Essays on over-education and returns to university quality in the Australian graduate labour market

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Essays on over-education and returns to university quality in the Australian graduate labour market

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Higher education provides access to most professional and managerial labour markets, and produces the knowledge that underpins economic growth. Accordingly, the economics of higher education is an important and growing topic for study. This thesis is comprised of three essays on topics in the economics of higher education, specifically over-education and returns to university quality, in the context of the Australian graduate labour market.

The first essay studies the incidence of over-education and its effect on earnings. The results show that between 24% and 37% of graduates are over-educated shortly after course completion, with over-education most common amongst young females and least common amongst older females. Over-education rates vary markedly across major fields of study and appear to reflect the relative demand for graduate labour. Over-education is less common three years after course completion; however a nontrivial proportion of graduates remain over-educated. On the effect of over-education on earnings, young over-educated graduates are not penalised after controlling for unobserved heterogeneity, whereas older over-educated graduates remain at an earnings disadvantage relative to their well-matched peers.

The second essay investigates the relationship between job search and over-education. Results from panel estimation suggest that jobs found through university careers offices are associated with a lower probability of over-education relative to jobs found through advertisements and personal contacts. This result arises regardless of gender and age. In contrast, direct employer contact is only beneficial to older males. University careers offices appear to be more effective than other forms of job search at matching the skills of graduates with the needs of employers.

The third essay analyses the relationship between university quality and graduates' starting salaries using a two-stage estimation methodology. The results suggest that average starting salaries for young undergraduates differ significantly across universities after controlling for relevant confounding factors, though the range of university effects is fairly small in relation to other salary determinants, particularly course area. The results are robust to alternative specifications and suggest that employers generally do not place salary premia on attending a high-quality or prestigious university, at least upon workforce entry.

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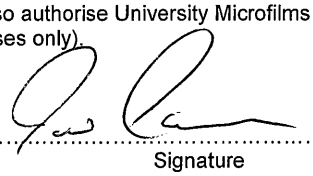

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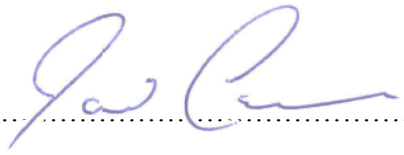
Signed 

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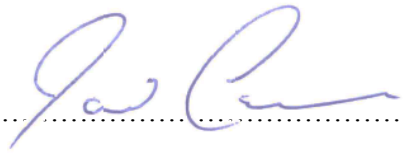
Signed 

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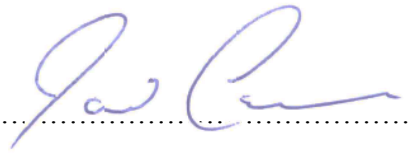
Signed 

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Abstract

Higher education provides access to most professional and managerial labour markets, and produces the knowledge that underpins economic growth. Accordingly, the economics of higher education is an important and growing topic for study. This thesis is comprised of three essays on topics in the economics of higher education, specifically over-education and returns to university quality, in the context of the Australian graduate labour market.

The first essay studies the incidence of over-education and its effect on earnings. The results show that between 24% and 37% of graduates are over-educated shortly after course completion, with over-education most common amongst young females and least common amongst older females. Over-education rates vary markedly across major fields of study and appear to reflect the relative demand for graduate labour. Over-education is less common three years after course completion; however a nontrivial proportion of graduates remain over-educated. On the effect of over-education on earnings, young over-educated graduates are not penalised after controlling for unobserved heterogeneity, whereas older over-educated graduates remain at an earnings disadvantage relative to their well-matched peers.

The second essay investigates the relationship between job search and over-education. Results from panel estimation suggest that jobs found through university careers offices are associated with a lower probability of over-education relative to jobs found through advertisements and personal contacts. This result arises regardless of gender and age. In contrast, direct employer contact is only beneficial to older males. University careers offices appear to be more effective than other forms of job search at matching the skills of graduates with the needs of employers.

The third essay analyses the relationship between university quality and graduates' starting salaries using a two-stage estimation methodology. The results suggest that average starting salaries for young undergraduates differ significantly across universities after controlling for relevant confounding factors, though the range of university effects is fairly small in relation to

other salary determinants, particularly course area. The results are robust to alternative specifications and suggest that employers generally do not place salary premia on attending a high-quality or prestigious university, at least upon workforce entry.

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Chapter 1

General Introduction

1.1 Introduction

The economics of higher education is a crucial topic for study. Expenditure on higher education is substantial, equivalent to 1.6% of GDP for OECD countries (OECD, 2013). Participation in higher education is also rising steadily, with global enrolments growing from 32.5 million in 1970 to 178 million in 2010, and forecast to further expand to reach 263 million by 2025 (Tremblay, Lalancette & Roseveare, 2012).

Higher education provides access to most professional and managerial labour markets (Hoenack, 1990), and serves as both incubator and storehouse of the knowledge underpinning economic growth and societal wellbeing. Given the importance of the topic to societies and individuals alike, it comes to no surprise that the literature on various issues relating to the economics of higher education is large and growing rapidly (Rothschild & White, 1993).

One such issue is that of over-education, the situation in which individuals possess more education than is required to perform their jobs. Since education is unlikely to confer a substantial productivity advantage if it is surplus to the requirements of the job, over-education represents an inefficient investment in human capital for both individuals undertaking education and the governments subsidising it. Graduate over-education was first brought to attention by Freeman (1976), and since then a broad international literature has emerged on the topic. Although different methods for identifying and measuring over-education are used, these studies generally conclude that a substantial proportion of individuals are over-educated for their jobs, and that over-educated individuals earn lower wages, on average, than those who are well matched (e.g. Alba-Ramirez, 1993; Duncan & Hoffman, 1981; Kler, 2005; Linsley, 2005; Mavromaras, McGuinness, O'Leary, Sloane & Wei, 2010; Rumberger, 1987; Tsai, 2010). Many

of these studies focus on higher education graduates; however few specifically consider recent course completers (e.g. Dolton & Vignoles, 2000; Frenette, 2004). Investigating over-education in the context of recent graduates would provide evidence as to whether it primarily affects new labour market entrants with limited workplace experience or is a persistent feature of the labour market (e.g. Thurow, 1975). Knowing this would help to inform discussions on the optimal level of investment in higher education, and would provide new information on the factors influencing the labour market outcomes of recent graduates.

The existing literature on the determinants of over-education has tended to focus on the influence of personal and enrolment characteristics (e.g. Battu, Belfield & Sloane, 1999; Dolton & Silles, 2001; McGuinness & Sloane, 2011; Verhaest & Omey, 2010), and general labour market conditions (e.g. Gottschalk & Hansen, 2003). Only a handful of studies consider whether over-education is related to information asymmetry in the job search process (e.g. Blázquez & Mora, 2010; Franzen & Hangartner, 2006; Kucel & Byrne, 2008), and none of these control for time-invariant unobserved differences across individuals, such as ability or motivation, which may be correlated with job search method use. A better understanding of this relationship would give new insights into the causes of over-education, and may suggest institutional arrangements to help reduce it.

Another important issue is that of university quality and its effect on graduates' subsequent earnings. Theories of human capital formation imply a positive relationship between institutional quality and labour market outcomes as a result of superior human capital accumulation, signalling of ability, or their combined effect. If empirically supported, this hypothesis would justify the use of differential fees across institutions. Although "quality" has been measured in many different ways, most studies find that graduating from a high-quality institution is associated with increased post-completion earnings (e.g. Black & Smith, 2004; Brewer, Eide & Ehrenberg, 1999; Milla, 2012; Monks, 2000; Thomas & Zhang, 2004); however the magnitude of this association ranges from negligible to large. The major limitation of the existing literature is that few studies investigate the returns to attending specific institutions, in

spite of evidence of heterogeneity in outcomes for graduates from ostensibly similar universities (Birch, Li and Miller, 2009).

1.2 Overview of essays

This thesis consists of three essays that study these issues in the context of the Australian graduate labour market. To date, two essays have been published in peer-reviewed journals, and the third has been submitted for peer review. All three essays have been published as discussion papers by the Institute for the Study of Labor (IZA—see Table 1.1). They are presented in Chapters 3, 4 and 5, respectively.

Table 1.1
Overview of the essays included in this thesis

	Essay 1	Essay 2	Essay 3
Presented in this thesis as:	Chapter 3	Chapter 4	Chapter 5
Published as discussion paper:	IZA DP No. 6047 (October 2011)	IZA DP No. 7202 (February 2013)	IZA DP No. 8473 (September 2014)
Submitted to journal:	Economics of Education Review	Education Economics	Economics of Education Review
Initial manuscript submitted:	9 October 2011	5 February 2013	1 October 2014
Revised manuscript submitted:	8 October 2012	4 March 2014	n/a
Date accepted for publication:	10 October 2012	21 March 2014	n/a
Published in Volume:	32	n/a	n/a

Essay 1 ("Over-education of recent higher education graduates: new Australian panel evidence") investigates the incidence of over-education amongst recent Australian bachelor degree graduates and its effect on their earnings. Over-education is measured on the basis of occupational skill levels (the so-called "Job Analysis" method), the choice of method being dictated by the survey data. Aside from its focus on recent graduates, the primary contributions of this study are that, firstly, it examines over-education by gender and age group, and secondly, it uses a panel estimation method to control for unobserved time-invariant individual heterogeneity. The results show that between 24% and 37% of graduates are over-educated shortly after the completion of their degrees, comparable to similar international studies. Discipline-specific over-education rates appear to reflect the relative demand for graduate

labour. Over-education was less common three years after course completion; however a nontrivial proportion of graduates remain over-educated in the labour market. Only older over-educated graduates suffer a significant wage penalty after controlling for unobserved heterogeneity.

Essay 2 ("Job search as a determinant of graduate over-education: evidence from Australia") investigates the relationship between job search and over-education for recent Australian bachelor degree graduates. Again, over-education is measured using the Job Analysis method. The main contribution of this study is a panel estimation methodology that controls for time-invariant unobserved differences across individuals that may be correlated with job search method usage, such as ability or motivation. The results suggest that jobs found through university careers offices are associated with a reduced over-education probability relative to those found through job advertisements, regardless of the gender or age group of the jobseeker. Direct employer contact is only advantageous for older males.

Essay 3 ("Returns to university quality in Australia: a two-stage analysis") investigates the relationship between university quality and the starting salaries of young Australian bachelor degree graduates. This study makes two primary contributions. First, it introduces a novel approach for dealing with the potential non-random selection of students into universities. Secondly, it employs a two-stage estimation methodology and an unusually large sample, which allows us to illustrate the diversity in returns to attending specific universities as well as relating these to differences in institutional characteristics commonly associated with quality. The results suggest that, although average starting salaries differ across universities, ceteris paribus, the range of estimated university effects is fairly small when compared to other salary determinants, particularly course area. These estimated university effects are significantly but weakly associated with university quality.

1.3 Data sources

The three essays constituting this thesis are based on two main data sources, the Australian Graduate Survey (AGS) and the Beyond Graduation Survey (BGS). Both surveys are coordinated by Graduate Careers Australia (GCA), an independent research organisation and leading authority on graduate employment issues in Australia. The data sources underpinning each essay are summarised in Table 1.2 and described in detail in Chapter 2.

Table 1.2
Overview of data sources

	Essay 1	Essay 2	Essay 3
Survey	BGS	BGS	AGS
Survey type	Panel	Panel	Cross-sectional
Administrations used	2010	2011	2010, 2011, 2012

The AGS is an annual national census of newly qualified higher education graduates. It is administered to new graduates from all Australian universities, and a number of non-university higher education providers, approximately four months after course completion. The AGS comprises the Graduate Destination Survey (GDS), which collects data on graduates' labour market outcomes and further study status, and, depending on the graduate, either the Course Experience Questionnaire (CEQ) or Postgraduate Research Experience Questionnaire (PREQ). The response rate is typically around 55%. Previous research has shown that the GDS data are generally representative of the graduate population and are reliable indicators of graduates' full-time labour market positions (Coates, Tilbrook, Guthrie & Bryant, 2006; Guthrie & Johnson, 1997).

The BGS is a panel survey follow-up to the AGS, in which AGS respondents are surveyed approximately three years after course completion. The BGS questionnaire is based on the AGS, enabling two periods of comparable labour market data to be collected for each respondent. Most universities choose to participate in the BGS, along with several non-university higher education providers. Although the BGS response rate is much lower than that of the AGS,

ranging from 15% to 17%, the sample of responses is generally representative of the population (GCA, 2011).

1.4 Thesis structure

The rest of this thesis is organised as follows. Chapter 2 presents a detailed overview of the data sources underpinning this thesis, providing a background to each and addressing matters of methodology, response and representativeness. Essay 1 on the incidence and wage effect of over-education is presented in Chapter 3. Essay 2 on job search as a determinant of over-education is presented in Chapter 4. Essay 3 on the relationship between university quality and starting salaries is presented in Chapter 5. Chapter 6 presents and discusses the conclusions from the three essays.

Chapter 2

Data Sources

2.1 Australian Graduate Survey

Graduates from Australian higher education institutions have been invited to respond to a national survey of their labour market outcomes since 1972. This survey has been revised numerous times over the years to account for the changing nature of Australian higher education, with the most recent version, dubbed the Australian Graduate Survey, dating from 2006. Funding for the AGS is currently provided by the Australian Government Department of Education, with material support provided by participating higher education institutions. The Australian Government uses AGS data extensively for sector planning, quality assurance through the Tertiary Education Quality Standards Agency (TEQSA), and providing information about courses and institutions to prospective students through the *MyUniversity* website. Participating institutions use the AGS data for their own internal planning and quality assurance purposes.

The AGS consists of two components: the GDS, which gathers data on the labour market outcomes and further study of recent graduates, and depending on whether the graduate completed a coursework degree or higher degree by research, either the CEQ or PREQ. A number of demographic and enrolment characteristics are directly populated into the data file from participating institutions' student data systems. As a labour market survey, the AGS has two main limitations. First, it does not capture the sum total of a graduate's labour market experience, only collecting data on whether the graduate was working in their final year of study. Second, it does not gather any data on individual ability. Both of these limitations are addressed in this thesis.

All Australian universities participate in the AGS on an annual basis, along with a smaller number of non-university higher education providers. Because universities account for 93% of all student load in Australian higher education (Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education [DIICCSRTE], 2013a), graduates from non-university higher education providers constitute a small minority of survey respondents.

All graduates who qualify for the award of a degree or diploma in a given calendar year are invited to participate in the AGS. Graduates are surveyed approximately four months after course completion. To account for most Australian universities having two graduation rounds per year, each annual AGS consists of two collections rounds. Students who complete their studies mid-year are surveyed as at 31 October, or 30 April the following year for the majority of students who complete their studies at the end of the year.

AGS data collection is undertaken using a standardised, decentralised model, under which participating institutions are permitted to survey their own graduates but are required to administer a standardised questionnaire with no scope for institutional variation.[1] Data collection is by means of online and paper questionnaires, and computer-assisted telephone interviews. Participating institutions are provided with a detailed administration manual by GCA to ensure a consistent approach to data collection and post-survey coding of open-text responses. After the completion of data collection, participating institutions return their data to GCA, where the institutional files are aggregated into a national data file. A number of validation and quality checks are performed on the data, and any irregularities are resolved with the institution in question.

Essay 3 uses pooled data from the 2010, 2011 and 2012 AGS administrations, which are summarised in Table 2.1. The construction of the analysis sample is outlined in Chapter 5 and expanded upon in Appendix A. Although administered as a census, the extent of non-response

[1] Institutions may choose to administer one or more of eight optional CEQ scales in addition to the three core scales; however they may not administer institution-specific questionnaire items.

to the AGS (typically around 45%) means that it is necessary to consider the secured responses to be a sample of the overall graduate population.

Table 2.1
AGS administrations used in this thesis

	2010	2011	2012
Participating universities	39	39	39
Participating non-university providers	14	12	10
Total participating institutions	53	51	49
Total reported survey population	222,347	238,822	248,493
Number of valid responses	125,776	134,388	137,800
Overall response rate (%)	56.6	56.3	55.5

Two studies have investigated the extent to which the GDS data are affected by non-response bias. Guthrie and Johnson (1997) surveyed non-responders to the 1996 GDS and concluded that the data gathered by the survey are reliable indicators of the full-time labour market position of the graduate population. The non-respondent group differed from respondents in relation to several demographic characteristics, including gender, age, level of qualification, fee paying status and attendance mode; however these differences were minor. In terms of fields of study, the non-respondent group closely reflected respondents. Coates et al. (2006) supported the findings of Guthrie and Johnson (1997), concluding that the sample of responses is generally representative of the broader graduate population and that estimates on these data are unbiased at the national level.

2.2 Beyond Graduation Survey

The BGS was created in 2009 as a panel survey follow-up to the AGS, whereby AGS respondents were invited to complete a survey on their labour market outcomes and further study approximately three years after course completion. Unlike the AGS, which is administered for the Australian Government, the BGS is conducted by GCA without external funding as a service to the higher education sector; however material support is still provided by participating higher education institutions, who, in turn, receive a national data file. The 2009

BGS, a large-scale pilot of the questionnaire and methodology, surveyed graduates who responded to the 2006 AGS.

Institutional participation in the BGS is open to any institution that participated in the corresponding AGS. Most universities choose to participate in the BGS, along with several non-university higher education providers. All AGS respondents from participating institutions for whom email contact details are available are invited to complete the BGS. The primary source of email addresses is an AGS questionnaire item asking graduates to provide a long-term email address for follow-up research, which are then supplemented by email addresses from institutions' student data systems, if available. Surveyed graduates are asked a range of questions concerning their labour market outcomes and further study status on 30 April for each of the three years since completing the AGS. These data are then merged with their original AGS response, giving four periods of labour market data for each respondent. Since respondents may incorrectly recall their activities in earlier periods, only the first (i.e. AGS) and most recent periods are used for analysis.[2]

BGS data collection is undertaken using a similar model to the AGS whereby participating institutions are permitted to survey their own graduates; however around two-thirds outsource the fieldwork to GCA. Data collection is by means of an online questionnaire. All post-survey data processing and coding is performed by GCA. Essays 1 and 2 use data from the 2010 and 2011 BGS administrations, respectively, which are summarised in Table 2.2. The construction of the two analysis samples are outlined in their respective chapters and expanded upon in Appendix A. The BGS response rate is much lower than that for the AGS (cf. Table 2.1), which is presumably due to graduates being less likely to respond to a survey from or on behalf of their university several years after graduation.

[2] From 2012 onwards, items relating to the intermediate years were dropped from the survey.

Table 2.2
BGS administrations used in this thesis

	2010	2011
Participating universities	29	31
Participating non-university providers	2	3
Total participating institutions	31	34
Total reported survey population	68,523	68,874
Number of valid responses	10,111	11,744
Overall response rate (%)	14.8	17.1

No formal study on non-responders has been conducted for the BGS, so the extent to which the data are affected by non-response is unclear; however the sample of responses is generally representative of the population in terms of gender, age and fields of study (GCA, 2011), and BGS respondents and non-responders tend to have very similar full-time employment rates and median starting salaries at the time of the AGS. This provides some evidence that the BGS data are not seriously affected by non-response, although it remains possible that graduates who achieve labour market success after course completion may be more likely to respond to a follow-up survey on their outcomes (Dolton & Vignoles, 2000). This is acknowledged as a potential limitation of the BGS data.

Chapter 3

Over-education of recent higher education graduates: new Australian panel evidence

Carroll, D and Tani, M. Over-education of recent higher education graduates: new Australian panel evidence. Economics of Education Review. 2013 Feb; 32: 207-18.

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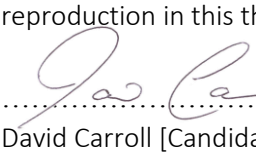

……

David Carroll [Candidate]

3.1 Introduction

Recent research into the Australian labour market has shown that holding a university degree is far from a guarantee of employment in a job that actually requires a university education. Different authors utilising different measurement techniques have estimated that anywhere from 20% to 45% of male university graduates and 17% to 38% of female university graduates in Australia are over-educated (e.g. Kler, 2005; Mavromaras et al., 2010), insofar that their respective levels of education exceed the requisite levels needed to perform their jobs (Linsley, 2005).[3] These studies, along with a body of similar research conducted overseas (e.g. Duncan & Hoffman, 1981; Groot & Maassen van den Brink, 2000; Hartog, 2000; McGuinness, 2006;

[3] Throughout the paper we use the word "over-education" to locate our work within a well-established literature. However, we believe that over-education can arguably be more rightly thought of as "under-utilisation". Being employed below their educational level does not necessarily mean that a graduate is over-educated, per se, but his/her productive capacity as a highly skilled worker is almost certainly under-utilised.

Metha, Felipe, Quising & Camingue, 2011; Rumberger, 1987), have generally found that over-educated individuals are typically at an earnings disadvantage relative to their peers in jobs matching their education level. Finding that the Australian labour market is characterised by over-educated workers holding university degrees is concerning since expenditure on higher education is both large, equivalent to 2% of Australia's GDP (Norton, 2012), and primarily publicly funded. Most Australian students are also required to contribute some monies to the cost of their higher education through the Government's Higher Education Contribution Scheme (HECS).

One feature of the existing literature into the over-education of tertiary-educated workers is its focus on university graduates in the sense of *degree holders* rather than in the sense of *recent course completers*. This approach may be problematic as controlling for unobserved heterogeneity amongst various cohorts of graduates with vastly different labour market experience necessitates of longitudinal data rather than cross-sectional surveys. Our study contributes to the existing literature in two ways.

First, it focuses on recent graduates. We believe that this group of graduates is deserving of specific attention because of its relative homogeneity compared with the tertiary-educated workforce as a whole, as its members are typically rich in education-specific human capital but generally poor in occupation-specific human capital. Our chosen focus is further justified on the basis that other studies have found that over-educated workers are typically "skilled" workers who lack experience, and that these individuals tend to move into higher-level jobs as their stock of occupation-specific human capital increases (e.g. Alba-Ramirez, 1993; Dolton & Vignoles, 2000; Sicherman, 1991; Sloane, Battu & Seaman, 1999). Investigating this in the context of recent graduates allows us to see whether over-education is indeed more common immediately following course completion or whether it is a persistent feature of the labour market (e.g. Thurow, 1975). We also investigate whether over-education varies based on major field of study undertaken, in line with the human capital hypothesis that individuals are paid more on the basis of additional education and, by implication, different educational content

(Becker, 1964). In particular we split our sample into four subgroups based on gender and age up to, and above, 25 years consistently with the graduate labour market statistics reported by GCA.

Second, we can control for unobserved individual heterogeneity thanks to a new panel data set concerning the work and study activities of recent Australian graduates, the BGS, which was conducted in 2010 by GCA. Because the survey did not specifically ask graduates whether they felt that they were in appropriate employment for their own level of education, we categorise correct matches or over-education on the basis of occupational skill levels in the Australian and New Zealand Standard Classification of Occupations (ANZSCO).

