



# Over-education of recent higher education graduates: New Australian panel evidence

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## ARTICLE INFO

### Article history:

Received 9 October 2011

Received in revised form 8 October 2012

Accepted 10 October 2012

### JEL classification:

I23

J24

### Keywords:

Over-education

Graduate labour market

Human capital

## ABSTRACT

This study investigates the incidence of over-education amongst recent Australian bachelor degree graduates and its effect on their earnings. We find that between 24% and 37% of graduates were 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 be associated with the relative demand for graduate labour. Overeducation was less common three years after course completion; however a nontrivial proportion of graduates remain over-educated. With regard to the effect of over-education on earnings, we find a notable age-related effect not reported in earlier studies. Young over-educated graduates were not penalised after unobserved heterogeneity had been addressed, whereas older over-educated graduates were at an earnings disadvantage relative to their well-matched peers.

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## 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, McGuinness, O'Leary, Sloane, & Wei, 2010), insofar that their respective levels of education exceed the requisite levels needed to perform their jobs (Linsley, 2005).<sup>1</sup> 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; 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

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<sup>1</sup> 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.

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 Graduate Careers Australia (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 Beyond Graduation Survey (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 correctly matches or over-/undereducation 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 2 presents a brief literature review and outlines our contribution. Section 3 describes data and variables used in this study. Section 4 outlines our estimation methodology. Section 5 presents the results. Conclusions and policy implications are presented in Section 6. Detailed definitions of the variables used in this study are presented in Appendix A.

## 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, 2010).<sup>2</sup> 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 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

<sup>2</sup> This includes all individuals in the labour force with an advanced diploma/diploma or higher qualification.

education level. The RM method is based on the average education level in a particular occupation,<sup>3</sup> 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 Beyond Graduation Survey, conducted as recently as 2010. Existing work has therefore investigated the over-education in Australia using two different data sets.<sup>4</sup> 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 and Vignoles (2000) and Frenette (2004). Dolton and 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.<sup>5</sup> 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 and 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).

### 3. Data

This study is based on data drawn from the 2010 Beyond Graduation Survey. Since 1972, graduates from Australian higher education institutions have participated in a national survey of their outcomes and activities

<sup>3</sup> 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).

<sup>4</sup> Other studies (e.g. Green, Kler, & Leeves, 2007; Piracha, Tani, & Vadean, 2012) have considered the over-education of first- and second-generation immigrants to Australia.

<sup>5</sup> 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.

approximately four months after course completion.<sup>6</sup> The current incarnation of this national graduate survey is known as the Australian Graduate Survey (AGS), conducted by Graduate Careers Australia on a semi-annual basis.<sup>7</sup> 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.<sup>8</sup> 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%.<sup>9</sup> The sample of secured responses was confirmed as being representative of the broader population under study (GCA, 2011).<sup>10</sup> Due to the under-representation of overseas graduates in the sample, as well as the increased potential for sampling bias resulting from the difficulty in contacting overseas graduates following their repatriation, all overseas graduates were excluded from the sample used in the analysis. 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.<sup>11</sup> This resulted in an working sample of 2005 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 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 A.

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.<sup>12</sup> The five skill levels in ANZSCO were condensed into a binary variable for this study,<sup>13</sup> 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.<sup>14</sup> 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

<sup>6</sup> 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 (Graduate Careers Australia, 2010).

<sup>7</sup> The AGS is administered semi-annually because most Australian higher education institutions have two major graduation rounds in a given year.

<sup>8</sup> 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.

<sup>9</sup> 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.

<sup>10</sup> 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).

<sup>11</sup> 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.

<sup>12</sup> 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).

<sup>13</sup> 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).

<sup>14</sup> 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.

**Table 1**  
Means for 2007 and 2010 job year subsamples.<sup>a</sup>

Variable	Name	2007 job				2010 job			
		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	majorc	0.074	0.207	0.106	0.217	0.077	0.218	0.112	0.221
Education	majorc	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
<i>Employment characteristics</i>									
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

<sup>a</sup> 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.

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

#### 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:

$$\ln Y_i = a_0 + aU_i + bX_i + \varepsilon_i \quad (1)$$

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.  $\varepsilon_i$  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).<sup>15</sup>

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,<sup>16</sup> by using a fixed-effects model to produce more robust estimates.<sup>17</sup> This takes the form:

$$\ln Y_{it} = a_0 + aU_{it} + \beta X_{it} + \delta_t + c_i + u_{it} \quad (2)$$

where  $\delta_t$  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  $t$  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.

## 5. Results

### 5.1. Incidence of graduate over-education

Table 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 and 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 and 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.<sup>18</sup> 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.

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 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. 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.<sup>19</sup> This is possibly due to the labour market for scientists favouring those who hold postgraduate qualifications,<sup>20</sup> 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

<sup>15</sup> 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.

