E I P

Literacy, Numeracy and Labour Market Success

00/9

Yew Liang Lee

Paul W. Miller

Department of Economics
The University of Western Australia

Evaluations and Investigations Programme
Higher Education Division
Department of Education,
Training and Youth Affairs

Department of Education,
Training and Youth Affairs

Literacy, Numeracy and Labour Market Success

Yew Liang Lee
Paul W. Miller

Department of Economics
The University of Western Australia

00/9
August 2000

Evaluations and Investigations Programme
Higher Education Division

Instructions for pdf navigation

- Use the arrows on the Acrobat menu bar to navigate forwards or backwards page by page
- Alternatively, use the arrow icons on your keyboard to navigate through the document.
- To enlarge the viewing screen either:
  - use the magnifying glass by clicking on the area you wish to enlarge or by forming a marquee over the area you wish to view (ie. hold the mouse button down and drag the magnifying glass over the area); or
  - use the view options menu bar at the bottom of the Acrobat screen.
- To pan out from the page, hold down the option button on your keyboard to change the +ve symbol on the magnifying glass to a –ve symbol , then click the mouse.
- To search for a word or phrase use the binoculars icon on the menu bar.
- The Contents pages are live, ie. if you click on a topic you will go to that page.
- You can return to the Contents page by clicking your mouse on 'Contents' on the top of each page.

ISBN 0 642 44860 4

ISBN 0 642 44861 2 (Online version)

DETYA No. 6491.HERCOOA

The report is funded under the Evaluations and Investigations Programme of the Department of Education, Training and Youth Affairs.

The views expressed in this report do not necessarily reflect the views of the Department of Education, Training and Youth Affairs.

Contents

Tables

Abstract

This paper uses data from the *Survey of Aspects of Literacy* to examine the relationship between educational attainment and labour market success within a framework that allows for the links among educational attainment, literacy and numeracy and various labour market outcomes. Education is argued to impart knowledge that is useful in the labour market, and hence to enhance an individual's productivity. An alternative explanation for the association between educational attainment and labour market outcomes is that education is a means of identifying innate ability. This explanation is known as the screening approach. In addressing the issue of whether education serves as a screening instrument or whether the better educated acquire skills that make them more productive, the analyses conducted in this study focus on literacy and numeracy skills.

There are six main sections in this paper. Section 2 provides a description of the *Survey of Aspects of Literacy* data. A discussion of the literature based on this data set is presented in Section 3. Section 4 focuses on the data issues that need to be addressed when the *Survey of Aspects of Literacy* is used to analyse labour market outcomes. The cross-tabulations of data on educational attainment, literacy, numeracy and labour market outcomes presented in this section show that there is a strong positive relationship between the level of educational attainment and labour market success. It is also found that higher levels of numeracy/literacy (either self-reported or test-based data) are associated with greater labour market success, and that the better educated have higher levels of numeracy/literacy.

In Section 5, multivariate analyses of the determinants of labour market outcomes that seek to ascertain the separate contributions of educational attainment and literacy and numeracy skills to labour market success and failure are presented. It is shown that between one-third and one-half of the *total* effect of education is in fact an *indirect* effect of education that arises due to the higher literacy and numeracy skills of the better educated. The results indicate that education does not simply act as a screening device. It is, as the results suggest, associated with better literacy and numeracy (measures of improvement in skills) that are well rewarded in the labour market. Therefore, education appears to affect labour market outcomes in large part through its effects on human capital skills that are embodied in people and which are not usually measurable.

Section 6 summarises the major findings, and concludes that part of the effect of educational attainment arises because of the improved literacy and numeracy skills (and other unmeasured skills) of the better educated. Education is argued to represent a productivity-enhancing process in which skills (including literacy and numeracy) are improved.

1. Introduction

One of the strongest empirical regularities in the Australian labour market is the positive association between educational attainment and labour market success. In analyses that examine the average income return to years of education, each additional year of education is associated with around eight per cent additional income. More detailed accounts of the labour market performance of the better educated have examined the income returns to different types of education. It has been reported that individuals who possess a degree have incomes around 50 per cent higher than those whose highest educational attainment is the completion of high school, while the income advantages of individuals who hold either a diploma or a certificate are 40 per cent and 10 per cent, respectively (see Preston (1997)). Similarly, when the determinants of unemployment rates are considered, the better educated are shown to have lower unemployment rates than early school leavers. The advantages of the tertiary educated in this regard are considerable (see Le and Miller (2000)).

Why are the better educated more successful in the labour market than the less-well educated?

This question has been discussed in the screening versus human capital debate (see, for example, Andrew Weiss (1995)). This debate, however, has not yielded much in the way of concrete evidence on the issue. In the Australian context, the matter has been examined by Miller and Volker (1984) and by McNabb and Richardson (1989). Miller and Volker (1984) compare the salaries of university graduates employed in areas where they might be expected to utilise skills acquired at university with salaries of graduates of equivalent background not so employed. Their argument is that if employers place little premium on skills acquired and use the awarding of a degree as a screen, there will be no difference between the salaries of these two groups. Comparisons made for economics and science graduates implied that for the most part the university education was providing a screening function.[1]

McNabb and Richardson (1989) examine the relevance of the screening hypothesis by comparing the earnings determination process for a number of groups, including wage and salary earners (where screening may be useful) and the self-employed (where it is assumed there is no immediate role for

1 Lang and Kropp (1986) argue that the test implemented by Miller and Volker (1984) is more a test of whether the skills accumulated in a degree are general or specific.

screening)[2], and in occupations categorised as screened or unscreened on the basis of initial earnings and educational attainment.[3] McNabb and Richardson's (1989) results from the latter analysis provided some support for the screening hypothesis, but their results from the former analysis do not. The test based on a categorisation of occupations as screened and unscreened is, however, generally regarded as a weak test, as it is based on a comparison of outcomes in occupations where screening is likely to be most and least powerful. It is therefore fair to conclude that the Australian research has not yielded much knowledge on the reasons why the better educated in the Australian labour market have labour market outcomes that are superior to those of their less-well educated counterparts.

One direction for research that might be fruitful is to examine the links between education, labour market outcomes and the specific skills that might be acquired in the education process (see Weiss (1995)). This approach has been taken by Altonji (1995) and Kang and Bishop (1986). These studies have examined the links between the number of courses undertaken per year of study and labour market outcomes, and the links between grades and labour market outcomes. The results attribute less than one-quarter of the total effect of schooling to the skills learned in school. However, the indices of skills learned given by courses undertaken, academic grades or test scores for basic skills of mathematics, reading and vocabulary (such as those used by Kang and Bishop (1986)) may be crude measures of the skills that are important in the labour market.

The aim of the current paper is to examine the relationship between labour market success and educational attainment within a framework that allows for the links among educational attainment, literacy and numeracy and various labour market outcomes (labour force participation, unemployment, incomes). The analyses undertaken will be based on the *Survey of Aspects of Literacy* that was conducted by the Australian Bureau of Statistics in 1996. This survey contains a range of data on numeracy and literacy skills unsurpassed in Australian data sets. These data relate to 'functional literacy and numeracy skills' and so may be better suited to examination of labour market outcomes than more standard academic test results. It also contains a range of information on demographic and workforce characteristics.

The specific questions that will be addressed using the *Survey of Aspects of Literacy* are: What are the gross increments in labour market outcomes (labour force participation, unemployment rates, incomes) associated with

2 This test is due to Wolpin (1977).

3 This test is due to Riley (1979).

various levels of qualifications (degree, diplomas, certificates etc.)? What are the typical increments in labour market outcomes associated with literacy and numeracy? Are some literacy skills (for example, prose literacy, document literacy and quantitative literacy) more valuable than others? How strong are the links between the highest educational attainment and levels of literacy and numeracy? To what extent do the (presumed) high levels of literacy and numeracy of the better educated account for their superior labour market outcomes in the Australian labour market?

The structure of this paper is as follows. Section 2 presents an overview of the *Survey of Aspects of Literacy*. Studies that have used these or related data are reviewed in Section 3. Section 4 introduces a number of issues that need to be addressed when analysing labour market outcomes using the *Survey of Aspects of Literacy*. It presents a number of cross-tabulations of data on educational attainment, literacy, numeracy and labour market outcomes. Multivariate analyses of the determinants of labour market outcomes that seek to ascertain the separate contributions of educational attainment and literacy and numeracy skills to labour market success and failure are presented in Section 5. Section 6 contains a summary and conclusion.

2. The *Survey of Aspects of Literacy*

The *Survey of Aspects of Literacy* was a national survey designed to assess directly the literacy and numeracy skills of Australia's adult population. The survey, which was conducted between May and July 1996, consisted of personal interviews administered to a representative sample of 10 700 people (aged 15 to 74) across Australia, but excluding those living in remote and sparsely settled areas. The response rate was 87 per cent.[4]

The focus of the *Survey of Aspects of Literacy* was on 'functional literacy and numeracy skills' defined as 'the information processing skills necessary to use printed material commonly encountered at work, at home and in the community'. The aims of the survey included identifying 'at risk' groups of individuals with low literacy and numeracy skills, evaluating literacy and numeracy assistance programs, identifying barriers to individuals who achieve skill levels sufficient for daily life and work, and providing statistical support for both planning and decision making.

Information on demographic characteristics, labour force status, educational attainment, language usage, daily and social activities, and literacy tasks in the workplace was collected. The demographic variables include sex, age, birthplace, state or territory of usual residence, year of arrival in Australia, age on arrival in Australia, and whether English was the first language. There are three broad categories of labour force status. They are 'employed', 'unemployed', and 'not in the labour force'. Individuals who were employed at the time of the survey were asked about the occupation and industry of their current job, and whether they worked part time or full time. Unemployed individuals were required to report the duration of their unemployment, while those who were not in the labour force were asked if they were still studying, engaged in home duties or were retired.

The survey collected details on the educational attainments of the respondents and their parents. Respondents were also required to report on the number of schools they attended before they turned 15 years. Those who left school early were asked the main reason for quitting school.

Individuals whose first language was not English were required to provide details on the languages usually spoken at home, the languages in which

[4] For more information, see ABS (1997).

they were most at ease, the age they learned to speak English and whether they attended English language classes. All respondents were asked to provide self-perceptions of English reading and writing skills, along with similar data on mathematical skills. These data relate to the needs of the daily life. Individuals who were employed were asked to report on the adequacy of their literacy and numeracy skills for the needs of their job.

The *Survey of Aspects of Literacy* collected details on the frequencies a public library was used, books and newspapers/magazines were read at home, and letters/memos were read or used in the workplace. Details were also collected on how often reports, articles, magazines or journals, bills, invoices, spreadsheets or budget tables were read or used in the workplace. The frequencies of participating in social activities (such as attending a movie, play or concert) were also recorded.

Three types of literacy are assessed in an objective manner in the *Survey of Aspects of Literacy*, namely prose literacy, document literacy and quantitative literacy. Prose literacy is defined as the knowledge and skills required to understand and use information from texts, including texts from newspapers, magazines and brochures. The material presented to respondents to assess their prose literacy varied in length, density, content and use of organisational aids such as headings, bullets and special type faces. Each prose selection was accompanied by questions or directives requiring specific tasks to be performed by the reader. These tasks represent three major aspects of information-processing: locating, integrating and generating. Locating tasks ask readers to find information in the text based on the specification of the question or directive. In the integrating tasks, readers must gather two or more pieces of information in the text. The information may be found in a single paragraph or in different paragraphs or sections. Generating tasks require readers to process information from the text or to make text-based inferences.

The tests for prose literacy included various tasks with different levels of difficulty, ranging from Level 1 to Level 5 (with Level 1 being the easiest and Level 5 being the most difficult). The degree of difficulty increases with the length and density of the information that readers must process, and the number of 'distractors' (i.e., information contained in the text that shares some of the features with the information being asked and which seems plausible but does not fully answer the question).[5]

[5] The objective measures of literacy and numeracy were obtained using methodology developed for the International Adult Literacy Survey by Statistics Canada and the Educational Testing Service in the United States of America. The methodology was extensively pilot-tested in Australia to ensure that it was suitable for the Australian context. The tasks were ranked in order of their difficulty on a scale of 0 to 500. Respondents were then assigned scores (also on a scale of 0 to 500) according to their performance on the tasks they were given. These scores were then categorised into five levels. People with Level 1 literacy/numeracy skills

The knowledge and skills needed to process information in materials such as tables, schedules, charts, graphs and maps are referred to as document literacy. Document literacy depends on the individual's abilities in locating, integrating, generating and transferring information. To assess their document skills respondents were presented with a variety of tasks, including tasks where they were required to match one or more features of information asked in a question to either identical or synonymous information given in the document (i.e., to locate information in a document), tasks where they had to integrate information by comparing and contrasting information from different parts of the document, tasks where they had to generate information by processing information found in the document and by making text-based inferences, and tasks where they had to transfer information from one source to another (e.g., when completing order forms).

As with the prose tasks, there are five different levels of document tasks. The difficulty associated with document tasks is affected by the structure and content of the document, the number of categories or features of information in the question that the reader must process or match, and the extent to which the information asked for in the question is related to the information stated in the document.

Quantitative literacy involves the ability to perform arithmetic operations using numbers embedded in printed texts or documents. A quantitatively literate person must be able to locate and extract numbers from different types of documents that contain similar but irrelevant information, and also be able to perform arithmetic operations when the operations to be used must be inferred from printed directions. Each type of question associated with a quantitative task extends over a range of difficulty (Level 1 to Level 5). Again a range of tasks were used in the assessment procedure, with the difficulty of the tasks depending on the particular operation required to perform a specific task, the number of arithmetic operations needed, the extent to which the numbers are contained in printed materials, and the extent to which an inference must be made to identify the type of operation to be performed.

have very poor skills, and they could be expected to experience considerable difficulties in using many of the printed materials that may be encountered in daily life. Level 2 people could be expected to experience some difficulties in using many of the printed materials encountered in daily life. At Level 3 people would be expected to have the ability to cope with a varied range of materials found in daily life and at work. People at Level 4 have good literacy skills, while people who possess Level 5 skills have very good literacy skills, and can make use of their skills for very demanding tasks.

In addition to these objective measures, the *Survey of Aspects of Literacy* collected information on individuals' perceptions of the adequacy of their own literacy skills for the needs of their daily life and for their job. It is acknowledged by Bianco (1997) that there are conceptual differences between these two measures. This view is reinforced by the low degrees of correlation between them reported in Section 5.

3. Literature review

This section has two main parts. The first part presents a discussion of the literature that uses the *Survey of Aspects of Literacy*. The second part contains a discussion of the literature that introduces specific academic skills into the human capital earnings function.