Our results indicate that between 24% and 37% of graduates were over-educated shortly after the completion of their studies. The rate of over-education did decline notably over the following three years, however, especially for young graduates. Graduates were much more likely to stay over-educated throughout than to become over-educated after having been in skilled employment. Over-education rates varied considerably across major fields of study, with high rates of over-education associated with high unemployment rates. With regard to its effect on earnings, young over-educated graduates were not penalised relative to those in appropriate jobs after unobserved heterogeneity had been addressed, whereas older over-educated graduates were at an earnings disadvantage.

Our findings have relevant theoretical and practical implications. From a theoretical standpoint, this study provides additional insights into the factors influencing the labour market outcomes for recent graduates, with specific focus on the manner by which employers reward the attainment of higher education qualifications. From a policy standpoint, this study may also help to inform debate concerning the optimal level of investment in higher education relative to other forms of post-compulsory education, such as vocational education and training (VET).

The rest of this paper is organised as follows. Section 3.2 presents a brief literature review and outlines our contribution. Section 3.3 describes data and variables used in this study. Section 3.4 outlines our estimation methodology. Section 3.5 presents the results. Conclusions and policy implications are presented in Section 3.6. Detailed definitions of the variables used in this study are presented in Appendix A at the end of this thesis.

3.2 Literature

The idea of university graduates being over-educated was brought to attention by Freeman (1976), who argued that during the 1970s the supply of graduates exceeded the demand for university-educated workers, forcing many into traditionally non-graduate jobs at relatively lower pay. Since then, a broad international literature has emerged concerning over-education. These studies generally conclude that a substantial proportion of the labour force possesses more education than is required to perform their jobs, and that individuals who are over-educated with respect to their job requirements typically earn lower wages, *ceteris paribus*, than their counterparts in more appropriate employment (e.g. Alba-Ramirez, 1993; Dolton & Vignoles, 2000; Duncan & Hoffman, 1981; Kler, 2005; Linsley, 2005; Mavromaras et al., 2010; Rumberger, 1987; Tsai, 2010).

As noted by Mavromaras et al. (2010), much of this literature has, for good reason, focused on university graduates. Firstly, university graduates have been the fastest-growing education group in Western labour markets in recent years, with the Australian labour market no exception; the proportion of workers in the labour market with a higher education qualification increased markedly from 28% in 2001 to 37% in 2010 (Australian Bureau of Statistics [ABS], 2001; ABS, 2010).[4] Secondly, the existence of over-educated graduates is puzzling, considering that rates of return to higher education degrees have been stable or increasing in recent years. Lastly, investment in tertiary education is typically the highest per capita amongst all education

[4] This includes all individuals in the labour force with an advanced diploma/diploma or higher qualification.

categories, and is often publicly funded, with over-education therefore representing a poor return on this substantial investment for both the individual and the economy at large.

Much of the variation in the incidence and effects of graduate over-education, even within similar labour markets, may be attributable to the different methods used to identify and measure the education-occupation mismatch. Three such methods dominate the literature. These are the Worker Self-Assessment (WA) method, the Realised Matches (RM) method and the Job Analysis (JA) method. The WA method measures over-education by comparing the minimum education level that a worker believes is required to perform his or her job to their actual education level. The RM method is based on the average education level in a particular occupation,[5] with a worker considered to be over-educated if his or her actual education level is more than one standard deviation above the average education level in his or her occupation. The JA method measures over-education on the basis of occupational definitions developed by professional job analysts. A worker is considered to be over-educated if his or her actual education level is higher than the required education level specified in the occupational classification. Each of these measures has advantages and limitations, as explored in detail in previous work (e.g. Dolton & Vignoles, 2000; Halaby, 1994; Hartog, 2000).

Australian studies of graduate over-education has focused exclusively on degree holders rather than recent higher education graduates, mostly because of the lack of suitable data concerning the outcomes and activities of recent graduates in the years immediately following course completion. Large-scale panel studies of recent higher education graduates are practically unheard of in Australia, with the first truly national study of this kind, the BGS, conducted as recently as 2010. Existing work has therefore investigated the over-education in Australia using two different data sets.[6]

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[5] The mean was the measure of central tendency first used by Verdugo and Verdugo (1989), although the mode has become a more common measure because both the mean and median are too dependent on the shape of the underlying education distribution (Mavromaras et al., 2010).

[6] Other studies (e.g. Green, Kler & Leeves, 2007; Kler, 2007; Messinis, 2008; Piracha, Tani & Vadean, 2012) have considered the over-education of first- and second-generation immigrants to Australia.

Kler (2005) analysed the incidence of over-education amongst Australian-born graduates aged 20-64 years using data from the 1996 Census of Population and Housing. Mavromaras et al. (2010) used panel data from the Household Income and Labour Dynamics in Australia (HILDA) survey to analyse the relationship between occupational mismatch and earnings for Australian graduates of working age. These authors also utilised different approaches to measuring graduate over-education, which is common in the literature. Using the JA method, Kler (2005) found that 21% of graduates were over-educated (with the same incidence observed for males and females), although the incidence of over-education was as high as 46% for male graduates and 38% for female graduates when measured using the RM method. Mavromaras et al. (2010), also using the JA method, found that 20% of male graduates and 17% of female graduates in their sample were over-educated.

Regarding the effect of over-education on earnings, Kler (2005) concluded that the returns to years of surplus education are typically lower than the returns to years of required education (although this wage penalty varied based on the specific over-education measure employed), while Mavromaras et al. (2010) identified significant negative returns to over-education for female graduates but not male graduates after controlling for individual fixed effects. While the study by Kler (2005) includes a rich set of education variables (e.g. degree level, major field of study), it does not decompose university graduates into recent and non-recent graduates, and is based only on a single cross-section of data from a time when just 16% of the labour force held higher education qualifications. The study by Mavromaras et al. (2010), while based on more recent data (2001-07) and utilising a panel estimation technique that allows for the control of unobserved heterogeneity, has only a limited number of the key education variables present in the study by Kler (2005).

The two studies which come closest to our own in terms scope and focus are those by Dolton & Vignoles (2000) and Frenette (2004). Dolton & Vignoles (2000) used a panel data set from the 1980 National Survey of Graduates and Diplomates (covering the period 1980-1986) in order to examine the incidence of over-education and its effect on earnings for a cohort of UK graduates

immediately after graduation and six years later.[7] Using the WA method, they found that 38% of graduates were over-educated in their first job after university and 30% were over-educated after six years, and that over-educated graduates earned lower wages, on average, than those in appropriate employment. Frenette (2004) investigated the incidence, persistence and economic returns to over-education amongst young graduates in full-time employment using data from several waves of the Canadian National Graduate Survey (covering the period 1982-1995). Also using the WA method, he found that 29% of bachelor degree graduates were over-educated two years after the completion of their studies, with 26% over-educated three years later. While over-education status tended to persist in the years after course completion, graduates were far more likely to move upward than downward in terms of over-education status. He also identified a wage penalty for over-educated undergraduates, the magnitude of which declined after unobserved heterogeneity was addressed. No significant wage penalty was observed for postgraduates.

In addition to using novel panel data for Australia, we extend the scope of the analyses conducted by Dolton & Vignoles (2000) and Frenette (2004) by investigating the effect of over-education on the wages of graduates from different major fields of study. We also split our sample into four gender-age cohorts, with two representing "traditional" school-leavers (i.e. aged 25 years and under at the time of graduation) and the other two representing the "non-traditional" or mature-age cohort, which has come to represent about 20% of Australia's overall undergraduate tertiary education enrolments (Department of Education, Employment and Workplace Relations [DEEWR], 2011).

[7] Although Dolton and Vignoles (2000) had access to panel data, they did not use panel estimation methods to control for individual fixed effects. It should be noted that they did control for an extensive set of individual factors, such as degree class, total work experience and number of training days undertaken, which may have minimised the impact of individual heterogeneity on their wage estimates.

3.3 Data

This study is based on data drawn from the 2010 BGS. Since 1972, graduates from Australian higher education institutions have participated in a national survey of their outcomes and activities approximately four months after course completion.[8] The current incarnation of this national graduate survey is known as the Australian Graduate Survey, conducted by GCA on a semi-annual basis.[9] The BGS was developed as a cohort-style follow-up to the AGS, whereby graduates who completed the AGS were invited to complete a survey concerning their work and study activities in the three years following course completion.[10] Surveyed graduates were asked a range of questions concerning their activities on April 30 in 2008, 2009 and 2010, which were subsequently merged with data on their activities in 2007 based on a unique identifier assigned to each graduate. In all, more than 70% of the institutions which participated in the 2007 AGS also participated in the 2010 BGS, thus ensuring a nationally-representative sample from a wide range of institutions.

Graduates were invited to complete the survey by email. Those who completed the 2007 AGS were asked at the time to supply a long-term email address as a means of facilitating follow-up research, which was used by GCA as the primary means of inviting graduates to participate in the 2010 BGS. The survey response rate was 15%.[11] The sample of secured responses was confirmed as being representative of the broader population under study (GCA, 2011).[12] Due to the under-representation of overseas graduates in the sample, as well as the increased potential

[8] Although the AGS is administered as a national census, the extent of non-response to the survey is typically around 40% for Australian domestic graduates (GCA, 2010a).
[9] The AGS is administered semi-annually because most Australian higher education institutions have two major graduation rounds in a given year.
[10] A large-scale pilot of the BGS was undertaken in 2009. This study is based on data from the 2010 BGS, which was the first year of the survey proper.
[11] Due to some of the data collection fieldwork being carried out by participating higher education institutions, the precise number of graduates who were sent but did not receive an invitation to participate in the survey is not known. As a result, the actual survey response rate may be higher than the figure given.
[12] The skew towards females in our sample is not unexpected considering that females constitute approximately 60% of course completions from Australian higher education institutions (DEEWR, 2011).

for sampling bias resulting from the difficulty in contacting overseas graduates following their repatriation, all overseas graduates were excluded from the analysis sample.

Although the long-term email approach utilised by the survey administrators likely reduced the potential for bias stemming from graduate mobility (i.e. moving house after graduation and failing to leave a forwarding address), it should be noted that graduates who had achieved labour market success may have been more likely to respond to this follow-up survey (Dolton & Vignoles, 2000), which would impact the generalisability of the results presented. Wage estimates are presented along with their standard errors throughout this paper so that readers may draw their own conclusions concerning the robustness of our results.

Graduates who were not in paid employment in 2007 were removed from the sample, as were those who were employed overseas at any time during the three-year period under review. We further restricted our sample to bachelor degree graduates to ensure a large sample that is relatively homogenous with respect to ability and background. Wages above the 99th percentile were removed, as were those below the Australian minimum hourly wage in 2007 and 2010.[13] This resulted in a working sample of 2,005 graduates, including 144 who were in paid employment in 2007 but not in 2010.

One limitation of the BGS and its progenitor, the AGS, is that neither survey captures the sum total of an individual's labour market experience. To address this, age was used as a proxy for potential experience. This limitation aside, the BGS provides rich data for other key human capital variables, such as major field of study. Table 3.1 presents the means of all the variables used in our analysis for each job year subsample, stratified by gender-age cohort. These variables are defined in detail in Appendix B.

[13] This involved the removal of cases with an hourly wage below $13.46 or above $96.54 in 2007, and below $14.30 or above $117.92 in 2010.

We utilised the JA method to construct the over-education variables of interest in this paper, with occupational skill levels drawn from ANZSCO serving as a basis.[14] The five skill levels in ANZSCO were condensed into a binary variable for this study,[15] with graduates in occupations classified as Skill Level 1, commensurate with a bachelor degree or higher qualification, classified as not over-educated, while graduates in occupations classified within the four lower skill levels were classified as over-educated. Based on our chosen definition, 634 graduates in our sample were over-educated in 2007 and 305 were over-educated in 2010. Our choice of over-education measure was constrained by the data available to us in the survey. Clearly, the ANZSCO-based definition would implicitly underestimate the extent of over-education for individuals with a postgraduate education, which further justifies our choice of a bachelor-only sample.

Graduates' occupations in 2007 and 2010 were coded manually on the basis of two open-response items: "what was the full title of your occupation?" and "what were the main tasks or duties in your job?". Respondents were instructed to describe their tasks and duties as fully as possible to facilitate accurate occupational coding.[16] By coding occupational categories (and, by extension, different skill levels) on the basis of their self-described tasks or duties *in addition to* the title of their occupation, we believe that we are addressing the main criticism associated with the use of the JA method: that it is based on the assumption that workers with the same occupation title are doing work of equal difficulty (Dolton & Vignoles, 2000). We propose that our approach represents a middle ground between the JA and WA methods; however, we do concede that our approach is still sensitive to the manner in which graduates describe their tasks

[14] In the context of ANZSCO, a skill level is a function of both the range and complexity of tasks in a particular occupation. A greater range and complexity of tasks accords with a higher skill level (ABS, 2006).

[15] Skill Level 1 is commensurate with a bachelor degree or higher qualification; Skill Level 2 with an Associate Degree, Advanced Diploma or Diploma; Skill Level 3 with an Australian Qualifications Framework (AQF) Certificate IV; Skill Level 4 with an AQF Certificate III or II; Skill Level 5 with an AQF Certificate I or compulsory secondary education (ABS, 2006).

[16] A graduate with the occupation title "Manager" with the duties of a finance manager will, for example, be assigned a higher skill level than a similarly titled graduate with the duties of a restaurant manager.

or duties, and thus remains subject to individual effects, which we capture in the error terms in the earning functions.

Table 3.1
Means for 2007 and 2010 job year subsamples[a]

		2007 job				2010 job			
Variable	Name	M ≤ 25	F ≤ 25	M > 25	F > 25	M ≤ 25	F ≤ 25	M > 25	F > 25
Log hourly wage	lnhwage	3.097	3.026	3.266	3.198	3.439	3.372	3.560	3.467
Over-educated	overed	0.305	0.366	0.298	0.242	0.124	0.174	0.210	0.159
Over-ed*technical majors	overeda	0.105	0.064	0.082	0.024	0.036	0.026	0.047	0.024
Over-ed*health/education	overedb	0.018	0.030	0.029	0.049	0.014	0.025	0.021	0.041
Over-ed*society and culture/arts	overedc	0.087	0.175	0.131	0.120	0.033	0.073	0.073	0.063
Age (years)	ageyrs	22.570	22.336	35.465	36.417	25.577	25.324	38.459	39.555
Sciences	majora	0.083	0.085	0.065	0.044	0.079	0.078	0.060	0.041
Information technology	majorb	0.090	0.012	0.135	0.020	0.091	0.010	0.137	0.022
Engineering and related	majorc	0.209	0.054	0.110	0.035	0.206	0.050	0.107	0.038
Health	majord	0.074	0.207	0.106	0.217	0.077	0.218	0.112	0.221
Education	majore	0.056	0.080	0.110	0.224	0.060	0.076	0.112	0.226
Society and culture	majorf	0.146	0.235	0.155	0.226	0.144	0.233	0.150	0.226
Creative arts	majorg	0.047	0.076	0.045	0.038	0.045	0.076	0.039	0.031
Technical majors	majori	0.381	0.151	0.310	0.100	0.376	0.139	0.305	0.101
Health/education	majorj	0.130	0.287	0.216	0.441	0.136	0.293	0.223	0.447
Society and culture/arts	majork	0.193	0.312	0.200	0.264	0.189	0.309	0.189	0.257
Paid work in final year of study	workstud	0.908	0.925	0.910	0.854	0.914	0.926	0.910	0.858
Employment characteristics									
Self employed	selfemp	0.018	0.009	0.061	0.024	0.022	0.018	0.064	0.019
Working part time or casual	ptime	0.159	0.212	0.135	0.244	0.043	0.113	0.064	0.267
Job tenure (months)	tenure	11.827	9.626	34.518	27.916	29.880	26.832	47.227	41.558
Employed in NSW	emploca	0.211	0.213	0.216	0.142	0.203	0.222	0.180	0.135
Employed in Qld	emplocb	0.179	0.166	0.249	0.257	0.196	0.170	0.258	0.255
Employed in SA	emplocc	0.090	0.116	0.143	0.171	0.093	0.110	0.137	0.178
Employed in WA	emplocd	0.139	0.167	0.090	0.135	0.120	0.151	0.099	0.120
Employed in Tas	emploce	0.011	0.020	0.008	0.022	0.007	0.021	0.009	0.019
Employed in NT	emplocf	0.004	0.009	0.024	0.024	0.010	0.009	0.021	0.026
Employed in ACT	emplocg	0.016	0.025	0.024	0.013	0.019	0.025	0.060	0.019
Mining sector	sectora	0.034	0.012	0.020	0.004	0.041	0.018	0.021	0.007
Manufacturing sector	sectorb	0.054	0.029	0.069	0.018	0.048	0.035	0.064	0.022
Utilities sector	sectorc	0.018	0.009	0.045	0.007	0.017	0.014	0.052	0.005
Construction sector	sectord	0.025	0.002	0.024	0.004	0.017	0.009	0.026	0.007
Wholesale and retail trade sector	sectore	0.110	0.126	0.065	0.016	0.074	0.074	0.030	0.014
Accom. and food services sector	sectorf	0.027	0.036	0.016	0.013	0.014	0.026	0.009	0.010
Transport and warehousing sector	sectorg	0.020	0.013	0.029	0.004	0.019	0.013	0.034	0.002
Info. media and comm. sector	sectorh	0.045	0.035	0.065	0.018	0.038	0.043	0.039	0.019
Professional services sector	sectori	0.269	0.177	0.118	0.131	0.273	0.179	0.129	0.127
Administration services sector	sectorj	0.002	0.031	0.016	0.011	0.017	0.029	0.026	0.014
Public administration sector	sectork	0.094	0.085	0.155	0.137	0.112	0.102	0.210	0.137
Education and training sector	sectorl	0.087	0.124	0.167	0.246	0.100	0.145	0.180	0.267
Health and social assistance sector	sectorm	0.092	0.217	0.135	0.310	0.084	0.214	0.133	0.296
Arts and recreation services sector	sectorn	0.020	0.030	0.008	0.007	0.024	0.023	0.000	0.010
Other sectors	sectoro	0.011	0.025	0.033	0.035	0.019	0.026	0.017	0.026
N		446	863	245	451	418	794	233	416

Notes: [a] M ≤ 25 = males aged 25 years and under; F ≤ 25 = females aged 25 years and under; M > 25 = males aged over 25 years; F > 25 = females aged over 25 years.

3.4 Estimation methodology

As in Dolton and Vignoles (2000), we begin our investigation by estimating the following earnings function separately for 2007 and 2010 jobs using OLS:

$$\ln Y_i = \alpha_0 + \alpha U_i + \beta X_i + \varepsilon_i \qquad (3.1)$$

where $\ln Y_i$ is the log of the graduate's hourly earnings and U_i is the over-education dummy variable described previously. X_i is a row vector of personal, educational and occupational individual characteristics that include age, major field of study, employment status during final year of study, job tenure, self-employment, working on a part-time or casual basis, location of employment and employment sector. ε_i is an i.i.d error term. Because a subset of 144 graduates in the initial sample was no longer working in 2010, it is possible that OLS estimation will yield biased and inconsistent estimates. Those who were still working in 2010 may be a non-random subsample of the complete sample. We therefore use Heckman's (1979) two-stage correction to control for selection bias in our 2010 subsample, a technique that yields consistent estimates under these conditions (Dolton & Vignoles, 2000).[17]

As OLS estimation of panel data can give biased estimates due to unobserved time-invariant heterogeneity, we follow the approach of Frenette (2004) and others,[18] by using a fixed-effects model to produce more robust estimates.[19] This takes the form:

$$\ln Y_{it} = \alpha_0 + \alpha U_{it} + \beta X_{it} + \delta_t + c_i + u_{it} \qquad (3.2)$$

where δ_t is the time-specific effect, c_i is the time-invariant individual fixed effect and u_{it} is an idiosyncratic error term. Other terms are as previously defined, but with the subscript t

[17] The variable included in the selection equation but excluded from the wage equations was a dummy variable indicating whether a graduate was engaged in a non-employment activity at some point between the two survey periods. Our reasoning is that graduates who are so engaged would be less likely to be in employment in 2010 than graduates who remained in the workforce throughout.

[18] See, for example, Bauer (2002), Mavromaras et al. (2010) and Tsai (2010).

[19] The appropriateness of using a fixed effects model over a random effects model in this case was established by performing a Hausman test on the estimates of both models (see Green, 2008). We also estimated a random effects model augmented with a Mundlak (1978) correction to control for the presence of unobserved time-invariant heterogeneity, but, as expected, this produced identical estimates to our fixed effects model.

indicating job year. We have modelled a time-specific effect in this earnings function because we suspect that there are time-specific factors that impact upon all individuals in our sample in the same way, such as the state of the labour market at the time of each survey period.

One potential shortcoming of our fixed-effects approach is that it cannot account for unobserved time-variant individual heterogeneity. For example, some graduates but not others may gain good-quality work experience in their initial jobs, which would not be captured by our model. Another potential shortcoming is that this technique does not control for potential selection into employment. Our estimates may be affected by the presence of characteristics that affect both the likelihood of over-education and participation in the labour force, such as ability level. We duly acknowledge both of these as possible limitations of our study.

3.5 Results

3.5.1 Incidence of graduate over-education

Table 3.2 shows that a sizable proportion of the graduates in all four gender-age cohorts were over-educated for the jobs that they held soon after the completion of their studies. The incidence of over-education ranged from 24% for older females to 37% for young females, with 30% of males in both age cohorts over-educated in their 2007 jobs. These figures are of a similar magnitude to those of Dolton & Vignoles (2000) and Frenette (2004), in spite of our data being collected in a different national context and at least a decade later.

The rate of over-education fell between the two survey periods, especially for young graduates who were more likely to be over-educated in their first post-study jobs than their older counterparts. This is consistent with the prediction of career mobility theory that some graduates may begin their careers in a job for which they are overqualified, because this job may serve as a stepping-stone to a better job in the future (Sicherman & Galor, 1990). Older graduates, who are more likely to possess at least some pre-study work experience and have been in their current jobs longer, on average, are therefore less likely to be over-educated upon completing their studies. The magnitude of the decline in over-education rates in the three-year period of

our study was greater than those observed by Dolton & Vignoles (2000) in a six-year period, or by Frenette (2004) in a five-year period. This could be the result of the strong Australian labour market for graduates at the time of the 2007 survey wave.[20] It is important to note that the 2008 financial crisis and its knock-on effects were still affecting graduate employment at the time of the 2010 survey wave (GCA, 2010). As a result, the over-education rate three years after course completion may have been lower still had this event not taken place.

