

Skill (mis-)matches and over-education of younger workers

AUSTRALIAN NATIONAL UNIVERSITY

Chris Ryan

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Australian Government
Department of Education, Employment
and Workplace Relations



NCVER

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About the research



Skill (mis-)matches and over-education of younger workers

Chris Ryan and Mathias Sinning, Australian National University

Younger workers, particularly those entering the workforce at ages 25–34 years, are more educated than ever before. The potential for these workers to be over-educated in their jobs might therefore be high. But does it follow that they are mismatched to the skill requirements of their jobs?

This study examines the link between over-education and skill mismatches for Australian workers aged 25–34 and 35–44 years of age, based on an analysis of data from the 1996 Survey of Aspects of Literacy and the 2006 Adult Literacy and Life Skills Survey. In addition, the wage returns from over-education and over-skilling are investigated.

This research provides an interesting comparison with work done by Mavromaras, McGuinness and King (<<http://www.ncver.edu.au/publications/2231.html>>), which also looked at job mismatch in workers, using data from the Household Income and Labour Dynamics in Australia (HILDA) survey.

Key messages

- ✧ This research confirms that there are substantial differences between the two concepts of over-education and over-skilling. Most over-skilled workers have low levels of education and require fewer skills at work than they actually have. The majority of under-skilled workers hold a university degree, suggesting that many highly educated workers find themselves in challenging jobs.
- ✧ However, over-education is associated with skills' under-utilisation.
- ✧ The effects of over-education on wages differ substantially across education levels, with the penalty from over-education less severe for highly educated workers than for workers with lower educational attainment.
- ✧ Ryan and Sinning find that it is the level of education more than the skill level of workers that determines their remuneration, with over-skilling having no additional effect on wages beyond that accounted for by over-education.

The cost of younger workers with vocational education and training (VET) qualifications being over-educated and in low-skill jobs is of concern. That this effect is also observed in slightly older workers suggests that some VET graduates find themselves entrenched in low-level jobs.

Tom Karmel
Managing Director, NCVER

Contents

Tables and figures	6
Executive summary	7
Introduction	9
Data and descriptive analysis	12
Data sources	12
Descriptive analysis	13
Skill (mis-)matches and over-education	21
Educational attainment	21
Occupation	24
Regression analysis	25
Summary	28
Returns from over-education and under-education	29
Educational attainment	29
Occupation	30
Over-education and over-skilling	30
Regression analysis	32
Summary	34
Conclusions and implications	36
References	37

Tables and figures

Tables

1	Measures of skill use and individual literacy of 25 to 34-year-olds, 1996 and 2006	14
2	Relative skill use measures of 25 to 34-year-olds, 1996 and 2006	16
3	Skill levels	18
4	Proportion of 25 to 34-year-old workers by occupation, 2006	25
5	Determinants of relative skill use of 25 to 34-year-old labour force participants	27
6	Weekly wages of full-time employed workers by educational attainment and age, 2006	30
7	Weekly wages of full-time workers employed by occupation and age, 2006	31
8	Weekly wages of 25 to 34-year-old full-time employed workers by skill or education, 1996 and 2006	31
9	Weekly wage determinants of 25 to 34-year-old labour force participants	33
10	Weekly wage determinants of 35 to 44-year-old labour force participants	35

Figures

1	Relative skill use measures of 25 to 34-year-olds, 2006	15
2	Over-skilled and under-skilled 25 to 34-year-old workers, 2006	17
3	Actual proportion of 25 to 34-year-old under- or over-skilled workers by under- or over-education	19
4	Expected proportion of 25 to 34-year-old under- or over-skilled workers by under- or over-education	20
5	Share of 25 to 34-year-olds by skill group and educational attainment, 2006	22
6	Share of 25 to 34-year-olds by over- or under-education and educational attainment, 2006	23
7	Proportion of 25 to 34-year-old workers by skill or education group and educational attainment	24

Executive summary

The literature on over-education and under-education is based on the idea that each occupation has a reference level of education required for adequate job performance. Workers are termed ‘over-educated’ if the educational ‘requirements’ of their jobs are less than their own educational attainment. From an econometric point of view, over-education can be considered as a waste of the private and social resources devoted to education, at least that part that is in excess of requirements.

In this study, we analyse the extent of over-education in the Australian labour market among workers aged 25 to 44 years of age. Our measure of over-education is based on an assessment by the Australian Bureau of Statistics (ABS) of the level of education typically required for the satisfactory conduct of the tasks involved in different occupations. Those with more education than is a typical measure are treated as over-educated. From a theoretical perspective, we expect that the effects of over-education are particularly strong among younger workers aged 25 to 34 years, who enter the labour market after receiving a relatively high level of education. By comparing this group of workers with older workers aged 35 to 44 years, we may draw inferences about the relevance of over-education for older (typically more experienced) workers.

Our purpose, however, is to go beyond an analysis only of over-education. We also want to examine the link between over-education and skill mismatches in the Australian labour market. Specifically, we use information on a set of narrow, but important, individual literacy and numeracy skills and the extent to which individuals report that they undertake tasks requiring those skills in their jobs to generate a measure of ‘relative skill use’. The measure reflects the skill requirements of workers’ jobs relative to the skills that individual workers possess. This measure allows us to distinguish between ‘over-skilled’ workers (those with high levels of skills who report rarely undertaking tasks involving such skills) and ‘under-skilled’ workers (those with low levels of skills who report frequently undertaking tasks involving skills they do not seem to have). In our empirical analysis, we analyse separate measures of over-education and of ‘over-skilling’. Such a distinction is relevant because highly educated (including over-educated) workers are not necessarily those who are over-skilled. In fact, it seems likely that highly educated workers have jobs that require more skills than they actually have, while less-educated (including under-educated) workers have jobs that require fewer skills than they actually have.

Our empirical analysis consists of two broad parts. The first is a descriptive analysis of the extent of over- and under-skilling in the workforce population and the characteristics of such workers (including their age, gender, education and occupation). We also examine changes in skills and skill requirements over time and the relationship between over-education and over-skilling. The first part of the study also involves regression analysis, which allows us to investigate the factors that are associated with skill mismatches. Following the economic literature on over-education, the second part of the analysis examines the relationship between over-skilling and over-education and wages, in which we pay particular attention to the returns from over-education.

Our interest lies in addressing the following questions:

- ✧ Are over-educated workers necessarily over-skilled and under-educated workers under-skilled?
- ✧ Are skill mismatches the result of over-education or under-education?
- ✧ What factors are responsible for the misallocation of individual skills and job requirements?

- ✧ Are the returns from over- or under-education attributable to individual skills or skill requirements at work?
- ✧ Are the returns from over-education different across age groups and do they change over time?

Our analysis is based on data from the 1996 Survey of Aspects of Literacy (SAL) and the 2006 Adult Literacy and Life Skills (ALLS) Survey. These surveys include information about the skills required in the workers' jobs and separate estimates of the skills that workers actually possess in different occupations and industries and allow an investigation of changes in these phenomena over time. Our empirical analysis concentrates on workers in younger age groups (25–34 years) but also includes comparisons with older workers (35–44 years). Changes in skill (mis-)matches are assessed by comparing workers aged 25–34 years observed in 1996 with workers aged 25–34 years in 2006. The results derived from this analysis permit inferences about the extent of any over-education among younger age cohorts and whether it has changed.

The major findings and their implications are highlighted in the points below:

Skill (mis-)matches and over-education:

- ✧ Substantial differences may be observed between the two concepts of over- or under-education and over- or under-skilling:
 - ◆ Most over-skilled workers have low levels of education and require fewer skills at work than they actually have because they work in low-skilled jobs.
 - ◆ The majority of under-skilled workers hold a university degree, suggesting that many highly educated workers have jobs that require more skills than they actually seem to possess.
 - ◆ By construction, over-educated workers have at least a post-school qualification and most of them hold a university degree, while most of the under-educated workers tend to be those without high-level post-school qualifications.
- ✧ Full-time employed workers tend to be in jobs with significantly higher skill requirements than part-time employed workers with the same skill level. Employer size is also a strong predictor of higher relative skill requirements at work.
- ✧ There are no gender differences in relative skill requirements (that is, skill requirements relative to skills) after controlling for other relevant factors.
- ✧ Education is positively associated with relative skill requirements at work.
- ✧ Under-educated workers use their relative skills more often than over-educated workers, so over-education does contribute to skill mismatches.

Returns from over-education and under-education:

- ✧ Both under-educated and under-skilled workers have, on average, higher wages than over-educated and over-skilled workers.
- ✧ In line with existing studies, a penalty from over-education is observed after controlling for the actual level of education. (The wage penalty results from the fact that over-educated workers would have been able to earn higher wages in jobs that require their level of education.)
- ✧ This penalty varies substantially by highest educational level and is more substantial for those with vocational qualifications than those with university degrees.
- ✧ After controlling for over-education, over-skilling has no additional effect on wages, indicating that the (observed) level of education rather than the (unobserved) skill level determines the remuneration of workers.
- ✧ When comparing different age cohorts, workers of the age cohort 35–44 years are affected by over-education in the same way as workers aged 25–34 years.

Introduction

The literature on over-education and under-education is based on the idea that there is a reference level of education for each occupation which is required for adequate job performance. Workers are termed ‘over-educated’ if the educational ‘requirements’ of their jobs are less than their own educational attainment. Over-education can be considered as a waste of the private and social resources devoted to education, at least that part that is in excess to requirements and to the extent that individuals would prefer and be suited to different jobs from those in which they find themselves. Empirical studies typically find that about 60% of workers are in jobs that appear to be appropriate for their educational qualifications (Miller 2007), while 15% of the Australian workforce may be over-educated (Voon & Miller 2005). Recent empirical studies on over-education have shown that the returns from ‘required’ schooling are higher than the returns from actual education (see, for example, Boothby 2002). Although the years of schooling that reflect over-education have a positive effect on wages, the returns from these surplus years are lower than the returns from required education.

Measures of over-education are typically derived in one of three ways. The first involves the detailed analysis of occupations and the tasks they require workers to undertake. Analysts align level of education to the satisfactory conduct of those specific tasks and designate individuals as over-educated if their schooling exceeds the assessed required level (the approach adopted in Kler 2005). A second approach is based on the subjective assessment of workers: workers may respond in questionnaires about the typical level of education held by other workers doing their job, or that they do not make use of their education in their work (for example, Duncan & Hoffman 1981; Sicherman 1991). The third is a statistical approach: analysts look at the distribution of the years of schooling of people who work in a particular occupation and designate as over-educated those with statistically unusually high levels of education for that occupation (the approach of Hartog [2000], which has been applied in Australian studies such as Voon and Miller [2005] and Messinis and Olekalns [2007]).

Our measure of over-education is of the first type: based on an assessment by the ABS of the level of education typically required for the satisfactory conduct of the tasks involved in different occupations. The measure is described in more detail in a later section. In this study, we analyse the extent of over-education in the Australian labour market among workers aged 25–44 years of age. From a theoretical perspective, we expect the effects of over-education to be most pronounced among younger workers aged 25 to 34 years, who are more recent entrants. By comparing this group with a group just marginally older, in this case workers aged 35–44 years, we can estimate whether the nature of over-education changes with experience.