3.1 Literature based on the *Survey of Aspects of Literacy*

There are only a few studies that have used the *Survey of Aspects of Literacy*, and these studies vary considerably in the subject matter they cover. Norton (1997) examines both prose and document skills, while Cumming (1997) presents a discussion of quantitative skills. Miller and Chiswick (1997) examine the impact that both literacy (prose and document) skills and quantitative skills have on labour market outcomes. Literacy problems in Australia, and the sort of policy that is needed to overcome these problems, are discussed in Bianco (1997).

The study by Norton (1997) emphasises the view of reading as an interactive process in which readers bring prior knowledge and experience to the text and use new information for their own purposes. The main aims in this study are to describe those people who operate predominantly at the lowest levels (Level 1 and Level 2) on both the prose and document scales, and also to compare the features of literacy materials at different difficulty levels to show how the texts affect the way in which people can gain information and use everyday print materials.

It is found that nearly half of the population are in Levels 1 and 2 on the prose and document scales. However, many of these people can do more advanced literacy tasks some of the time, depending on both the reader's experience and the particular features of the text and the tasks. As the level of difficulty of the tasks increased, more Level 1 and 2 people did not attempt them.

Norton (1997) reported that the proportion of Level 1 and 2 people was higher outside the Australian capital cities than in the capital cities. The proportion of people at Levels 1 and 2 increased by age group, and decreased with the level of schooling. It was also shown that employed people were not as likely to be at Levels 1 and 2 as people who were unemployed or those not in the labour force. Interestingly, the *Survey of*

Aspects of Literacy shows that many Level 1 and 2 workers perform literacy-related tasks daily. For example, with reference to the prose scale, some 17 per cent of Level 1 and 25 per cent of Level 2 workers read or use bills, invoices, spreadsheets or budget tables as a part of their main job.

Recognising the literacy tasks that the least skilled can or cannot undertake successfully on a regular basis is argued by Norton (1997) to be important for a range of workplace (e.g., effective use of skills) and social (e.g., maximising the understanding gained from printed materials) issues.

In studying the quantitative literacy performance of Australians, Cumming (1997) focuses on the characteristics of those people who were grouped at Levels 1 and 2 (i.e., those who have low skills in quantitative literacy). An attempt was made to explore what quantitative literacy means, and what should be done to help people with Levels 1 and 2 quantitative literacy skills.

The results presented in Cumming (1997) show that over 6 million (i.e., 46 per cent) Australians have Levels 1 and 2 quantitative literacy skills. It is found that a smaller proportion of Australians who spoke English as their first language were identified at quantitative literacy Levels 1 or 2 skills compared with Australians who first spoke another language. There were fewer men than women at Levels 1 and 2, and fewer of the better educated than of the less well educated had Levels 1 or 2 quantitative skills. In addition, it is shown that those with Levels 1 or 2 skills are less likely to have worked in the last 12 months. Cumming (1997) suggests that while these differences in the proportion of those who have worked may be due to different educational opportunities, age and life experiences, it is also possible that low quantitative skill level is a barrier to employment.

Cumming (1997) notes that individuals with Level 1 quantitative skills are likely to have considerable difficulty in coping appropriately with the quantitative literacy demands of their work, training and the personal and social aspects of daily life. It is argued that the needs of these people should be recognised. In particular, the ways in which information is presented for those who are older and the assistance that is provided to help its dissemination and interpretation should be examined.

In the study conducted by Miller and Chiswick (1997), the links between literacy/numeracy skills and labour force status, occupational distributions and levels of socioeconomic status of the employed, and the unemployment duration of the unemployed are examined. It is reported that males have higher levels of document and quantitative literacy than females. Individuals whose first language was not English have literacy and numeracy skills that are inferior to those individuals who usually speak a language other than English.

The examination of the links between literacy/numeracy skills and labour market outcomes indicated that labour force participation rates decline with lower levels of literacy/numeracy. This decline was reported as being greater for females than for males, and also greater among individuals who spoke a language other than English as their first language compared to monolingual English speakers.

Miller and Chiswick (1997) point out that lower levels of labour force participation among those who lack basic literacy/numeracy skills could be due to 'education'. It can be argued that the better educated are more likely to participate in the labour market and to possess higher levels of skills complementary to their formal education, including literacy skills. Alternatively, the relatively low levels of labour force participation at the lower levels of literacy may also be a response to inferior job opportunities among those who lack basic literacy/numeracy skills.

It is also shown that there exists a negative relationship between unemployment rates and literacy/numeracy skill levels. That is, unemployment rates increase as the levels of literacy or numeracy decline. Moreover, unemployment durations are greater among individuals with English language deficiencies.

The results generated by Miller and Chiswick (1997) suggest that language and literacy skills are major determinants of occupation attainment, with the better jobs going to those with higher levels of literacy and numeracy. This effect is larger for women than for men. Hence, Miller and Chiswick (1997) conclude that both literacy and numeracy are important contributors to many dimensions of labour market success.

The study by Bianco (1997) identifies literacy problems in Australia, and provides recommendation of what sort of policy is needed to overcome these problems. He reports that the assessed literacy and quantitative skills were correlated more strongly more strongly with language first spoken (English/non-English) than with place of birth or year of arrival in Australia. The results on literacy and quantitative dimensions reveal the very significant advantage associated with English as a language usually spoken at home. The importance of language first spoken is also a theme in the studies by Cumming (1997) and Miller and Chiswick (1997).

With the *Survey of Aspects of Literacy* providing compelling statistical evidence of adult literacy problems, Bianco (1997) argues that there is a need for a policy that specifically addresses literacy. He recommends programs designed around personal, community and family settings and contexts rather than vocationally oriented, or job-training, programs. Effective policy, according to Bianco (1997), must be sensitive to literacy problems beyond their economic effects alone, and address citizenship and social participation issues as well as individuals' personal motivations and goals.

3.2 Literature on specific academic skills in human capital theory

There is a wide range of reasons why the better educated have labour market outcomes superior to those of the less well educated. In sorting or signalling models, educational attainment serves as a proxy for productivity-enhancing factors that firms cannot observe. For example, better-educated workers have lower propensities to quit or to be absent. They also have more perseverance. Weiss (1988) finds that lower quit behaviour and lower rates of absenteeism of high school graduates explain substantially all of the relationship between high school graduation and earnings. Under these scenario, the conventional estimates of the returns to education will reflect the way firms make inferences about productivity differences using information on educational attainment.

A further explanation for the links between education and labour market success is that higher-ability people choose to stay in school longer because they receive higher benefits from schooling. This generates a positive correlation between the ability to learn and the length of schooling chosen and hence gives rise to the proposition that educational attainment sorts by ability (Weiss (1983)).

The more conventional explanation of the greater labour market success of the better educated, however, is that individuals learn something in school that affects their productivity, and it is this learning-induced productivity increase that leads to superior labour market outcomes. This human capital perspective has been examined in a number of studies. For example, Altonji (1995) examines the effect course work in school has on earnings using data from the *National Longitudinal Survey of the High School Class of 1972* and various follow-ups (including earnings in 1986). He finds that taking the average high school course load rather than (hypothetically) not taking any courses in the year of study either has no significantly positive effect on wages or actually decreases wages.[6] Altonji (1995) also reports that course work has no significantly positive effect on wages even 13 years after individuals have graduated from high school. Course work (and ability), on the other hand, does affect the returns to post-secondary schooling. Hence it is argued that while there may not be a direct effect of secondary school work on productivity, it may be complementary to learning in post-secondary school. Kang and Bishop (1986) also find that academic courses had insignificant direct effects on wage outcomes.

[6] The average high school course load is the mean of total semester hours. It works out to be 133.33 hours, which amounts to 4.44 courses meeting 5 days a week each semester during 10th, 11th, and 12th grade.

These results cast considerable doubt on the human capital view of schooling as representing a value-adding or skill acquisition process. Weiss (1995) reviews a number of factors that could account for the results and hence support the interpretation of the correlation between labour market success and secondary schooling as being due to the skills learned in secondary school. One of the most plausible explanations suggested by Weiss (1995) is that learning in primary school may be generating the positive correlation between secondary schooling and wages. Under this interpretation, children are taught about cooperation, perseverance, and delay of gratification in primary school. Those who learn these affective skills are likely to stay in school longer.

Altonji (1995) and Kang and Bishop (1986) have also examined whether the positive correlation between schooling and wages could be explained by a relationship between grades/test scores and wages. However, they fail to find evidence that learning in secondary school is making any substantial contribution to the positive relationship between schooling and earnings; learning in secondary school can explain at most one-quarter of the higher earnings of high-school graduates. This result may, however, simply indicate that the test scores used are poor indicators of labour market capabilities: the tests used measure only the levels of basic skills in areas such as mathematics, reading and vocabulary (see Kang and Bishop (1986)).

This brief review reveals two main findings. First, the overseas literature suggests that the link between skills learned in school and labour market success is weak. There is some doubt, however, as to whether the measures of skills used in these studies are appropriate indicators of labour market capabilities. Second, the few studies that have utilised the *Survey of Aspects of Literacy* have suggested that functional literacy/numeracy skills may have a strong influence on labour market outcomes. The links between functional literacy/numeracy skills and labour market outcome is investigated in detail in the analyses that follow.

4. Methodology and data considerations

This section has two main aims. First, the *Survey of Aspects of Literacy* data on the main measures of labour market outcomes—incomes and labour force status—are outlined. The approaches taken in the literature to deal with the main features of these data are reviewed. Second, a number of cross-tabulations of labour market outcomes by educational attainment, numeracy and literacy are presented in order to establish the basic patterns in the data.

4.1 Methodology

There are two variables in the *Survey of Aspects of Literacy* that are considered for analysis as indicators of labour market outcomes. The first is incomes and the second is labour force status (employed, unemployed, not in the labour force). A number of issues arise when attempts are made to use these data in modelling exercises. These are reviewed here.

The income data in the *Survey of Aspects of Literacy* are available in deciles only.[7] The cut-off points for the deciles are known, and hence the data can be thought of as having been made available in 10 categories. When data are made available in this way, researchers have used a number of strategies. The first types of strategies essentially involve ad hoc measures for assigning income values to each of the categories. The use of mid-point values for closed income intervals, and 1.5 times the open-upper income bracket is one method (e.g., Chiswick and Miller (1995)). Combining mid-point values for closed income intervals, and Pareto estimates for the open-upper income bracket, is another method (e.g., Jones (1992))[8]. Elaborate forecasting measures have also been employed (e.g., Roussel (1999)). The results from these studies tend to match reasonably closely the results from studies using superior income data. The main deficiency is that the use of the mid-point for the income interval in place of the actual value generates errors of measurement in the dependent variable that are generally thought to be correlated with the explanatory variables. The reason for this correlation is that any variable that affects location across categories (e.g., additional education should be associated with membership of a higher income

[7] As the deciles are constructed from categorical data, they are not exact. The per cent of valid income data in the deciles ranges from a low of 8.4 per cent to a high of 12.8 per cent.

[8] See Parker and Fenwick (1983) for comment on this methodology.

category) should also affect location within each category (e.g., the better educated should have an actual income level closer to the upper boundary of any given category than the less-well educated). Thus, when each person is assigned the mid-point of the category, systematic errors of measurement can be introduced. This will result in bias to the estimates. This can be explained as follows.[9] Assume the true value of the dependent income variable is Y^*. In its place we measure $Y = Y^* + \nu$, where is a measurement error. Then the regression model of $Y^* = \beta X + \varepsilon$ will be replaced by $Y - \nu = \beta X + \varepsilon$ or by $Y = \beta X + \mu$, where $\mu = \varepsilon + \nu$. In this case, if ν is correlated with X, then $cov(X,\mu) \neq 0$, and OLS estimates of β will be inconsistent. The slope coefficients can be under- or over-estimates of the true values. In practice, the smaller the number of income categories, the larger the measurement error and the greater the extent of the bias.[10]

A second approach that has been adopted involves the use of the average income of the occupation of employment in replacement of deficient income data (see, for example, Miller, Mulvey and Martin (1995)). This is not a practical alternative with the *Survey of Aspects of Literacy*, as the data on occupation contain only eight categories. Use of this alternative construct would actually compound any problems. The reason is that there are fewer categories being used, and, with the dependent variable being formed in this way, all intra-occupational variations in income are averaged out. Hence, the inter-occupational but not the intra-occupational earnings effects are captured in study of variations in incomes (see Lee, Miller and Martin (2000)).

A third approach involves matching the modelling procedure to the way the income data are presented. Stewart (1983) suggests that if the dependent variable is reported only by range (say, K different ranges), then there will always be K-1 interior limit values. With the categorical income data in the *Survey of Aspects of Literacy*, the limit values are 2000, 6600, 13 000, 19 000, 24 000, 28 000, 32 800, 40 000, 50 000, or some transformation (e.g., logarithmic) thereof. Stewart (1983) outlines several estimators that may be used in this instance to obtain consistent estimates, and compares these estimates, in theory and in practice, with least squares. Kidd (1993) employed a maximum likelihood estimator outlined by Stewart (1983) in his study of Australian income data.

[9] See Stewart (1983) for an alternative exposition.

[10] Kidd (1993) argues that given the measurement error in survey income data (see Duncan and Hill (1985)), the availability of income data only in grouped form need not be viewed too negatively.

A final approach that has been used is to employ indicators of labour market outcomes other than income in studies of labour market success and failure. This approach has generally been used when a data set lacks any measure of incomes, but it could also be used where the income data have deficiencies that cause the researcher concern. Chiswick and Miller (1992), for example, undertake research on the links between the education that immigrants receive after they arrive in Australia and labour market success using employment status (employed, unemployed, non-participant).

The modelling of labour force status can aim to explain the distribution of the population across the three mutually exclusive and exhaustive categories of employment, unemployment and non-participation. Alternatively, it can focus on subsets of these categories, and attempt to explain either the labour force participation decision (that is, membership of either the employment or unemployment categories versus non-participation in the labour force) or the unemployment outcome among labour force participants. Examples of research that has examined the allocation of individuals across the employment, unemployment and non-participation categories include Chiswick and Miller (1992) and Brooks and Volker (1985). Chiswick and Miller (1994) is an example of a study that looks at the labour force participation decision (and which reviews relevant literature) while Le and Miller (2000) review a large number of studies that focus on the unemployment outcome. The information in the *Survey of Aspects of Literacy* on labour force status is readily amenable to analysis using the techniques (discrete choice modelling) generally favoured in the literature. These techniques are reviewed in Section 5.