Table 3.2
Incidence of over-education amongst selected graduate cohorts in their 2007 and 2010 jobs[a]

	2007 job				2010 job			
Graduate cohort	M ≤ 25	F ≤ 25	M > 25	F > 25	M ≤ 25	F ≤ 25	M > 25	F > 25
Major field of study								
Sciences	65	58	25	30	12	26	21	35
Information technology	28	20	21	33	8	13	9	33
Engineering and related	13	23	33	13	9	10	20	6
Health	21	12	23	7	16	10	15	9
Education	4	6	4	15	4	5	4	10
Management and commerce	32	39	21	25	14	19	24	16
Society and culture	46	59	66	45	20	24	34	24
Creative arts	43	47	64	47	11	22	56	23
Final year work status								
Paid work in final year of study	32	37	31	26	13	18	22	17
No paid work in final year of study	20	26	18	12	6	10	14	12
Work type								
Working full time	72	71	52	26	22	38	27	14
Working part time or casual	23	27	26	23	12	15	21	17
Total	30	37	30	24	12	17	21	16
n	446	863	245	451	418	794	233	416

Notes: [a] M ≤ 25 = males aged 25 years and under; F ≤ 25 = females aged 25 years and under; M > 25 = males aged over 25 years; F > 25 = females aged over 25 years.

Focusing solely on cohort-level over-education rates is of limited utility because of the high variation in over-education rates across major fields of study, and the differing enrolment profiles of traditional and non-traditional graduates of both genders (see Table 3.1). With some minor variations across cohorts and time periods, the fields with high rates of over-education tended to be sciences, management and commerce, society and culture, and creative arts. Again, with some minor variations, the fields with lower rates of over-education were information technology, engineering and related, health, and education.

[20] Full-time unemployment for recent Australian domestic bachelor degree graduates in 2007 was 5%, the lowest level since 1990 (GCA, 2007).

Somewhat surprising is the very high rate of over-education amongst young sciences graduates, especially considering that these graduates would presumably be of high ability in terms of their technical skills.[21] This is possibly due to the labour market for scientists favouring those who hold postgraduate qualifications,[22] which could result in new bachelor-degree science graduates remaining in lower-skilled work while they attempt to secure employment related to their field of study. The much lower rate of over-education for these graduates after three years suggests that many graduates were either able to secure this type of employment, or chose to secure skilled employment in another sector. Because the BGS data does not measure the relevance of field of study to employment, we cannot identify the correct interpretation. Much of the within-field variation in over-education rates across cohorts appears to be an artefact of statistics computed on the basis of relatively few cases, such as the example of older females from information technology courses. Disciplinary differences not reflected in our highly aggregated major fields of study could also be a contributing factor.

To investigate whether the prevailing economic conditions affect over-education, we correlate field-specific over-education rates in Table 3.2 with field-specific cohort unemployment rates calculated from the 2007 and 2010 AGS rounds. A higher unemployment rate is indicative of a lesser demand or excess supply of graduates from a particular field, or both. In any case, we find a positive correlation between these two variables in both time periods,[23] suggesting that graduates are more likely to accept jobs below their education level when more of their peers are unemployed. Frenette (2004) reported a similar relationship between unemployment and over-education. It is possible that graduates who choose over-education over unemployment do

[21] The broad discipline areas within the sciences field are natural sciences, physical sciences and mathematics, and agriculture and environmental studies.

[22] Analysis of data from the 2011 AGS indicates that individuals from the science field were much more likely to be working in a related job after course completion if they had completed a postgraduate degree. Considering Australian science graduates employed domestically, 68% of postgraduates were in related jobs, compared with 43% of bachelor degree graduates. No other field enjoyed a postgraduate advantage of this magnitude. Details of this analysis are available from the authors.

[23] Pearson's correlation was used. 2007: $r = 0.684$, $n = 32$, $p = 0.000$; 2010: $r = 0.575$, $n = 32$, $p = 0.001$.

so to sustain themselves until a better opportunity arises, whilst also allowing them to remain in paid employment.

Table 3.2 also shows that graduates who were in paid work during their final year of study were consistently more likely to be over-educated than those were not, in spite of the former group presumably having more work experience. This could reflect that many students simply remain in the job that they held during their final year of study upon graduation. The small minority of graduates who did not work in their final year of study may represent an élite group who do not need to work to support themselves whilst at university. Such students would likely have strong social capital, which would aid their post-study job search.

With the exception of older females, graduates in part-time or casual jobs were much more likely to be over-educated than those in full-time positions. This was especially evident for young graduates in their first post-study jobs and, to a lesser extent, older male graduates. This may simply be a reflection of most skilled jobs being full-time in nature; however these figures clearly show that working part time and being educationally well-matched are not mutually exclusive. While the large decline in the proportion of over-educated part-time workers in the three cohorts between 2007 and 2010 indicates that many were able to secure appropriate employment, the proportion of graduates in part-time work also decreased considerably over the same period. Part-time employment was still common amongst older females three years after course completion, and experienced a lower rate of over-education than full-time employment. Older females may prefer part- to full-time employment as it allows them to balance work and familial responsibilities. Many well-matched workers in this cohort are likely to be working part-time hours by choice; perhaps more so than other cohorts.

Table 3.3 shows the transition into and out of over-education between 2007 and 2010. It is apparent that the majority of graduates who are over-educated in their first jobs after course completion are no longer over-educated three years later, suggesting that over-educated graduates may use their jobs as stepping-stones into more appropriate employment. This was particularly evident for young males. However, a nontrivial proportion of graduates who were

over-educated upon graduation remain over-educated after three years in the labour market. Only a small minority of graduates who were in well-matched jobs after course completion were over-educated three years later, suggesting that graduates are far more likely to remain over-educated than to become over-educated after having been in skilled employment. The most likely outcome suggested by Table 3.3, however, is that graduates secure appropriate work after course completion and remain in such for at least three years afterwards.

Table 3.3
Transition into and out of over-education between 2007 and 2010[a]

	2010 job			
2007 job	Over-educated	Not over-educated	Total	*n*
Males aged 25 years and under				
Over-educated	20	80	100	125
Not over-educated	9	91	100	293
Total	12	88	100	-
n	52	366	-	418
Females aged 25 years and under				
Over-educated	38	62	100	281
Not over-educated	6	94	100	513
Total	17	83	100	-
n	138	656	-	794
Males aged over 25 years				
Over-educated	46	54	100	67
Not over-educated	11	89	100	166
Total	21	79	100	-
n	49	184	-	233
Females aged over 25 years				
Over-educated	37	63	100	99
Not over-educated	9	91	100	317
Total	16	84	100	-
n	66	350	-	416

Notes: [a] Figures are based on the subset of graduates who were employed in both survey years.

Table 3.4 shows the transition into and out of over-education on the basis of whether graduates changed jobs between 2007 and 2010. Considering those graduates who remain over-educated throughout, the majority of young graduates changed jobs at least once, while the majority of older graduates did not change jobs. Young graduates appear more active than their older counterparts in trying to escape from over-education, though one cannot rule out that the youth labour market is increasingly characterised by insecure forms of employment for those in lower-skilled jobs. The fact that a substantial minority of graduates were able to escape over-education without a change in job suggests that some employers do give additional responsibilities to

recently qualified staff. The converse is also true for graduates who go from being well-matched to over-educated, though this is not a common occurrence for those who secure appropriate employment after course completion. With regard to graduates who remained well-matched throughout, similar proportions across cohorts changed jobs, although the majority of graduates stayed in the job that they held shortly after course completion. Because they were already in appropriate employment, it is likely that many job changers did so simply for a better or different job opportunity.

Table 3.4
Relationship between over-education and job-changing behaviour between 2007 and 2010[a]

	Changed jobs between 2007 and 2010			
2007 job/2010 job[b]	Yes	No	Total	*n*
Males aged 25 years and under				
O/O	68	32	100	25
O/N	65	35	100	100
N/O	74	26	100	27
N/N	41	59	100	266
Females aged 25 years and under				
O/O	67	33	100	107
O/N	76	24	100	174
N/O	71	29	100	31
N/N	47	53	100	482
Males aged over 25 years				
O/O	39	61	100	31
O/N	56	44	100	36
N/O	72	28	100	18
N/N	41	59	100	148
Females aged over 25 years				
O/O	32	68	100	37
O/N	58	42	100	62
N/O	66	34	100	29
N/N	42	58	100	288

Notes: [a] Figures are based on the subset of graduates who were employed in both survey years. [b] O = over-educated; N = not over-educated.

3.5.2 Effect of over-education on wages

Table 3.5 gives log hourly earnings estimates, where the coefficients are approximately equal to percentage differences. Considering first the OLS estimates [Equation (3.1)], young females and older males who were over-educated shortly after course completion were at an earnings disadvantage in comparison with their well-matched peers, suggesting that some young males and older females are able to find equal or better paying non-professional jobs. After three

years, however, over-educated graduates across all four cohorts experienced a similar earnings penalty relative to those in appropriate employment. These range from 9% for older females to 13% for older males.

Table 3.5
Wage effects of over-education: main effects[ab]

	OLS		
Variable	2007	2010[c]	Fixed Effects
Males aged 25 years and under			
Over-educated	-0.0080	-0.0975**	0.0309
	(0.031)	(0.042)	(0.031)
n	446	418	836
Prob > *F*	0.0000	0.0000	0.0000
R-squared	0.24	-	0.61
Lambda	-	0.0333	-
		(0.098)	
Females aged 25 years and under			
Over-educated	-0.0519***	-0.1030***	-0.0058
	(0.020)	(0.025)	(0.023)
n	863	794	1,588
Prob > *F*	0.0000	0.0000	0.0000
R-squared	0.15	-	0.62
Lambda	-	-0.0348	-
		(0.078)	
Males aged over 25 years			
Over-educated	-0.1322**	-0.1252**	-0.0954**
	(0.055)	(0.054)	(0.045)
n	245	233	466
Prob > *F*	0.0001	0.0000	0.0000
R-squared	0.29	-	0.55
Lambda	-	0.1194	-
		(0.200)	
Females aged over 25 years			
Over-educated	-0.0262	-0.0930**	-0.1023***
	(0.035)	(0.039)	(0.034)
n	451	416	832
Prob > *F*	0.0000	0.0003	0.0000
R-squared	0.18	-	0.50
Lambda	-	-0.2219***	-
		(0.080)	
Controls			
Age/age squared	Yes	Yes	No
Major field of study	Yes	Yes	No
Final year work status	Yes	Yes	No
Employment characteristics	Yes	Yes	Yes
Job year	No	No	Yes

Notes: [a] Standard errors are in parentheses. [b] The dependent variable is log hourly wage. [c] Heckman corrected estimates.
* significant at 10%; ** significant at 5%; *** significant at 1%

The statistically significant selection term (lambda) for older female graduates suggests non-random selection into employment three years after course completion. No such bias is

observed for the other cohorts. The fact that lambda is negative implies that the unobserved factors that make ongoing participation more likely tend to be associated with lower earnings. Although the exact reason for this is not clear from our data, it may reflect that some higher-earning females in this age range are better placed to temporarily leave the workforce to start a family.

As OLS estimates may not properly take into account that over-educated graduates may possess different levels of motivation and ability, we control for unobserved heterogeneity using the fixed-effect model shown in Equation (3.2). The results from this model are presented in Table 3.6, alongside the corresponding OLS estimates. Two main findings emerge from the fixed-effects models. First, the earnings penalties for young over-educated graduates become smaller and no longer statistically significant, echoing findings from Bauer (2002), Frenette (2004), Tsai (2010), and Mavromaras et al. (2010) amongst others. This result suggests that young over-educated graduates may possess certain unobservable characteristics that contribute to lower earnings, such as lower ability, and hence may accept jobs beneath their education level simply because of this.

Second, the earnings penalties for older over-educated graduates remain statistically significant and similar in magnitude to the OLS estimates implying that, regardless of ability, older graduates earn less when they are employed in jobs that do not require a higher education. Earnings, therefore, appear to be more closely associated with the characteristics of the job than the characteristics of the graduate. Because we cannot easily attribute over-education amongst older graduates to lower ability, we must assume that some are over-educated due to search frictions (Tsai, 2010), while others may be so by choice. Our data do not distinguish between voluntary and involuntary over-education.

Table 3.6
Wage effects of over-education: field of study interactions[ab]

	OLS		
Variable	2007	2010[c]	Fixed Effects
Males aged 25 years and under			
Over-educated[d]	0.0533	-0.0136	0.0104
	(0.048)	(0.074)	(0.054)
Over-educated*technical majors	-0.0723	-0.1205	-0.0132
	(0.063)	(0.102)	(0.069)
Over-educated*health/education	0.0206	-0.0363	0.2291*
	(0.114)	(0.145)	(0.135)
Over-educated*society and culture/arts	-0.1701**	-0.1492	0.0677
	(0.071)	(0.111)	(0.078)
n	446	418	836
Prob > *F*	0.0000	0.0000	0.0000
R-squared	0.24	-	0.61
Lambda	-	0.1117	-
		(0.103)	
Females aged 25 years and under			
Over-educated[d]	-0.0935***	-0.1351***	-0.0342
	(0.033)	(0.046)	(0.042)
Over-educated*technical majors	0.0043	-0.0770	0.0345
	(0.051)	(0.075)	(0.067)
Over-educated*health/education	0.0665	0.0388	0.0423
	(0.057)	(0.074)	(0.075)
Over-educated*society and culture/arts	0.0915**	0.0849	0.0398
	(0.042)	(0.059)	(0.051)
n	863	794	1,588
Prob > *F*	0.0000	0.0000	0.0000
R-squared	0.15	-	0.62
Lambda	-	-0.0601	-
		(0.079)	
Males aged over 25 years			
Over-educated[d]	-0.3022***	-0.1303	-0.1684**
	(0.100)	(0.089)	(0.084)
Over-educated*technical majors	0.1008	0.2302*	0.1085
	(0.135)	(0.132)	(0.112)
Over-educated*health/education	0.5244***	-0.1685	-0.1714
	(0.173)	(0.168)	(0.195)
Over-educated*society and culture/arts	0.2796*	-0.1441	0.1967
	(0.145)	(0.126)	(0.123)
n	245	233	466
Prob > *F*	0.0000	0.0000	0.0000
R-squared	0.32	-	0.56
Lambda	-	-0.0237	-
		(0.196)	
Females aged over 25 years			
Over-educated[d]	-0.0516	-0.0226	-0.1001
	(0.073)	(0.089)	(0.069)
Over-educated*technical majors	-0.0797	-0.1524	-0.0066
	(0.127)	(0.127)	(0.116)
Over-educated*health/education	0.0066	-0.0926	-0.1253
	(0.099)	(0.108)	(0.094)
Over-educated*society and culture/arts	0.0818	-0.0671	0.0749
	(0.090)	(0.108)	(0.087)

Table 3.6 (*Continued*)

	OLS		
Variable	2007	2010[c]	Fixed Effects
n	451	416	832
Prob > *F*	0.0000	0.0006	0.0000
R-squared	0.18	-	0.51
Lambda	-	-0.2661***	-
		(0.079)	
Controls			
Age/age squared	Yes	Yes	No
Major field of study	Yes	Yes	No
Final year work status	Yes	Yes	No
Employment characteristics	Yes	Yes	Yes
Job year	No	No	Yes

Notes: [a] Standard errors are in parentheses. [b] The dependent variable is log hourly wage. [c] Heckman corrected estimates. [d] The omitted base case is *management and commerce*.
* significant at 10%; ** significant at 5%; *** significant at 1%

We lastly investigate the impact of major field of study on the wage effect of over-education by incorporating four over-education*field interaction terms into our earnings functions. We combined the seven major fields of study included as controls in our initial wage equations into three dummy variables to avoid overly low numbers of observations. These are: "technical majors", which includes the sciences, information technology and engineering fields; "health/education" and "society and culture/arts", both of which are self-explanatory. The field of "management and commerce" remained the omitted base case. Estimates are presented in Table 3.6. Considering only the fixed-effects estimates [Equation (3.2)], the only statistically significant earnings penalty (at the 5% level) emerges for older males graduating in management and commerce, whose over-education penalty is estimated at 17% of their earnings. Young male health/education graduates receive a 23% earnings *premium* as a result of working in a job that does not require a higher education. Although this estimate was only significant at the 10% level, it might suggest that young men from these fields can find better-paying jobs outside of the graduate labour market.

3.6 Conclusions and implications

Using a new panel data set on recent Australian bachelor degree graduates, we investigate the incidence of over-education and its effect on earnings, both immediately after course completion and three years later. We find that between 24% and 37% of graduates were over-

educated for the jobs they held shortly after course completion in 2007. The rate of over-education fell notably by 2010, especially for young graduates who were more likely to be over-educated initially. The extent of this fall, however, was far greater than that observed in earlier studies. The over-education rate varied considerably across major fields of study, which appeared to be strongly associated with the demand for skills vis-à-vis the supply of graduate labour. The majority of graduates who are over-educated shortly after course completion are no longer over-educated three years later, reflecting that over-education can be a stepping-stone into appropriate employment. Becoming over-educated after having been in skilled employment was not a common occurrence. Importantly, while many graduates are able to escape over-education within three years, a nontrivial proportion of graduates remained over-educated throughout. This finding is somewhat troubling, given that over-education has been linked in the past to lower job satisfaction, reduced individual-level productivity and lower firm-level profits (e.g. Tsang & Levin, 1985).

With regard to the effect of over-education on earnings, we identified a notable age-related effect not identified in earlier studies. After controlling for unobserved heterogeneity using a fixed-effects model, the earnings of young over-educated graduates did not differ significantly to those of their well-matched peers. This suggests that earnings penalties observed using OLS are the result of the former group having relatively lower ability, or other unobserved characteristics, which might also explain their over-education in the first place. Older over-educated graduates, however, remained at an earnings disadvantage after we accounted for unobserved heterogeneity, suggesting that earnings are more closely associated with the characteristics of the job than those of the graduate. This suggests to reject a strict human capital interpretation of the returns to a higher education, at least for older graduates. They may be over-educated due to bad luck in their job search, or it could be voluntary in some cases. The inclusion of a job satisfaction measure in the BGS would allow us to make such a distinction.

From a policy standpoint, these results may be cause for some concern. Because a higher education qualification is unlikely to confer a substantial productivity advantage if it is surplus

to the requirements of an occupation, the extent of over-education discussed here is consistent with a skills' surplus in many areas of the Australian graduate labour market, and inefficient public and individual investments in human capital. Over-education would not be such a concern if it was strictly a short-term phenomenon; however our results show that a non-negligible number of graduates are still over-educated three years after course completion. Far from being guaranteed an escape from over-education, these graduates will need to compete with successive waves of new graduates for a finite number of professional jobs after having spent an extended period of time in lower-skilled work. This in itself may send a negative signal to prospective employers, making an escape from over-education increasingly unlikely.

A contributing factor of over-education identified in this study was excess supply of graduates from particular major fields of study. An obvious solution to reducing over-education is to limit the number of students graduating from these fields, so that supply is more in accordance with demand. While obvious, this solution is somewhat problematic in that the majority of fields exhibiting the signs of excessive supply are also arguably "cash cow" degrees for higher education providers, which generate needed student-based income. Over-education in these fields will likely increase in the immediate term as Government-imposed caps are removed from higher education enrolments, unless demand for these degrees increases beyond the levels observed in our study.

Another means to address over-education could see prospective higher education students provided with detailed and objective pre-enrolment information concerning their likelihood of securing appropriate employment after the completion of their studies. This may encourage some would-be students into other pathways, such as VET, if they see that many graduates from their chosen field fail to find appropriate employment. On the demand side, the Australian Government may be well advised to establish policies that will stimulate demand for graduate labour, especially in fields that are necessary to secure Australia's future as a knowledge economy but currently show signs of limited demand for graduate skills, such as the sciences and other related technical disciplines.

While this study has provided new insights into over-education in the Australian graduate labour market, a three-years out perspective may not be sufficient basis on which to draw conclusions on graduate over-education in the longer-term. Follow-up studies of recent Australian graduates will provide further evidence concerning whether over-education is indeed a persistent feature of the graduate labour market, or is a temporary mismatch primarily afflicting recent graduates with limited post-study experience.

Chapter 4

Job search as a determinant of graduate over-education: evidence from Australia

Carroll, D and Tani, M. Job search as a determinant of graduate over-education: evidence from Australia. Education Economics. 2014 Apr. doi:10.1080/09645292.2014.908164

Declaration

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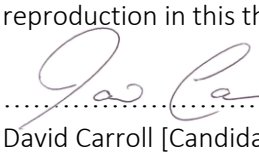

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David Carroll [Candidate]

4.1 Introduction

It is well documented that a substantial proportion of university graduates possess more education than is strictly required for them to perform their jobs, both at labour market entry and later in their careers (e.g. Carroll & Tani, 2013; Dolton & Vignoles, 2000; Frenette, 2004; Hartog, 2000). Over-education is costly, being associated with reduced earnings (e.g. Alba-Ramirez, 1993), lower job satisfaction and reduced productivity (e.g. Tsang & Levin, 1985). A common reason given for over-education is a lack of suitable job offers. Carroll and Tani (2013), for example, found that over-education rates in different academic disciplines are strongly correlated with discipline-specific unemployment rates. Similarly, Gottschalk and Hansen (2003), analysing over-education rates over time, found that graduates are more likely to be over-educated during periods of higher unemployment, presumably because skilled jobs are harder to come by.

There is some evidence, however, that factors other than the availability of suitable job offers lead to over-education. A recent survey of Australian employers found that 28% would have recruited more recent graduates had more suitable candidates applied (GCA, 2012a), at a time when 40% of recent bachelor degree graduates reported being in work that did not require a university education. This could suggest that graduates lack sufficient knowledge about the availability of suitable job offers, or that they may have insufficient knowledge about the suitability of specific job offers. In other words, information asymmetry in the job search process may contribute to over-education. Our study examines this premise by analysing the relationship between over-education and job search methods.

A common proposition in the job search literature is that informal search methods, such as personal contacts, are better than formal search methods at transferring detailed and trustworthy information between applicants and potential employers (e.g. Montgomery, 1991; Saloner, 1985). This should reduce the uncertainty in the hiring process for applicants and employers alike—the suitability of the job in the case of the former and the applicant in the case of the latter. In turn, this should lead to better quality job matches. Over-education may still occur, however, if jobseekers take up employment outside their area of expertise to shorten their job search (using sub-optimally their skills, as in Bentolila, Michelacci & Suarez, 2010), or when referrals for roles at an appropriate skill level cannot be found (e.g. Calvó-Armengol & Jackson, 2004; Datcher Loury, 2006).

