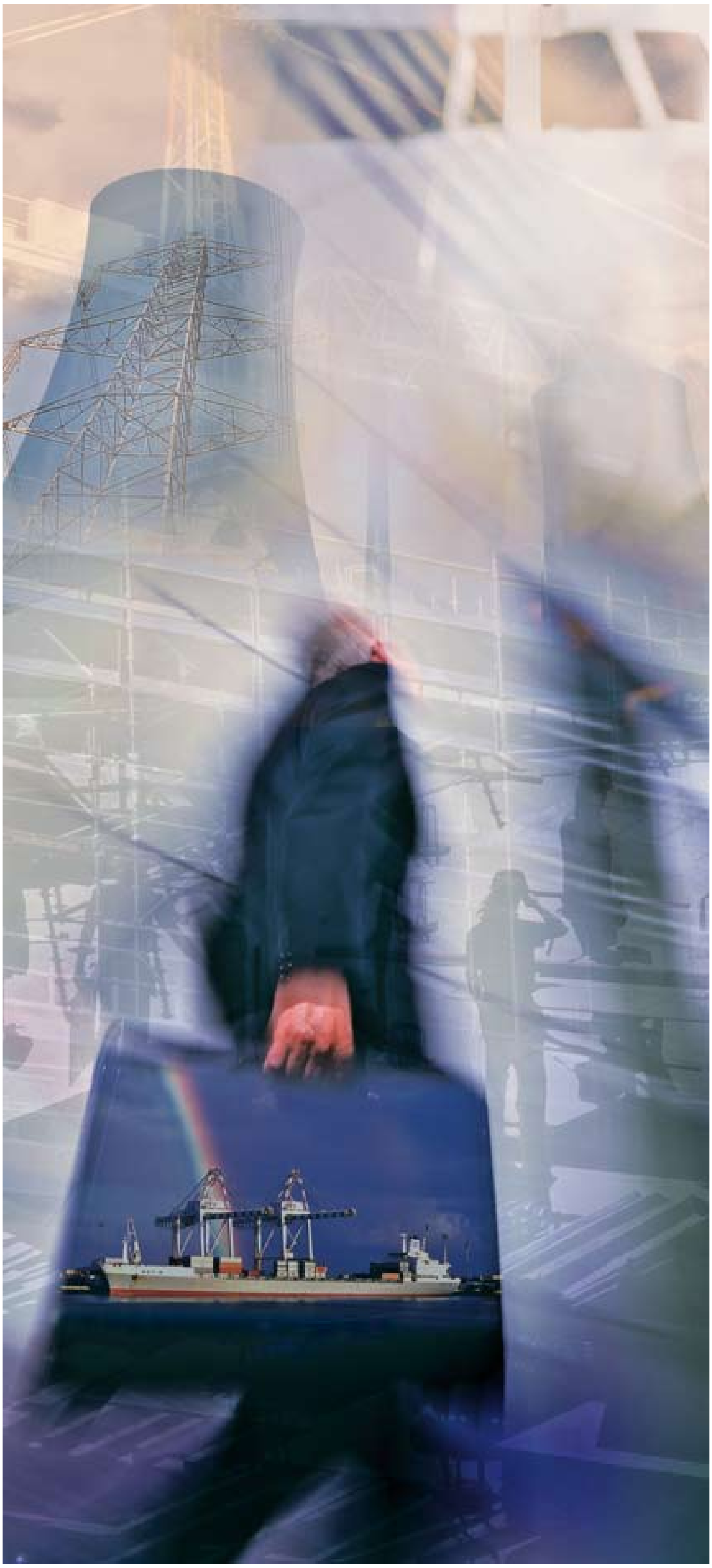

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Degree Choice and Employment
- Accounting for Self and Sample Selection Bias

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I: Introduction

The literature on the economics of education has primarily been focussed on the wage that a graduate commands. In terms of the expected benefit of completing a tertiary qualification, the probability of finding employment plays an equally – that is, equal to wage projections – central role in any analysis of graduate outcome. Indeed the uses of modelling graduate employability extend beyond the (by no means unimportant) purpose of better informing individuals in their utility-maximising decisions. Traditionally, graduate wages are often quoted by education institutions and government bodies alike to encourage enrolment into certain disciplines; yet the relationship between one's probability of finding employment and one's salary is not necessarily a positive one. There could, for example, be demand for highly-able economist, reflected in high remuneration for those positions. But the *specific* demand for highly-able economists means lower-able economists are not considered for employment altogether. Agents in the labour market could wrongly perceive that the high remuneration for economists indicates a high demand for economists *in general*. This ‘separation of markets’ within disciplines is only noticeable through a study of graduate employability. Such a study allows scrutiny of the labour market reception for particular tertiary qualifications and allows investigation into questions as to whether or not too many students are choosing courses that are in over-supply. From a policy perspective, in discovering the particular determinants of graduate employability, government and education bodies alike can take the necessary steps toward ensuring students are employable upon graduation.

Recently, in the UK, graduate employability, modelled as the probability of finding employment within six months after graduation, was used to rank various universities with respect to graduate outcome (see Smith et al 2000 and Bratti et al 2003). It is arguable that employability is a better – i.e., better than wages – indicator of graduate outcome. Assuming that individuals don’t always choose the highest paying firm due to geographical or other unobservable costs, variation in wages between graduates of the same discipline does not provide accurate information in terms of outcome ranking. In terms of employability, however, an involuntarily unemployed graduate does, necessarily, have a worse outcome than an employed accountant.