4.2 Labour market success: A first look

This segment of the study will commence with an examination of the variation in the labour force status and raw income data across levels of educational attainment. It will then extend the analysis to an examination of the patterns in the data on the links between labour market success and measures of literacy and numeracy.

4.2.1 Labour market success and educational attainment

Table 1 lists information on labour market success at various educational attainments. There are three main education variables available in the Survey, 'Level of Educational Attainment', 'Age Left School' and 'Years of Formal Education Completed'. The cross-tabulations provided below will use the 'Level of Educational Attainment', as this offers the sharpest distinctions

among the various levels of schooling. The 'Level of Educational Attainment' variable contains the following categories: (i) Higher degree, (ii) Postgraduate diploma, (iii) Bachelor degree, (iv) Undergraduate diploma, (v) Associate diploma, (vi) Skilled vocational qualifications, (vii) Basic vocational qualifications, (viii) Completed highest level of secondary school available, (ix) Has not completed the highest level of secondary school available, (x) Never attended school. The latter category has too few observations for meaningful analysis, and the respondents in it are merged with the group that had not completed the highest level of secondary school available.

The income data available comprise two variables, 'Personal Income from Wages, Salary or Self-Employment Only', and 'Personal Income from all Sources'. Both variables are presented in deciles, as explained earlier. The analyses in this study utilise the former variable as it is more closely identifiable with the outcomes of individual choice.

A third group of variables that is of relevance covers labour force and employment status. The labour force status variable distinguishes respondents according to whether they were employed, unemployed or not in the labour force. The employment status variable provides more detail on the employment and unemployment categories. The analyses presented below are based on the labour force status variable.

Table 1 lists data on labour force participation rates, unemployment rates and income distributions by level of educational attainment. These data are presented for the total population, and also for males and females separately (Tables 2 and 3).

It is readily apparent from the first two columns of data that there tends to be a strong positive relationship between the level of educational attainment and the rate of participation in the labour force, and a strong inverse relationship between the level of educational attainment and the rate of unemployment among labour force participants. Hence, the participation rate ranges from 57 per cent among individuals who did not complete the highest level of secondary school available to 93 per cent for individuals with a Higher degree. With respect to the unemployment rate, the Table 1 data reveal that this ranges from a low of only 2.2 per cent among those with a Higher degree through to 11.2 per cent for individuals who did not complete the highest level of secondary school available. The main conclusion from the first two columns of data is that higher levels of education are associated with much greater involvement in the paid labour force and with much lower rates of unemployment.

The information on the distribution of the employed across income classes in the second set of columns in Table 1 reveals a tendency for the better educated to be more likely to be in the upper-ends of the income distribution compared to the less-well educated. Hence, 67 per cent of individuals with a Higher degree, and 34 per cent of those with a Bachelors degree are in the top one-fifth of the income distribution, compared to 11 to 13 per cent of those whose highest level of educational attainment is the completion of secondary school or below. Conversely, only 8 per cent of individuals with a Higher degree and 14 per cent of those with a Bachelor degree are in the lower one-fifth of the income distribution, compared to 20 to 27 per cent of those whose highest level of educational attainment is the completion of secondary school or below. According to these data, higher levels of educational attainment are associated with a more favourable position in the income distribution.

There is one aspect of Table 1 that might be described as a puzzle. This concerns the per cent of individuals in the lowest one-fifth of the income distribution among the lower levels of educational attainment. Hence, whereas 27 per cent of those whose highest level of educational attainment was the completion of secondary school were in the bottom one-fifth of the income distribution, only 20 per cent of those in the lower level of educational attainment of not having completed the highest level of secondary school available were in this income bracket. An alternative description of these data is that the income distribution for those who did not complete secondary school is more compressed towards the population median than the income distribution for those whose highest level of educational attainment was the completion of secondary school.

To establish whether this is an anomaly, comparable data to those presented in Table 1 were extracted from the Australian Bureau of Statistics' *Survey of Employment and Unemployment Patterns.*[11] These data, presented in Appendix A, differ from those listed in Table 1 in a number of respects. However, of particular interest is the comparison of the percentage representations of the lower educational attainments in the various fifths of the income distribution.

[11] The *Survey of Employment and Unemployment Patterns* covers 15–59 year olds only. Restricting the range of ages covered in the analysis of the *Survey of Aspects of Literacy* to this group affects the labour force participation rate but has little impact on the income distribution data. Hence, the comparisons discussed here are in no way distorted by the different age groups covered.

The data from the *Survey of Employment and Unemployment Patterns* also reveal a tendency for those in the lowest level of educational attainment to have a lower proportional representation in the bottom one-fifth of the income distribution. It is, however, less obvious than that reported in Table 1. In addition, the differences between the better educated and the less well educated are more pronounced in the *Survey of Employment and Unemployment Patterns* than in the Table 1 data.[12]

Examination of data on labour market outcomes by level of educational attainment for males and females separately (Tables 2 and 3) shows that the links reported above for the total sample carry across to both males and females. Hence, for both males and females there is a strong positive association between labour force participation rates and the level of educational attainment, and a strong inverse relationship between unemployment rates and educational attainment. The better educated are also more favourably placed in the income distribution compared to the less-well educated. It is also noted that the (possibly perverse) differences between those who completed secondary school and those who did not in the representation in the lowest one-fifth of the income distribution is more acute for males than for females. Hence, whereas 23 per cent of males who complete secondary school were located in the bottom fifth of the income distribution, only 13 per cent of males who did not complete secondary school were similarly placed.

There are many other skills and attributes that are linked to labour market success. The skills that are of particular interest to the current study are for literacy and numeracy. As shown in Section 2, the *Survey of Aspects of Literacy* contains a rich array of data on these skills. Further comments on key variables follow.

[12] When the *Survey of Employment and Unemployment Patterns* income data are analysed using a conventional human capital income equation, those who completed secondary school have a significant hourly income advantage over those who did not complete secondary school of the order of ten per cent (see Le and Miller (1999a)). Applying the same type of model to the *Survey of Aspects of Literacy* data reveals that the hourly incomes of the two groups do not differ significantly. Moreover, the income advantages of the tertiary educated in the *Survey of Aspects of Literacy* are up to 15 per cent lower than those revealed from an analysis of the *Survey of Employment and Unemployment Patterns*, which are of the same order of magnitude as were reported in Preston (1997) on the basis of study of information from the *Census of Population and Housing*.

4.2.2 Labour market success and literacy and numeracy

The Survey contains data on both subjective and objective measures of literacy and numeracy. The subjective data include information on self-perception of English writing skills, English reading skills and mathematical skills for the needs of daily life. There are data on self-perception of English reading and writing skills and also mathematical skills for the needs of the main job. Information was also collected on whether the respondent needed help to read newspapers, other forms of written material, needed help to fill out forms, write notes and do basic arithmetic. Details on the individual's overall satisfaction with English reading and writing skills, whether job opportunities are limited by English reading skills, writing skills or mathematical skills are available. The objective data relate to prose, document and quantitative skills.

Table 4 lists data on labour market outcomes cross-tabulated by respondents' perceptions of their English reading skills for the needs of daily life. This is representative of the data on self perceptions of literacy and numeracy skills. Information on labour market outcomes by respondents' perceptions of mathematical and writing skills is presented in Appendix B.

English reading skills are classified into four levels, 'Excellent', 'Good', 'Moderate' and 'Poor'. It is noted that there is a very strong, positive relationship between labour force participation rates and the level of reading skills, with the participation rate among those with 'Excellent' skills, at 78 per cent, being almost 2.5 times that of those with 'Poor' reading skills (33 per cent). The unemployment rate of these groups differs by a factor of almost four, with that of individuals with 'Excellent' reading skills being 5.5 per cent and that of individuals with 'Poor' reading skills being 20 per cent. These differentials between employment status at the extreme levels of reading skills are comparable to those reported in Table 1 for level of educational attainment.

The information on the distribution of individuals at each of the levels of reading skills across income classes presented in the remaining columns of this table reveal a link between level of reading skill and position in the income distribution. Hence, 22 per cent of those with 'Excellent' reading skills are in the top one-fifth of the income distribution compared to only 5 per cent of the small number of people with 'Poor' reading skills. It is also to be noted that the income distribution for the lower levels of reading skills tends to be more compressed than that for workers with 'Excellent' reading skills.

Examination of the data in Appendix B reveals that the patterns in the information on self perception of writing and mathematical skills are similar to those discussed above for the self-reported data on English reading skills.

The information on one of the objective measures of literacy will also be presented. Thus, information on labour market outcomes cross-classified by prose skill is presented in Table 5. Similar information is presented in Appendix C for document skill and quantitative skill. In this instance the data are presented for five levels of skill, with Level 1 being the lowest and Level 5 the highest. It is apparent that labour force participation rates rise with prose skill level, with the rate being 48 per cent at the lowest level of skill, and 92 per cent at the highest level of skill. Conversely, unemployment rates fall with level of prose skill, being 16 per cent at the lowest level of skill and only 2 per cent at the highest level of skill. Income levels are also related to prose skills. Only 10 per cent of those with the lowest level of skill are in the top one-fifth of the income distribution, compared to 31 per cent of those with the highest level of skill.

The Table 5 data also exhibit one further interesting characteristic that parallels with the features of the income distribution discussed in relation to educational attainment. And that is that at the lowest level of skill, there is a tendency for a relatively high representation in the middle one-fifth of the income distribution compared to higher levels of skill. Consequently, not only are individuals with the lowest level of skill underrepresented in the top one-fifth of the income distribution compared to workers in the adjacent skill level, but they are also underrepresented in the bottom one-fifth of the income distribution.

The data presented in Appendix C on labour market outcomes by document skill and quantitative skill are quite similar to those discussed for prose skills.

4.2.3 Educational attainment, literacy and numeracy

It is readily apparent from the analyses outlined above that level of educational attainment, literacy and numeracy are closely linked to the various labour market outcomes considered. The difficulty for understanding these links is that level of educational attainment and skills like literacy and numeracy are, in turn, related. Tables 6 and 7 present data that illustrate the relationships.

Table 6 lists data on individuals' self perceptions of their English reading skills for the needs of daily life at each level of educational attainment. There is obviously a close association between levels of each of these types of human capital skills. Hence, over three-quarters of individuals possessing a Bachelor degree, Postgraduate diploma or Higher degree rate their reading skills as 'Excellent', whereas only 43 per cent of individuals who did not complete secondary school have rated their reading ability in the top skill level. There are clear divisions in these data between those who did not attend secondary

school and the adjacent level of educational attainment of having completed secondary school, and between the Associate diploma and Undergraduate diploma levels.

Table 7 presents information on the objective measure of prose skill by level of educational attainment. Recall that level 5 is the highest level on the scale of measurement used here. Again it is apparent that there is a positive association between the two types of human capital skills: the better educated possess higher levels of prose skills than do the less-well educated. It is also the case that there appear to be two main thresholds in the data: that between those who had not completed secondary school and those who had completed secondary school, and that between those whose highest level of educational attainment is an Associate diploma and those who possess an Undergraduate diploma. The extent of improvement with educational attainment in the objective measure of prose skills seems to be greater than the improvement in the subjective measure, as indicated in the Table 6 data.

These various cross-tabulations indicate that the human capital skills of education, literacy and numeracy are each associated with economic success, as measured by the labour force participation rate, the unemployment rate and position in the income distribution. They also show that attempts to assess the economic advantage to the attainment of higher levels of educational attainment that do not take account of the different levels of literacy and numeracy at the different educational attainments are likely to be misleading. Analysis of the determinants of labour market outcomes within a framework that takes account of literacy and numeracy skills as well as educational attainment may permit improved insights into the reasons why the better educated have economic outcomes superior to those of the less well educated.

5. Multivariate analyses

The multivariate analyses presented in this section focus largely on understanding the relationships among labour force status, educational attainment, literacy and numeracy. Some estimations are undertaken where the focus is on the determinants of income. These are provided in Appendix D.

5.1 Methodological considerations

Studies of the determinants of labour market outcomes have generally employed probability models where the participation decision is examined separately from the employment/unemployment outcome conditional on being in the labour force. This generally appears to be for expositional purposes, and because few additional insights have been gained from the studies that have adopted a more general multinomial specification of the probability model where the allocation of workers across the employment, unemployment and not-in-the-labour force states is considered simultaneously (see, for example, Wooden (1991), Brooks and Volker (1985)). Single equation logit models of participation and of unemployment among labour force participants will be estimated in this study.

5.1.1 Labour force participation rates

The decision to enter the labour force is a major one for many individuals. It will be affected by a large range of factors. Research into these has largely concentrated on the labour supply decisions of females. Chiswick and Miller (1994) and Kenyon and Wooden (1996) provide overviews. Kenyon and Wooden (1996, p.20) report that the cross-sectional studies show that ' ... female participation will increase with wage and non-wage income, with educational attainment and decrease with the number of children at home'. The study that is probably of most relevance to the current research is by Chiswick and Miller (1994).

Chiswick and Miller (1994) model female labour supply using a standard reduced form specification in which the participation decision is related to the respondent's age, educational attainment, location of current residence, marital status, presence and age structure of children, husband's income, birthplace, duration or residence in Australia, citizenship and English language practice. They show that among their sample of 25–64 year olds,

labour force participation rates decline with age, particularly from age 40 onwards. The degree of participation in the labour force increases with educational attainment, tends to be lower in non-metropolitan areas than in metropolitan areas and is lower if children less than 15 years of age are present in the household, with the effect in this regard being more pronounced if the children are less than two. Labour force participation rates are lower among the married than for single persons for the foreign born, but there is no difference in this regard among the native born. Another difference between the foreign born and native born arose in relation to the impact of husband's income: there was an inverted U-shaped relationship between labour force participation rates and husband's income among the foreign born, but husband's income had little impact on labour force involvement among the native born. It was also reported that labour force participation rates are lower among the foreign born with very short duration of residence.

Chiswick and Miller (1994) also include a binary variable for English language proficiency in some of their specifications. This is set to one for individuals who speak only English at home, or if a language other than or in addition to English is spoken in the home, they speak English 'very well'. The variable was set to zero where a language other than English is spoken in the home and the respondent speaks English 'well', 'not well' or 'not at all'. Inclusion of this variable in the model was associated with only minor changes in most coefficients, including that associated with educational attainment. They show that immigrants possessing English language fluency had participation rates about 4 percentage points higher than other groups. This effect was the equivalent of that of about 1.5 years of schooling.