Empirical evidence on how job search affects labour market outcomes is mixed (for a review, see Mouw, 2003). Franzen and Hangartner (2006) find that informal job search methods are associated with a lower over-education probability than formal search methods, whereas Kucel and Byrne (2008) report the opposite effect. Recent work by Blázquez and Mora (2010) suggests that graduates who find work through university careers offices are least likely to be over-educated. These contrasting outcomes are unfortunately of little help to university managers and education policymakers facing critical decisions about the funding needs of

careers offices at a time of shrinking budgets and low employment growth in high-income economies.

This paper adds empirical evidence to this literature by analysing the relationship between graduate over-education and job search methods based on a unique panel data set, the BGS, which collected labour market data on a single cohort of recent Australian graduates surveyed in 2008 and 2011. Our study's contribution is the use of a panel estimation methodology and hence the production of estimates that control for time-invariant unobserved differences across individuals, such as ability or motivation, which may be correlated with the use of different job search methods, and which studies based on cross sectional data could not address. Moreover, it highlights the potential role of job search methods in contributing to the observed incidence of education-occupation mismatch.

Our analysis considers five job search methods: university-based methods (graduate careers offices and fairs), advertisements, contact networks, direct employer contact and other methods not listed on the survey. The results show that finding employment via a university-based job search method is associated with a reduced probability of over-education compared with responding to an advertisement. The estimated effect arises for both young "traditional" graduates (aged less than 25 years) and older "non-traditional" graduates, with an average reduction of 6 and 3 percentage points (p.p.) for young males and females, respectively, and an 8 p.p. reduction for older graduates of both genders. Older males who found their jobs through direct employer contact were also on average 9 p.p. less likely to be over-educated.

These findings carry relevant implications for theory and policy, as they provide new insights into the causes of graduate over-education and possible institutional arrangements to reduce it. Expenditure on higher education in developed economies represents a substantial proportion of the government budget. Ways to understand and reduce over-education contribute to fostering labour market policies focused on efficiency.

The rest of the paper is organised as follows. Section 4.2 presents a brief review of the literature relating to the determinants of over-education, with a focus on those that address job search. Section 4.3 describes the data and variables used. Section 4.4 outlines our empirical strategy. Section 4.5 presents a discussion of results. Conclusions and implications are given in Section 4.6. Variables are defined in Appendix C.

4.2 Background

A broad international literature has shown that a substantial proportion of graduates work in occupations that do not notionally require a university degree and that these over-educated individuals are typically at an earnings disadvantage relative to their well-matched peers (for a review, see Kucel, 2011). Field of study has been shown to be a key factor influencing over-education, with over-education less likely amongst graduates from engineering, mathematics, sciences, law and medicine (Battu et al., 1999), and other "prestigious" courses (McGuinness & Sloane, 2011, p. 144). This may be related to the labour market demand for discipline-specific skills (Carroll & Tani, 2013). Over-education is also more likely for graduates who achieved low grades (Dolton & Silles, 2001). Even when using different measures of over-education, field of study and final grades emerge as consistent determinants (Verhaest & Omey, 2010). Over-education is more likely for graduates who were in work during their final year of study and those in part-time work in the graduate labour market (Dolton & Silles, 2001). Graduates are also more likely to be over-educated during periods of higher unemployment (Gottschalk & Hansen, 2003), presumably because skilled jobs are more scarce.

Three previous studies have investigated the relationship between job search and graduate over-education, the focus of this paper, in some detail. Franzen and Hangartner (2006), using cross-sectional data from the 2001 Swiss Graduate Survey, report that graduates who found their jobs through contact networks or direct employer contact were more likely to be in a job that required an appropriate qualification than graduates who found their jobs through formal search methods. Kucel and Byrne (2008), using a pooled cross section from the UK Quarterly Labour

Force Survey spanning 2003-2005 to investigate whether different search methods were associated with different over-education probabilities, report that responding to advertisements, using private employment agencies, and using search methods not listed on the survey reduced the probability of over-education relative to finding a job through contact networks. In fact, the only search method in their study that was associated with a higher probability of over-education than contact networks was the state employment office, which is known to be of limited effectiveness in matching workers with employers (Rees, 1966). It is not clear why the results on the use of social contacts differ to such an extent between these two studies, though it may be related to differences in the definition of their respective job search variables. Kucel and Byrne (2008) include only those who found their jobs through someone already in the firm in their social contacts category, while Franzen and Hangartner (2006) had access to a richer data on social contacts, including friends, relatives, colleagues, professors and former employers.

Blázquez and Mora (2010), using cross-sectional data from a 2001 survey of Spanish university graduates, report that those who found their jobs through a university careers office were the least likely to be over-educated, with a greater over-education probability associated with the use of advertisements (4 p.p.), personal networks (6 p.p.), public entry examinations (11 p.p.) and agencies (12 p.p.). This is consistent with the proposition that university careers reduce information asymmetry and improve job match quality between employers and their future employees. The result for public entry examinations was attributed to graduates taking public service jobs to achieve job security, even though the roles may be below their education level. The relative effectiveness of advertisements vis-à-vis personal networks is in line with Kucel and Byrne (2008); however the result for agencies is difficult to interpret without more information on this search method.

Based on the premise that over-education may be related to information asymmetry between applicants and employers, we would expect university-based job search to be associated with a reduced probability of over-education. Given the role of the university careers office, job offers obtained through this method should generally be appropriate for university graduates.

Likewise, employers seeking tertiary-educated workers should be confident that applicants from a university careers office possess the necessary educational background. Although there is evidence that job search through personal contacts results in better job match quality, this method is likely to be less effective for new graduates, as they generally may lack the contacts needed to secure high-skilled jobs. Applicants contacting an employer directly are typically screened based on observable characteristics, such as work history, so we would expect this method to offer new graduates, especially school-leavers, no advantage over job advertisements, which employ a similar screening method.

A common empirical limitation of these studies is that none are able to control for time-invariant unobserved differences across individuals, such as ability or motivation, which may be correlated with the use of different job search methods. An individual who invests time and effort in using a university careers office to find a job, for example, may be a more conscientious student than one who uses a less costly search method, and it is this unobserved characteristic rather than the job search method itself that influences their probability of over-education. This limits the ability of these studies to draw inferences about the nature of the link between job search and over-education. This limitation can be addressed somewhat if panel data are available by the inclusion of Mundlak (1978) correction terms in the econometric model, as these control for the "average" impact of the unobserved time-invariant individual effect.

We are able to do this thanks to a unique data set that surveys the 2007 graduating class in 2008 and again in 2011. Our approach builds on the result that field of study is an important determinant of over-education. In particular, we include controls for seven fields of study. We are unable to control for students' academic performance, as indicated by grades, as these are not available in the data set.

We split the sample into four gender-age cohorts, representing traditional school-leavers and the non-traditional mature-age cohort. As mature-age students, who represent 25% of undergraduate enrolments in Australia (DEEWR, 2008a), likely differ from school-leavers in terms of their

previous work experience and professional maturity, this may affect the success of different job search methods.

4.3 Data

Since 1972, graduates from Australian higher education institutions have participated in a representative national survey on their labour market outcomes around four months after completing their studies. The current incarnation of this survey is the AGS, which is administered annually by GCA. The BGS, on which our analysis is based, is a cohort-style follow-up survey to the AGS, with respondents invited to complete a survey on their activities three years after completing the AGS. The 2011 BGS surveyed graduates who completed their studies in 2007 and responded to the 2008 AGS. The response rate to the BGS was 20% and the resultant pool of responses was representative of the overall survey population (GCA, 2012b). Our cohort of interest is Australian resident bachelor degree graduates who were employed in Australia. From the initial sample of 11,744 graduates, we excluded 1,913 overseas residents, 4,436 graduates who had completed a postgraduate degree, 314 who were employed overseas, 253 who were self-employed,[24] 981 who were not working in both periods and a further 1,160 with missing data. Our analysis sample consists of 2,687 graduates, with two matched observations for each individual taken three years apart.

We used the Job Analysis method to construct our over-education dependent variable.[25] This choice was dictated by the survey data. Occupational skill levels from ANZSCO served as a basis for classification (ABS, 2006). The five skill levels in ANZSCO were coded into a binary variable to avoid small cell sizes. Graduates in Skill Level 1 occupations, requiring a bachelor degree or higher qualification, were classified as not over-educated. Graduates in the four non-degree skill levels were classified as over-educated. This definition implicitly underestimates the extent of over-education for postgraduates, hence our preference for a bachelor-only sample.

[24] Self-employed graduates were excluded as they are not relevant to an investigation of job search methods.
[25] For a discussion of the different over-education measures see, for example, Hartog (2000).

Occupations were manually coded by a team of trained coders on the basis of two open-text items: "what was the full title of your occupation?" and "what were the main tasks and duties in your job?". By categorising graduates on their tasks in addition to their occupation title, the main criticism of the JA method, the assumption that workers with the same occupation title are doing work of equal difficulty (Dolton & Vignoles, 2000), is at least partially addressed.

The key explanatory variables of interest are a set of four dummies indicating how graduates first found out about the job they held at the time of the survey. Graduates were presented with a list of 12 response options and were instructed to select only one. These responses were combined into five broad categories to prevent overly low numbers of observations. These are as follows: *university-based methods*, which include university careers offices and job fairs organised by the university; *contact networks*, which includes friends, relatives and work contacts; *direct employer contact*, which denotes job search by employing a potential employer directly; and *other methods*, which reflects methods not listed on the survey, for which we have no information. The omitted reference category, *advertisements*, covers print and online job advertisements. These variables can be thought of as job finding methods, since a job search method is only recorded in our data when it is successful. This presents a key drawback, common to the other studies in this literature. The BGS has no data on job offers that are not accepted, notably arrival rates and skill-level distributions for different search channels.[26] We acknowledge this as a limitation of our study.

As the BGS does not record the entire span of a graduate's labour market experience, we use age in years as a proxy for potential experience in our econometric models. The university quality variable is generated as the first principal component of two relevant university-level indicators, student-staff ratios and first-year attrition rates,[27] which are moderately and significantly correlated.[28]

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[26] The use of multiple job search methods has been noted by, for example, Holzer (1988).

[27] Student-staff ratios were computed based on data from DEEWR (2008a; 2008b). Data on first-year attrition rates were sourced from DEEWR (2009). Principal component analysis (n = 32) was used to

All variables are defined in Appendix C. Sample means for the variables used in the analysis are given in Table 4.1, stratified by gender-age cohort. Search method usage is fairly consistent across cohorts; however young graduates are somewhat more likely to use university-based search methods. Consistent with the other studies that have covered this topic, a substantial proportion of graduates in the sample find employment through contact networks; however a smaller proportion contacted employers directly than was the case in the study by Franzen and Hangartner (2006). Relative to Blázquez and Mora (2010), a broadly similar share of graduates in our sample use university-based search methods.

Table 4.2 shows over-education rates in each survey wave. The over-education rates soon after graduation are similar in magnitude to those in comparable studies (e.g. Dolton & Vignoles, 2000; Frenette, 2004). The over-education rates show a downward trend with time after graduation, though to a greater extent than in earlier studies.[29] Table 4.2 also reports the proportion of successful search methods in each survey wave. The most notable change is the general decline in the proportion of jobs found through university-based methods and the corresponding increase in the proportion found through advertisements and contact networks. Given that university careers offices serve to disseminate information on graduate job vacancies, it follows that this search method would be increasingly less useful as graduates move on to higher-level roles.

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generate our university quality variable. Both indicators loaded on one component, which explained 67% of the total variance. Factor scores were extracted and used in our econometric models. Smaller values of this variable are associated with higher-quality universities.

[28] Pearson's correlation was used: r = 0.341, n = 32, p = 0.070.

[29] Carroll and Tani (2013) attributed this to a relatively buoyant graduate labour market.

Table 4.1
Sample means

Variable	Name	Traditional (aged < 25)		Non-traditional (aged ≥ 25)	
		Male	Female	Male	Female
Over-educated	overed	0.269	0.314	0.225	0.217
Age	ageyr1	23.779	23.611	34.842	37.268
Sciences	majora	0.109	0.109	0.082	0.048
Information technology	majorb	0.096	0.008	0.109	0.021
Engineering and related	majorc	0.156	0.033	0.123	0.020
Health	majord	0.082	0.204	0.128	0.243
Education	majore	0.035	0.118	0.112	0.177
Society and culture	majorf	0.184	0.240	0.197	0.300
Creative arts	majorg	0.039	0.098	0.041	0.061
University quality	unqual	-0.438	-0.421	-0.167	-0.058
Paid work in final year of study	fywork	0.895	0.917	0.907	0.865
Working part time or casual	ptwork	0.163	0.221	0.117	0.236
University-based methods	jbscha	0.230	0.180	0.138	0.118
Contact networks	jbschb	0.250	0.230	0.247	0.237
Direct employer contact	jbschc	0.142	0.150	0.175	0.167
Other methods	jbschd	0.126	0.143	0.167	0.196
Employed in Vic	empsta	0.307	0.370	0.227	0.270
Employed in Qld	empstb	0.200	0.175	0.197	0.209
Employed in SA/NT	empstc	0.090	0.092	0.111	0.154
Employed in WA	empstd	0.082	0.069	0.107	0.121
Employed in Tas	empste	0.012	0.013	0.036	0.024
Observations (*n*)		1,024	2,400	732	1,218

4.4 Empirical approach

We estimate the probability of graduate over-education as a function of potential explanatory variables, including age, field of study, university quality, work status during final year of study, working on a part-time or casual basis, job search method and employment location. We add a time dummy for 2011 to account for time-specific factors that affect all individuals in the sample, such as labour market conditions. Using a binary over-education indicator as the dependent variable, we estimate the following random-effects probit model:

$$y_{it}^{*} = x_{it}\beta + c_i + e_{it} \qquad (4.1)$$

where $y_{it} = 1$ if the graduate is over-educated ($y_{it}^{*} > 0$) and $y_{it} = 0$ otherwise. x_{it} contains all of the observed explanatory variables, and the error term comprises an individual effect c_i, and a stochastic error term e_{it}, which are assumed to be distributed independently of x_{it}. As noted earlier, the assumption of zero correlation between the individual effect and the explanatory variables may be unrealistic in practice. Unobserved time-invariant factors, such as ability or

motivation, may affect selection into different job search methods. If this is not controlled for, the estimates on the effect of job search methods on over-education may be inconsistent.

Table 4.2
Over-education rates and proportions of successful search methods in the 2008 and 2011 survey waves

Year	Variable	Traditional (aged < 25)		Non-traditional (aged ≥ 25)	
		Male	Female	Male	Female
Over-education					
2008	Over-educated	32	40	29	27
	Not over-educated	68	60	71	73
2011	Over-educated	19	21	18	16
	Not over-educated	81	79	82	84
Job search method					
2008	Advertisements	22	28	25	26
	University-based methods	28	21	15	16
	Contact networks	23	21	22	21
	Direct employer contact	12	15	19	17
	Other methods	14	15	18	21
2011	Advertisements	27	32	32	28
	University-based methods	17	15	10	7
	Contact networks	28	24	25	28
	Direct employer contact	15	14	18	17
	Other methods	12	14	15	19
Graduates (*n*)		572	1,294	306	515

This potential problem is addressed by augmenting Equation (4.1) with the means of all time-variant explanatory variables (or "Mundlak correction terms"). Formally:

$$y_{it}^{*} = x_{it}\beta + \bar{x}_{i}\xi + a_i + e_{it} \qquad (4.2)$$

where $\bar{x}_i$ is the time average of x_{it} and a_i is the individual effect, with $a_i|x_i \sim N(0, \sigma_a^2)$. The intuition is that, although ability and motivation are time dependent, they are likely to vary more across individuals than across time for each individual. Hence, removing the average impact of the individual effect will ideally control for a substantial portion of this unobserved variable, with the result that the estimates on the time-varying variables, including job search method, should be consistent.

While an advance on previous studies, this approach still has two limitations. First, it does not account for time-variant factors. Some graduates may, for example, gain skills in their first jobs after graduation, which would influence their over-education probability but would not be

captured by our model. Another potential limitation is that this approach does not control for unobserved factors that may affect the graduate's decision to enter the labour market. Although roughly 80% of graduates in all four cohorts had a job when surveyed in 2008, there is a risk that those who do not participate in the labour market are a self-selected group.[30] We acknowledge these as limitations of the empirical approach.

4.5 Results

Table 4.3 reports probit coefficients from the estimation of Equation (4.1), along with average marginal effects (AMEs), for the key explanatory variables.[31] It is evident that finding a job using a university-based search method is significantly associated with a lower probability of over-education compared with responding to an advertisement (the reference category) across all four cohorts, with 18 p.p. and 14 p.p. observed for young males and females, respectively, and 13 p.p. and 15 p.p. for older males and females. This result broadly echoes Blázquez and Mora (2010) and is consistent with the earlier proposition that university careers offices reduce information asymmetry, leading to better match quality. Given their remit, university careers offices appear to provide graduates with reliable and detailed information on the availability of appropriate jobs for their level of education and experience. On the employer side, university-based search methods target individuals who are finishing a degree, which may lessen the uncertainty in the hiring process. Employers can be sure that they are recruiting individuals with the necessary educational background for skilled employment. In addition, investing time and effort in visiting a university careers office or fair may send a positive productivity signal to potential employers.

[30] To assess the potential importance of sample selection, we estimated for each cohort and panel wave a probit model with a Heckman-style sample selection correction. No significant selection effect was observed, which suggests that the results presented in this paper are robust. Full results of this testing are available on request.

[31] Results on the control variables are available from the authors on request.

Table 4.3

Random-effects probit coefficients and average marginal effects for the determinants of over-education[ab]

Variable	Traditional (aged < 25)		Non-traditional (aged ≥ 25)	
	Male	Female	Male	Female
Probit coefficients				
University-based methods	-0.8823***	-0.6932***	-0.6795**	-0.9235***
	(0.211)	(0.150)	(0.283)	(0.270)
Contact networks	-0.0192	0.2523**	-0.2501	-0.0906
	(0.176)	(0.126)	(0.219)	(0.180)
Direct employer contact	0.0632	0.2394*	-0.5687**	-0.2351
	(0.199)	(0.145)	(0.244)	(0.208)
Other methods	-0.2489	-0.0753	-0.2067	-0.1884
	(0.215)	(0.150)	(0.240)	(0.204)
Reference category: Advertisements				
Controls				
Age/age squared	Yes		Yes	
Major field of study	Yes		Yes	
University quality	Yes		Yes	
Paid work in final year of study	Yes		Yes	
Working part time or casual	Yes		Yes	
Employment location	Yes		Yes	
Job year	Yes		Yes	
Mundlak time-averages	No		No	
Average marginal effects				
University-based methods	-0.1797***	-0.1359***	-0.1275**	-0.1541***
Contact networks	-0.0039	0.0495**	-0.0469	-0.0151
Direct employer contact	0.0129	0.0470*	-0.1067**	-0.0392
Other methods	-0.0507	-0.0148	-0.0388	-0.0314
Observations (*n*)	1,024	2,400	732	1,218
Log likelihood	-465.73	-1088.08	-317.46	-501.48
Prob > *F*	0.0000	0.0000	0.0000	0.0000

Notes: [a] Standard errors are in parentheses. [b] The dependent variable is a dummy to indicate over-education.
* significant at 10%; ** significant at 5%; *** significant at 1%

Because random-effects estimates might be inconsistent due to unobserved time-invariant heterogeneity, we report the coefficients from the estimation of Equation (4.2) in Table 4.4. It can be seen that, even after controlling for the unobserved time-invariant individual effect, university-based job search is still associated with a significantly lower probability of over-education, with 6 p.p. and 3 p.p. observed for young males and females, respectively, and 8 p.p. for older graduates of both genders. The magnitude of the estimated effect is notably weaker in the Mundlak-corrected specification, however, which implies that at least some of the estimated effect may be attributed to graduates' unobserved characteristics. One explanation is that graduates who use university-based job search methods tend to be more capable individuals, or

are better screened prior to applying for the job, and this accounts for at least some of the estimated effect associated with this method.

Table 4.4
Mundlak-corrected random-effects probit coefficients and average marginal effects for the determinants of over-education[ab]

Variable	Traditional (aged < 25)		Non-traditional (aged ≥ 25)	
	Male	Female	Male	Female
Probit coefficients				
University-based methods	-0.5568*	-0.4480**	-0.7146*	-0.7883**
	(0.313)	(0.205)	(0.422)	(0.359)
Contact networks	0.2855	0.1449	-0.5207	-0.0237
	(0.262)	(0.171)	(0.333)	(0.243)
Direct employer contact	0.3656	0.0414	-0.7848**	0.0546
	(0.272)	(0.192)	(0.324)	(0.285)
Other methods	-0.1625	-0.1749	-0.1369	0.1212
	(0.292)	(0.196)	(0.347)	(0.281)
Reference category: Advertisements				
Controls				
Age/age squared	Yes		Yes	
Major field of study	Yes		Yes	
University quality	Yes		Yes	
Paid work in final year of study	Yes		Yes	
Working part time or casual	Yes		Yes	
Employment location	Yes		Yes	
Job year	Yes		Yes	
Mundlak time-averages	Yes		Yes	
Average marginal effects				
University-based methods	-0.0630*	-0.0328**	-0.0789*	-0.0790**
Contact networks	0.0278	0.0088	-0.0561	-0.0022
Direct employer contact	0.0346	0.0026	-0.0872**	0.0051
Other methods	-0.0176	-0.0119	-0.0136	0.0112
Observations (*n*)	1,024	2,400	732	1,218
Log likelihood	-461.19	-1073.98	-313.45	-495.53
Prob > *F*	0.0000	0.0000	0.0022	0.0000

Notes: [a] Standard errors are in parentheses. [b] The dependent variable is a dummy to indicate over-education.
* significant at 10%; ** significant at 5%; *** significant at 1%

Older males who found their jobs through direct employer contact were 9 p.p. less likely to be over-educated (see Table 4.4); however no advantage was observed for the other cohorts. Franzen and Hangartner (2006) reported a similar result, albeit in a pooled sample. It is not clear why the effectiveness of this search method should vary across cohorts to this extent, although it may reflect the type of job that graduates are seeking. Older graduates, who began study later in life and presumably have previous work experience that can be used as a productivity signal, may have more success in obtaining skilled work by approaching an employer directly than a traditional graduate with limited experience. The fact that the estimate is statistically

significantly different from zero for older males but not females suggests that males tend to have more previous work experience. Alternatively, it could underlie the presence of gender differences, and possibly discrimination, in occupational destinations. With reference to the field of education, Table 4.1 shows that males are more likely than females to study information technology, engineering, and management and commerce. It could be that employers in these fields are more likely to hire direct applicants than those in female-dominated fields, such as health and education. Young females who found work through direct employer contact had a greater probability of over-education in the conventional random-effects specification. Once the unobserved individual effect is controlled for, this result is no longer significant. This implies that young females who use this job search method may be of lower ability, on average, than their peers.

