or other of these variables appeared to be significant, which suggests that they are highly correlated. Brooks and Volker also estimate an equation for reservation wages as a function of unemployment duration as well as other personal and background characteristics. Strombach, Dockery and Ying (1998) estimate similar models for the probability of remaining in unemployment

or leaving unemployment for full-time or part-time work.[24] They do not consider the reservation wage and find that longer spells of unemployment significantly reduce an individual's chances of getting a job.

Miller and Volker (1987) is the only Australian study of which we are aware that estimates an equation for unemployment duration directly. They exclude the reservation wage from their analysis, citing evidence that minimum wages, not reservation wages, are the real constraint facing job seekers in the youth labour market.

As already mentioned, the estimation methods outlined above use job-search theory to suggest which variables should be included to explain unemployment duration, but it is not possible to relate the estimated parameters back to the theory. The analysis which follows extends this literature by deriving an empirical model for unemployment duration which is directly related to job-search theory. The development of the empirical model in Section 4 ensures that the analysis is consistent with the economic model and that complications suggested by theory, such as the joint determination of the duration of unemployment and the reservation wage, are correctly dealt with.

Although these issues have not been addressed with Australian data, they have received some attention in non-Australian literature.[25] In part, both the Australian and overseas literatures have been constrained by the lack of appropriate data.

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[24] In contrast to Brooks and Volker (1985), this study considers these transition probabilities individually and therefore cannot impose the constraint that the probabilities sum to one.

[25] An excellent survey of the empirical job-search literature, including structural models of unemployment duration and reservation wages, can be found in Devine and Kiefer (1991).

The framework that we have used to analyse the duration of unemployment is developed in Section 4 and follows the work of Lancaster (1985), Jones (1988) and Gorter and Gorter (1993).

3 The Data Source and Reservation Wages

Before discussing the empirical model, it is useful to get a feel for the data which will be used. Section 3.1 describes the Survey of Employment and Unemployment Patterns (SEUP) and the definition of our sample. Section 3.2 considers some descriptive evidence about the minimum acceptable wage rates reported in the SEUP.

3.1 The Sample

The SEUP is a longitudinal survey; information is collected from the same individuals over a number of years. The panel of individuals was established between April and July 1995 and includes people who were aged 15 to 59 at that time and who were living in private dwellings in both urban and rural areas. A time line of the important events in the compilation of the SEUP data is presented in Table 16.

At the first interview, three sub-groups were defined: Jobseekers; a Population Reference Group; and persons known to have been labour-market programme participants. Jobseekers are defined as those who were unemployed, marginally attached to the labour force (that is discouraged job seekers) or under-employed in May 1995. They are the focus of this paper. The Jobseeker panel provides a far greater number of observations on episodes of unemployment than the Population Reference Group, and has a greater proportion of long-term unemployed.

At each interview, individuals are asked to divide their time over the relevant survey period (column 3 of Table 16) into periods of work, looking for work, or absence from the labour market. Clearly, these categories are not mutually exclusive as it is possible to be both working and looking for work. In this paper we focus on people who were looking for work and who were not employed at the end of the period covered in the third interview, that is in September 1996. This definition corresponds more closely to the more familiar concept of unemployment, than the Jobseeker definition used in the SEUP, although, given the different survey questions in the SEUP and the Labour Force survey, it satisfies less stringent activity and availability criteria.

Table 16: Timing Of Events In The Compilation Of The SEUP

Interview	Date	Period covered	Details
First	April 1995 to July 1995	5 September 1994 to 28 February 1995	Panel established Sub-groups defined
Second	September 1995 to November 1995	1 March 1995 to 3 September 1995	
Third	September 1996 to November 1996	4 September 1995 to 1 September 1996	

From this sample, we retain for analysis all individuals with valid answers to all the questions used in our econometric estimation in Section 6. This resulted in a sample of 1,063 unemployed job seekers.[26] Of these 1,063 individuals, around 32 per cent reported that they had been retrenched or that their employer had gone out of business, 23 per cent reported that they had previously been employed in temporary or seasonal jobs, 10.5 per cent reported that they had left

[26] Another 337 unemployed job seekers answered all questions but didn't know their hourly reservation wage. The definition of reservation wages used in our analysis is discussed in Section 3.2.

unsatisfactory work arrangements, pay or hours and 17 per cent reported that they had left for child care, health and other reasons. The remaining 17.5 per cent either had never worked or had not had a job since 1985.[27]

Of those unemployed job seekers who have had a job at some time in the past, 75 per cent have been in relatively low-skilled professions: intermediate and elementary clerical, sales, service, transport and production workers, and labourers and related workers. By contrast, only 47 per cent of employed people at that time worked in these occupations.

Analysing the unemployed job seekers by educational attainment, 50 per cent have not achieved the highest level of secondary school. Another 19 per cent have completed the highest level of secondary school but have no further qualifications, with 21 per cent completing vocational qualifications and just 10 per cent a degree or post-graduate diploma. By comparison, the proportion of employed respondents who have not completed high school is 34 per cent and the proportion with graduate qualifications is 22 per cent, suggesting that the unemployment pool is less well educated on average.

Figure 17 plots the distribution of unemployment duration where this is defined as the number of days of unemployment up to 1 September 1996.[28] [29] The

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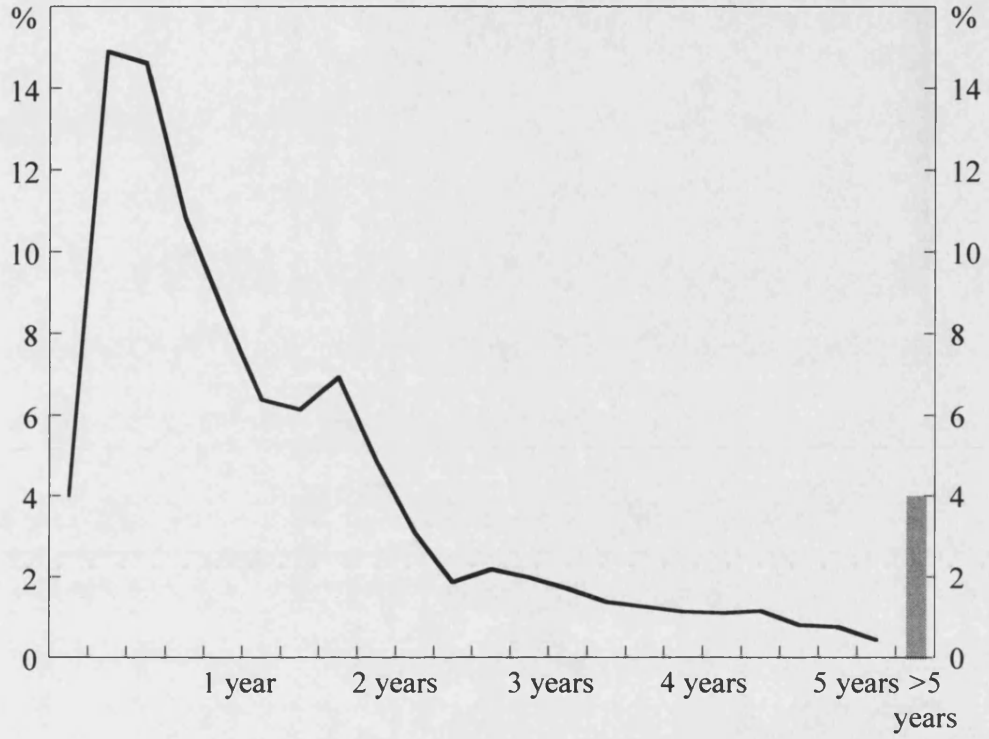
[27] The SEUP asks unemployed people whether they have had a job since 1985. There is no labour-market information before this date.

[28] All distributions have been estimated using kernel density estimation (Silverman, 1986).

[29] International studies have indicated that, at successive interviews, respondents tend to change their answers to questions concerning their labour-market status at a particular point in time. To try to ensure the reliability of retrospective data, the ABS use dependent interviewing whereby the interviewer reminds the respondent of their labour-market activity at the end of the previous period. To further facilitate accuracy

distribution is positively skewed with 44 per cent of the sample having an unemployment duration longer than 12 months, and 4 per cent having a duration in excess of five years. The average unemployment duration is 520 days.