In this study an attempt will also be made to model labour supply within a reduced form context. In this model the person's tendency to join the labour force can be expressed as

$$PR^*_i = X\beta_i + \varepsilon_i$$

where PR^*_i is a latent index that captures the propensity of individual i to join the labour force, X is a vector of observed factors (e.g., educational attainment, age, birthplace, etc.) that are held to influence labour supply decisions, β is a vector of coefficients to be estimated, and ε is a stochastic error term that captures the net influences on labour supply decisions of all unobserved factors and also the influence of purely chance events.
The explanatory variables in this model will be restricted to those used in the typical study, as the primary aim is to ascertain the extent to which the effects of schooling on labour supply decisions can be linked to literacy and numeracy.

Two outcomes are derived from PR* with reference to an arbitrary threshold of zero. Thus, the individual is held to be a labour force participant (PR = 1) where PR* exceeds zero, and is outside the labour force (PR = 0) otherwise. With the logit model to be employed here, the natural logarithm of the odds ratio of the probability of labour force participation (PR) to the probability of non-participation in the labour force (1 – PR), $\log \left[\frac{PR^*_i}{1 - PR^*_i}\right] = X_i\beta$.

The parameter estimates in the logit model record the impact on the logarithm of the odds ratio of a small change in the explanatory variables. Of greater interest in most cases, however, are the partial effects of explanatory variables on the probability of being a labour force participant. These can be computed as

$$\frac{\delta PR}{\delta X_k} = PR(1 - PR)\beta_k$$

where X_k is the kth explanatory variable and β_k is its associated estimated coefficient. It is convenient to evaluate these partial effects at the sample mean participation rates. However, as many of the variables used in this study are categorical, the partial effect can only be considered as an approximation, as it applies a concept that is relevant to an infinitesimally small change to a variable that can only have discrete changes. In such cases predicted values for various groups (e.g., with a University degree, completed the highest level of secondary school available) can be compared to assess the effect on labour force participation rates of various characteristics.

5.1.2 Unemployment rates

Australian studies of the incidence of unemployment have tended to focus on three types of determinants of unemployment outcomes. The first are those factors that affect unemployment outcomes through human capital effects; the second are composite variables such as birthplace and gender that will capture the influence of a range of phenomena, including discrimination, pre-labour market choice, and other unobserved factors that are correlated with the particular characteristics; and past labour market experiences that affect current labour market outcomes.

Le and Miller (2000) provide a review of the approaches taken by various studies within this broad framework. Selected comments from this review follow.

The types of human capital that may impact on unemployment outcomes include formal education, qualifications, English language skills and the accumulation of knowledge of the labour market that occurs through labour market activity. The many studies reviewed by Le and Miller (2000) show that

educational attainment and qualifications are key determinants of unemployment outcomes. Age is also a statistically significant determinant of unemployment, with unemployment rates declining with age (or labour market experience) among the early age groups. However, the age effects on unemployment rates in the post-24 years group are modest.

Variables for English language skills have been included in a number of studies that focus on the labour market outcomes of the foreign born. The studies undertaken to date on the role of English language skills in this regard have been restricted to self-reported data. The typical study (e.g., Inglis and Stromback (1986)) has distinguished individuals who speak a language other than English at home and self-report their English skills as 'Good', those who speak a language other than English at home and self-report their English skills as 'Poor', and monolingual English speakers. The most recent of these studies (e.g., Miller and Neo (1997) and Le and Miller (1999b)) report that both groups who speak a language other than English at home have higher unemployment rates than monolingual English speakers, though the group with the lowest level of English skills experiences the highest rate of unemployment.

Studies that focus on the composite variables obtained from demographic group identifiers have focused on the relative employment outcomes of women, immigrants and Indigenous Australians. These studies generally show that Indigenous Australians experience a serious employment disadvantage in the labour market. Among the foreign born, those who were born in a non-English-speaking country experience a high unemployment rate compared to those who were born in English-speaking countries. There was, however, only a modest unemployment rate differential between the Australian born and the overseas born from English speaking countries. The difference between the unemployment rates of males and females was also quite minor in those studies that addressed this issue.

The final set of variables included in some studies of labour market outcomes comprises information on the person's previous labour market activities. There are two classes of models that follow this approach, namely inertia models and state dependence models. In inertia models the lagged information on labour market activity is to be interpreted as a proxy for unobserved variables (e.g., ability, work ethic). In state dependence models, being unemployed helps shape the character and behaviour of the individual. In situations of negative state dependence, for example, the longer the person has been unemployed the more difficult it will be to find work, because of the attitudes developed, the decay of work skills and the information conveyed to prospective employers by a lengthy period of unemployment. This phenomenon is often labelled the 'scar' effect of a spell of

unemployment. The studies that have followed this practice have shown that the individual's employment history exerts a major influence on current labour market activity (see, for example, Le and Miller (1999b)).

The studies reviewed in Le and Miller (2000) employed a number of estimation techniques. The logit model is the more popular, however. The motivation behind a logit model of unemployment is similar to that outlined above in relation to the participation decision, and so need not be repeated here.

5.2 Specification issues

The model specifications adopted here are constrained by the way the data from the *Survey of Aspects of Literacy* are made available to the research community. While information on educational attainment, age, birthplace, duration of residence, gender, disability and location is available, there are no data on marital status or family details like the presence of children and the income of the spouse. In addition, there is a lack of details on labour market history that might facilitate an approach along the lines of that used by Le and Miller (1999b). Participation rates and unemployment rates are therefore both related only to the contemporaneously measured personal characteristics of educational attainment, age, birthplace, duration of residence, disability, location and, where appropriate, literacy and numeracy. Separate equations are estimated for males and for females. Means and standard deviations for all variables are presented in Appendix E. This Appendix also contains a brief description of the variables.

5.3 Results

5.3.1 Conventional models of labour market outcomes

Results from conventional models (which do not contain information on literacy and numeracy) of labour force participation and of unemployment are presented in Table 8.[13] The discussion will focus first on males. The estimates of the determinants of male participation rates are presented in the first column, and of male unemployment rates in the second column of the

[13] The data used in the estimations are weighted, with the weights available in the unit record file being scaled so that they sum to the actual sample size. This enables the gains in efficiency from using the weights to be achieved while avoiding the inflation of 't' statistics that would otherwise occur where unscaled weights were used.

table. There is a strong, positive relationship between labour force participation and educational attainment once account is taken of age, birthplace and duration of residence, disability status and location. The effects of education in this regard are more pronounced among the tertiary educated, with the differences in labour force participation rates among the lower levels of educational attainment being statistically insignificant once account is taken of the differences in the other determinants of labour market activity at the various educational attainments. Age also has a strong effect on labour force participation rates, with participation rates rising with age until around age 35. Beyond this threshold participation rates decline with age. This pattern of labour market attachment is typical in the literature (see, for example, Miller and Neo (2000)).

Birthplace and duration of residence both also matter when labour market attachment is being considered. Labour force participation rates are lower among the overseas born than among the native born, with the differentials in this regard being much greater among immigrants from non-English speaking countries. The participation rate differences between the foreign born from English speaking countries and the native born are quickly reduced as the period the immigrant has resided in Australia lengthens, with the participation rates of male immigrants from English speaking countries exceeding those of the native born after about 7 years of residence. The participation rates of male immigrants from non-English speaking countries, however, never gain parity with those of the native born. Participation rates are also relatively low for those who have a disability. Location, however, does not appear to have an impact on labour force participation rates once other differences in the sample are taken into account.

Estimates of the unemployment model for males are listed in the second column of Table 8. In this instance the influence of educational attainment on labour market outcomes is particularly strong. The magnitude of the estimated effects on the education variables are similar to those presented in Le and Miller (1999b), Table 4.3. The other variables included in the model are generally significant. There is a pronounced U-shaped relationship between age and unemployment status. Hence, unemployment rates decrease with age up to around age 50, and then increase among the older age groups.[14] Unemployment rates are higher among the overseas born than among the native born, and particularly so among the overseas born from non-English speaking countries. The unemployment rates of the foreign born decrease

14 In Miller and Neo's (2000) study based on the 1991 Australian Census of Population and Housing, there is also a U-shaped relationship between age and unemployment rates, though the lowest unemployment rates are experienced by those aged around 45.

with duration of residence in Australia for the first 21 years of residence in Australia. As a result, the unemployment rate of the foreign born from English-speaking countries gain parity with those of the Australia born after 16 years of residence in Australia. However, despite the pronounced reduction in unemployment rates with duration of residence, the unemployment rates of the foreign born from non-English speaking countries do not catch up with those of the native born. Miller and Neo (2000) report a similar result on the basis of their study of data from the 1991 Census of Population and Housing.

Results for the models of labour force participation and unemployment for females are presented in the final two columns of Table 8. It is readily apparent from these results that education is an important determinant of labour market outcomes among females. Labour force participation rates increase strongly with level of education, and unemployment rates are much lower among better educated females than among their less well educated counterparts. Of some note is the apparent greater strength of the participation rate effect associated with educational attainment among females compared to males. For example, the coefficients on the 'Completed secondary school' and 'Basic vocational qualification' variables are statistically significant for females, whereas they are insignificant in the equation for males.

Among other findings of note for the female sample are the statistical insignificance of age and period of residence in the unemployment model.

Hence, the main finding from Table 8 is that the strong links between labour market outcomes, as measured by labour force participation rates and unemployment rates, and education attainment that were evident in the cross tabulations of these factors reviewed previously carries across to the multivariate analysis.

5.3.2 The role of literacy and numeracy in models of labour market outcomes

What happens when account is taken of the differences in literacy and numeracy across the levels of educational attainment? To examine this issue, the specification contained in Table 8 was augmented with variables for literacy and numeracy. There is a wealth of information in the survey in this regard, and some comments on the modelling procedure are in order.

The analysis was undertaken as follows. First, the focus was upon only six of the measures available in the survey, these being the three objective measures and the three subjective measures used in the cross tabulations

reported on above. Second, dummy variables were created for each of the possible categories within each of these measures. The 'Excellent' category was selected as the benchmark group in the case of the self perceptions measures, and skill level one was selected as the benchmark group in the case of the test-based measures. This selection was motivated by two concerns, namely the desire to have an extreme literacy/numeracy category as the benchmark group to aid interpretation, and the desire to have a reasonably sizeable representation of the sample in the benchmark group so that the comparisons made against the benchmark group will be robust.

Third, variables from each of the measures of literacy and numeracy are simultaneously entered into the equations determining labour force status. There are a total of 21 variables; four each for prose skill, document skill and quantitative skill, and three each for the self reports on reading, writing and mathematical skills. Many of the variables for literacy and numeracy were statistically insignificant or incorrectly signed in this encompassing specification, especially in the models of unemployment. This result occurs even though when sets of variables for just one dimension of literacy or numeracy (e.g., just the self perceptions data on mathematical skills) were entered into the estimating equation, most coefficients were highly significant and correctly signed. This outcome is not all that surprising, given that the correlation between each of the measures of literacy and numeracy is expected to be quite high.

To illustrate the relationships between the various measures of literacy and numeracy, a correlation matrix is presented in Table 9 for the male sample used in the analysis of unemployment outcomes.[15] These correlations are polychoric correlations that are appropriate when each of the variables under consideration is categorical.[16] From the data in Table 9 the correlation between the self perceptions of reading and writing skills is 0.851 while that between the self perceptions of reading and quantitative skills is 0.627. Two patterns are apparent here. First, the correlations among the objective measures are higher than those among the self assessments. Specifically, the correlations among the test-based measures range from 0.897 to 0.969 while those among the self-reported measures range from 0.627 to 0.851.

[15] Appendix F contains correlation matrices for each of the other three samples used in this study.

[16] The usual correlations are Pearson product moment correlations, which are appropriate for variables measured on a continuous scale. The literacy and numeracy measures (denote two of these by L_1 and L_2), while being presented as categorical data, can be thought of as having underlying continuous indices (say L_1^* and L_2^*). With the assumption that L_1^* and L_2^* have a bivariate normal distribution, their correlation is referred to as a polychoric correlation coefficient (see Neale and Cardon (1992)).

Second, the correlations between the self assessments and the objective measures are lower than either those computed between various self assessments, or those computed between various objective measures. The highest correlation coefficient between a self-reported measure and a test-based measure occurs in the case of the self-perception of mathematical skills and quantitative skill level, being 0.533.

Given the high degree of correlation among the measures of literacy and numeracy, which makes entering all the measures of literacy and numeracy simultaneously into an estimating equation for determining labour market outcomes problematic, an alternative approach to estimation must be considered.

The approach to be taken in such a situation depends ultimately on the purpose of the study. If the primary purpose of the estimating is forecasting, and the collinearity structure among the literacy and numeracy variables is likely to persist over time, then the encompassing model that includes all variables for literacy and numeracy might be preferred. Similarly, where the focus is on variables other than the literacy/numeracy variables, and the precision with which the effects of these other variables can be estimated is not greatly affected by the collinearity among the literacy/numeracy variables, then the encompassing model might also be preferred. However, where emphasis is placed on reliable estimation of the separate effects of literacy and numeracy on labour market outcomes, then alternative approaches might be considered.

Principal components analysis could be applied to the measures of literacy and numeracy, with an aim of summarising their information content into a small number of composite variables for inclusion in the model. A difficulty with this approach is the recovery of the information in the literacy and numeracy variables in the context of their effects on labour market outcomes.