This paper models the employability of graduates as the probability of finding fulltime employment within six months of graduation, given that the graduate is looking for work. In modelling this it takes into account two problems that have been ignored in other studies: firstly, the problem of the self-selection of more employable students into certain degrees; and secondly, the problem of sample-selection where graduates who choose to pursue further study are not considered in the sample even though they have characteristics that may systematically make them more (or less) employable had they chosen to enter the labour market.

i. Self-selection of Degree Choice

Disaggregation by academic degree is fairly common for any econometric equation trying to explain wages[1], but not so for employability. Lewis et al's (2004) paper on the private rate of return to an economics degree disaggregates employability by law, business and other graduates; it finds that rates of return are significantly affected by the probability of being unemployed. The problem with such an exercise is the self-selection of more employable individuals into certain academic degrees. Economics graduates, for example, may be more employable in the market, but this could be due to the fact that individuals with certain characteristics that make them more employable (such as a better natural ability) tend to select economics degrees (for whatever reasons). A researcher may then falsely ascribe the success in employment to the economics degree, when in fact it is the other (shared) characteristics of economics graduates that made them more employable. Consequently, an individual without such a characteristic who does economics would not enjoy an equal probability of employment. Econometrically, self-selection is a problem of the endogeneity of the explanatory variable which, in this case, is the dummy variable used to represent the individual's choice of an academic degree.

[1] See, for example, Chuang & Chow (2001) and Borland et al (2002) for wage determination equations that use disaggregated university disciplines as explanatory variables in application to the rate of return to education.

Self-selection has primarily been modelled between the choice of completing a degree and otherwise (see, for example, Willis & Rosen 1979 for the U.S.; Vella & Gregory 1996 for Australia; Chuang & Chao 2001 for Taiwan). In the case of self-selection with respect to academic degrees, modelling the characteristics that influence the choice of the degree allows the bias to be corrected for. No past studies have modelled the choice of degrees with respect to accounting for self-selection in either wage or employment-probability equations. With respect to modelling the choice of degrees strictly for its own interest, the literature is limited (see Blakemore & Low 1984 and Rask & Bailey 2002). The cause of the general lack of literature on the modelling of degree choices could be ascribed to its econometric complexity: although Rask and Bailey adopted the mixed-multinomial logit (which incidentally only saw use in recent years due to its computational difficulty[2]), Blakemore and Low's older paper use the standard multinomial logit, thereby running into the 'Independence of Irrelevant Alternatives (IIA)' assumption which states that the probability of choosing a certain alternative is not affected by the number of alternatives available (Maddala 1983, pg 61). This study adopts the use of McFadden's (1977) nested logit model which allows for the relaxation of the IIA assumption. Its econometric specification is discussed in section (insert).

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[2] See McFadden & Train 1996 for a discussion.

ii. Sample-Selection of Graduates Pursuing Further Study

Every year the Graduate Careers Council of Australia publishes statistics on Australia's tertiary education sector gathered through the Graduate Destination Survey (GDS). The 2005 report indicates that 52.9% of all fresh graduates were employed in full-time jobs within four months of graduation, whilst 23% chose to pursue further education. This indicates that studies that take into account the outcome of only individuals who choose to enter the labour market are ignoring a sizable amount of graduates who choose to pursue further study. How employable are these graduates? Why are they pursuing further study rather than entering the labour market? Although there is the temptation to liken the decision to pursue a post-graduation[3] qualification purely based on the earnings premium associated with it, there is the possibility that post-graduation study is simply the result of unfavourable market conditions or other unobserved factors particular to the individual. Again, the literature has been silent concerning this 'further study' effect and continues to ignore the employability of graduates who chose not to enter the labour force, thus misrepresenting the employability of graduates in general. This results in what is commonly known as *sample selection bias*, i.e., bias resulting from the systematic omission of certain groups of observations.

The question as to whether or not a student pursues further study (of whatever form) is in many ways of interest in itself. Theoretically, the choice mechanism should be no different than the cost-benefit analysis associated with the choice of whether or not to

[3] The term 'post-graduation' is intentionally used here in its purely literal sense to differentiate it from 'postgraduate', a term commonly associated with higher research degrees alone.

pursue an undergraduate qualification. According to Spence (1973), individuals with different abilities face different costs in obtaining a qualification, but enjoy the same benefits[4] once the qualification is obtained; therefore, assuming there is a positive correlation between ability and later on, productivity in the labour force, one can deduce that those who pursue higher or further education are those who are more productive and therefore, more employable. If graduates who are more employable are choosing to do further study rather than enter the labour force, a study that models employability purely based on those entering the labour force will be understating the average employability of graduates and would thus be biased. Additionally, following the train of thought pursued by rate of return calculations, post-graduation qualifications entail either higher probabilities of employment and higher lifetime wages or some positive combination of both. Since this study is focused on the employability of graduates, a direct application of the results would be to predict the probability of employment for those who chose further study, thereby clarifying whether there are any effects of masked or delayed unemployment[5] amongst them.