Figure 17: Distribution of Unemployment Duration



3.2 Reservation Wages

Reservation wages are collected by asking job seekers how many hours per week they would like to work and, based on those hours, what is the minimum weekly take-home pay (or reservation wage) that they would be prepared to accept if they were offered a job. Respondents indicated ranges within which their desired hours and reservation wage fell; there were 7 bands for desired hours and 30

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in recalling the dates of events, each respondent is supplied with a calendar to record their labour-market activity; use of the calendar, however, is not compulsory.

bands for wages. For each respondent, the hourly reservation wage is calculated by dividing the midpoint of the indicated band for the reservation wage by the midpoint of the band for desired hours.

To gain some understanding of the pattern of hourly reservation wages, Table 17 gives the medians and means of the ratio of hourly reservation wages to previous hourly pay in most recent employment for different groups of people who were unemployed at September 1996. The first thing which is notable about this table is that the means are much greater than one. It is hard to understand why people would only accept a job if it paid more than their previous job, especially if they did not leave their last job voluntarily. The median values reported in Table 17 are, however, much closer to one.[30]

One possible explanation for the high mean ratios is that previous pay has not been indexed. We also report the median and average unemployment duration for each group to gauge the extent to which this is likely to be an issue. As the mean and median durations are typically not more than a couple of years and cover the relatively low inflation 1990s, this lack of indexation is unlikely to have a large effect. Measurement error may also go some way towards explaining these unrealistically high mean ratios. The dollar ranges for pay in jobs held prior to September 1994 are different to the ranges provided for reservation wages. As such, the same response to both questions may result in different hourly rates and hence, a ratio that differs from one.

Although the levels of the ratios themselves are puzzling, their relative values accord with prior intuition. The young have higher ratios than older age groups and those who were previously retrenched have lower ratios than those who left

their job due to dissatisfaction with working conditions. This suggests that reservation wage data are meaningful.[31]

Table 17: Ratio Of Reservation Wages To Previous Earnings

Sample Includes All Unemployed Individuals Who Report A Previous Wage

	Reservation wage/previous pay		Unemployment duration (in days)	
	Median	Mean	Median	Mean
Total sample	1.00	1.35	260	470
Males	1.00	1.28	261	474
Females	1.05	1.50	254	463
Age				
15 to 19	1.09	1.45	149	233
20 to 34	1.00	1.27	253	411
35 to 49	1.00	1.48	303	525
49 to 59	1.00	1.26	699	855
Reason for leaving last job				
Retrenched or employer went out of business	0.95	1.13	303	565
Previous job temporary or seasonal	1.08	1.37	153	276
Unsatisfactory work arrangements/pay/hours	1.03	1.51	168	391

[30] This is consistent with a highly skewed distribution of these ratios.

[31] The reasons for leaving one's previous job are also important if they are included in a regression of the ratio of reservation wages to previous earnings on the personal characteristics and previous job attributes used in Section 6. Individuals who left their previous job because it was unsatisfactory or because it was temporary have significantly higher ratios, whereas individuals who were retrenched or their employers went out of business have significantly lower ratios. Individuals who

It is also of interest to consider the relationship between reservation wages and minimum wages. Figure 18 plots the distribution of hourly reservation wages for unemployed job seekers as at 1 September 1996. The minimum wage reference point on this graph is an hourly wage calculated from the C14 classification in the Metal Industry Award, which was used as a benchmark minimum in the 1996 Safety Net Review. The gross level of this award is $349 per 38 hour week. Assuming that there are no transfer payments and no deductions, and that the individual works full-time, this translates to an after-tax hourly minimum wage of $7.90, and is therefore comparable to the reservation wages which are also net figures.[32]

The striking feature of the graph is that around one quarter of the sample have hourly net reservation wages below the legal minimum of $7.90 per hour. One qualification to this is that young workers are likely to face lower minimum wages as Australia has a system of age based discounts to the adult award wage. This discount declines with age, up to the age of 21 and can be as much as 50 per cent for 16 year-olds in some occupations. Around 52 per cent of workers under 21 are employed on youth wages. Training wages and apprenticeships also provide a discount to employers with the understanding that structured training will be provided to the employee. Around 13 per cent of young workers are paid in this manner.

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have higher housing costs or were previously employed as managers or professionals in the manufacturing industry also have significantly higher ratios.

[32] The SEUP asks for reservation wages in net terms and usual weekly earning in gross terms. ABS internal research suggests that respondents answer these questions with the correct measures, although using these two different concepts is likely to increase respondent error. The idea that respondents mistakenly answer these questions using the same concept is at least tentatively supported by the ratios of hourly reservation wages to hourly pay reported in Table 17 which tend to be around 1.

Figure 18: Distribution of Hourly Reservation Wages

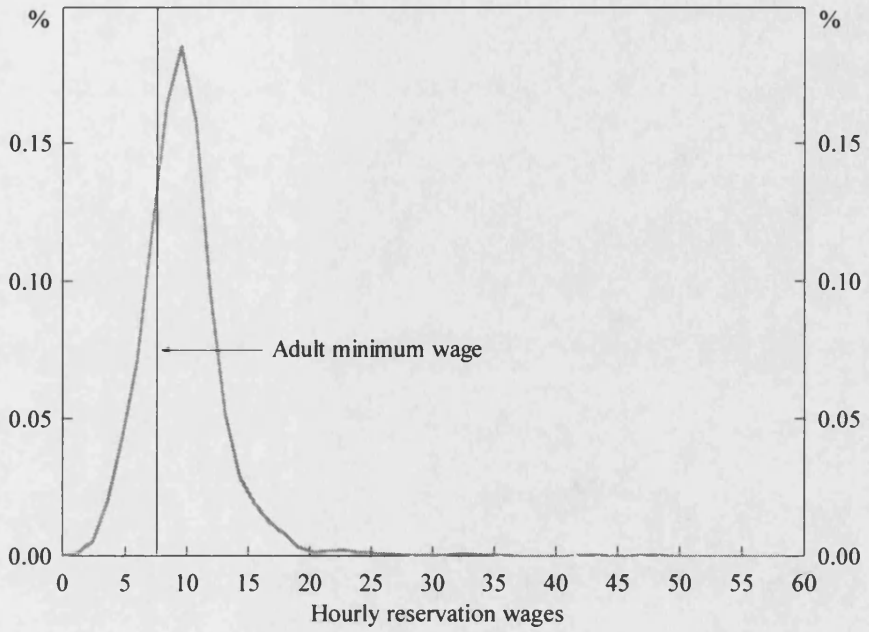

Figure 19 plots the distribution of reservation wages separately for 15 to 19 year-olds and for those older than 19 years. The benchmark minimum wage used for the youth is $5.30. This is the minimum wage paid to 18 year-old metal workers and is close to the Retail Trade Award for 18 year-olds, which covers a large number of teenage workers. Twelve per cent of teenagers report reservation wages below this benchmark and the proportion of adult workers reporting reservation wages below $7.90 falls to 18 per cent.

Figure 19: Distribution of Hourly Reservation Wages

By age

This evidence suggests that the minimum wage, rather than the reservation wage, may be acting as a constraint on employment, at least for some individuals.[33] It should also be stressed, however, that the relationship between minimum wages and reservation wages is only one element in a relatively complex relationship between legal minimum wage rates and employment levels. In particular, Figure 18 and Figure 19 only present the supply side and have no information about the demand response of employers to lower legal minima. Other factors such as equity and income distribution, as well as employment consequences, need to be

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[33] Miller and Volker (1987) argue that it is the minimum wage and not reservation wages which is the binding constraint on youth employment. This is based on the observation that actual youth wages are on average 25 per cent higher than reservation wages and that award wages constitute, on average, around 95 per cent of the full-time wages bill.

considered when assessing its appropriate level of a minimum wage. This is beyond the scope of the current chapter.

Although we have used a benchmark minimum, it is important to bear in mind that there is a system of award wages, which in general sits on top of the minimum wages presented in Figure 18 and Figure 19. In many cases the relevant award wage will be the constraint facing job seekers rather than the benchmark minimum shown in the graph.