An alternative is to estimate a model that includes all the variables for literacy and numeracy and apply a general-to-specific modelling strategy. In this alternative, variables that are insignificant or have 'perverse' signs are eliminated from the estimating equation in a sequential manner until the model contains only statistically significant terms with economically meaningful magnitudes. Application of this general-to-specific modelling approach needs to confront the issue that there is not necessarily a unique path from the general model to the specific model. However, there is one lesson from the application in this particular instance which can govern the way the data can be analysed. In general, it is only possible to include one of the sets of self perceptions measures (i.e., self perceptions data on either reading skills, writing skills or mathematical skills) *and* one of the sets of test-based measures (i.e., prose skill, document skill or quantitative skill) if

the aim is to have significant, and economically meaningful, estimates of the literacy/numeracy parameters. Drawing upon this, nine models were estimated that included the various combinations of self perceptions measures (of either reading, writing or mathematical skills) and test-based measures (i.e., prose, document or quantitative skill). This procedure was followed for the models of labour force participation and unemployment for both males and females. In other words, for four model situations, namely (i) male labour force participation; (ii) male unemployment; (iii) female labour force participation; (iv) female unemployment, nine models were estimated that, in addition to the variables in the specifications in Table 8, contained one of the following combinations of variables (where the number of variables for each skill is given in parentheses):

- Self perception of reading skills (3)—prose skill (4)
- Self perception of reading skills (3)—document skill (4)
- Self perception of reading skills (3)—quantitative skill (4)
- Self perception of writing skills (3)—prose skill (4)
- Self perception of writing skills (3)—document skill (4)
- Self perception of writing skills (3)—quantitative skill (4)
- Self perception of mathematical skills (3)—prose skill (4)
- Self perception of mathematical skills (3)—document skill (4)
- Self perception of mathematical skills (3)—quantitative skill (4)

The likelihood functions for these models were then compared. Table 10 gives the Chi-Squared statistics for the test of overall goodness of fit for the nine models of male unemployment to illustrate the approach taken. This comparison shows that in three model situations (male unemployment, female participation, female unemployment) the combination of information on self-perceptions of mathematical skills and test-based measures of document skills maximised the likelihood function. In the remaining model (male labour force participation) the model based on self perceptions of mathematical skills and test-based measures of document skills was (slightly) dominated by the combination of self-perceptions of writing skills and test-based measures of quantitative skills. For uniformity, and because it makes little difference to the argument, models based on the self-perceptions of mathematical skills and the test-based measures of document skill will be discussed here. This model will be subsequently termed the restricted model.

Estimates from the restricted models are presented in Table 11. There are two reasons for presenting these estimates. The first is to inform on the types of effects literacy and numeracy have on labour force participation and unemployment. The second is to provide a preliminary examination of the

impact that inclusion of measures of literacy and numeracy have on the partial effects of educational attainment on labour market outcomes. In this regard it is useful to provide an outline of the way the partial effects are to be interpreted.

The conventional model of labour force status listed previously can be re-written as:

$PR^*_i = \alpha + \alpha_1 E + ...$

where E denotes the level of education. The coefficient α_1 in this model can be viewed as capturing the *total* effect of educational attainment on labour market outcomes.

When the model is augmented with variables for literacy (L) and numeracy (N) we have

$PR^*_i = \gamma_0 + \gamma_1 E + \gamma_2 L + \gamma_3 N + ...$

In this equation provides a measure of the direct effect of education on labour market outcomes. $(\alpha_1 - \gamma_1)$ provides an estimate of the indirect effect of education on labour market outcomes that occurs via the measures of literacy and numeracy. The effect of education can be viewed as

$$\frac{\delta PR^*}{\delta E} = \gamma_1 + \gamma_2 \frac{\delta L}{\delta E} + \gamma_3 \frac{\delta N}{\delta E}$$

$\left(\gamma_2 \frac{\delta L}{\delta E} + \gamma_3 \frac{\delta N}{\delta E} \right)$ records the impact of education on labour market success that occurs because those with higher levels of education have higher levels of literacy and numeracy, and literacy and numeracy are themselves associated with superior labour market outcomes. This impact might be viewed as part of the option value of education.[17]

Turning to the results listed in Table 11, the first point to note is that, in general, the higher the level of literacy/numeracy, the higher the labour force participation rate and the lower the unemployment rate. These effects are slightly stronger for males than for females, and slightly stronger for the test-based measure (document skill) than for the self perceptions variable (mathematical skill).

Comparison of the size of the coefficients for the extreme categories (of 'Poor' for the self perception of mathematical skill and of skill level five for

[17] The issue here is what benefits can be attributed to the attainment of a given level of education (*E*'). Assume only individuals with education level *E*' have the option of investing in additional skills that are valued in the labour market. Then the benefits of these additional skills might be credited to the education that opened up for the individual the "option" of the further investments.

document skill) for the literacy/numeracy variables with the coefficients for tertiary qualifications (Higher degree, Postgraduate diploma, Bachelor degree) suggests that the human capital skills reflected in the self perceptions data on mathematical skill and the document skill data have, in combination[18], a greater impact on labour market outcomes than the possession of tertiary qualifications.

Finally, comparison of the estimates associated with the education variables in Table 8 (which does not include the information on literacy and numeracy) with the estimates in Table 11 (which includes this information) shows that most coefficients are smaller, in absolute value, in Table 11 as compared to Table 8. For example, focusing on the Bachelor degree variable, the Table 11 coefficients are between 23 and 43 per cent smaller than those in Table 8. In other words, between one-quarter and two-fifths of the *total* effects associated with formal education in the Table 8 results appear to be due to the *indirect* effect of education that occurs via literacy and numeracy skills.

While the measures of literacy and numeracy are highly correlated, they are not perfectly correlated. Each may therefore be thought of as containing elements of specific information. It would therefore be expected that when all variables are included in the estimating equation that the coefficients on the education variables that record only the *direct* effects of education would be reduced even further compared to Table 11. Tables 12 to 15 contain estimates that inform on this matter.

The first column of each of these tables lists estimates of the *total* effects of education from the model that does not incorporate any information on literacy/numeracy (these are from Table 8). The second column of the tables lists estimates of the *direct* effects of education from the restricted model that includes only variables for self perception of mathematical skills and document skill (these are from Table 11). The third column of data in each of Tables 12 to 15 contains estimates of the *direct* effects of the education variables from specifications that contain all the variables for literacy and numeracy being considered in this section of the study (21 in all).

Reading across each row of data in these tables we observe a progressive lowering, in absolute value, of the effects of education on labour force outcomes as more information on the individual's literacy and numeracy skills is incorporated into the estimating equation. It is also the case that most of the change occurs as the comparison is made between the 'simple model'

[18] That is, the comparison is between a person with both "Poor" mathematical skill and Level 1 document skill, and a person with both "Excellent" mathematical skill and Level 5 document skill.

and the 'restricted model'. Comparison of the coefficient on the Bachelor degree variable for the 'full model' and for the 'simple model', for example, shows that the coefficients are reduced by between 33 and 45 per cent. This type of effect is typical. In other words, a conclusion that can be drawn from this analysis is that the education effect in the typical study of labour force participation and of unemployment is an over-estimate of the *direct* contribution of schooling per se after its effects on literacy and numeracy are held constant. At least one-third, and perhaps as much as one-half of the effect commonly attributed to education is in fact due to the better literacy and numeracy skills of the better educated.

There is no information on the timing of the acquisition of the literacy and numeracy skills.[19] They could have been acquired as part of the education process, or subsequently. If the latter is the case, they would typically be regarded as part of the option value of education and hence be viewed as a component of the returns to education. What seems to be clear is that education is more than just a screen. The *indirect* effect of education that occurs because those with higher levels of education have higher levels of literacy and numeracy (i.e., $\gamma_2 \frac{\delta L}{\delta E} + \gamma_3 \frac{\delta N}{\delta E}$) is quite important. Hence education is in large part about generating the skills, or laying the foundation for the acquisition of skills, like literacy and numeracy, that are valued in the labour market.

[19] An instrumental variables model could be considered if the data set contained sufficient instruments. However, as even the "restricted" model contains seven potentially endogenous literacy/numeracy variables, this approach cannot be adopted with the specifications considered in this study.

6. Conclusion

Many studies of labour market outcomes have a human capital perspective. Generally, however, this does not extend beyond an analysis of the effects of formal education and labour market experience. It is now taken more or less for granted that formal education and labour market experience are associated with superior labour market outcomes, whether measured by the degree of labour force participation, the extent of unemployment, or the wage and occupational status among the employed. Why the better educated have such advantages is less clear. The two main schools of thought are that education imparts knowledge that is useful in the labour market (the human capital approach) and that the education system is a means of identifying innate ability rather than being a value-adding process (the screening approach).

The analyses presented in this study address the issue of whether the education system serves mainly as a screening device or whether the better educated possess skills that make them more employable and more productive. The focus is on literacy and numeracy skills.

It is shown that higher levels of education are associated with greater labour market success. It is also shown that higher levels of numeracy/literacy, whether measured from self-reported data or from objective test data, are also associated with greater labour market success. As the better educated also have higher levels of numeracy and literacy, it is possible that part of the improvement in labour market outcomes conventionally attributed to the attainment of more education could in fact be due to achievements in literacy and numeracy.

The estimation of models of labour market outcomes that include variables for both level of education and literacy/numeracy shows that at least one-third and perhaps as much as one-half of the *total* effect of education is in fact an *indirect* effect of education that arises due to the higher literacy and numeracy skills of the better educated. Education is certainly not simply a screen. It is associated with improvements in skills (here literacy and numeracy) that are rewarded well in the labour market. Hence education affects labour market outcomes through its effects on human capital skills that are embodied in people and which are not usually measurable.

These findings do not devalue the importance of education. Rather they help unravel the way education is able to impact on labour market outcomes. They show that part of the effect of educational attainment arises because of the improved literacy and numeracy skills and presumably other unmeasured skills of the more highly educated. Education appears to represent a value-adding process in which skills, including literacy and numeracy, are improved.

Table 1: Labour market outcomes by level of educational attainment, males and females, 1996 *Survey of Aspects of Literacy*

Level of Educational Attainment	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Higher degree	2.67	92.71	2.21	7.62	3.55	9.17	12.70	66.96	100.00
Postgrad diploma	3.24	87.30	3.06	19.35	11.68	8.51	23.32	37.14	100.00
Bachelor degree	11.47	88.95	3.20	13.62	15.15	14.29	23.34	33.59	100.00
Undergrad diploma	3.03	75.05	3.09	10.65	22.71	22.61	24.56	19.47	100.00
Associate diploma	8.46	82.39	4.48	12.41	15.68	16.28	24.32	31.30	100.00
Skilled vocational qualification	19.10	76.12	5.31	10.01	15.49	23.33	32.70	18.47	100.00
Basic vocational qualification	6.42	77.92	7.83	17.65	29.64	27.57	17.01	8.13	100.00
Completed secondary school	17.14	74.86	7.31	26.63	22.51	20.47	17.64	12.75	100.00
Not completed secondary school	28.47	57.35	11.16	19.99	23.09	27.28	18.22	11.42	100.00
Total[c]	100.00	70.53	7.21	17.07	19.52	21.72	22.12	19.57	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 9 302, representing a weighted population of 13 220 773.

(d) Totals may not sum to 100 due to rounding.

Table 2: Labour market outcomes by level of educational attainment, males, 1996 *Survey of Aspects of Literacy*

Level of Educational Attainment	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Higher degree	3.21	94.39	1.86	3.30	3.36	2.96	14.04	76.34	100.00
Postgrad diploma	2.46	92.36	4.49	13.50	7.03	1.67	16.77	61.03	100.00
Bachelor degree	10.46	95.17	3.55	10.51	11.14	14.43	18.97	44.96	100.00
Undergrad diploma	2.33	81.84	3.18	9.56	5.81	26.12	25.42	33.10	100.00
Associate diploma	9.94	84.72	5.19	8.55	10.09	13.71	26.30	41.35	100.00
Skilled vocational qualification	25.84	82.70	4.66	7.25	10.87	21.01	38.28	22.59	100.00
Basic vocational qualification	2.81	83.68	15.82	19.76	21.60	24.07	14.88	19.70	100.00
Completed secondary school	16.57	82.89	7.04	22.59	18.48	19.55	19.79	19.59	100.00
Not completed secondary school	26.38	69.58	13.17	13.64	15.03	26.67	25.56	19.11	100.00
Total[c]	100.00	79.79	7.81	12.38	13.03	20.00	26.39	28.22	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 4261, representing a weighted population of 6 607 242.

(d) Totals may not sum to 100 due to rounding.

Table 3: Labour market outcomes by level of educational attainment, females, 1996 *Survey of Aspects of Literacy*

Level of Educational Attainment	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Higher degree	1.94	88.81	3.06	17.36	3.97	23.12	9.69	45.85	100.00
Postgrad diploma	4.29	83.28	1.80	23.92	15.31	13.84	28.42	18.51	100.00
Bachelor degree	12.84	83.10	2.81	17.07	19.59	14.14	28.18	21.01	100.00
Undergrad diploma	3.98	70.39	3.02	11.51	36.16	19.82	23.89	8.62	100.00
Associate diploma	6.45	78.09	3.05	20.50	27.40	21.66	20.18	10.25	100.00
Skilled vocational qualification	9.94	61.51	7.24	19.79	31.85	31.50	12.95	3.91	100.00
Basic vocational qualification	11.34	76.01	4.91	16.94	32.35	28.75	17.73	4.22	100.00
Completed secondary school	17.91	67.14	7.64	31.71	27.58	21.62	14.94	4.15	100.00
Not completed secondary school	31.32	47.72	8.84	27.27	32.31	27.98	9.82	2.61	100.00
Total[c]	100.00	61.29	6.43	23.44	28.36	24.07	16.33	7.82	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 5041, representing a weighted population of 6 613 531.

(d) Totals may not sum to 100 due to rounding.

Table 4: Labour market outcomes by self-perception of English reading skills for the needs of daily life, males and females, 1996 *Survey of Aspects of Literacy*[a]

English Reading Skill Level	% of population	Participation rate (%)	Unemployment rate (%)[b]	% Representation in each one-fifth of Income Distribution[c]					
				0–20	21–40	41–60	61–80	81–100	Total[e]
Excellent	57.58	77.50	5.51	19.22	19.34	18.80	21.03	21.60	100.00
Good	33.99	68.89	7.68	13.98	19.21	25.94	23.41	17.46	100.00
Moderate	7.15	57.01	13.45	12.91	22.31	24.01	25.13	15.65	100.00
Poor	1.29	32.91	19.97	25.90	20.90	27.53	20.93	4.75	100.00
Total[d]	100.00	70.64	7.17	17.08	19.53	21.72	22.13	19.55	100.00

(a) Individuals who did not report a level of reading skills are excluded from the table.

(b) Computed among labour force participants.

(c) Computed only for employed persons with valid information on income.

(d) The total number of cases in the first two columns is 9277, representing a weighted population of 13 184 287.

(e) Totals may not sum to 100 due to rounding.

Table 5: Labour market outcomes by prose skills, males and females, 1996 *Survey of Aspects of Literacy*

Prose Skills	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Level 1	10.56	47.90	16.28	13.39	21.75	32.65	22.39	9.80	100.00
Level 2	25.14	67.72	7.43	14.03	21.54	25.53	24.23	14.67	100.00
Level 3	40.59	78.19	5.90	18.60	19.10	19.47	21.45	21.38	100.00
Level 4	20.72	84.29	3.92	19.11	17.49	17.34	20.69	25.37	100.00
Level 5	29.86	92.14	1.58	20.56	14.46	11.95	22.51	30.53	100.00
Total(c)	100.00	70.53	7.21	17.07	19.52	21.72	22.12	19.57	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 9302, representing a weighted population of 13 220 773.

