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DISCUSSION PAPER SERIES

IZA DP No. 11477

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ABSTRACT

Does It Pay to Graduate from an 'Elite' University in Australia?

In Australia, the so-called Group of Eight (Go8) universities have lower student-to-staff ratios, better qualified staff, superior research outcomes, and generally better placement in university rankings compared to non-Go8 universities. They are also typically the most competitive universities for prospective undergraduates to enter. Prior published research, mainly focusing on the United States, has found that graduates of prestigious and selective colleges enjoy a wage premium over graduates of other institutions when they enter the labour market. In this paper, we use data from the Graduate Destination Survey and data on Australian Tertiary Admission Ranks (ATARs) to investigate the existence of a Go8 premium in the Australian labour market and to determine the extent to which it is due merely to the recruitment of better students. We find statistically significant evidence of unconditional Go8 premia ranging from 4.3% to 5.5% and find that between 13% and 46% of these premia are due to student selection. We also find evidence of considerable heterogeneity within the Go8 and other university groupings, and that field of study and geographical region have relatively large impacts on graduate starting salaries. We conclude that, while Go8 premia exist, a graduate's alma mater is a relatively minor consideration in the determination of graduate salaries in Australia.

JEL Classification: A23, J24

Keywords: human capital, returns to education, wage premium, graduate labour market

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1. Introduction

The measurement of university quality is a topic that has received considerable attention in recent years. There now exist a number of published rankings of universities which receive significant media coverage, and the Australian government (let alone each university) devotes substantial resources to measuring the performance of its universities in teaching and research. In light of the large investments in university education made by students, their families, businesses, and the government, this concern about quality is understandable. Nonetheless, the definition and measurement of university quality are not straightforward matters, and competing claims of superiority are inevitably controversial.

The objective of the research reported in this paper is to investigate whether there exist systematic differences between the starting salaries of otherwise similar graduates from different Australian universities. In particular, we wish to determine whether there exists a Go8 premium by which students who graduate from the Go8 universities attract systematically higher starting salaries when they enter the workforce than they would do if they instead graduated from a non-Go8 institution. We acknowledge that the production of well-paid graduates is only one of many objectives of Australian universities. However, it is a primary concern of prospective undergraduate students and, since the measurement of starting salaries is relatively straightforward, it is an aspect of university quality that is particularly well-suited for empirical research.

While the relationship between earnings and education is well established, there is less evidence of university-specific premia once university selectivity and field of education are controlled for. 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 student-to-staff ratios 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 for salary differentials across graduates from different universities are not necessarily mutually exclusive, but their dual existence makes empirical analysis problematic since any apparent wage premium enjoyed by the graduates of supposedly better-quality universities may, to an unknown extent, be due to those universities recruiting students whose characteristics make them more likely to be higher paid wherever they studied. That is to say; it may be the students who are 'better quality' rather than the university.

To address this selection problem, most empirical 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 included as covariates in an earnings model (e.g. Rumberger & Thomas, 1993; Holmlund, 2009; Monks, 2000; Chevalier & Conlon, 2003; Thomas & Zhang, 2005; Birch et al., 2009; Walker & Zhu, 2017). Monks (2000), for example, uses Armed Forces Qualifications Test scores as a measure of academic ability and preparation. He found that graduates from the 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 to those who gained admission to an elite college but did not attend. They generally find 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 is 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 are 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. The inclusion of university intercepts nevertheless allows the returns to attending specific institutions to be estimated. Predicted earnings vary 26% across the 43 institutions in their study, but they caution that some of this heterogeneity may reflect sampling variation. Brewer et al. (1999) use a multinomial logit to estimate the type of institution 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 result 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 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 may present difficulties in practice. More recently, Walker and Zhu (2017) measure the degree of university selectivity using the mean standardised A-level scored by undergraduate entry year for each institution, which they combine with survey data from the UK Labour Force Survey. They find that university selectivity explains most of the wage premium after controlling for the field of study.

In Australia, Birch et al. (2009), Lee (2014) and Koshy et al. (2016) find no evidence of a Go8 effect on salaries. Koshy et al. (2016) did find some evidence of a negative salary effect from attending regional universities, particularly for females. However, since they did not attempt to control for selection bias, it is possible that this is due to differences in the quality of student cohorts rather than differences in the quality of universities. Cherastidtham and Norton (2014) find no evidence that Go8 students attract higher starting salaries but did find evidence that their lifetime salaries are higher by around 6%, using socioeconomic variables to control for selection bias. Considering outcomes other than starting salary, Li and Miller (2013) find evidence that graduates from Go8 and ATN universities are less likely than other graduates to be employed in jobs that do not require their qualification, and Lee (2014) found that graduating from a Go8 university has a positive impact on occupational prestige. However, in neither of these papers was an attempt made to control selection bias.

