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University Selectivity and the Relative Returns to Higher Education: Evidence from the UK

by

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and

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Abstract

We study the labour market wage outcomes of university graduates by course (i.e. by subject and institution) in the UK using the Labour Force Survey (LFS). We match this data to a measure of course "selectivity" (the mean standardised admission scores at the course level) using data on high school achievement scores of students admitted to these courses. Unlike earlier UK studies, we are able to consider the effect of differences across undergraduate degree subjects, and in particular the selectivity of both the subject studied and of the Higher Education Institution (HEI) attended.

Our results show that selectivity of undergraduate degree programmes plays an important role in explaining the variation in the relative graduate wages across HEIs and subjects. In fact, much of the observed differential in relative wage outcomes across courses is due to the quality of students that HEIs select. That is not to say that the effect of course selectivity on wages implies that degrees are just signals of existing ability differences.

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1. Introduction

Higher education (HE) selectivity, often referred to as college selectivity in the US, is concerned with the quality of the students that attend each Higher Education Institution (HEI). HE selectivity is typically measured by the average ability of students on a course, as measured by the mean Standard Aptitude Test (SAT) scores in the US, or "A-level" scores in the UK. The strong correlation between HE selectivity and the labour market success of college graduates is firmly established in the literature (e.g. Dale and Krueger, 2002, 2014) – those students who attended higher rated institutions, earn higher wages. Dale and Krueger (2002 and 2014) go on to examine the impact of self-selection on this correlation by controlling for the average SATs score of the colleges that students applied to. While they are cautious about the validity of this, their data shows convincingly that the correlation becomes weaker and statistically insignificant. There are very few UK studies that focus on this important topic, mostly due to data limitations. On the other hand, the UK is a good laboratory for addressing this topic because of the relatively homogeneous nature of the HE landscape, and the low levels of non-completion and delayed completion. Heterogeneity is largely confined to (strong) differences in the degree of selectivity across courses.

The contribution of this paper, which builds on previous Labour Force Survey (LFS) analysis by Walker and Zhu (2013), is to examine the labour market earnings of graduates in the UK using the LFS (broadly equivalent to the US CPS data). This is matched to course "selectivity", as measured by mean standardised scores at the institution-subject-cohort level in national examinations at the end of High School using data provided by the Higher Education Statistics Agency (HESA). Course subject is defined by the Joint Academic Coding System (JACS) and we are able to obtain well determined estimates even when we disaggregate to as many as 16 subject groups (although we present just three broad subject groups in some of the work reported here).¹ Unlike earlier UK studies, we are able to consider the effect of differences across undergraduate (UG) degree subjects and institutions, and in particular we consider the selectivity of the *subject* studied at the institution attended. To the best of knowledge, we are the first UK study combining a nationally representative survey data (LFS) with mean standardized A-level scores by UG entry year, the HEI attended, and the subject studied. To allow for subject-specific grade inflation in admission scores, we use the detrended

¹ We omit nursing. Sadly, this JACS grouping places Economics in the same group as the rest of Social Studies and we are not able to separate them out. The results in Britton et al (2016) suggest that the annual earnings of Economics is substantially higher than the rest of the group.

selectivity scores from a subject-specific regression on a linear time trend, as our measure of selectivity – which we simply refer to as selectivity hereafter. Our results show that UG degree programme selectivity plays an important role in explaining the variation in the graduate wage premium across subjects and institutions.

The remainder of the paper is organized as follows. Section 2 briefly reviews the literature. Section 3 presents the institutional background while Section 4 introduces the data. Section 5 presents the results and Section 6 checks the robustness. Section 7 explores the causal effect of broad HEI type and broad subjects of study using an Inverse Probability Weighted Regression Adjustment approach. Finally, Section 8 concludes.

2. Literature Review

The literature on college selectivity can be classified into two strands. The first is concerned with the relationship between college selectivity and students' college choice and performance; while the second is concerned with the estimation of returns to college selectivity. Davies and Guppy (1997), using the US NLSY data, find that socio-economic status (SES) predicts entry into selective colleges, but not subject studied directly - except for the most lucrative majors within selective colleges. Moreover, men were more likely to enter fields of study with higher economic returns than women. Hoxby (2009) reviews the trend in college selectivity in the US over the past four decades: she finds that US colleges are not getting more selective, except at the very top end; and changes in selectivity are mostly due to the falling costs of distance and information. Descriptive analysis by Chetty et al (2017) of US college students since 1999 suggest that, while students from high income backgrounds are much more likely to attend highly selective colleges, the earnings of low and high-income background students are similar, conditional on college attended. Smith (2013), using a large twins dataset with application and enrolment information from the US, finds that a student's probability of degree completion within four years increases by choosing a more selective institution - an increase of 5 percentage points from choosing an institution with a median SAT score 100 points higher than the alternative. However, one should be cautious in interpreting the twins fixed-effect estimates as causal because these twins, not all identical, are unlikely to be as good as randomly assigned to different institutions. Indeed, Goodman et al. (2015) find that one's own college choice is partially affected by the college choice made by one's older sibling. Nonetheless, Smith (2013) found that methodology made little difference to the results.

While earlier studies on returns to college selectivity are by and large descriptive in

nature, the more recent literature pays closer attention to data quality and methodological issues in order to minimize bias in the estimates. Loury and Garman (1995) present a model where human capital depends on both performance at college (e.g. GPA) and college selectivity. Using the National Longitudinal Study (NLS) of the High School Class of 1972, they show that omitting college performance overstates the effect of college selectivity for Whites and understates it for Blacks. However, Black students with below median SAT scores of the college they attend have lower probability of graduation.

Causal estimation of the effect of college selectivity on earnings may also be biased by selection on unobservables, as elite colleges assess applicants on characteristics that are related to future earnings but, in general, would be unobservable to the econometrician. In order to moderate this bias, Dale and Krueger (2002) match students who applied, and were accepted by, with those rejected by the same set of colleges. Using the College and Beyond data set and the National Longitudinal Study (NLS) of the High School Class of 1972, they find little evidence of returns to attending more prestigious colleges for students with the same ability. Similarly, after partially adjusting for unobserved student ability by controlling for the average SAT score of the colleges that students applied to, Dale and Krueger (2014) conclude that estimates of the effects of college characteristics fall substantially and are generally indistinguishable from zero, except for students from disadvantaged backgrounds.²

It is usual to group UK HEIs into the three primary types in descending order of selectivity — the Russell Group, which is the self-selected "elite" research intensive universities that include Oxford and Cambridge; pre-1992 "Old" universities outside the Russell Group; and the post-1992 "New" universities which were formerly polytechnics prior to the end of the "binary divide" that existed between universities and polytechnics.³ There are very few studies on HE selectivity in the UK. Chevalier and Conlon (2003) is the first UK study on the subject. Using exit surveys of three UK graduate cohorts, known as the Destinations of Leavers from Higher Education (DLHE), they find that attending "Elite" (Russell Group) universities leads to a 6% wage premium, compared to "New" (post-1992) universities; and no significant differences between "Old" and "New". But wages were observed soon after graduation when wages are typically very noisy and little other information

² Brewer et al. (1999) find significant returns to attending elite private HEIs in the US even after accounting for selection using tuition fees and financial aid. Chen et al. (2012) also find substantial returns to MBA programme selectivity using the Dale and Krueger method.

³ We use RG, Old and New as short-hand hereafter.

will be available to the employer, and their Propensity Score Matching estimates are imprecise because of thin common support. Hussain et al. (2009) use four graduate cohort studies and five different measures of HEI quality including the total tariff score⁴ at admission. They also find a positive return to attending a higher quality institution, of about 6% earnings difference for one standard deviation increase in the composite HEI quality index that they construct. Again, this study uses only recent graduates where employers may depend heavily on the quality signal associated with HEI reputation.

Finally, Broecke (2012) uses data that is collected from UK graduates three years after graduation who respond to the follow-up of the DLHE exit survey, for just the 2004/5 cohort of graduates. The response rate is low, and there is clear non-random non-response, and the earnings is still confined to a relatively early part of a graduate's career. It compares the earnings of graduates who satisfied the entry conditions for their preferred institution, with applicants that failed to satisfy the entry conditions at the same institution but went to their second choice institution instead. This is effectively a difference in differences design. The analysis controls for subject of study, and for the overall A-level score achieved, and the parameter of interest is the coefficient on the institutional selectivity measure (the average tariff score requirement for admission). While the author is cautious in interpreting the results, it seems that the part that signalling plays in the estimates is likely to be quite large at this relatively early point in a graduate career, compared to later on when we might expect the value added to productivity by the course attended to have a greater weight.

Most recently, Britton *et al.* (2016) have examined the annual earnings of English domiciled graduates up to 10 years after graduation, allowing for HE selectivity using the HESA data in the same way as used here. Their data comes from the Her Majesty's Revenue & Customs (HMRC, the UK tax authority) merged with Student Loan Company (SLC) data on graduates. SLC debt repayments in the UK are linked to earnings and are administered by HMRC through the Pay-As-You-Earn (PAYE) system. They find substantial annual earnings premia for Medicine, Economics, Law, Maths and Business relative to the excluded category – which broadly reflects our results. Moreover, they find large differences associated with a (relatively crude) measure of family background on median graduate earnings– a raw gap of

⁴ We use the variable that HESA labels "Total Tariff (average pre-university test score – A-level or equivalent)". This is missing for a large minority of cells because there is a variety of alternative qualifications that are regarded as equivalent to a specific A-level score. This is unimportant provided the A-level score still provides a measure of the overall degree of selectivity of a course.

25% in favour of students from higher income families: but this fails to be statistically significant (at the 5% level) in their multivariate analysis which accounted for HEI attended and subject chosen.⁵

Their study differs from ours in four important ways. First, their outcome variable is tax year earnings, while we focus on hourly wages - which we feel is likely to be a better measure of productivity. Secondly, the LFS interviews all cohorts each year (although we can only include those for which HESA data is available which limits our data to entry cohorts from 1992⁶) so even our own sample contains few observations with more than 20 years of post-graduation work experience. In contrast, their HMRC data is restricted to individuals who are in the SLC scheme from 1998 and so will have no more than 10 years of work experience⁷. Thirdly, our sample only covers all graduates working as employees, whereas the HMRC data includes only those who choose to take out a loan.⁸ Finally, the HMRC data is the universe of students and is much larger than our survey-based data, and this will adversely affect the precision of our estimates, relative to theirs.

3. Institutional Background

Higher education in the UK is almost universally provided by publicly funded universities, that are independent not-for-profit institutions and there is little direct control that the government exercises over any institution. However, public subsidies have fallen dramatically in recent years with the introduction of large tuition fees supported by a sophisticated student loan scheme.⁹

Over the past half century, the UK HE sector has experienced several rounds of expansion, the most recent of which took place in the early 1990s. The 1992 Higher Education

⁵ The Walker and Zhu (2013) analysis of QLFS 1993 to 2010 cannot distinguish between HEI types due to data limitations prior to 2011.

⁶ In fact, we restrict the data to entry cohorts from 1992/93 because this is when the "binary divide" (between universities and "polytechnics") was abandoned. Moreover, HESA data only became available for entry cohorts from 2000/01. However, we believe that *relative* admission "tariffs" changed little over time and we use STATA's extensive missingness capabilities to allow us to retain data back to the end of the binary divide.

⁷ Whether one can extrapolate from the HMRC data to cover the whole of the working lifecycle is a question that we try to pursue later here.

⁸ While many law, accounting, and medical graduates become self-employed this is not typical early in the lifecycle and we find only 12% of the working graduates in the LFS cohorts that we use are self-employed. We know little about selection into loans, but the means-tested nature of the loan repayments mechanism suggests that those with higher rates of return will be less likely to participate in the programme because they would enjoy lower subsidies.

⁹ See Walker and Zhu (2013) for details of the background to the history of student financial arrangements in the UK.

Act granted university status and degree awarding power to all higher education institutions, including ex-polytechnics – who responded by changing their names to replace the title polytechnic, with university.

Most universities offer a wide range of majors. UG majors in England, Wales and Northern Ireland are typically of three years' duration. Professional vocational subjects are offered as UG majors in the UK – for example Law, Architecture, Medicine and Dentistry are all subjects that can be studied at UG level although, amongst these, only Law is available as a three-year degree. Many of the less selective institutions do not offer these professional majors, although they do tend to offer a wider range of more vocational subjects that do not feed into the traditional "professions". Universities will have pre-requisites for entry into many majors - for example, Science A-levels are required for entry to Medicine students; Maths is required for Science, Technology, Engineering, and Maths (STEM), as well as for most Economics majors; while A-levels in one or more modern languages is a requirement for most modern language majors.

Students in England, Wales and Northern Ireland typically study just four, or even three, A-Level subjects during the two years of post-compulsory schooling in senior high school.¹⁰ The narrow nature of the high school curriculum and the use of pre-requisites for many subjects imply that students, effectively constrain their university major by the subject choices that they make at the age of 16. There is a single portal that is used to apply to all HEIs and the same information is circulated to all HEIs that a student applies to. Typically, students will apply for a range of HEIs at age 18 that offer the, sometimes narrow, range of major(s) that might be open to them. The range of HEIs that a student applies to will be driven, in part, by their expectations of their likely level of achievement at the end of high school. Most applicants will apply to the same subject at all of the five HEIs that they choose. Applicants are well aware of the likely grade requirements for admission since this is posted by institutions, and have a good idea of their likely grades at the end of their A-level studies so tend to apply for several institutions that match their likely grades, and often to several slightly less selective institutions.

University applicants are already heavily selected since the senior high school participation rate is still well below 100%. Students apply ahead of their high school graduation

¹⁰ The Scottish school qualifications are completely different and many students in Scottish HEIs study for duration of 4 instead of 3 years. Therefore, we drop Scottish HEIs from this study.

examinations on the basis of grades predicted by teachers and are made offers of admission that are conditional on grades achieved. They are allowed to provisionally accept two such offers; one of which is nominated as the insurance offer - against missing the conditions of the most preferred offer. Those who satisfy their conditional offers are admitted to their most preferred HEI, and students who do not are passed to their second most preferred HEI. Students who fail to meet either conditional offer can apply through a "clearing" mechanism that matches such students to remaining vacant places in that entry year.¹¹

The UK is small and yet students typically apply to HEIs that are some distance from the parental home – there is a tradition of college being a rite of passage associated with leaving home. Institutions usually provide accommodation in halls of residence (dorms) to ease the transition from home. Most institutions provide a full range of subjects, although there are some exceptions (Imperial College London is heavily focused on science and engineering, while the LSE is focused mostly on social science). However, there are large regional differentials in earnings, especially among graduates and we capture these using regional fixed effects for London, rest of South East, Wales and Scotland - relative to the rest of England¹².

A large majority of students move straight from high school to university although many of the less selective institutions admit a large number of "mature" students and students with unconventional entry qualifications. Completion rates are very high – typically over 90% and most drop-outs occur close to the start of their studies. UG courses in the UK are quite specialized and, nonetheless, the proportion attending graduate school to gain PG qualifications is as common as in the US. Machin and Lindley (2013) find that just over one third of graduates in both the UK and the US have PG qualifications.

¹¹ Over 98% of applicants received at least one offer (in 2016) and about 70% make the grades by their most preferred institution, and around 12% gain places via the clearing mechanism. Only the most selective institutions/subjects will interview prospective students.

¹² Note that there are strong differences in the proportions of graduates from each institution working in London so it is important to include regional fixed effects so as to not attribute these effects to institutions whose graduates are more likely to move to London. However, there is strong correlation between region in which the HEI was located and the region of places of work, see Table A9 in the Appendix.

4. Data

Our analysis is based on the Labour Force Survey which is broadly comparable to the US Current Population Survey (CPS). The LFS data is a short rotating panel and we first construct a sample of employees aged 20 to 60 years old, who hold at least a first (UG) degree, using Waves 1 and 5 (the waves that contain earnings and hours of work data), in the QLFS 2012₀₁-2015₀₂ inclusive, the years for which the information on HEI attended, and subject studied, was available.¹³ We exclude Scottish HEIs because of their different secondary school qualifications and their distinctive four-year duration. We exclude all post-1992 universities that are not also ex-polytechnics, since these are very new HEIs with very few observations in our data. We include medicine but exclude subjects allied to medicine.¹⁴ There are 20,597 observations in our graduate sample. We merge the LFS data with collapsed data drawn from the Higher Education Statistics Agency (HESA) that provides data on the extent of selectivity by institution and course for all graduates since 2001. The HESA data we use is based on the individual student records of all A-level scores for UK domiciled, full-time, first degree (which excludes a relatively small minority of students who study a Foundation Year degree that combine academic and workplace skills) students studying at UK HE providers - but only for the entry years 2000/01-2013/14. A-levels are graded A*, A, B, C, D, E and Fail. We derive standardised A-level scores by UG entry cohort, HEI and subject, after normalization (with zero mean and unity standard deviation) within each cohort. Table 1 shows the frequencies in the LFS data by subject (JACS) area, HEI type and gender.