Another factor which is likely to affect the reservation wages reported by the unemployed who are expecting to earn low incomes, is the interaction of the tax and transfer systems. For example, a couple earning $349 per week from one full-time income with two children under 5, one child aged between 5 and 12, paying $120 per week in rent could receive as much as $312 in social security payments.[34] As family income increases, means tested social security payments fall and tax payments rise. If the non-working partner starts working 15 hours per week at adult benchmark minimum wages, family social security payments will fall to $207 and taxes will rise from $46 to $51. Consequently, job seekers in families with significant transfer payments may report higher reservation wages because they need to be compensated for the loss of welfare payments.

4 A Structural Model of Unemployment Duration

Having described the data source and the key variables, we now turn to developing an empirical model from the underlying job-search theory. In Section 4.1 we start by looking at the individual job seeker who receives job offers which arrive randomly at a predetermined rate, with wage offers being

drawn randomly from a predetermined wage distribution (the wage-offer distribution). From the basic model we derive the distribution of incomplete unemployment durations facing an individual when they first become unemployed.

In Section 4.2, we discuss the assumptions that are required to incorporate individual characteristics which are likely to affect the duration of unemployment. We also discuss the individual characteristics that we include in the estimation. In Section 4.3, we combine the results of Sections 4.1 and 4.2 to derive an expression for the expected log of incomplete duration for an individual. By assuming that the distribution of individuals who flow into unemployment is the same at each point in time, we can then justify estimating this expression across individuals as a cross-section regression.

4.1 Deriving the Distribution of Incomplete Duration for an Individual

Job seekers in the standard job-search framework set a reservation wage which is the minimum wage that they would be willing to accept. The reservation wage is determined by equating the expected benefits of accepting an offer with the expected costs of further search and the opportunity cost of forgoing potentially better offers. The reservation wage will be a function of things such as the costs of search, the rate at which job offers arrive and the distribution of wage offers. If these determinants do not vary with the duration of unemployment, the reservation wage and the probability of leaving unemployment will remain constant and the model is said to be stationary.

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[34] Information provided by the Department of Social Security.

The starting point for our analysis is to consider the hazard rate. This is the instantaneous probability of exiting unemployment for an individual, equal to the product of the probability that a job offer arrives and the probability that the individual will accept the job offer, that is the wage offer lies above the individual's reservation wage. More formally, the hazard rate for individual i can be written as:[35]

$$\theta_i = \lambda_i(1 - F_i(\xi_i)) \tag{37}$$

where: θ_i is the hazard rate;

λ_i is the job-offer arrival rate;

ξ_i is the constant reservation wage; and

$F_i(w)$ is the cumulative distribution of wage offers.

If the hazard rate is constant, the distribution of completed unemployment spells, T, facing a newly unemployed individual, i, will be exponential:

$$g_i(T) = \theta_i e^{-\theta_i T} \tag{38}$$

However, the data we use from the SEUP are from currently unemployed individuals. Therefore, we are interested in the distribution of incomplete spells of unemployment rather than of completed spells. The probability of observing an individual with an incomplete duration of unemployment of length t, is the

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[35] The notation is intended to be consistent with Lancaster (1985), although the derivations are more closely aligned with Jones (1988).

probability that the individual did not leave unemployment earlier. This probability is given by $1\text{-}G_i(t)$ for individual i, where $G_i(t)$ is the cumulative distribution function corresponding to the density function $g_i(t)$. The expression $1\text{-}G_i(t)$ is also known as the survivor function. The distribution of incomplete spells for an individual will, therefore, be the normalised survivor function:[36]

$$p_i(t) = \frac{1 - G_i(t)}{\int_0^\infty (1 - G_i(s))ds} = \theta_i e^{-\theta_i t} \tag{39}$$

The final expression in Equation 39 can be obtained by integrating Equation 38 over T to obtain $G(t)$ and substituting this into Equation 39.

4.2 Incorporating Individual Characteristics

In order to transform the theory into an estimable model, it is necessary to add more structure. The first step is to make an assumption about the wage-offer distribution. One of the most common and tractable assumptions is that wage offers are drawn from a Pareto distribution. This means that the probability of a given wage offer exceeding the reservation wage can be expressed as:

$$1 - F(\xi_i) = (A_i / \xi_i)^\alpha \tag{40}$$

$$\Rightarrow \theta_i = \lambda_i (A_i / \xi_i)^\alpha \tag{41}$$

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[36] This result can be more formally derived using the standard results from renewal theory, see Lancaster (1992).

where: A_i is the origin of the Pareto distribution, that is some absolute minimum wage level facing individual i; and

α is the scale parameter which can also be interpreted as the constant elasticity of the hazard with respect to the reservation wage (ξ).

The second step is to assume that the probability of receiving and accepting a job not accounted for by the reservation wage, is an exponential function of the individual's characteristics, X_i:

$$\lambda_i A_i^{\alpha} = \exp(k + X_i'\beta + u_i) \qquad (42)$$

The explanatory variables, represented by X_i in Equation 42, are included to capture those factors which affect the probability of receiving and accepting job offers, given the reservation wage. The job-offer arrival rate will be affected by the attractiveness of the individual to the employer. Variables which will capture this effect include educational attainment, previous occupation and reasons for leaving the last job. These variables are also likely to capture the important elements of the wage-offer distribution facing an individual. Personal characteristics such as gender, age and English language proficiency may also be important. These variables may also affect the degree of search intensity, which will in turn affect the job-offer arrival rate. Other variables which could be important for explaining search intensity include housing costs and eligibility for benefits which capture an individual's financial capacity to continue job search.

In general these variables are self-explanatory and Appendix D provides more detailed definitions. Some variables, however, have required more construction due to the design and availability of information from the survey. Eligibility for

unemployment benefits is likely to be an important explanator of labour-market outcomes and has occupied a large amount of space in the job-search literature. While the SEUP collects unit record data on episodes of income support, including the value of unemployment benefits received, these data are not publicly available due to confidentiality restrictions. We have derived a proxy variable for unemployment benefit eligibility based on answers to questions concerning the main sources of income.

If the respondent was unemployed at the time of the third interview and on 1 September 1996, we classify them as eligible for unemployment benefits if social security was their main source of weekly income in the week prior to the interview. This accounts for around 80 per cent of the people that we classify as unemployment benefit recipients. If they were unemployed on 1 September 1996 but not in the week before the third interview, they are classified as eligible for unemployment benefits if their main source of income in the last financial year was social security.

In general, it is important to control for the fact that different people live in different places, because local labour-market conditions and wage rates are likely to be important. For Australia, it would be obvious to control for the state in which the individual lives as well as the section of state which describes whether the respondent lives in a rural area, a country town, a capital city, or a non-capital city. However, for confidentiality reasons, the Australian Bureau of Statistics (ABS) does not release information about the state of residence.

Instead, we control for the state of the local labour market using an index of socioeconomic disadvantage compiled by the ABS. This index measures the extent to which the local area displays characteristics such as a high proportion of low income families, low average education levels and high unemployment

rates.[37] A higher score in the index of socioeconomic disadvantage suggests that the area is less disadvantaged. The SEUP provides information about the decile of each individual's local area ranked by the index of socioeconomic disadvantage. Gregory and Hunter (1995) have shown that socioeconomic disadvantage and unemployment rates are highly correlated across local areas.

4.3 An Empirical Model

The objective of Section 4 is to derive an empirical model which relates the duration of unemployment to the reservation wage and to other explanatory variables. We can derive an expression for the expected log of incomplete unemployment duration for a given individual as follows:

$$\begin{aligned} E(\log t_i \mid \theta_i) &= \int_0^\infty \log(s) p_i(s) ds \\ &= \int_0^\infty \log(s) \theta_i e^{-\theta_i s} ds \\ &= -c - \log(\theta_i) \end{aligned} \tag{43}$$

where c is Euler's constant ≈ 0.577.

Therefore,

$$E(\log t_i \mid \xi_i, X_i) = -(c+k) + \alpha \log(\xi_i) - X_i' \beta - E(u_i \mid \xi_i, X_i) \tag{44}$$

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[37] The local area used by the ABS for this index is the Collection District (CD) which is a small area defined by the ABS for statistical collection purposes.