In this paper, we use data on graduate characteristics from the national Graduate Destination Survey (GDS) to measure the impact of alma mater on graduate starting salaries, and data on Australian Tertiary Admission Ranks (ATARs) to control for selection. Our main contributions to the literature are firstly that ours is the first published paper to present statistically significant evidence of Go8 premia for graduate starting salaries, and secondly that we adopt a novel methodology and rich set of data to account for selection. We find that the magnitudes of the unconditional premia are relatively small—ranging from 4.3% to 5.5%. Furthermore, we find that between 13% and 46% of these unconditional premia are due to the Go8 universities recruiting superior students, as measured by the ATAR. We also find considerable variation in starting salaries within the Go8 and other university groups; however, this is largely explained by field of study choices and regional variations in salaries. Ultimately, the graduate labour market perceives, at best, only minor differences in the quality of Australian universities.

The rest of this paper is organised as follows. Section 2 describes the data and variables used in our analysis. Section 3 presents the empirical analysis. Conclusions and implications are presented in Section 4. Sample descriptive statistics are presented in the Appendix.

2. Data and variables

We draw on two data sets to estimate the economic returns to attending different universities. The first contains data on graduates' demographic and enrolment characteristics and labour market outcomes from the 2013, 2014 and 2015 rounds of the GDS. The GDS is conducted approximately four months after course completion, with all new graduates from Australian universities and participating non-university higher education institutions invited to complete a survey on their labour market and educational activities on a given reference date.[1] The average response rate across the three survey rounds comprising our data set is 54.4% (Graduate Careers Australia [GCA], 2016). Previous research has shown that GDS

[1] The GDS concluded in 2015 and has been replaced by the Graduate Outcomes Survey (GOS).

data are generally representative of the graduate population as a whole and are reliable indicators of graduates' full-time labour market positions (Coates, Tilbrook, Guthrie & Bryant, 2006). We pool multiple years of data to maximise the number of observations available for estimation, relying on the relative stability of the graduate labour market over the period (GCA, 2016).

The second data set contains mean ATARs of commencing students at the field of study level at every Australian public university in 2010[2], sourced from the Commonwealth Higher Education Statistics Collection. ATAR is the main criterion for entry into most undergraduate degrees in Australia for domestic students.[3] It is a percentile score denoting a student's ranking relative to his or her peers upon completion of secondary education and can therefore be viewed as a proxy for the 'quality' of students admitted by different universities.

Using data from these two sources, we construct two analysis files. The first, constructed from the GDS data set, is a graduate-level file containing observations on our cohort of interest—domestic bachelor degree graduates who graduated from an Australian public university. We restrict the sample to young graduates to minimise the influence of (unobserved) work experience on our empirical results, and also because mature-age students are commonly admitted via non-ATAR pathways; domestic undergraduates because students in this cohort are generally admitted on the basis of ATAR; and graduates from public universities because ATAR data are not available for other higher education institutions[4]. We further exclude graduates from the University of Melbourne, as it is impossible to reliably link ATAR and GDS data for this institution; and graduates in fields of study with no

[2] Given that a full-time bachelor degree in Australia is generally three to four years in duration, students commencing their studies in 2010 will generally be graduating in the years covered by our GDS data.
[3] ATAR is not used in Queensland, which retains its Overall Position (OP) system. A concordance table is produced by tertiary education authorities to allow conversion between OP and ATAR.
[4] For context, public universities account for 92% of all higher education student load in Australia (Department of Education and Training [DET], 2016a).

corresponding record in the ATAR data set[5]. Graduates with missing data on any of the explanatory variables are also excluded. GDS respondents are asked to report their annual salary in their main paid job. Since this earnings measure is less suitable for part-time or casual workers, the analysis sample is restricted to graduates in full-time jobs. Graduates earning salaries above the 99th percentile are excluded as extreme outliers, and those reporting earnings below the annualised minimum wage are excluded as invalid. These exclusions yield a final graduate-level analysis file containing 29,586 observations. The construction of this file is summarised in Table 1.