The HESA data contains all students in all subjects in all cohorts. We collapse this data to cohort*subject*institution cells. Figure 1 shows the variation in mean selectivity across institutions and the within institution standard deviation, where the data has been standardized to have zero mean and unit variance within each cohort. The mean of the raw data is close to BBB. The size of the institution is indicated by the size of the blob (for the 79 institutions who have a minimum cell size of 15 individuals), and the colour indicates institution type (orange is New; teal is Old; and red is RG). The estimated slope of this relationship is 0.129 (robust

¹³ The data is readily available from the UK Data Service, subject to registering with them and undertaking some training. The data is potentially highly disclosive and can only be used via Citrix server within the UK Data-Service's Secure Data Lab. Our own STATA code is available to researchers, via the Secure Lab, who wish to explore the data.

¹⁴ This group is dominated by nursing, a non-traditional graduate discipline. Moreover, many (of the higher earning) doctors have some self-employed income that is not recorded in our data. Indeed, many doctors who are in General Practice (i.e. physicians who work in the community) are entirely self-employed.

SE=0.009 and R^2 =0.775) and there is a clear increase in institutional variance as we move up the selectivity gradient. The data neatly divides between New, Old and RG, with little overlap (Queens University Belfast is the exception and is one of the few institutions in Northern Ireland). The New HEIs are surprisingly tightly clustered, while the RG HEIs have surprisingly large differences within the group.¹⁵ To allow for subject-specific grade inflation in admission scores, we use the detrended mean standardized A-Level scores from a subject-specific regression on a linear time trend, as our preferred measure of selectivity.¹⁶

	Men				Women			
JACS Subject Area	New	Old	RG	Total	New	Old	RG	Total
Medicine & dentistry	10^{*}	31	118	159	24	41	173	238
Biological/Veterinary	200	184	242	626	335	307	380	1,022
Agriculture & related	46	28	33	107	42	37	54	133
Physical sciences	189	248	431	868	135	133	211	479
Maths & computing	374	285	417	1,076	96	88	164	348
Engineering & tech	523	327	473	1,323	53	32	69	154
Architect/build/plan	247	55	87	389	69	13	51	133
Social studies	258	240	344	842	442	332	357	1,131
Law	117	61	131	309	207	118	136	461
Bus/admin studies	634	275	252	1,161	645	249	229	1,123
Mass comms & docs.	119	33	41	193	138	55	58	251
Languages	41	94	153	288	146	261	330	737
Historical/philosophic	83	168	226	477	102	140	272	514
Creative arts & design	260	76	67	403	338	103	102	543
Education	221	121	185	527	636	382	445	1,463
Combined	536	398	457	1,391	641	589	500	1,730

Table 1:Frequencies by subject, HEI type and gender, graduate sample

Note: *: cell size rounded. The data is our full graduate sample (see sample note for details). New universities refer to ex-polytechnics which became universities post-1992. Old universities refer to universities founded pre-1992 which are not in the Russell Group (RG) of elite pre-92 institutions which form an association of 24 (as of 2012) public research-intensive universities, including Oxford and Cambridge.

¹⁵ In the Appendix Figures A1, A2 and A3 we present the corresponding figures for each group of majors - STEM, Social Sciences, and Arts/Humanities.

¹⁶ Appendix Table A1 shows an OLS regression of the detrended standardized A-Level mean on the (unadjusted) standardized A-Level mean with full interactions with subject dummies, where the interaction terms are jointly significant (p=0.000) as well as individually significant for many subjects. This suggests that overlooking subject-specific inflation will lead to biased estimates in the effects of selectivity on wages.



Figure 1: Standard Deviation and Mean standardized A-Level scores by HEI, All subjects

Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.129 (rse=0.009), R²=0.775.

Figure 2 shows the differences in the degree of selectivity (measured by the detrended standardized mean A-level scores of 2002+ entry students) by subject group and by the three main institutional types. "New" universities are considerably less selective than the "Old" (by roughly half of a standard deviation) and, on average require modest grades in three A-level at around grades CCC, and the "Old" are considerably less selective (by roughly another half of a standard deviation) than the "Russell Group" of elite institutions that includes Oxford and Cambridge. Old institutions typically require 3 A-levels at grades BBB, while RG institutions typically require three A-level subjects at grades AAA. The most demanding subjects at the most selective institutions will demand three A* grades, but it is only in Medicine that all HEI types demand similar grades.

Overall, education and agricultural & related are the least demanding subjects, and the professional degrees in law and medicine & dentistry the most demanding, with STEM below that and Arts/Humanities below STEM. In all subjects except medicine & dentistry, RG is substantially more demanding that Old, which is more demanding that New.

Table 2 shows the mean log real gross hourly wages¹⁷ for each cell of the data.¹⁸ Russell Group (RG) graduates, both men and women, earn 0.11-0.12 log points more than graduates from Old (pre-92 non-Russell) universities; who in turn earn 0.06-0.07 log points more than graduates from New (post-1992) universities. Across subjects, graduates in Medicine and Dentistry (excluding graduate nurses) have the highest wages, followed by Business and Administrative Studies, Social Studies (which includes Economics), Law, and then most of the Science, Technology, Engineering and Maths (STEM) subjects. The subjects with the lowest wages tend to be Arts and Humanity disciplines such as Creative Arts and Design, Mass Communication, Languages, but also includes Agriculture.

¹⁷ We only observe wages for those who are employees. Our inability to analyze the self-employed is a major drawback of the LFS data and is likely to bias estimated subject effects because of the large proportion of self-employed who study Accountancy, Law, and Medicine/Dentistry.

¹⁸ Table A2 in the Appendix shows the log real weekly earnings by subject, HEI type and gender. Table A3 show log real gross hourly wages and log real gross weekly earnings by region of place of work and gender.

Figure 2: Selectivity Scores by Subject and HEI Type



Note: Based on post-2002 cohorts with actual A-Level scores. Orange is New; teal is Old; red is RG.

	Men				Women			
JACS Subject Area	New	Old	RG	Total	New	Old	RG	Total
Medicine & dentistry	2.93	3.25	3.33	3.29	2.91	3.20	3.14	3.13
Biological/Veterinary	2.73	2.79	3.02	2.86	2.66	2.68	2.83	2.73
Agriculture & related	2.86	2.71	2.99	2.86	2.64	2.54	2.73	2.65
Physical sciences	2.91	2.95	3.06	3.00	2.68	2.71	2.83	2.75
Maths & computing	2.86	3.00	3.15	3.01	2.74	2.88	2.98	2.89
Engineering & tech	3.03	3.10	3.19	3.10	2.75	2.93	2.88	2.85
Architect/build/plan	2.98	2.94	2.98	2.98	2.72	2.47	2.87	2.75
Social studies	2.81	2.93	3.05	2.94	2.66	2.68	2.84	2.72
Law	2.78	2.95	3.17	2.98	2.65	2.81	2.92	2.77
Bus/admin studies	2.95	3.10	3.11	3.02	2.75	2.82	2.92	2.80
Mass comms & docs.	2.61	2.73	2.80	2.67	2.67	2.53	2.70	2.65
Languages	2.86	2.79	2.93	2.88	2.65	2.67	2.78	2.71
Historical/philosophic	2.71	2.80	2.87	2.82	2.60	2.74	2.70	2.69
Creative arts & design	2.68	2.88	2.69	2.72	2.45	2.54	2.57	2.49
Education	2.90	2.87	2.98	2.92	2.74	2.82	2.86	2.80
Combined	2.89	2.95	3.04	2.95	2.64	2.70	2.85	2.72
Total	2.88	2.95	3.06	2.96	2.67	2.73	2.85	2.75

Table 2: Log real gross hourly wages by subject, HEI type and gender, graduate sample

Note: April 2012 constant prices. See note Table 1.

The UK HE UG sector underwent a major expansion around 1992. An increasing minority of students also have post-graduate qualifications. Therefore, in Table 3 we compare log hourly wages, log weekly earnings and log weekly hours by postgraduate (PG) status, gender, and whether the graduate entered HE by 1992. One picture that emerges is that for both genders, the unconditional PG premium in both wages and earnings, seems to have widened substantially after the HE expansion, although this could be partly due to the fact that post-HE expansion cohorts are still at an early stage of their career. The merged LFS-HESA sample contains 10,602 graduates who entered HE in 1992 or later, with mean standardised A-Level entry scores matched at the HEI-subject (JACS) level for post-2002 UG entry cohorts.¹⁹ For 1992-2001 UG entry cohorts, which is more than 70% of our data, we impute the missing A-Level scores and examine the robustness of the results to including this extended sample.²⁰

¹⁹ HESA data for 00/01-01/02 cohorts cannot be used because of inconsistencies in the tariff score calculations.

²⁰ We test for the robustness with respect to including of the 1992-2001 UG entry cohorts in Section 6. Pre-1991 cohorts are not used as they pre-date the major HE expansion which gave ex-polytechnics university status.

		Pre-92 U	G entry of	cohorts	Post-92 UG entry cohorts			
		No PG	PG	Total	No PG	PG	Total	
Male	Log hourly wage	3.09	3.16	3.11	2.78	2.93	2.81	
	Log weekly earnings	6.75	6.79	6.76	6.43	6.57	6.46	
	Log weekly hours	3.70	3.71	3.70	3.67	3.70	3.67	
	Age	48.5	49.1	48.7	31.3	32.5	31.5	
	Obs	3627	1561	5188	4007	942	4949	
Female	Log hourly wage	2.79	2.97	2.85	2.60	2.82	2.66	
	Log weekly earnings	6.17	6.37	6.24	6.08	6.29	6.13	
	Log weekly hours	3.44	3.50	3.46	3.51	3.56	3.52	
	Age	48.4	48.7	48.5	30.7	32.4	31.1	
	Obs	3160	1622	4782	4276	1402	5678	
Total	Log hourly wage	2.95	3.06	2.99	2.69	2.86	2.73	
	Log weekly earnings	6.48	6.58	6.51	6.25	6.40	6.28	
	Log weekly hours	3.58	3.61	3.59	3.59	3.62	3.59	
	Age	48.5	48.9	48.6	31.0	32.4	31.3	
	Obs	6787	3183	9970	8283	2344	10627	

Table 3: Summary stats by PG, HE-expansion cohorts and gender, graduate sample

Note: Full graduate sample (see sample note for details). Monetary variables are in April 2012 prices.

Figure A4 in the Appendix shows mean log real hourly wage by age for men and women holding UG degrees only, and for those graduates who also have higher degrees. For all four demographic groups, the age-wage profiles are very steep until the early 30s and, in the case of men, keep rising to about age 40. This suggests that an exclusive focus on the early career might lead to biased results. Figure A5 shows the corresponding life cycle weekly earnings pattern by gender and PG status. While the age-earnings profiles for men are rather similar to those for the age-wage profiles, the age-earnings profiles for women turn out to level out sooner, at around age 30, presumably due to lower hours of work associated with childbearing and child rearing.²¹ All of our analysis is conditional on being employed and our data is not able to credibly allow for non-random selection into employment.

²¹ Figure A6 and A7 in the Appendix show the age-wage profiles by birth cohorts for male and female undergraduates respectively. Note that the 1973-82 and 1983-92 cohorts correspond to pre and post-HE expansion. Of these, the 1983-1992 cohorts use actual HESA A-Level scores, while the 1973-82 birth cohorts use imputed A-Level scores. The lack of any discontinuity in the age profiles across birth cohorts suggests that the results can be generalised to other cohort/ages for which we do not have A-Level scores.

5. Empirical Results

Before we turn to the effect of HE selectivity, we first present conventional wage equations as a benchmark in Table 4, for men and women separately, using the full graduate sample. In contrast to the results presented in Walker and Zhu (2013), where the LFS data did not include HEI, here we provide estimates that include HEI type differentials which we could only provide in our earlier work from a separate survey.

In columns (1) and (4), we control for age, age squared, non-white, decades of birth, year and wave of survey, region of place of work and HEI type. In columns (2) and (5), we additionally control for degree subjects. Finally, in columns (3) and (6), we further add family circumstance controls such as partnership status, if any; and number of dependent children and age of the youngest child, if any. We resist controlling for PG qualifications so these results should be interpreted as including the option value of the possibility of pursuing PG studies.

The wage coefficients for attending Russell Group are robust across different specifications: at around 9% for men and 11% for women relative to New university graduates. Old university, relative to new, are similarly stable across specifications and are approximately 7% for men and 5% for women and these estimates are statistically significantly different to both RG and New. The subject differentials reflect those in Walker and Zhu (2013) with large positive effects for Medicine/Dentistry, Law, Business & Administrative Studies, and Maths, relative to the Languages omitted subject; and large negative ones for other Arts subjects, and even for Historical & Philosophical Studies. There are strong and conventional regional (of employment) differentials; and conventional coefficients; on family background variables.^{22,23} The large estimates of the effects of age reflect the young nature of the data.

²² Table A4 present the corresponding wage equations with additional controls for types of PG qualifications and degree class of the first degrees. Again, the results suggest that coefficients on HEI type, PG type and UG degree class are insensitive to controls for degree subject and family circumstances.

²³ We compare estimates using actual versus using imputed A-Levels for pooled men and women, in Table A6, which includes controls for HEI fixed-effect or type. The results are again very similar reinforcing the idea that including cohorts with imputed A-Level scores is acceptable.

		Men			Women	
	Baseline	+Subject	+Family	Baseline	+Subject	+Family
	(1)	(2)	(3)	(4)	(5)	(6)
Age of respondent	0.140***	0.134***	0.114***	0.128***	0.124***	0.122***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Age sq	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-white	-0.089***	-0.115***	-0.113***	-0.028^{*}	-0.049***	-0.037**
	(0.018)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)
Born in 1950s	-0.005	0.007	0.007	-0.037	-0.023	-0.011
	(0.050)	(0.049)	(0.048)	(0.050)	(0.049)	(0.049)
Born in 1960s	-0.070**	-0.054*	-0.045	-0.136***	-0.129***	-0.059^{*}
	(0.031)	(0.030)	(0.030)	(0.031)	(0.030)	(0.030)
Born in 1970s	-0.037**	-0.028	-0.027	-0.071***	-0.064***	-0.026
	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.017)
year2013=1	0.063***	0.062***	0.063***	0.033***	0.034***	0.035***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
year2014=1	0.082	0.082	0.085	0.057	0.058	0.061
	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
year2015=1	0.096	0.095	0.097	0.070	0.069	0.073
T 1	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
London	0.281	0.298	0.301	0.281	0.295	0.294
South a set	(0.012)	(0.012)	(0.011)	(0.012)	(0.012)	(0.012)
Southeast	0.084	(0.085)	(0.083)	(0.059)	(0.001)	(0.062)
Walaa	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)
wales	-0.001	-0.003	-0.002	(0.009)	(0.003)	(0.000)
Scotland	(0.024) 0.079**	(0.023) 0.077**	(0.023) 0.071**	(0.021)	(0.021)	(0.021)
Scotland	(0.034)	(0.032)	(0.032)	(0.033)	(0.041)	(0.043)
Northern Ireland	-0 153***	-0.157***	-0.164^{***}	-0.114^{***}	-0.105***	-0.094***
Northern netand	(0.026)	(0.025)	(0.025)	(0.022)	(0.022)	(0.022)
Old university	0.058***	0.065***	0.065***	0.046***	0.046***	0.042^{***}
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
RG university	0.099***	0.091***	0.088***	0.119***	0.106***	0.108***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Medicine & dentistry	× ,	0.426***	0.412***	× ,	0.448***	0.443***
-		(0.038)	(0.037)		(0.029)	(0.029)
Biological/Veterinary		0.054^{*}	0.051*		0.081^{***}	0.076^{***}
sciences		(0.029)	(0.029)		(0.021)	(0.021)
Agriculture & related		0.012	0.004		0.009	0.002
		(0.051)	(0.050)		(0.040)	(0.040)
Physical sciences		0.102^{***}	0.100^{***}		0.071^{***}	0.063**
		(0.029)	(0.028)		(0.025)	(0.025)
Mathematics & computing		0.172^{***}	0.175^{***}		0.191***	0.190^{***}
		(0.028)	(0.028)		(0.029)	(0.029)
Engineering & technology		0.225***	0.221^{***}		0.149^{***}	0.131***
		(0.027)	(0.027)		(0.039)	(0.038)
Architecture, building &		0.142***	0.141***		0.059	0.059
planning		(0.032)	(0.031)		(0.041)	(0.041)
Social studies		0.078	0.077^{-10}		0.065	0.063
		(0.029)	(0.028)		(0.020)	(0.020)

Table 4:Wage equations without PG and degree class controls, various
specifications, full graduate sample

Law		0.171***	0.168***		0.145***	0.144***
		(0.034)	(0.034)		(0.028)	(0.027)
Business & administrative		0.208^{***}	0.201***		0.152^{***}	0.143***
studies		(0.028)	(0.028)		(0.021)	(0.021)
Mass communications &		-0.057	-0.053		0.021	0.013
documentation		(0.039)	(0.039)		(0.030)	(0.030)
Historical & philosophical		-0.050	-0.048		0.002	-0.005
studies		(0.032)	(0.032)		(0.026)	(0.025)
Creative arts & design		-0.045	-0.046		-0.088***	-0.098***
		(0.033)	(0.033)		(0.024)	(0.024)
Education		0.052^{*}	0.037		0.123***	0.122^{***}
		(0.030)	(0.030)		(0.019)	(0.019)
Combined		0.100^{***}	0.102^{***}		0.060^{***}	0.059^{***}
		(0.028)	(0.027)		(0.019)	(0.019)
Partner present			0.119^{***}			0.060^{***}
			(0.011)			(0.010)
Any dependent children in			0.046^{*}			-0.110***
family <19			(0.024)			(0.023)
Number of dependent			0.005			-0.055***
children in family <19			(0.009)			(0.010)
Age youngest child in			0.001			-0.010***
family under 19			(0.001)			(0.001)
Constant	-0.272***	-0.271***	0.021	-0.092	-0.084	0.100
	(0.099)	(0.101)	(0.110)	(0.089)	(0.088)	(0.099)
Observations	10137	10137	10137	10460	10460	10460
R^2	0.276	0.308	0.322	0.210	0.240	0.254

Note: Robust standard errors (RSE) in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01. Full graduate sample (see sample notes for details). Omitted category: New (post-1992) universities; Languages degree; born in the 80's or 90's; survey year = 2012. Education is for those with UG degrees in Education. Many will be teachers, although most teachers will have a PG teaching qualification as well as an UG degree in some specific subject. We exclude parameter estimates for region of birth, region of university attended, born outside the UK, and wave – all of which are statistically insignificant.