(d)Totals may not sum to 100 due to rounding.

Table 6: Self-perception of English reading skills for the needs of daily life by level of educational attainment, males and females, 1996 *Survey of Aspects of Literacy*[a]

Level of Educational Attainment	English Reading Skill Level				
	Excellent	Good	Moderate	Poor	Total[b]
Higher degree	89.24	9.41	1.35	0.00	100.00
Postgrad diploma	87.44	12.56	0.00	0.00	100.00
Bachelor degree	76.23	22.00	1.76	0.00	100.00
Undergrad diploma	73.86	24.78	1.35	0.00	100.00
Associate diploma	62.85	28.98	6.82	1.35	100.00
Skilled vocational qualification	46.91	41.79	9.93	1.38	100.00
Basic vocational qualification	59.00	35.24	5.30	0.46	100.00
Completed secondary school	64.87	30.65	3.25	1.23	100.00
Not completed secondary school	42.88	42.47	12.27	2.37	100.00
Total	57.58	33.98	7.15	1.29	100.00

(a) Table excludes individuals who did not report on reading skill level.

(b) Totals may not sum to 100 due to rounding.

Table 7: Prose skills by level of educational attainment, males and females, 1996 *Survey of Aspects of Literacy*

Level of Educational Attainment	Prose Skill Level					
	Level 1	Level 2	Level 3	Level 4	Level 5	Total[(a)]
Higher degree	1.24	2.86	37.42	50.34	8.13	100.00
Postgrad diploma	0.00	9.27	28.81	43.90	18.02	100.00
Bachelor degree	2.25	10.80	37.73	40.93	8.29	100.00
Undergrad diploma	2.33	11.96	43.25	36.61	5.86	100.00
Associate diploma	8.54	17.37	47.38	24.64	2.06	100.00
Skilled vocational qualification	12.22	33.51	40.36	13.20	0.71	100.00
Basic vocational qualification	7.28	25.53	47.07	18.83	1.30	100.00
Completed secondary school	8.40	18.34	47.30	23.33	2.62	100.00
Not completed secondary school	18.37	36.93	35.73	8.22	0.75	100.00
Total	10.56	25.14	40.59	20.72	2.99	100.00

(a) Totals may not sum to 100 due to rounding.

Table 8: Logit model of labour force participation and unemployment, males and females, 1996 *Survey of Aspects of Literacy*(a)

Variable	Males		Females	
	Participation	Unemployment	Participation	Unemployment
Constant	–0.602	0.741	–0.468	–1.640
	(1.09)	(1.23)	(1.33)	(2.15)
Level of Education (Did not complete secondary school)				
Higher degree	1.964	–2.087	2.547	–1.083
	(3.11)	(2.70)	(4.40)	(1.26)
Postgraduate diploma	1.158	–0.905	1.347	–1.672
	(2.01)	(1.64)	(5.24)	(2.29)
Bachelor degree	1.466	–1.359	1.423	–1.440
	(3.91)	(4.07)	(8.94)	(4.00)
Undergraduate diploma	0.480	–1.381	1.254	–1.153
	(1.26)	(2.11)	(5.89)	(2.05)
Associate diploma	0.594	–1.017	1.094	–1.432
	(2.56)	(3.53)	(5.90)	(3.11)
Skilled vocational qualification	0.437	–1.008	0.428	–0.436
	(2.69)	(5.03)	(3.62)	(1.72)
Basic vocational qualification	0.100	0.284	0.929	–0.779
	(0.29)	(0.95)	(6.69)	(2.71)
Completed secondary school	–0.179	–0.874	0.411	–0.479
	(1.04)	(4.21)	(3.96)	(2.25)
Age	0.245	–0.146	0.090	–0.012
	(8.71)	(4.42)	(5.10)	(0.29)
Age squared (÷100)	–0.357	0.154	–0.157	–0.036
	(10.48)	(3.56)	(7.15)	(0.60)

(continued)

Table 8: Logit model of labour force participation and unemployment, males and females, 1996 *Survey of Aspects of Literacy*(a) (continued)

Variable	Males		Females	
	Participation	Unemployment	Participation	Unemployment
Birthplace (Australia)				
Overseas—English speaking country	–1.931 (4.20)	1.664 (3.23)	–2.314 (7.33)	1.123 (1.62)
Overseas—non-English speaking country	–3.309 (7.95)	2.498 (5.11)	–2.756 (8.89)	1.643 (2.36)
Period of Residence (POR)	0.338 (4.05)	–0.171 (1.96)	0.280 (5.38)	–0.016 (0.15)
POR squared (÷100)	–0.898 (3.30)	0.411 (1.47)	–0.686 (4.22)	–0.151 (0.46)
Disabled	–1.539 (12.05)	0.626 (4.11)	–0.500 (6.21)	0.666 (3.83)
Location (whole of state)				
City	–0.090 (0.44)	–0.194 (0.83)	0.214 (1.81)	–0.126 (0.45)
Non-city	–0.041 (0.19)	0.231 (0.97)	0.112 (0.90)	0.368 (1.29)
χ^2 (17)	586.62	156.61	635.77	107.87
Pseudo R^2	0.231	0.091	0.119	0.077
Prediction success (%)	88.87	92.10	73.00	93.30
Sample size	3621	3176	4285	2894

(a) 't' statistics in parentheses.

Table 9: Correlations between measures of literacy and numeracy, 1996 *Survey of Aspects of Literacy*, male unemployment sample[(a)]

	Self-Perceptions Data			Test-Based Data		
	Reading	Writing	Mathematical	Prose	Document	Quantitative
Reading	1.0					
Writing	0.851	1.0				
Mathematical	0.627	0.652	1.0			
Prose	0.529	0.520	0.449	1.0		
Document	0.429	0.498	0.486	0.923	1.0	
Quantitative	0.481	0.486	0.533	0.897	0.969	1.0

(a) Polychoric correlations based on 3176 observations.

Table 10: Chi-Squared statistics of overall goodness-of-fit, male unemployment model

Self-Perception of:	Prose skill	Document skill	Quantitative skill
Reading	185.12	196.88	198.04
Writing	187.37	197.97	199.83
Mathematical	193.94	204.20	203.22

Table 11: Logit model of labour force participation and unemployment including literacy and numeracy variables, males and females, 1996 *Survey of Aspects of Literacy*[a]

Variable	Males		Females	
	Participation	Unemployment	Participation	Unemployment
Constant	–0.486	1.524	–0.213	–1.494
	(0.84)	(2.36)	(0.56)	(1.87)
Level of Education (Did not complete secondary school)				
Higher degree	1.546	–1.333	1.938	–0.543
	(2.36)	(1.69)	(3.24)	(0.62)
Postgraduate diploma	0.877	–0.269	0.787	–1.202
	(1.47)	(0.47)	(2.97)	(1.62)
Bachelor degree	1.127	–0.768	0.910	–0.995
	(2.84)	(2.14)	(5.36)	(2.64)
Undergraduate diploma	0.160	–0.789	0.879	–0.833
	(0.40)	(1.18)	(4.03)	(1.46)
Associate diploma	0.265	–0.594	0.797	–1.278
	(1.08)	(1.96)	(4.20)	(2.75)
Skilled vocational qualification	0.228	–0.736	0.194	–0.232
	(1.34)	(3.55)	(1.57)	(0.88)
Basic vocational qualification	–0.074	0.564	0.687	–0.560
	(0.20)	(1.81)	(4.82)	(1.90)
Completed secondary school	–0.438	–0.509	0.085	–0.196
	(2.34)	(2.28)	(0.77)	(0.87)
Age	0.249	–0.146	–0.077	0.010
	(8.76)	(4.35)	(4.27)	(0.23)
Age squared (÷100)	–0.361	0.149	–0.139	–0.070
	(10.44)	(3.39)	(6.13)	(1.13)
Birthplace (Australia)				
Overseas—English speaking country	–1.959	1.421	–2.226	1.026
	(4.20)	(2.70)	(6.82)	(1.42)
Overseas—non-English speaking country	–3.183	1.862	–2.290	1.144
	(7.47)	(3.69)	(7.08)	(1.56)
Period of Residence (POR)	0.350	–0.141	0.274	–0.006
	(4.16)	(1.59)	(5.09)	(0.05)
POR squared (÷100)	–0.944	0.347	–0.678	–0.170
	(3.43)	(1.22)	(4.04)	(0.50)

(continued)

Table 11: Logit model of labour force participation and unemployment including literacy and numeracy variables, males and females, 1996 *Survey of Aspects of Literacy*[(a)] (continued)

Variable	Males		Females	
	Participation	Unemployment	Participation	Unemployment
Disabled	–1.493	0.568	–0.371	0.498
	(11.50)	(3.65)	(4.45)	(2.74)
Location (whole of state)				
City	–0.114	–0.254	0.187	–0.142
	(0.55)	(1.07)	(1.54)	(0.50)
Non-city	–0.029	0.190	0.116	0.370
	(0.13)	(0.78)	(0.91)	(1.28)
Self-perception of mathematical skills (excellent)				
Good	–0.453	–0.310	–0.519	0.388
	(2.95)	(1.77)	(5.68)	(2.05)
Moderate	–0.513	0.091	–0.802	0.006
	(2.61)	(0.43)	(7.12)	(0.02)
Poor	–1.283	0.638	–1.354	1.292
	(4.40)	(1.87)	(6.75)	(3.30)
Document Skill Level (one=minimum)				
Two	0.285	–0.641	0.463	–0.783
	(1.66)	(3.34)	(4.20)	(3.22)
Three	0.530	–1.101	0.662	–0.993
	(2.80)	(5.17)	(5.57)	(3.92)
Four	0.063	–1.187	0.713	–0.846
	(0.25)	(4.08)	(4.42)	(2.58)
Five (maximum)	–0.370	–1.703	1.682	–2.454
	(0.77)	(2.12)	(3.32)	(1.80)
χ^2 (24)	628.30	204.20	801.95	144.85
Pseudo R^2	0.247	0.118	0.150	0.104
Prediction success (%)	88.70	92.00	74.26	93.30
Sample size	3621	3176	4285	2894

(a) 't' statistics in parentheses.

Table 12: Selected coefficients from logit models of labour force participation, males, 1996 *Survey of Aspects of Literacy*[a]

	Simple Model[b]	Restricted Model[c]	Full Model[d]
Level of Education (Did not complete secondary school)			
Higher degree	1.964 (3.11)	1.546 (2.36)	1.332 (2.02)
Postgraduate diploma	1.158 (2.01)	0.877 (1.47)	0.674 (1.12)
Bachelor degree	1.466 (3.91)	1.127 (2.84)	0.924 (2.29)
Undergraduate diploma	0.480 (1.26)	0.160 (0.40)	0.028 (0.07)
Associate diploma	0.594 (2.56)	0.265 (1.08)	0.127 (0.51)
Skilled vocational qualification	0.437 (2.69)	0.228 (1.34)	0.226 (1.30)
Basic vocational qualification	0.100 (0.29)	–0.074 (0.20)	–0.130 (0.36)
Completed secondary school	–0.179 (1.04)	–0.438 (2.34)	–0.522 (2.70)
X^2 (17)	586.62	628.30	672.27
Pseudo R^2	0.231	0.247	0.265
Prediction success (%)	88.87	88.70	88.57
Sample size	3621	3621	3621

(a) 't' statistics in parentheses.

(b) The simple model does not include any literacy or numeracy variables. The coefficients are from Table 8.

(c) The restricted model includes three variables for self-perceptions of mathematical skills and four variables for document skills. The coefficients are from Table 11.

(d) The full model includes variables for self-perceptions of reading, writing and mathematical skills and for prose, document and quantitative skills. Twenty one variables are used for these influences.

Table 13: Selected coefficients from logit models of labour force participation, females, 1996 *Survey of Aspects of Literacy*[a]

	Simple Model[b]	Restricted Model[c]	Full Model[d]
Level of Education (Did not complete secondary school)			
Higher degree	2.547 (4.41)	1.938 (3.24)	1.819 (3.11)
Postgraduate diploma	1.347 (5.24)	0.787 (2.97)	0.726 (2.70)
Bachelor degree	1.423 (8.94)	0.910 (5.36)	0.855 (4.97)
Undergraduate diploma	1.254 (5.89)	0.879 (4.03)	0.846 (3.84)
Associate diploma	1.094 (5.90)	0.797 (4.20)	0.803 (4.14)
Skilled vocational qualification	0.428 (3.62)	0.194 (1.57)	0.152 (1.22)
Basic vocational qualification	0.929 (6.69)	0.687 (4.82)	0.637 (4.44)
Completed secondary school	0.411 (3.96)	0.085 (0.77)	0.056 (0.50)
X^2 (17)	635.77	801.95	856.67
Pseudo R^2	0.119	0.150	0.160
Prediction success (%)	73.00	74.26	74.35
Sample size	4285	4285	4285

For notes to table see Table 12.

Table 14: Selected coefficients from logit models of unemployment, males, 1996 *Survey of Aspects of Literacy*[a]

	Simple Model[b]	Restricted Model[c]	Full Model[d]
Level of Education (Did not complete secondary school)			
Higher degree	–2.087 (2.70)	–1.333 (1.69)	–1.312 (1.65)
Postgraduate diploma	–0.905 (1.64)	–0.269 (0.47)	–0.263 (0.45)
Bachelor degree	–1.359 (4.07)	–0.768 (2.14)	–0.747 (2.05)
Undergraduate diploma	–1.381 (2.11)	–0.789 (1.18)	–0.831 (1.24)
Associate diploma	–1.017 (3.53)	–0.594 (1.96)	–0.633 (2.04)
Skilled vocational qualification	–1.008 (5.03)	–0.736 (3.55)	–0.738 (3.53)
Basic vocational qualification	0.284 (0.95)	0.564 (1.81)	0.513 (1.62)
Completed secondary school	–0.874 (4.21)	–0.509 (2.28)	–0.517 (2.28)
X^2 (17)	156.61	204.20	218.66
Pseudo R_2	0.091	0.118	0.127
Prediction success (%)	92.10	92.00	91.94
Sample size	3176	3176	3176

For notes to table see Table 12.