Table 1. Construction of graduate-level analysis file

Exclusion	Exclusions (n)	Total obs (n)
Full GDS sample	-	412,762
Not undergraduate	185,205	227,557
Not domestic	39,028	188,529
Not aged <25	62,424	126,105
Not in full-time job	74,680	51,425
Institution out of scope	2,807	48,618
Missing ATAR	4,865	43,753
Missing data	6,139	37,614
Salary missing/out of range	8,028	29,586

The dependent variable was constructed as the log of annual full-time salary, and dummy explanatory variables were constructed for 29 fields of study, 12 regions in which graduates work, 35 different universities, and gender (female).

The second analysis file is constructed by computing the mean of each variable in the first analysis file within each field of study at each university, which yields 544 valid cases. Mean ATARs for each field of study at each university are then appended to the file from the ATAR data set. The result is an analysis file where the dependent and all explanatory

[5] This is most likely due to inconsistencies in the field of study coding between the ATAR and GDS data sets, and potentially students changing courses between commencement and completion.

variables are at the same level of aggregation, which is necessary for our empirical methodology (see Section 3).

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 groupings of institutions: Universities in the Group of Eight (Go8) are generally considered to be the most prestigious and research intensive in Australia[6]; the five universities in the Australian Technology Network (ATN) are all former institutes of technology[7] and have a heritage of working closely with industry; and the 13 categorised as new generation universities (NGUs)[8] are all former colleges of advanced education[9] that were granted university status following the Australian higher education reforms of the late 1980s. The 11 remaining institutions have been classified as other universities (OU), most of which were established during the 1960s and 1970s, some as research-intensive universities.

Mean characteristics of the institutions covered by our analysis are presented by group in Table 2. Interestingly, Go8 and ATN institutions, in addition to being the largest, also tend to have the best-qualified academics and most favourable student-to-staff ratios (the means of all variables in the graduate- and course-level analysis files for each university, respectively, are reported in Table A1 in the Appendix).

[6] The University of Melbourne, not included in our study, is a Go8 member.
[7] All five were granted university status in the late 1980s and early 1990s.
[8] Not to be confused with the now-disbanded NGU group, which consisted of 10 universities.
[9] Ranking below universities, CAEs were originally designed to provide sub-degree qualifications of a more vocational nature.

Table 2. Mean institutional characteristics

	Institutions in group	Student load[a]	Student-to-staff ratio[b]	Academic staff with PhD (%)[c]
Go8	7	34,000	17.8	74.7
ATN	5	33,784	20.6	74.2
NGU	13	16,437	24.6	61.5
Other	11	23,217	20.7	70.4

[a] DET (2016a); [b] DET (2016b); [c] DET (2016c).

3. Empirical Analysis

As a preliminary analysis, Figure 1 shows the sample mean annual salary and the sample mean ATAR of students at the 36 universities that we consider.

