DISCUSSION PAPER SERIES

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ABSTRACT

The Scarring Effect of Graduate Underemployment: Evidence from the UK*

The UK has one of the highest proportions of tertiary educated workers in Europe but also one of the highest rates of graduate underemployment. Little is known however about the extent to which there is a scarring effect of early graduate underemployment on future labour market outcomes. In this paper, we examine the effect of early underemployment using data on 67,000 graduates from undergraduate degrees in the UK in 2013. Labour market outcomes at six-months and 42-months post-graduation are linked to administrative records covering higher education, prior attainment, demographics and family background. We find that compared to being in a graduate job six-months post-graduation, early experience of underemployment increases the probability of being underemployed three years later by 0.24. Oster bounds analysis suggests that the causal effect of early underemployment on later underemployment is at least +0.18. This is a large effect relative to the base risk of underemployment at 42-months for those in a graduate job at six-months which is just 0.09. We highlight important implications of these findings, with arguments from both equity and efficiency for policies to help graduates to attain graduate level jobs.

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1 Introduction

The UK has one of the highest proportions of tertiary educated workers in Europe (above 40%) and this figure will continue to rise with more than 50% of each cohort of school-leavers now embarking on a higher education course before the age of 30 (ONS, 2020). This makes the UK relatively more vulnerable than its competitors to the risk of graduates failing to attain a graduate job i.e. being underemployed. Around one-third of UK graduates are underemployed, compared to less than one-fifth in Germany, Italy and most Scandinavian countries (Green and Henseke, 2017). The immediate wage penalties of graduate underemployment are well known, estimated to be around 45% for UK graduates (Green and Henseke, 2016a), which is the largest penalty in Europe, and the issue of graduate underemployment is only likely to become more acute over time given this trend in higher education participation. It is also likely to affect other European countries given similar increasing trends in higher education participation over recent years.

While the extent of and penalty for graduate underemployment are known, the *persistence* of graduate underemployment is much less understood both for the UK and elsewhere. It is important to address this as the persistence of graduate underemployment has consequences for graduates, the Government, for society and the economy more generally. Graduates care about their lifetime earnings, and persistently being underemployed will reduce their earnings trajectory with potentially substantial cumulative effects. This affects the graduate's ability to repay student loans, and has wider implications for life events such as gaining entry to housing market, and the timing of family formation and fertility. Moreover, not being in a job that utilises the skills that an individual has attained also has implications for job satisfaction and mental health (Maynard and Feldman, 2011). For the UK Government who fund higher education through income contingent student loans, the amount repaid depends directly on graduates' earnings, hence lower earnings will result in lower repayments and a higher subsidy to the higher education sector. Lower graduate earnings also impact the tax take, further reducing the flow of money available for Government spending. This lower level of Government resource has implications for public spending, quality of services, and wider economic impacts on growth should the economy not be utilising the skilled labour available (Valero and Van Reenan, 2019). There are also societal implications for inequality depending on who the underemployed graduates are, and wider concerns about the perceived value of higher education, potentially leading to societal disillusionment with higher education. Therefore, there are a range of motivations for tackling graduate underemployment including economic efficiency concerns as well as equity.

We contribute to addressing the gap in the literature using linked survey and administrative data to

examine the 'scarring' effect of graduate underemployment for 55,000 graduates who completed their undergraduate degrees in the UK in 2013. We use the Destinations of Leavers from Higher Education Longitudinal (DLHE-L) data which is a survey of graduates recorded 42-months after graduation (in 2016 for our graduates). We link this data back to the same graduates when interviewed in the Destinations of Leavers from Higher Education (DLHE) data recorded six-months after graduation (2013). We also link to administrative higher education data for these graduates from the Higher Education Statistics Agency student record data, which covers all aspects of their higher education (higher education institution (HEI) attended, subject studied, degree class recorded), their school prior attainment, demographics and family background.

We find that compared to attaining a graduate job six-months post-graduation, early experience of underemployment increases the probability of being underemployed three years later by 0.24 after controlling for a rich set of covariates. This is a large effect relative to the base risk of underemployment at 42-months for those in a graduate job at six-months which is just 0.09 *ceteris paribus*. Though we have a rich set of controls, identification relies on selection-on-observables i.e. we assume that, conditional on the controls, there is no difference between those who are underemployed at six-months and those who are in a graduate job at that point, such that any persistence between the early and later outcome captures a causal effect of the early underemployment. To test the plausibility of this assumption, we construct Oster (2019) bounds for the causal effect of the early underemployment and under realistic assumptions find a range of 0.18-0.24. This suggests that early underemployment causally increases the chances of later underemployment by at least 0.18. This is an important finding as early graduate underemployment is much more prevalent than early unemployment and yet has a similar sized negative effect on the prospects of attaining a graduate job in the future. We further test the robustness of the findings by considering specifications which do not require individuals to be in the labour market 42-months post-graduation in order to be included in the sample. Firstly, we look at an alternative measure of poor labour market outcome ('mal-employment'), and secondly, we look at the effect of early underemployment on the full range of possible labour market states 42-months after graduation. Each of these models confirms the negative impact of failing to get a graduate job on future graduate-level employment, supporting the findings of our main empirical approach. Heterogeneity analysis reveals that the impact of early underemployment is more severe for women, for black graduates, for those from Wales, those attending newer universities, those studying social science subjects, those attaining a lower class of degree and those from a state school or a school outside the UK. Again there are important policy implications for widening successful participation in higher education