In order to assess the value-added of HEIs, we include a full set of HEI fixed effects in Table 5 using the post-1992 entry sample with actual or imputed standardized A-Level scores,²⁴ as opposed to the HEI type indicators in Table 4, but we omit detailed subject controls for the moment because institutions would be dropped if they did not provide all subjects. Odd-numbered columns show the main coefficients of interest without controls for selectivity, and even-numbered columns show the effect of controlling for institutional selectivity. Supercolumns are for samples of males, females, and both respectively, where the latter includes a female dummy. The omitted category is Manchester Metropolitan University (MMU), the largest New institution in the UK, and therefore our measure of value added is the estimated fixed effect of each institution relative to MMU.

²⁴ We exclude HEIs with fewer than 15 graduates in the post-1992 graduate sample. This resulted in a small reduction of the sample size to 10,602 instead of 10,627 as in Table 3.

	Men		Wo	men	Pooled		
	No A-	A-Level	No A-	A-Level	No A-	A-Level	
	Level		Level		Level		
	(1)	(2)	(3)	(4)	(5)	(6)	
Age of respondent	0.173^{***}	0.172^{***}	0.192^{***}	0.193***	0.182^{***}	0.182^{***}	
	(0.015)	(0.015)	(0.014)	(0.014)	(0.010)	(0.010)	
Age squared	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
Non-white	-0.070***	-0.071***	-0.044**	-0.047**	-0.057***	-0.058***	
	(0.022)	(0.022)	(0.019)	(0.019)	(0.014)	(0.015)	
London	0.297^{***}	0.296^{***}	0.295^{***}	0.294^{***}	0.296^{***}	0.295^{***}	
	(0.016)	(0.016)	(0.015)	(0.015)	(0.011)	(0.011)	
Southeast	0.085^{***}	0.087^{***}	0.102^{***}	0.101^{***}	0.092^{***}	0.093***	
	(0.017)	(0.017)	(0.017)	(0.017)	(0.012)	(0.012)	
Wales	-0.067**	-0.067**	0.000	-0.003	-0.030	-0.031	
	(0.032)	(0.032)	(0.032)	(0.032)	(0.023)	(0.023)	
Scotland	0.097^{*}	0.092^{*}	-0.010	-0.010	0.034	0.031	
	(0.051)	(0.051)	(0.055)	(0.055)	(0.039)	(0.039)	
Northern Ireland	-0.146**	-0.144**	-0.137**	-0.133**	-0.138***	-0.134***	
	(0.062)	(0.062)	(0.054)	(0.055)	(0.041)	(0.041)	
Female					-0.117***	-0.115***	
					(0.008)	(0.008)	
Selectivity		0.078***		0.086***		0.084***	
		(0.012)		(0.011)		(0.008)	
Constant	-0.778***	-0.717***	-1.029***	-0.998***	-0.832***	-0.787***	
	(0.220)	(0.219)	(0.204)	(0.203)	(0.150)	(0.149)	
Observations	4938	4938	5664	5664	10602	10602	
R^2	0.384	0.388	0.320	0.327	0.357	0.363	

Table 5:Wage equations with HEI fixed effects and selectivity controls

Note: Standard errors in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01. Years fixed effects and cohort fixed effects are not reported. The HEI fixed-effect estimates are presented in Table A7 in the Appendix.

Consistent with the full sample, there is a significant wage penalty of being non-white and a substantial wage premia for working in London or the South-east region. Controlling for HEI-fixed effects, a one standard deviation increase in selectivity (roughly corresponding to the gap between RG and New universities on average) increases hourly wage by 0.08 log points for both men and women. This is a little larger than previous estimates, reflecting the young nature of graduates used in previous work. The higher moments of the selectivity scores are sometimes statistically significant, but they do not affect the coefficients of other key variables, or the R^2 . This estimate is squarely in the ballpark of the existing UK literature.

The estimated institutional fixed effects, for pooled men and women, from the estimation in Table 5 (columns 5 and 6) are plotted in Figures 3, 4 and 5. These present scatter plots of unadjusted and selectivity-adjusted HEI fixed effects (relative to MMU) by selectivity score, for all subjects pooled together. Each dot represents a unique HEI with a given mean A-Level admission score on the horizontal axis, and the mean unadjusted (for both HEI and

subject) wage on the vertical axis; and the size of the bubble is proportional to the number of graduates from that HEI in the sample. In Figure 3, the A-Level scores on the x-axis, shows that graduates from more selective HEI's (that demand higher scores) earn significantly more than graduates of less selective HEI's that demand lower grades (the dashed orange line, with a slope of 0.190 and a robust standard error (RSE) of 0.013, reflects a weighted least square regression of the unadjusted HEI fixed-effect estimates on standardized entry scores) – there would *appear* to be a large return to attending a more selective HEI.

In contrast, when we control for course selectivity, using standardised mean admission standards in Figure 4, we find much lower wage differentials, on average (the dashed orange line is much flatter with a slope of 0.107 (RSE=0.013), reflecting a weighted least square regression of the selectivity-adjusted HEI fixed-effect estimates on standardized entry scores). Failing to control for HEI selectivity gives the *mistaken* impression that more selective HEIs add considerably more value, when in fact much of this is due to their greater selectivity.

Figure 5 shows the scatter plots of unadjusted versus the selectivity-adjusted relative fixed effects (using pooled men and women). HEIs above (below) the 45 degree line have an over(under)estimate of value added (relative to MMU). According to this figure, Birmingham (an Old university) has the same adjusted valued added as Liverpool JM (a New university), but apparently 10% higher unadjusted value. Similarly, Birmingham and Swansea have the same unadjusted value added, but Swansea has around 5% higher true adjusted value added, despite the former being a more prestigious Russell Group institution. To focus minds, a student who could have been admitted to Birmingham but instead goes to Liverpool JM does, on average, equally as well in the labour market. Similarly, a student who could have attended Cambridge would, on average, do just as well if she had attended Bath. Note that ALL of the RG HEIs are above the 45° line, while most of the New HEIs are below.

The analysis above pools all subjects.²⁵ Yet we know that there are considerable differences in selectivity by subject and there are some differences in subject mix across institutions that will confound the analysis. Thus, in Figures 6, 7 and 8 we present the plots of unadjusted HEI fixed-effects against selectivity for the three subject groups, together with the fitted lines for both adjusted (solid orange) and unadjusted (dashed blue) FE's, respectively.²⁶

²⁵ We present the HEI fixed-effect estimates for pooled subjects in Table A7 and the corresponding estimates for the 3 broad subject groups in Table A8 in the Appendix.

²⁶ We drop "combined" degrees where the subject mix varies considerably across students. We also drop "education" because it is small and many institutions do not provide such a course.



Figure 3: Scatter plots of unadjusted HEI fixed effects by standardized A-Level scores, all subjects

Note: Orange is New; teal is Old; and red is RG. The vertical axis records the estimated fixed effects for a specification that is unadjusted, i.e. does NOT control for selectivity. The size of the blob indicates institution size. Fitted line: slope=0.190 (rse=0.013), R²=0.675. Omitted HEI: MMU. Size of the bubble is proportional to cell size.



Figure 4: Scatter plots of selectivity adjusted HEI fixed effects by standardized A-Level scores, all subjects

Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.107 (rse=0.013), R²=0.394. Omitted HEI: MMU. The vertical axis records the estimated fixed effects for a specification that is adjusted, i.e. does control for selectivity.



Figure 5: Scatter plots of unadjusted vs. selection-adjusted HEI fixed-effects, all subjects

Note: The vertical (horizontal) axis records the estimated fixed effects for a specification that is unadjusted (adjusted), i.e. does NOT (does) control for selectivity.

Institutions included have a minimum cell size of 10 individuals. The fact that the slopes for the adjusted HEI fixed-effects are a lot flatter than those for the unadjusted across all subjects highlights the importance of controlling for selectivity when estimating returns to higher education. It is clear that there is strong sorting by HEI types even within the broad subject groups, with very little overlap in their selectivity scores. On the other hand, the fitted lines representing a weighted least square regression of the selectivity-adjusted HEI fixed-effects gives the best fit (in term of R^2) for STEM, and the worst fit for Art & Humanities, with Social Sciences somewhere in between. This implies that more selective HEIs add more value in STEM subjects, but much less so in Arts and Humanity subjects.

Figure 9 shows how the effect of A-level scores on wages by disaggregated subject, without and with controlling for HEI fixed-effects. On average, allowing for HEI fixed-effects reduces the effect of selectivity on wages by almost 40%, from 0.134 log points to 0.084 log points for a one SD increase. However, there is substantial variation across subjects. For subjects like Law or Maths/Computing, a one SD difference scores could explain around 0.18 log points differences in the wage differential; while, at the other extreme, Architecture is very insensitive – a one SD difference in A-Level scores only explains 0.03 log points difference in the wage differential. Once we allow for HEI fixed-effects, the effect of one SD increase in A-Level scores will only increase wages by 0.055, 0.056 and 0.025 log points for Maths/Computing, Law and Architecture respectively. Figure 10 shows the adjusted value added of HEIs, ranked by their (adjusted) value added, together with the 95% confidence intervals, where red is Russell Group, teal is Old universities, and orange is New universities. Relative to MMU, itself a New university, only about a quarter of HEIs, with a mixture of RG and Old universities in our sample have significantly higher value-added. On the other hand, roughly 15% of HEIs, with a mixture of Old and New universities, fared considerably worse. While the top quarter of HEIs adds significantly more value than the bottom quarter, they are not significant greater than the middle. It is also clear that RG institutions dominate the top half of the estimates.

Only 82.5% of graduates in our sample hold at least 2 A-Levels. So we check the robustness of estimated adjusted value-added distributions in Figure 11 by excluding those without at least 2 A-Levels. The pattern looks very similar, although the ranking seems slightly sensitive to the changes in sample. Using the subsample of graduates with at least 2 A-Levels, Figures 12 to 14 show the estimated adjusted value-added distributions for STEM, Social Sciences and Arts & Humanities, respectively. Due to the smaller cell sizes, the 95%

confidence intervals are much wider than those in Figures 10 and 11. In principle, population data would reduce these confidence intervals by an order of twenty.

6. Robustness

Table 6A assesses the sensitivity of returns to HEI types and subjects with respect to institutional selectivity, without and with controlling for post-graduate degrees (we group all such degrees together, and degree class (we code "First" and "Upper Second", that around half of students achieve, as "good" compared to the lower classifications).²⁷ Columns (1), (3) and (5) correspond to columns (2), (4) and (6) in Table 5 for men, women and pooled respectively, but now with subject controls added and HEI fixed effects replaced by HEI type dummies. The wage premia for studying languages (the reference subject) at Russell Group universities as opposed to New universities are substantial, for both men and women. Moreover, getting a good degree or PG qualification also carry significant wage premia. However, they do not appear to matter for the coefficients of A-Level scores or HEI types for both genders. This pattern implies that our key estimates of the HEI value added are insensitive to how we control for PG qualifications or UG degree class.

Another concern is that the effect of selectivity might vary with the years of employment since graduation. This might arise if course selectivity has some value as a signal – since employers know little about their employees' productivities soon after graduation, they may use college selectivity as a signal. We might expect the value of such a signal would diminish as new information about productivity is revealed by experience. In the first 3 columns of Table 6B we replicate Table 6A, but now adding years since graduation and its interaction to the selectivity measure. There seems to be no evidence of such an effect for men, and for women it appears that a more selective degree has growing value in the market. In the last 3 columns, we only allow the effect of selectivity to vary with age up to the median age in our sample (32 and 31 for men and women respectively). This finding implies that studies on returns to university selectivity using new graduates are likely to be biased -especially for women.

²⁷ Appendix Table A5 replicates Table 6 for weekly earnings to better facilitate a comparison with other research that looks at earnings rather than hourly wage.



Figure 6: Scatter plots of HEI fixed effects unadjusted for selectivity, STEM

Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.205 (rse=0.017), R²=0.612. Omitted HEI: MMU. Size of the bubble is proportional to cell size. The solid line fits the unadjusted HEI fixed-effects whereas the dashed line fits the adjusted HEI fixed-effects.



Figure 7: Scatter plots of HEI fixed effects unadjusted for selectivity, Social Sciences

Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.214 (rse=0.028), R²=0.464. Omitted HEI: MMU. Size of the bubble is proportional to cell size. The solid line fits the unadjusted HEI fixed-effects whereas the dashed line fits the adjusted HEI fixed-effects.



Figure 8: Scatter plots of HEI fixed effects unadjusted for selectivity, Arts/Humanities

Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.151 (rse=0.025), R²=0.304. Omitted HEI: MMU. Size of the bubble is proportional to cell size. The solid line fits the unadjusted HEI fixed-effects whereas the dashed line fits the adjusted HEI fixed-effects.

Figure 9: Effect of Standardized A-Level score on Wages by subject



Note: Blue: coefficient of A-Level without HEI fixed-effect, Red: coefficient of A-Level with HEI fixed-effect. N=10,602. Minimum number of graduates per subject is more than 100.



Figure 10: Estimated Adjusted Value Added Distributions, all subjects

Note: orange is New; teal is Old; and red is RG. The dotted lines show the confidence interval around the estimated value added relative to MMU.



Figure 11: Estimated Adjusted Value Added Distributions, all subjects, A-Level subsample

Note: orange is New; teal is Old; and red is RG. The dotted lines show the confidence interval around the estimated value added relative to MMU.



Figure 12: Estimated Adjusted Value Added Distributions, STEM subjects, A-Level subsample

Note: orange is New; teal is Old; and red is RG. The dotted lines show the confidence interval around the estimated value added relative to MMU. Minimum cell size (number of graduates per HEI) is 10.



Figure 13: Estimated Adjusted Value Added Distributions, Social Sciences, A-Level subsample

Note: orange is New; teal is Old; and red is RG. The dotted lines show the confidence interval around the estimated value added relative to MMU.



Figure 14: Estimated Adjusted Value Added Distributions, Arts & Humanities, A-Level subsample

Note: orange is New; teal is Old; and red is RG. The dotted lines show the confidence interval around the estimated value added relative to MMU.