Table 15: Selected coefficients from logit models of unemployment, females, 1996
Survey of Aspects of Literacy

	Simple Model[a]	Restricted Model[b]	Full Model[c]
Level of Education (Did not complete secondary school)			
Higher degree	–1.083	–0.543	–0.637
	(1.26)	(0.62)	(0.73)
Postgraduate diploma	–1.672	–1.202	–1.109
	(2.29)	(1.62)	(1.48)
Bachelor degree	–1.440	–0.995	–0.958
	(4.00)	(2.64)	(2.51)
Undergraduate diploma	–1.153	–0.833	–0.752
	(2.05)	(1.46)	(1.31)
Associate diploma	–1.432	–1.278	–1.315
	(3.11)	(2.75)	(2.81)
Skilled vocational qualification	–0.436	–0.232	–0.240
	(1.72)	(0.88)	(0.90)
Basic vocational qualification	–0.779	–0.560	–0.569
	(2.71)	(1.90)	(1.92)
Completed secondary school	–0.479	–0.196	–0.203
	(2.25)	(0.87)	(0.88)
X^2 (17)	107.87	144.85	162.65
Pseudo R^2	0.077	0.104	0.117
Prediction success (%)	93.30	93.30	93.33
Sample size	2894	2894	2894

For notes to table see Table 12.

Appendix A

Table A1: Labour market outcomes by level of educational attainment, males and females, 1995 *Survey of Employment and Unemployment Patterns*

Level of Educational Attainment	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Higher degree	2.35	98.91	–	13.04	4.35	6.52	13.04	63.04	100.00
Postgrad diploma	2.51	88.78	–	18.37	4.08	14.29	24.49	38.78	100.00
Bachelor degree	12.49	85.35	1.69	14.22	11.64	15.09	23.28	35.78	100.00
Undergrad diploma	3.89	83.55	–	16.22	17.57	14.86	24.32	27.03	100.00
Associate diploma	5.53	90.12	0.94	8.57	12.38	22.86	25.71	30.48	100.00
Skilled vocational qualification	18.01	86.72	6.16	9.69	17.81	23.75	27.81	20.94	100.00
Basic vocational qualification	5.78	70.28	5.88	22.92	26.04	19.79	28.13	3.13	100.00
Completed secondary school	18.42	72.47	8.97	27.27	23.57	21.89	17.17	10.10	100.00
Not completed secondary school	31.01	72.06	9.72	23.29	27.59	20.94	18.20	9.98	100.00
Total[c]	100.00	78.36	6.39	18.61	20.23	20.06	21.79	19.31	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 1954, representing a weighted population of 9 350 884.

(d)Totals may not sum to 100 due to rounding.

Appendix B

Table B1: Labour market outcomes by self-perception of English writing skills for the needs of daily life, males and females, 1996 *Survey of Aspects of Literacy*[a]

English Writing Skill Level	% of population	Participation rate (%)	Unemployment rate (%)[b]	% Representation in each one-fifth of Income Distribution[c]					
				0–20	21–40	41–60	61–80	81–100	Total[e]
Excellent	47.87	79.11	4.96	19.70	18.95	18.30	20.97	22.08	100.00
Good	38.78	70.18	7.57	14.54	20.46	25.71	21.33	17.96	100.00
Moderate	11.10	61.51	12.41	14.75	18.87	21.81	38.28	16.29	100.00
Poor	2.25	35.52	15.28	15.90	18.78	25.04	30.07	10.20	100.00
Total[d]	100.00	70.64	7.18	17.06	19.52	21.72	22.12	19.57	100.00

(a) Individuals who did not report a level of reading skills are excluded from the table.

(b) Computed among labour force participants.

(c) Computed only for employed persons with valid information on income.

(d) The total number of cases in the first two columns is 9277, representing a weighted population of 13 187 223.

(e) Totals may not sum to 100 due to rounding.

Table B2: Labour market outcomes by self-perception of mathematical skills for the needs of daily life, males and females, 1996 *Survey of Aspects of Literacy*[a]

Mathematical Skill Level	% of population	Participation rate (%)	Unemployment rate (%)[b]	% Representation in each one-fifth of Income Distribution[c]					
				0–20	21–40	41–60	61–80	81–100	Total[e]
Excellent	44.10	82.80	5.33	18.13	17.71	18.22	22.17	23.77	100.00
Good	41.85	68.60	7.17	15.76	20.03	24.71	22.19	17.30	100.00
Moderate	12.71	56.68	10.08	18.31	23.65	22.55	21.97	13.52	100.00
Poor	1.34	38.66	27.13	10.82	24.14	35.79	19.67	9.58	100.00
Total[d]	100.00	70.59	7.19	17.07	19.52	21.72	22.12	19.57	100.00

(a) Individuals who did not report a level of reading skills are excluded from the table.

(b) Computed among labour force participants.

(c) Computed only for employed persons with valid information on income.

(d) The total number of cases in the first two columns is 9289, representing a weighted population of 13 202 485.

(e) Totals may not sum to 100 due to rounding.

Appendix C

Table C1: Labour market outcomes by document skills, males and females, 1996 *Survey of Aspects of Literacy*

Document Skills	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Level 1	9.83	45.54	17.40	14.59	23.67	31.56	21.27	8.91	100.00
Level 2	25.36	66.92	8.30	16.32	23.96	24.60	21.91	13.22	100.00
Level 3	42.35	79.69	4.96	17.35	18.74	20.64	22.80	20.46	100.00
Level 4	19.53	86.10	4.20	18.65	14.68	16.96	21.01	28.71	100.00
Level 5	2.93	90.96	1.60	17.25	10.72	11.21	24.46	36.36	100.00
Total[c]	100.00	70.53	7.21	17.07	19.52	21.72	22.12	19.57	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 9302, representing a weighted population of 13 220 773.

(d) Totals may not sum to 100 due to rounding.

Table C2: Labour market outcomes by quantitative skills, males and females, 1996 *Survey of Aspects of Literacy*

Quantitative Skills	% of population	Participation rate (%)	Unemployment rate (%)[a]	% Representation in each one-fifth of Income Distribution[b]					
				0–20	21–40	41–60	61–80	81–100	Total[d]
Level 1	9.16	45.86	18.18	16.75	25.62	32.00	18.25	7.38	100.00
Level 2	24.28	65.93	7.77	17.85	24.58	23.50	22.02	12.06	100.00
Level 3	41.91	78.90	5.27	18.24	18.66	21.84	21.89	19.37	100.00
Level 4	20.88	86.18	4.28	14.65	14.48	16.53	23.76	30.58	100.00
Level 5	3.77	94.22	1.73	13.23	9.56	12.75	25.65	38.82	100.00
Total[c])	100.00	70.53	7.21	17.07	19.52	21.72	22.12	19.57	100.00

(a) Computed among labour force participants.

(b) Computed only for employed persons with valid information on income.

(c) The total number of cases in the first two columns is 9302, representing a weighted population of 13 220 773.

(d) Totals may not sum to 100 due to rounding.

Appendix D

This appendix presents results from an examination of the income data in the *Survey of Aspects of Literacy* using an estimator provided by Stewart (1983). Stewart's (1983) model is based on a latent dependent variable, Y*, that is generated in the following manner:

$Y_i^* = X_i\beta + \mu_i$, i = 1, ... ,n

where Y_i^* is the unobserved dependent (income) variable, X_i is a row vector of explanatory variables and β is a column vector of parameters to be estimated. Instead of being presented with information on Y_i^*, information is provided on income in categorical form according to the algorithm:

k = 1 if $A_o < Y_i^* \leq A_1$

k = 2 if $A_1 < Y_i^* \leq A_2$

...

k = K if $A_{K-1} < Y_i^* \leq A_K$

where A_o, A_1, ...A_K are the boundaries of the income categories.

As noted in the text, the boundaries for the income categories in the *Survey of Aspects of Literacy* are 2000, 6600, 13 000, 19 000, 24 000, 28 000, 32 800, 40 000, 50 000. The natural logarithm of these values are used in place of the Ak's in the above exposition.

This estimator was applied to three main models. First, a simple 'schooling and experience' model was estimated. This model included only variables for educational attainment (eight dummy variables for highest level of educational attainment, with the group who did not complete the highest level of secondary school as the benchmark group), labour market experience (computed using information on age and years of schooling), birthplace (where the Australian born, those born abroad in the main English-speaking countries and those born abroad in other than the main English-speaking countries are distinguished), period of residence in Australia of the overseas born, location (where residents of capital cities, residents of the balance of the state and those where the capital city/balance of state disaggregation is not available are distinguished) and disability status. The other models estimated are the 'restricted' and 'full' models used in the study of labour force status. In the restricted model variables for the self-reported mathematical skills and for the test-based measures of document skills are included in the estimating equation. In the 'full' model,

all 21 variables used previously to capture dimensions of literacy and numeracy are included in the estimating equation. Separate equations are estimated for males and females.

Table D1 lists results for the 'simple' and 'restricted' models. These are sufficient to illustrate the main findings from this exploratory analysis.

First, the results from the 'simple' model show that incomes increase with the level of post-secondary qualifications. Males with a Bachelor degree have incomes 45.5 per cent higher than the benchmark group of early school leavers. While this appears to be a substantial gain in income from the acquisition of this type of qualification, Preston's (1997) analysis of census data suggests that the increment in incomes to a degree in 1991 were over 60 per cent.

Second, there is no evidence that individuals who completed secondary school (and who did not acquire post-secondary qualifications) have higher incomes than the benchmark group who did not complete the highest level of secondary school available. In contrast, Preston's (1997) study reveals an income advantage of 12.6 per cent to males who completed high school. The absence of an income return to the completion of high school in this study (and the near to perverse results for males) is an anomaly. It is, however, consistent with the findings from the cross-tabulations discussed in the text.

Third, the increase in income with years of labour market experience is quite sharp, and much greater than has been reported in comparable analyses of other data sets (see, for example, Preston (1997)). Evaluated at 10 years of labour market experience, for example, the increase in income with experience for males is 6.5 per cent in the current analysis, about double that reported by Preston (1997).

Fourth, the elasticity of income with respect to labour supply, at 0.52 for males and 0.62 for females, is lower than has been reported in other studies of income determination, where the estimates are much close to unity.

Fifth, consistent with the literature, overseas born males from non-English speaking countries are at a significant income disadvantage compared to the Australian born. The incomes of the overseas born from English-speaking countries do not differ significantly from the income of the Australian born. It is also seen that the income position of the foreign born does not improve with duration of residence in Australia. This result is also broadly consistent with the Australian literature on immigrant economic adjustment.

Finally, it is noted that the introduction of the variables for literacy and numeracy has little impact on the estimated impacts associated with the other variables. Indeed, the additional seven variables in the 'restricted' model are insignificant as a group in each equation presented in the Table. None of the individual literacy/numeracy variables are significant in the case of females, and only two regressors are significant in the case of males. These findings suggest that males with either of the two middle document skill levels (skill levels three and four) have incomes some 15 per cent higher than other groups.

In summary, there are many inconsistencies between the results for the variables other than the literacy/numeracy variables in Table 1 and the findings reported in the reasonably vast Australian literature on wage determination. It is therefore unclear how much weight to attach to the findings for the literacy/numeracy variables. Further analysis of the income data therefore does not appear to have an appropriate foundation.

Table D1: Models of income, males and females, 1996 *Survey of Aspects of Literacy*[a]

Variable	Males		Females	
	Simple Model	Restricted Model	Simple Model	Restricted Model
Constant	4.715	4.560	4.213	4.171
	(15.53)	(14.65)	(18.76)	(17.23)
Level of Education (Did not complete secondary school)				
Higher degree	1.040	1.033	0.597	0.554
	(7.72)	(7.35)	(3.92)	(3.55)
Postgraduate diploma	0.253	0.250	0.307	0.264
	(1.92)	(1.83)	(2.92)	(2.43)
Bachelor degree	0.455	0.442	0.396	0.352
	(6.18)	(5.50)	(5.56)	(4.73)
Undergraduate diploma	0.135	0.120	0.275	0.242
	(1.04)	(0.91)	(2.55)	(2.22)
Associate diploma	0.277	0.263	0.162	0.143
	(3.84)	(3.50)	(1.80)	(1.58)
Skilled vocational qualification	0.106	0.097	0.131	0.115
	(1.99)	(1.80)	(1.76)	(1.54)
Basic vocational qualification	–0.336	–0.348	0.099	0.083
	(2.84)	(2.92)	(1.39)	(1.16)
Completed secondary school	–0.100	–0.107	0.020	–0.009
	(1.62)	(1.66)	(0.30)	(0.14)
Experience	0.085	0.084	0.049	0.047
	(12.10)	(11.91)	(6.82)	(6.57)
Experience squared	–0.001	–0.001	–0.001	–0.001
	(9.65)	(9.40)	(5.70)	(5.37)

(continued)

Table D1: Models of income, males and females, 1996 *Survey of Aspects of Literacy*[a] (continued)

Variable	Males		Females	
	Simple Model	Restricted Model	Simple Model	Restricted Model
Labour supply	0.515	0.515	0.621	0.622
	(12.97)	(12.97)	(21.88)	(21.92)
Birthplace (Australia)				
Overseas—English speaking country	0.018	0.033	–0.047	–0.042
	(0.16)	(0.29)	(0.37)	(0.33)
Overseas—non-English speaking country	–0.280	–0.233	–0.020	0.017
	(2.47)	(1.99)	(0.17)	(0.14)
Period of Residence (POR)	0.006	0.005	0.010	0.010
	(1.23)	(1.09)	(1.88)	(1.88)
Disabled	–0.122	–0.124	0.007	0.014
	(2.68)	(2.72)	(0.13)	(0.26)
Location (balance of state)				
City	0.304	0.310	0.132	0.127
	(4.75)	(4.84)	(1.91)	(1.84)
Non-city	0.230	0.232	0.030	0.037
	(3.40)	(3.43)	(0.40)	(0.49)
Self-perception of mathematical skills (excellent)				
Good	(b)	0.074	(b)	–0.026
		(1.69)		(0.57)
Moderate	(b)	0.051	(b)	–0.097
		(0.76)		(1.45)
Poor	(b)	0.135	(b)	–0.134
		(0.81)		(0.76)
Document Skill Level (one=minimum)				
Two	(b)	0.111	(b)	0.027
		(1.52)		(0.31)
Three	(b)	0.145	(b)	0.137
		(1.99)		(1.60)
Four	(b)	0.156	(b)	0.048
		(1.86)		(0.50)
Five (maximum)	(b)	0.132	(b)	0.193
		(0.95)		(1.30)
Log–Likelihood	–5820.6	–5817.4	–4796.0	–4790.2
Sample size	2453	2453	2120	2120

(a) 't' statistics in parentheses.

(b) Variable not entered.

Appendix E

The variables used in the statistical analyses are defined as follows.

Higher degree—This is a dichotomous variable and is set equal to unity if the individual possesses a higher degree. For individuals who do not hold these qualifications the variable is set to zero.