In equilibrium, if the flow into unemployment is the same over time, we can treat Equation 44 as a regression model where the individuals used for estimation are a cross-section of unemployed people with incomplete durations at a particular point in time. To the extent that the assumptions made above are acceptable, the parameters of this model can be directly related to the underlying theory and this model can be regarded as a structural model. If the assumptions which have been made are not acceptable, Equation 44 is still a valid reduced-form regression for which theory has only provided guidance as to the types of variables to include.

5 Estimation Results

If the conditional expectation of the error term in Equation 44 is zero and the stationary job-search framework is appropriate, then OLS estimation is the appropriate estimation strategy. However, if omitted variables result in the conditional expectation of the error term being non-zero or, if the reservation wage is dependent on unemployment duration, it will be necessary to use instrumental variable methods to ensure that parameter estimates are not biased and inconsistent. In Section 5.1 the results of estimating the unemployment duration equation assuming that there are no problems with omitted variables or endogeneity are presented. In Section 5.2 we discuss the implementation of instrumental variable estimation and present the results of this method. Finally, in Section 5.3, we consider estimating Equation 44 for males and females separately.

5.1 OLS Estimation

The results of estimating Equation 44 over the whole sample by OLS are presented in the first column of Table 18. The hourly reservation wage is of the expected sign, but is statistically insignificant, suggesting that although the reservation wage is of critical importance in the theoretical economic model, other factors are more important in explaining unemployment duration empirically. Gorter and Gorter (1993), using data for the Netherlands, also find no effect and attribute this to the fact that the job-offer arrival rate is the binding constraint.

It has been noted by several authors that the longer-term unemployed do not receive many job offers and that they usually accept those offers that they do receive.[38] The data in the SEUP suggest that very few job offers are rejected by Australian job seekers. In sum, 72 per cent of job offers made between September 1994 and September 1996 were accepted, 1.6 per cent were rejected for another job offer and 3.9 per cent were rejected because the potential employee already had a job. Only 7.5 per cent of job offers were rejected because the job was unsuitable.

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[38] Jones (1989) found that 85 per cent of a sample of unemployed in the UK in September 1982 accepted job offers they had received; Holzer (1988) found that 66 per cent of a sample of unemployed male youth in the USA in 1981 had not received any job offers in the previous month; and van den Berg (1990) found that job offers arrived very infrequently for a panel of Dutch men, and that 97 per cent of these offers were accepted.

Table 18: Estimation Results
Number of Observations: 1, 063

	OLS Estimation	IV First Stage	IV Second Stage
Hourly reservation wage	0.135	-	-1.922
	(0.131)		(1.205)
Search Incentives			
Log family income	-0.084*	0.041**	-
	(0.044)	(0.010)	
Family size	-0.013	0.005	-0.002
	(0.031)	(0.007)	(0.035)
Unemployment benefit	0.701**	-0.011	0.679**
eligibility	(0.131)	(0.031)	(0.141)
Log housing costs	-0.222**	0.014	-0.194**
	(0.061)	(0.015)	(0.073)
Education			
Degree/diploma	-0.451**	0.048	-0.352*
	(0.160)	(0.038)	(0.191)
Vocational qualifications	-0.096	0.009	-0.077
	(0.110)	(0.026)	(0.123)
Completed high school	0.013	0.035	0.086
	(0.112)	(0.027)	(0.131)
(Less than high school)			
Personal characteristics			
Male	-0.005	0.005	0.006
	(0.090)	(0.021)	(0.100)
Age	0.020**	0.006**	0.033**
	(0.004)	(0.001)	(0.009)
English first language	0.125	-0.105**	-0.093
	(0.208)	(0.049)	(0.258)
English as a second	0.088	-0.027	0.032
language, high proficiency	(0.082)	(0.020)	(0.974)
Married	0.213*	-0.014	0.184
	(0.112)	(0.027)	(0.121)
Work Experience			
No previous job	0.238	0.118**	0.481
	(0.218)	(0.052)	(0.281)
Previous hourly pay	-0.172**	0.049**	-0.072
	(0.081)	(0.019)	(0.110)

continued next page

Table 18: Estimation Results *(continued)*

Number of Observations: 1,063

	OLS Estimation	IV First Stage	IV Second Stage
Work Experience			
Manufacturing	0.336**	-0.036	0.263*
	(0.123)	(0.029)	(0.144)
Manager/professional	0.743**	0.100*	0.950**
	(0.217)	(0.052)	(0.266)
Advanced clerical	0.036	0.116**	0.274
	(0.203)	(0.048)	(0.260)
Trade	0.167	0.030	0.227
	(0.145)	(0.034)	(0.165)
(Low-skilled occupations)			
Manager in manufacturing	-1.106**	0.063	-0.975*
	(0.524)	(0.125)	(0.590)
Reasons for leaving job			
Temporary job	-0.559**	0.027	-0.504**
	(0.112)	(0.027)	(0.129)
Ill health	0.238	-0.001	0.235
	(0.214)	(0.051)	(0.238)
Unsatisfactory conditions	-0.130	0.007	-0.117
	(0.149)	(0.035)	(0.166)
Child care	0.249*	-0.003	0.242
	(0.150)	(0.036)	(0.167)
(Lost job/firm bankrupt)			
Local environment			
Capital city	-0.076	0.078**	0.085
	(0.097)	(0.023)	(0.140)
Rural area	-0.040	0.062*	0.088
	(0.137)	(0.033)	(0.165)
(Other urban area)			
Index of disadvantage	0.012	0.003	0.017
	(0.016)	(0.004)	(0.018)
R^2	0.16	0.16	n.a.
H_0: Overall insignificance	7.61***	7.53***	6.34***

Notes: Standard errors in parentheses
* denotes significance from zero at the 10 per cent level
** denotes significance from zero at the 5 per cent level
*** denotes p-value of this test is zero to four decimal places

One possible reason for the low level of job offers, and consequently the insignificance of the reservation wage variable, is that reported reservation wages are sometimes below Australia's award system and minimum safety net pay levels. For these respondents, changes in reservation wages are not likely to have an effect on unemployment duration and this may bias our results away from finding a significant role for reservation wages. This explanation can be discounted, however, as the reservation wage variable remains insignificant when the unemployment duration regression is estimated for a sample restricted to respondents with reservation wages above $10.00, which is clearly above the minimum.

The next set of control variables presented in Table 18 have been included to capture the impact of financial factors on the incentives to search. The log of family income has a marginally significant negative effect on the duration of unemployment. To the extent that individuals with higher family income have lower costs of search, we would expect the sign of this effect to be positive. Finding that there is a negative relationship between family income and duration suggests that this variable is capturing quality differences in the sample rather than different incentives to search for work. The effects of the other three variables in this group are consistent with the interpretation that they represent financial factors affecting the costs of search.

Individuals from larger families are likely to experience shorter durations of unemployment, all else equal, which can either be attributed to the fact that each individual has fewer resources available to fund search or because they need to search harder to find work to support dependants. Eligibility for unemployment benefits significantly increases the duration of unemployment. However, the construction of benefit eligibility implies that ineligibility arises either from the means test or because individuals are only short-term unemployed, and therefore

are likely to possess relatively more skills than the long-term unemployed.[39] This raises some question as to whether the actual effect being captured is one of search intensity or of worker quality.

Higher housing costs are associated with significantly lower durations of unemployment. This is likely to capture the effect of financial responsibilities on the degree of search effort and consequently on the probability of receiving and accepting a job offer. The result may also indicate that housing costs are correlated with skills and ability, although we believe that we have adequately controlled for this more directly through education variables and previous hourly pay.

The estimated effects of other variables included to control for the factors which affect whether an acceptable job offer arrives, given the reservation wage, accord with our economic priors. They are also consistent with previous estimates presented by Jones (1988) for the UK and Miller and Volker (1987) for the youth labour market in Australia. Note that where there are mutually exclusive and exhaustive sets of dummy variables, one category has been omitted and the coefficients should be interpreted as the effect of having the given characteristic relative to having the omitted characteristic. These omitted categories have been included in parentheses in Table 18.

Unemployment durations for more educated individuals are relatively low and this is reflected in the results. The duration of unemployment for job seekers who have a degree or diploma is significantly lower than it is for those who did not

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[39] Short-term unemployed may not be captured by our eligibility measure if they were unemployed in September 1996, but had left unemployment by the third interview,

complete high school. Vocational qualifications also tend to reduce unemployment duration, although this effect is not significant. The results suggest that the unemployment duration experienced by those who completed high school and did not obtain further qualifications is not noticeably different from those who did not complete high school.