Our purpose, however, is to go beyond an analysis solely of over-education. We also want to examine the link between over-education and skill mismatches in the Australian labour market. In our empirical analysis, we analyse separate measures of over-education and of ‘over-skilling’. Such a distinction is relevant because highly educated (including over-educated) workers are not necessarily those who are over-skilled. In fact, it is possible that highly educated workers have jobs that require more skills than they actually have, while less-educated (including under-educated) workers have jobs that require fewer skills than they actually have. Examples of the former case might be in professions where graduates take some time to acquire the full set of skills necessary for their jobs, such as in medicine and law. While these might be considered temporary and are rectified by the

process of skill accumulation on the job or with additional formal training, there may be other cases where the state may be longer lasting.

Over-skilling has also been the subject of study in the context of the Australian labour market. It could be measured in analogous ways to ‘over-education’. If multi-dimensional measures of worker skills were available, it would be possible to measure ‘typical’ or assign required skill levels in an occupation and compare them with those of actual incumbents, or to ask people whether their skills are fully or partially utilised in the jobs. The latter approach has been adopted in recent studies in Australia (McGuinness & Wooden 2007; Mavromaras, McGuinness & Wooden 2007; Mavromaras, McGuinness & Fok 2009).

The approach to measuring over-skilling in this paper is different. We use information on a set of narrow, but important, individual skills and the extent to which individuals report they undertake tasks requiring those skills in their jobs to generate a measure of ‘relative skill use’. The measure reflects the skill (literacy and numeracy) requirements of workers’ jobs relative to the skills that individual workers possess. This measure allows us to distinguish between ‘over-skilled’ workers (those with high levels of skills who report rarely undertaking tasks involving such skills) and ‘under-skilled’ workers (those with low levels of skills who report frequently undertaking tasks involving skills they do not seem to have).

Our empirical analysis consists of two broad parts. The first part is a descriptive analysis of the extent of over- and under-skilling in the workforce and the characteristics of such workers (including their age, gender, education and occupation). We also examine changes in skills and skill requirements over time and the relationship between over-education and over-skilling. The first part of the study also involves regression analysis, which allows us to investigate the factors that are associated with skill mismatches. Following the economic literature on over-education, the second part of the analysis examines the relationship between over-skilling and over-education and wages, paying particular attention to the returns from over-education.

Our interest lies in addressing the following questions: Are over-educated workers necessarily over-skilled and under-educated workers under-skilled? Are skill mismatches the result of over-education or under-education? What factors are responsible for the misallocation of individual skills and job requirements? Are the returns from over- or under-education attributable to individual skills or skill requirements at work? Are the returns from over-education different across age groups and do they change over time? Answers to such questions can inform our view on the relationship between over-education and the match between individual skills and job requirements among workers.

Our analysis is based on data from the 1996 Survey of Aspects of Literacy (SAL) and the 2006 Adult Literacy and Life Skills (ALLS) Survey. These surveys include information about the skills required in the workers’ jobs and separate estimates of the skills workers actually possess in different occupations and industries and allow an investigation of changes in these phenomena over time. Since we might expect that over-education is most relevant for younger workers, the empirical analysis concentrates on workers of younger age groups but also includes comparisons with older workers. Specifically, changes in skill (mis-)matches are assessed by comparing workers aged 25–34 years observed in 1996 with workers aged 25–34 years in 2006. The results derived from this analysis permit inferences about the extent of any over-education among younger age cohorts and whether it has changed.

In the Australian context, only a few studies have made explicit use of the concept of over-skilling, which represents a very different approach to measuring job mismatches (McGuinness & Wooden 2007; Mavromaras, McGuinness & Wooden 2007; Mavromaras, McGuinness & Fok 2009). These studies focus exclusively on the analysis of subjective skill measures. We contribute to this literature by comparing an objective skill measures to a ‘conventional’, albeit somewhat limited, measure of over-education.

Our findings suggest that there are substantial differences in the two concepts of over- or under-education and over- or under-skilling. Specifically, most over-skilled workers have low levels of

education and require fewer skills at work than they actually have, while the majority of under-skilled workers hold a university degree, suggesting that many highly educated workers have jobs that require more skills than they actually seem to possess. By construction, over-educated workers have at least a post-school qualification and most of them hold a university degree, while most of the under-educated workers tend to be those without high-level post-school qualifications. Full-time employed workers tend to be in jobs with significantly higher skill requirements than part-time employed workers with the same skill level. Employer size is also a strong predictor of higher relative skill requirements at work. After controlling for other relevant factors, there are no gender differences in relative skill requirements (that is, skill requirements relative to skills). Education is positively associated with higher relative skill requirements at work. Finally, under-educated workers use their relative skills more often than over-educated workers.

Empirical evidence on over-education (see, for example, Sicherman 1991; Hartog 2000; Boothby 2002) usually suggests that:

- ✧ Over-educated workers earn more than other workers in comparable jobs but who have the schooling level that matches the requirements of those jobs.
- ✧ Over-educated workers earn less than workers with comparable schooling in jobs which require this level of schooling.
- ✧ Under-educated workers earn more than comparably educated workers in jobs which match their schooling, but less than workers in jobs with comparable educational requirements whose schooling matches these requirements.

Our results confirm some but not all of these findings. Specifically, we find that both under-educated and under-skilled workers have, on average, higher wages than over-educated and over-skilled workers. In line with existing studies, a penalty from over-education is observed after controlling for the actual level of education. Moreover, after controlling for over-education, over-skilling has no additional effect on wages, indicating that the (observed) level of education rather than the skill level of workers, which may be hard to observe, determines their remuneration. As commonly found, male workers have significantly higher wages than female workers, even in this case after controlling for over-education and relative skill usage.

Data and descriptive analysis

This chapter contains a description of the data and provides descriptive evidence on skills, skill requirements at work and educational attainment. Particular attention is paid to the relationship between skill (mis-)matches and over- or under-education. The analysis concentrates on the sample of younger workers aged 25–34 years.

Data sources

The empirical analysis uses information from two comparable surveys of one person from Australian households conducted in 1996 and 2006 by the ABS, the Survey of Aspects of Literacy and the Adult Literacy and Life Skills Survey, both undertaken as part of international projects.

The Survey of Aspects of Literacy (1996)

The Survey of Aspects of Literacy was a national survey designed to measure certain aspects of the literacy and numeracy skills of Australians. Personal interviews were carried out over a nine-week period between May 1996 and July 1996. The sample consists of 9302 respondents aged 15–74 years living in private dwellings, but excluded persons living in remote and sparsely settled areas. The data include information about the literacy and numeracy skills of individuals that are deemed necessary to use printed material typically found at work, at home, and in the community (ABS 1997a, 1997b). The survey was part of an international project led by Statistics Canada called the International Adult Literacy Survey.¹

There were two major components to the survey:

- ✧ Self-assessed reports by individuals of their reading, writing and basic mathematical skills for the needs of daily life and their main job:
 - ◆ Respondents were asked a series of questions to obtain background socio-demographic information (such as age, gender etc.).
 - ◆ Respondents were asked to rate their reading, writing and basic mathematical skills.
 - ◆ Information was collected about the frequency with which respondents undertook selected literacy and numeracy activities in daily life and at work, and about their English and other language skills.
- ✧ An objective, test-based assessment of literacy and numeracy skills, with respondents asked to undertake a set of tasks:
 - ◆ Each respondent was asked to complete six relatively simple literacy-related tasks.
 - ◆ Those who completed two or more of these correctly were then given 46 additional tasks drawn from a pool of 108, using commonplace examples of printed material and requiring varying degrees of comprehension and arithmetic skills.

¹ The questionnaire and task booklets were administered in English and people with poor English language were excluded from the survey. This might have excluded some migrants, and possibly Indigenous Australians. Since remote and very remote areas were excluded from the sampling frame, a significant proportion of the Indigenous population was excluded from the survey as well.

The data from this survey include three objective skill measures:

- ✧ *document literacy*: the effective use of information contained in materials such as tables, schedules, charts, graphs and maps
- ✧ *prose literacy*: the skills required to understand and use information from various kinds of prose texts, including texts from newspapers, magazines and brochures
- ✧ *quantitative literacy*: the ability to perform arithmetic operations using numbers contained in printed texts or documents. This is a very narrow measure of the numeracy skills of individuals.

The Adult Literacy and Life Skills Survey (2006)

The Adult Literacy and Life Skills Survey was conducted in Australia as part of an international study coordinated by Statistics Canada and the Organisation for Economic Co-operation and Development (OECD). Personal interviews were carried out from July 2006 to January 2007 from private dwellings throughout non-remote areas of Australia. The sample consists of 8988 respondents aged 15 to 74 years.

The Adult Literacy and Life Skills Survey is divided into two sections:

- ✧ A background questionnaire, including individual and household information such as general demographic information, linguistic information, parental information, labour force activities, literacy and numeracy practices in daily life and at work, frequency of reading and writing activities, participation in education and learning, social capital and wellbeing, information and communication technology, personal and household income.
- ✧ After the background questionnaire, each respondent was asked to complete a set of six basic questions. Only respondents who correctly answered a minimum of three questions of this basic component moved onto a main component, consisting of three blocks designed to measure (ABS 2006a):
 - ◆ *document literacy*: the efficient use of information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables and charts
 - ◆ *prose literacy*: the knowledge and skills required to understand and use information from various kinds of narrative texts, including texts from newspapers, magazines and brochures
 - ◆ *numeracy*: the ability to effectively manage and respond to the mathematical demands of diverse situations
 - ◆ *problem-solving*: goal-directed thinking and the ability to act in situations for which no routine solution is available
 - ◆ *health literacy*: the knowledge and skills required to understand and use information relating to health issues such as drugs and alcohol, disease prevention and treatment, safety and accident prevention, first aid, emergencies and staying healthy.

Like the Survey of Aspects of Literacy, individuals also provided self-assessments of their English reading and writing skills for the needs of daily life and of their main job.

Descriptive analysis

Based on the information available in the two datasets, two types of scales were developed for use in the analysis that follows:

- ✧ measures of job tasks
- ✧ measures of individual literacy.

Ryan and Sinning (2009) provide a detailed description of the construction of these measures and analyse the relationship between workers' skills and skill requirements of their jobs in Australia, paying particular attention to older workers.

Measures of job tasks reflect reports by individuals of the frequency with which they undertook literacy and numeracy tasks at work. Respondents in both surveys were asked a partially overlapping set of questions about the literacy and numeracy tasks they undertook at work. These included, for example, how often they wrote ‘reports or articles’, or ‘letters or memos’, or how often they filled in forms such as ‘bills, invoices or budgets’, or how often they calculated ‘prices, costs or budgets’. Ryan and Sinning (2009) provide a detailed description of the empirical approach that was applied to generate the job task measures.

The individual skill measures utilised in the empirical analysis here include document and prose literacy as well as numeracy (using scales contained in the data) as well as self-assessed skills (based on a scale we develop).² We place all the scales developed onto a 0–500 range, consistent with the literacy and numeracy scales provided in the ABS data.