Using contact networks offers no advantage over job advertisements, which is consistent with Kucel and Byrne (2008) and Blázquez and Mora (2010), as well as many earlier studies that failed to find a positive link between informal job search and labour market outcomes. This could reflect the quality of graduates' contact networks. Since our sample consists entirely of new bachelor degree graduates, it is possible that, for many, their contact networks are not able to provide referrals for roles at an appropriate skill level. Also, their contact networks may use information on appropriate vacancies to improve their own situation rather than passing it along, since many would likely be graduate jobseekers themselves. Graduates may also opt to take lower-skill jobs through their contact networks to avoid unemployment. Younger female graduates who found work through direct employer contact were 5 p.p. more likely to be over-educated in the base specification; however this was again non-significant in the Mundlak-corrected model.

The residual category of other methods was not linked to a different probability of over-education in either specification, though this result may obscure a plethora of alternative job search methods used by respondents in this category (e.g. voluntary work, public employment office).

In light of the fact that graduates in part-time employment are more likely to be over-educated than their peers in full-time positions (Carroll & Tani, 2013), it is possible that the impact of job search on over-education may be indirect through their impact on part-time employment status. To this end, we performed a sensitivity analysis by re-estimating the models with no control for part-time employment. The results were generally robust to the removal of this variable; however the result on the university-based methods variable was no longer significant for older males at a 10% level, although the sign on this covariate remained negative. Young graduates of both genders who found their jobs via their contact networks were significantly more likely to be over-educated ($p < 0.10$) once the control for part-time employment was removed. For older males, this implies that university-based job search may reduce the probability of over-education by increasing the likelihood of full-time employment in the graduate labour market. The result for young graduates implies that the use of contact networks is associated with finding part-time work, which is consistent with the proposition that graduates may take lower-skilled jobs found through their contact networks to stave off unemployment.

4.6 Conclusions and implications

Although graduate over-education is a common and well-documented phenomenon, which is costly for both the affected individual and the wider economy, the determinants of over-education are not well understood. The purpose of this study was to analyse the link between job search and over-education for Australian bachelor degree graduates, using panel data from the 2011 BGS and an empirical approach that allowed us to control for the time-invariant unobservable characteristics of graduates affecting previous studies. The results show that finding a job using a university-based search method is associated with a reduced probability of over-education compared with responding to a job advertisement, although for older male graduates this effect may be indirect, through a greater likelihood of finding full-time work. Finding work through contact networks offered no benefit in terms of over-education probability relative to advertisements, and may even be detrimental for young graduates. Direct employer contact was associated with a reduced probability of over-education for older males

only, with no significant effect seen in the other cohorts. The differences between cohorts may be due to differences in work experience, or gender differences in occupational destinations.

In light of the evidence that university-based job search methods are associated with a reduced probability of over-education, it is somewhat surprising that this method is not more widely used by graduate jobseekers. Data from the 2011 AGS show that university-based search methods are used by only 47% of bachelor degree graduates as part of their job search strategy.[32] By contrast, 78% used advertisements, 61% contacted employers directly and 52% used their contact networks to search for work. These results suggest the potential benefit of providing incentives to graduands to make the necessary investment of time and effort to visit the university careers office, or better "advertise" it if a lack of awareness is responsible for the low usage of this search channel. Conversely, it could be that the low usage of university-based methods reflects a low offer arrival rate relative to other search channels. In this case, graduate jobseekers may be acting optimally by favouring channels that have higher arrival rates, even if they are associated with a higher probability of over-education. We are unable to investigate this empirically due to a lack of data on rejected offers, which means that this remains an important area for future research.

[32] Graduates who had searched for work in the 12 months prior to the AGS were instructed to identify all of the search methods they had used. This did not specifically relate to the job they held at the time of the survey, nor did it ask whether this job search was ultimately successful (GCA, 2012c).

Chapter 5

Returns to university quality in Australia: a two-stage analysis

Carroll, D, Heaton, C and Tani, M. Returns to university quality in Australia: a two-stage analysis. Submitted to Economics of Education Review, [2014 Oct]

Declaration

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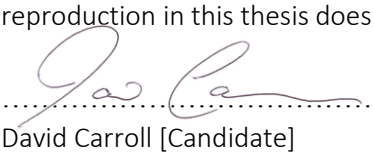

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David Carroll [Candidate]

5.1 Introduction

Over the past two decades, universities in a number of English-speaking countries such as Australia, Ireland, the UK and New Zealand have faced increased government pressure to raise their teaching and research quality standards. This pressure has taken the form of financial incentives for achieving desired educational targets, to which universities have responded by recruiting established or promising researchers and implementing activities to manage and enhance teaching performance, such as extra training for academics and well-defined course criteria against which students can form and evaluate their expectations.

Despite these initiatives, little research exists about the nexus between the "quality" of the tertiary institution from which one graduates and the earnings, or job quality, obtained in the labour market upon graduation. Theories of human capital formation purport the existence of a positive relationship between institutional quality and labour market outcomes as a result of superior human capital accumulation, signalling of ability, or their combined effect (e.g. Brewer

et al., 1999; Dale & Krueger, 2002; Long, 2008; Monks, 2000; Rumberger & Thomas, 1993). If empirically supported, this hypothesis justifies the existence of differential undergraduate fees across universities, as progressively introduced in the United Kingdom and Australia.

One major obstacle to empirical analysis of this topic is the common lack of data matching individuals with the characteristics of the educational institution attended. Typically the dependent variable is binary (e.g. high/low quality) to overcome the small number of cases in each institution. The literature generally finds very small or no positive earning premia associated with better quality or more prestigious universities, implying that earning differentials are effectively determined by course area and individual performance (e.g. Betts, Ferrall & Finnie, 2007; Birch et al., 2009; McGuinness, 2003).

This paper overcomes the small-data limitation as well as the selectivity affecting university choice thanks to a large pooled data sample sourced from the GDS. This survey collects information on graduates from all Australian universities. Using a two-stage estimation methodology, the empirical analysis tests whether the starting salaries of young Australian bachelor degree graduates differ on the basis of the university attended, *ceteris paribus*, and whether any differences in their returns to education are associated with institutional characteristics commonly associated with quality, such as the staff to student ratio and the proportion of faculty holding a PhD.

This study contributes to the literature on two fronts. First, it applies a novel approach for dealing with the potential non-random selection of students of different ability levels into universities, exploiting the cut-off scores of the Australian Tertiary Admissions Rank (ATAR), which determines their admission. Second, in addition to estimating the returns to attending specific universities, it attempts to explain these differences in returns empirically on the basis of widely accepted measures of university quality.

The results show that estimated returns do vary significantly across universities, but the range of the effects is 12 percentage points (p.p.) after controlling for exogenous personal and enrolment

characteristics, compared with 61 p.p. across course areas. There are few significant differences at the top and bottom of the distribution of 35 tertiary institutions relative to the middle, and these do not appear to be particularly strong. A one standard deviation increase in university quality is associated with an increase of 0.19 p.p. in the estimated university-specific wage premium.

These results suggest that the provision of human capital accumulation is relatively consistent across Australia's public universities, as found in other countries, and suggests that universities have little justification in raising their tuition fees relative to others solely on the basis of quality differences, real or perceived.

The rest of this paper is organised as follows. Section 5.2 presents a brief literature review and outlines our contribution. Section 5.3 describes the data and variables used in our analysis. Section 5.4 describes our two-stage estimation methodology. Results are presented and discussed in Section 5.5. Conclusions and implications are presented in Section 5.6. A formal derivation of the specification of our regression model is given in Appendix D.

5.2 Literature

In the literature estimating the returns to attending a high-quality college or university, "quality" has been measured in numerous ways. These include selectivity in admissions (e.g. Brewer et al., 1999; Monks, 2000; Thomas & Zhang, 2005), institution type (e.g. Birch et al., 2009; Monks, 2000), reputation (e.g. Milla, 2012), and various institution-level inputs, such as staff to student ratios, mean faculty salaries, and expenditures per student (e.g. Betts et al., 2007; Black & Smith, 2006; Long, 2008). Black and Smith (2006) use factor analysis to combine correlated institution-level inputs into a single, and intuitively more reliable, measure of latent college quality. In spite of these differences in measurement, most studies find that graduating from a high-quality institution is associated with increased post-completion earnings, but the magnitude of the estimated effect ranges from negligible to large (for a survey see Brand & Halaby, 2003).

From a theoretical perspective, there are two main reasons why institutional quality may influence graduates' earnings. Under a human capital interpretation (Becker, 1964), institutions may facilitate the production of human capital at different rates. If institutional factors such as class sizes and faculty qualifications are important in the human capital production function, then graduates of "better" institutions (i.e. those with more favourable ratios) should be paid a premium due to their enhanced productivity relative to their peers.

Under a signalling interpretation (Spence, 1973), employers, believing that attending a prestigious university is correlated with productivity, will pay a premium to graduates from these institutions, especially when institutional quality is more visible to employers than individual productivity, such as in the case of recent graduates with limited work histories. These two explanations are not necessarily mutually exclusive. In either case, as noted by Monks (2000), individuals seeking to maximise the net present value of their lifetime wealth should attempt to enrol in an institution whose graduates earn higher wages.

Establishing a causal relationship between institutional quality and earnings is difficult and problematic due to selection on the part of both the student and the institution (Long, 2008). As a result, students admitted to high-quality institutions may possess different characteristics to those admitted to lower-quality ones. If these characteristics are positively correlated with earnings, the premium associated with attending a high-quality institution will be overstated. To address this selection problem, most studies rely on what Heckman and Robb (1985, p. 243) refer to as "selection on observables", whereby variables typically associated with selection bias, such as test scores and family socioeconomic background, are entered as covariates in an earnings model (e.g. Birch et al., 2009; Chevalier & Conlon, 2003; Holmlund, 2009; Monks, 2000; Rumberger & Thomas, 1993; Thomas & Zhang, 2005). Monks (2000), for example, uses Armed Forces Qualifications Test scores as a measure of academic ability and preparation. He found that graduates from highly or most selective institutions tend to earn more than those from less selective ones, and that graduates from research-intensive and private universities earn more than those from liberal arts colleges and public institutions.

Dale and Krueger (2002) account for selection by comparing the outcomes of selective elite college graduates against those who gained admission to an elite college but did not attend. They generally found no difference in earnings between the two groups; however students from a low-income background did earn more if they attended a selective college. Their approach was criticised by Long (2008), who noted that there may be unobserved traits that prompt high-achieving students to attend less-selective colleges, which may in turn be correlated with their outcomes. As such, this technique may in fact exacerbate the selection problem.

Betts et al. (2007) employ a university fixed-effects approach, in which a set of university intercepts are included in the earnings model along with one or more university quality measures. To the extent that the most able students always attend certain universities, the intercepts remove the average ability of the university's student body from the earnings equation. They find that earnings are positively associated with high professor-student ratios and tuition fees, but only for males. Higher enrolments were associated with reduced earnings for graduates of both sexes. The key drawback of this approach is that it relies on variation in university characteristics over time, which may often be too strong an assumption in practice.[33] The inclusion of university intercepts nevertheless allows the returns to attending specific institutions to be estimated. Predicted earnings varied 26% across the 43 institutions in their study, but they cautioned that some of this may reflect sampling variation.

Brewer et al. (1999) use a multinomial logit to estimate the institution type chosen and then construct a correction factor based on Lee (1983), which is then included in the earnings equation as a covariate. Grouping colleges on the basis of selectivity, they report a large premium associated with attending an elite private college and a smaller premium to attending a middle-rated private collage, relative to a low-rated private college. A similar story is observed in relation to top-rated public institutions, though this evidence is weak due to small sample size. A limitation of the selection model approach is that it becomes difficult to implement as

[33] Kingston and Smart (1990), for example, note that institutional rankings change little over time. Indeed, a cursory examination of the data on university characteristics shows this to be true for Australia.

the number of institution types in the multinomial logit increases. The authors find little evidence of a selection effect, but emphasise that correcting for selectivity in the college selection process remains important in principle.

Long (2008) uses an instrumental variable approach to account for selection using college proximity as an instrument. He finds no significant effect of institutional quality on earnings using instrumental variables, but significant effects on a number of college characteristics when using ordinary least squares (OLS). As noted by Monks (2000), instrumental variables works well when there are few variables to instrument, but it becomes problematic as the number of variables increases. It also assumes the availability of suitable instruments, which must have a significant effect on institutional quality, while having no effect on earnings except via the instrumental variable. Finding instruments that meet these criteria may be difficult in practice.

While many studies investigate the returns to institutional quality in the USA and Europe, the Australian literature is much thinner. One notable study is that of Birch et al. (2009), who investigate whether the institution attended has an influence on graduates' starting salaries. Using data from the 2003 GDS and a selection on observables approach, they find little variation across university groups, echoing earlier results by Miller and Volker (1983), though variation in starting salaries between the universities with the lowest and highest estimated premia was 25 percentage points.

Relative to Birch et al. (2009), this study controls for the potential self-selection of students of various abilities into universities of different quality. In addition, it controls for regional effects in their earnings model. This is likely to be relevant given the extent of regional wage differences in Australia (e.g. Mishra & Ray, 2013), and the fact that most graduates find work in the region where their university is located, implying that the "true" effect of attending a particular institution may be overstated if it is located in a high-wage region. Finally, this study attempts to explain the differences in returns across universities by relating them directly to measures of quality covering both teaching and research.

5.3 Data and variables

The data used are pooled from three rounds of the GDS (2010-2012). The GDS is a national survey of Australian higher education graduates, administered by GCA since 1972. Each round consists of two separate collections to account for most Australian universities having two major graduation rounds each year. The GDS is conducted approximately four months after course completion. All new graduates from participating higher education institutions are invited to respond to the GDS, which includes all 39 Australian universities and a number of non-university higher education providers. Respondents are asked a range of questions relating to their activities on a given reference date with an emphasis on their labour market outcomes. The average response rate across the three rounds in the pooled sample was 55.8%. Previous studies (e.g. Guthrie & Johnson, 1997) have found that the GDS is not affected by non-response bias. We pool multiple years of data to increase the precision of the estimates, relying on the stability of the graduate labour market over the period (GCA, 2013).

Respondents are asked to report their annual salary in their main paid job. Since this earnings measure is less suitable for casual workers, the analysis is restricted to graduates in full-time jobs. The mean full-time starting salary of the graduates in the sample is $48,698 in 2012 Australian dollars. To eliminate regional effects from the analysis, the annual salary variable is normalised by dividing it by the mean salary in the employment region and multiplying by 100. The resulting variable has mean 100 and standard deviation 27.6, and is measured in percentage points. Normalisation is required because it is not possible to control for regional effects using the typical approach of regional dummy variables. This is due to the vast majority of new graduates finding work in the region where their university is located (92% of the graduates in the sample), leading to severe multicollinearity between regional and university dummies, and therefore inconsistent and unstable parameter estimates on the variables of interest.

The analysis is also restricted to “traditional” bachelor degree graduates aged less than 25 years at the time of the survey to reduce the influence of heterogeneity in work experience. The

analysis is further restricted to Australian domestic students due to the under-representation of overseas graduates in the sample. Finally, salaries in the top and bottom 2% of the distribution are also excluded to minimise the influence of extreme outliers. This results in a sample of 36,204 graduates. Definitions and means of the variables used are presented in Table 5.1.

Table 5.1
Summary statistics of explanatory variables[a]

Variable	Mean	Variable	Mean (St. Dev.)
Course area		ATAR cut-off score	57.808 (15.347)
Accounting	0.066		
Agriculture	0.005	Female	0.627
Architecture	0.007		
Built environment	0.024	*Occupation*	
Communications	0.050	Managers	0.057
Computing and information technology	0.036	Technicians and trades workers	0.033
Environmental studies	0.006	Community and personal service workers	0.042
Dentistry	0.002	Clerical and administrative workers	0.126
Economics	0.010	Sales workers	0.043
Education and training	0.097	Machinery operators and drivers	0.002
Engineering and technology	0.089	Labourers	0.008
Rehabilitation	0.047	(Professionals)	
Health services and support	0.037		
Tourism and hospitality	0.010	*Industry*	
Humanities and social sciences	0.038	Agriculture, forestry and fishing	0.004
Languages	0.009	Mining	0.017
Law	0.028	Manufacturing	0.031
Para-legal studies	0.010	Electricity, gas and water supply	0.010
Pharmacy	0.023	Construction	0.034
Sport and leisure	0.010	Wholesale trade	0.009
Mathematics	0.003	Retail trade	0.065
Medicine	0.014	Accommodation and food services	0.023
Nursing	0.083	Transport, postal and warehousing	0.013
Psychology	0.022	Information media and telecommunications	0.037
Sciences	0.041	Financial and insurance services	0.057
Social work	0.009	Rental, hiring and real estate services	0.013
Surveying	0.002	Administrative and support services	0.024
Veterinary science	0.003	Public administration and safety	0.070
Creative arts	0.024	Education and training	0.123
(Business and management)		Health care and social assistance	0.222
		Arts and recreation services	0.017
Survey year		Other services	0.012
Year 2010	0.313	(Professional, scientific and technical services)	
Year 2011	0.342		
(Year 2012)		*n*	36,204

Notes: [a] With the exception of ATAR cut-off score, all variables are dummy coded with 1 = named value and 0 = other values. Omitted reference categories are given in parentheses.

The empirical analysis is restricted to 36 Australian public universities, data on which can be found in the Commonwealth Higher Education Statistics Collection (HESC). Private universities and higher education providers are not subject to the same reporting requirements as

public universities, making it impossible to find key data. This restriction is not a major concern because the vast majority of Australian higher education students enrol in a public university.[34] Importantly, the University of Melbourne is also excluded from the analysis, as it is impossible to reliably match its ATAR cut-off scores to GDS records.

Because the Code of Practice governing the use of data from the GDS discourages the publication of institutional results, we assign each university a random identifier based on broad university group. Four groups currently exist: the Group of Eight (Go8) consists of the universities generally considered to be the most prestigious and research intensive in Australia;[35] the Australian Technology Network (ATN) consists of five universities, all former institutes of technology, with a heritage of working closely with industry; Innovative Research Universities Australia (IRUA) consists of seven universities, all formed in the 1960s and 1970s as research intensive universities; and the Regional Universities Network (RUN) comprises six universities located outside of capital cities. The groups were formed to promote the mutual objectives of the member institutions, and therefore represent universities with a similar style and focus. In addition, there are 11 universities that do not belong to a university group. To facilitate the analysis, we create 35 university dummy variables, with a Go8 university as the omitted reference category.

Summary statistics on the universities are presented in Table 5.2. These include the number of graduates in the analysis sample, the ratio of full-time equivalent (FTE) academic staff to one hundred FTE students, and the percentage of academic staff with a PhD.[36] It is notable that Go8 universities tend to lead in terms of staff to student ratios and academic staff qualifications, both of which are typical indicators of institutional quality. Also notable is the relative heterogeneity of the university groups in relation to these characteristics.

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[34] Public universities account for 93% of all higher education student load in Australia (DIICCSRTE, 2013a).
[35] The University of Melbourne, not included in our study, is a member of the Go8.
[36] Staff to student ratios were constructed using data from DIICCSRTE (2013a; 2013b). Data on academic staff qualifications were drawn from DIICCSRTE (2013b).

Table 5.2
Summary statistics on the universities in our analysis sample

University[a]	*n*	FTE staff per 100 FTE students[b]	Academic staff with PhD (%)
Group of Eight			
go81	403	11.599	80.129
go82	533	7.777	76.599
go83	1,811	6.795	68.096
go84	2,348	6.610	77.536
go85	1,019	7.899	84.579
go86	901	6.789	70.940
(go87)			
Australian Technology Network			
atn1	2,606	4.155	70.145
atn2	2,665	4.097	69.708
atn3	1,982	3.674	71.137
atn4	1,756	4.057	57.132
atn5	1,750	2.980	62.664
Innovative Research Universities Australia			
irua1	1,328	4.022	69.673
irua2	68	6.623	33.191
irua3	1,235	4.887	57.331
irua4	1,251	4.264	71.768
irua5	689	5.102	59.223
irua6	422	4.210	57.547
irua7	500	5.958	67.188
Regional Universities Network			
run1	398	3.155	63.253
run2	243	2.700	56.596
run3	321	3.590	62.500
run4	410	3.347	59.050
run5	369	2.874	48.232
run6	259	4.961	68.468
Ungrouped universities			
uni1	686	3.640	45.199
uni2	1,333	4.453	74.573
uni3	598	3.530	64.610
uni4	1,123	3.024	59.603
uni5	777	3.716	50.739
uni6	1,100	3.634	66.736
uni7	1,461	3.900	65.124
uni8	860	3.452	56.688
uni9	338	6.323	63.549
uni10	503	3.128	56.732
uni11	517	4.086	59.103

Notes: [a] All variables are dummy coded with 1 = named value and 0 = other values. The omitted reference university is *go87*. [b] FTE = full-time equivalent.

Since these indicators are noisy measures of latent university quality, we opt for composite indicator following Black and Smith (2006). Hence we apply a principal component analysis to

the two university quality measures (n = 35), and the first principal component, explaining 71% of the total variance, was extracted as university quality indicator.[37]

Our control variable for graduates' academic ability is course-level data on ATAR cut-off scores sourced from the HESC (see Section 5.4). The ATAR is the main criterion for entry into most undergraduate degrees in Australia.[38] It is a percentile score denoting a student's ranking relative to his or her peers upon completion of secondary education. The ATAR cut-off scores denote the lowest ATAR that was accepted into a particular course of study. The cut-off scores were matched to the graduates in the sample on the basis of their institution and course area.

5.4 Estimation methodology

One of the key challenges in estimating the returns to university quality is addressing the potential non-random selection of students into universities. This is exacerbated by the fact that the data do not contain individual-level proxies for academic ability, such as test scores or grade point averages. It is nevertheless possible to use course-level data on ATAR cut-off scores, which establish a lower bound for the course to which the graduate was admitted, and the statistical property of the cut-off ATAR scores, which are ranks uniformly distributed in the 0-100 range. Consider the regression model:

$$y_i = \beta_0 + \sum_{j=2}^{m} \alpha_j D_{ij} + \gamma A_i + \varepsilon_i \qquad (5.1)$$

where D_{ij} is a set of dummy variables indicating course and A_i is the ATAR of student i, which is unobservable. Two types of selection are likely to occur. First, universities select students on the basis of their ATAR. Second, students self-select into their preferred university, presumably also based partly on ATAR, as those with high scores may be less willing to enrol in courses with low cut-offs. Both of these selection mechanisms will result in dependence between A_i and

[37] The resulting university quality scores are strongly correlated with those produced by Williams (2007) (r = 0.807), which were relatively more focused on institutional research performance.
[38] The ATAR is not used in Queensland, which retains its Overall Position (OP) system. A table is produced by tertiary education authorities to allow conversion between OP and ATAR.