Personal characteristics may also affect the probability of receiving a job offer if they are used as a screening device by potential employers or if these characteristics capture search intensity. Older workers clearly experience longer durations of unemployment, whereas other characteristics such as gender, English language proficiency and marital status appear to have little independent effect on unemployment duration.

Previous work experience is also an indicator of the desirability of job seekers to potential employers. Those with no previous work experience do tend to have longer unemployment duration, although this is not a statistically significant effect. Higher previous hourly pay, which is likely to capture unmeasured features of previous work experience or individual ability, significantly decreases unemployment duration. Those who previously worked in more highly paid jobs are likely to have skills and experience that are relatively attractive to potential employers.

Job seekers who previously worked in the manufacturing industry experience significantly longer durations of unemployment. This appears to suggest that a lack of labour mobility is hampering the employment prospects of those who worked in industries subject to significant structural change. A somewhat more

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and had not been unemployed long enough in the year to September 1996 to say that their main source of income over the year had been social security.

surprising result is that more skilled occupations, in particular managers and professionals, experience longer durations of unemployment than job seekers in low-skilled occupations. At first, this would appear to be difficult to reconcile with the fact that structural change has favoured skilled labour.

One possibility is that education and previous hourly wages capture the skill differentials between job seekers and that the occupation variables are capturing adverse selection; unemployed individuals in an occupation with low unemployment rates tend to be of poor quality relative to their peers. As such, their unemployment is an important signal of their quality. This is in contrast to occupations with high unemployment rates where the quality of unemployed workers may not be very different to the quality of employed workers.

This result may also indicate a lack of willingness by those who were previously managers or professionals to accept work in a different area. This would be the case if managers and professionals have more occupation-specific human capital and are willing to search longer for jobs which match these skills than other unemployed people whose skills are more generic. This suggests the importance of non-wage characteristics of job offers.

Another possibility is that managers and professionals from declining industries such as manufacturing have skills specific to that industry and have difficulty finding another job. We have attempted to control for this by including an interaction variable which indicates if the job seeker was previously employed as a manager or a professional in the manufacturing industry. This variable is significantly negative, suggesting that this explanation does not have support in the data.

People who left their last job because it was temporary or seasonal have significantly lower durations of unemployment than those who were retrenched or were working for a firm which went bankrupt. Job seekers who left their jobs voluntarily because their conditions of work were unsatisfactory also experience lower durations of unemployment, although this is not statistically significant. This result supports the idea that potential employers use a job-seeker's reason for leaving last job as a screening device (and that leaving because work conditions were unsatisfactory is not deemed to be a bad signal).

However, it could also be taken to indicate that the reason for leaving the last job also measures the search effectiveness and/or preferences of the individual. This is supported by the result that people who left their jobs due to ill health or for child care reasons experience much longer durations of unemployment. While the results are not shown, it is also interesting to note that ill health and child care reasons for leaving employment are more important explanators of unemployment duration for the group of people who did not report a reservation wage. This may be another indication that for some groups, considerations other than the hourly wage are a more important measure of the acceptability of job offers.

Finally, the results presented in Table 18 indicate that the local environment does not have a strong effect on the unemployment duration of job seekers, although this must be qualified to some extent by the lack of information about the state of residence.

5.2 Instrumental Variable Estimation

The assumption that the conditional expectation of the error term is zero will be violated if omitted variables are correlated with other explanatory variables or the reservation wage varies over the duration of unemployment. Theory suggests that all the variables which affect the job-offer arrival rate and the parameters of the wage-offer distribution will also affect the reservation wage. Therefore, in the case of omitted variables, there will be a correlation between the error term and the reservation wage variable which will exist even if the sample size is very large, ensuring that the OLS parameter estimates are inconsistent.

The solution to this problem is to instrument the reservation wage. The choice of instrument must be restricted to variables which directly affect the reservation wage but which do not affect the job-offer arrival rate or the wage-offer distribution. The most likely candidates are therefore variables which affect the cost of unemployment such as the level of unemployment benefits. Instrument choice is discussed in more detail below.

The second assumption which must hold for OLS estimation to be appropriate is that the reservation wage has no duration dependence. If this is not true, it is necessary to think about the duration of unemployment and the reservation wage as two endogenous variables in a simultaneous system. There are several arguments for why reservation wages will decline with duration. These include:

- declining job offers because employers use duration as a screening device or because human capital diminishes with time spent out of work;

- limits to search due to fixed working life, fixed level of assets available to fund search, limited duration of unemployment benefits; and

- learning about the wage-offer distribution.

In terms of the derivation of the duration equation above, the progression from Equation 37 to Equation 38 will no longer be valid in general. However, by making specific assumptions about the relationship between the reservation wage and the duration of unemployment, Lancaster (1985) shows that it is possible to derive a tractable expression for the reservation wage equation in a simultaneous system, where the duration equation is the same as Equation 44. In particular, by assuming that the reservation wage declines exponentially as a function of the duration of unemployment and that its minimum level is an exponential function of background characteristics, the second equation of the simultaneous system will be log linear.

$$\log \xi = -\rho \log t + Z'\gamma + k + \varepsilon \qquad (45)$$

The parameter ρ will have a structural interpretation as the exponential rate of decline in reservation wages with duration, if the underlying assumptions are accepted. Regardless of whether the coefficients can be interpreted as structural estimates, the estimation of Equation 44 will still require instrumental variable techniques to deal with the endogeneity bias introduced by the log of the reservation wage. We have already argued that all the variables in X (Equation 44) must also be in Z (Equation 45). Therefore identification of our unemployment duration equation requires that there are some variables in Z and not in X. These variables are appropriate instruments for the reservation wage in estimating Equation 44. Practically, the choice of instruments will be the same as for the omitted variable single equation case discussed above.

The best candidates for instruments are variables which affect the costs of unemployment, because they have a direct effect on the level of the reservation

wage but are not generally considered to directly affect the job-offer arrival rate or the parameters of the wage-offer distribution. The most obvious candidate for an instrument is therefore the level of unemployment benefits. This is the instrument used by Jones (1988) and Gorter and Gorter (1993).

As already mentioned, the SEUP does not provide information about the level of unemployment benefits, although we have been able to construct a variable which measures eligibility. This would be a valid instrument except that it is likely to affect the degree of search intensity and hence, the job-offer arrival rate. Wadsworth (1991) provides evidence of this indirect effect for the UK. Further evidence from UK data suggests that although eligibility increases the number of job-search methods used, through information and incentive effects, there is no evidence that the level of unemployment benefits has an effect (Schmitt and Wadsworth 1993). This suggests that variables which affect the level of benefits, rather than eligibility for benefits, are more likely to be valid instruments. Using this reasoning, Lancaster (1985) uses the number of dependents as an instrument.

Using information about the number of search methods reported by individuals in our sample, it is possible to obtain some evidence about the factors that affect the search effort of job-seekers in Australia.[40] As for the UK, eligibility for unemployment benefits significantly increases the number of job-search methods reported. This information, combined with the fact that it is a significant explanator of unemployment duration in the results presented above, suggest that it cannot be used as an instrument.

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[40] Results of this estimation are available from the author on request.

Variables that have been included in this analysis which are likely to capture the level of unemployment benefits rather than eligibility *per se* are the log of family income and family size, due to the presence of means testing and taper rates which are a function of the number of dependants. Larger family sizes, being female and having left previous employment for child care reasons have a significantly negative effect on the number of job-search methods reported. This is consistent with labour supply decisions and job-search decisions, especially of females, being affected by family considerations. This result also indicates that family size, despite having no direct effect on the duration of unemployment, will not be an appropriate instrument for the reservation wage due to its indirect effect on unemployment duration through search effort.

Interestingly, the log of family income, and other financial considerations which do not directly affect the level of unemployment benefits paid such as housing costs, have no significant effect on the number of reported job-search methods. This is consistent with the results presented above, which suggest that the effect of family income on duration was not related to search incentive effects. This information, combined with the marginal significance of this variable in Table 18 suggests that the log of family income can be considered as an instrument for the reservation wage. Having English as a second language is also associated with fewer reported job-search methods.