While the measures of individual literacy in the 2006 data contain both an underlying, continuous score on a 0–500 range and a summary indicator in the form of a five-point scale (with known thresholds from the underlying scale), the literacy skill levels of the 1996 survey were only published in Australia on the same summary five-point scale used in 2006. To overcome this problem, a continuous scale is predicted for 1996, given the observed five-point scale scores of individuals and a small set of other characteristics. A detailed description of the prediction of continuous literacy measures is provided by Ryan and Sinning (2009). Table 1 includes the means and standard deviations of job task and individual literacy measures for 25 to 34-year-old male and female workers of both surveys. All measures range on a 0–500 scale.

Table 1 Measures of skill use and individual literacy of 25 to 34-year-olds, 1996 and 2006

	Mean value by gender and year			
	1996		2006	
	<i>Males</i>	<i>Females</i>	<i>Males</i>	<i>Females</i>
Measures of skill use				
Literacy use	287.3 (113.1)	276.2 (110.5)	302.6 (109.7)	310.7 (105.7)
Numeracy use	268.9 (96.4)	239.0 (91.1)	303.1 (90.2)	281.9 (95.1)
Measures of individual literacy				
Document literacy	288.3 (53.6)	289.9 (49.9)	292.7 (51.3)	296.1 (44.0)
Prose literacy	283.9 (52.7)	295.6 (49.1)	284.3 (48.2)	297.0 (42.8)
Numeracy			292.2 (55.1)	286.8 (49.8)
Self-assessed skills	352.9 (58.0)	356.7 (48.6)	371.6 (95.5)	396.1 (86.6)
Number of observations	845	795	594	589

Notes: Weighted numbers based on weights provided by ABS. Standard deviations in parentheses.

Source: ABS, Survey of Aspects of Literacy, Australia, Basic Confidentialised Unit Record File, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

The numbers reveal that the average literacy use of young males and females in their jobs has increased between 1996 and 2006, with the increase appearing to be more substantial for employed females. There also appears to be a substantial increase in average numeracy use. The table further contains summary estimates of the individual skill scales. While the difference in document literacy between male and female workers is relatively small, the average level of prose literacy is higher for

² Since the relationship between literacy skills and literacy use at work seems to be very similar for document and prose literacy (Ryan & Sinning 2009), our analysis focuses predominantly on document literacy.

women than for men. These measures show little change between 1996 and 2006. Numeracy skills of male workers (only observed in 2006) are higher than those of female workers.³ While the self-assessed skills of men and women do not differ substantially in 1996, men report considerably lower skill levels than women in 2006. All of the average values for 25 to 34-year-olds reported in table 1 are very close to those for the entire workforce reported in Ryan and Sinning (2009), except that the growth in literacy and numeracy use at work between 1996 and 2006 appears to be more pronounced for this group.

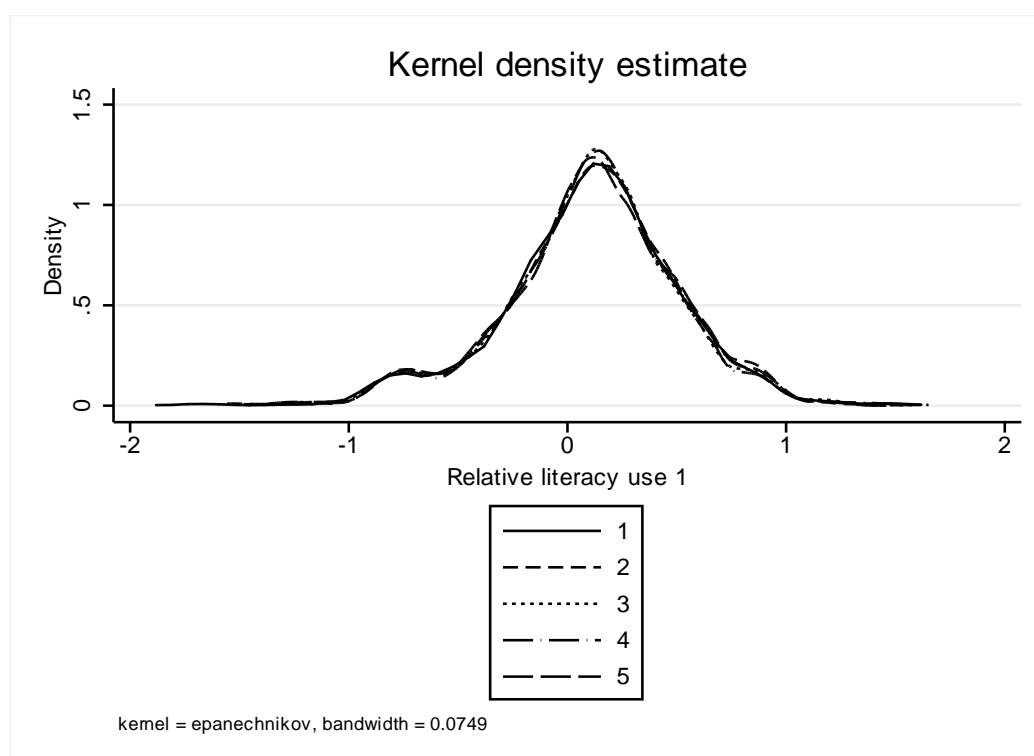
The concept of over-skilling

To investigate over-skilling and under-skilling in the Australian labour force, a measure is needed that indicates how well workers are matched to their jobs. Our data may be used to generate the following measures of relative skill use:

- ✧ relative literacy use 1: literacy use at work relative to document literacy skills
- ✧ relative literacy use 2: literacy use at work relative to prose literacy skills
- ✧ relative numeracy: numeracy use at work relative to numeracy skills.

All three measures can be centred on zero by subtracting average skill use conditioned on the observed individual skill level and divided by individual skills to ensure that the measures pick up the individual skill use rather than the average skill use within skill groups. As a result of the normalisation, the means of the resulting measures are close to zero.

Figure 1 Relative skill use measures of 25 to 34-year-olds, 2006



Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

³ The quantitative literacy domain, derived from the 1996 Survey of Aspects of Literacy, cannot be compared with the expanded measure of adult numeracy of the 2006 Adult Literacy and Life Skills Survey (ABS 2006). For that reason, this report only considers the measure of the 2006 survey.

Figure 1 includes the density functions of our first measure ('relative literacy use 1'). Since both skill use and individual skill measures were generated by multiple imputation, we obtain five variables for every relative skill use measure. Although these variables do not differ substantially from each other, information from all five variables needs to be used in order to make valid inferences.⁴ Summary statistics of the relative skill use measures of 25 to 34-year-old male and female workers are presented in table 2. The numbers suggest that in 1996 relative literacy use measures were higher for males than for females. However, due to the strong increase in relative literacy use of female workers over time, our relative literacy skill measures of average female workers in 2006 are higher than those of average male workers.

Table 2 Relative skill use measures of 25 to 34-year-olds, 1996 and 2006

	Mean value by gender and year			
	1996		2006	
	<i>Males</i>	<i>Females</i>	<i>Males</i>	<i>Females</i>
Relative literacy use 1	0.055 (0.397)	0.009 (0.393)	0.091 (0.400)	0.122 (0.396)
Relative literacy use 2	0.051 (0.402)	0.008 (0.387)	0.093 (0.408)	0.118 (0.393)
Relative numeracy use			0.113 (0.340)	0.058 (0.363)
Number of observations	845	795	594	589

Notes: Weighted numbers based on weights provided by ABS. Standard deviations in parentheses.

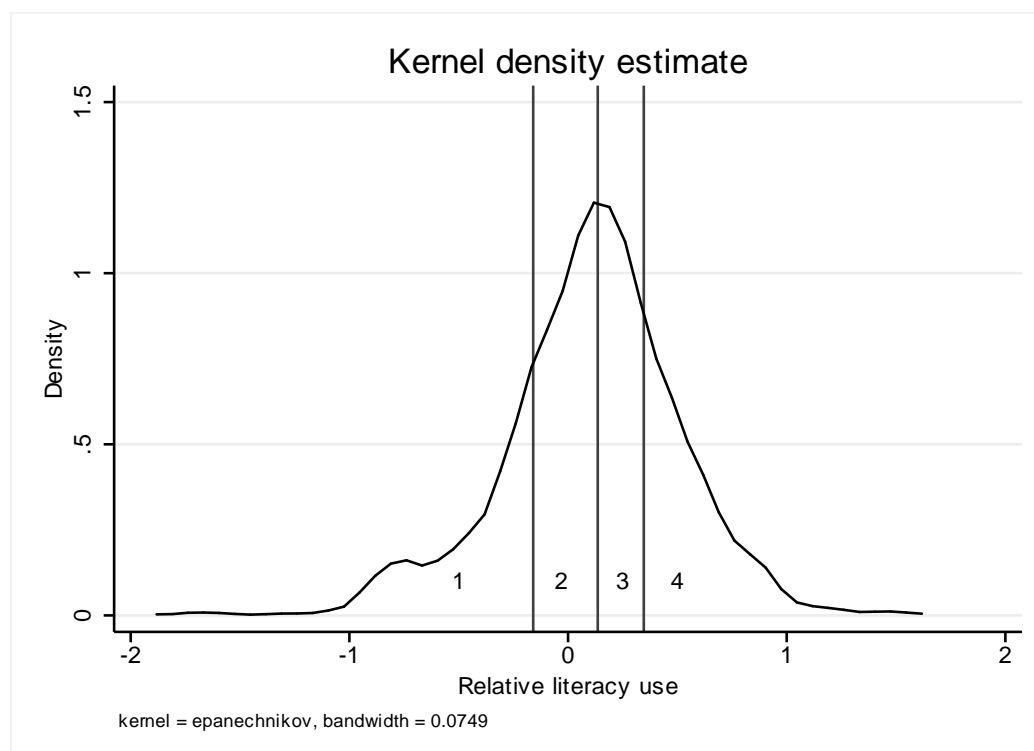
Source: ABS, Survey of Aspects of Literacy, Australia, Basic Confidentialised Unit Record File, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

The numbers in table 2 indicate that these changes stem largely from a strong increase in skill requirements for female workers between surveys, while changes in the skills of individuals within these age ranges between 1996 and 2006 were rather moderate. Finally, our relative numeracy use measure (only observed in 2006) suggests that relative numeracy use requirements are higher for males than for females.

In order to investigate over-skilling (and under-skilling) in the Australian labour market, we partition the relative skill use distribution into four groups or quartiles (that is, each distribution is divided into four groups of approximately equal size). We use quartile group membership to distinguish between over- and under-skilled workers. Figure 2 provides an example based on one of the five relative literacy use measures presented in figure 1. Specifically, we treat the two groups just above and below the median as relatively well-matched (groups 2 and 3). We treat the first quartile (group 1) as being over-skilled, since workers in this group do not make much use of their (relatively high) skills at work. At the same time, workers in the top quartile (group 4) may be considered as under-skilled, because they encounter high skill requirements—given the (relatively low) skills they have.

⁴ The main idea of multiple imputation is to replace missing values by estimates derived from a regression of the outcome measure on a set of explanatory variables. To simulate the sampling distribution of the missing values appropriately, each missing value is replaced by five generated values that are imputed by the process of randomly drawing a residual five times to obtain five different imputations referred to as 'implicates'. Due to the generation of more imputed values, this procedure improves the approximation to the true sampling distribution. In practice, the average of these values is calculated to produce the best estimate of what the results would have been if the missing data had been observed (Rubin 1987).