]	Men	W	omen	1	A 11
	Subjects	PG & Good	Subjects	PG & Good	Subjects	PG & Good
	-	Degree	-	Degree	-	Degree
	(1)	(2)	(3)	(4)	(5)	(6)
Course	0.078^{***}	0.075***	0.071***	0.070^{***}	0.075***	0.073***
selectivity	(0.013)	(0.013)	(0.012)	(0.012)	(0.009)	(0.009)
Age of respondent	0.171^{***}	0.173***	0.189^{***}	0.183***	0.178^{***}	0.176^{***}
0	(0.015)	(0.015)	(0.014)	(0.014)	(0.010)	(0.010)
Age squared	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-white	-0.096***	-0.087^{***}	-0.061***	-0.053***	-0.079^{***}	-0.070^{***}
	(0.022)	(0.022)	(0.018)	(0.018)	(0.014)	(0.014)
Born in 1970s	-0.010	-0.010	-0.011	-0.010	-0.011	-0.008
	(0.022)	(0.022)	(0.022)	(0.022)	(0.016)	(0.016)
year2013=1	0.063^{***}	0.060^{***}	0.026^{*}	0.024^{*}	0.041^{***}	0.039***
	(0.015)	(0.015)	(0.014)	(0.013)	(0.010)	(0.010)
year2014=1	0.087^{***}	0.082^{***}	0.059***	0.057***	0.071***	0.066***
	(0.015)	(0.015)	(0.014)	(0.014)	(0.010)	(0.010)
year2015=1	0.097^{***}	0.090^{***}	0.066^{***}	0.063***	0.078^{***}	0.073***
	(0.018)	(0.018)	(0.017)	(0.016)	(0.012)	(0.012)
London	0.309^{***}	0.301***	0.295^{***}	0.293***	0.305***	0.300^{***}
	(0.015)	(0.014)	(0.013)	(0.013)	(0.010)	(0.010)
Southeast	0.089***	0.092***	0.090***	0.089***	0.090***	0.091***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.011)	(0.011)
Wales	-0.078***	-0.069**	-0.013	-0.003	-0.039*	-0.030
	(0.030)	(0.029)	(0.028)	(0.028)	(0.020)	(0.020)
Scotland	0.086*	0.087*	-0.036	-0.028	0.018	0.022
	(0.051)	(0.051)	(0.055)	(0.054)	(0.039)	(0.038)
Northern Ireland	-0.172***	-0.178***	-0.126***	-0.108***	-0.146***	-0.138***
	(0.029)	(0.028)	(0.026)	(0.026)	(0.020)	(0.019)
Old university	0.052***	0.049***	0.022	0.003	0.037***	0.026**
2	(0.016)	(0.016)	(0.015)	(0.015)	(0.011)	(0.011)
RG university	0.052***	0.043***	0.082***	0.072***	0.069***	0.058***
2	(0.015)	(0.015)	(0.015)	(0.015)	(0.011)	(0.010)
Female	. ,		. ,	. ,	-0.101***	-0.114***
					(0.008)	(0.008)
Medicine &	0.215^{***}	0.256^{***}	0.292^{***}	0.325^{***}	0.269***	0.306***
dentistry	(0.054)	(0.054)	(0.037)	(0.037)	(0.030)	(0.031)
Biological/Vet	0.023	0.041	0.020	0.013	0.020	0.024
sciences	(0.038)	(0.038)	(0.024)	(0.023)	(0.020)	(0.020)
Agriculture &	0.047	0.062	-0.068	-0.055	-0.028	-0.017
related	(0.068)	(0.066)	(0.046)	(0.046)	(0.039)	(0.038)
Physical sciences	0.097**	0.113***	0.044	0.035	0.067^{***}	0.069***
2	(0.038)	(0.038)	(0.030)	(0.030)	(0.023)	(0.022)
Mathematics &	0.176^{***}	0.197^{***}	0.178^{***}	0.177^{***}	0.160^{***}	0.172^{***}
computing	(0.037)	(0.037)	(0.036)	(0.035)	(0.022)	(0.022)
Engineering &	0.202***	0.209***	0.109**	0.099*	0.174***	0.174***
technology	(0.037)	(0.037)	(0.051)	(0.051)	(0.024)	(0.023)
Architecture,	0.145***	0.140^{***}	0.039	0.019	0.106***	0.092***
building & plan	(0.041)	(0.041)	(0.051)	(0.051)	(0.028)	(0.028)
Social studies	0.118***	0.130***	0.027	0.030	0.063***	0.069***
	(0.038)	(0.038)	(0.025)	(0.025)	(0.021)	(0.021)
Law	0.124***	0.137***	0.096***	0.092***	0.105***	0.107^{***}

Table 6A:Wage equations without and with PG and degree class controls

	(0.044)	(0.044)	(0.031)	(0.030)	(0.025)	(0.025)
Business & admin	0.185^{***}	0.197^{***}	0.129***	0.128^{***}	0.150^{***}	0.154^{***}
studies	(0.038)	(0.037)	(0.026)	(0.025)	(0.021)	(0.020)
Mass comms &	-0.041	-0.032	0.021	0.011	-0.012	-0.014
documentation	(0.048)	(0.047)	(0.036)	(0.036)	(0.029)	(0.028)
Historical & philo-	-0.033	-0.036	-0.016	-0.015	-0.028	-0.033
sophical studies	(0.042)	(0.042)	(0.031)	(0.030)	(0.024)	(0.024)
Creative Arts	-0.011	-0.002	-0.108***	-0.099***	-0.068***	-0.060***
and Design	(0.042)	(0.041)	(0.028)	(0.027)	(0.023)	(0.023)
Education	0.124***	0.118^{***}	0.126***	0.077^{***}	0.130***	0.098^{***}
	(0.043)	(0.043)	(0.024)	(0.025)	(0.021)	(0.021)
Combined	0.110^{***}	0.131***	0.059^{**}	0.082^{***}	0.077^{***}	0.097^{***}
	(0.037)	(0.037)	(0.023)	(0.023)	(0.020)	(0.020)
Good Degree (I/2I)		0.104^{***}		0.087^{***}		0.094^{***}
		(0.011)		(0.011)		(0.008)
PG indicator		0.039^{***}		0.114^{***}		0.079^{***}
		(0.014)		(0.013)		(0.009)
Constant	-0.819***	-0.942***	-0.991***	-0.978***	-0.814***	-0.858***
	(0.216)	(0.217)	(0.198)	(0.197)	(0.147)	(0.146)
Observations	4938	4938	5664	5664	10602	10602
R^2	0.390	0.402	0.334	0.351	0.372	0.386

Note: RSE in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01. Merged LFS/HESA graduate sample (see sample notes for details). Institutional fixed effects not reported. Omitted category: New (post-1992) universities; Lower Second Class or Below (2II) degree; Languages. Columns 1, 3 and 5 correspond to columns 2, 4 and 6 in Table 5, but with additional subject dummies.

	I	Full age range	e	Below Median Age			
	(1)	(2)	(3)	(4)	(5)	(6)	
	Men	Women	All	Men	Women	All	
Selectivity	0.045**	0.017	0.029**	0.080***	0.017	0.030**	
	(0.021)	(0.019)	(0.014)	(0.015)	(0.019)	(0.014)	
Years since graduation	0.031***	-0.006	0.010	-0.000	0.000	-0.000	
-	(0.011)	(0.010)	(0.007)	(0.002)	(0.002)	(0.001)	
Years since graduation	0.003	0.005^{***}	0.004^{***}	-0.001	0.005^{***}	0.004^{***}	
* selectivity	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)	
Age squared	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	
Non-white	-0.087***	-0.053***	-0.069***	-0.087***	-0.053***	-0.069***	
	(0.022)	(0.018)	(0.014)	(0.022)	(0.018)	(0.014)	
Born in 1970s	-0.018	-0.008	-0.010	-0.010	-0.008	-0.009	
	(0.022)	(0.022)	(0.016)	(0.027)	(0.023)	(0.017)	
year2013=1	0.060^{***}	0.024^{*}	0.039***	0.060^{***}	0.024^{*}	0.039***	
	(0.015)	(0.013)	(0.010)	(0.015)	(0.013)	(0.010)	
year2014=1	0.080^{***}	0.056^{***}	0.066^{***}	0.082^{***}	0.056^{***}	0.066^{***}	
	(0.015)	(0.014)	(0.010)	(0.015)	(0.014)	(0.010)	
year2015=1	0.080^{***}	0.065^{***}	0.070^{***}	0.091***	0.063***	0.073***	
	(0.018)	(0.017)	(0.012)	(0.018)	(0.016)	(0.012)	
London	0.300^{***}	0.294^{***}	0.300^{***}	0.301***	0.294^{***}	0.300^{***}	
	(0.014)	(0.013)	(0.010)	(0.014)	(0.013)	(0.010)	
Southeast	0.091***	0.089^{***}	0.090^{***}	0.092^{***}	0.089^{***}	0.091***	
	(0.015)	(0.015)	(0.011)	(0.015)	(0.015)	(0.011)	
Wales	-0.071**	-0.003	-0.030	-0.069**	-0.003	-0.030	

Table 6B:Wage equations with selectivity interacted with years since graduation

	(0.029)	(0.028)	(0.020)	(0.029)	(0.028)	(0.020)
Scotland	0.085^{*}	-0.029	0.022	0.087^*	-0.028	0.022
	(0.051)	(0.054)	(0.039)	(0.051)	(0.054)	(0.038)
Northern Ireland	-0.179***	-0.112***	-0.140***	-0.178***	-0.112***	-0.141***
	(0.028)	(0.026)	(0.019)	(0.028)	(0.026)	(0.019)
Old university	0.050***	0.005	0.026**	0.049^{***}	0.005	0.026**
-	(0.016)	(0.015)	(0.011)	(0.016)	(0.015)	(0.011)
RG university	0.044^{***}	0.071^{***}	0.058^{***}	0.043***	0.071^{***}	0.058^{***}
•	(0.015)	(0.015)	(0.010)	(0.015)	(0.015)	(0.010)
Female			-0.113***			-0.113***
			(0.008)			(0.008)
Medicine & dentistry	0.253^{***}	0.327^{***}	0.306***	0.257^{***}	0.326^{***}	0.306***
5	(0.054)	(0.037)	(0.031)	(0.054)	(0.037)	(0.031)
Biological/Vet sciences	0.041	0.014	0.024	0.041	0.014	0.024
6	(0.038)	(0.023)	(0.020)	(0.038)	(0.023)	(0.020)
Agriculture & related	0.064	-0.055	-0.017	0.062	-0.056	-0.017
8	(0.066)	(0.046)	(0.038)	(0.067)	(0.046)	(0.038)
Physical sciences	0.111***	0.035	0.068***	0.113***	0.035	0.069***
	(0.038)	(0.030)	(0.022)	(0.038)	(0.030)	(0.022)
Mathematics & computing	0.196***	0.175***	0.171***	0.197***	0.176***	0.171***
	(0.037)	(0.036)	(0.022)	(0.037)	(0.036)	(0.022)
Engineering & technology	0.207***	0.102**	0.173***	0.209***	0.101**	0.174***
gg.cg.g.	(0.037)	(0.051)	(0.023)	(0.037)	(0.051)	(0.023)
Architecture, building &	0.139***	0.022	0.093***	0.140***	0.022	0.094***
nlan	0.127	0.022	0.075	0.110	0.022	0.071
pian	(0.041)	(0.051)	(0.028)	(0.042)	(0.051)	(0.028)
Social studies	0.128***	0.032	0.069***	0.129^{***}	0.031	0.070***
boolar stadies	(0.038)	(0.022)	(0.021)	(0.038)	(0.025)	(0.070)
Law	0.136***	0.093***	0.107***	0.137***	0.093***	0.107***
Luw	(0.044)	(0.030)	(0.025)	(0.044)	(0.030)	(0.025)
Business & admin studies	0.196***	0.129***	0.153***	0 197***	0.128***	0.154***
	(0.037)	(0.025)	(0.020)	(0.037)	(0.025)	(0.020)
Mass comms &	-0.032	0.012	-0.015	-0.032	0.012	-0.015
documentation	(0.032)	(0.012)	(0.028)	(0.032)	(0.036)	(0.028)
Historical & philosophical	-0.039	-0.014	-0.033	-0.037	-0.014	-0.032
studies	(0.03)	(0.030)	(0.024)	(0.037)	(0.030)	(0.032)
Creative Arts	-0.005	-0.100***	-0.061***	-0.002	-0.100***	-0.061***
and Design	(0.041)	(0.027)	(0.023)	(0.002)	(0.027)	(0.023)
Education	0.119***	0.078***	0.098***	0.117^{***}	0.078***	0.098***
Education	(0.043)	(0.070)	(0.021)	(0.043)	(0.070)	(0.021)
Combined	0.129***	0.083***	0.097***	0.131***	0.082***	0.097***
Combined	(0.037)	(0.003)	(0.027)	(0.037)	(0.002)	(0.027)
Good Degree $(I/2I)$	0.104^{***}	0.088***	0.094***	0.103***	0.088***	0.094***
Good Degree (1/21)	(0.011)	(0.000)	(0.004)	(0.011)	(0.000)	(0.004)
PG indicator	(0.011) 0.037***	0.113***	0.078***	0.030***	0.113***	0.078***
I G indicator	(0.037)	(0.013)	(0,009)	(0.03)	(0.013)	(0,009)
Constant	-0.278	$-1 134^{***}$	-0 654***	_0.9/0***	_0 901***	-0.878***
Constant	(0 310)	(0.291)	(0.216)	(0.240)	(0.211)	(0.160)
Observations	<u></u> <u></u> <u></u>	566/	10602	<u>/038</u>	5664	10602
R^2	0 102	0 352	0.386	+230 0 402	0 352	0.386
<u></u> *	0.403	0.333	0.300	0.402	0.555	0.300

Note: RSE in parentheses, ${}^*p < 0.1$, ${}^{**}p < 0.05$, ${}^{***}p < 0.01$.

7. Treatment Effect of HEI Type and Broad Subject Groups

It seems likely that graduates' earnings will, to some extent, reflect their pre-university test scores – high scoring high school students will, on average, ultimately earn more. It also seems possible that students who attend different HEIs will ultimately earn different amounts and that this will, in part, reflect different admission requirements on HEIs as well as the individual student test scores. In particular, students with the same score but at different institutions might well earn different amounts. The regression analysis in the previous sections, while controlling for selectivity of institution and subject group, may still not be regarded as causal. The counterfactual depends on there being no unobservable confounders (i.e. selection only on observables) and a parametric functional form assumption (that the relationship between wages and test scores was, for example, linear). There may be unobserved confounders such as non-cognitive skills and personality traits. The usual approaches to this problem is to search for an instrument for the choices that individuals make; or to exploit discontinuities associated with admission requirements. In this application, the choice set is so large that it would be difficult to envisage a large number of instruments being available. Kirkeboen et al (2016) is the exception – they are able to do precisely this because of the closely observed and rigid nature of the Norwegian higher education system whereby admission to a course depends only on having at least the requisite high school score, and because their data recorded the next best alternative to the course each student was admitted to. Here, we have to rely on the assumption that there is no selection on unobservables. In this section, we explore the causal effect of HEI type and subject on log hourly wages, using the "doubly robust" inverse-probability weighted regression-adjustment (IPWRA) estimator (see Wooldridge 2007, and Imbens and Wooldridge 2009).

This estimator applies regression methods to weighted data. That is, where the data distribution is thin the method weights observations in the sparse parts to give them greater influence. Imagine, for the sake of the exposition, that there are just three institutions (a, b and c) and just one subject (see Figure 15 below). Students apply to institutions before their test scores are known and suppose that the test score was a simple scalar figure. Institutions differ in terms of their "selectivity" (i.e. the test score level that they require to gain admission). Individuals are made offers of a place at each of the institutions they apply to and these offers are conditional on test score achieved. Suppose that a is more selective than b, and b is more selective than c. Individuals are limited to apply to a small number of institutions (say just one for the purposes of this exposition). Some individuals who fail to make the critical test score

to meet the condition of their offer might nonetheless gain a place at that institution – for example, this might be allowed if the institution finds itself with spare capacity. If not, they might seek a place elsewhere, at a less selective institution, where spare capacity might exist. Thus, there may be some students at highly selective institutions that have low test scores. Equally, there might be some students who attend less selective institutions where they easily made the grade for admission but who had decided to attend this weaker institution for idiosyncratic reasons. Therefore, there will be a distribution of test scores within institutions, as well as differences in the average scores across institutions.

Importantly, the distributions of individual test scores at each institution are likely to overlap. For example, the lower tail of the distribution for institution a is likely to overlap with the upper tail of the distribution for b, and the upper tail of scores at c is likely to overlap with the bottom tail of the scores at b. Notice, in Figure 15, that although there is considerable overlap in the test score distributions between a and b, and between the distributions of institutions b and c, there is almost no overlap between the distributions of institutions a and c. Had we omitted institution b the results would be highly dependent on the validity of the assumption that the relationship between wages and scores was linear. The linearity assumption is strong – but it allows us to extrapolate the effect of test scores on wages across the test score distribution, even to those parts of the distribution where data is sparse. If the functional form assumptions of linearity and additivity were correct then we could rely on the differences in the estimated OLS intercepts in Figure 15 to provide measures of institutional relative value added. The essence of the regression method is that all observations are equally weighted and that the counterfactual level of wage is obtained from a prediction using a linear equation.

One solution to the sparsity of data in the tails for the top and bottom institutions is to attach greater weight to observations that do occur in the range where the data is sparse. This is what the Inverse Probability Weighting (IPW) method does. If we over-weighted the weakest students in the best institution then this would improve the overlap with weaker institutions, and not just the next weakest. Similarly, if we over-weighted the best students in the weakest institution we would also improve the overlap with all institutions, not just the next worst. It is this property, that weighting improves overlap between all pairs of institutions, that gives IPWRA its advantage over estimation methods that rely on matching just pairs of institutions together. It is only by including intermediate institutions is it possible to estimate the effect of course on wage outcomes across all courses.

Figure 16 illustrates how this works. By increasing the weight of the weakest students in the top institution and the strongest in the bottom we can examine the validity of the assumption that one can linearly extrapolate from the dense part of the data. In Figure 15, the extreme individuals happen to lie close to the fitted linear line so the weight given to them in Figure 16 makes little difference to the estimates. This is the single robustness property.



Figure 15: OLS methodology

Note: Red, blue and green dots indicate hypothetical students at institution a, b and c respectively. The dashed lines fit wages on test scores for in a regression with institution dummies.



Figure 16: IPWRA methodology

Indeed, IPWRA is *doubly* robust in the sense that it combines both the regression approach and IPW approach, and offers protection against misspecification in either step.