given this profile of the more detrimental effects of early underemployment. Inequalities in early graduate job attainment relating to certain socio-demographic characteristics are exacerbated by the greater penalty for underemployment for graduates from these particular backgrounds. The equity concerns are compounded by the economic inefficiency of under-utilisation of the graduate skills of these individuals, further underscoring the importance of addressing the issue for the Government, as well as other key stakeholders within the higher education sector.

The rest of the paper proceeds as follows: section 2 discusses the extant literature, section 3 then describes the data before section 4 outlines our empirical approach. Section 5 presents the results, finally section 6 provides discussion and conclusions.

2 Previous Literature

The majority of the existing literature on graduate underemployment has focused on describing and documenting the extent and (wage) penalties for graduates who fail to attain a job at a level commensurate with their (higher) education. There is a large literature that documents graduate underemployment for the UK and a range of European countries, and this literature finds that the UK has one of the highest rates of graduate underemployment in Europe with approximately one-third of UK graduates failing to attain a graduate job – this compares with less than one-fifth in Germany, Italy and most Scandinavian countries (Green and Henseke, 2017). This level of underemployment appears to be a fairly stable feature of the UK graduate labour market: earlier work by Dolton and Vignoles (2000) estimated the incidence of graduate underemployment in the UK using a 1980 National Survey of Graduates, finding 38% of graduates underemployed amongst those in their first job, declining to 30% for those who have been in the labour market for six years. They also found that the incidence varied by gender, quality of education, and degree subjects.

The high level of graduate underemployment in the UK is in part related to the fact that the UK has one of the highest proportions of tertiary educated workers in Europe, with around 40% of workers having a higher education degree (Green and Henseke, 2017). This figure is likely to increase given that the UK's higher education initial participation rate (HEIP17-30) has been above 50% since 2015/16 and was 53.4% in 2019/20 (ONS, 2020)[1] indicating that in each cohort of school leavers, more than half begin a course in

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[1]Since 2020 the ONS calculates a different measure of higher education participation and so comparable figures are not available for the most recent years.

higher education between the ages of 17 and 30.

The immediate wage penalties of graduate underemployment are well known, estimated to be approx. 45% for UK graduates (Green and Henseke, 2016a). This is the largest penalty in Europe, with much previous research establishing that the UK penalty is higher than in comparable European countries (Green and Henseke 2016b; Crivellano, 2016; Green and Zhu, 2010). For example, the penalty in Germany is 25%, and in France 32%, while the Scandinavian countries tend to have much lower underemployment wage penalties (22% Norway, 24% Sweden).

So while the extent of graduate underemployment and the wage penalties associated with it are established, there is much less known about the *persistence* of graduate underemployment. A study by Mavromaras et al. (2013) looks at the impact of previous *over*-skilling on future *over*-skilling amongst workers of different education levels, which is a complementary angle from which to look at *under*employment. Using Australian panel data, they find a persistence in graduate over-skilling outcomes, though these are not as strong as for lesser educated individuals and the effects are correlational rather than definitively causal. Similarly, Nunley et al. (2017) use a resume audit study to assess the impact on callback rates in job applications of periods of underemployment on a graduate's CV in the US. They find that underemployed graduates have callback rates 30% lower than those with graduate level experience, indicating that there is a penalty for graduate underemployment and the authors conclude this is due to a scarring effect. These studies suggest that failure to secure a graduate job can lead to becoming trapped in lower-paying jobs with limited prospects. To our knowledge, only one previous paper has addressed the question of graduate underemployment persistence for the UK. Mosca and Wright (2011) also used the DLHE and DLHE-L data for the UK to examine the relationship between early and later underemployment for a cohort of graduates graduating in 2003. They find that early underemployment increases the probability of later underemployment by 0.26. However, the study does not have data linked back to the HESA student record and so has only a limited set of control variables, and is unable to capture the socio-economic background or schooling history of the graduates. These factors are important correlates of early and later graduate labour market outcomes and so likely introduce bias into the estimated effect. There is also incomplete linkage between the DLHE-L and DLHE and so the sample is only 10,400 graduates. Our study is the first to address the question of the persistence of graduate underemployment in the UK with a large sample of graduates with linked DLHE and DLHE-L data, and importantly much more complete data due to the linkage with the administrative HESA data.