Figure 2 Over-skilled and under-skilled 25 to 34-year-old workers, 2006



Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

The concept of over-education

In addition to over- and under-skilling, we can differentiate between over- and under-education if we assign 'required' levels of education to specific types of jobs. In this case, we utilise information from the ABS (2006b), which provides a translation of both education levels and the Australian and New Zealand Standard Classification of Occupations (ANZSCO) into five different skill levels. Although the categories available in both surveys do not match these classifications entirely, they allow us to assign skill levels to the observed education and occupation categories that are quite close to the original classifications. Table 3 provides an overview of the original classifications of the ABS and the skill levels that we assigned to the education and occupation categories in our data. Matching the skill levels with levels of education and occupation in our data allows us to distinguish between the following groups:

- ✧ over-educated workers, that is, workers whose education is associated with a skill level that is above the typically required skill level of their occupation
- ✧ well-matched workers, that is, workers whose education is associated with a skill level that equals the typically required skill level of their occupation
- ✧ moderately under-educated workers, that is, workers whose education is associated with a skill level that is one level below the typically required skill level of their occupation
- ✧ severely under-educated workers, that is, workers whose education is associated with a skill level that is more than one level below the typically required skill level for their occupation.

Since about half of the workers in our data may be considered as under-educated according to this definition, a distinction between moderately and severely under-educated workers is necessary.

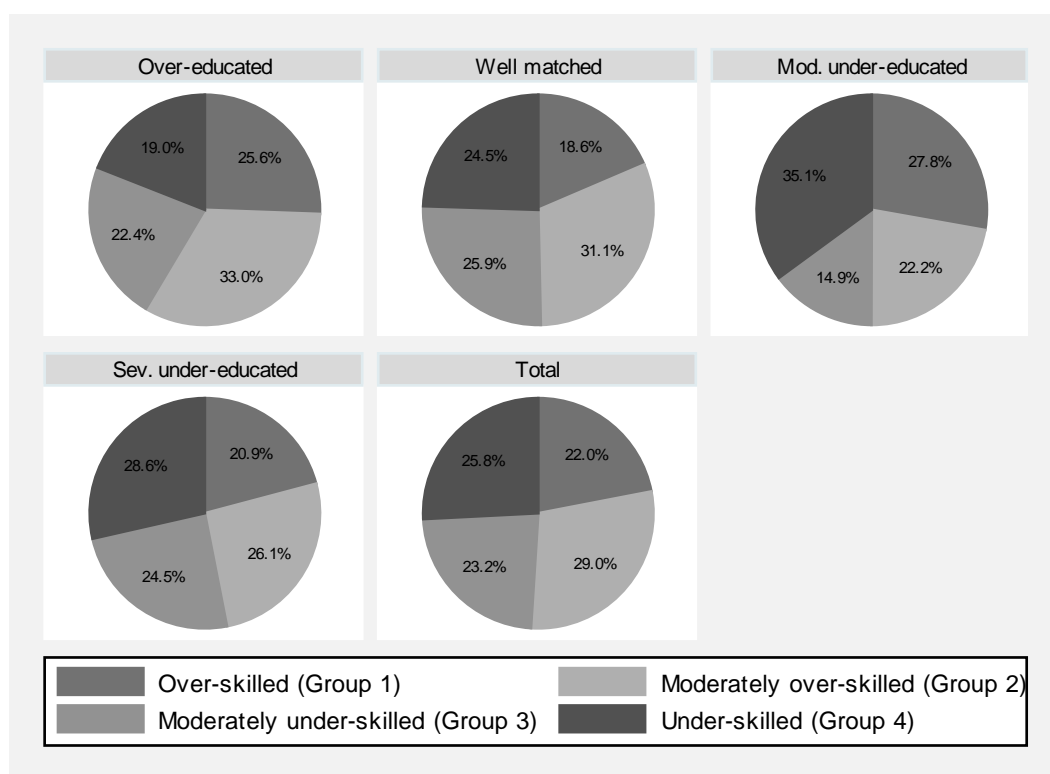
Table 3 Skill levels

Classification	Skill level
Education levels (ABS)	
Bachelor degree or higher	1
Advanced diploma or diploma	2
Certificate IV	3
Certificate II or III	4
Certificate I or compulsory secondary education	5
Available education levels	Assigned skill level
Bachelor degree or higher	1
Advanced diploma or diploma	2
Certificate III or IV	3
Certificate I or II	4
Year 12 or below	5
ANZSCO	Predominant skill levels
Managers	1, 2
Professionals	1
Clerical and administrative workers	2, 3
Technicians and trades workers	2, 3, 4, 5
Sales workers	2, 3, 4, 5
Community and personal service workers	2, 3, 4, 5
Machinery operators and drivers	4
Labourers	4, 5
Available occupation levels	Assigned skill level
Managers	1
Professionals	1
Para-professionals	2
Clerks	3
Trades workers	3
Sales workers	4
Machinery operators and drivers	4
Other	5

Over-skilling vs over-education

Given the information about both over- or under-educated and over- or under-skilled workers, the first question we would like to answer is: are over-educated workers necessarily over-skilled and under-educated workers under-skilled? Existing studies have found that over-education and over-skilling are only weakly correlated with each other (see, for example, Green & McIntosh 2007; Sloane 2007; Mavromaras, McGuinness & Wooden 2007). The proportions reported in figures 3 and 4 provide evidence in favour of a rather weak correlation between the two concepts.

Figure 3 Actual proportion of 25 to 34-year-old under- or over-skilled workers by under- or over-education



Notes: Weighted numbers based on weights provided by ABS. Number of observations: 1183.

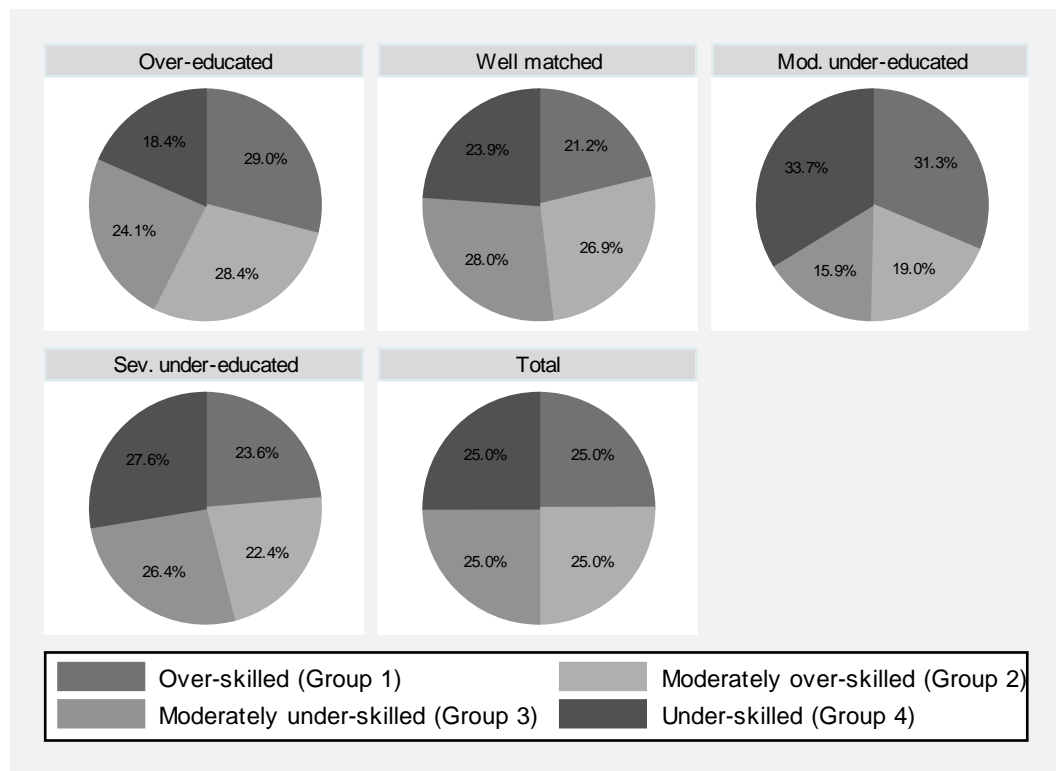
Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Figure 3 contains the actual proportion of 25 to 34-year-old workers within each skill/education group. From the first pie chart, some 19% of the overeducated group are under-skilled, while 25.6% are over-skilled. More of the severely under-educated group are under-skilled (28.6%), and fewer are over-skilled (20.9%). Figure 4 contains the expected proportions that would have resulted if 25% of the workers had been in each skill group. The transformation of the actual numbers was employed to facilitate a comparison between subgroups.

For example, a proportion above 25% in figure 4 indicates that a subgroup is over-represented (that is, the number of workers in this subgroup is above average), while a proportion below 25% denotes that a subgroup is under-represented. Given this definition, we find that the proportion of over-skilled workers who are also over-educated (29.0%) is indeed above average. However, this proportion is still relatively small if compared, for example, with the proportion of over-skilled workers who are moderately under-educated (31.3%). At the same time, the share of under-skilled workers who are severely under-educated is 27.6%. Again, this share also appears to be relatively small if compared with the share of, for instance, severely under-educated workers who are well-matched with regard to their skills (that is, those in groups 2 and 3).

Overall, these numbers suggest that the positive correlation between over-education and over-skilling is rather weak.

Figure 4 Expected proportion of 25 to 34-year-old under- or over-skilled workers by under- or over-education



Notes: Weighted numbers based on weights provided by ABS. Number of observations: 1183.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Skill (mis-)matches and over-education

This chapter includes an analysis of the determinants of relative (literacy) skill use of young labour force participants. It concentrates on:

- ✧ the role of educational attainment
- ✧ the role of occupations
- ✧ the relative importance of over- or under-education in explaining skill (mis-)matches.

Particular attention is paid to the comparison of workers aged 25–34 years in 1996 with workers aged 25–34 years in 2006.

Existing studies have typically focused on the returns from over-education, using measures derived from an assessment of the difference between a worker's educational attainment and the level of education required by the job. Only a few studies have made explicit use of the concept of over-skilling, which represents a very different approach to measuring job mismatches (McGuinness & Wooden 2007; Mavromaras, McGuinness & Wooden 2007; Mavromaras, McGuinness & Fok 2009). These latter studies find that:

- ✧ Wage penalties are associated with over-skilling.
- ✧ Over-skilled workers are more mobile than other workers.

While the studies on over-skilling mentioned above focus exclusively on the analysis of subjective skill measures, our data allow us to provide empirical evidence on objective skill measures. Moreover, we are able to investigate the relationship between skill (mis-)matches and over-education in the Australian labour market.