D_{ij}. However, neither selection mechanism violates the standard assumption that the error term ε_i in Equation (5.1) has an expected value of zero conditional on A_i and D_{ij}. If individual-level ATAR data were available, the estimation of Equation (5.1) would be unproblematic. However A_i is not directly observed and estimating Equation (5.1) without it results in the compound error term $\gamma A_i + \varepsilon_i$ being correlated with the course dummies D_{ij}, leading to inconsistent OLS estimates.

This problem is solved by the fact that the course in which the graduate enrolled and the corresponding ATAR cut-off score, which will be denoted by c_i, are observed. The key feature of the ATAR is that it is a rank and consequently it is uniformly distributed between the values of 0 and 100. Since, by construction, the ATAR of each enrolled student is at least as high as the minimum course ATAR cut-off score, it is possible to exploit the statistical properties of the uniform distribution and the observed cut-off score to control for non-random selection into each course area to obtain the regression model (see Appendix D for a formal derivation of the specification):

$$y_i = \beta_0 + \sum_{j=2}^{m} \alpha_j D_{ij} + \gamma \frac{100+c_i}{2} + \eta_i \qquad (5.2)$$

where

$$\eta_i = \gamma A_i - \gamma \frac{100+c_i}{2} + \varepsilon_i. \qquad (5.3)$$

Since the expected value of the error term conditional on the course cut-off score and dummy variable is zero and its variance is $\sigma^2 + \frac{\gamma^2}{12}(100 - c_i)^2$, the parameters in Equation (5.2) may be consistently estimated by OLS with robust estimation. Therefore, to the extent that the ATAR is a valid proxy, this approach allows one to control for graduates' academic ability and preparedness, estimating the true effect of attending a particular course at a specific university.

The empirical analysis is based on a two-stage estimation methodology to estimate the relationship between university quality and graduate starting salaries. This approach is not

commonly used in the university quality literature (e.g. Card & Krueger, 1992), but it offers two important advantages. First, it avoids aggregation bias in the standard errors resulting from the inclusion of university-level variables in the wage regressions (Moulton, 1986). Second, it allows one to illustrate the diversity in returns to attending specific universities and determine the extent to which these are associated with institutional quality.

As a result in the first stage, the normalised starting salary y_i is regressed on course area D_{ij}, the ATAR cut-off score c_i, a set of controls consisting of gender, occupation, industry and survey year dummies X_i, and a separate dummy variable for each university U_{ik}. Formally:

$$y_i = \beta_0 + \sum_{j=2}^{29} \alpha_j D_{ij} + \gamma \frac{100+c_i}{2} + \delta X_i + \sum_{k=2}^{35} \theta_k U_{ik} + \eta_i. \qquad (5.4)$$

Given the likely heteroskedasticity, Equation (5.4) is estimated using OLS with White's standard errors (first stage). The estimates of the average university premia $\widehat{\theta_k}$ are then regressed on the university quality indicator Q_k (second stage):

$$\widehat{\theta_k} = \beta_0 + \alpha Q_k + \varepsilon_k. \qquad (5.5)$$

Equation (5.5) is estimated using OLS. Donald and Lang (2007) provide a rationale for the use of OLS in this setting.

5.5 Results

We begin by estimating a variant of Equation (5.4) with a full set of university dummies and controls for survey year only, and present the estimated university effects in Figure 5.1. Each estimate is depicted with its 95% confidence interval. These results show a wide range in salary premia, with 22 p.p. separating the universities with the highest and lowest average starting salaries relative to the regional mean. For the most part, the increase in estimated premia is fairly gradual and even, with the exception of the two institutions at the top end of the distribution (go86 and go82) and the one at the bottom (run1). The universities go86 and go82 were the only two with a larger premium than the omitted reference university (go87), based on the fact that their estimated premia were greater than zero. In the case of go87, this does not

appear to be statistically significant. A series of *F*-tests indicates that the university dummies are jointly different from each other, as were the dummies constituting each of the five institutional groups. The latter result underscores the benefit of investigating individual universities previously highlighted by Birch et al. (2009), and could explain why in their study there was little variation in starting salaries across university groups.

Go8 and ATN universities are generally over-represented in the top of the distribution whilst the lowest-ranked Go8 (go85) is 20th out of 35 universities, with the lowest-ranked ATN (atn1) 21st overall. There is no clear pattern observed in relation to the other university groups. Notably, university (and survey year) account for very little of the variation in starting salaries, with an *R*-squared of 0.024. Birch et al. (2009) report a similar figure (0.015).

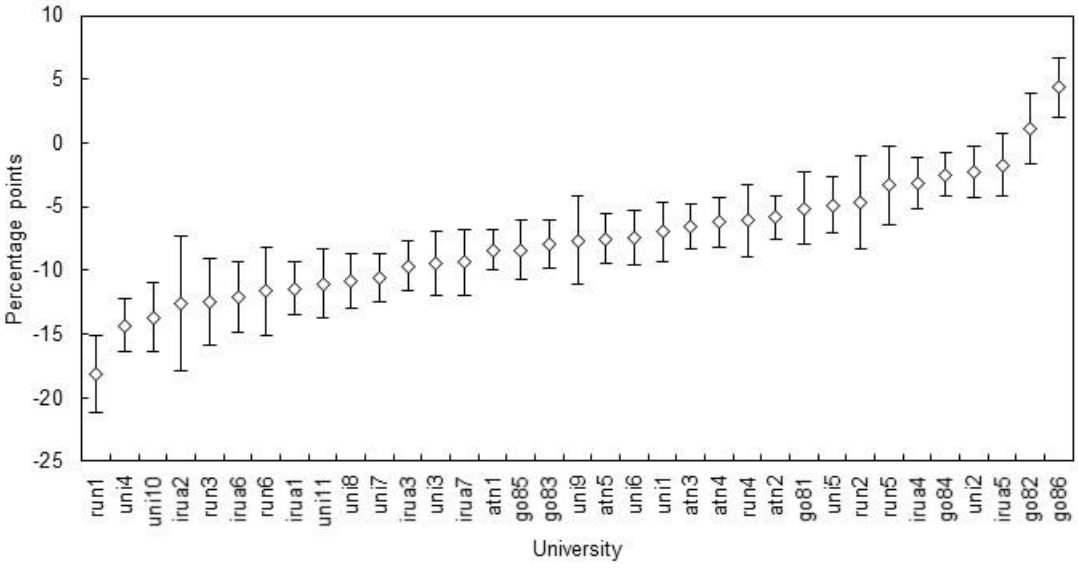

Figure 5.1. Estimated university effects from Model 1, with 95% confidence intervals.

Next, to control for differences in exogenous enrolment and personal characteristics, we augment the initial model with a set of dummies for course area, a dummy variable for females and the ATAR cut-off score for the course in which the graduate was enrolled.

The estimated university effects are presented in Figure 5.2 and the estimates on the control variables are given in the Model 2 column in Table 5.3. This model explains much more of the

variation in starting salaries, with an *R*-squared of 0.154. Of the additional controls, the 29 course area dummies provide the greatest increase in explanatory power, accounting for 14.1% of the variance in starting salaries.

Looking at the university effects in Figure 5.2, the addition of controls for enrolment and personal characteristics narrows the range in university premia, with only 12 p.p. separating the institutions at the top and bottom of the distribution. This increase in estimated premia is even more gradual with the addition of controls for enrolment and personal characteristics, which, given the importance of course area as a determinant of starting salaries, suggests that the outliers seen in Figure 5.1 can be attributed largely to differences in the courses undertaken by students.

The university estimates from Models 1 and 2 are strongly correlated, implying that the addition of controls for enrolment and personal characteristics has not changed the relative order of the universities to a great extent. Four Go8 universities, including the reference university, are at the top. The overlapping error bars suggest few significant differences at the top and bottom of the distribution relative to the middle; however an *F*-test soundly rejects the hypothesis that all 35 university dummies are equivalent.

As shown in Table 5.3, starting salaries vary considerably on the basis of course area, in line with the findings of numerous earlier studies (e.g. Betts et al., 2007; Birch et al., 2009; Chia & Miller, 2008; Rumberger & Thomas, 1993). Sixty-one p.p. separate the highest-earning course area (dentistry) and the lowest (pharmacy); considerably more than the 12 p.p. separating the universities with the highest and lowest estimated premia.

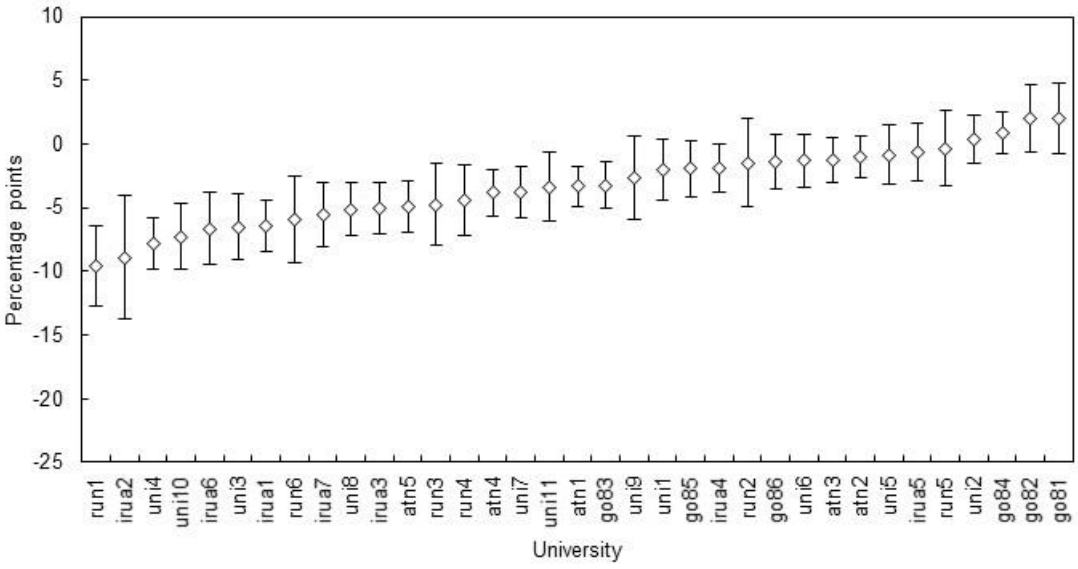

Figure 5.2. Estimated university effects from Model 2, with 95% confidence intervals.

Table 5.3
Results on control variables[ab]

Variable	Model 2	Model 3
Course area[c]		
Accounting	0.62 (0.57)	-1.75 (0.57)***
Agriculture	-8.21 (1.98)***	-3.06 (1.97)
Architecture	-19.02 (1.60)***	-17.52 (1.58)***
Built environment	7.99 (1.02)***	4.23 (0.99)***
Communications	-12.08 (0.65)***	-8.98 (0.65)***
Computing and information technology	6.48 (0.77)***	4.15 (0.73)***
Environmental studies	0.63 (1.99)	-1.86 (1.70)
Dentistry	39.41 (4.56)***	38.51 (4.47)***
Economics	5.28 (1.34)***	3.50 (1.27)***
Education and training	8.25 (0.55)***	1.37 (0.83)*
Engineering and technology	21.04 (0.60)***	13.91 (0.59)***
Rehabilitation	11.36 (0.71)***	7.08 (0.88)***
Health services and support	5.11 (0.86)***	3.44 (0.95)***
Tourism and hospitality	-9.62 (1.26)***	0.44 (1.27)
Humanities and social sciences	-4.06 (0.76)***	-2.36 (0.70)***
Languages	-5.42 (1.57)***	-4.14 (1.39)***
Law	6.67 (0.95)***	6.73 (0.93)***
Para-legal studies	-5.92 (1.42)***	-3.52 (1.32)***
Pharmacy	-21.60 (0.97)***	-14.22 (1.04)***
Sport and leisure	-6.01 (1.49)***	-3.63 (1.41)**
Mathematics	6.74 (2.34)***	3.06 (2.11)
Medicine	19.77 (1.36)***	16.56 (1.45)***
Nursing	-0.54 (0.59)	-5.00 (0.82)***
Psychology	-2.92 (1.00)***	-1.41 (0.91)
Sciences	-4.91 (0.87)***	-4.58 (0.79)***
Social work	5.33 (1.25)***	3.63 (1.21)***
Surveying	12.91 (2.91)***	8.70 (2.84)***
Veterinary science	-3.44 (1.86)*	-5.73 (1.83)***
Creative arts	-17.15 (0.92)***	-12.22 (0.88)***

Table 5.3 (*Continued*)

Variable	Model 2	Model 3
ATAR cut-off score	0.03 (0.03)	0.04 (0.03)
Female	-3.89 (0.32)***	-3.70 (0.30)***
Occupation[d]		
Managers		0.23 (0.62)
Technicians and trades workers		-9.68 (0.79)***
Community and personal service workers		-10.24 (0.82)***
Clerical and administrative workers		-9.53 (0.43)***
Sales workers		-16.26 (0.73)***
Machinery operators and drivers		-15.21 (3.08)***
Labourers		-24.08 (1.94)***
Industry[e]		
Agriculture, forestry and fishing		-0.84 (2.11)
Mining		34.39 (1.26)***
Manufacturing		3.76 (0.80)***
Electricity, gas and water supply		13.09 (1.21)***
Construction		10.28 (0.83)***
Wholesale trade		-3.35 (1.37)**
Retail trade		-12.00 (0.71)***
Accommodation and food services		-14.35 (0.94)***
Transport, postal and warehousing		1.50 (1.26)
Information media and telecommunications		-3.63 (0.72)***
Financial and insurance services		9.21 (0.61)***
Rental, hiring and real estate services		-1.45 (1.22)
Administrative and support services		-6.20 (0.81)***
Public administration and safety		9.46 (0.52)***
Education and training		5.03 (0.78)***
Health care and social assistance		1.87 (0.67)***
Arts and recreation services		-9.57 (1.06)***
Other services		-4.42 (1.30)***
Controls		
University	Yes	Yes
Survey year	Yes	Yes
n	36,204	36,204
Prob > *F*	0.000	0.000
R-squared	0.154	0.259

Notes: [a] Heteroskedastic-consistent standard errors are in parentheses. [b] The dependent variable is starting salary normalised by employment region. [c] The omitted reference category is *business and management*. [d] The omitted reference category is *professionals*. [e] The omitted reference category is *professional, scientific and technical services*.
* Significant at 10%; ** Significant at 5%; *** Significant at 1%

The results reveal that the coefficient on the ATAR cut-off variable is small in magnitude at 0.03 (0.03) and not statistically significant ($p > 0.100$). While seemingly counterintuitive, there are two plausible, non-mutually exclusive explanations for this result. First, high-ability individuals may self-select into course areas leading to better paid jobs, resulting in academic ability being captured by the course area dummies instead of the ATAR cut-off variable. To test this, we estimated Model 2 without the course area dummies. This resulted in the coefficient on

the ATAR cut-off variable increasing to 0.15 (0.03) and becoming statistically significant ($p <$ 0. 001), which is consistent with our hypothesis.

Second, it could be that many students who gained admission with a low ATAR drop out prior to graduation and thus do not appear in the data. Evidence in support of this is given by Kemp and Norton (2014), who report higher attrition rates amongst low-ATAR applicants.

Finally for the first stage, we augment Model 2 with sets of dummies for occupation and industry. The estimated university effects are presented in Figure 5.3 and the results on the control variables are given in the Model 3 column of Table 5.3. Adding controls for occupation and industry further narrows the range between universities to 8 p.p., largely due to a reduction of the negative premia associated with universities at the bottom of the distribution. This implies that some of the university effect may be attributed to graduates from certain universities being less likely to secure high-paying roles. Again, the *F*-tests establish that the estimated premia are still jointly different from each other, both in aggregate and within institutional groups.

The inclusion of controls for occupation and industry increases the explanatory power of the model considerably, with an *R*-squared of 0.259. The coefficients on both the occupation and industry dummies vary notably, indicating that employment characteristics play a key role in starting salary determination. Course area remain an important determinant of starting salaries, with much variation still observed after controlling for occupation and industry, albeit with changes in the premia associated with particular courses. No substantive changes are observed in relation to the coefficients on the ATAR cut-off and female variables.

Having established that starting salary premia vary significantly across universities, we attempt to explain them on the basis of the composite quality indicator. Since employment characteristics are likely endogenous, the second-stage model is based on the university estimates from Model 2. Figure 5.4 plots the university estimates against the quality indicator measured in *z*-scores. Again, the error bars represent the 95% confidence interval around each university estimate. The figure also depicts the OLS regression line formalised in Equation (5.5)

to relate the two variables. The coefficient on Q_k is 0.1934 (0.062), indicating a positive and significant relationship between university premia and quality, implying that an increase of one standard deviation in quality is associated with an increase in estimated premium of 0.19 p.p. This magnitude is small relative to that relating premia with the corresponding course area.

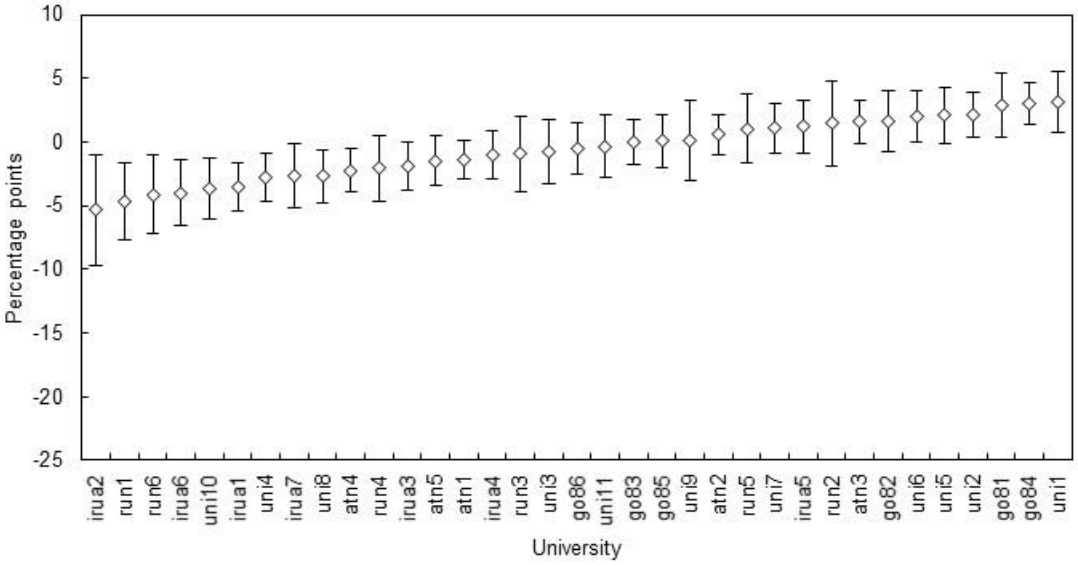

Figure 5.3. Estimated university effects from Model 2, with 95% confidence intervals.

Only four universities deviate seriously from the predicted relationship, exhibiting low university quality scores and relatively high premia compared with universities at a similar level of quality (run2, run5, uni1, uni5). This could be the result of institutional attributes not measured (or proxied) by the quality indicator that could lead to superior graduate labour market outcomes, such as links with industry or a favourable reputation with employers. Alternatively, it could be the result of local labour market factors not eliminated through the normalisation procedure. Estimating Equation (5.5) without these outlier institutions improves the fit considerably, with an *R*-squared of 0.532. The magnitude of the estimated coefficient on Q_k also increases to 0.2681 (0.047), providing further evidence of a general association between university quality and starting salaries.

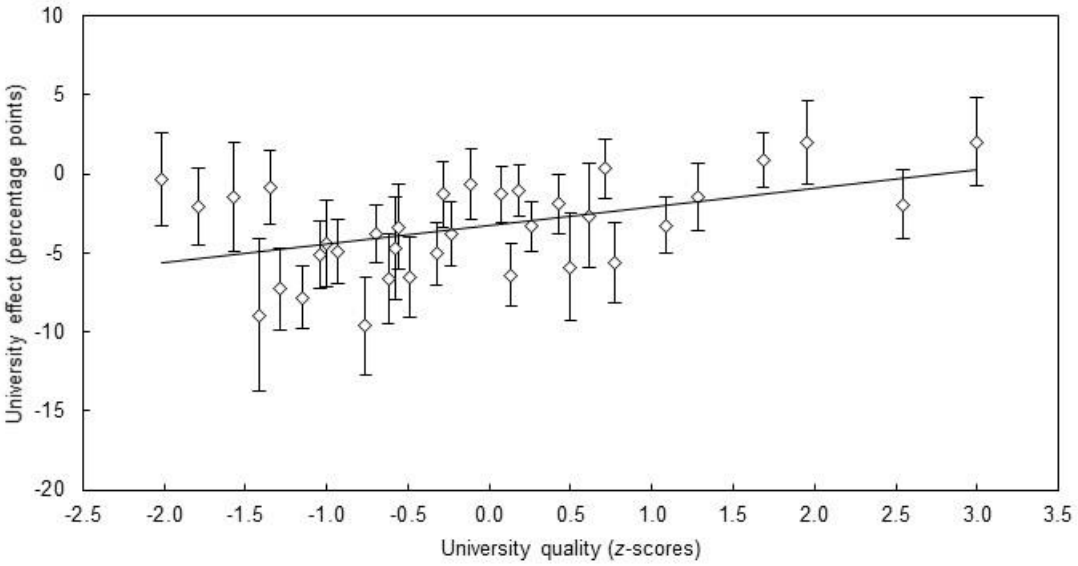

Figure 5.4. Estimated university effects from Model 2 vs. university quality scores.

To check the validity of the results, we perform two robustness checks. First, because graduates in full-time employment may constitute a non-random subsample, we add graduates not in full-time work and estimate Model 2 using Heckman's (1979) two-step procedure. The results obtained suggest no significant selection effect, and the university estimates are little affected by the inclusion of the selection bias control factor.

Second, we estimate Model 2 with the logarithm of the starting salary as the dependent variable to determine the extent to which regional effects influence the university premia. In terms of the first stage, using the logarithm instead of the starting salary normalised by region, results in substantial changes to the university estimates, with evidence of clustering by region. Moreover, the model estimated using the logarithm has a somewhat lower fit, with an *R*-squared of 0.115.

In terms of the second stage, regressing the estimated premia on university quality still yields a positive and significant relationship, but the strength of the relationship is weaker, with an *R*-squared of 0.179. From these results, we prefer the normalisation approach to transform the dependent variable, though in either case the results support the existence of a positive and significant, albeit small, relationship between quality and university premia.