II: Data Description and Summary

The data set used for this study is a combination of University of Tasmania (UTAS) GDS results from 2004 and 2005. The specificity and localised sampling, far from being a drawback, allows for the inclusion of variables otherwise unavailable at a national level. A unique data set particular to the University of Tasmania was able to be obtained by

[4] Borland's (2002) paper indicates that the base-case postgraduate earns a 6.5% higher rate of return whence compared to undergraduates.
[5] That is, choosing to do further study as a *consequence* of facing unemployment in the labour market, or using further study as a method of delaying labour force participation.

matching up IDs of Tasmanian graduates who participated in the GDS with their respective 'Best 5' score[6]; that is, the results that Tasmanian applicants used when first applying for entry into the University of Tasmania were attached to their subsequent GDS responses[7]. The Best 5 scores are essentially used as a proxy for the generic or innate ability of the student, unadulterated by whatever human capital a university degree might have later contributed.

The response rate to the UTAS GDS survey in 2004 was 1847 (63.5%) of 2909 graduates, whilst in 2005 it was 1832 (62.4%) of 2935 graduates, giving a total response of 3679 graduates. Of these, 3026 were undergraduate graduates. However, because only observations for which Best 5 scores were available were kept, observations involving postgraduate, overseas, and interstate students were discarded. The remaining sample size was 1831 (78.31%) observations out of an estimated[8] 2338 *Tasmanian undergraduate*[9] graduates. The results of this study are therefore biased towards undergraduate Tasmanian students and should only be extrapolated to other samples with due caution.

Of the 3026 undergraduate students who responded to the GDS, 1353 (44.71%) were employed in a fulltime job at the time of the survey, whilst 1143 (37.78%) were undertaking further study on a fulltime basis. For this study's sample 825 (45.06%) of the

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[6] A score based on the sum of the best five subjects for the Tasmanian Certificate of Education (TCE).
[7] The merging of the data sets were done entirely by university administration and student I.D.'s were removed to maintain the confidentiality of GDS respondents.
[8] Data on the exact number of Tasmanian graduates was unavailable and as such the approximate total presented here was calculated based on the mean percentage-share of offers to Tasmanian pre-tertiary students (40%) in relation to the total number of offers in 2002/2003 (where 3 years is the average time taken to complete a bachelor degree), multiplied by the total number of undergraduate graduates in 2004/2005.
[9] The definition of undergraduate here is taken to include those with Honours degrees; whilst Tasmanian is taken to be students who completed their TCE.

1831 were employed fulltime, whilst 722 (39.43%) were undertaking further studies fulltime. The similarity of percentages between this study's sample and the original complete GDS sample indicate that there is no loss of generality in using the smaller sample. Of the 1091 graduates in the labour force – i.e., graduates actively looking for work – 266 (24.38%) were unemployed, where unemployed in this case refers to an individual who is not studying fulltime, is looking for work, but is not in a fulltime job within six months of graduation. Table 2A depicts the course choices of those pursuing further studies.

Table 2A: *Further Study Groups*

Diploma	Bachelor	Honours	Grad Certificate	Grad Diploma	Grad Degree
4	91	274	93	43	69
Preliminary Postgraduate	(Coursework) Masters	(Research) Masters	PhD	Other	Not Reported
8	25	9	59	9	38

A large portion of those pursuing higher studies chose to do Honours (37.95%) whereas less than ten percent of them were pursuing higher research degrees. Notably, 95 graduates were pursuing additional *undergraduate* qualifications.

Table 2B depicts the number of students pursuing further study as a percent of the total sample (1813), as well as the number of students employed as a percent of the number in the labour force (1091), disaggregated by their respective degree choices. The pattern that emerges seems to indicate a negative relationship between the two variables, with degrees such as Accounting, Engineering and Pharmacy/Medicine having the highest employment rates but also the lowest ratio of students pursuing further studies.

Table 2B: Percent Employed and Percent Enrolled in Further Study,

Sorted by Ascending Order.

	%(Studying/Total)		%(Employed/ LabourForce)
Education	1.09	**Fine Arts**	45.24
Pharm/Med	2.74	**Soc Science**	59.20
Otherhealth	4.03	**Science**	59.70
Accounting	8.60	**Education**	61.54
Nursing	9.02	**Lang/Phil**	62.96
Business	13.83	**Agri/Envi**	69.23
Engi	13.85	**Otherhealth**	69.93
Econs/Fin	37.21	**Law**	71.88
Agri/Envi	39.06	**Architect**	76.47
IT	40.71	**Business**	79.01
Architect	48.48	**IT**	79.10
Soc Science	60.57	**Econs/Fin**	85.19
Fine Arts	62.16	**Accounting**	90.59
Science	69.12	**Engi**	92.86
Law	72.65	**Nursing**	95.87
Lang/Phil	72.73	**Pharm/Med**	100.00

The only degrees that seems to behave contrary to the general relationship is Education and Other Health Sciences, with a low percentage of those who choose to pursue further study (1% and 4% respectively), yet only 62% and 70% respectively of those in the labour force were employed. The general negative relationship indicates that there is the possibility that degrees associated with high graduate unemployment result in graduates choosing further study as a consequence of facing unemployment in the labour force; or alternatively, the decision to pursue further study and not work is part of a far-sighted optimal decision made when an individual chooses a degree.