<sup>16</sup> See, for example, Bauer (2002), Mavromaras et al. (2010) and Tsai (2010).

<sup>17</sup> 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.

<sup>18</sup> Full-time unemployment for recent Australian domestic bachelor degree graduates in 2007 was 5%, the lowest level since 1990 (GCA, 2007).

<sup>19</sup> The broad discipline areas within the sciences field are natural sciences, physical sciences and mathematics, and agriculture and environmental studies.

<sup>20</sup> 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.

**Table 2**Incidence of over-education amongst selected graduate cohorts in their 2007 and 2010 jobs.<sup>a</sup>

Graduate cohort	2007 job				2010 job			
	M ≤ 25	F ≤ 25	M > 25	F > 25	M ≤ 25	F ≤ 25	M > 25	F > 25
<i>Major field of study</i>								
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
<i>Final year work status</i>								
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
<i>Work type</i>								
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
<i>n</i>	446	863	245	451	418	794	233	416

<sup>a</sup> 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.

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 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,<sup>21</sup> 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 so to sustain themselves until a better opportunity arises, whilst also allowing them to remain in paid employment.

Table 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 elite 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 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

<sup>21</sup> Pearson's correlation was used. 2007:  $r = 0.684$ ,  $n = 32$ ,  $p = 0.000$ ; 2010:  $r = 0.575$ ,  $n = 32$ ,  $p = 0.001$ .

**Table 3**Transition into and out of over-education between 2007 and 2010.<sup>a</sup>

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

<sup>a</sup> Figures are based on the subset of graduates who were employed in both survey years.

**Table 4**Relationship between over-education and job-changing behaviour between 2007 and 2010.<sup>a</sup>

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

<sup>a</sup> Figures are based on the subset of graduates who were employed in both survey years.

<sup>b</sup> O = over-educated; N = not over-educated.

been in skilled employment. The most likely outcome suggested by Table 3, however, is that graduates secure appropriate work after course completion and remain in such for at least three years afterwards.

Table 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.

## 5.2. Effect of over-education on wages

Table 5 gives log hourly earnings estimates, where the coefficients are approximately equal to percentage differences. Considering first the OLS estimates [Eq. (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.

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 Eq. (2). The results from this model are presented in Table 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



**Table 5**  
Wage effects of over-education: main effects.<sup>a,b</sup>

Variable	OLS		Fixed effects
	2007	2010 <sup>c</sup>	
<i>Males aged 25 years and under</i>			
Over-educated	−0.0080 (0.031)	−0.0975** (0.042)	0.0309 (0.031)
<i>n</i>	446	418	836
Prob > F	0.0000	0.0000	0.0000
R-squared	0.24	–	0.61
Lambda	–	0.0333 (0.098)	–
<i>Females aged 25 years and under</i>			
Over-educated	−0.0519*** (0.020)	−0.1030*** (0.025)	−0.0058 (0.023)
<i>n</i>	863	794	1588
Prob > F	0.0000	0.0000	0.0000
R-squared	0.15	–	0.62
Lambda	–	−0.0348 (0.078)	–
<i>Males aged over 25 years</i>			
Over-educated	−0.1322** (0.055)	−0.1252** (0.054)	−0.0954** (0.045)
<i>n</i>	245	233	466
Prob > F	0.0001	0.0000	0.0000
R-squared	0.29	–	0.55
Lambda	–	0.1194 (0.200)	–
<i>Females aged over 25 years</i>			
Over-educated	−0.0262 (0.035)	−0.0930** (0.039)	−0.1023*** (0.034)
<i>n</i>	451	416	832
Prob > F	0.0000	0.0003	0.0000
R-squared	0.18	–	0.50
Lambda	–	−0.2219*** (0.080)	–
<i>Controls</i>			
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

<sup>a</sup> Standard errors are in parentheses.<sup>b</sup> The dependent variable is log hourly wage.<sup>c</sup> Heckman corrected estimates.

\*\* Significant at 5%.

\*\*\* Significant at 1%.