5.6 Conclusions and implications

The empirical results are broadly consistent with much of the existing literature that finds a positive but weak association between university quality and graduate earnings (e.g. Black & Smith, 2004; Brewer et al., 1999; Chevalier & Conlon, 2003; Holmlund, 2009; McGuinness, 2003). Perhaps the most relevant finding is that the range of estimated university effects is quite narrow—12 p.p. after controlling for exogenous personal and enrolment characteristics—and that there are few significant differences in estimated effects at the top and bottom of the universities' distribution relative to the middle.

Given the degree of heterogeneity in university characteristics, these results are somewhat unexpected. We highlight three plausible explanations. First, the quality of undergraduate teaching may be more homogenous across universities than is implied by these characteristics, with the result that human capital production in Australian higher education institutions is only weakly related to the university attended. Since the sector is characterised by large public institutions subject to considerable central governmental regulation and oversight, there is less scope for large cross-university variation.

Second, it could be that university characteristics such as faculty qualifications and staff to student ratios are not as important to the production of human capital as this and other studies have assumed (e.g. Betts et al., 2007; Holmlund, 1999; Rumberger & Thomas, 1993).

Third, it could be that employers do not use institutional quality as a signal of unobserved productivity, at least for young bachelor degree graduates. Employers, facing imperfect information about the productivity of recent graduates may be unwilling to pay a premium solely on the basis of attending a particular university. Any human capital benefits associated with attending a prestigious university would therefore only be reflected in graduates' salaries once employers had learned their actual ability, potentially several years after labour market entry. To investigate this last point further, we estimate a simple panel data model with a random individual effect based on the BGS, which follows up a subset of graduates three years

after completing the 2009 GDS. Due to the relatively small number of graduates in the BGS analysis sample (n = 1015), we regress the logarithm of salary on the university quality indicator, time, an interaction term of these two variables, and the personal and enrolment variables from Model 2. The estimated coefficient on the quality*time interaction term is 0.0102 (0.010) and is not statistically significant ($p > 0.100$), providing some evidence that graduates from high-quality universities do not experience stronger early-career salary growth than those from lower-quality institutions after controlling for personal and enrolment characteristics. This is consistent with the proposition that human capital production is relatively homogenous across institutions.

From a policy perspective, the results suggest that even under a deregulated fee system, Australian universities appear to have little justification for charging undergraduate fees according to "quality" differences. Few, if any, significant differences in the returns to education between institutions at the top and middle of the distribution remain after controlling for differences in course offerings and student characteristics. This implies that the Australian higher education sector is not characterised by a handful of elite universities, at least as far as the graduate labour market is concerned. Universities would be more justified in setting their fees, at least in part, on the expected labour market outcomes for different course areas. Under the current system, students in economics and dentistry courses, for example, pay the same contribution, in spite of the latter group having a far greater earnings potential than the former.

Chapter 6

Conclusions

Worldwide investment in higher education is large and growing, making the economics of higher education a field of ever-increasing importance. This thesis has examined three crucial issues relating to the economics of higher education, specifically the incidence and wage effect of over-education, the role of job search as a determinant of over-education, and the relationship between university quality and graduate starting salaries. All three issues are examined in the context of the Australian graduate labour market, using recent and detailed data on the early-career outcomes of bachelor degree graduates drawn from two large-scale national surveys. Although based on Australian data, this thesis draws upon and contributes to international bodies of literature.

Concerning the incidence of over-education, the first essay of the thesis finds that between 24% and 37% of graduates are over-educated shortly after course completion and, while the over-education rate fell markedly within three years, a nontrivial proportion of graduates remain over-educated. A similar trend was observed in earlier overseas studies. Over-education rates vary considerably by major field of study and appear to be associated with the demand for discipline-specific skills in the graduate labour market. This suggests that a major contributing factor to over-education is an excess supply of graduates from particular fields of study, which is consistent with several studies that found a relationship between over-education and unemployment. This presents a challenge for education policymakers, since the oversupplied fields tend also to be popular with students, and are an important source of student-based income for institutions. A possible way of reducing over-education may be to provide prospective students with detailed and objective pre-enrolment information about their likelihood of securing appropriate employment after course completion, addressing the

information asymmetry that is presumably contributing to students' decisions to enrol in fields of study with limited labour market opportunities. On the demand side, the government may invest in strategies that stimulate demand for labour in fields necessary for the ongoing development of a knowledge-based economy but which currently show limited demand for graduate skills, such as the sciences and high-technology disciplines.

On the wage effect of over-education, I find that over-educated graduates suffer a wage penalty relative to their well-matched peers, supporting a large body of existing research. For young graduates, this appears to be the result of over-educated graduates having lower ability, or other unobserved characteristics, relative to well-matched graduates, which may help to explain their over-education in the labour market. Older over-educated graduates still suffer a wage penalty after controlling for unobserved heterogeneity, which suggests that wages are more closely associated with the characteristics of the job than of the graduate. This, in turn, suggests to reject a strict human capital interpretation of the returns to higher education, at least for older graduates. They may be over-educated due to bad luck in their job search or, for some, over-education may be voluntary.

Regarding job search as a determinant of over-education, the second essay concludes that finding a job through a university careers office is associated with a reduced probability of over-education compared with answering a job advertisement, consistent with the findings of one earlier study in the small literature on this topic. Finding a job through direct employer contact was associated with a reduced probability of over-education for older males only. Because university careers offices appear to be relatively more effective than other job search methods at matching the skills of graduates with the needs of employers, encouraging graduate jobseekers to use this search channel may be a way of reducing over-education, especially since earlier research points to the existence of unfilled vacancies for graduate employment, even when a substantial proportion of graduates are over-educated in their jobs. Understanding why this seemingly effective job search channel is not more widely used by graduate jobseekers is an important area for future research.

The third essay finds a positive but fairly weak association between university quality and starting salaries, echoing the findings of other studies in numerous countries. Average starting salaries differ significantly across universities after controlling for relevant confounding factors; however the range of estimated university effects is quite narrow in relation to other salary determinants, particularly course area. This suggests that employers do not generally place a substantial premium on attending a high-quality or prestigious university, at least upon workforce entry. This may be due to human capital production being more homogenous across universities than is implied by the heterogeneity in their characteristics, or potentially that institutional characteristics commonly associated with quality are not as important to human capital production as previously assumed. Moreover, it could be that employers do not use institutional quality as a signal of unobserved productivity for young graduates.

These results suggest that universities have little justification for charging markedly different undergraduate fees on the basis of quality differences, real or perceived. They would be more justified in setting their fees based on the expected labour market outcomes for different course areas, which vary notably. Likewise, for students seeking a high return on their educational investment, choice of course area appears more important than choice of institution.

The Australian Parliament is currently debating changes to university funding, which, if implemented, would see government caps on student fees removed. Under the current system, the government sets the maximum contribution a student can be charged for their course and pays the remaining amount. Under the proposed system, there will be no maximum contribution amount and universities can set course fees as they see fit. Moreover, the government will reduce its subsidy, leaving students to pay the difference (Parliament of Australia, 2014). If implemented, it will be interesting to see what impacts a deregulated environment has on the results presented herein.

If students are provided with pre-enrolment information on their expected labour market outcomes, requiring them to contribute a greater share to their education may see a fall in enrolments in fields with limited opportunities in the graduate labour market due to the probability of a suboptimal return on their investment. This should theoretically lead to a fall in the over-education rate as the oversupply of graduate labour in certain fields is corrected by market forces. Additionally, to the extent that the labour market uses course fees as a proxy for unobserved course quality, greater diversity in fees across universities may see an increase in the heterogeneity of returns to attending specific institutions; however the evidence of a negligible association between university quality and graduate earnings in countries with deregulated fee structures, such as the USA, casts some doubt on this hypothesis.

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Appendix A Analysis sample construction

Table A.1
Analysis sample construction for Essay 1

Exclusion	Cases
Overseas residents	1,624
Postgraduate degree completers	3,495
Graduates not in paid employment in 2007	653
Graduates employed overseas	244
Graduates with extreme wage values	626
Cases with missing data	1,464
Initial sample	10,111
Analysis sample	2,005

Table A.2
Analysis sample construction for Essay 2

Exclusion	Cases
Overseas residents	1,913
Postgraduate degree completers	4,436
Graduates employed overseas	314
Self-employed graduates	253
Graduates not working in both waves	981
Cases with missing data	1,160
Initial sample	11,744
Analysis sample	2,687

Table A.3
Analysis sample construction for Essay 3

Exclusion	Cases
Graduates from out-of-scope institutions	31,802
Overseas residents	83,100
Non-bachelor degree graduates	111,522
Graduates aged 25 and above	52,808
Graduates not in paid full-time employment	54,549
Graduates employed overseas	714
Graduates with extreme wage values	1,767
Cases with missing data	25,498
Initial sample	397,964
Analysis sample	36,204

Appendix B Variable definitions for Essay 1

This appendix defines the variables included in the analysis undertaken in Essay 1. All dummy variables have been coded such that 1 = yes and 0 = no.

lnhwage: Natural logarithm of hourly wage.

overed: Dummy variable to indicate over-education. Interaction terms denoted with *a* if **under** equals 1 and **majori** equals 1, *b* if **under** equals 1 and **majorj** equals 1, *c* if **under** equals 1 and **majork** equals 1.

ageyrs: Age in years at the time of the survey.

ageyrs2: Quadratic term for **ageyrs**.

major: Dummy variables to indicate major field of study; denoted with *a* if sciences, *b* if information technology, *c* if engineering and related, *d* if health, *e* if education, *f* if society and culture, *g* if creative arts, *i* if combined technical majors, *j* if combined health/education, *k* if combined society and culture/arts, base case being management and commerce.

workstud: Dummy variable to indicate that a graduate was in paid employment during his or her final year of study.

selfemp: Dummy variable to indicate that a graduate was self employed.

ptime: Dummy variable to indicate employment on a part-time or casual basis.

tenure: Number of months spent in current job at the time of the survey.

tenure2: Quadratic term for **tenure**.

emploc: Dummy variables to indicate employment location; denoted with *a* if New South Wales, *b* if Queensland, *c* if South Australia, *d* if Western Australia, *e* if Tasmania, *f* if Northern Territory, *g* if Australian Capital Territory, base case being Victoria.

sector: Dummy variables to indicate employment sector; denoted with *a* if mining, *b* if manufacturing, *c* if utilities, *d* if construction, *e* if wholesale and retail trade, *f* if accommodation and food services, *g* if transport and warehousing, *h* if information media and telecommunications, *i* if professional services, *j* if administration services, *k* if public administration, *l* if education and training, *m* if health care and social assistance, *n* if arts and recreation services, *o* if other services, base case being financial and insurance services.

jobyear: Dummy variable to indicate year 2010.

lambda: Selection bias control factor (see Heckman, 1979).

Appendix C Variable definitions for Essay 2

This appendix defines the variables included in the analysis undertaken in Essay 2. Dummy variables have been coded such that 1 = yes and 0 = no.

overed: Dummy variable to indicate over-education.

ageyr1: Age in years at the time of each survey wave.

ageyr2: Quadratic term for **ageyr1**.

major: Dummy variables to indicate major field of study; denoted with *a* if sciences, *b* if information technology, *c* if engineering and related, *d* if health, *e* if education, *f* if society and culture, *g* if creative arts, reference category being management and commerce.

unqual: University quality score.

fywork: Dummy variable to indicate that a graduate was in paid employment during his or her final year of study.

ptwork: Dummy variable to indicate employment on a part-time or casual basis.

jbsch: Dummy variables to indicate job search method; denoted with *a* if university-based methods, *b* if contact networks, *c* if direct employer contact, *d* if other methods, reference category being advertisements.

empst: Dummy variables to indicate employment location; denoted with *a* if Victoria, *b* if Queensland, *c* if South Australia/Northern Territory, *d* if Western Australia, *e* if Tasmania, reference category being New South Wales/Australian Capital Territory.

jbyear: Dummy variable to indicate year 2011.

m_ptwork: Mundlak time-average for **ptwork**.

m_jbsch: Mundlak time-average for **jbsch**.

m_empst: Mundlak time-average for **empst**.

Appendix D Derivation of the regression specification for Essay 3

This appendix provides a derivation of the specification of the regression model for Essay 3 [Equations (5.2) and (5.3)].

Recall that

$$y_i = \beta_0 + \sum_{j=2}^{m} \alpha_j D_{ij} + \gamma A_i + \varepsilon_i. \quad \text{(D.1)}$$

Assume that

$$E\left(\varepsilon_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = 0 \quad \text{(D.2)}$$

$$Var\left(\varepsilon_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = \sigma^2 \quad \text{(D.3)}$$

$$E\left(A_i \varepsilon_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = 0. \quad \text{(D.4)}$$

Since, by construction, (i.e. $A_i \geq c_i$), it follows that $\forall n \in \mathbb{N}$:

$$E\left(A_i^n \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = E(A_i^n | \{D_{ij}: j = 1, \dots, m\}, A_i \geq c_i). \quad \text{(D.5)}$$

It can be shown that the truncated uniform density for the ATAR is

$$f(A_i | A_i > c_i) = \frac{1}{100 - c_i} 1(c_i \leq A_i \leq 100). \quad \text{(D.6)}$$

From standard results for uniform densities and Equation (D.5):

$$E\left(A_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = \frac{1}{2}(100 + c_i) \quad \text{(D.7)}$$

$$Var\left(A_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = \frac{1}{12}(100 - c_i)^2. \quad \text{(D.8)}$$

Consequently, as an alternative to Equation (5.6), the following equivalent regression model may be written:

$$y_i = \beta_0 + \sum_{j=2}^{m} \alpha_j D_{ij} + \gamma \frac{100 + c_i}{2} + \eta_i \quad \text{(D.9)}$$

where

$$\eta_i = \gamma A_i - \gamma \frac{100 + c_i}{2} + \varepsilon_i. \quad \text{(D.10)}$$

Using Equations (D.7), (D.8) and (D.10), it is simple to show that $E\left(\eta_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = 0$ and $Var\left(\eta_i \middle| c_i, \{D_{ij}: j = 1, \dots, m\}\right) = \sigma^2 + \frac{\gamma^2}{12}(100 - c_i)^2$. Consequently, the parameters in

Equation (D.9) may be consistently estimated by OLS, and the standard errors of the parameter estimates may be consistently estimated using White's heteroskedasticity-consistent covariance matrix estimator (robust estimation).

Addendum: Revisions in response to examiners' comments

Comment 1.1

Truncate sentence 3 of paragraph 2 on p. 15 after 'appropriate employment', and then insert the following as a new sentence: "The negative wage effect of over-education has been documented in various countries, including the USA (e.g. Duncan & Hoffman, 1981; Rumberger, 1987; Verdugo & Verdugo, 1989; Tsai, 2010), the UK (Chevalier, 2003; Dolton & Silles, 2001; Dolton & Vignoles, 2000), Germany (e.g. Bauer, 2002), Spain (e.g. Alba-Ramirez, 1993), Canada (e.g. Frenette, 2004), Australia (e.g. Kler, 2005; Linsley, 2005; Mavromaras et al., 2010), and numerous developing economies (e.g. Metha et al., 2011). For systematic reviews of the evidence on over-education, see Leuven and Oosterbeek (2011), McGuinness (2006), and Groot and Maassen van den Brink (2000)."

Include the following new entries in the References section (pp. 80-9):

- Chevalier, A. (2003). Measuring over-education. *Economica, 70* (279), 509-531.
- Leuven, E., & Oosterbeek, H. (2011). *Overeducation and mismatch in the labor market* (Discussion Paper No. 5523). Bonn: IZA.

Comment 1.3

Insert the following section after paragraph 1 on p. 23: "In the first step of the Heckman two-step procedure, we estimate using a probit model the probability that a graduate is still working in the 2010 subsample as a function of age, major field of study, employment status during final year of study, and a dummy variable indicating that the graduate took a break of any duration from paid work between the two survey waves; the latter being an exclusion restriction (i.e. a variable affecting selection but not the outcome). We construct the inverse Mills ratio (lambda) from the estimated probabilities obtained in the first stage, which is then included as an additional control in the wage regression [Equation (3.2)]. A significant estimated coefficient on

the lambda term in the outcome equation indicates non-random selection into work in the 2010 subsample."

Comment 1.8

Replace sentence 1 of paragraph 2 on p. 13 with "Most studies into the over-education of tertiary-educated workers focus their attention on all degree holders and not just recent graduates."

Comment 1.9

Insert the following in sentence 1 of paragraph 2 on p. 17 after 'surplus education': "—that is, education in excess of that required for a particular job (Duncan & Hoffman, 1981)—".

Comment 1.11

Insert the following after sentence 6 of paragraph 1 on p. 45: "It is interesting to note, however, that around 13% of graduates still report being in jobs obtained through university-based methods three years after course completion. In many cases, this likely reflects graduates who are still in their first post-study jobs; however some may be graduates who have completed further postgraduate study between the two survey waves, or have remained in close contact with their university through the alumni association or their former lecturers. Data limitations with the BGS mean that we cannot say for certain."

Comment 1.13

Insert the following as a footnote at the end of sentence 3 of paragraph 1 on p. 38: "Some graduates may have taken jobs below their education level simply due to their having lower ability. Carroll and Tani (2013) provide some evidence of this relationship."

Comment 1.14

Truncate sentence 2 of paragraph 2 on p. 54 after 'combined effect', and then replace sentence 3 of paragraph 2 on p. 55 with the following: "While the literature is somewhat inconclusive, the general consensus is that there is a positive relationship between university quality and earnings (e.g. Behrman, Rosenzweig & Taubman, 1996; Black & Smith, 2004; Brewer et al., 1999;

Chevalier & Conlon, 2003; Hoekstra, 2009; Monks, 2000); however the institutional effect tends to be small (McGuinness, 2003),* and explains little of the total variance in earnings (James, Alsalam, Conaty & To, 1989; Rumberger & Thomas, 1993). This implies that earning differentials across universities are largely determined by other factors, with evidence showing that both course area and individual performance are key determinants of earnings for university graduates (e.g. Betts, Ferrall & Finnie, 2007; Birch et al., 2009; McGuinness, 2003)." Insert the following footnote at '*': "Some studies, however, report a more substantial effect (e.g. Brewer et al., 1999; Hoekstra, 2009; Thomas, 2003)."

Include the following new entries in the References section (pp. 80-9):

- Behrman, J.R., Rosenzweig, M.R., & Taubman, P.T. (1996). College choice and wages: estimates using data on female twins. *Review of Economics and Statistics*, 78 (4), 672-685.
- Hoekstra, M. (2009). The effect of attending the flagship state university on earnings: a discontinuity-based approach. *Review of Economics and Statistics*, *91* (4), 717-724.
- James, E., Alsalam, N., Conaty, J., & To, D. (1989). College quality and future earnings: where should you send your child to college? *American Economic Review, 79* (2), 247-252.
- Thomas, S.L. (2003). Longer-term economic effects of college selectivity and control. *Research in Higher Education*, 44 (3), 263-299.

Comment 1.15

'Remove 'Chevalier & Conlon, 2003' from the citations in sentence 4 of paragraph 3 on p. 57. Then insert the following as a new paragraph before paragraph 1 on p. 58: "A growing number of studies use matching techniques to estimate the returns to university quality, which rely on the "common support" assumption (i.e. there is a group of observationally similar graduates from high and lower-quality institutions whose outcomes can be compared) to account for the selection problem (e.g. Black & Smith, 2004; Brand & Halaby, 2003; Chevalier & Conlon, 2003). This method still assumes that all selection occurs on observables, but unlike regression-

based approaches, matching does not impose functional form restrictions, such as linearity. In their seminal paper, Black and Smith (2004) use propensity score matching to investigate the quality-wage effect. They report a positive association between university quality and wages in the USA, supporting the findings of much of the earlier regression-based literature."

Insert the following as a new paragraph after paragraph 2 on p. 59: "Behrman et al. (1996) use data on female twins born in Minnesota to difference out unobserved family characteristics. They find that graduates from high-quality institutions enjoy significantly higher earnings later in life. Hoekstra (2009) investigates the wage effect of attending the flagship state university using a regression discontinuity design that compares the earnings of graduates who were marginally above and below the cut-off for admission. He reports that attending the flagship state university is associated with substantially higher earnings for young white men."

Comment 1.16

Replace sentence 2 of paragraph 2 on p. 55 with "Most studies tend to group (ostensibly) similar institutions to overcome the small number of cases in each institution. While appropriate from the perspective of statistical power, amalgamating a large number of universities into a small number of quality groups could serve to obscure differences in returns to attending specific institutions." Then replace sentence 1 of paragraph 3 with "This paper overcomes the common limitation of small sample sizes at the institution level thanks to a large pooled data sample from the GDS."

Comment 1.18

Insert the following in sentence 3 of paragraph 2 on p. 64 after 'secondary education': ", which is calculated based on their overall academic achievement in Year 12". Then insert the following after sentence 3: "A student with an ATAR of 80, for example, has performed better than 80% of ATAR-eligible candidates." Then insert the following as a footnote at the end of sentence 4 of the same paragraph: "Our analysis is based on actual ATAR cut-offs in each course. These may differ from published cut-offs, which are determined prior to the admissions

round, depending on the number of applications, the standard of the applicants, and the number of places available in the course."

Comment 1.21

Replace sentence 2 of paragraph 1 on p. 66 with the following: "First, it avoids the problem of aggregation bias caused by combining variables measured at two different levels of aggregation (Moulton, 1986), specifically starting salary (individual) and university quality (university)." Then include the following before the last sentence of Section 5.4 on p. 66: "Both the outcome and explanatory variables in Equation (5.5) are measured at the same level of aggregation (university), thereby ensuring that our results are not affected by aggregation bias."

Comment 1.23

Insert the following after sentence 2 of paragraph 1 on p. 73: "In the first step, we estimate, using a probit model, the probability of a graduate being in full-time work as a function of the variables from Model 2. Additionally, we use as an exclusion restriction a dummy variable that equals one if the graduate is in paid work in his or her final year of study, which exploratory analysis showed was positively related to selection into full-time work but not directly related to starting salary. We then constructed the inverse Mills ratio (lambda) term in the conventional way." Then replace sentence 3 with "The lambda term is only statistically borderline significant (-2.69 [1.36], p = 0.48), and the university estimates are little affected by its inclusion in the outcome equation."

Comment 1.25

In sentence 4 of paragraph 2 on p. 60, replace "employment region" with "state or territory in which the graduate is employed,".

Comment 1.30

Replace sentence 1 of paragraph 2 on p. 72 with "Unexpected results are found in relation to four universities in the top left of Figure 5.4 (run2, run5, uni1, uni5), in that their graduates are

paid a relatively high premium compared with those from other universities at a similar level of quality."