III: Methodological Framework

Consider the latent index Y_i^* that determines whether or not individual *i* is employed within six months after graduation. This could be the result of either market conditions or the ability and characteristics of the individual in question. The equation is simply:

$$Y_i^* = \boldsymbol{\beta}' \mathbf{X}_i + u_i \tag{3.1}$$

where $\boldsymbol{\beta}$ is a vector of coefficients, $\mathbf{X}$ is a vector of explanatory variables and u is the error term.

Y*, however, is unobservable. What we do observe is variable Y that takes on the value 1 when an individual is employed in a fulltime job at the time of the survey and the value 0 otherwise. Assuming a normal distribution of errors, equation 3.1 can be modelled as the standard probit. As previously dicussed, two theoretical issues arise from equation 3.1, being that of self-selection and sample selection bias.

i: Self-selection of Degree Choice

In the vector of explanatory variables, **X**, each observation will have 16 dummy variables[10] reflecting their choice of a university degree, with a binary value of 1 for the degree actually chosen and 0 for all other degrees. Theoretically these dummy explanatory variables are considered endogenous due to the fact that the choice of a degree is influenced by variables that affect the probability of employment as well, e.g., ability, gender and other factors: this could result in highly biased estimates in equation

[10] Presented in section 3.6.

3.1. To account for this, the choice of a degree is modelled using what is commonly known as McFadden's (1977) nested logit. Suppose, as per the Random Utility Model, there is an unobservable utility index, U^*_{ij}, that varies across each individual i and each degree choice j that the individual faces. The utility index is simply the result of the cost-benefit calculation the individual makes in choosing a degree and therefore the individual will choose the degree with the highest utility with respect to himself:

$$U^*_{ij} = \boldsymbol{\alpha}' \mathbf{Z}_j + \boldsymbol{\gamma}' \mathbf{W}_i + \boldsymbol{\varepsilon}_{ij} \qquad (3.3)$$

where $\boldsymbol{\alpha}$ and $\boldsymbol{\gamma}$ are vectors of coefficients; $\mathbf{Z}$ is a vector of explanatory variables that vary with *alternatives*; $\mathbf{W}$ is a vector of explanatory variables that vary with *individuals*[11]; and $\boldsymbol{\varepsilon}$ is a matrix of error terms assumed to be distributed according to the multivariate generalised extreme value distribution[12].

The main advantage of the nested logit over its more common predecessor, the multinomial logit, is the relaxation of the 'Independence of Irrelevant Alternatives' (IIA) assumption which requires that the predicted probabilities remain consistent regardless of the number of alternatives or choices included in the model. This is often referred to as the 'red bus – blue bus' problem that occurs in unordered choice models where the choices are close substitutes of each other. With 16 different degree choices in this study, the problem of closeness or substitutability is highly plausible. If the IIA assumption fails to hold, the estimated coefficients produced by a multinomial logit would be inconsistent

[11] Traditionally the *multinomial* logit is used to model individual-varying explanatory variables whilst McFadden's (1974) *conditional* logit is used to model choice-varying explanatory variables (see Maddala 1983, pg 41-46).

[12] McFadden (1977) gives the proof to the derivation of this unique distribution under the framework of the random utility model.

due to a high sensitivity to the number of alternatives included. The nested logit allows for substitutability between choices by modelling a sequential decision process in the fashion of a tree where initially choices are made between branches (yielding the *marginal* probability of selecting the branch), and once the branch has been chosen, the twigs relevant to that branch will yield the probability of choosing the twig *conditional* on having chosen the branch; the joint probability is then simply the product of the two. The IIA assumption is only required to hold within branches but not across them. In the case of this study, the decision process has been modelled such that the student first chooses a faculty (branch) and from that faculty, a specific degree (twig). Several Hausman specification tests were carried out to determine the need for the nested structure. The results[13] indicate that the IIA assumption is violated with the removal of any faculty choice, therefore indicating that the nested structure is required.

This study uses Stata 9 to run a nested logit based on the Random Utility Model, adopting Florian Heiss' (2002) Stata update called 'nlogitrum' that ensures consistency with random utility theory. The model can be expressed econometrically as:

$$\Pr(\text{Faculty} = k) = \frac{e^{\tau_k \cdot \text{IV}_k}}{\sum_m e^{\tau_m \cdot \text{IV}_m}} \tag{3.4}$$

$$\Pr(\text{Degree} = j \mid \text{Faculty} = k) = \frac{e^{\frac{1}{\tau_k} \cdot (\alpha' Z_j + \gamma' W_i)}}{e^{\text{IV}_k}} \tag{3.5}$$

[13] Appendix C details the test and results.

$$\mathrm{IV}_k = \ln \sum_n e^{1/\tau_n (\alpha' Z_j + \gamma' W_i)} \tag{3.6}$$

$$\Pr(\text{Degree} = j\,,\ \text{Faculty} = k) = \text{equation (3.4)} \bullet \text{equation (3.5)} \tag{3.7}$$

where subscript *m* refers to all possible faculty choices including *k* and subscript *n* refers to degree choices *within* faculty choice *k*; 'IV' is the inclusive value, often defined as an 'index of the expected maximum utility from the choice of alternatives in the lower-levels [twigs] of the partitioned tree' (Hensher 1986); τ is the Inclusive Variable (IV) parameter, also referred to as dissimilarity parameters (Heiss 2002) since they effectively show the differences between the specified nests. If all values of τ are equal to unity, then the nested logit, as specified in this study[14], collapses into McFadden's (1974) conditional logit.