Figure 1

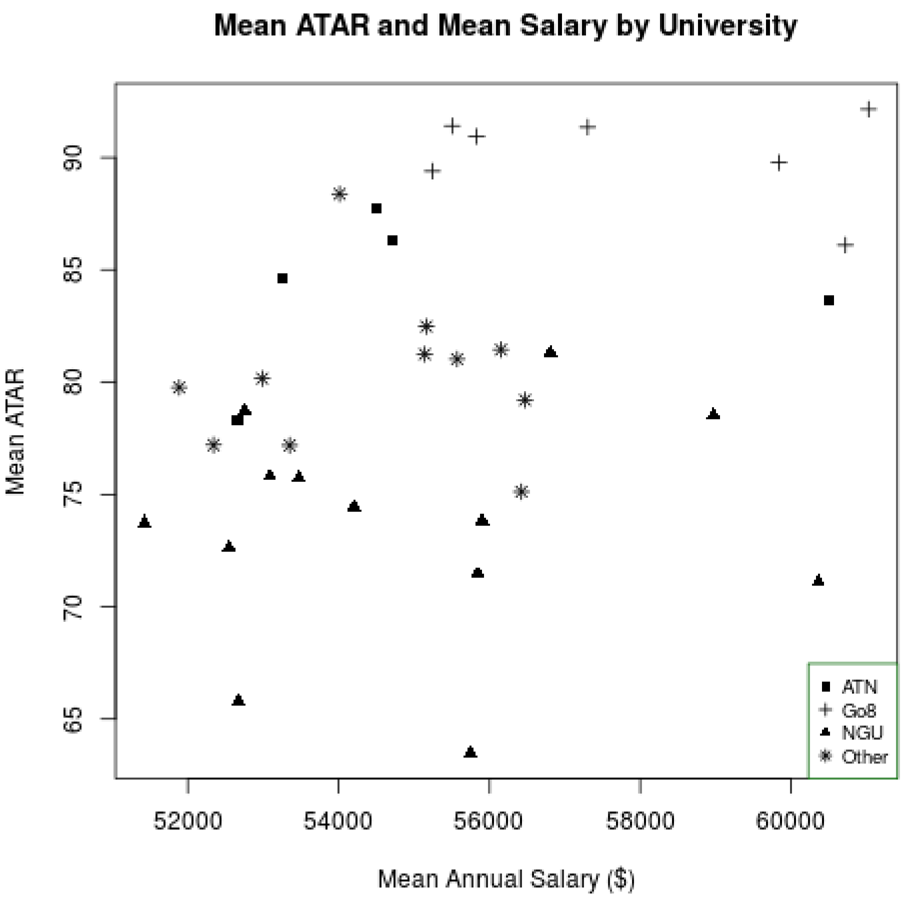

Figure 1 shows evidence of differences in mean graduate salaries, both between universities that are in different groups, and between universities that are in the same group.

Table 3 provides the mean annual salary for each of the four groups of universities (Column 2). Table 3 also provides the apparent Go8 premium that is earned by students who graduate from Go8 universities, relative to each of the other university groups (Column 3).

Table 3. Summary statistics by university group

	Mean ATAR	Mean Salary	Go8 Premia	Range
Go8	90.1	$57,302	*Reference*	10.5%
ATN	84.2	$54,949	4.3%	14.9%
NGU	73.0	$54,336	5.5%	17.4%
Other	80.4	$54,346	5.4%	8.8%

The unconditional Go8 premium is fairly small, ranging from 4.3% to 5.5%. The fourth column of Table 3 presents the range of mean salaries of the universities within each group[10]. It is clear that the range of mean graduate salaries across the universities within each group is much larger than the differences in mean graduate salaries between the university groups. This is also reflected in Figure 1.

In order to check that the observed differences of sample mean graduate salaries are not merely due to sampling variation, we conduct pairwise Welch t-tests of the equality of expected values for every possible pair of universities (Welch, 1947). Figure 2 plots the p-values for pairwise t-tests of the null hypothesis that two universities have equal mean graduate starting salaries. Since there are 36 universities, this results in 630 distinct pairs of universities to test. Standard hypothesis testing procedures that control the probability of false rejection for a single hypothesis are likely to result in many spurious rejections if applied to all 630 hypotheses. To avoid this problem, we adjust the p-values of the tests using the

[10] That is, within each group of universities we compute the mean graduate salary for each university, and then calculate the difference between the highest mean and lowest mean within each group and express it as a percentage of the lowest mean.

multiple testing stepwise procedure of Holm (1979). Note that Holm's procedure provides strong control of the family-wise error rate—that is to say, the probability of rejecting one or more true null hypotheses out of the 630 null hypotheses is controlled by the procedure, for any combination of true and false null hypotheses. White squares in Figure 2 indicate pairs of universities for which the null hypothesis of equal mean graduate salaries is not rejected. For all the non-white squares, the null hypothesis is rejected for the corresponding pair of universities, and the probability of at least one false rejection is less than 0.1. For all the black squares, the null hypothesis is rejected for the corresponding pair of universities, and the probability of at least one false rejection is less than 0.01. Shades of grey indicate rejection probabilities lying between 0.01 and 0.1.