**Table 6**  
Wage effects of over-education: field of study interactions.<sup>a,b</sup>

Variable	OLS		Fixed effects
	2007	2010 <sup>c</sup>	
<i>Males aged 25 years and under</i>			
Over-educated <sup>d</sup>	0.0533 (0.048)	−0.0136 (0.074)	0.0104 (0.054)
Over-educated * technical majors	−0.0723 (0.063)	−0.1205 (0.102)	−0.0132 (0.069)
Over-educated * health/education	0.0206 (0.114)	−0.0363 (0.145)	0.2291* (0.135)
Over-educated * society and culture/arts	−0.1701** (0.071)	−0.1492 (0.111)	0.0677 (0.078)
<i>n</i>	446	418	836
Prob > F	0.0000	0.0000	0.0000
R-squared	0.24	–	0.61
Lambda	–	0.1117 (0.103)	–

**Table 6 (Continued)**

Variable	OLS		Fixed effects
	2007	2010 <sup>c</sup>	
<i>Females aged 25 years and under</i>			
Over-educated <sup>d</sup>	−0.0935*** (0.033)	−0.1351*** (0.046)	−0.0342 (0.042)
Over-educated * technical majors	0.0043 (0.051)	−0.0770 (0.075)	0.0345 (0.067)
Over-educated * health/education	0.0665 (0.057)	0.0388 (0.074)	0.0423 (0.075)
Over-educated * society and culture/arts	0.0915** (0.042)	0.0849 (0.059)	0.0398 (0.051)
<i>n</i>	863	794	1588
Prob > F	0.0000	0.0000	0.0000
R-squared	0.15	–	0.62
Lambda	–	−0.0601 (0.079)	–
<i>Males aged over 25 years</i>			
Over-educated <sup>d</sup>	−0.3022*** (0.100)	−0.1303 (0.089)	−0.1684** (0.084)
Over-educated * technical majors	0.1008 (0.135)	0.2302* (0.132)	0.1085 (0.112)
Over-educated * health/education	0.5244*** (0.173)	−0.1685 (0.168)	−0.1714 (0.195)
Over-educated * society and culture/arts	0.2796* (0.145)	−0.1441 (0.126)	0.1967 (0.123)
<i>n</i>	245	233	466
Prob > F	0.0000	0.0000	0.0000
R-squared	0.32	–	0.56
Lambda	–	−0.0237 (0.196)	–
<i>Females aged over 25 years</i>			
Over-educated <sup>d</sup>	−0.0516 (0.073)	−0.0226 (0.089)	−0.1001 (0.069)
Over-educated * technical majors	−0.0797 (0.127)	−0.1524 (0.127)	−0.0066 (0.116)
Over-educated * health/education	0.0066 (0.099)	−0.0926 (0.108)	−0.1253 (0.094)
Over-educated * society and culture/arts	0.0818 (0.090)	−0.0671 (0.108)	0.0749 (0.087)
<i>n</i>	451	416	832
Prob > F	0.0000	0.0006	0.0000
R-squared	0.18	–	0.51
Lambda	–	−0.2661*** (0.079)	–
<i>Controls</i>			
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

<sup>a</sup> Standard errors are in parentheses.<sup>b</sup> The dependent variable is log hourly wage.<sup>c</sup> Heckman corrected estimates.<sup>d</sup> The omitted base case is *management and commerce*.

\* Significant at 10%.

\*\* Significant at 5%.

\*\*\* Significant at 1%.

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.

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 6. Considering only the fixed-effects estimates [Eq. (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.

## 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.

## Appendix A. Definition of variables

The variables included in the wage equations are defined as follows. All dummy variables have been coded such that 1 = yes and 0 = no. Sample means are presented in Table 1.

<b>lnhwage:</b>	Natural logarithm of hourly wage.
<b>overed:</b>	Dummy variable to indicate over-education. Interaction terms denoted with <i>a</i> if <b>under</b> equals 1 and <b>majori</b> equals 1, <i>b</i> if <b>under</b> equals 1 and <b>majorj</b> equals 1, <i>c</i> if <b>under</b> equals 1 and <b>majork</b> equals 1.
<b>ageyrs:</b>	Age in years at the time of the survey.
<b>ageyrs2:</b>	Quadratic term for <b>ageyrs</b> .
<b>major:</b>	Dummy variables to indicate major field of study; denoted with <i>a</i> if sciences, <i>b</i> if information technology, <i>c</i> if engineering and related, <i>d</i> if health, <i>e</i> if education, <i>f</i> if society and culture, <i>g</i> if creative arts, <i>i</i> if combined technical majors, <i>j</i> if combined health/education, <i>k</i> if combined society and culture/arts, base case being management and commerce.
<b>workstud:</b>	Dummy variable to indicate that a graduate was in paid employment during his or her final year of study.
<b>selfemp:</b>	Dummy variable to indicate that a graduate was self employed.
<b>ptime:</b>	Dummy variable to indicate employment on a part-time or casual basis.
<b>tenure:</b>	Number of months spent in current job at the time of the survey.
<b>tenure2:</b>	Quadratic term for <b>tenure</b> .
<b>emploc:</b>	Dummy variables to indicate employment location; denoted with <i>a</i> if New South Wales, <i>b</i> if Queensland, <i>c</i> if South Australia, <i>d</i> if Western Australia, <i>e</i> if Tasmania, <i>f</i> if Northern Territory, <i>g</i> 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).

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