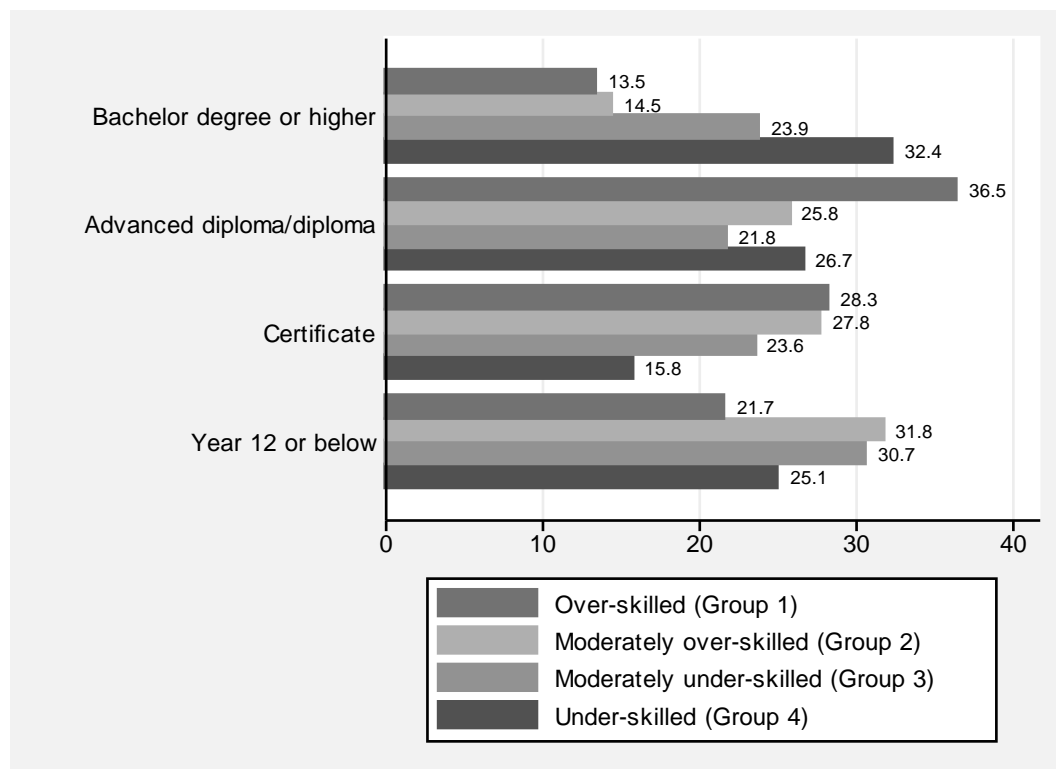
Educational attainment

Educational attainment is an important determinant of the skills individuals use at work. At the same time, a relatively high level of education is a prerequisite for someone to be considered 'over-educated'. Figures 5 and 6 show the shares of 25 to 34-year-old workers from different skill or education groups accounted for by people with differing levels of educational attainment. For example, people with bachelor or higher-level degrees make up 13.5% of the over-skilled group and 32.4% of the under-skilled group.

The numbers in figure 5 reveal an interesting relationship. Specifically, only very few over-skilled workers (13.5%) have a university degree, while the highest education of 21.7% of over-skilled workers is only Year 12 or below. This finding suggests that over-skilled workers are in fact workers with relatively low levels of education whose jobs often require fewer skills than they actually have. At the same time, the majority of under-skilled workers hold a university degree, which suggests that many highly educated workers have jobs that require higher-level skills than they actually possess.

For vocational education, the figure indicates that the largest share of over-skilled workers are those with diplomas or advanced diplomas, with the second largest share of over-skilled workers among individuals with certificate qualifications.

Figure 5 Share of 25 to 34-year-olds by skill group and educational attainment, 2006



Notes: Weighted numbers based on weights provided by ABS. Number of observations: 1183.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

In contrast to the results we obtain for the relative skill use measure in figure 5, we observe a completely different relationship between educational attainment and over- or under-education. Specifically, figure 6 reveals that, by construction, over-educated workers have at least a certificate and most of them hold a university degree. At the same time, only a few workers with a university degree seem to be moderately under-educated, while most of the under-educated workers are those without a university degree. Overall, these numbers highlight substantial differences between the two concepts of over- or under-education and over- or under-skilling, which have to be considered explicitly in our empirical analysis.⁵

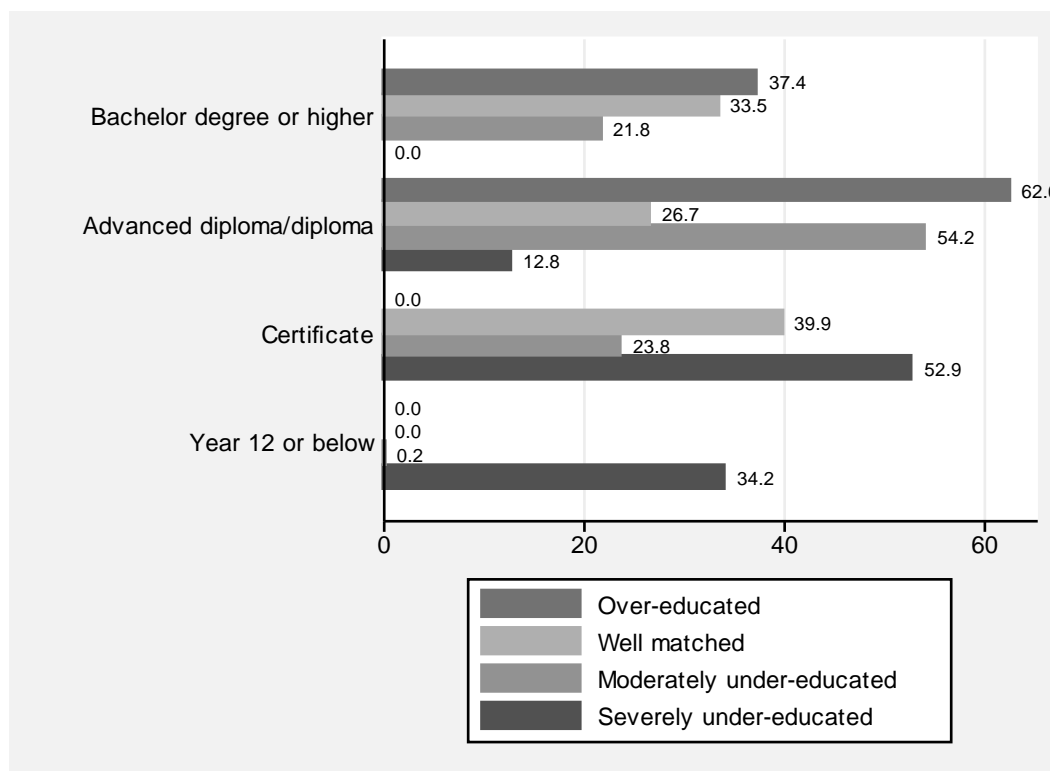
Given the proportions in figures 5 and 6, we can investigate further how over-skilling and over-education are associated with educational attainment by considering the three dimensions at the same time. Specifically, we can address questions such as ‘What is the share of over-educated and over-skilled workers with a certain level of education?’ or ‘What is the share of over-educated and under-skilled workers with a certain level of education?’ Figure 7 contains the shares of 25 to 34-year-old workers in particular skill or education groups across education levels in 2006. (The shares sum to 100 across the education levels.) The numbers reveal that more than 60% of the workers who are over-educated hold a bachelor or higher university degree. At the same time, the majority of under-educated workers are in the lowest educational category, regardless of which skill group they belong to.

Overall, most over-educated workers are highly educated (and most under-educated workers are less educated), while skills are more evenly distributed across different levels of education. These patterns highlight the relevance of differentiating between the two concepts in our empirical analysis.

⁵ For simplicity, we limit our analysis to four broad categories of educational attainment. Since our data allow a distinction between workers with a bachelor degree and workers with a higher graduate degree, we may observe moderately under-educated workers in the group of workers with a bachelor degree or higher (that is, workers with a bachelor degree who work in jobs that require a higher degree).

For both those with diplomas or advanced diplomas and those with certificate qualifications, there is evidence of over-education, in conjunction with either under- or over-skilling, but also of substantial numbers of graduates in positions for which they appear both under-educated and under-skilled.

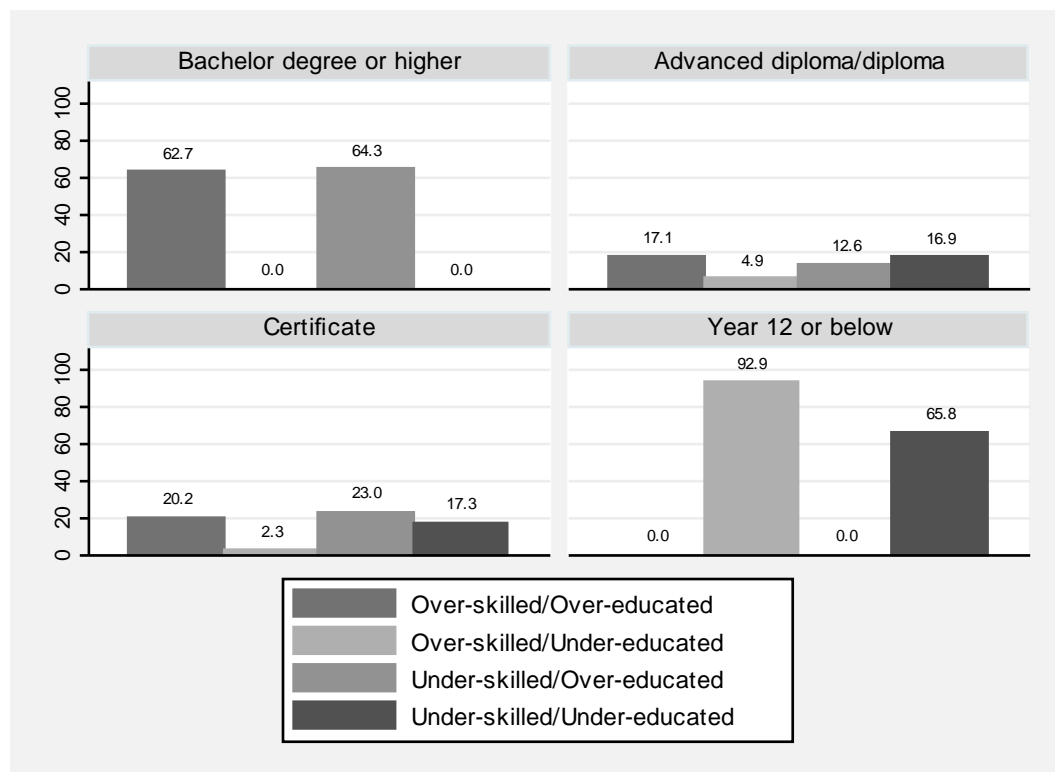
Figure 6 Share of 25 to 34-year-olds by over- or under-education and educational attainment, 2006



Notes: Weighted numbers based on weights provided by ABS. Number of observations: 1183.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Figure 7 Proportion of 25 to 34-year-old workers by skill or education group and educational attainment



Notes: Weighted numbers based on weights provided by ABS. Number of observations: 1183.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Occupation

In addition to education, over-skilling and over-education may vary substantially across occupational groups. Table 4 summarises the shares of 25 to 34-year-old workers by occupation in 2006.

The numbers in table 4 suggest that:

- ✧ Workers in high-skill occupations (such as managers and professionals) tend to be well-matched, under-skilled or under-educated rather than over-skilled or over-educated.
- ✧ Trades workers and machinery operators and drivers are mostly over-educated or moderately under-educated. While many machinery operators and drivers are over-skilled, trades workers appear to be more evenly distributed across skill groups.
- ✧ Most sales workers are either over-skilled or under-skilled. While most of them are well-matched with regard to educational attainment, a sizeable part is severely under-educated.