Figure 2

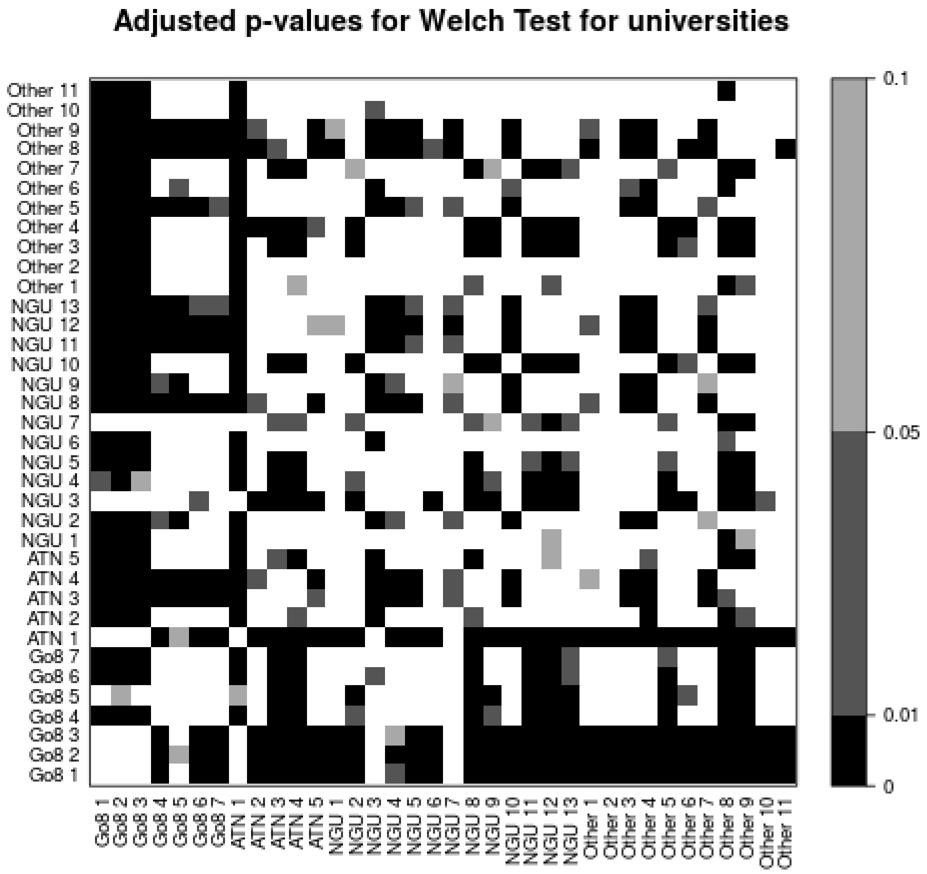

Figure 2

shows clear evidence of the existence of pairwise differences in the expected values of the salaries of graduates from different universities. This evidence is particularly strong for the universities that we have labelled Go8_1, Go8_2, Go8_3 and ATN_1, which are significantly different to most other universities.

In Table 4 we provide p-values for Welch tests of the null hypotheses that the mean salaries of groups of universities are equal. Note that, with the exception of the null hypothesis that the mean salaries of the NGU universities are equal to the mean salaries of the 'other' universities, we find strong evidence of pairwise differences between the mean salaries of university groups.

Table 4. P-values of Welch test

	ATN	NGU	Other
Go8	0.000	0.000	0.000
ATN		0.006	0.006
NGU			0.961

Figure 1 and Table 3 also provide information on the mean ATARs of graduates from both individual universities and groups of universities, respectively. The six universities with the highest graduate salaries are all Go8 institutions, and the ranking of university groups by mean ATAR is the same as the ranking by mean graduate salary.

To determine the extent to which the Go8 premia depicted in Figure 1 and Tables 3 and 4 are due to these universities selecting better quality students, as measured by the ATAR, we specify the following regression model:

$$(1)\ lnSalary_{ij} = \mu + \sum_{r=1}^{28} \alpha_r FoS_{rij} + \sum_{r=1}^{11} \beta_r Region_{rij} + \sum_{r=1}^{34} \gamma_r Uni_{rij} + \delta ATAR_{ij} + \zeta Female_{ij} + \varepsilon_{ij}, i = 1, \dots, n_j, j = 1, \dots, m$$

where :

$Salary_{ij}$ is the annual salary of the i^th^ graduate from the j^th^ academic program;

$FoS_{rij}, r = 1, \ldots, 29$ is a set of dummy variables indicating the field of study of the i^th^ graduate from the j^th^ academic program;

$Region_{rij}, r = 1, \ldots, 12$ is a set of dummy variables indicating the region in which a graduate works;

$Uni_{rij}, r = 1, \ldots, 35$ is a set of dummy variables indicating the university from which the person graduated;

$ATAR_{ij}$ is the ATAR of the i^th^ graduate from the j^th^ academic program;

$Female_{ij}$ is a dummy variable that takes a value of 1 if the i^th^ graduate from the j^th^ academic program is female;

m is the number of programs;

n_j is the number of graduates from program j.