Our study is complementary to the much larger existing body of literature on the scarring effects of

unemployment. There is plenty of evidence to suggest that periods of unemployment have a significant impact on the chances of future unemployment and these findings are consistent across different national contexts. For example, Nilsen and Reiso (2011) uses Norwegian individual register data, covering the period 1986-2008, and find that unemployment has a negative effect on later labour market attachment. Schmillen and Umkehrer (2017) use German administrative data spanning a 24 year period and find that each additional day of unemployment in the first eight years of being in the labour market increases unemployment in the next 16 years by half a day. Importantly, the 'scarring' effects they identify are more pronounced for those groups who are already more likely to suffer from lengthy and repeated periods of unemployment. Analysis of Belgian administrative data by Cockx and Picchio (2013) shines a light on the embryonic labour market phases in terms of transitions from school to work. In common with other research, they find the 'scarring' effect of unemployment on future employment with school leavers who delay entering the labour market by one year having a reduced likelihood of employment in the following two years – for men the reduction is from 60% to 16%, for women it is from 47% to 13%. They highlight a key policy implication of their findings is that young people should be offered employment experience as quickly as possible after finishing school – to stave off the possible negative effects of missing out on the opportunity to build human capital in the workplace.

Whilst clear evidence exists of scarring effects of unemployment, it is also likely that such effects will necessarily be mediated by country-specific education/training systems and labour markets, educational and work histories and employment sector. For example, research by Shi et al. (2018), using data collected from recruiters in Switzerland found that whilst unemployment negatively impacted recruiters perceptions of the suitability of candidates, this was moderated by the applicant's educational and work history. There is also some evidence that the wage penalty might differ internally within countries according to region. Using Italian panel data, Lupi and Ordine (2002) found that the wage penalty was less in areas of high unemployment, which they attribute to periods of unemployment being seen as more 'normal' in these areas. These studies imply a degree of heterogeneity in the scarring effects of unemployment – likely to also be apparent when thinking about scarring effects of underemployment for UK graduates.

There are a large number of studies from the UK that have sought to estimate the size of any future wage and employment penalties faced by those with a past unemployment history. Using British Household Panel Survey (BHPS) data between 1991-97 and difference-in-difference approach, Arulampalam (2001) found that a period of unemployment carried a wage penalty of around 6% on re-entering employment, but that this builds such that three years later the earnings loss is even greater, with earnings 14% lower

than they would have been without the spell of unemployment. Gregory and Jukes (2001) conduct similar analysis using linked New Earnings Survey Panel Dataset (NESPD) and the Joint Unemployment and Vacancies Operating System (JUVOS) dataset. By contrast, they find that experiencing unemployment reduces earnings on re-entry to the labour market by approx. 10% but that this penalty largely disappears after two years of being continuously re-employed. However, they find heterogeneity in the unemployment effect depending on the length of the spell. An unemployment spell lasting six months (one-year) adds 5 percentage points (11 pp) to the 10% penalty i.e. a year of unemployment doubles the wage penalty of experiencing unemployment. Subsequent continuous employment erodes this penalty but wages are still as much as 13% lower two years later for those who had been unemployed for one-year before re-entering employment. Arulampalam, Gregg, and Gregory (2001) show how the findings from these two studies closely support each other once the duration of unemployment is considered. Finally for the UK, using data from the UK's National Child Development Study, Gregg (2001) found that for men, conditional on background characteristics, experiencing an extra three months of unemployment between ages 16 and 23 leads to an extra 1.33 months out of work between ages 28 and 33, approx. one month of which is unemployment. Similarly, Gregg and Tominey (2005) using the same NCDS data found a substantial and significant wage penalty for early experience of unemployment (between ages 16 and 23) for men on earnings at age 42 – lowering them by 13-21% depending on the duration of early unemployment. The penalty is less (between 9-11%) for those who managed to avoid repeated periods of unemployment after age 23.

Finally, our work also complements the literature that investigates the factors determining who attains the premium graduate jobs in the UK. For example, Macmillan et al. (2015) investigate the characteristics of graduates who attain the highest occupational classes of jobs using DLHE and DLHE-L data for graduates from 2007. They found an important role for family background and private education in securing a top graduate job 42-months post-graduation. Similarly, Laurison and Friedman (2016) using Labour Force Survey data find a class gradient in access to top graduate positions in the UK, with traditional professions – including law, medicine and finance – dominated by those whose parents were higher managers and professionals themselves. This echoes Wakeling and Savage (2015) whose analysis of the Great British Class Survey shows that entry to the highest occupational class jobs is stratified by parental social class even after conditioning on higher education institution and subject of undergraduate degree. This literature consistently finds socio-economic and socio-cultural gradients both in access to (elite) higher education and in graduate outcomes and early career progression conditional on higher education attainment. While this

literature highlights patterns that foreshadow the findings of our heterogeneity analysis, it does not tend to look at the role of early graduate experience in determining later outcomes which is the primary focus of our paper.