Compared to the simple IPW, it improves on the precision of estimation. IPWRA estimates the average treatment effect (ATE) of any HEI type and subject group relative to an omitted category (here we choose STEM subjects at New universities), allowing for selection into a particular HEI type and subject relative to the omitted category using multinomial logit model in the first step. Due to concerns of cell sizes and common support, we group the JACS subjects into STEM, Social Sciences and Arts & Humanities.

Table 7 presents the selectivity scores and frequencies for each of the 3 by 3 HEI type - subject combination, for men and women separately. It is clear that there is larger variation in A-Level scores across HEI types than across subjects, conditional on type. On the other hand, the variation in frequencies across gender reflects the differences in subject popularity, e.g. women appear to prefer Social Sciences and Arts & Humanities to STEM, relative to men. Table 8 reports the ATE estimates of HEI type-subject combination relative to New-STEM on wages (the full set of the IPWRA estimates of control variables are reported in the Appendix Tables A10 and A11), as well as the corresponding OLS estimates. It turns out that by treating university type and subject choice as exogenous, OLS substantially underestimates the effect of attending the most prestigious HEIs for men, while the opposite seems to be true for women. Similar effects are true in the case of the middle ranking institutions. Tables 9 and 10 repeat the exercise, by focusing on the subject dimension first and then on selection into New versus Old or RG HEIs conditional on choosing one particular subject group. Given the UK admissions system, this seems like a plausible approximation of reality as there are typically prerequisites in A-Levels for most subject choices.

Table 9 reports the ATE estimates, as well as the corresponding OLS estimates, of the effect of HEI types. It is striking that treatment effect estimates do not differ from the OLS estimated for both genders, suggesting that it might be appropriate to treat subject choice as exogenous in studies of the college premium. Table 10 treats subjects as exogenous and then estimates the treatment effect of HEI-type. This suggests that the returns to attending selective universities vary by subject and gender. For Arts & Humanities, there is little to differentiate between HEI-types for both genders. For Social Sciences, attending RG universities increase wages relative to attending New universities; but attending an Old university is only significant for men. The largest returns to attending more selective universities are found for men studying STEM subjects.

	Mer	1	Wom	en
	A-Level Mean	Obs	A-Level Mean	Obs
	(1)	(2)	(3)	(4)
New - STEM	-0.474	801	-0.422	432
New - Social Science	-0.456	539	-0.476	722
New - Arts & Humanities	-0.434	313	-0.456	472
Old - STEM	0.074	485	0.175	321
Old - Social Science	0.015	286	0.043	362
Old - Arts & Humanities	-0.016	212	-0.016	280
RG - STEM	0.510	819	0.582	645
RG - Social Science	0.391	362	0.471	418
RG - Arts & Humanities	0.360	255	0.390	437
Total	-0.018	4,072	0.017	4,089

Table 7: Selectivity by HEI type and subjects

Table 8: IPWRA of HEI type and broad subjects on wages

	Treatr	nent Effects			OLS	
	Men	Women	Pooled	Men	Women	Pooled
	(1)	(2)	(3)	(4)	(5)	(6)
ATE (ref: New - STEM)						
New - Social Science	0.075^{***}	-0.071**	-0.007	0.007	0.010	0.003
	(0.029)	(0.031)	(0.025)	(0.020)	(0.023)	(0.015)
New - Arts & Humanities	-0.010	-0.050	-0.040	-0.155***	-0.065***	-0.106***
	(0.036)	(0.035)	(0.030)	(0.025)	(0.024)	(0.017)
Old - STEM	0.161^{***}	-0.047	0.054^{*}	0.038^{*}	-0.053*	-0.001
	(0.031)	(0.037)	(0.028)	(0.022)	(0.028)	(0.017)
Old - Social Science	0.133***	-0.036	0.045	0.085^{***}	0.032	0.055^{***}
	(0.036)	(0.033)	(0.028)	(0.028)	(0.028)	(0.020)
Old - Arts & Humanities	0.003	-0.156***	-0.077***	-0.090***	-0.121***	-0.110***
	(0.037)	(0.033)	(0.028)	(0.031)	(0.030)	(0.021)
RG - STEM	0.153^{***}	0.039	0.102^{***}	0.115^{***}	0.071^{***}	0.092^{***}
	(0.033)	(0.041)	(0.030)	(0.023)	(0.027)	(0.017)
RG - Social Science	0.196***	0.049	0.108^{***}	0.109***	0.070^{**}	0.086^{***}
	(0.041)	(0.038)	(0.031)	(0.027)	(0.029)	(0.020)
RG - Arts & Humanities	0.027	-0.119***	-0.065**	-0.104***	-0.072***	-0.084***
	(0.039)	(0.038)	(0.032)	(0.030)	(0.028)	(0.020)
Female						-0.131***
						(0.009)
Selectivity				0.039***	0.047^{***}	0.042^{***}
-				(0.014)	(0.014)	(0.010)
Observations	3950	4083	8138	4072	4089	8161
R^2				0.404	0.355	0.391

RSE in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01. The observations which are off common support are excluded from the treatment effect models. Other controls include age, age squared, nonwhite, dummies for decade of birth, survey years, and regions. PG and good degree dummies only enter the outcome (wage) equations but not the treatment (selection) equations in the Treatment Effects specifications.

		Treatment			OLS	
	Men	Women	Pooled	Men	Women	Pooled
	(1)	(2)	(3)	(4)	(5)	(6)
ATE (ref: STEM)						
Social Sciences	0.010	0.024^{*}	0.015	0.009	0.017	0.008
	(0.014)	(0.015)	(0.010)	(0.014)	(0.014)	(0.010)
Arts & Humanities	-0.178***	-0.100***	-0.141***	-0.170***	-0.097***	-0.133***
	(0.017)	(0.015)	(0.011)	(0.016)	(0.015)	(0.011)
Female						-0.131***
						(0.009)
Selectivity				0.118^{***}	0.143***	0.130^{***}
-				(0.010)	(0.010)	(0.007)
Observations	4072	4089	8161	4072	4089	8161
R^2				0.399	0.350	0.387

Table 9: IPWRA/OLS of broad subjects on wages

RSE in parentheses, *p < 0.1, **p < 0.05, ***p < 0.01. Other controls include age, age squared, nonwhite, dummies for decade of birth, survey years, and regions. PG and good degree dummies only enter the outcome (wage) equations but not the treatment (selection) equations in the Treatment Effects specifications.

		Men			Women	
	STEM	Social	Arts &	STEM	Social	Arts &
		Science	Humanities		Science	Humanities
	(1)	(2)	(3)	(4)	(5)	(6)
ATE (ref: New	universities)					
Old	0.156^{***}	0.078^{**}	0.018	-0.081**	0.028	-0.096***
	(0.033)	(0.031)	(0.034)	(0.041)	(0.028)	(0.033)
RG	0.162^{***}	0.138^{***}	0.058	-0.005	0.108^{***}	-0.053
	(0.034)	(0.039)	(0.041)	(0.041)	(0.036)	(0.036)
Mean wage	2.726***	2.789^{***}	2.713***	2.763***	2.630^{***}	2.632***
(ref group)	(0.027)	(0.018)	(0.026)	(0.031)	(0.018)	(0.025)
Observations	2103	1187	765	1397	1502	1186

Table 10: IPWRA of HEI type on wages, conditional on broad subjects

RSE in parentheses, p < 0.1, p < 0.05, p < 0.01. Other controls include age, age squared, nonwhite, dummies for decade of birth, survey years, and regions. PG and good degree dummies only enter the outcome (wage) equations but not the treatment (selection) equations in the Treatment Effects specifications.

8. Conclusions

We study the graduate wage premium in the UK and unlike earlier UK studies, we are able to consider the effect of differences in UG degree subjects, degree class and in particular the selectivity of the subject at the institution attended. This is important, as earlier studies from the US (e.g. Loury and Garman 1995) have shown that omitting university performances might lead to biased estimates of the effects of college selectivity. Our results show that UG degree programme selectivity, as proxied by de-trended A-Level tariff scores of the degree programme attended, plays an important role in explaining the variation in the graduate wage premium across HEI types and subjects. Moreover, the extent to which more selective institutions add value varies substantially by subject and gender.

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Appendix





Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.099 (rse=0.012), R^2 =0.543.

Figure A2: Std Dev and Mean standardized A-Level scores by HEI, Soc Science



Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.146 (rse=0.013), R²=0.678.

Figure A3: Std Dev and Mean standardized A-Level scores by HEI, Arts & Humanities



Note: orange is New; teal is Old; and red is RG. The size of the blob indicates institution size. Fitted line: slope=0.141 (rse=0.017), R^2 =0.623.

Figure A4: Age-wage profile by sex and PG status



Note: smoothed Epanechnikov kernel-weighted local polynomial regression of log real gross hourly wage (April 2012 constant prices) on age.

Figure A5: Age-earnings profile by sex and PG status



Note: smoothed Epanechnikov kernel-weighted local polynomial regression of log real gross weekly earnings (April 2012 constant prices) on age.

Figure A6: Age-wage profile by birth cohorts: male undergraduates only



Note: smoothed Epanechnikov kernel-weighted local polynomial regression of log real gross hourly wages (April 2012 constant prices) on age. Full graduate sample.

Figure A7: Age-wage profile by birth cohorts: female undergraduates only



Note: smoothed Epanechnikov kernel-weighted local polynomial regression of log real gross hourly wages (April 2012 constant prices) on age. Full graduate sample.

	Coef.	Robust	t	P>t
		Std. Err.		
Medicine & dentistry	0.377	0.115	3.29	0.001
Biological/Vet sciences	-0.041	0.023	-1.80	0.072
Agriculture & related	0.024	0.042	0.58	0.563
Physical sciences	-0.052	0.026	-1.99	0.047
Mathematics & computing	-0.062	0.025	-2.44	0.015
Engineering & technology	-0.066	0.027	-2.39	0.017
Architecture, building & plan	-0.056	0.031	-1.81	0.070
Social studies	-0.095	0.023	-4.13	0.000
Law	0.106	0.030	3.54	0.000
Business & admin studies	-0.035	0.023	-1.52	0.128
Mass comms & documentation	-0.020	0.034	-0.58	0.562
Historical & philosophical studies	-0.013	0.026	-0.49	0.626
Creative Arts and Design	-0.072	0.029	-2.52	0.012
Education	-0.263	0.027	-9.85	0.000
Combined	-0.168	0.023	-7.25	0.000
(Standardized Mean) A-Level	0.658	0.032	20.31	0.000
Medicine & dentistry*A-Level	0.076	0.094	0.82	0.414
Biological/Vet sciences*A-Level	-0.044	0.043	-1.02	0.309
Agriculture & related*A-Level	-0.080	0.105	-0.76	0.446
Physical sciences*A-Level	-0.010	0.047	-0.20	0.838
Mathematics & computing*A-Level	0.046	0.045	1.03	0.301
Engineering & technology*A-Level	0.015	0.050	0.30	0.767
Architecture, building & plan*A-Level	-0.155	0.066	-2.35	0.019
Social studies*A-Level	0.059	0.042	1.41	0.158
Law*A-Level	0.113	0.048	2.37	0.018
Business & admin studies*A-Level	-0.074	0.041	-1.81	0.070
Mass comms & documentation*A-Level	-0.006	0.065	-0.10	0.922
Historical & philo-sophical studies*A-Level	-0.009	0.052	-0.17	0.862
Creative Arts and Design*A-Level	-0.006	0.056	-0.11	0.913
Education*A-Level	-0.101	0.046	-2.21	0.027
Combined*A-Level	-0.133	0.040	-3.30	0.001
Constant*A-Level	0.034	0.019	1.83	0.067

Table A1:Regression of detrended Standardized A-Level mean score on the subjects and
standardized A-Level mean scores

Note: N=10,602, R² = 0.4995. Test of joint significance of the interaction terms: $F_{(15, 10570)}$ =4.69 (p=0.0000).

		Μ	en			Wor	nen	
	New	Old	RG	Total	New	Old	RG	Total
JACS Subject Area								
(numerical)								
Medicine & dentistry	6.67	7.04	7.16	7.11	6.39	6.60	6.74	6.68
Biological/Veterinary sciences	6.37	6.39	6.65	6.49	6.13	6.11	6.27	6.18
Agriculture & related	6.54	6.47	6.72	6.58	6.06	6.00	6.26	6.13
Physical sciences	6.55	6.60	6.72	6.65	6.13	6.13	6.26	6.19
Mathematics & computing	6.50	6.64	6.79	6.65	6.14	6.34	6.36	6.29
Engineering & technology	6.70	6.76	6.86	6.77	6.08	6.38	6.44	6.30
Architecture, building &	6.65	6.63	6.62	6.64	6.22	5.89	6.35	6.24
planning								
Social studies	6.45	6.57	6.71	6.59	6.11	6.13	6.26	6.17
Law	6.42	6.59	6.80	6.61	6.07	6.31	6.43	6.24
Business & administrative	6.61	6.77	6.75	6.68	6.24	6.29	6.43	6.29
studies								
Mass communications & docs	6.22	6.34	6.42	6.29	6.13	5.91	6.19	6.10
Languages	6.42	6.37	6.61	6.51	6.05	6.01	6.17	6.09
Historical/philosophical	6.33	6.48	6.48	6.45	5.97	6.16	6.19	6.14
studies								
Creative arts & design	6.30	6.48	6.26	6.33	5.85	5.94	5.97	5.89
Education	6.49	6.49	6.61	6.53	6.17	6.23	6.24	6.21
Combined	6.53	6.60	6.69	6.60	6.09	6.08	6.28	6.14
Total	6.52	6.60	6.72	6.61	6.11	6.14	6.29	6.18

 Table A2:
 Log real gross weekly earnings by subject, HEI type and gender, graduate sample

 Mon
 Women

Note: full graduate sample (see sample note for details). April 2012 constant prices. New universities refer to ex-polytechnics which became universities post-1992. Old universities refer to pre-1992 universities which are not Russell Group. RG universities refers to the association of 24 public research universities known as the Russell Group (as of 2012). N=20,597.

,	Log gross	hourly wage	Log gross we	eekly earnings
	Men	Women	Men	Women
Region of Place of				
Work				
Tyne & Wear	2.78	2.67	6.42	6.11
Rest of Northern	2.80	2.65	6.45	6.12
South Yorkshire	2.81	2.69	6.43	6.14
West Yorkshire	2.89	2.69	6.52	6.14
Rest of Yorks &	2.84	2.63	6.48	6.06
East Midlands	2.89	2.71	6.55	6.14
East Anglia	2.91	2.66	6.57	6.07
Central London	3.22	3.06	6.90	6.62
Inner London	3.14	2.89	6.77	6.39
Outer London	3.03	2.84	6.66	6.28
Rest of South Ea	3.00	2.76	6.66	6.15
South West	2.94	2.68	6.58	6.09
West Midlands Me	2.95	2.77	6.61	6.22
Rest of West Mid	2.92	2.68	6.57	6.03
Greater Manchest	2.89	2.70	6.52	6.16
Merseyside	2.83	2.74	6.47	6.19
Rest of North We	2.91	2.66	6.55	6.09
Wales	2.85	2.73	6.49	6.14
Strathclyde	3.04	2.83	6.71	6.33
Rest of Scotland	3.07	2.76	6.71	6.13
Northern Ireland	2.76	2.58	6.44	6.06
Total	2.06	2.75	6.61	6 1 9
10(a)	2.90	2.13	0.01	0.18

Table A3:	Log real gross hourly wages and log real gross weekly earnings by region (of place
	of work) and gender, full graduate sample

Note: full graduate sample (see sample note for details). All monetary variables in April 2012 constant prices). N=20,597.