Once the results are obtained, the Inverse-Mills' Ratios (or pseudo-residuals) are calculated and used in the probit equation for employability (equation 3.1) in order to correct for possible endogeneity. This 'heckit' methodology (named after James Heckman) is suggested by Arendt and Holm (2006) in the application to binary endogenous explanatory variables (as in this case). Following Lee's (1983) adaptation of the *multinomial* case of Heckman's (1979) two-step procedure, Bourguignon et al (2004) suggest the addition of the single correction term to the equation in question (in this case, equation 3.1), meaning that the correction term will include predicted values from the

[14] Depending on the type of variables used (refer to footnote 14), the nested logit can collapse to either a multinomial or conditional logit.

nested logit only for the degree that the individual *actually* chose (as opposed to the practically intractable method of including one correction term for each *possible* degree choice, which is 16 in this case). Since the nested logit is assumed to be distributed with generalised extreme value, the predicted values are first multiplied by the inverse of the standard cumulative to make it compatible with the probit of equation 3.1. The correction term, then, will be of the following form:

$$\lambda \frac{(\varphi[\Phi^{-1}[G]])}{G} \tag{3.8}$$

where λ is the coefficient to be estimated by the probit of equation 3.1; φ is the standard normal density function; Φ is the standard normal cumulative distribution function; and G is the predicted values from the nested logit (equation 3.7). So long as the errors in the degree choice equation 3.3 are correlated with the employability equation 3.1, the probability of being employed will be affected by variables in the degree choice equation as well[15]. Although providing consistent estimates, the heckit correction term results in heteroskedasticity and the standard errors of the model are therefore inefficient (Arendt & Holm 2006). To account for this, Stata's robust heteroskedastic-consistent standard errors were used.

ii: Sample-Selection of Graduates in the Labour Force

The second problem with modelling employability of an individual within six months of graduation is the selection criteria for including individuals in the sample.

[15] See Raaum and Torp (2000) for a discussion of the effects of observable variables and unobservables (residuals) from the selection equation on the primary (in this case, employability) equation.

Only individuals who are *not* pursuing further studies upon graduation are considered since palpably, those pursuing further study are involved in a 'positive outcome'[16] and cannot be considered unemployed. If, however, on average, those excluded from the employability sample have a systematic higher (or lower) chance of being employed (had they chosen to enter the labour market), then the sample considered suffers from what Greene (1990, pg 740) calls 'incidental truncation' or more commonly, sample selection bias, meaning the sample considered is non-randomly selected. The consequence of this is that the coefficients (vector $\boldsymbol{\beta}$ in equation 3.1) would be biased towards individuals who have decided to enter the labour force; thus graduates who chose to pursue further study would not be able to use the results to get an indication of how employable they are. A similar 'heckit' (or, Heckman's two-step method) as adopted for the endogeneity problem in the previous section is applied in this case. Consider the probability that individual i is observed *not* pursuing fulltime further study and is therefore considered in the labour force[17] as:

$$L_i^* = \boldsymbol{\eta}' \mathbf{X}_i + e_i \tag{3.9}$$

$$\text{Prob}\,(L_i = 1) = \text{Prob}(e_i < \boldsymbol{\eta}' \mathbf{X}_i) \tag{3.10}$$

where L* is the unobservable index associated with being in fulltime further study; L is a dummy variable that equals 0 if the individual is doing fulltime further study and 1 otherwise; e is the error term (assumed normally distributed) associated with the probit of

[16] Smith et al 2000 indicate that a positive outcome for a graduate involves only either employment or further study.
[17] Individuals who are *both* not enrolled in fulltime study *and* not looking for employment are not considered in the sample.

L; $\boldsymbol{\eta}$ is a vector of coefficients; and $\mathbf{X}$ is the same vector of variables used in the employability probit (equation 3.1).

The variable Y of equation 3.1 is only observable if L = 1, that is, a graduate can only be considered unemployed (or employed) if they are *not* pursuing fulltime further study. Following Arendt and Holm (2006), the following correction term is included in the probit of equation 3.1:

$$\rho \frac{(\varphi[\eta' X_i])}{(\Phi[\eta' X_i])} \qquad (3.11)$$

where ρ is the correlation between the error terms of equation 3.1 and the selection probit of equation 3.9; φ is the standard normal density function; and Φ is the standard normal cumulative distribution function.

Stata's 'heckprob' command, using maximum likelihood methods based on Van de Ven and Van Praag's (1981) paper, ensures that the standard errors of the correction term are consistent and homoskedastic. This correction term is similar to the one adopted in section 3.3 since it is essentially allowing for correlation between error terms of the different equations.

iii: Explanatory Variables for the Employability (Probit) & Selection (Probit) Equations

The variables presented in Table 3C satisfy the vector **X** in equation (3.1) – (3.2) and (3.9) – (3.11). All data on the variables presented here are from UTAS GDS 2004/2005, except for the Best 5 scores which were merged from UTAS student records. Once the maximum likelihood process is carried out, variables that were found insignificant in either equation were removed to minimise collinearity in the correction terms[18]. The Honours and Best 5 variables were removed from the employability probit and the Gender and Permanent Residency variables were removed from the selection equation in the final model.