Overall, these numbers provide evidence for substantial heterogeneity across occupations in relation to over-skilling and over-education.

Table 4 Proportion of 25 to 34-year-old workers by occupation, 2006

Occupation	Relative skill use			
	Group 1 (over-skilled)	Group 2	Group 3	Group 4 (under-skilled)
Managers	0.083 (0.276)	0.296 (0.458)	0.285 (0.453)	0.337 (0.475)
Professionals	0.064 (0.245)	0.327 (0.470)	0.354 (0.479)	0.255 (0.437)
Para-professionals	0.117 (0.322)	0.327 (0.470)	0.235 (0.425)	0.321 (0.468)
Clerks	0.276 (0.448)	0.301 (0.460)	0.205 (0.405)	0.218 (0.414)
Trades workers	0.286 (0.454)	0.299 (0.460)	0.152 (0.361)	0.262 (0.441)
Sales workers	0.428 (0.496)	0.181 (0.386)	0.120 (0.326)	0.271 (0.446)
Machinery operators and drivers	0.447 (0.502)	0.292 (0.459)	0.147 (0.358)	0.114 (0.320)
Other	0.461 (0.502)	0.258 (0.440)	0.166 (0.374)	0.116 (0.322)
Total	0.220 (0.414)	0.290 (0.454)	0.232 (0.422)	0.258 (0.438)

Occupation	Over- or under-education			
	Over-educated	Well-matched	Moderately under-educated	Seriously under-educated
Managers	0.000 (0.000)	0.366 (0.483)	0.146 (0.355)	0.488 (0.502)
Professionals	0.000 (0.000)	0.764 (0.426)	0.101 (0.302)	0.136 (0.343)
Para-professionals	0.425 (0.496)	0.171 (0.377)	0.132 (0.340)	0.272 (0.446)
Clerks	0.392 (0.490)	0.175 (0.381)	0.009 (0.095)	0.424 (0.496)
Trades workers	0.538 (0.500)	0.009 (0.093)	0.453 (0.500)	0.000 (0.000)
Sales workers	0.057 (0.232)	0.674 (0.470)	0.010 (0.099)	0.260 (0.440)
Machinery operators and drivers	0.275 (0.451)	0.000 (0.000)	0.725 (0.451)	0.000 (0.000)
Other	0.359 (0.483)	0.641 (0.483)	0.000 (0.000)	0.000 (0.000)
Total	0.215 (0.411)	0.409 (0.492)	0.149 (0.356)	0.227 (0.419)

Notes: Weighted numbers based on weights provided by ABS. Number of observations: 1183. Standard deviations in parentheses.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Regression analysis

So far, we have shown that the relationship between over-education and over-skilling has a number of predictable features. In line with existing studies (Green & McIntosh 2007; Sloane 2007; Mavromaras, McGuinness & Wooden 2007), our findings suggest that over-education and over-skilling are only weakly correlated with each other. Moreover, we provide evidence for a weak

correlation between over-skilling and educational attainment and a positive correlation between over-education and educational attainment. Given these results, we now examine the extent to which over-education affects skill (mis-)matches in the Australian labour market. We are particularly interested in the effect of over-education on relative skill use that remains when other determinants of relative skill use (including educational attainment) are taken into account. To estimate the relevant effects, a multivariate regression model is employed. The estimates of such a model can answer a number of important questions, including:

- ✧ How does educational attainment affect relative skill use?
- ✧ How does over-education affect relative skill use (after controlling for educational attainment)?
- ✧ Are there differences in the relative skill use between full-time and part-time employed workers?
- ✧ Is there a significant gap in relative skill use?
- ✧ How does employer size affect relative skill use?
- ✧ Do these effects change over time?

To answer these questions, the following regression equation is estimated for the pooled data from both surveys (all explanatory variables have an associated parameter that we estimate):

$$\begin{aligned} & \text{intercept} \\ & + \text{indicator for full-time employment} \\ & + \text{female indicator} \\ & + \text{highest level of education indicators} \\ \text{Relative skill use} = & + \text{employer size indicator} \\ & + \text{indicator variables for over-/under-education} \\ & + \text{year indicator} \\ & + \text{interaction between all variables with year indicator} \\ & + \text{occupation and industry indicators} \\ & + \text{residuals} \end{aligned}$$

Table 5 contains the estimates of a linear regression model estimated by ordinary least squares (OLS). The first column reports the parameter estimates, that is, the effects of different determinants on relative skill requirements. The second column includes the t-values that correspond to the model parameters (that is, parameter estimate/standard error). In general, variables are interpreted to have a significant effect on the dependent variable of a regression equation where the absolute value of their t-value exceeds 1.96. The parameters on such variables are said to be statistically different from zero at the 95% level.

Using this criterion, our estimates suggest, for example, that full-time employed workers are in jobs with significantly higher skill requirements than part-time employed workers with the same skill level (since the t-value for full-time employment is [much] larger than 1.96 and the sign of the parameter estimate and the t-value is positive).

The quantitative interpretation of the parameter estimate simply indicates that the relative skill use measure of full-time employed workers is 0.229 units higher than the relative skill use measure of (comparable) part-time employed workers. Although the size of this effect is difficult to interpret, it still allows us to provide a qualitative interpretation (that is, we may conclude that the effect is significantly positive). Moreover, when we compare the effect of 0.229 with other parameter estimates, we may at least conclude that the effect of full-time employment is relatively large.

Since the estimates are strongly influenced by the way in which the models are specified, it is necessary to take a closer look at all variables that were included in the regression equation:

- ✧ *Female indicator*: after controlling for relevant determinants, gender differences in relative skill use are insignificant in both years.
- ✧ *Highest level of education*: the coefficients on the indicator variables for the highest level of education suggest that education is positively associated with relative skill use. Compared with the reference group (that is, the group of persons with education below Year 12), all coefficients are positively associated with relative skill use, suggesting that relative skill requirements at work increase with education.
- ✧ *Employer size*: the coefficient on the variable denoting the number of persons employed at the location of the individual's main job suggest that employer size is a strong predictor of relative skill requirements at work.

Table 5 Determinants of relative skill use of 25 to 34-year-old labour force participants

	Estimate	t-value
Intercept	-0.136	-2.63
Full-time employed		
Full-time employed	0.229	8.37
Female		
Female	-0.016	-0.68
Highest level of education		
Year 11 and below (reference group)		
Year 12	0.131	2.88
Vocational qualification	0.236	6.30
Bachelor degree or higher	0.289	6.30
Employer size		
500 and over	0.102	4.18
Over-/under-education		
Severely under-educated (reference group)		
Moderately under-educated	-0.144	-3.63
Well-matched	-0.240	-6.35
Over-educated	-0.294	-5.73
Year 2006		
Year 2006	0.067	1.17
Interaction terms:		
Year 2006 ×		
Full-time employed		
Full-time employed	-0.042	-0.92
Female		
Female	0.042	1.16
Highest level of education		
Year 11 and below (reference group)		
Year 12	0.286	1.01
Vocational qualification	0.056	0.87
Bachelor degree or higher	0.033	0.46
Employer size		
500 and over	-0.068	-1.91
Over-/under-education		
Severely under-educated (reference group)		
Moderately under-educated	-0.009	-0.14
Well-matched	-0.006	-0.09
Over-educated	-0.077	-1.02
R-squared	0.188	
F-value	13.41	

Notes: Number of observations: 2823. Weighted linear regression based on weights provided by ABS. The regression further includes occupation and industry indicators.

Source: ABS, Survey of Aspects of Literacy, Australia, Basic Confidentialised Unit Record File, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

- ✧ *Over- or under-education:* after controlling for educational attainment, the effect of over-education on relative skill use is significantly negative, indicating that under-educated workers use their relative skills more often than over-educated workers.
- ✧ *Year indicator and interaction terms:* to investigate differences in the effects of the determinants of relative skill use between 1996 and 2006, the year indicator for 2006 is interacted with all other explanatory variables of the model. The estimates of the interaction terms indicate that the effects of the explanatory variables considered in our regression model have not changed significantly between 1996 and 2006.

Summary

This chapter investigates the determinants of relative skill requirements of young workers. We found that there are substantial differences between the two concepts of over- or under-education and over- or under-skilling. Specifically, most over-skilled workers have low levels of education and require fewer skills at work than they actually have. In fact, the majority of under-skilled workers hold a university degree, suggesting that many highly educated workers have jobs that require more skills than they actually have. Most over-educated workers have at least a certificate and most of them hold a university degree. In general, over-education is associated with skills' under-utilisation by workers, so over-education does contribute to skill mismatches.

Returns from over-education and under-education

Following the economic literature on the returns from over-education and under-education, this chapter contains an analysis of the effects of over-education and under-education on wages of young Australian workers. It focuses on:

- ✧ the role of demographic factors
- ✧ the role of educational attainment
- ✧ the role of occupation
- ✧ a distinction between over-education and over-skilling.

Empirical evidence on over-education (see, for example, Sicherman 1991; Hartog 2000; Boothby, 2002) usually suggests that:

- ✧ Over-educated workers earn more than workers in jobs with comparable educational requirements but with the schooling level that matches these requirements.
- ✧ Over-educated workers earn less than workers with comparable schooling in jobs which require this level of schooling.
- ✧ Under-educated workers earn more than comparably educated workers in jobs which match their schooling, but less than workers in jobs with comparable educational requirements whose schooling matches these requirements.

The aim of this chapter is to investigate the effects of over-education and under-education on wages, after controlling for a number of other relevant factors. Particular attention is paid to the effects of educational attainment and over- or under-skilling. The empirical analysis concentrates on workers aged 25–34 years but also includes comparisons with workers aged 35–44 years. The findings derived from this analysis allow inferences about the extent to which over-education and over-skilling affect the remuneration of workers after the effects of educational attainment and other factors are taken into account.

Educational attainment

Human capital accumulation plays a major role in explaining differences in wages between individuals. Table 6 contains the average weekly wages of full-time employed workers by education and age in 2006. Confirming the patterns of other data, the numbers show that highly educated workers in the differing age groups earn higher wages than less-educated workers and that, overall, the wages of younger workers are lower than those of older workers.

Table 6 Weekly wages of full-time employed workers by educational attainment and age, 2006

	Mean value by age group		
	20–24 years	25–29 years	30–34 years
Postgraduate degree, graduate diploma/ graduate certificate	1054 (62)	1059 (131)	1213 (161)
Bachelor degree	942 (122)	1032 (123)	1163 (180)
Advanced diploma/diploma	831 (118)	958 (160)	1077 (190)
Certificate	716 (104)	861 (140)	994 (164)
Year 12	761 (137)	820 (145)	982 (177)
Year 11 or below	726 (109)	795 (143)	874 (158)
Total	791 (150)	918 (169)	1051 (203)
Number of observations	291	435	490

Notes: Weighted numbers based on weights provided by ABS. Standard deviations in parentheses.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Occupation

The numbers in table 7 reveal that the wages of full-time employed workers differ somewhat across occupations. While the wages of managers and professionals are above average, the wages of workers in other occupations are below average. Within the group of workers aged 25–29 years, ‘other workers’ (mainly labourers) have the lowest wage rate (\$669), while the wages of trades and sales workers and machinery operators and drivers are somewhat higher. Within the 30–34 years group of workers, wage levels are more comparable.