juli graduai	c sumpte					
		Men			Women	
	Baseline	+subject	+Family	Baseline	+subject	+Family
	(1)	(2)	(3)	(4)	(5)	(6)
Age of respondent	0.141***	0.135***	0.115***	0.124***	0.121***	0.119***
	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Age sq	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Non-white	-0.088***	-0.111***	-0.108***	-0.024	-0.041**	-0.029*
	(0.018)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)
Born in 1950s	0.035	0.051	0.053	0.006	0.014	0.032
	(0.051)	(0.050)	(0.050)	(0.052)	(0.051)	(0.051)
Born in 1960s	-0.050	-0.033	-0.018	-0.068**	-0.062*	0.001
	(0.032)	(0.031)	(0.032)	(0.033)	(0.033)	(0.033)
Born in 1970s	-0.024	-0.014	-0.009	-0.040^{*}	-0.041*	-0.005
	(0.020)	(0.020)	(0.020)	(0.022)	(0.022)	(0.022)
year2013=1	0.062^{***}	0.062^{***}	0.063***	0.030^{***}	0.031***	0.033***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
year2014=1	0.080^{***}	0.080^{***}	0.083***	0.057***	0.057^{***}	0.060^{***}
	(0.012)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
year2015=1	0.093***	0.092***	0.095***	0.066***	0.063***	0.068***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.013)
London	0.275^{***}	0.291***	0.294^{***}	0.283^{***}	0.289^{***}	0.288^{***}
	(0.012)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
Southeast	0.086^{***}	0.083***	0.083***	0.059^{***}	0.058^{***}	0.060^{***}
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Wales	-0.057**	-0.059**	-0.059**	0.004	0.003	0.006
	(0.024)	(0.023)	(0.023)	(0.021)	(0.020)	(0.020)
Scotland	0.073^{**}	0.071^{**}	0.065^{**}	0.028	0.034	0.037
	(0.033)	(0.032)	(0.032)	(0.033)	(0.033)	(0.033)
Northern Ireland	-0.152***	-0.157***	-0.163***	-0.092***	-0.095***	-0.084***
	(0.026)	(0.025)	(0.025)	(0.022)	(0.021)	(0.021)
Old university	0.053***	0.062^{***}	0.062^{***}	0.026^{**}	0.026^{**}	0.023**
	(0.011)	(0.011)	(0.011)	(0.010)	(0.011)	(0.010)
RG university	0.081^{***}	0.076^{***}	0.073***	0.093^{***}	0.090^{***}	0.092^{***}
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Master's	0.058^{***}	0.054^{***}	0.054^{***}	0.154^{***}	0.150^{***}	0.143***
	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Doctorate	0.081***	0.105***	0.104***	0.210***	0.214***	0.211***
	(0.020)	(0.020)	(0.020)	(0.024)	(0.024)	(0.024)
PGCE	-0.068***	-0.033	-0.034	0.102^{***}	0.090^{***}	0.092^{***}
	(0.017)	(0.022)	(0.023)	(0.012)	(0.015)	(0.015)
PG type other or don't	0.022	-0.002	0.007	0.205^{***}	0.173***	0.171^{***}
know	(0.027)	(0.027)	(0.027)	(0.023)	(0.023)	(0.023)
Distinction	0.097^{***}	0.089^{***}	0.091***	0.144^{***}	0.139***	0.136***
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Merit (2I)	0.078^{***}	0.086***	0.086***	0.110^{***}	0.109***	0.110***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Third class	-0.043**	-0.056***	-0.051***	-0.048*	-0.046*	-0.041
	(0.019)	(0.019)	(0.019)	(0.026)	(0.026)	(0.026)
Deg Class: Pass	-0.105***	-0.117***	-0.109***	0.025	0.014	0.010
-	(0.026)	(0.026)	(0.026)	(0.029)	(0.029)	(0.030)
Other degree class	-0.003	-0.049	-0.047	0.286***	0.187***	0.187***
C C	(0.050)	(0.048)	(0.048)	(0.035)	(0.035)	(0.035)

Table A4:Wage equations with PG and degree class controls, various specifications,
full graduate sample

Degree class unknown	-0.048*	-0.069**	-0.081***	0.112***	0.092***	0.087***
	(0.028)	(0.028)	(0.028)	(0.030)	(0.029)	(0.029)
Medicine Pass degree	0.486	0.221	0.208	0.494	0.254	0.265
	(0.048)	(0.060)	(0.060)	(0.047)	(0.056)	(0.056)
Born 50s * good degree	-0.069**	-0.083	-0.083	-0.067**	-0.067**	-0.079***
	(0.031)	(0.031)	(0.031)	(0.030)	(0.030)	(0.030)
Born 60s * good degree	-0.036	-0.039*	-0.046***	-0.107***	-0.112***	-0.105
	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)
Born 70s * good degree	-0.021	-0.023	-0.028	-0.032	-0.027	-0.028
	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)
Medicine & dentistry		0.404^{***}	0.391***		0.316***	0.310***
		(0.044)	(0.043)		(0.034)	(0.035)
Biological/Veterinary		0.050^{*}	0.047		0.053***	0.050^{**}
sciences		(0.029)	(0.029)		(0.020)	(0.020)
Agriculture & related		0.032	0.023		-0.003	-0.009
		(0.050)	(0.050)		(0.040)	(0.040)
Physical sciences		0.104^{***}	0.102^{***}		0.047^{*}	0.041
		(0.029)	(0.028)		(0.025)	(0.025)
Mathematics & computing		0.186^{***}	0.189^{***}		0.180^{***}	0.179^{***}
		(0.028)	(0.027)		(0.029)	(0.029)
Engineering & technology		0.236***	0.232***		0.118***	0.101***
		(0.027)	(0.027)		(0.040)	(0.039)
Architecture, building &		0.145***	0.142***		0.016	0.018
planning		(0.032)	(0.031)		(0.041)	(0.041)
Social studies		0.081***	0.080***		0.053***	0.052***
		(0.029)	(0.028)		(0.020)	(0.020)
Law		0.182***	0.177***		0.130***	0.129***
		(0.034)	(0.034)		(0.028)	(0.027)
Business & administrative		0.212***	0.205***		0.133***	0.126***
studies		(0.028)	(0.028)		(0.021)	(0.021)
Mass communications &		-0.061	-0.059		-0.011	-0.018
documentation		(0.039)	(0.038)		(0.030)	(0.030)
Historical & philosophical		-0.055*	-0.053*		-0.006	-0.012
studies		(0.032)	(0.033)		(0.025)	(0.012)
Creative arts & design		(0.032)	(0.032)		-0.089***	-0.098^{***}
creative arts & design		(0.03)	(0.032)		(0.024)	(0.024)
Education		0.0033)	(0.032) 0.077**		0.024)	0.083***
Education		(0.092)	(0.077)		(0.000)	(0.03)
Combined		(0.033)	(0.033) 0.110***		(0.020)	(0.020)
Combined		(0.027)	(0.027)		(0.079)	(0.078)
Douterousd		(0.027)	(0.027)		(0.019)	(0.019)
Partnered			0.118			(0.057)
A 1 1 (1 ¹ 11)			(0.011)			(0.010)
Any dependent children in			0.042			-0.104
family < 19			(0.024)			(0.023)
Number of dependent			0.003			-0.054
children in family < 19			(0.008)			(0.010)
Age youngest child in			0.000			-0.009
tamily < 19	a dubub	a	(0.001)	_ · · ·		(0.001)
Constant	-0.347***	-0.345***	-0.052	-0.109	-0.109	0.072
	(0.102)	(0.103)	(0.112)	(0.088)	(0.089)	(0.099)
Observations	10137	10137	10137	10460	10460	10460
R^2	0.291	0.321	0.334	0.249	0.266	0.279

	<u>Mass equations</u>	on	Wor	non	<u>A</u>	11
					A	\downarrow DC &
	+ Subjects	+ FO &	+ Subjects	+ FU &	+ Subjects	+ FO &
		Degree		Degree		Degree
	(1)	(2)	(3)	(4)	(5)	(6)
Age of respondent	(1)	$\frac{(2)}{0.200^{***}}$	(3)	0.210***	$\frac{(3)}{0.200^{***}}$	(0)
Age of respondent	(0.018)	(0.209)	(0.021)	(0.219)	(0.014)	(0.208)
A	(0.018)	(0.018)	(0.021)	(0.021)	(0.014)	(0.014)
Age sq	-0.002	-0.002	-0.003	-0.003	-0.003	-0.005
Non white	(0.000)	(0.000) 0.146***	(0.000)	(0.000)	(0.000) 0.120***	(0.000)
Non-white	-0.130	-0.140	-0.107	-0.099	-0.130	-0.121
\mathbf{P}_{orm} in 1070a	(0.030)	(0.029)	(0.029)	(0.029)	(0.021)	(0.021)
Bolli III 1970s	-0.037	-0.039	(0.020)	(0.023)	(0.021)	(0.021)
voor2012_1	(0.020)	(0.020)	(0.032)	(0.052)	(0.021)	(0.021) 0.022*
year2015-1	(0.033)	(0.030)	(0.010)	(0.008)	(0.020)	(0.025)
voor2014-1	(0.017)	(0.017)	(0.020)	(0.020)	(0.014)	(0.013)
year2014-1	(0.081)	(0.070)	(0.030)	(0.034)	(0.004)	(0.039)
voor2015-1	(0.018)	(0.018) 0.083***	(0.020)	(0.020)	(0.014)	(0.014)
year2015-1	(0.039)	(0.083)	(0.070)	(0.000)	(0.075)	(0.070)
London	(0.021) 0.218***	(0.021) 0.200***	(0.024) 0.368***	(0.024)	(0.010) 0.340***	(0.010) 0.244***
London	(0.018)	(0.309)	(0.010)	(0.300)	(0.013)	(0.013)
Southeast	0.106***	(0.018) 0.108***	(0.019)	(0.019)	0.085***	(0.013)
Southeast	(0.017)	(0.017)	(0.004)	(0.004)	(0.005)	(0.030)
Wales	(0.017)	(0.017)	(0.023)	(0.023)	(0.013)	(0.014)
w ales	(0.033)	(0.033)	(0.041)	(0.027)	(0.027)	(0.027)
Scotland	(0.033) 0.102*	0.103	0.041)	0.055	(0.027)	(0.027)
Scotland	(0.062)	(0.103)	(0.078)	(0.077)	(0.053)	(0.053)
Northern Ireland	-0 162***	-0.170***	-0 134***	-0.115***	-0 146***	-0.138***
Northern netand	(0.031)	(0.030)	(0.040)	(0.040)	(0.027)	(0.027)
Selectivity	0.031)	0.076***	0.075***	(0.040)	(0.027)	(0.027)
Selectivity	(0.015)	(0.070)	(0.073)	(0.018)	(0.017)	(0.012)
Old university	0.041**	0.039**	0.015	-0.006	0.026*	0.012)
old university	(0.041)	(0.03)	(0.013)	(0.022)	(0.020)	(0.015)
RG university	0.059***	0.052***	0.022)	0.082^{***}	0.080***	0.069***
ite university	(0.019)	(0.052)	(0.022)	(0.002)	(0.015)	(0.015)
Female	(0.01))	(0.010)	(0.022)	(0.022)	-0 265***	-0.278***
1 childre					(0.010)	(0.010)
Medicine & dentistry	0 434***	0 481***	0.457^{***}	0.488^{***}	0 456***	0 494***
Weaterne & dentistry	(0.065)	(0.066)	(0.048)	(0.050)	(0.039)	(0.039)
Biological/Veterinary	0.015	0.035	0.063*	0.055	0.048	0.052*
sciences	(0.053)	(0.053)	(0.036)	(0.036)	(0.030)	(0.030)
Agriculture & related	0.130	0.148*	0.022	0.034	0.065	0.076
	(0.082)	(0.081)	(0.065)	(0.066)	(0.052)	(0.051)
Physical sciences	0.122**	0.143***	0.081*	0.070	0.107***	0.109***
	(0.051)	(0.051)	(0.046)	(0.045)	(0.032)	(0.031)
Mathematics & computing	0.193***	0.216***	0.183***	0.180***	0.183***	0.196***
	(0.051)	(0.051)	(0.056)	(0.056)	(0.031)	(0.031)
Engineering & technology	0.231***	0.239***	0.208***	0.195***	0.238***	0.237***
6 6	(0.051)	(0.050)	(0.065)	(0.065)	(0.031)	(0.031)
Architecture, building &	0.181***	0.180***	0.129**	0.104*	0.176***	0.162***
planning	(0.055)	(0.055)	(0.060)	(0.060)	(0.036)	(0.036)
Social studies	0.152***	0.165***	0.033	0.035	0.082***	0.088***
	(0.051)	(0.051)	(0.038)	(0.038)	(0.030)	(0.030)
Law	0.130**	0.147**	0.130***	0.126***	0.133***	0.134***

Table A5:Weekly earnings equations without and with PG and degree class controls

	(0.059)	(0.058)	(0.046)	(0.046)	(0.036)	(0.036)
Business & administrative	0.211***	0.225***	0.199***	0.197^{***}	0.204^{***}	0.207^{***}
studies	(0.051)	(0.051)	(0.037)	(0.037)	(0.029)	(0.029)
Mass communications &	-0.057	-0.045	0.054	0.044	0.004	0.002
documentation	(0.065)	(0.065)	(0.049)	(0.048)	(0.039)	(0.039)
Historical & philosophical	-0.039	-0.040	0.022	0.023	-0.009	-0.014
studies	(0.057)	(0.057)	(0.044)	(0.044)	(0.034)	(0.034)
Creative arts & design	-0.015	-0.005	-0.114***	-0.105***	-0.065**	-0.056*
	(0.056)	(0.056)	(0.041)	(0.041)	(0.033)	(0.032)
Education	0.141^{***}	0.149^{***}	0.136***	0.081^{**}	0.142^{***}	0.111^{***}
	(0.053)	(0.054)	(0.036)	(0.037)	(0.030)	(0.031)
Combined	0.135***	0.156^{***}	0.081^{**}	0.106^{***}	0.102^{***}	0.123***
	(0.050)	(0.050)	(0.035)	(0.035)	(0.028)	(0.028)
Good Degree (I/2I)		0.113***		0.083^{***}		0.096^{***}
		(0.013)		(0.017)		(0.011)
PG indicator		0.019		0.130***		0.077^{***}
		(0.016)		(0.018)		(0.013)
Constant	2.202^{***}	2.051***	2.091***	2.124***	2.397***	2.349***
	(0.265)	(0.267)	(0.308)	(0.307)	(0.209)	(0.208)
Observations	4938	4938	5664	5664	10602	10602
R^2	0.362	0.372	0.178	0.188	0.290	0.298

Note: RSE in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01. Merged LFS/HESA graduate sample (see sample notes for details). Institutional fixed effects not reported. Omitted category: New universities; Lower Second Class; Languages.

	Sample with a	actual A-Level	Sample with	n imputed A-
	score	s only	Level sc	ores only
	HEI FE &	HEI Type &	HEI FE &	HEI Type &
	No A-Level	Mean A-	No A-Level	Mean A-
		Level		Level
	(1)	(2)	(3)	(4)
Age of respondent	0.193***	0.209^{***}	0.190***	0.185***
	(0.049)	(0.048)	(0.014)	(0.013)
Age sq	-0.003***	-0.003***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.000)	(0.000)
Non-white	-0.043*	-0.046**	-0.061***	-0.062***
	(0.022)	(0.022)	(0.019)	(0.018)
Born in 1970s			-0.022	-0.019
			(0.017)	(0.016)
year2013=1	0.048^{***}	0.049^{***}	0.039***	0.038***
	(0.017)	(0.017)	(0.013)	(0.013)
year2014=1	0.069^{***}	0.066^{***}	0.074^{***}	0.073***
	(0.017)	(0.017)	(0.013)	(0.013)
year2015=1	0.102^{***}	0.103***	0.071^{***}	0.071^{***}
	(0.019)	(0.019)	(0.016)	(0.016)
London	0.257^{***}	0.259^{***}	0.313***	0.305***
	(0.018)	(0.015)	(0.013)	(0.012)
Southeast	0.081^{***}	0.093***	0.095***	0.087^{***}
	(0.020)	(0.017)	(0.015)	(0.013)
Wales	-0.007	-0.027	-0.029	-0.033
	(0.037)	(0.034)	(0.028)	(0.025)
Scotland	0.033	0.055	0.035	-0.004
	(0.057)	(0.057)	(0.047)	(0.048)
Northern Ireland	-0.070	-0.122**	-0.153***	-0.145***
	(0.096)	(0.055)	(0.045)	(0.022)
Detrended Standardized A-Level mean		0.063***		0.102^{***}
score				
		(0.013)		(0.010)
Female	-0.074***	-0.078***	-0.135***	-0.135***
	(0.012)	(0.012)	(0.010)	(0.009)
Old university		0.057^{***}		0.011
		(0.018)		(0.013)
RG university		0.070^{***}		0.068^{***}
		(0.018)		(0.013)
Constant	-0.941	-1.159*	-0.959***	-0.809***
	(0.628)	(0.614)	(0.211)	(0.208)
HEI fixed effect	Yes	No	Yes	No
Observations	3087	3087	7515	7515
R^2	0.357	0.327	0.270	0.262

Table A6:Robustness of wage equations w.r.t. the exclusion of imputed A-Levels, Pooled Men
and Women

Note: RSE in parentheses, * p < 0.1, ** p < 0.05, *** p < 0.01. Columns (1) and (3) control for HEI fixed-effects, while columns (2) and (4) present parsimonious specification with HEI types dummies and selectivity measures only.