Table 3C: *Variables in the Employability and Selection Equations*

	Description & Expectation
Age & Age Squared	Although age and age squared are traditionally used in employment and wage equations, in this case one would expect that the sample consists mainly of fresh graduates therefore age may not give traditional results since an older fresh graduate normally indicates quite the opposite – that the person took longer to acquire the degree or is a mature-aged student. However, the variables could also be capturing the effects of older graduates with working experience, in which case the standard quadratic relationship of employability with age would apply.
Residency	A dummy variable scored '1' if a person *does not* permanently reside in Australia: this variable is used to capture the opportunities of the foreign-born in the local labour market. Since those without Best 5 scores were removed from the sample, foreign-born are limited to those who completed the TCE.
Gender	A dummy variable scored '1' if a person is female. Significance would indicate gender bias in the labour market.
Best 5 score	Refer to table 3B for description[19]. Significance of the term would indicate that controlling for human capital or signalling associated with a degree, pre-tertiary ability still plays a part in obtaining a job.
Final Year Work	An indicator of work experience; scored '1' if the person was involved in any paid employment during his final year of studying at UTAS. Significance could mean employers value work experience.
Honours	A dummy variable scored '1' if a person completed an Honours degree. There is a strong a priori expectation for this variable to be significant if

[18] Puhani (2000) gives a good discussion of the limitations of the Heckman procedure and the problem of collinearity inherent in the correction term.

[19] Traditionally, in modelling whether a student chooses to pursue higher education, both ability and family proxies are recommended (Borland et al 2000); in this case data was unavailable for family background indicators.

	the traditional rate of return hypothesis is to hold[20].
15 Degree Choices & 1 Base Case	Appendix B discusses the complete division and grouping of the degrees into 16 dummy variables, with Pharmacy/Medicine serving as the base case in order to avoid the dummy variable trap. Significance of different degrees generally gives an idea of the labour market conditions associated with the field or discipline.

IV: Results

Table 5C presents the results from the employability probit (equation 3.1) without any corrections and also with both endogeneity (equation 3.8) and selection (equation 3.11) corrections. The former are biased results and are only presented as a source of comparison. The constant term was not found to be significant (probably due to the continuous Age variable) and was therefore removed. The results presented are in terms of marginal effects of a change in the variables on the probability of employment.

The first important thing to note is that both the Best 5 and Honours variables were removed from the equation due to insignificance, and consequentially, to minimise collinearity with the selection correction term. Both these variables, however, are indicators of some form of human capital (or signalling) and their insignificance indicates that rather than innate academic ability (Best 5) or further specialised knowledge (Honours), degree choice and final year working experience are the main influences on the probability of employment.

[20] Note that for Law degrees alone, Honours qualifications are awarded based on academic merit and not on any additional coursework/research requirements; therefore, the significance of the Honours variable, as applied to the case of Law degrees, reflects the importance of academic merit rather than additional education.

Table 5C: *Employability Probit with & without Self & Sample Selection corrections*

	No Corrections			**Both Corrections**	
	dy/dx	**P-value**		**dy/dx**	**P-value**
Pr(Employed)					
age	0.039	0		0.040	0
age square	-0.001	0.002		-0.001	0.008
residency	-0.414	0.047		-0.439	0.002
final year work	0.129	0		0.229	0
gender	-0.058	0.037		-0.078	0.016
Accounting	-0.251	0.074		-0.419	0
Education	-0.569	0		-0.594	0
Otherhealth	-0.515	0		-0.577	0
Nursing	-0.033	0.768		-0.115	0.325
Agri/Envi	-0.529	0		-0.646	0
Architect	-0.468	0.005		-0.697	0
Engi	-0.173	0.247		-0.388	0.002
IT	-0.455	0.001		-0.623	0
Science	-0.607	0		-0.710	0
Business	-0.438	0.001		-0.568	0
Econs/Fin	-0.380	0.023		-0.592	0
Soc Science	-0.596	0		-0.713	0
Law	-0.508	0		-0.678	0
Lang/Phil	-0.575	0		-0.688	0
FineArts	-0.694	0		-0.718	0
Self-selection	n/a	n/a		0.010	0.018
Sample-selection	n/a	n/a		0.621*	0.038**

***** This is not a marginal effect but simply the coefficient of the correction term (**ρ** in equation 3.11).

****** The significance of the selection coefficient is essentially a likelihood ratio test of the independence of the employability equation and selection equation.

Although both self-selection and sample-selection correction terms are found to be significant at a 5% level of significance, the removal of the self-selection correction term does not change the estimated coefficients by much[21]. Several degrees, however, are significantly affected by the correction. Accounting, Architecture, Engineering and Economics/Finance degrees have 6%, 9%, 10% and 5% less chance of being employed

[21] Refer to Appendix F for a comparison.

respectively once self-selection is taken into account. The fact that employability drops after self-selection is taken into account suggests that positive self-selection occurs in the affected degrees. This means that students who are more likely to be employed (for whatever reasons) tend to choose those degrees: self-selection correction accounts for this bias by lowering the probability of finding employment in application to an average, randomly selected individual. In spite of this result, non-correction only results in an insignificant upward bias in the mean predicted conditional[22] probability of employment, suggesting that self-selection is not a problem if general forecasting is of interest, but important if statements are to be made about individual degrees.