The second column of Table 18 presents the results of estimating the reduced form reservation wage equation. The log of family income has a significantly positive effect on the log level of the reported reservation wage. Therefore, one of the important characteristics of an instrument, that it is correlated with the variable it is being used as an instrument for, has been fulfilled. Interestingly, neither eligibility for unemployment benefits or the log of housing costs which

are important influences on the duration of unemployment, appear to have an effect on the level of the reservation wage.

In general, the other variables which are important explanators of the reservation wage in this reduced form regression are work experience variables. Older individuals and individuals with higher hourly pay in their previous job report significantly higher reservation wages. Both these variables are likely to capture some measure of previous experience. Also, individuals from more skilled professions have higher reservation wages than low-skilled workers. The highest premium appears to exist for advanced clerical workers. Perhaps more puzzling is that individuals with no previous work experience have higher reservation wages. This may indicate that these individuals have had less experience with the labour market and therefore do not assess their value to employers correctly. Individuals from 'other urban areas', that is, outside capital cities, appear to have significantly lower reservation wages, as do individuals who have English as their first language.

The results of estimating Equation 44 using the log of family income as an instrument are presented in the final column of Table 18. The first thing to note is that the estimated effect of reservation wages is still insignificant, but has changed sign. The effects of the variables which condition for personal characteristics, the attractiveness of the individual to potential employers and factors which influence search effort are essentially the same.

If there are omitted variables or the reservation wage is duration dependent, the instrumental variable estimates will be unbiased, but the OLS estimates of Equation 44, excluding the log of family income as an explanator, will be biased. Whether this bias is present can be tested formally using a Hausman test. The null hypothesis of the Hausman test is that the two sets of estimates are not

statistically different, that is the OLS estimates do not have a statistically significant bias. Under the null hypothesis, neither estimate will be biased although the instrumental variable estimates will be inefficient. We test this null hypothesis by estimating the log duration equation (Equation 44), replacing the log reservation wage with the predicted reservation wage and the prediction error from the reduced form reservation wage equation (Equation 46).

$$\log t_i = \mu_0 + \mu_1 \log(\hat{\xi}_i) + \mu_2(\log(\xi_i) - \log(\hat{\xi}_i)) + X_i'\mu_3 + u_i \qquad (46)$$

Testing the equality of the coefficients μ_1 and μ_2 is equivalent to testing the null hypothesis that the OLS estimates are not biased. The F-statistic for this test is 3.56 which has a p-value of 0.059. Thus, there is some evidence to suggest that the OLS estimates are upwardly biased and that IV is the appropriate estimation method. Given that the coefficient on the reservation wage is less plausible when instrumental variable methods are used, and that the overall conclusions of the two estimation techniques are essentially the same, we will restrict further estimation and discussion to OLS estimates.[41]

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[41] Had there been more than one instrument available, it would have been possible to test the validity of the extra instruments by assuming the validity of one. This is essentially a test of the overidentifying restrictions implied by having more instruments than variables to be instrumented.

5.3 Estimation Results by Gender

Although the dummy variable for gender in Table 18 is not significant, it is possible that different characteristics influence the outcomes of males and females differently. To examine this issue more closely, we have estimated the factors which affect the duration of unemployment males and females separately. Given the discussion above, only OLS estimates are reported in Table 19.

There are some notable differences in the results of estimating Equation 44 by OLS separately for males and females. Perhaps most interestingly, the reservation wage is significant and of the expected sign for females. This suggests that the time women spend looking for work could be reduced if they were willing to accept a lower hourly wage. However, it does not immediately follow from this observation, that the female unemployment rate would fall if women could be persuaded to accept a lower hourly wage.

The definition of job-search in the SEUP is less strict than the labour force definition of unemployment. Evidence discussed earlier suggested that females with larger families and who left their previous employment for child care reasons were likely to report a lower number of job-search methods. It is possible that there is a significant number of females in the sample who are marginally attached to the labour force, but would be willing to enter the labour force and work if they were offered sufficient incentives, eg enough pay to cover child care costs. Thus, lower wages may not reduce the unemployment rate due to lower participation.

Table 19: Estimation Results By Gender

	Males	Females
Hourly reservation wage	-0.077	0.407**
	(0.174)	(0.203)
Search Incentives		
Unemployment benefit eligibility	0.546**	0.921**
	(0.170)	(0.216)
Log housing costs	-0.326**	-0.070
	(0.078)	(0.102)
Log family income	-0.119**	-0.051
	(0.058)	(0.071)
Family size	-0.025	0.001
	(0.038)	(0.057)
Education		
Degree/diploma	-0.360*	-0.547**
	(0.211)	(0.258)
Vocational qualifications	-0.038	-0.197
	(0.137)	(0.192)
Completed high school	-0.065	0.130
	(0.144)	(0.186)
(Less than high school)		
Personal characteristics		
Age	0.020**	0.021**
	(0.005)	(0.203)
English first language	-0.14	0.295
	(0.278)	(0.332)
English as a second language, high proficiency	-0.070	0.250*
	(0.112)	(0.127)
Married	0.386**	0.101
	(0.148)	(0.183)
Work Experience		
No previous job	0.256	0.048
	(0.279)	(0.362)
Previous hourly pay	-0.183*	-0.191
	(0.104)	(0.134)
Manufacturing	0.504**	0.002
	(0.148)	(0.233)

Continued next page

Table 19: Estimation Results By Gender *(continued)*

	Males	Females
Work Experience		
Manager/professional	0.674**	0.820**
	(0.277)	(0.357)
Advanced clerical	0.307	-0.207
	(0.285)	(0.299)
Trade	0.153	0.526
	(0.155)	(0.409)
(Low-skilled occupations)		
Manager in manufacturing	-1.119**	-0.804
	(0.575)	(1.483)
Reasons for leaving job		
Temporary job	-0.543**	-0.684**
	(0.135)	(0.208)
Ill health	0.348	-0.096
	(0.261)	(0.386)
Unsatisfactory conditions	-0.302*	0.167
	(0.180)	(0.271)
Child care	0.408*	0.056
	(0.223)	(0.226)
(Lost job/firm bankrupt)		
Local environment		
Capital city	-0.021	-0.123
	(0.121)	(0.167)
Rural area	0.054	-0.154
	(0.166)	(0.250)
(Other urban area)		
Index of disadvantage	0.018	0.003
	(0.020)	(0.027)
Observations	682	381
R^2	0.18	0.21
H_0: Overall insignificance	5.49***	3.65***

Notes: Standard errors in parentheses
* denotes significance from zero at the 10 per cent level
** denotes significance from zero at the 5 per cent level
*** denotes p-value of this test is zero to four decimal places

The log of family income and the log of housing costs do not affect the unemployment duration of females, but significantly increase the duration of males. This suggests that the log of family income cannot be used as an instrument to test whether instrumental variable estimation is appropriate for the male sample. For females, however, the log of family income is significant in the reduced form reservation wage regression, and the coefficient on the reservation wage in the duration equation, estimated using the log of family income as an instrument, changes sign and becomes insignificant. The null hypothesis that the OLS estimates are not biased is overwhelmingly accepted using a Hausman test of the form described in Equation 46. This provides further evidence that the OLS estimates presented in Table 18 should be given more weight than the estimates obtained using the log of family income as an instrument.

In general, previous work experience and marital status are more important factors for determining the unemployment duration of males. This probably reflects the fact that women, especially married women with families, are generally more likely to leave the labour force than are males. The unemployment duration of females, is more dependent on observable measures of quality such as educational attainment than on recent labour-market experience.

6 Conclusions

The aim of the analysis in this chapter is to understand the factors which affect the duration of unemployment within the context of the basic job-search model. The analysis differs from much of the previous analysis of this question for the Australian labour market because our data provide information on a wide cross-section of Australian job seekers and our empirical model is derived directly from job-search theory. It is possible to estimate this model because our

data include information about the reservation wage which, despite being the central focus of economic models, is frequently unavailable in survey data. In addition, this chapter estimates a model which allows for reservation wages and unemployment duration to be jointly determined, which has not been the focus of past papers.