Postgraduate diploma—This is a dichotomous variable and is set equal to unity if the individual possesses a postgraduate diploma. For individuals who do not hold these qualifications the variable is set to zero.

Bachelor degree—This is a dichotomous variable and is set equal to unity if the individual possesses a bachelor degree. For individuals who do not hold these qualifications the variable is set to zero.

Undergraduate diploma—This is a dichotomous variable and is set equal to unity if the individual possesses an undergraduate diploma. For individuals who do not hold these qualifications the variable is set to zero.

Skilled vocational qualification—This is a dichotomous variable and is set equal to unity if the individual possesses a skilled vocational qualification. For individuals who do not hold these qualifications the variable is set to zero.

Basic vocational qualification—This is a dichotomous variable and is set equal to unity if the individual possesses a basic vocational qualification. For individuals who do not hold these qualifications the variable is set to zero.

Completed highest level of secondary school—This is a dichotomous variable and is set equal to unity if the individual completed the highest level of secondary school. For individuals who do not meet this criterion the variable is set to zero.

Has not completed highest level of secondary school—This is a dichotomous variable and is set equal to unity if the individual has not completed the highest level of secondary school. For individuals who do not meet this criterion the variable is set to zero. This category is used as the benchmark group.

Age—This is a continuous variable that measures the individual's age. It is formed from the mid-points of the 5-year age brackets used in the presentation of the sample information in the Confidentialised Unit Record File.

Born abroad in main English-speaking country—This is a dichotomous variable and is set equal to unity if the individual was born outside Australia in a main

English-speaking country. Individuals not meeting these criteria are assigned a value of zero.

Born abroad in other country—This is a dichotomous variable and is set equal to unity if the individual was born outside Australia in a non-English-speaking country. Individuals not meeting these criteria are assigned a value of zero.

Born in Australia—This is a dichotomous variable and is set equal to unity if the individual was born in Australia. Individuals not meeting this criterion are assigned a value of zero. This category is used as the benchmark group in the analysis.

Disability (Nature of Handicap)—This is a dichotomous variable and is set to unity if the individual has a disability. The variable is set to zero for individuals without a disability.

City—This is a dichotomous variable and is set equal to unity if the individual resides in a capital city. Individuals residing in other regions are assigned a value of zero for this variable.

Non-City—This is a dichotomous variable and is set equal to unity if the individual resides in the balance of the State or Territory. Individuals residing in other regions are assigned a value of zero for this variable.

Whole of State—This is a dichotomous variable and is set equal to unity if the individual resides in the whole of State. Individuals residing in other regions are assigned a value of zero for this variable. This category is used as the benchmark group in the statistical analyses.

Period of residence—This is a continuous variable that measures the years individuals born outside Australia have resided in Australia. It is computed from the year of arrival in Australia. If the year of arrival is greater than zero then period of residence is equal to 96.5 minus the year of arrival.

Participation index—This variable is set equal to unity if the individual is in the labour force (employed or unemployed). Individuals who are not in the labour force are assigned a value of zero.

Unemployment index—This variable is set equal to unity if the individual who is in the labour force is actually unemployed. Individuals who are in the labour force who are employed (i.e., not unemployed) are assigned a value of zero.

Table E1: Means and standard deviations of variables, males and females, 1996 *Survey of Aspects of Literacy*(a)

Variable	Males		Females	
	Participation	Unemployment	Participation	Unemployment
Level of Education				
Higher degree	0.027	0.030	0.012	0.016
	(0.16)	(0.17)	(0.11)	(0.13)
Postgraduate diploma	0.024	0.025	0.031	0.038
	(0.15)	(0.16)	(0.17)	(0.19)
Bachelor degree	0.087	0.096	0.094	0.117
	(0.28)	(0.29)	(0.29)	(0.32)
Undergraduate diploma	0.025	0.025	0.036	0.040
	(0.16)	(0.16)	(0.19)	(0.20)
Associate diploma	0.092	0.094	0.053	0.062
	(0.29)	(0.29)	(0.22)	(0.24)
Skilled vocational qualification	0.239	0.245	0.107	0.106
	(0.43)	(0.43)	(0.31)	(0.31)
Basic vocational qualification	0.031	0.031	0.094	0.110
	(0.17)	(0.17)	(0.29)	(0.31)
Completed secondary school	0.170	0.167	0.179	0.185
	(0.38)	(0.37)	(0.38)	(0.39)
Did not complete secondary school	0.306	0.288	0.395	0.325
	(0.46)	(0.45)	(0.49)	(0.47)
Age	38.166	37.180	38.071	36.193
	(12.87)	(12.19)	(12.84)	(11.80)
Birthplace				
Australia	0.740	0.750	0.737	0.753
	(0.44)	(0.43)	(0.44)	(0.43)
Overseas—English speaking country	0.113	0.118	0.109	0.112
	(0.32)	(0.32)	(0.31)	(0.32)
Overseas—non-English speaking country	0.147	0.132	0.155	0.135
	(0.35)	(0.34)	(0.36)	(0.34)
Period of Residence (POR)	5.103	4.918	5.072	4.905
	(9.75)	(9.59)	(9.67)	(9.55)
Disabled	0.300	0.258	0.254	0.202
	(0.46)	(0.44)	(0.44)	(0.40)
Location				
Whole of State	0.105	0.106	0.105	0.101
	(0.31)	(0.31)	(0.31)	(0.30)
City	0.576	0.578	0.580	0.593
	(0.49)	(0.49)	(0.49)	(0.49)
Non-city	0.318	0.316	0.315	0.306
	(0.47)	(0.46)	(0.46)	(0.46)
Sample size	3621	3176	4285	2894

(a) Figures in parentheses are standard deviations.

Appendix F

Table F1: Correlations between measures of literacy and numeracy, 1996 *Survey of Aspects of Literacy*, female unemployment sample[(a)]

	Self-Perceptions Data			Test-Based Data		
	Reading	Writing	Mathematical	Prose	Document	Quantitative
Reading	1.0					
Writing	0.881	1.0				
Mathematical	0.600	0.621	1.0			
Prose	0.582	0.519	0.384	1.0		
Document	0.499	0.463	0.419	0.901	1.0	
Quantitative	0.461	0.437	0.496	0.863	0.958	1.0

(a) Polychoric correlations based on 2894 observations.

Table F2: Correlations between measures of literacy and numeracy, 1996 *Survey of Aspects of Literacy*, male participation sample[(a)]

Self-Perceptions Data		Test-Based Data				
	Reading	Writing	Mathematical	Prose	Document	Quantitative
Reading	1.0					
Writing	0.859	1.0				
Mathematical	0.637	0.663	1.0			
Prose	0.562	0.561	0.485	1.0		
Document	0.534	0.542	0.520	0.931	1.0	
Quantitative	0.524	0.532	0.563	0.906	0.971	1.0

(a) Polychoric correlations based on 3621 observations.

Table F3: Correlations between measures of literacy and numeracy, 1996 *Survey of Aspects of Literacy*, female participation sample[(a)]

Self-Perceptions Data	Test-Based Data					
	Reading	Writing	Mathematical	Prose	Document	Quantitative
Reading	1.0					
Writing	0.882	1.0				
Mathematical	0.611	0.633	1.0			
Prose	0.637	0.593	0.460	1.0		
Document	0.575	0.549	0.483	0.926	1.0	
Quantitative	0.544	0.527	0.545	0.895	0.966	1.0

(a) Polychoric correlations based on 4285 observations.

References

Altonji, J. 1995, 'The Effects of High School Curriculum on Education and Labour Market Outcomes', *Journal of Human Resources*, Vol. 30, No. 3, pp.48–83.

Australian Bureau of Statistics 1997, *Aspects of Literacy: Assessed Skill Levels, Australia 1996*, ABS Catalogue 4228.0, Australian Government Publishing Service, Canberra.

Bianco, L.B. 1997, 'Public Policy and Literacy Research Data: Will Knowing Lead to Doing?', in Australian Bureau of Statistics, *Aspects of Literacy: Assessed Skill Levels, Australia 1996*, ABS Catalogue 4228.0, Australian Government Publishing Service, Canberra.

Brooks, C. & Volker P.A. 1985, 'Labour Market Success and Failure: An Analysis of the Factors Leading to the Workforce Destinations of the Australian Population', in Volker, P.A. (ed.) *The Structure and Duration of Unemployment in Australia*, Australian Government Publishing Service, Canberra, pp.43–71.

Chiswick, B.R. & Miller, P.W. 1992, *Post-Immigration Qualifications in Australia: Determinants and Consequences*, Australian Government Publishing Service, Canberra.

——1994, 'Language and Labor Supply: The Role of Gender Among Immigrants in Australia', in Slottje, D.J. (ed.) *Research on Economic Inequality*, Vol. 5, pp. 153–189.

——1995, 'The Endogeneity Between Language and Earnings', *Journal of Labor Economics*, Vol. 13, No. 2, pp.246–288.

Cumming, J. 1997, 'The Quantitative Literacy Performance of Australians: Implications of Low Skill Levels', in Australian Bureau of Statistics, *Aspects of Literacy: Assessed Skill Levels, Australia 1996*, ABS Catalogue 4228.0, Australian Government Publishing Service, Canberra.

Duncan, G.J. & Hill, D.H. 1985, 'An Investigation of the Extent and Consequences of Measurement Error in Labor-economic Survey Data', *Journal of Labor Economics*, Vol. 3, No.4, pp.508–532.

Inglis, P.A. & Stromback, T. 1986, 'Migrants' Unemployment: The Determinants of Employment Success', *Economic Record*, Vol. 62, No. 178, pp.310–324.

Jones, F.L. 1992, *Sex and Ethnicity in the Australian Labour Market: The Immigrant Experience,* Australian Bureau of Statistics Occasional Paper, Commonwealth Government Printer, Canberra.

Kang, S. & Bishop, J. 1986, 'Effects of Curriculum on Labor Market Success Immediately After High School', J*ournal of Industrial Teacher Education,* Vol. 23, pp.14–29.

Kenyon, P. & Wooden, M. 1996, 'Labour Supply', in Norris, K. & Wooden, M. (eds.), *The Changing Australian Labour Market,* Australian Government Publishing Service, Canberra.

Kidd, M.P. 1993, 'Immigrant Wage Differentials and the Role of Self-Employment in Australia', *Australian Economic Papers,* Vol. 32, No. 60, pp.92–115.

Lang, K. & Kropp, D. 1986, 'Human Capital versus Sorting: The Effects of Compulsory Attendance Laws', *Quarterly Journal of Economics,* Vol. 101, pp.609–624.

Le, A.T. & Miller, P.W. 1999a, *Job Quality and Churning of the Pool of the Unemployed: An Application Using the Survey of Employment and Unemployment Patterns,* Australian Bureau of Statistics Occasional Paper 6293.0.00.003, Ausinfo, Canberra.

——1999b, *A Risk Index Approach to Unemployment: An Application Using the Survey of Employment and Unemployment Patterns,* Australian Bureau of Statistics Occasional Paper 6293.0.00.001, Ausinfo, Canberra.

——2000, 'Australia's Unemployment Problem', *Economic Record* (forthcoming).

Lee, Y.L., Miller, P.W. & Martin, N. 2000, 'Can Earnings Data be Imputed Using Occupational Attainment', mimeo, Department of Economics, The University of Western Australia.

McNabb, R. & Richardson, S. 1979, 'Earnings, Education and Experience: Is Australia Different?', *Australian Economic Papers,* Vol. 28, No. 52, pp.57–75.

Miller, P.W. & Volker, P.A. 1984, 'The Screening Hypothesis: An Application of the Wiles Test', *Economic Inquiry,* Vol. 22, No. 1, pp.121–127.

Miller, P.W., Mulvey, C. & Martin, N. 1995, 'What do Twins Studies Reveal About the Economic Returns to Education?: A Comparison of Australian and US Findings', *American Economic Review,* Vol.85, No.3, pp.586–599.

Miller, P.W. & Chiswick, B.R. 1997, 'Literacy, Numeracy and the Labour Market', in Australian Bureau of Statistics, *Aspects of Literacy: Assessed Skill Levels, Australia 1996*, ABS Catalogue 4228.0, Australian Government Publishing Service, Canberra.

Miller, P.W. & Neo, L. 1997, 'Immigrant Unemployment: The Australian Experience', *International Migration*, Vol. 35, No. 2, pp.155–183.

——2000, 'Labor Market Flexibility and Immigrant Adjustment', mimeo, Department of Economics, The University of Western Australia.

Neale, M.C. & Cardon, L.R. 1992, *Methodology for Genetic Studies of Twins and Families*, Kluwer Academic, Dordrecht.

Norton, M. 1997, 'So – How Many People Can't Read?', in Australian Bureau of Statistics, *Aspects of Literacy: Assessed Skill Levels, Australia 1996*, ABS Catalogue 4228.0, Australian Government Publishing Service, Canberra.

Parker, R.N. & Fenwick, F. 1983, 'The Pareto Curve and its Utility for Open-Ended Income Distributions in Survey Research', *Social Forces*, Vol.61, No.3, pp.872–885.

Preston, A. 1997, 'Where are We Now With Human Capital Theory', *Economic Record*, Vol. 73, No. 220, pp.51–78.

Riley, J. 1979, 'Testing the Educational Screening Hypothesis', *Journal of Political Economy*, Vol. 87, No. 5(pt.2), pp.S227–SS252.

Roussel, S. 1999, 'Factors Influencing Employees' Participation in Education & Training: Evidence from the ABS Surveys of Education & Training 1989, 1993 & 1997', mimeo, Education and Training Research Section, Department of Education, Training and Youth Affairs.

Stewart, M.B. 1983, 'On Least Squares Estimation when the Dependent Variable is Grouped', *Review of Economic Studies*, Vol. 50, No. 163, pp.737–753.

Weiss, A. 1983, 'A Sorting-Cum-Learning Model of Education', *Journal of Political Economy*, Vol. 91, pp.420–42.

——1988, 'High School Graduation, Wage and Performance', *Journal of Political Economy*, Vol. 96, No. 4, pp. 785–820.

——1995, 'Human Capital vs Signalling Explanations of Wages', *Journal of Economic Perspectives*, Vol. 9, No. 4, pp.133–154.

Wolpin, K. 1977, 'Education and Screening', *American Economic Review*, Vol. 65, No. 5, pp. 949–958.

Wooden, M. 1991, 'The Experience of Refugees in the Australian Labour Market', *International Migration Review*, Vol. 25, No. 3, pp.514–535.