Without sample-selection correction, the predicted conditional probability of finding employment, calculated at the mean of each explanatory variable, is 80%, whereas the selection correction reduces the probability to 70%; this indicates, again, that there is positive selection occurring. In this case, positive selection means graduates who choose to enter the labour force have systematically higher probabilities of being employed when compared to those who pursue further study. For example, the uncorrected results suggest that an individual who *chose to enter the labour force* with an Accounting degree might have a 25% *less* chance of finding a job relative to a Pharmacist/Medicine graduate. This number, however, is misrepresenting the contribution of an Accounting degree to the employability of the graduate *population* and is only applicable to those who chose to enter the labour force. The fact that Accounting graduates from the graduate population

[22] The *conditional* probability – that is, conditional on having chosen to enter the labour force – is used here since the decision to enter the labour market is entirely an individual decision, therefore the joint probability (of being in the labour force *and* in a fulltime job) is not relevant as an indicator of market conditions and employability, which is the focus of this study.

as a whole actually have 42% less chance of finding a job relative to Pharmacist/Medicine graduates indicates that Accounting graduates who choose to enter the labour force are more employable than their counterparts who pursue further study. One possible reason for this result is that those who choose to enter the labour force are, for whatever reasons, more confident of finding employment in the first instance. Selectivity bias is prevalent in all the degree choices and is reflected in a fall in their respective effects on the probabilities of employment after the correction. The effect of final year work experience on one's employability, however, was being understated: selection correction increases the effect from 13% to 23%. This is because a graduate who worked during his final year is more likely to enter the labour force *and* find a fulltime job: the relationship between the two outcomes suggests that individuals who enter the labour force do so due to their more employable status.

Social Science, Science and Fine Arts degrees fare the worst in terms of graduate employability, experiencing, on average, a 71% less chance of being employed compared to Pharmacy/Medicine degrees, *ceteris paribus*. It should be noted that for degrees that are not highly specialised[23], the employability of a graduate does not necessarily reflect the market demand in a particular field or industry; for example, an Economics/Finance graduate may be more employable than a Business graduate, but this does not necessarily mean there is a greater demand for economists as Economics degrees may be simply giving a signal that their graduates are generically better equipped and thence, more able to take on business roles as well.

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[23] Specialised in this sense refers to degrees where the skills learnt are rarely applicable to other fields, e.g. Pharmacy and Medicine.

At first glance, the Age term seem to indicate that the older one is, the higher the probability that one will find a fulltime job. The significance of the Age Squared term, however, counteracts this effect. Plotting the values of the marginal effect of Age and Age Squared jointly[24], one finds that the maximum of the quadratic curve for the employability equation lies at age 20. Since the youngest graduates in the sample were 19 years old, the result indicates that fresh/early graduates enjoy the highest probability of employment. Theoretically this is in line with the finding that the Honours variable is insignificant in determining employability as well: employers are seeking to hire graduates as soon as possible, perhaps due to specialised training that only the employer can provide.

Labour market bias arises in the form of non-residents and women, who have 44% and 8% (respectively) less chance of finding a job. Of the former, there is an indication that employers are unwilling to hire those without permanent residency, although the sample size of non-residents in the labour force is only 7 and is only representative of non-residents who completed the TCE.

The significant difference in the Final Year Work variable after correction, as well as the size of its marginal effect on the probability of employment, warrants additional attention. After correction, the variable suggests that someone who works in his final year has a 23% higher chance of finding a job upon graduation. This could be due to connections to the labour market established in work placements during their final year of

[24] Refer to appendix G for the chart.

study: the GDS indicates that 176 (21% of those who are employed) graduates who worked during their final year are in a fulltime job with the same employer upon graduation. However, there were a total of 673 graduates in fulltime jobs that had indicated that they worked in their final year, meaning that direct market connections cannot entirely explain the higher probability of employment. Indeed, this suggests that either work experience gives graduates an edge in securing jobs by increasing their interview skills and confidence, or, employers themselves value work experience. Final year work experience need not necessarily increase the productivity of an individual but could, rather, be serving as a signal of the individual's productivity. These examples are neither exclusive nor exhaustible but, rather, suggest that the decision as to whether or not to work during one's university years plays a crucial role in determining one's employability upon graduation.

The coefficients uncovered from the employability probit with endogeneity and selection corrections were used to predict the mean probabilities of employment disaggregated by academic degrees and also by the 722 who were pursuing further study and the 1091 in the labour force. A comparison of the employability of those in the labour market and of those pursuing further study is important in uncovering whether or not low chances of employment causes graduates to choose further education. Theoretically, those who pursue further study are those with higher ability; they therefore should have a higher probability of employment had they instead chosen to enter the labour market. The empirical results are contrary to this: the average predicted employment probability of those in the labour market, *conditional* on having chosen to enter the labour market, is 75%, whereas it is 61% for those involved in further study. This could be due to a labour market that values those with final year work experience rather than good academic ability (as represented by the Honours or Best 5 variables)[25]. Table 5D presents the disaggregated results.