The results suggest that although the reservation wage plays a central role in the theory, it is not a significant factor in explaining incomplete unemployment spells in the aggregate labour market. The key binding constraint on gaining employment is the probability of receiving a job offer. One possible explanation for the low job-offer arrival rate is that minimum wages are too high. Evidence presented in Section 3 shows that a significant proportion of job seekers have reservation wages which lie below the minimum wage, although direct comparison is complicated by the system of award wages, age discounts and potential measurement differences. Further evidence in Section 5, however, suggests that minimum wages cannot be the full explanation for why reservation wages are not important determinants of the duration of unemployment.

There is evidence that the reservation wage affects the duration of unemployment for females. However, this result does not necessarily imply that the female unemployment rate would fall if females were willing to accept a lower hourly rate. Given other evidence presented in Section 5 that the job-search behaviour of females is affected by family considerations, and that the definition of a job-seeker in this sample includes individuals who are marginally attached to the labour force, it is likely that reservation wages affect participation decisions, rather than a willingness to accept work once in the labour force.

Job-search theory also suggests that factors which affect the probability of receiving a job offer given the reservation wage should be controlled for. We

found that variables which capture the attractiveness of the job seeker to potential employers such as past work experience and educational attainment, and factors which influence the search effectiveness of job seekers such as eligibility for unemployment benefits, were important for explaining unemployment duration.

What is clear from this analysis is that the basic job-search model which focuses on reservation wages is not sufficient for explaining the duration of unemployment experienced by different individuals. Future research should aim to understand the impact of institutions such as minimum and award wages on the demand for labour, how active the unemployed are in applying for jobs and the importance of non-wage characteristics on job offers. This will involve developing empirical models which jointly consider firms' decisions to offer jobs, and individuals' decisions to accept or reject them.

APPENDIX D: DATA FROM THE SEUP

The following variables take the value one when the characteristic is present and zero otherwise. Omitted variables from sets of mutually exclusive and exhaustive sets of dummy variables are in parenthesis.

- personal characteristics: married, male;
- previous work experience: no previous job, manufacturing, manager, advanced clerical, trade, (low skilled), manager-manufacturing;
- education: degree/diploma, vocational qualifications, high school, (less than high school);
- section of state: capital city, rural area, (other urban); and
- left previous job due to: temporary or holiday job, ill health, child care, unsatisfactory work/pay/hours, (lost job or worked for bankrupt firm).

The following variables are multi-valued variables:

- age: is the midpoint of the range for age recorded in the SEUP;
- family size: is recorded at the Wave 2 interview and is only recorded for families larger than one. Missing values are therefore, replaced with one;
- log unemployment duration: the log of the number of days of job search in which there have been no concurrent working episodes. For jobs prior to September 1994, the end date of the last full-time job is considered prior to the last part-time job;

- log of current income of the family unit: records the dollar value of the midpoint of the range of the family's current weekly income;

- housing costs: dollar value of the range of the decile in which housing costs of the respondent fall. Housing costs include principal repayments on loans as well as interest costs and rent for renters;

Language proficiency variables are defined as:

- 'English first language' takes the value one if their first spoken language was English and they usually speak English in the home and zero otherwise; and

- 'English language proficiency' takes the value zero if English is the first language, takes the value one if English is not the first language but is spoken very well, etc. through to 5 if the respondent does not speak English. It is recorded at the Wave 1 interview and is self-evaluated.

Other variables which required more construction are defined as:

Index of socioeconomic disadvantage

The ABS's index of socioeconomic disadvantage measures the extent to which the local area, displays characteristics such as a high proportion of low income families, low average education levels, employed labourers and high unemployment rates.[42] A higher score in the underlying index of socioeconomic disadvantage suggests that the area is less disadvantaged. The SEUP provides

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[42] The local area used by the ABS for this index is the Collection District (CD) which is a small area defined by the ABS for statistical collection purposes.

information about the decile of each individual's local area ranked by the index of socioeconomic disadvantage.

Log of hourly reservation wages

Desired hours and reservation wages are taken to be the midpoints of the reported ranges. For the range 49 hours and over we arbitrarily choose 49 hours. For the highest reservation wage we use $1,179.50.

Hours in previous job

We first take the midpoint of the range of hours that the respondent previously worked. If the respondent didn't have a job post September 1994, we take the response to the question concerning usual hours in last full-time job. If there is no previous full-time job we take the last part-time job. If there was no previous job we replace missing values with zero.

Wage in last full-time job

We first take the midpoint of the range of wages that the respondent previously worked for. If the respondent didn't have a job post September 1994, we take the response to the question concerning usual weekly income in last full-time job. If there is no previous full-time job we take the last part-time job. If there was no previous job we replace missing values with zero.

Log hourly pay

This variable is the log of the ratio of the wage in last job to hours in last job. It is set to zero if there is no last job recorded.

Unemployment benefit eligibility

This variable is set to one if the respondent is considered eligible for unemployment benefits. If the respondent was unemployed in both the person-level data and in our sample which is based on the episodal data, they are said to be eligible for unemployment benefits if their main source of weekly income in the week prior to the interview was social security. This accounts for around 80 per cent of the people who end up being classified as unemployment benefit recipients. If they were unemployed at the end of Wave 2 but not at the interview, they are classified as eligible for unemployment benefits if their main source of income in the last financial year was social security. Therefore, those who are not classified as eligible will include some individuals who were eligible, but whose unemployment spell at the end of Wave 2 was not long enough to report unemployment benefits were their main source of income over the year and who left unemployment before the interview date.

REFERENCES

Akerlof, G. (1997), 'Social Distance and Social Decisions', *Econometrica,* 65(5), pp. 1005–1027.

Aungles, P. and B.P. Stewart (1986), 'The Duration of Unemployment of CES Registered Job-seekers: An Econometric Analysis', Bureau of Labour Market Research Working Paper No. 66.

Banerjee, A. and T. Besley (1991), 'Peer Group Externalities and Learning Incentives: A Theory of Nerd Behaviour' mimeo (Princeton University).

Binmore, K.G., A. Rubenstein and A. Wolinski (1986), 'The Nash Bargaining solution in Economic Modelling', *Rand Journal of Economic Studies,* 17, pp.176-188.

Börsch-Supan, A. and V.A. Hajivassiliou (1993), 'Smooth Unbiased Multivariate Probability Simulators for Maximum Likelihood Estimation of Limited Dependent Variable Models', *Journal of Econometrics,* 58(3), pp.347-368.

Braithewaite, J. (1987), *Staying or Leaving? Commonwealth Financial Assistance to Secondary Students*, Centre for Research in Education and Work, Macquarie University and Commonwealth Department of Education.

Brooks, C. (1986), 'An Analysis of Factors Influencing the Probability of Transition from Unemployment to Employment for Australian Youth', Bureau of Labour Market Research Working Paper No. 63.

Brooks, C. and P. Volker (1985), 'The Influence of Unemployment Duration and Heterogeneity on the Transition from Unemployment for Australian Youth', Bureau of Labour Market Research Working Paper No. 55.

Case, A.C. and L.F. Katz (1991), 'The Company You Keep: The Effects of Family and Neighbourhood on Disadvantaged Youth', NBER Working Paper No. 3705.

Cleveland, W.S. (1993), 'Visualising Data', Hobart Press, Summit, New Jersey.

Chapman, B.J. (1997), 'Conceptual Issues and the Australian Experience with Income Contingent Charges for Higher Education', *Economic Journal,* 107, pp. 738–751.

Chapman, B.J. and P.N. Smith (1992), 'Predicting the Long-term Unemployed: A Primer for the Commonwealth Employment Service', in R. G. Gregory and T. Karmel (eds), *Youth in the Eighties: Papers from the Australian Longitudinal Survey Research Project,* Centre for Economic Policy Research and Department of Employment, Education and Training, Canberra, pp. 263–281.

Cooper, R. and A. John (1988), 'Coordinating Coordination Failures in Keynesian Models', *Quarterly Journal of Economics,* 103(3), pp. 441–463.

Corcoran, M., R. Gordon, D. Laren and G. Solon (1992), 'The Association Between Men's Economic Status and Their Family and Community Origins', *The Journal of Human Resources,* 27(4), pp. 575-601.

Crane, J. (1991), 'The Epidemic Theory of Ghettos and Neighbourhood Effects on Dropping Out and Teenage Childbearing', *American Journal of Sociology,* 96(5), pp. 1226–1259.