The estimation of Equation 1 is complicated by the fact that data on the ATARs of individual students are not available. However, we do have data on the mean ATAR of students in each field of study at each university. Therefore, we obtain an estimable model by taking the means of the variables in Equation 1 to yield:

(2) $$\overline{lnSalary}_j = \mu + \sum_{r=1}^{28} \alpha_r \overline{FoS}_{rj} + \sum_{r=1}^{11} \beta_r \overline{Region}_{rj} + \sum_{r=1}^{34} \gamma_r \overline{Uni}_{rj} + \delta \overline{ATAR}_j + \zeta \overline{Female}_j + \bar{\varepsilon}_j, j = 1, \ldots, m$$

where $\overline{lnSalary}_j = \frac{1}{n_j}\sum_{i=1}^{n_j} lnSalary_{ij}$, $\overline{FoS}_{rj} = \frac{1}{n_j}\sum_{i=1}^{n_j} FoS_{rij}$, $\overline{Region}_{rj} = \frac{1}{n_j}\sum_{i=1}^{n_j} Region_{rij}$, $\overline{Uni}_{rj} = \frac{1}{n_j}\sum_{i=1}^{n_j} Uni_{rij}$, $\overline{ATAR}_j = \frac{1}{n_j}\sum_{i=1}^{n_j} ATAR_{ij}$, and $\overline{Female}_j = \frac{1}{n_j}\sum_{i=1}^{n_j} Female_{ij}$.

Since the numbers of students in each field of study at each university vary widely, even if ε_{ij} in Equation 1 is approximately homoscedastic, the error term $\bar{\varepsilon}_j$ in Equation 2 will be severely heteroskedastic. Large efficiency gains might be expected if Equation 2 is estimated using weighted least squares (WLS) with the number of students in each field of study at each university used as the weights. We do so, computing the standard errors of the coefficient estimates using White's heteroscedasticity-consistent covariance estimator (White, 1980).

To avoid perfect multicollinearity, we (arbitrarily) omit the dummy variables corresponding to Creative Arts, the Sydney region, and the university that we have labelled NGU_12.

Table 5. WLS coefficient estimates and p-values

Variable	Coefficient	p-value	Variable	Coefficient	p-value	Variable	Coefficient	p-value	Variable	Coefficient	p-value
constant	10.519	0.000	Pharmacy	−0.081	0.000	Tasmania	−0.020	0.861	NGU_7	−0.019	0.836
Accounting	0.067	0.000	Sport	0.079	0.002	NT	0.272	0.023	NGU_8	0.078	0.036
Agriculture	0.064	0.086	Mathematics	0.161	0.000	Go8_1	0.172	0.008	NGU_9	0.028	0.263
Architecture	−0.078	0.026	Medicine	0.299	0.000	Go8_2	0.155	0.003	NGU_10	0.120	0.003
Built_environment	0.125	0.000	Nursing	0.203	0.000	Go8_3	0.082	0.139	NGU_11	0.101	0.078
Business and_management	0.103	0.000	Psychology	0.112	0.000	Go8_4	0.130	0.001	NGU_13	0.073	0.152
Communications	0.026	0.038	Sciences	0.101	0.000	Go8_5	0.135	0.009	OU_1	0.080	0.156
Comp_and_IT	0.134	0.000	Social_work	0.239	0.000	Go8_6	0.081	0.048	OU_2	−0.025	0.779
Environmental	0.121	0.000	Surveying	0.184	0.000	Go8_7	0.024	0.789	OU_3	0.070	0.018
Dentistry	0.463	0.000	Vet_science	0.031	0.231	ATN_1	0.011	0.906	OU_4	0.035	0.092
Economics	0.124	0.000	Melbourne	−0.013	0.812	ATN_2	0.162	0.020	OU_5	0.050	0.357
Education	0.244	0.000	Brisbane	−0.063	0.376	ATN_3	0.053	0.374	OU_6	0.084	0.032
Eng_and_tech	0.239	0.000	Adelaide	−0.115	0.144	ATN_4	0.083	0.028	OU_7	0.188	0.007
Rehabilitation	0.216	0.000	Perth	0.115	0.240	ATN_5	0.129	0.019	OU_8	0.056	0.299
Health	0.203	0.000	ACT	−0.026	0.670	NGU_1	0.093	0.139	OU_9	0.089	0.087
Tourism	0.089	0.001	Regional_NSW	0.097	0.036	NGU_2	0.081	0.168	OU_10	−0.002	0.953
Humanities and_social sciences	0.127	0.000	Regional_VIC	0.046	0.509	NGU_3	0.140	0.030	OU_11	0.086	0.315
Languages	0.117	0.000	Regional_QLD	0.003	0.962	NGU_4	0.092	0.093	atar	0.003	0.001
Law	0.163	0.000	Regional_SA	−0.068	0.443	NGU_5	−0.011	0.901	female	−0.129	0.000
Para_legal	0.128	0.000	Regional_WA	0.346	0.008	NGU_6	0.149	0.007			