Over-education and over-skilling

When relating over-education and over-skilling to educational attainment, the concepts of over-education and over-skilling turn out to be very different. For that reason, table 8 presents the weekly wages of 25 to 34-year-old full-time employed workers by skill and education group. Interestingly, the numbers suggest that both under-educated and under-skilled workers have, on average, higher wages than over-educated and over-skilled workers. Although this result does not allow inferences about the effect of over-education (or over-skilling) on wages (other relevant factors have to be taken into account), it suggests that over-education and over-skilling may have similar effects on wages. Previous studies usually find a positive return from over-education, although this return is smaller than the return from the required level of education. Even though we are not able to observe the required level of education in our data, we may investigate the effect of over-education (and over-skilling) on wages by controlling for actual education. Specifically, following the empirical framework provided by Sicherman (1991) and Hartog (2000), our empirical model measures the penalty from over-education (and the return from under-education) rather than the return from over-education (and the penalty from under-education).

Table 7 Weekly wages of full-time workers employed by occupation and age, 2006

	Labour force participation by age		
	20–24 years	25–29 years	30–34 years
Managers	865 (123)	1087 (120)	1211 (193)
Professionals	979 (104)	1084 (89)	1208 (133)
Para-professionals	833 (110)	921 (92)	975 (142)
Clerks	694 (68)	834 (88)	893 (148)
Trades workers	595 (101)	693 (81)	836 (171)
Sales workers	784 (81)	862 (88)	1020 (120)
Machinery operators and drivers	755 (78)	762 (78)	945 (151)
Other	632 (67)	669 (84)	826 (86)
Total	791 (150)	918 (169)	1051 (203)
Number of observations	291	435	490

Notes: Weighted numbers based on weights provided by ABS. Standard deviation in parentheses.

Source: ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Table 8 Weekly wages of 25 to 34-year-old full-time employed workers by skill or education, 1996 and 2006

	Mean value by gender and year			
	1996		2006	
	Males	Females	Males	Females
Group 1 (over-skilled)	491 (196)	279 (140)	802 (286)	519 (237)
Group 2	596 (191)	356 (157)	1008 (281)	690 (268)
Group 3	679 (180)	422 (164)	1079 (257)	753 (262)
Group 4 (under-skilled)	680 (167)	435 (154)	1068 (242)	768 (253)
Over-educated	587 (179)	361 (159)	886 (261)	621 (250)
Well-matched	606 (228)	380 (188)	1052 (300)	807 (275)
Moderately under-educated	590 (207)	303 (156)	874 (313)	527 (281)
Severely under-educated	641 (156)	402 (136)	996 (248)	662 (212)
Total	613 (174)	421 (159)	992 (249)	740 (264)
Number of observations	845	795	594	589

Notes: Weighted numbers based on weights provided by ABS. Standard deviation in parentheses.

Source: ABS, Survey of Aspects of Literacy, Australia, Basic Confidentialised Unit Record File, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Regression analysis

In the following, a multivariate linear regression model is employed to investigate the determinants of wages. The model is estimated separately for the sample of 25 to 34-year-old and the sample of 35 to 44-year-old workers. Moreover, to investigate changes over time, the analysis is performed separately for 1996 and 2006. Specifically, a regression model of the following form is considered (all explanatory variables have an associated model parameter):

$$\begin{aligned} & \text{intercept} \\ & + \text{full-time employment indicator} \\ & + \text{female indicator} \\ & + \text{highest level of education indicators} \\ \ln(\text{weekly wage}) = & + \text{interaction terms between highest level of education indicators and over-/} \\ & \text{under-education indicators} \\ & + \text{skill group indicators} \\ & + \text{employer size indicator} \\ & + \text{occupation and industry indicators} \\ & + \text{residuals} \end{aligned}$$

Table 9 includes the estimates of the wage determinants of 25 to 34-year-old workers in 1996 and 2006. As in the last chapter, variables are interpreted to have a significant effect on the dependent variable of a regression equation where their t-value (parameter estimate/standard error) exceeds 1.96. The parameters on such variables are said to be statistically significant different from zero at the 95% level.

The estimates show a number of features common to the wage determination literature: that wages of full-time employed workers are higher than part-time employed workers (the reference group) and that females earn less than (comparable) males—by 16.1% (15.8%) in 1996 (2006).⁶

Further, wages rise with higher levels of education. At the same time, the effects of over-education on wages are significantly negative, suggesting that a penalty from over-education is observed after controlling for the actual level of education.⁷

The observed negative effect of over-education on wages is in line with the findings of previous studies which suggest that the return from over-education is negative after controlling for the actual level of education (see, for example, Hartog 2000; Boothby 2002). These studies also argue that this result is consistent with a positive return from over-education after controlling for the required level of education. Since the return from over-education is smaller than the return from required education, a penalty from over-education is observed after controlling for actual (rather than required) educational attainment.

⁶ Since we use the logarithm of wages as a dependent variable in our regression, the marginal effects of the parameter estimates b are given by: $m(b) = \exp(b) - 1$. Consequently, the marginal effects of the female indicator are $m(-0.176) = \exp(-0.176) - 1 = -0.161 = -16.1\%$ and $m(-0.172) = \exp(-0.172) - 1 = -0.158 = -15.8\%$, respectively. The marginal effects of the remaining coefficients are interpreted correspondingly.

⁷ To facilitate interpretation, we have restricted the sum of the interaction terms in each education group to zero. This restriction allows us to interpret the coefficients of the interaction terms as deviations from the overall education group indicator. For example, having a bachelor degree or higher and being over-educated in 1996 results in a wage increase of $\exp(0.181-0.035)-1 = 0.157 = 15.7\%$ compared with the reference group (Year 12 and below). As a result of the restriction, some of the t-values have the same size within a group of restricted coefficients.

Table 9 Weekly wage determinants of 25 to 34-year-old labour force participants

	1996		2006	
	Estimate	t-value	Estimate	t-value
Intercept	4.962	19.10	5.694	54.30
Full-time employed				
Full-time employed	0.715	12.06	0.672	26.00
Female				
Female	-0.176	-4.98	-0.172	-11.04
Highest level of education				
Year 12 and below (reference group)				
Certificate I/II	0.264	3.51	0.208	2.03
Certificate III/IV	0.285	5.11	0.153	4.18
Advanced diploma or diploma	0.297	5.94	0.194	6.17
Bachelor degree or higher	0.181	6.50	0.114	5.07
Interaction with certificate I/II				
Severely under-educated	0.250	3.65	0.145	1.70
Moderately under-educated	0.056	1.02	-0.040	-0.36
Well-matched	-0.034	-0.50	-0.250	-1.23
Over-educated	-0.272	-2.46	0.145	1.70
Interaction with certificate III/IV				
Severely under-educated	0.160	3.29	0.137	4.33
Moderately under-educated	-0.027	-0.57	-0.027	-0.85
Well-matched	-0.069	-2.18	0.011	0.42
Over-educated	-0.063	-2.08	-0.121	-2.64
Interaction with advanced diploma or diploma				
Severely under-educated	-	-	-	-
Moderately under-educated	0.131	3.77	0.076	2.79
Well-matched	-0.036	-0.96	-0.025	-0.90
Over-educated	-0.094	-3.05	-0.051	-2.14
Interaction with bachelor degree or higher				
Severely under-educated	-	-	-	-
Moderately under-educated	-0.035	-2.16	-0.039	-3.49
Well-matched	0.071	2.16	0.078	3.49
Over-educated	-0.035	-2.16	-0.039	-3.49
Relative literacy use				
Group 1 (over-skilled)	-0.057	-1.57	-0.045	-2.27
Group 2	-0.017	-0.85	0.002	0.09
Group 3	0.001	0.04	-0.003	-0.17
Group 4 (under-skilled: reference group)				
Employer size				
500 and over	-0.018	-0.89	-0.009	-0.74
R-squared	0.719		0.836	

Notes: Number of observations: 1996: 1640; 2006: 1183. Weighted linear regression based on weights provided by ABS. The regression further includes occupation and industry indicators.

Source: ABS, Survey of Aspects of Literacy, Australia, Basic Confidentialised Unit Record File, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Even though we observe a significant penalty from over-education, our findings suggest that the size of the effect of over-education on wages differs substantially across education levels. Specifically, while over-education results in a wage reduction of 23.8% for workers with a certificate I/II, the wage reduction for over-educated workers with a bachelor degree or higher is 3.6%.⁸ While the

⁸ These results follow from $\exp(-0.272) - 1 = -0.238$ and $\exp(-0.035) - 1 = -0.036$, respectively.

corresponding wage effect is insignificant for workers with certificate I/II in 2006, a negative effect of 3.8% (that is, $\exp[-0.039]-1$) still occurs for over-educated workers with a bachelor degree or higher. Compared with the negative wage effects of over-educated workers with vocational qualifications, a penalty from over-education for workers with degrees of 3.6%–3.8% appears to be rather small. Overall, we draw the following conclusions from these results:

- ✧ The effects of over-education on wages differ substantially across education levels.
- ✧ The penalty from over-education may be less severe for highly educated workers than for workers with lower educational attainment.
- ✧ We would probably have overestimated the effect of over-education on wages of highly educated workers if we had used the conventional linear wage function (which includes continuous variables for actual or required education).

In addition, after controlling for over-education, we find that over-skilling has little additional effect on the wages of young workers. This result is in line with the numbers in table 8, which suggest that the (unconditional) effects of over-education and over-skilling on wages operate in the same direction. Given the significant effect of over-education and the insignificant effect of over-skilling, our estimates indicate that the (observed) level of education seems to determine wages, while (unobserved) skills seem to be less relevant. While this result seems inconsistent with other recent work (such as Mavromaras, McGuinness & Wooden 2007; Mavromaras, McGuinness & Fok 2009), which points to a negative effect of over-skilling on wages, our measure is quite different from that used in these other studies, but with the available data we are not able to assess whether this is the reason for the difference. Finally, the coefficients of the employer size indicator suggest that firm sizes do not affect wages of younger workers significantly.

Since over-education typically results in skill mismatches for younger workers, we have focused on workers aged 25–34 years in our analysis. To investigate the extent to which over-education affects older age cohorts, we present the estimates of wage determinants of 35 to 44-year-old workers in table 10. The estimates do not differ qualitatively from those presented in table 9, except that over-skilling may have a negative impact on wages. In general, the results suggest that workers of the age cohort 35 to 44 years are affected by over-education in the same way as workers aged 25 to 34 years.

Summary

The determinants of the wages of younger workers were investigated in this chapter. Both under-educated and under-skilled workers have on average higher wages than over-educated and over-skilled workers. In line with existing studies, a penalty from over-education is observed after controlling for the actual level of education. However, our findings suggest that the effects of over-education on wages differ substantially across education levels. After controlling for over-education, over-skilling has no additional effect on wages, indicating that the (observed) level of education rather than the (unobserved) skill level determines the remuneration of workers.