			, an subjects			Unadj	usted	Adjusted for A	-Level Mean
Rank	Institution	Selectivity	Institution	Log real	Number of	Coefficient	SE	Coefficient	SE
	Name	2	Type	hourly wage	graduates				
1	Imperial	0.752	RG	3.085	46	0.307	0.051	0.200	0.051
2	LSE	0.663	RG	3.064	27	0.289	0.084	0.189	0.083
3	Cambridge	0.649	RG	2.982	190	0.223	0.036	0.123	0.038
4	KCL	0.624	RG	2.912	58	0.193	0.057	0.096	0.056
5	Oxford	0.558	RG	3.069	126	0.265	0.041	0.173	0.041
6	Bristol	0.547	RG	2.853	142	0.156	0.042	0.065	0.043
7	Nottingham	0.518	RG	2.896	181	0.199	0.034	0.111	0.035
8	Warwick	0.478	RG	2.910	134	0.208	0.037	0.123	0.038
9	Newcastle	0.465	RG	2.794	205	0.201	0.035	0.117	0.035
10	UCL	0.464	RG	3.015	74	0.265	0.055	0.182	0.056
11	Liverpool	0.446	RG	2.843	208	0.175	0.036	0.092	0.036
12	Birmingham	0.432	RG	2.779	249	0.131	0.033	0.049	0.034
13	Exeter	0.428	RG	2.784	131	0.065	0.043	-0.016	0.043
14	Sheffield	0.419	RG	2.806	235	0.138	0.033	0.058	0.034
15	Durham	0.416	RG	2.854	178	0.181	0.036	0.102	0.037
16	York	0.396	RG	2.755	134	0.100	0.041	0.022	0.041
17	Manchester	0.378	RG	2.827	365	0.141	0.028	0.065	0.029
18	Southampton	0.365	RG	2.818	202	0.086	0.038	0.010	0.039
19	QMUL	0.316	RG	2.815	49	0.086	0.066	0.016	0.067
20	Leeds	0.310	RG	2.814	367	0.128	0.029	0.057	0.030
21	Cardiff	0.271	RG	2.809	246	0.145	0.035	0.078	0.035
22	Queens	0.181	RG	2.663	157	0.140	0.050	0.076	0.050
23	Leicester	0.153	Old	2.817	185	0.137	0.039	0.079	0.039
24	Lancaster	0.137	Old	2.613	186	0.022	0.036	-0.035	0.036
25	Bath	0.098	Old	2.905	101	0.193	0.038	0.140	0.038
26	OtherUoL	0.079	Old	2.829	54	0.016	0.070	-0.035	0.069
27	Bangor	0.067	Old	2.586	97	0.043	0.042	-0.007	0.043
28	East Anglia	0.041	Old	2.676	130	0.031	0.040	-0.017	0.040
29	City	0.018	Old	2.812	32	0.098	0.084	0.052	0.085
30	Reading	0.013	Old	2.752	158	0.059	0.037	0.012	0.037
31	Surrey	0.011	Old	2.717	87	0.054	0.047	0.008	0.048

 Table A7: Table 5 HEI fixed-effect coefficients, all subjects

32	Sussex	0.006	Old	2.728	98	0.001	0.045	-0.044	0.045
33	Swansea	0.003	Old	2.790	130	0.126	0.040	0.081	0.040
34	Aston	0.002	Old	2.872	52	0.201	0.054	0.156	0.053
35	Aberystwyth	-0.001	Old	2.690	116	0.005	0.038	-0.039	0.038
36	Goldsmith	-0.019	Old	2.608	36	-0.147	0.061	-0.190	0.062
37	Cranfield	-0.020	Old	2.750	16	-0.046	0.121	-0.090	0.121
38	OU	-0.044	Old	2.582	121	-0.125	0.042	-0.167	0.042
39	Ulster	-0.066	Old	2.481	145	0.040	0.051	-0.003	0.052
40	Essex	-0.072	Old	2.552	55	-0.074	0.065	-0.113	0.065
41	Brunel	-0.095	Old	2.863	93	0.128	0.047	0.092	0.048
42	RHUL	-0.107	Old	2.924	54	0.094	0.057	0.058	0.057
43	Kent	-0.127	Old	2.733	105	0.017	0.043	-0.017	0.043
44	Lampeter	-0.134	Old	2.541	35	-0.125	0.066	-0.159	0.066
45	Hull	-0.141	Old	2.718	181	0.100	0.035	0.067	0.035
46	Salford	-0.147	Old	2.717	155	0.029	0.039	-0.004	0.039
47	Bradford	-0.224	Old	2.836	80	0.089	0.050	0.063	0.050
48	Keele	-0.284	Old	2.657	93	0.009	0.046	-0.013	0.047
49	Northumbria	-0.335	New	2.568	190	-0.009	0.032	-0.026	0.033
50	London Met	-0.388	New	2.770	61	-0.105	0.053	-0.117	0.053
51	Bournemouth	-0.401	New	2.690	141	0.023	0.038	0.012	0.038
52	Notts Trent	-0.425	New	2.700	240	0.076	0.033	0.067	0.033
53	Leeds Met	-0.442	New	2.562	217	-0.034	0.036	-0.042	0.035
54	UCLAN	-0.454	New	2.507	170	-0.065	0.035	-0.072	0.035
55	Brighton	-0.469	New	2.716	84	-0.000	0.044	-0.006	0.044
56	Pouthmouth	-0.471	New	2.664	175	-0.017	0.038	-0.022	0.038
57	L SouthBank	-0.473	New	2.681	50	-0.122	0.059	-0.128	0.059
58	Westminster	-0.478	New	2.763	60	0.035	0.056	0.032	0.056
59	Staffs	-0.498	New	2.694	173	0.023	0.036	0.020	0.036
60	Ox Brookes	-0.501	New	2.781	107	0.070	0.041	0.067	0.041
61	Hudders	-0.524	New	2.591	173	-0.010	0.034	-0.011	0.034
62	Sheffield H	-0.525	New	2.636	279	0.006	0.031	0.004	0.031
63	Plymouth	-0.529	New	2.593	194	-0.036	0.035	-0.037	0.035
64	W London	-0.533	New	2.566	36	-0.224	0.074	-0.224	0.073
65	Teesside	-0.536	New	2.558	102	-0.085	0.046	-0.086	0.045
66	Coventry	-0.538	New	2.670	136	-0.007	0.041	-0.007	0.041
	-								

67	Man Met	-0.539	New	2.601	312	0.000		0.000	
68	B'ham City	-0.548	New	2.644	92	0.034	0.046	0.035	0.046
69	Lpool JM	-0.584	New	2.666	153	0.047	0.035	0.050	0.035
70	W England	-0.591	New	2.654	187	0.008	0.034	0.012	0.034
71	Herts	-0.593	New	2.715	152	-0.045	0.039	-0.040	0.039
72	Sunderland	-0.593	New	2.586	130	-0.060	0.040	-0.056	0.039
73	Middlesex	-0.608	New	2.787	85	-0.047	0.049	-0.040	0.049
74	Greenwich	-0.623	New	2.634	85	-0.138	0.046	-0.130	0.045
75	E London	-0.626	New	2.690	47	-0.071	0.068	-0.064	0.067
76	Anglia Ruskin	-0.631	New	2.579	92	-0.125	0.043	-0.118	0.043
77	Wolves	-0.638	New	2.544	126	-0.118	0.040	-0.110	0.040
78	Kingston	-0.640	New	2.741	116	-0.048	0.043	-0.039	0.042
79	DeMontfort	-0.669	New	2.599	138	-0.040	0.038	-0.029	0.038

Note: Sorted by selectivity.

	<i></i>	<i>, , , , , , , , , ,</i>	STEM			Soc	ial Science	s	Arts &	& Humanit	ies
Overal	Institution name	Institution	Mean A-	Coeff	SE	Mean A-	Coeff	SE	Mean A-	Coeff	SE
l rank		Type	Level Score			Level Score			Level Score		
1	Imperial	RG	0.918	0.136	0.078						
2	LSE	RG				0.780	0.235	0.122			
3	Cambridge	RG	0.632	0.146	0.071	0.586	0.262	0.088	0.937	0.110	0.076
4	KCL	RG	0.836	0.174	0.086	0.743	-0.039	0.115	0.497	0.053	0.135
5	Oxford	RG	0.654	0.180	0.073	0.767	0.425	0.079	0.506	0.147	0.084
6	Bristol	RG	0.714	0.007	0.075	0.580	0.198	0.094	0.288	0.014	0.093
7	Nottingham	RG	0.635	0.050	0.065	0.545	0.162	0.082	0.355	0.121	0.093
8	Warwick	RG	0.662	0.120	0.065	0.586	0.110	0.103	0.449	0.198	0.083
9	Newcastle	RG	0.538	0.101	0.063	0.433	0.126	0.077	0.463	0.096	0.087
10	UCL	RG	0.562	0.119	0.120	0.555	0.209	0.100	0.356	0.193	0.116
11	Liverpool	RG	0.544	-0.033	0.070	0.423	0.222	0.073	0.410	0.157	0.078
12	Birmingham	RG	0.549	0.063	0.067	0.493	0.059	0.064	0.390	0.024	0.076
13	Exeter	RG	0.473	-0.047	0.080	0.586	-0.175	0.110	0.418	-0.027	0.089
14	Sheffield	RG	0.583	0.033	0.069	0.420	0.133	0.063	0.304	0.016	0.081
15	Durham	RG	0.534	0.122	0.075	0.414	0.271	0.067	0.504	0.056	0.082
16	York	RG	0.524	-0.002	0.092	0.317	0.201	0.089	0.492	-0.017	0.081
17	Manchester	RG	0.515	-0.008	0.062	0.422	0.164	0.055	0.140	-0.002	0.066
18	Southampton	RG	0.480	0.061	0.070	0.296	0.027	0.074	0.278	-0.140	0.081
19	QMUL	RG	0.500	-0.146	0.082				0.079	0.242	0.168
20	Leeds	RG	0.436	0.069	0.063	0.334	0.146	0.060	0.250	0.002	0.062
21	Cardiff	RG	0.393	0.079	0.065	0.243	0.188	0.071	0.149	-0.176	0.092
22	Queens	RG	0.214	0.100	0.096	0.268	0.132	0.100	-0.059	0.106	0.106
23	Leicester	Old	0.459	-0.004	0.074	0.183	0.236	0.077	0.032	0.041	0.080
24	Lancaster	Old	0.348	-0.006	0.069	0.220	0.064	0.069	0.160	-0.066	0.081
25	Bath	Old	0.357	0.027	0.071	-0.030	0.171	0.073			
26	OtherUoL	Old	0.408	0.177	0.116				0.140	-0.069	0.129
27	Bangor	Old	0.331	-0.081	0.082	0.148	0.081	0.101	-0.121	0.015	0.099
28	East Anglia	Old	0.259	-0.118	0.086	0.142	0.045	0.078	0.079	-0.012	0.081
29	City	Old				0.205	0.186	0.134			
30	Reading	Old	0.017	-0.034	0.067	0.186	0.053	0.090	-0.039	-0.068	0.115
31	Surrey	Old	0.110	-0.070	0.076	0.082	0.237	0.093	0.054	-0.200	0.144

 Table A8: Table 5 HEI fixed-effect coefficients, by broad subject groups, pooled

32	Sussex	Old	0.254	-0.074	0.095	0.120	0.014	0.066	-0.094	0.003	0.096
33	Swansea	Old	0.257	-0.007	0.074	-0.058	0.192	0.078	-0.101	0.108	0.092
34	Aston	Old	-0.159	-0.043	0.091	0.307	0.257	0.090			
35	Aberystwyth	Old	0.221	-0.118	0.071	-0.094	0.029	0.072	-0.113	-0.004	0.086
36	Goldsmith	Old							0.101	-0.196	0.092
37	Cranfield	Old	0.031	-0.134	0.139						
38	OU	Old	0.051	-0.293	0.080	-0.037	-0.063	0.083	0.034	-0.034	0.105
39	Ulster	Old	0.052	0.005	0.103	-0.066	0.114	0.095	-0.017	-0.030	0.112
40	Essex	Old	0.013	-0.334	0.108	-0.139	-0.103	0.129			
41	Brunel	Old	-0.061	0.075	0.079	0.100	0.143	0.123	0.021	-0.018	0.150
42	RHUL	Old	0.078	-0.073	0.090	-0.204	0.095	0.115	0.057	0.136	0.121
43	Kent	Old	-0.093	-0.011	0.085	-0.049	0.157	0.070	-0.135	0.080	0.080
44	Lampeter	Old							0.147	-0.261	0.093
45	Hull	Old	0.019	-0.008	0.069	-0.121	0.227	0.065	-0.130	0.051	0.083
46	Salford	Old	-0.145	0.006	0.071	-0.132	0.081	0.091	-0.062	0.006	0.071
47	Bradford	Old	-0.224	0.017	0.082	-0.111	-0.026	0.131			
48	Keele	Old	-0.495	0.033	0.106	-0.133	-0.016	0.091	-0.251	-0.001	0.130
49	Northumbria	New	-0.318	-0.080	0.063	-0.214	0.080	0.061	-0.268	-0.129	0.081
50	London Met	New				-0.354	-0.069	0.082	-0.179	-0.050	0.118
51	Bournemouth	New	-0.451	-0.086	0.081	-0.342	0.007	0.063	-0.245	0.132	0.073
52	Notts Trent	New	-0.465	-0.029	0.071	-0.248	0.168	0.067	-0.321	0.081	0.070
53	Leeds Met	New	-0.381	-0.003	0.080	-0.416	-0.053	0.058	-0.300	-0.009	0.083
54	UCLAN	New	-0.304	-0.152	0.064	-0.480	0.011	0.067	-0.440	0.029	0.076
55	Brighton	New	-0.485	-0.097	0.108	-0.262	0.023	0.073	-0.418	-0.074	0.145
56	Pouthmouth	New	-0.424	-0.053	0.071	-0.423	0.096	0.078	-0.504	-0.214	0.070
57	L SouthBank	New	-0.373	-0.238	0.094	-0.668	0.012	0.118	-0.386	-0.096	0.138
58	Westminster	New	-0.507	-0.080	0.182	-0.380	0.164	0.084	-0.337	0.176	0.108
59	Staffs	New	-0.467	0.072	0.071	-0.445	0.122	0.061	-0.373	-0.067	0.102
60	Ox Brookes	New	-0.430	-0.096	0.100	-0.301	0.216	0.063			
61	Hudders	New	-0.469	-0.048	0.070	-0.532	0.087	0.067	-0.477	0.008	0.067
62	Sheffield H	New	-0.489	-0.042	0.064	-0.420	0.095	0.058	-0.503	-0.091	0.066
63	Plymouth	New	-0.396	-0.034	0.071	-0.500	0.080	0.063	-0.528	-0.117	0.089
64	W London	New				-0.500	-0.260	0.129			
65	Teesside	New	-0.464	0.006	0.087	-0.496	-0.099	0.078	-0.518	-0.196	0.077
66	Coventry	New	-0.520	-0.083	0.083	-0.525	0.116	0.067	-0.375	-0.136	0.115

67	Man Met	New	-0.492	0.000		-0.521	0.000		-0.382	0.000	
68	B'ham City	New	-0.471	0.026	0.089	-0.454	0.120	0.090	-0.333	-0.122	0.116
69	Lpool JM	New	-0.499	-0.072	0.067	-0.532	0.182	0.063	-0.610	0.088	0.084
70	W England	New	-0.503	-0.004	0.064	-0.605	0.013	0.079	-0.525	0.022	0.076
71	Herts	New	-0.519	-0.041	0.070	-0.508	-0.072	0.073	-0.684	-0.122	0.096
72	Sunderland	New	-0.494	-0.275	0.089	-0.627	0.069	0.071	-0.563	-0.030	0.084
73	Middlesex	New	-0.565	-0.125	0.116	-0.627	-0.057	0.108	-0.339	0.067	0.083
74	Greenwich	New	-0.572	-0.065	0.089	-0.582	-0.091	0.084			
75	E London	New	-0.362	-0.091	0.145	-0.808	-0.127	0.136			
76	Anglia Ruskin	New	-0.497	-0.026	0.129	-0.578	-0.105	0.070	-0.517	-0.131	0.105
77	Wolves	New	-0.406	-0.152	0.084	-0.731	-0.126	0.086	-0.654	-0.067	0.071
78	Kingston	New	-0.512	-0.039	0.078	-0.643	0.057	0.104	-0.622	-0.051	0.071
79	DeMontfort	New	-0.575	-0.036	0.075	-0.676	0.172	0.063	-0.480	-0.128	0.072

Note: Sorted by selectivity across all subjects as in Table A7.