Comment 2.1

Add the following as a new section after Section 1.1, titled "1.2 Economic returns to higher education: theoretical background". As a result of this addition, the current Sections 1.2, 1.3 and 1.4 will become Sections 1.3, 1.4 and 1.5, respectively. "This thesis examines economic returns associated with higher education, specifically job quality and earnings. Two main theories exist that attempt to explain the causal relationship between education and labour market outcomes, namely human capital and signalling."

"The human capital model (Becker, 1964; Mincer, 1958) is an elaboration of the intuitive notion that the function of education and training is to provide students with knowledge and skills that will be valuable later in life (Quiggin, 1999). Under the human capital model, education directly increases individual productivity by augmenting skills, which is reflected in higher earnings and better job quality. In relation to higher education, the basic model posits that individuals make the decision to attend university by comparing the discounted lifetime earnings they expect to receive if they attend university to the direct (e.g. tuition fees) and indirect costs (e.g. foregone earnings and leisure time) associated with attending. A rational student will therefore invest into his/her human capital up to the point where marginal revenue from this investment will equal the opportunity costs of resources needed for the investment. Thus, a narrow interpretation of the human capital model suggests that acquiring formal education is an investment decision. The human capital model may also be used to explain why students choose to enrol in different fields of study and at different higher education institutions. A student may, for example, choose to enrol at an institution with higher tuition costs if they believe that the present value of the benefits of attending that institution, such as higher future earnings, outweighs that of the costs."

"Human capital decisions are made under a great deal of uncertainty about future earnings. In the absence of information on the economic outcomes of higher education, students must rely on the experiences of students who have preceded them, and estimates of their own intellectual

abilities (Manski, 1993). An example of this could be a student who has insufficient information about the expected returns to different fields of study due to a lack of familiarity with higher education, and unwittingly enrols in a field with limited labour market opportunities. For this student, information asymmetry has led to him/her making a suboptimal human capital investment. Students also make their human capital decisions within varying labour market environments—students whose responses to labour market conditions can differ based on myriad factors, including gender and social status (Beattie, 2002). For these reasons, students at the same ability level and with the same capacity to borrow may still make different decisions about what constitutes the optimal level of investment in their human capital."

"A broader interpretation of the human capital model may encompass the acquisition of skills and knowledge that does not contribute to increased economic returns. As noted by Quiggin (1999), a knowledge of, and capacity to appreciate, literature, for example, provides a consumption stream not reflected in labour market outcomes. Under this interpretation, enrolling in a field with poor labour market opportunities may not necessarily constitute a suboptimal human capital investment if the returns sought are non-economic. Indeed, some individuals may study purely for the enjoyment of learning something new."

"In addition to formal education, individuals can augment their human capital stock through work experience and on-the-job training. All else being equal, the longer the duration of employment experience, the more skills are acquired, which should result in increased individual productivity. Similarly, good-quality work experience should theoretically be more conducive to human capital accumulation than low-quality experience. As an example, a graduate with a given duration of experience in a professional role will likely possess a more valuable stock of human capital than a graduate with an equivalent duration of experience in a low-skilled role, all else being equal. Thus, graduates with otherwise identical credentials may achieve substantially different outcomes in the labour market several years after course completion based on the duration and quality of their accumulated work experience, and on-the-job training."

"Whereas the human capital model proposes that education increases individual productivity by augmenting skills, the signalling model (Spence, 1973; Stiglitz, 1975) operates through the informational role of education. Under the signalling model, education provides a means of sorting students, resulting in the most able being placed into the most difficult, and best remunerated, jobs. Thus, the output of the education system is a ranking, the quality of which is determined by its correlation with the capacity to perform high status jobs (Quiggin, 1999)—education itself has no causal effect on individual productivity."

"From an individual's perspective, it matters little which model is most correct. Whether higher education endows an individual with human capital, or serves merely as a signal of existing human capital, labour market outcomes remain an increasing function of educational attainment. For an individual seeking to maximise the net present value of their lifetime wealth, the higher education decision rests more on the established positive correlation between education and labour market outcomes than the specific mechanism underpinning it. Moreover, because societies that allocate intelligent individuals to positions where they produce large externalities should have higher growth than ones that do not, education is arguably a good investment for society, even if only a signal of unobservable inborn ability (Lang, 1994).

"This thesis does not seek to present a formal test of the human capital and signalling models; an extensive, albeit inconclusive, literature already exists on this subject,* and, in any case, the two theories are not likely to be mutually exclusive. Rather, the human capital and signalling models are used as a framework for discussing the empirical results in the studies constituting this thesis."

Insert the following footnote at '*': "For reviews of the relevant literature, see Chevalier, Harmon, Walker and Zhu (2004), and Riley (2001)."

Include the following new entries in the References section (pp. 80-9):

- Beattie, I.R. (2002). Are all adolescent econometricians created equal? Racial, class, and gender differences in college enrollment. *Sociology of Education*, *75* (1), 19-43.

- Chevalier, A., Harmon, C., Walker, I., & Zhu, Y. (2004). Does education raise productivity, or just reflect it? *The Economic Journal*, *114* (499), F499-F517.
- Manski, C.F. (1993). Adolescent econometricians: how do youth infer the returns to schooling? In C.T. Clotfelter & M. Rothschild (Eds.), *Studies of supply and demand in higher education* (pp. 43-60). Chicago: University of Chicago Press.
- Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy*, *66* (4), 281-302.
- Murphy, K.M., Shleifer, A., & Vishny, R.W. (1991). The allocation of talent: implications for growth. *Quarterly Journal of Economics*, *102* (2), 503-530.
- Quiggin, J. (1999). Human capital theory and education policy in Australia. *Australian Economic Review*, *32* (2), 130-144.
- Riley, J.G. (2001). Silver signals: twenty-five years of screening and signaling. *Journal of Economic Literature*, *39* (2), 432-478.
- Stiglitz, J.E. (1975). The theory of "screening," education, and the distribution of income. *American Economic Review*, *65* (3), 283-300.

Comment 2.2

Insert the following as a new paragraph after paragraph 1 of Section 3.2 on p.15: "While over-education and its effects are well recorded, the question remains—why are some graduates over-educated? According to human capital theory (Becker, 1964), individuals are paid the value of their marginal product, which is determined by their human capital, rather than the characteristics of their jobs. Firms and employees are assumed to fully utilise their human capital, with over-education the result of labour market disequilibria—restrictive work practices or other labour market rigidities may prevent firms from utilising every individual's human capital and paying them the value of their potential marginal product (Green, McIntosh & Vignoles, 1999). Firms may, for example, be unable to easily adapt their production technologies to fully utilise the human capital available to them (Duncan & Hoffman, 1981; Rumberger, 1987). If some firms cannot adapt their production methods to take advantage of

their available human capital, then the productivity, and hence, the earnings of their workers may be less than they would be elsewhere (Dolton & Silles, 2001). On one hand, we might expect firms to find ways to fully utilise the human capital of their workers, thereby making over-education a short-term problem for the labour market; however, the extent to which this is true would depend on firms' capacity to utilise an ever-growing number of highly-educated workers. Consequently, over-education may also be a long-run problem."

"On the employee side, over-education may also be the result of having insufficient human capital in other areas, such as work experience (Alba-Ramirez, 1993), which may take additional time after graduation to accumulate. Therefore, graduates who begin their careers over-educated may, upon accumulating additional skills and experience, be promoted into jobs that allow them to utilise their education. Likewise, some graduates may be over-educated because they are low skill despite their high education. Some high-ability individuals may find themselves over-educated due to search frictions (Tsai, 2010), while others may be over-educated by choice. A graduate may, for example, prefer to work in a job in which his/her education is under-utilised than accept a high-skill job in another city, or one with less flexible working arrangements."

Include the following new entry in the References section (pp. 80-9):

- Green, F., McIntosh, S., & Vignoles, A. (1999). *'Overeducation' and skills – clarifying the concepts* (Paper No. CEPDP0435). London: Centre for Economic Performance, London School of Economics and Political Science.

In sentence 1 of paragraph 2 of Section 3.2, change 'this literature' to "the existing over-education literature".

Comment 2.3

Insert the following after paragraph 1 on p. 38: "Economic job search theory is grounded on the assumption that both employees and employers lack perfect information. In a perfectly competitive labour market, both parties would possess complete and accurate information about

the relevant characteristics of jobs, employers and jobseekers, and this would allow optimal matches between jobs and individuals (Huang & Western, 2012). Information asymmetries occur when employers and/or jobseekers lack relevant information. Jobseekers and employers try to minimise these information asymmetries by acquiring relevant information, but doing so is costly (Stigler, 1962). As such, an efficient search method may be viewed as one that enables the transfer of detailed and trustworthy information between jobseekers and employers at low cost. This would provide both parties with an improved understanding of each other's suitability, thus providing jobseekers and employers with a smaller set of alternatives to consider, which can be evaluated with greater ease."

"The choice of search methods may also be important because different methods give access to different pools of employment. Vacancies found through university careers offices would be more likely than those found through a job advertisement to require a university education, for example; however search methods vary in their cost and effectiveness for individual workers, which may discourage their use. The same is likely true from the employer's perspective—employers face considerable variations in vacancy durations and applicant quality with respect to their choice of recruitment strategies (Roper, 1988)."

Insert the following in sentence 1 of paragraph 2 on p. 38 after 'formal search methods': ", such as responding to job advertisements,". Insert the following at the end of paragraph 2: "In a like vein, university careers offices should be an effective job search method for graduates and employers of graduates alike. From the jobseeker perspective, university careers offices provide graduates with objective information about the availability of suitable job offers for their level of education and experience. From the employer perspective, university careers office provide a highly-educated applicant pool, thereby reducing uncertainty in the hiring process."

Include the following new entries in the References section (pp. 80-9):

- Huang, X., & Western, M. (2012). How do Australians search for jobs? In J. Pietsch & A. Haydn (Eds.), *Identity, fear and governance in the 21st century* (pp. 171-191). Canberra: ANU E Press.
- Roper, S. (1988). Recruitment methods and vacancy duration. *Scottish Journal of Political Economy*, *35* (1), 51-64.
- Stigler, G.J. (1962). Information in the labor market. *Journal of Political Economy*, *70* (5), 94-105.

Comment 2.4

In sentence 3 of paragraph 1 on p. 57, replace everything after 'production function,' with the following: "then high-quality universities (i.e. those with more staff per student, better-qualified faculty, etc.) would appear to provide their students with better resources for human capital improvement than lower-quality ones. Under a human capital interpretation, graduates from high-quality institutions should fetch a premium in the labour market due to their higher productivity relative to their peers, all else being equal." In sentence 1 of paragraph 2, replace 'prestigious' with "high-quality", then insert the following after 'productivity': "—in other words, that high-ability individuals choose to attend, and graduate from, high-quality universities." Insert the following sentence after sentence 1: "Employers may receive information regarding university quality from numerous sources, including published university rankings, previous experience with alumni of the institutions, and from the institutions themselves through their marketing efforts." In sentence 3 of paragraph 2, insert the following after 'mutually exclusive': "—indeed, it is probable that both the human capital and signalling theories account for any university quality premium."

Comment 2.5

Insert the following as a new paragraph after the last paragraph of Section 2.2 on p. 9. "As a labour market survey, the AGS has some limitations that must be acknowledged. First, it is possible that administering the survey only four months after course completion is too soon to obtain an accurate picture of graduates' labour market outcomes resulting from their degree—

indeed, this very issue prompted the development of the BGS (see Section 2.2). This is because, under a human capital interpretation of the returns to education, four months might be too short a time for employers to accurately observe and reward graduates' productive capacity. This is addressed in Essay 3 by performing a sensitivity analysis of the main results using BGS data."

"Second, the survey does not capture the sum total of a graduate's labour market experience, only collecting information on whether the graduate was working in their final year of study. A related limitation is that the survey does not collect any details about graduates' final-year work, such as whether the job was related to their studies, or highly skilled in nature. Given the influence of work experience on an individual's human capital stock, this is a notable limitation. This potential heterogeneity in work experience is addressed in Essay 3 by restricting the analysis sample to "traditional" bachelor degree graduates (i.e. aged less than 25 years)."

"Finally, the survey contains no individual-level ability proxy, such as tertiary entrance rank or university grade point average. Given that ability and attending a high-quality university are presumably correlated, the omission of this variable complicates the estimation of a *ceteris paribus* university quality effect. This is addressed in Essay 3 using course-level entry cut-offs."

Insert the following as a new paragraph after the last paragraph of Section 2.3 on p. 11: "Aside from the fact that it is administered longer after graduation, the BGS shares the main limitations of its progenitor—it collects no data on graduates' previous work histories, little data on their final-year employment, and no individual-level proxy for ability. The absence of data on work experience is addressed in Essays 1 and 2 by treating age as a proxy for potential experience. The lack of an individual ability proxy is again an issue in both essays, due to the expected correlations between ability and over-education (Essay 1), and job search method use (Essay 2). This is addressed using panel data techniques that allow us to control for unobserved differences across individuals."

Comment 2.11

Insert the following as a new paragraph directly after paragraph 1 on p. 75: “These results raise an interesting question—in light of the very modest differences in salaries across institutions, why do students go to the effort of enrolling at high-quality, and indeed highly selective, universities? We propose two possible explanations. First, under Australia’s partially-regulated higher education system, it is no more costly for a high-ability student to attend a high-quality university than a low-quality one, all else being equal. Given this, students may choose to attend these universities for reasons other than the expected returns (vis-à-vis other institutions), such as prestige, the campus experience, or studying with other high-ability students. Second, it could be due to information asymmetry. Students may indeed choose to attend a high-quality university incorrectly assuming a substantial return because they lack accurate information on the returns to attending different institutions. University marketing departments commonly emphasise the labour market advantages resulting from attending one institution over others, which, as suggested by our results, may be somewhat overstated. Even graduate salary data published by the Australian Government may be potentially misleading, because they are simple descriptive statistics that do not account for the composition of institutions’ respective student bodies.

Comment 2.13

Insert the following as a footnote at the end of sentence 4 of paragraph 2 on p. 62: “A list of the universities in each group at the time of writing is presented in Appendix D.” Include the following university list as a new Appendix D, titled “Australian university groupings”. As a result of this inclusion, the current Appendix D will become Appendix E.

Group of Eight	*Regional Universities Network*
Australian National University	CQUniversity
Monash University	Southern Cross University
The University of Adelaide	Federation University Australia
The University of Melbourne	The University of New England
The University of New South Wales	University of Southern Queensland
The University of Queensland	University of the Sunshine Coast
The University of Sydney	
The University of Western Australia	*Ungrouped universities*
	Australian Catholic University
Australian Technology Network	Charles Sturt University
Curtin University	Deakin University
Queensland University of Technology	Edith Cowan University
RMIT University	Macquarie University
University of South Australia	Swinburne University of Technology
University of Technology Sydney	University of Canberra
	University of Tasmania
Innovative Research Universities Australia	University of Western Sydney
Charles Darwin University	University of Wollongong
Flinders University	Victoria University
Griffith University	
James Cook University	
Murdoch University	
La Trobe University	
The University of Newcastle	

Comment 2.15

Replace Figures 5.1, 5.2 and 5.3 with the following revised figures, which include a horizontal axis at zero:

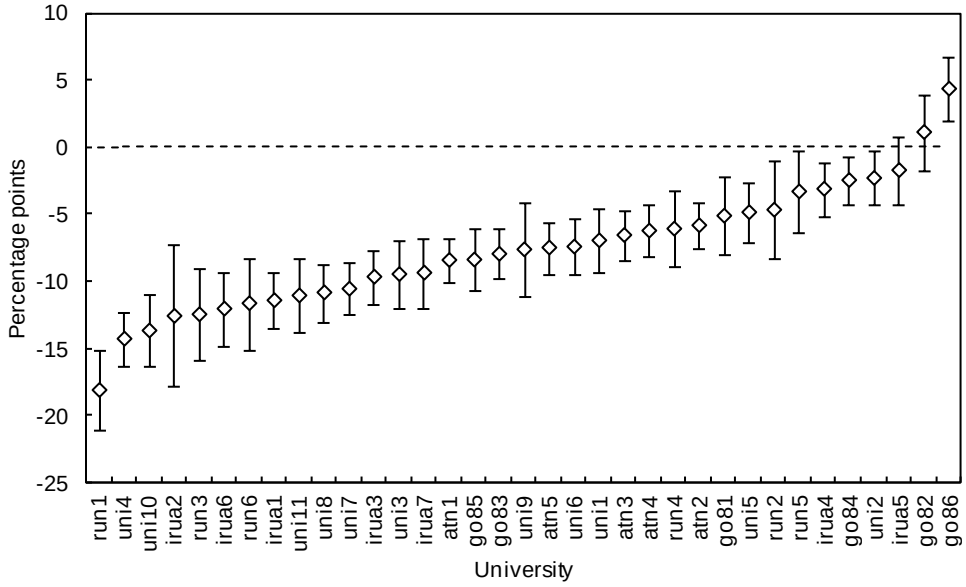

Figure 5.1

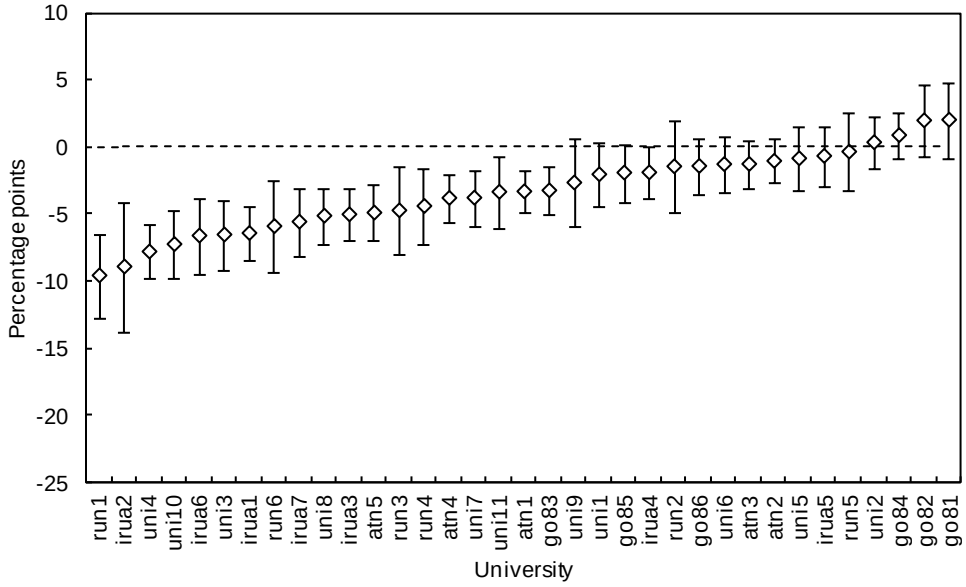

Figure 5.2

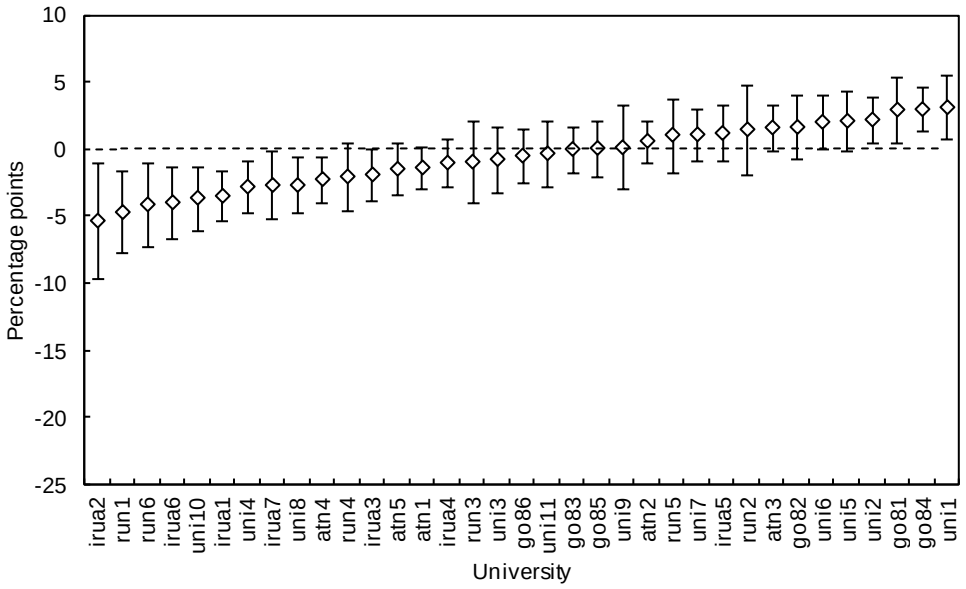

Figure 5.3

Comment 2.16

Insert the following text as a new paragraph after paragraph 1 on p. 75: "Although our results have provided evidence against the existence of a substantial university quality effect with respect to starting salaries, it could be that attending a high-quality university has a positive effect on the probability of obtaining work.* This will be investigated in a subsequent paper."

Insert the following footnote at '*': "Birch et al. (2009) compared employment probabilities across university groups, finding no substantial differences. Their approach was limited, however, in that they made no distinction between full- and part-time employment, and did not examine individual institutions."

Comment 2.17

Insert the following after sentence 2 of paragraph 2 on p. 76: "In relation to this result, it is important to note that the follow-up survey was conducted during a period of relatively high graduate unemployment, stemming from the 2008 financial crisis. The over-education rate three-years after course completion may have been lower still if not for the economic downturn."

Insert the following after sentence 4 of paragraph 2: “This result also implies that, with Government-imposed caps removed from higher education enrolments, and with universities and Government actively trying to increase higher education participation, over-education will likely increase in the short term, at least in certain fields of study—unless, of course, there is growth in the demand for graduate skills, which is currently at its lowest level in a generation (GCA, 2014).”

In sentence 6 of paragraph 2, replace the first word (‘A’) with the following: “Applying market principles, a”. Then insert the following after ‘reducing over-education’: “without resorting to reintroducing enrolment caps”.

Insert the following after sentence 2 of paragraph 2 on p. 77: “This may suggest that the academic standards of some higher education institutions are not sufficiently high. Increasing participation in higher education to ensure that “Australia’s future skills needs are met” (Universities Australia, 2013, p. 13) is not a sufficient objective in and of itself—to achieve this, the graduates produced through Australian higher education must also have the necessary ability, specifically in a discipline that is relevant to the needs of the labour market.”

Include the following new entries in the References section (pp. 80-9):

- Graduate Careers Australia. (2014). *GradStats* (December 2014). Melbourne: Author.
- Universities Australia. (2013). *A smarter Australia: an agenda for higher education 2013-2016*. Canberra: Author.

Additional corrections

The reference in Footnote 8 on p. 19 should be “GCA, 2010”. The reference list entry ‘Graduate Careers Australia. (2010a)’ on p. 83 should be “(2010)”. The subsequent entry ‘(2010b)’ should be removed altogether, as it is not cited in the thesis.