Table 10 Weekly wage determinants of 35 to 44-year-old labour force participants

	1996		2006	
	Estimate	t-value	Estimate	t-value
Intercept	5.559	60.88	6.000	83.69
Full-time employed				
Full-time employed	0.673	36.09	0.570	39.66
Female				
Female	-0.380	-20.18	-0.175	-15.51
Highest level of education				
Year 12 and below (reference group)				
Certificate I/II	0.132	2.90	0.069	1.46
Certificate III/IV	0.204	6.81	0.169	5.95
Advanced diploma or diploma	0.248	7.72	0.203	8.22
Bachelor degree or higher	0.174	5.83	0.143	8.30
Interaction with certificate I/II				
Severely under-educated	0.112	2.67	0.083	1.70
Moderately under-educated	0.013	0.23	0.038	0.61
Well-matched	-0.050	-0.77	-0.041	-0.79
Over-educated	-0.076	-0.92	-0.080	-0.72
Interaction with certificate III/IV				
Severely under-educated	0.145	4.60	0.118	5.11
Moderately under-educated	-0.061	-1.42	-0.050	-2.72
Well-matched	-0.036	-1.05	-0.011	-0.63
Over-educated	-0.047	-1.12	-0.057	-2.80
Interaction with advanced diploma or diploma				
Severely under-educated	-	-	-	-
Moderately under-educated	0.135	4.67	0.099	4.58
Well-matched	-0.092	-2.85	-0.048	-2.16
Over-educated	-0.043	-1.61	-0.050	-2.28
Interaction with bachelor degree or higher				
Severely under-educated	-	-	-	-
Moderately under-educated	-0.034	-2.45	-0.038	-4.71
Well-matched	0.069	2.45	0.076	4.71
Over-educated	-0.034	-2.45	-0.038	-4.71
Relative literacy use				
Group 1 (over-skilled)	-0.081	-3.32	-0.044	-3.09
Group 2	-0.040	-1.83	-0.008	-0.71
Group 3	-0.028	-1.56	0.008	0.66
Group 4 (under-skilled: reference group)				
Employer size				
Employer size	-0.025	-1.46	0.004	0.43
R-squared	0.849		0.896	

Notes: Number of observations: 1996: 1660; 2006: 1419. Weighted linear regression based on weights provided by ABS. The regression further includes occupation and industry indicators.

Source: ABS, Survey of Aspects of Literacy, Australia, Basic Confidentialised Unit Record File, 1996, 4228.0; ABS, Adult Literacy and Life Skills Survey, Australia, Basic Confidentialised Unit Record File, 2006, 4228.0.

Conclusions and implications

In this study, we examine the link between skill mismatches in the Australian labour market and over-education. Measures of over-education are typically derived from an assessment of the difference between a workers' educational attainment and the level of education required by the job. In our empirical analysis, we compare such a measure of over-education with an alternative measure of over-skilling.

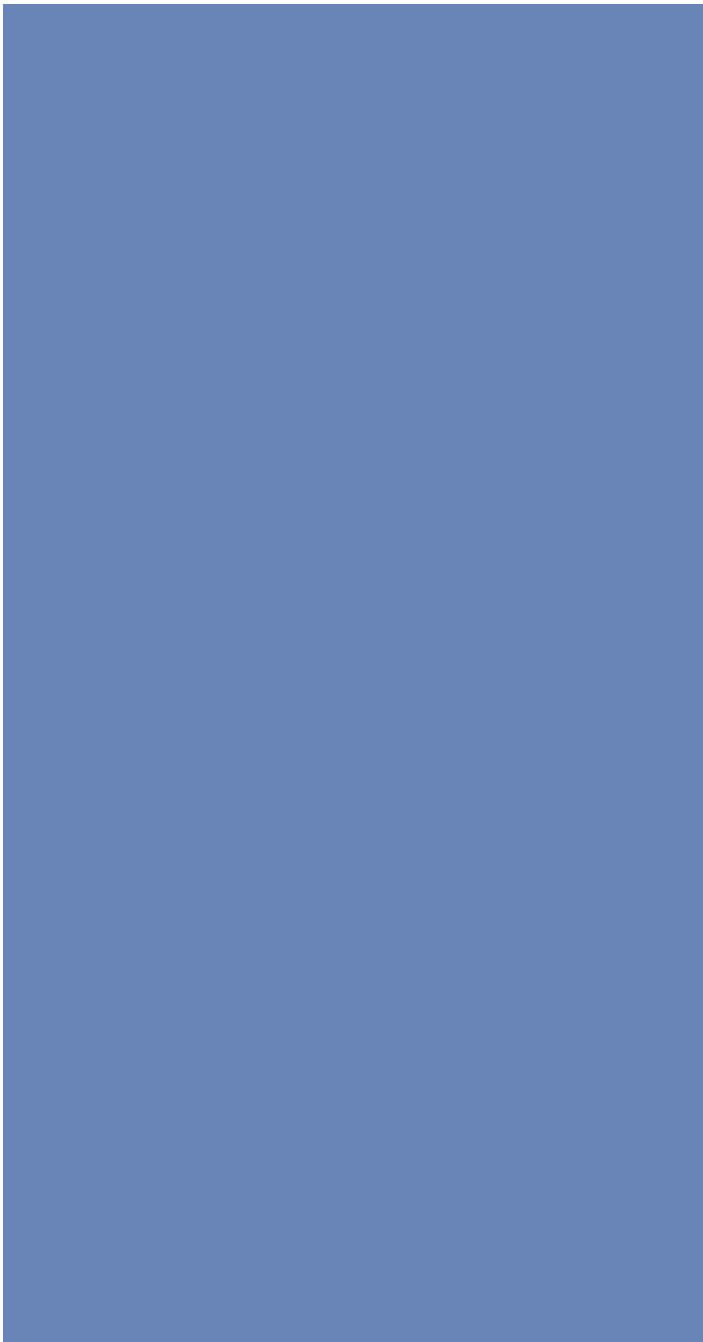
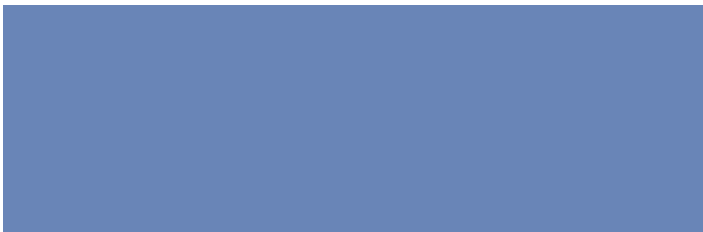
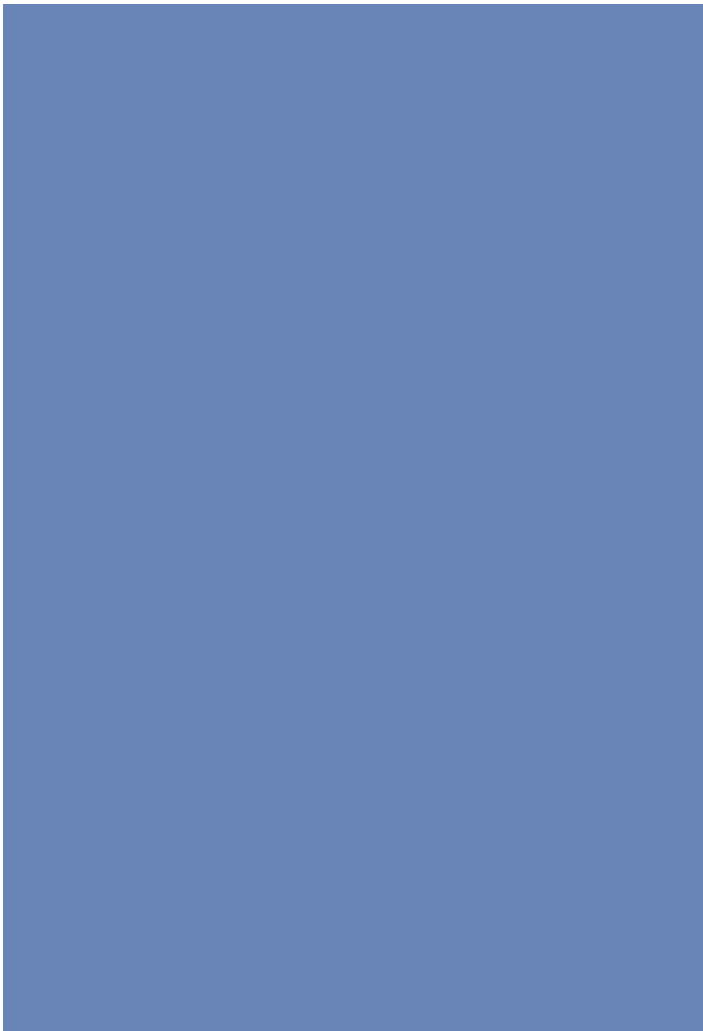
The findings drawn from the analysis include:

- ✧ *Skill (mis-)matches and over-education*: substantial differences may be observed between the two concepts of over- or under-education and over-or under-skilling. Specifically, most over-skilled workers have low levels of education and require fewer skills at work than they actually appear to have, while the majority of under-skilled workers tend to hold a university degree, suggesting that many highly educated workers have jobs that require more skills than they actually have. By construction, over-educated workers have at least a post-school qualification, with many of them holding a university degree, while most of the under-educated workers are those without university degree. Full-time employed workers are in jobs with significantly higher skill requirements than part-time employed workers with the same skill level. After controlling for other relevant factors, gender differences in relative skill requirements (that is, skill requirements relative to skills) are insignificant. Education is positively associated with relative skill requirements at work. Hence, both those with degrees and vocational qualifications report higher levels of skills usage than do those without post-school qualifications. Employer size is a strong, positive predictor of relative skill requirements at work. Finally, under-educated workers use their relative skills more often than over-educated workers, so over-education does contribute to skill mismatches.
- ✧ *The returns from over-education and under-education*: both under-educated and under-skilled workers enjoy, on average, higher wages than over-educated and over-skilled workers. In line with existing studies, a penalty from over-education is observed after controlling for the actual level of education. However, our findings also suggest that the effects of over-education on wages differ substantially across education levels and that the penalty from over-education is less severe for workers with degrees than for workers with vocational qualifications. Estimating the effect of over-education on wages of highly educated workers with the conventional model (that is, including continuous variables for actual or required education) would have led to an exaggeration of the effect. Moreover, after controlling for over-education, over-skilling has little additional effect on wages, indicating that the (observed) level of education rather than the (unobserved) skill level determines the remuneration of workers. Finally, when comparing different age cohorts, workers of the age cohort 35–44 years are affected by over-education in much the same way as workers aged 25–34 years, except that the impact of over-skilling for that group may be negative.

The results in the paper seem to fit the over-education literature a little better than the over-skilling literature at present. The penalties from over-education are more severe than any from over-skilling, especially for those with vocational qualifications. It is unclear whether this differing level of correspondence reflects our joint analysis of education and skills or the specific measures available to us. An obvious concern from this paper is the cost of being over-educated among those young workers with VET qualifications who find themselves in low-skill jobs. That this effect is observed among slightly older workers also points to the possibility that some VET graduates find themselves entrenched in jobs which may not make best use of their training and qualifications.

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