Crockett, G.V. (1994), 'Search Intensity Amongst the Young Unemployed', Curtin University of Technology School of Economics and Finance Working Paper No. 94.01.

Datcher, L. (1982), 'Effects of Community and Family Background on Achievement', *Review of Economics and Statistics,* 64, pp. 32–41.

Dearden, L. (1995), *Education, Training and Earnings in Australia and Britain,* unpublished Ph.D. thesis, University of London.

Dearden, L. and A. Heath (1996), 'Income Support and Staying in School: What Can we Learn from Australia's AUSTUDY Experiment?', *Fiscal Studies,* 17(4), pp. 1-30.

Debelle, G. and T. Swann (1998), 'Stylised Facts of the Australian Labour Market', Reserve Bank of Australia Discussion Paper No. 9804.

Devine, T.J. and N.M. Kiefer (1991), *Empirical Labor Economics: The Search Approach,* Oxford University Press, New York.

Dockery, A.M. and K. Norris (1996), 'The 'Rewards' for Apprenticeship Training in Australia' *Australian Bulletin of Labour,* 22(2), pp. 109–125.

Durlauf, S. (1994), 'Spillovers, Stratification and Inequality', *European Economic Review,* 38(3-4), pp. 836–845.

Durlauf, S. (1996a), 'A Theory of Persistent Income Inequality' *Journal of Economic Growth,* 1(1), pp. 75–93.

Durlauf, S. (1996b), 'Neighbourhood Feedbacks, Endogenous Stratification and Income Inequality', in W. Barnett, G. Gandolo and C. Hillinger (eds) *Dynamic Disequilibrium Modelling: Theory and Applications: Proceedings of the Ninth International Symposium in Economic Theory and Econometrics*, International Symposia in Economic Theory and Econometrics, Cambridge University Press, Cambridge, pp. 505-534.

Evans, W.N., W.E. Oates, and R.M. Schwab (1992), 'Measuring Peer Group Effects: A Study of Teenage Behaviour', *Journal of Political Economy,* 100(5), pp. 966–991.

Fahrer, J. and A. Heath (1992), 'The Evolution of Employment and Unemployment in Australia', Reserve Bank of Australia Discussion Paper No. 9215.

Fernandez, R. and R. Rogerson (1996), 'Income Distribution, Communities and the Quality of Public Education', *Quarterly Journal of Economics,* 66, pp. 135–164.

Foster, W. and R. Gregory (1982), 'The Contribution of Teenage Separation to Teenage Unemployment Separation', *Economic Record,* 58, pp. 118–133.

Gorter, D. and C. Gorter (1993), 'The Relation Between Unemployment Benefits, the Reservation Wage and Search Duration', *Oxford Bulletin of Economics and Statistics,* 55(2), pp. 199–214.

Gregory, R.G. and B. Hunter (1995), 'The Macro Economy and the Growth of Ghettos in Urban Poverty in Australia', Economics Program Research School of Social Sciences, Australian National University Discussion Paper No. 325.

Gregory, R.G. and F. Vella (1996), 'Selection Bias and Human Capital Investment: Estimating the Rates of Return to Education of Young Males', *Labor Economics,* 3(2), pp. 197–219.

Gruen, D., A. Pagan and C. Thompson (1999), 'The Phillips Curve in Australia', *Journal of Monetary Economics,* 44(2), pp. 223-258.

Holzer, H.J. (1988), 'Search Method Use by Unemployed Youth', *Journal of Labor Economics,* 6(1), pp. 1–20.

Hunter, B. (1995), 'Changes in the Geographic Dispersion of Urban Employment in Australia: 1976-1991', Unpublished PhD Manuscript, Australian National University.

Jencks, C. and S. Mayer (1990), 'The Social Consequences of Growing up in a Poor Neighbourhood', in Laurence E. Lynne Jr. and Michael G.H. McGeary (eds), *Inner City Poverty in the United States* National Academy Press, Washington D.C., pp. 111–186.

Jones, S.R.G. (1988), 'The Relationship Between Unemployment Spells and Reservation Wages as a Test of Search Theory' *The Quarterly Journal of Economics*, 103(4), pp. 741–765.

Jones, S.R.G. (1989), 'Job Search Methods, Intensity and Effects', *Oxford Bulletin of Economics and Statistics*, 51(3), pp. 277–296.

Keane, M.P. (1992), 'A Note on Identification in the Multinomial Probit Model', *Journal of Business and Economic Statistics*, 10(2), pp. 193–200.

Lancaster, T. (1985), 'Simultaneous Equations Models in Applied Search Theory' *Journal of Econometrics*, 28(1), pp. 113–126.

Lancaster, T. (1992), *The Econometric Analysis of Transition Data*, Econometric Society Monographs No.17, Cambridge University Press, Cambridge.

Larum, J. and J.J. Beggs (1989), 'What Drives Australian Teenage Labour Force Participation?' *Australian Journal of Statistics* 31A, pp. 125-142.

Lewis, P.E.T. and P. Koshy (1998), 'Youth Employment, Unemployment and School Participation', The Centre for Labour Market Research Discussion Paper 98/3.

McGregor, A. (1983), 'Neighbourhood Influence on Job Search and Job Finding Methods', *British Journal of Industrial Relations*, 21, pp. 91–99.

Manski, C. (1993), 'Identification of Endogenous Social Effects: The Reflection Problem', *Review of Economic Studies* 60, pp. 531–542.

Manski, C. (1995), *Identification Problems in the Social Sciences*: Harvard University Press, Cambridge, Massachusetts.

Miller, P.W. and P. Volker (1987), 'The Youth Labour Market in Australia: A Survey of Issues and Evidence', Australian National University Centre for Economic Policy Research Discussion Paper No. 171.

Miller, P.W. and P. Volker (1989), 'Socioeconomic Influences on Educational Attainment: Evidence and Implications for the Tertiary Education Finance Debate', *Australian Journal of Statistics* 31A, pp. 47-70.

Montgomery, J. (1991), 'Social Networks and Labour Market Outcomes: Towards an Economic Analysis', *American Economic Review* 81, pp. 1408–1418.

Mortensen, D.T. and C.A. Pissarides (1999), 'New Developments in Models of Search in the Labour Market', Centre for Economic Policy Research Discussion Paper No. 2053.

Pissarides, C. (1990), *Equilibrium Unemployment Theory*, Basil Blackwell, Oxford.

Rees, A., (1966), 'Information Networks in Labour Markets', *American Economic Review*, 56, pp. 559–566.

Robertson, D. and J. Symons (1996), 'Do Peer Groups Matter? Peer Group Versus Schooling Effects on Academic Achievement', CEP Discussion Paper No. 311.

Rosier, M.J. (1978), 'Early School Leavers in Australia: Family, School and Personal Determinants of the Decision of 16-year-old Australians to Remain at School or to Leave', International Association for the Evaluation of Educational Achievement IEA Monograph Studies No. 7.

Schmitt, J. and J. Wadsworth (1993), 'Unemployment Benefit Levels and Search Activity', *Oxford Bulletin of Economics and Statistics* 55(1), pp. 1–24.

Silverman, B. (1986) *Density Estimation for Statistics and Data Analysis*, Chapman and Hall, New York.

Stromback, T., M. Dockery and W. Ying (1998), 'Transitions in the Labour Market: Evidence from the Survey of Employment and Unemployment Patterns', Melbourne Institute Working Paper Series No. 1/98.

Struefert, P. (1991) 'The Effect of Underclass Isolation on Schooling Choice', Mimeo (University of Wisconsin).

van den Berg, G.J. (1990), 'Search Behaviour, Transitions to Nonparticipation and the Duration of Unemployment', *Economic Journal*, 100(402), pp. 842–865.

Wadsworth, J. (1991), 'Unemployment Benefits and Search Effort in the UK Labour Market', *Economica*, 58, pp. 17–34.

Williams, T.H., M. Batten, S. Girling-Butcher and J. Clancy (1981), *School and Work in Prospect: 14-Year Olds in Australia*, A.C.E.R., Hawthorn.

Wolinski, A. (1987), 'Matching, Search and Bargaining', *Journal of Economic Theory* 17, pp.176-188.