Table 5D: *Mean Predicted Employability*

	ARTS				
	Education	*Soc Science*	*Lang/Phil*	*Law*	*Fine Arts*
Labour	0.6179	0.5916	0.6271	0.7218	0.4539
Studying	0.6157	0.5579	0.6017	0.6925	0.4196
Difference	0.0022	0.0336	0.0255	0.0293	0.0344
	COMMERCE				
	Accounting	*IT*	*Business*	*Econs/Fin*	
Labour	0.9071	0.7914	0.7918	0.8479	
Studying	0.9032	0.7512	0.7777	0.8122	
Difference	0.0039	0.0402	0.0140	0.0357	
	SCIENCES				
	Agri/Envi	*Architect*	*Engineering*	*Science*	
Labour	0.6853	0.7612	0.9273	0.5961	
Studying	0.6559	0.7340	0.9191	0.6004	
Difference	0.0295	0.0272	0.0082	-0.0043	
	HEALTH			**HEALTH PRO**	
	Other Health	*Nursing*		*Pharm/Med*	
Labour	0.7012	0.9598		0.9769	
Studying	0.6815	0.9491		0.9774	
Difference	0.0197	0.0108		-0.0005	

The only degrees where those involved in further study are on average, more likely to be employed, are Science and Pharmacy/Medicine degrees; although Accounting, Engineering and Education degrees come close behind, having less than 1% difference in employment probabilities of those in the labour force and those in further study. All these

[25] 49% of those in further study were working in their final year, whilst the number was 80% for those in the labour force.

degrees have a different proportion of their graduates in higher studies[26], therefore displaying a lack of any systematic pattern between further study enrolment proportions and labour market/further study employability differences. Even so, degrees with the lowest average probability of employment (Social Science, Fine Arts and Science), *regardless* of whether their graduates are in the labour market or enrolled in further study, also have the highest proportions enrolled in further study. This could be the result of graduates knowing (or experiencing) the low chances of acquiring a job with their chosen degree; consequentially, the graduates in question pursue further study in the form of higher degrees or branch out to other disciplines in hopes of maximising future employment probability. As the data descriptions in Chapter Four showed earlier, only a small percent of those pursuing further study are actually doing higher research degrees. 300 graduates, who, bearing in mind had already completed undergraduate qualifications, pursued certificates, diplomas and degrees. This indicates that retraining and branching into other degrees is highly plausible.

Graduates from Fine Arts, IT, Economics/Finance and Social Science degrees show the largest difference in employability between the two groups: on average those in further study are 3-4% less likely to find employment had they chosen to enter the labour force whence compared to their peers who actually did choose to enter the labour market. This suggests that on average, those who enrol in further study in these cases do so due to either (or a combination of both) the low probability of being employed in a labour market that emphasises work experience rather than academic ability; or, an academic system that better rewards the academically inclined.

[26] Figure 4A

V: Conclusions

This study has been concerned with the employability of recent UTAS graduates: it models the probability of being employed within six months after graduation by taking into account firstly, the decisions made when choosing a degree; and secondly, the decisions made when choosing between entering the labour force or pursuing further study. The predictions from the modelling were then used to make a comparison of employability between different groups.

The results indicate that self-selection of individuals into certain degrees is significant when determining an individual's employability and is an important factor if proper inter-degree comparisons are to be made. Without accounting for sample selection resulting from the decision between labour force participation and further study, employability is, on average, over predicted by 10%.

Concerning the different degrees at UTAS, this study found that there are significant differences in the employability of a graduate based on the choice of an academic discipline, with graduates from Pharmacy and Medicine degrees around 98% likely to find fulltime employment within six months of graduation; whereas the probability is only 45% for graduates from Fine Arts degrees. Studies that use graduate employability yet do not take into account this disaggregated information on tertiary education could give highly misleading results due to generalisation.

Neither pre-tertiary nor Honours qualifications affect the probability of *employment* in this study. Whether or not these results remain particular to the labour market for Tasmanian graduates remains to be seen; however, it does indicate that pre-tertiary scores and even Honours qualifications are, in this case, an indicator of academic ability rather than skills that employers are looking for. Rather, work experience during university years and the choice of a major are the main determinants of whether or not a person is employed should they choose to enter the labour market.

An application of the results was to predict the employability of those who chose to do further study upon graduation, had they instead chosen to enter the labour force. Two significant results emerged from the exercise: the first was that degrees with the lowest average probability of employment also had the largest proportion of its graduates doing further study; and second, barring Pharmacy, Medicine and Science degrees, on average, individuals pursuing further study after graduation *would have* a lower chance of employment had they chosen to enter the labour market with their cohort. Compared to their job-seeking counterparts, the predictions indicate that graduates who pursue further study are, on average, 14% less likely to find fulltime work with their undergraduate qualifications. This comes from the earlier result which highlights the importance of work experience during university years and the *lack* of importance of either Honours degrees or pre-tertiary scores: this suggests there is not a high correlation between academic merit and employability. Another possible corollary from the result would be that low probabilities of employment cause individuals to instead opt toward further study, where the restrictions to entry are by far lower, and, indeed, where academic merit is more valued. Although the evidence for this is not conclusive, one thing is clear: those who pursue further study are neither more able nor employable as common economic theory would propound.

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