R^2 = 0.835; n = 544; p-values are computed using White's Heteroscedasticity Covariance Estimator with a divisor of n-k.

The coefficient estimates and p-values[11] computed using the WLS method are presented in Table 5.

Table 6. Mean coefficients

	Go8	ATN	NGU	Other
Mean Coefficient	0.111	0.088	0.077	0.065
Conditional Go8 Premium		2.3%	3.4%	4.7%

In Table 6 we present the mean values of the coefficient estimates for each group of universities and the estimated conditional Go8 premia over each of the other university groups, computed from Table 5. These premia may be compared to the unconditional premia presented in Table 3. Controlling for the ATAR, the region in which a graduate works, the gender of the graduate, and the field of study reduces the estimated Go8 premium over the ATN universities from 4.3% to 2.3%, reduces the Go8 premium over the NGU universities from 5.5% to 3.4%, and reduces the estimated Go8 premium over the 'other' universities from 5.4% to 4.7%.

Table 7. p-values for pairwise group mean equality of salaries

	ATN	NGU	OU
Go8	0.00168	0.1081	0.0047
ATN		0.6325	0.1876
NGU			0.4541

In Table 7 we present p-values for heteroscedasticity-robust pairwise F-tests of the null hypotheses that the mean coefficients of each of the university groups are equal. Note that we have strong evidence that the Go8 premia over the ATN and Other university groups persist when we control for ATAR, field of study, region of work and gender. However, at the 5%

[11] The p-values presented have not been adjusted to control the family-wise error rate.

significance level, we are unable to reject the hypotheses of equal mean coefficients between the Go8 and NGU groups and all pairs of university groups that do not include the Go8.

The estimated impact of a 1-point improvement of the ATAR on a graduate's salary is 0.3%. Using the data in Table 4, this suggests that a considerable proportion of the apparent Go8 premium is due to the Go8 universities selecting better quality students, as measured by the ATAR. In particular, of the 4.3% Go8 premium over the ATN universities, approximately 1.8 percentage points are due to the superior ATAR; of the 5.5% Go8 premium over the NGU universities, approximately 5.1 percentage points are due to the superior ATAR; and of the 5.4% Go8 premium over the Other universities, approximately 2.9 percentage points are due to the superior ATAR. In each case, the observed premia in Table 3 are also determined by differences in field of study concentrations, and to a smaller extent by the region in which graduates work. While the estimated coefficient on the $\overline{Female_j}$ dummy variable is both large and statistically significant (favouring males), the gender distribution across universities is reasonably uniform. Consequently, gender imbalances are unlikely to explain much of the observed Go8 premia.

Table 8. p-values for equality of coefficients within university groups

Go8	ATN	NGU	OU
0.282	0.435	0.023	0.288

We now present test results for the null hypotheses that the coefficients within each university group are identical. The p-values for the heteroscedasticity-robust F-test are presented in Table 8. At the 5% significance level, we have no evidence that the premia attached to individual universities differ within the Go8, ATN and Other university groups, conditional on the field of study, region of work, and gender. This is in contrast to the unconditional pairwise test results presented in Figure 1, which show strong evidence of differences within university groups.

In summary, we find statistically significant evidence of Go8 premia that are largely but not completely explained by the Go8 universities selecting higher quality students than other universities, as measured by the ATAR. However, when we control for the ATAR, the field of study, the region in which a graduate works, and the gender of a graduate, the Go8 premia are fairly small—ranging from 2.3% when Go8 universities are compared to ATN universities, to 4.7% when compared to Other universities. Mean graduate salaries across universities that are in the same group may vary by up to 17.4%, a range which appears to be explained largely by variations in fields of study. Consequently, while Go8 premia appear to exist, they play a relatively small role in the determination of graduate salaries.