Region in which UG HEI	North	North	York-	East	West	Eastern	London	South	South	Wales	Scotland	HEI
was located	East	West	shire	Midland	Midland	England		East	West			Share
North East	42.16	7.67	14.10	3.56	2.87	3.49	9.92	8.08	4.24	0.82	3.08	7.31
North West (inc Mersey)	3.67	44.42	9.06	4.74	5.81	2.35	10.20	10.70	4.63	2.50	1.93	14.04
Yorkshire and	4.13	12.03	37.15	9.20	4.72	2.97	11.19	11.37	4.20	1.47	1.57	14.31
Humberside												
East Midlands	2.57	6.09	7.71	26.87	8.22	5.80	16.81	17.25	5.95	1.47	1.25	6.82
West Midlands	0.83	9.00	6.02	9.20	32.14	3.33	13.06	15.46	7.34	2.45	1.17	10.23
Eastern	2.03	2.60	4.47	4.15	3.50	17.24	26.18	30.57	6.67	1.22	1.38	6.16
London	0.99	2.93	3.47	2.23	3.26	4.17	43.91	28.38	7.77	1.03	1.86	12.12
South East	1.18	3.49	2.23	3.11	3.91	4.62	23.83	43.09	11.22	1.98	1.35	11.91
South West	1.19	2.69	2.19	3.44	4.94	3.13	16.71	23.47	37.73	3.13	1.38	8.00
Wales	1.15	5.31	3.98	3.01	5.75	1.77	10.53	15.31	14.42	36.81	1.95	5.66
Unspecified (Open Univ.)	3.75	6.06	11.11	8.66	7.22	6.78	6.78	20.78	14.14	3.03	11.69	3.47
Share of region of work	5.12	11.51	10.50	6.66	7.60	4.45	18.18	20.39	9.73	3.84	2.02	100.00

Table A9: Cross tab of region of universities attended and region of place of work, row percentages and frequencies, Men & Women Pooled, N=19,982

Frequencies

Region in which UG HEI	North	North	York-	East	West	Eastern	London	South	South	Wales	Scotland	Total
was located	East	West	shire	Midland	Midland	England		East	West			region of
												UG HEI
North East	616	112	206	52	42	51	145	118	62	12	45	1,461
North West (inc Mersey)	103	1,246	254	133	163	66	286	300	130	70	54	2,805
Yorkshire and	118	344	1,062	263	135	85	320	325	120	42	45	2,859
Humberside												
East Midlands	35	83	105	366	112	79	229	235	81	20	17	1,362
West Midlands	17	184	123	188	657	68	267	316	150	50	24	2,044
Eastern	25	32	55	51	43	212	322	376	82	15	17	1,230
London	24	71	84	54	79	101	1,063	687	188	25	45	2,421
South East	28	83	53	74	93	110	567	1,025	267	47	32	2,379
South West	19	43	35	55	79	50	267	375	603	50	22	1,598
Wales	13	60	45	34	65	20	119	173	163	416	22	1,130
Unspecified (Open Univ.)	26	42	77	60	50	47	47	144	98	21	81	693
Total region of work	1,024	2,300	2,099	1,330	1,518	889	3,632	4,074	1,944	768	404	19,982

Note: Northern Ireland dropped due to small cell sizes.

Outcome (wage)	New-STEM	New-SocSc	New-Arts	Old-STEM	Old-SocSc	Old-Arts	RG-STEM	RG-SocSc	RG-Arts
equations									
Age of respondent	0.213***	0.011	0.266***	0.103*	0.248^{***}	0.128^{*}	-0.012	0.404^{***}	0.130*
	(0.065)	(0.065)	(0.051)	(0.057)	(0.087)	(0.076)	(0.056)	(0.071)	(0.069)
Age sq	-0.003**	0.001	-0.004***	-0.001	-0.003**	-0.001	0.001	-0.006***	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Non-white	-0.305***	-0.186***	-0.168^{*}	0.165^{***}	-0.038	-0.154	0.082^*	0.125	0.021
	(0.081)	(0.055)	(0.096)	(0.060)	(0.108)	(0.149)	(0.047)	(0.087)	(0.078)
Born in 1970s	0.041	-0.182**	0.202^{**}	-0.149*	-0.020	-0.052	0.099	0.203^{**}	0.143
	(0.101)	(0.076)	(0.096)	(0.083)	(0.143)	(0.114)	(0.100)	(0.101)	(0.115)
Year=2013	0.113^{*}	0.058	0.047	0.009	0.014	0.046	0.036	0.117	0.163**
	(0.060)	(0.048)	(0.076)	(0.045)	(0.088)	(0.076)	(0.060)	(0.099)	(0.073)
Year=2014	0.188^{**}	0.144^{***}	0.079	-0.041	-0.065	0.015	0.060	0.220^{***}	0.118^*
	(0.078)	(0.049)	(0.071)	(0.060)	(0.098)	(0.075)	(0.075)	(0.065)	(0.068)
Year=2015	0.098	0.081	0.206^{**}	0.036	0.075	0.040	-0.001	0.279^{***}	-0.007
	(0.082)	(0.056)	(0.086)	(0.060)	(0.104)	(0.095)	(0.092)	(0.070)	(0.079)
London	0.239***	0.544^{***}	0.426^{***}	0.274^{***}	0.342***	0.351***	0.312***	0.256^{***}	0.456^{***}
	(0.070)	(0.049)	(0.055)	(0.065)	(0.061)	(0.059)	(0.061)	(0.068)	(0.060)
SE	0.058	0.291^{***}	0.055	0.047	0.198^{***}	0.101	0.036	0.191^{*}	0.274^{***}
	(0.045)	(0.065)	(0.069)	(0.054)	(0.061)	(0.085)	(0.068)	(0.110)	(0.104)
Wales	-0.120	0.141^{*}	0.289^{***}	-0.134	-0.144**	0.115	-0.088	0.119	-0.100^{*}
	(0.137)	(0.072)	(0.067)	(0.086)	(0.071)	(0.101)	(0.076)	(0.084)	(0.052)
Scotland	0.167	0.432^{***}	0.088	0.219	0.017	-0.188^{*}	0.114	0.047	-0.076
	(0.156)	(0.076)	(0.129)	(0.154)	(0.248)	(0.102)	(0.116)	(0.406)	(0.157)
Northern Ireland	-	-	-	-	-	-	-	-	-
Selectivity	-0.086^{*}	-0.002	0.243^{***}	-0.016	0.044	-0.016	0.071^{**}	-0.016	-0.076^{*}
	(0.047)	(0.023)	(0.052)	(0.033)	(0.063)	(0.052)	(0.033)	(0.063)	(0.045)
Good Degree (I/2I)	0.168^{***}	0.100^{***}	0.110^{**}	0.173^{***}	0.140^{**}	0.056	-0.006	0.095	0.047
	(0.050)	(0.038)	(0.053)	(0.041)	(0.063)	(0.057)	(0.066)	(0.061)	(0.063)
PG indicator	-0.049	-0.096*	0.004	0.032	0.061	0.087	0.156^{***}	0.219^{***}	0.017
	(0.041)	(0.058)	(0.064)	(0.054)	(0.067)	(0.059)	(0.060)	(0.053)	(0.061)
Constant	-1.577^{*}	1.089	-2.030***	0.266	-1.877	-0.137	2.344***	-4.136***	-0.035
	(0.923)	(0.933)	(0.763)	(0.878)	(1.223)	(1.134)	(0.874)	(1.060)	(1.014)

Table A10: Full set of IWPRA estimates of Table 8, Men

Treatment equations	New-STEM	New-SocSc	New-Arts	Old-STEM	Old-SocSc	Old-Arts	RG-STEM	RG-SocSc	RG-Arts
^									
Age of respondent		0.203	-0.164	-0.123	0.076	-0.202	0.219	0.178	0.064
C		(0.156)	(0.179)	(0.170)	(0.195)	(0.216)	(0.179)	(0.205)	(0.223)
Age sq		-0.004	0.002	0.002	-0.002	0.003	-0.004	-0.004	-0.003
		(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Non-white		0.545^{***}	-0.294	-0.043	-0.292	-0.691*	-0.225	-0.106	-1.882***
		(0.185)	(0.258)	(0.257)	(0.290)	(0.357)	(0.255)	(0.271)	(0.545)
Born in 1970s		0.575^{***}	0.135	0.272	0.360	0.139	0.616^{**}	0.256	1.155***
		(0.222)	(0.269)	(0.259)	(0.293)	(0.332)	(0.259)	(0.299)	(0.329)
Year=2013		0.021	0.023	-0.101	-0.169	-0.244	-0.153	-0.103	0.096
		(0.153)	(0.186)	(0.181)	(0.205)	(0.235)	(0.174)	(0.196)	(0.230)
Year=2014		-0.238	0.023	0.046	-0.028	-0.174	-0.215	-0.407**	0.253
		(0.160)	(0.187)	(0.180)	(0.200)	(0.224)	(0.179)	(0.204)	(0.228)
Year=2015		-0.121	-0.136	-0.044	-0.615**	0.063	0.044	-0.264	0.127
		(0.185)	(0.228)	(0.218)	(0.276)	(0.256)	(0.204)	(0.244)	(0.282)
London		0.261	0.618^{***}	0.336^{*}	1.205^{***}	1.203^{***}	0.408^{**}	1.236***	1.079^{***}
		(0.160)	(0.179)	(0.182)	(0.190)	(0.200)	(0.171)	(0.181)	(0.196)
SE		0.054	0.248	0.538^{***}	0.655^{***}	0.206	0.318^{*}	0.329	0.218
		(0.157)	(0.179)	(0.167)	(0.198)	(0.239)	(0.164)	(0.203)	(0.223)
Wales		0.728^*	-1.468	1.764^{***}	2.049^{***}	2.004^{***}	1.299***	1.328^{***}	0.654
		(0.388)	(1.032)	(0.389)	(0.398)	(0.425)	(0.392)	(0.468)	(0.599)
Scotland		0.586	0.659	0.231	1.360**	1.257**	0.525	0.160	1.011^{*}
		(0.558)	(0.638)	(0.619)	(0.578)	(0.592)	(0.546)	(0.716)	(0.562)
Northern Ireland		-	-	-	-	-	-	-	-
Selectivity		0.192	0.302^{*}	3.491***	3.158***	3.007***	5.296***	4.794^{***}	4.722^{***}
		(0.166)	(0.177)	(0.196)	(0.202)	(0.202)	(0.197)	(0.203)	(0.208)
Constant		-2.654	2.368	2.208	-0.979	2.725	-2.894	-2.481	-0.176
		(2.340)	(2.671)	(2.549)	(2.923)	(3.233)	(2.668)	(3.024)	(3.293)

Outcome (wage)	New-STEM	New-SocSc	New-Arts	Old-STEM	Old-SocSc	Old-Arts	RG-STEM	RG-SocSc	RG-Arts
_equations									
Age of respondent	0.215^{***}	0.249^{***}	0.125^{**}	0.241^{***}	0.060	0.231***	0.249^{***}	0.132	0.185^{***}
	(0.050)	(0.046)	(0.051)	(0.058)	(0.053)	(0.058)	(0.088)	(0.084)	(0.060)
Age sq	-0.003***	-0.003***	-0.001	-0.003***	-0.000	-0.003***	-0.004**	-0.001	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Non-white	-0.013	-0.061	-0.025	-0.025	-0.030	0.163**	-0.102	-0.305**	0.145
	(0.072)	(0.126)	(0.072)	(0.082)	(0.085)	(0.076)	(0.095)	(0.128)	(0.139)
Born in 1970s	-0.067	0.152^{*}	0.101	-0.006	0.003	0.203^{**}	0.148	-0.127	-0.084
	(0.080)	(0.087)	(0.077)	(0.104)	(0.110)	(0.087)	(0.151)	(0.106)	(0.114)
Year=2013	0.052	-0.035	0.034	0.097	-0.009	0.167^{***}	-0.110	0.220^{**}	-0.010
	(0.074)	(0.058)	(0.055)	(0.069)	(0.064)	(0.055)	(0.093)	(0.089)	(0.079)
Year=2014	0.115	-0.053	0.011	0.171^{**}	0.161^{***}	0.211^{***}	-0.180**	0.170^{**}	0.097
	(0.074)	(0.086)	(0.051)	(0.073)	(0.059)	(0.058)	(0.076)	(0.082)	(0.062)
Year=2015	-0.005	0.032	0.193***	0.049	0.052	0.279^{***}	-0.045	0.225^{*}	0.127
	(0.072)	(0.062)	(0.065)	(0.088)	(0.074)	(0.078)	(0.106)	(0.119)	(0.093)
London	0.223^{***}	0.234^{***}	0.350^{***}	0.272^{***}	0.240^{***}	0.216^{***}	0.206^{***}	0.429^{***}	0.382^{***}
	(0.058)	(0.073)	(0.055)	(0.065)	(0.064)	(0.070)	(0.070)	(0.059)	(0.070)
SE	-0.012	0.140^{**}	0.143***	0.077	0.070	0.128^{**}	-0.087	0.142	0.130**
	(0.087)	(0.058)	(0.055)	(0.072)	(0.060)	(0.055)	(0.129)	(0.095)	(0.054)
Wales	-0.273	0.134***	0.022	0.070	0.032	0.110	-0.021	0.133	0.107
	(0.197)	(0.046)	(0.126)	(0.078)	(0.071)	(0.080)	(0.097)	(0.130)	(0.133)
Scotland	0.202	0.267	-0.030	-0.160	0.199	-0.393	-0.004	-0.027	0.073
	(0.221)	(0.340)	(0.072)	(0.227)	(0.182)	(0.243)	(0.123)	(0.080)	(0.122)
Northern Ireland	-0.534***	-0.028	0.063	-0.202^{*}	-0.047	-0.169*	-0.183**	-0.148	-0.070
	(0.062)	(0.168)	(0.126)	(0.116)	(0.089)	(0.087)	(0.080)	(0.126)	(0.138)
Selectivity	0.302^{***}	0.016	0.278^{***}	0.003	0.122^{***}	0.033	0.100	0.147^{***}	0.038
	(0.038)	(0.022)	(0.041)	(0.043)	(0.039)	(0.045)	(0.071)	(0.032)	(0.045)
Good Degree (I/2I)	0.177^{***}	0.080^{**}	0.082^{**}	0.030	0.233***	0.134***	-0.007	-0.013	0.328***
	(0.051)	(0.034)	(0.040)	(0.060)	(0.053)	(0.052)	(0.109)	(0.070)	(0.086)
PG indicator	0.215^{***}	0.147^{***}	0.108^{*}	0.170^{***}	0.203***	0.108^{**}	0.027	0.033	0.047
	(0.050)	(0.051)	(0.062)	(0.054)	(0.055)	(0.048)	(0.082)	(0.056)	(0.058)
Constant	-1.400^{*}	-1.822***	-0.187	-1.745**	0.777	-1.753**	-1.202	-0.267	-1.310
	(0.732)	(0.686)	(0.704)	(0.850)	(0.758)	(0.807)	(1.217)	(1.233)	(0.852)

Table A11: Full set of IWPRA estimates of Table 8, Women

Treatment equations	New-STEM	New-SocSc	New-Arts	Old-STEM	Old-SocSc	Old-Arts	RG-STEM	RG-SocSc	RG-Arts
Age of respondent		0.102	0.106	-0.086	0.022	0.281	0.461^{**}	0.132	0.024
		(0.161)	(0.180)	(0.209)	(0.194)	(0.216)	(0.192)	(0.197)	(0.191)
Age sq		-0.002	-0.003	0.001	-0.001	-0.005	-0.008**	-0.002	-0.001
		(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)
Non-white		0.326	-0.578^{**}	0.170	0.048	-0.557*	-0.443*	-0.325	-1.317***
		(0.199)	(0.259)	(0.267)	(0.247)	(0.311)	(0.261)	(0.266)	(0.325)
Born in 1970s		0.246	0.618^{**}	0.277	0.362	0.438	0.181	0.145	0.319
		(0.244)	(0.278)	(0.334)	(0.303)	(0.327)	(0.301)	(0.312)	(0.313)
Year=2013		-0.216	-0.042	-0.169	-0.451**	-0.086	-0.175	-0.104	-0.209
		(0.174)	(0.188)	(0.219)	(0.210)	(0.223)	(0.202)	(0.218)	(0.211)
Year=2014		-0.317*	-0.236	-0.401*	-0.642***	-0.223	-0.515**	-0.188	-0.354*
		(0.175)	(0.192)	(0.217)	(0.211)	(0.224)	(0.204)	(0.216)	(0.210)
Year=2015		0.045	-0.187	-0.353	-0.293	-0.352	-0.319	-0.079	-0.174
		(0.205)	(0.231)	(0.269)	(0.248)	(0.280)	(0.241)	(0.259)	(0.249)
London		0.191	0.621^{***}	0.411^{*}	0.710^{***}	0.656^{***}	0.445^{**}	0.877^{***}	1.068^{***}
		(0.185)	(0.198)	(0.240)	(0.216)	(0.230)	(0.207)	(0.211)	(0.204)
SE		0.140	0.018	0.862^{***}	0.765^{***}	0.842^{***}	0.409^{**}	0.370^{*}	0.430**
		(0.169)	(0.191)	(0.202)	(0.201)	(0.209)	(0.196)	(0.215)	(0.203)
Wales		1.023	1.699**	3.408^{***}	3.324***	3.263***	2.501^{***}	2.693***	2.102^{***}
		(0.785)	(0.778)	(0.768)	(0.764)	(0.775)	(0.779)	(0.787)	(0.808)
Scotland		-1.572***	-1.429**	0.051	0.150	-0.113	-0.804	-0.979	-0.114
		(0.577)	(0.660)	(0.554)	(0.488)	(0.557)	(0.563)	(0.761)	(0.587)
Northern Ireland		1.437	0.970	3.722***	4.421***	4.058^{***}	3.804***	4.579^{***}	3.820***
		(1.068)	(1.162)	(1.078)	(1.048)	(1.055)	(1.079)	(1.066)	(1.086)
Selectivity		-0.346**	-0.259	3.335***	2.769^{***}	2.502^{***}	4.865***	4.489^{***}	4.150^{***}
		(0.159)	(0.161)	(0.207)	(0.193)	(0.184)	(0.194)	(0.203)	(0.191)
Constant		-0.945	-0.513	1.393	0.359	-4.208	-6.499**	-2.254	0.129
		(2.377)	(2.630)	(3.041)	(2.824)	(3.193)	(2.811)	(2.903)	(2.812)