4. Conclusions and implications

In contrast to the existing Australian literature (Birch et al., 2009; Lee, 2014; Koshy et al., 2016), we find statistically significant evidence of differences in graduate starting salaries between Australian universities. In particular, we find that Go8 premia exist; however, the premia are quite small. 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 student-to-staff ratios are not as important to the production of human capital as this and other studies have assumed (e.g. Rumberger & Thomas, 1993; Holmlund, 2009; Betts et al., 2007). For example, having a large share of academic staff with a PhD may contribute to an institutions' research output, but it may not contribute substantially to human capital production in young undergraduates; likewise for student-to-staff ratios, if academic staff are more focused on research than teaching.

Third, it could be that employers do not use institution attended 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 substantial 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—this is consistent with Cherastidtham and Norton (2014), who find no differences in starting salaries, but higher lifetime earnings associated with graduating from a Go8 university.

From a policy perspective, the results suggest that even under a deregulated fee ecosystem, as is often proposed for Australian higher education, universities appear to have little justification for charging undergraduate fees according to so-called quality differences. Few significant differences in the returns to education between institutions remain after controlling for differences in course offerings and student characteristics, which 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. Rather than some universities setting uniformly higher fees than others, a system in which fees vary across fields of study in a manner that reflects differences in graduate salaries would be more justified.

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Appendix

Table A1. Means for graduate- and course-level analysis files.

Variable	Grad	Course	Variable	Grad	Course	Variable	Grad	Course
Log_salary	10.898	10.872	Surveying	0.001	0.004	NGU_2	0.014	0.018
Field of study			Vet_science	0.002	0.006	NGU_3	0.009	0.017
Accounting	0.038	0.022	*Employment region*			NGU_4	0.009	0.017
Agriculture	0.004	0.009	Melbourne	0.207	0.181	NGU_5	0.015	0.029
Architecture	0.008	0.022	Brisbane	0.116	0.097	NGU_6	0.015	0.031
Built_env	0.025	0.031	Adelaide	0.073	0.065	NGU_7	0.001	0.011
Bus_and_mgt	0.202	0.064	Perth	0.071	0.101	NGU_8	0.037	0.035
Communications	0.043	0.048	ACT	0.041	0.060	NGU_9	0.014	0.015
Comp_and_IT	0.040	0.055	Regional_NSW	0.069	0.073	NGU_10	0.034	0.022
Environmental	0.004	0.026	Regional_VIC	0.043	0.041	NGU_11	0.012	0.028
Dentistry	0.003	0.011	Regional_QLD	0.072	0.103	NGU_13	0.014	0.031
Economics	0.011	0.024	Regional_SA	0.015	0.014	OU_1	0.010	0.024
Education	0.106	0.063	Regional_WA	0.011	0.018	OU_2	0.008	0.028
Eng_and_tech	0.110	0.055	Tasmania	0.009	0.023	OU_3	0.046	0.031
Rehabilitation	0.045	0.033	NT	0.007	0.015	OU_4	0.037	0.040
Health	0.048	0.048	*University*			OU_5	0.032	0.031
Tourism	0.007	0.013	Go8_1	0.027	0.031	OU_6	0.034	0.031
Hum_and_soc_sci	0.038	0.059	Go8_2	0.010	0.020	OU_7	0.010	0.024
Languages	0.008	0.017	Go8_3	0.086	0.040	OU_8	0.044	0.037
Law	0.030	0.050	Go8_4	0.065	0.031	OU_9	0.027	0.033
Para_legal	0.009	0.026	Go8_5	0.046	0.046	OU_10	0.003	0.011
Pharmacy	0.020	0.013	Go8_6	0.040	0.039	OU_11	0.008	0.024
Sport	0.008	0.035	Go8_7	0.016	0.031	*Other explanatory variables*		
Mathematics	0.004	0.015	ATN_1	0.041	0.028	atar	-	81.049
Medicine	0.015	0.011	ATN_2	0.061	0.035	female	0.607	0.635
Nursing	0.079	0.051	ATN_3	0.036	0.037			
Psychology	0.023	0.055	ATN_4	0.054	0.028			
Sciences	0.040	0.061	ATN_5	0.074	0.040			
Social_work	0.007	0.028	NGU_1	0.006	0.017	Obs (n)	29,586	544

Omitted dummy variables correspond to Creative Arts, the Sydney region, NGU_12, and males.