In light of the findings of the separate literatures on the penalties for graduate underemployment and the scarring effects of unemployment, it is likely that early graduate underemployment will have an impact on a graduate's later employment outcomes. This is currently an under-researched area, and so here we bring together these two literatures to start to close the gap in academic and policy understanding.

3   Data

To understand the persistence of graduate underemployment and be able to plausibly separate scarring effects from heterogeneity based on individual and institutional characteristics, requires a range of detailed data covering a graduates early years in the labour market, their higher education experience, and their background socio-demographic and educational characteristics. To create such a dataset, we use the 2016 Destinations of Leavers from Higher Education Longitudinal (DLHE-L) data which is a survey of graduates recorded 42-months after graduation. The data contains a rich set of information on the graduates' current labour market state, and for those employed, the nature of their job with regard to job title, occupation, sector, industry, and also their hours, and job satisfaction. This data is linked back to the same graduates when interviewed in the Destinations of Leavers from Higher Education (DLHE) data recorded six-months after graduation in 2013. This is then linked backwards to administrative higher education data for these graduates from the Higher Education Statistics Agency student record data, which covers all aspects of their higher education (higher education institution (HEI) attended, subject studied, degree class recorded), their school prior attainment, demographics and family background. This backward linkage ensures that we have all the information at each time point for every graduate in the DLHE-L sample. The total sample is 106,630 graduates who obtained a degree in 2013, and of these 70% obtained an undergraduate degree. It is these graduates that we focus on, and after data cleaning we obtain a usable sample of 67,381.

While the HESA student record data is administrative, capturing information for all students attending higher education institutions in the UK, the DLHE and DLHE-L are surveys and as such do not achieve 100% response rates. Of the undergraduates who graduated in 2012/13 66.1% returned information in the initial DLHE survey at six-months, representing 370,315 graduates. Of these, 107,340 completed the

DLHE-L survey, a response rate of 28.9%. Using the HESA student record data for 2012/13 graduates we can compare the characteristics of those who graduated with the just under one-third of the cohort who are in our full HESA-DLHE-DLHE-L dataset. As can be seen in Table 1, the sample is broadly representative of the graduate population from 2012/13. Compared to the full graduate population the sample is weighted more towards females than males (60% female in HESA-DLHE-DLHE-L versus 55% female in HESA), and though the age in the sample is approx. three years older this is consistent with age being recorded in the DLHE-L data which is three-and-a-half years post-graduation. With regard to ethnic composition, the proportions Black and Asian are similar in both the sample and the HESA data, with the sample having a higher proportion White – though this may be because there is substantially more missing data on ethnicity in the HESA population. In terms of background characteristics, our sample is very close to the HESA population: the proportion with at least one graduate parent is 40% in our sample, 38% in the HESA population, and the occupational breakdown of the graduate's parents is very similar for all categories. The HESA data has more missing information on area level participation in higher education (POLAR – which classifies areas in terms of the proportion of 18/19 year olds who go to higher education), but the comparison suggests our sample over-represents areas in the middle quintiles and under-represents those in the areas with the highest/lowest participation in HE. Overall the comparison provides reassurance that the graduates in our sample are from very similar family backgrounds to the full population who graduated in 2012/13. With regard to region of domicile, the sample is very similar to the full HESA population, the only exception being the over-representation of London in the sample (21% versus 13%) offset by slight under-representation of graduates from the EU, Scotland and the West Midlands. In terms of school type, graduates from state schools are under-represented in the sample, though the proportion from independent (private) schools is very similar – this anomaly may be due to the relatively high level of missingness of this variable in each dataset. Similarly, the proportion of graduates who have entered university via a non-standard qualifications route (i.e. those with no A-levels which are the main qualifications for university entry) is almost exactly the same in the sample and the full population, though again there is non-trivial missingness of this variable. The final part of Table 1 shows the type of university attended and the degree class attained. Here the proportions attending the most elite universities (Russell Group), the older pre-1992 universities (next most prestigious), the post-1992 universities (former polytechnic colleges and newly created universities) and 'Other' universities (these are post-1992 institutions that do not have polytechnic or central institution roots), are very close to each other in the sample and the graduate population. Similarly, the proportions attaining first or second class degrees are close, albeit with the sample slightly over-representative of first and upper second-class

and under-representative of lower second class degrees and below. This close match of the university characteristics is important, given the likelihood that university attended and degree class attained are two of the most important drivers of graduate employment. In all, the comparison shows that while our sample is not fully representative of the full graduate population from 2012/13, the graduates in our sample are representative in terms of family background and university experience, which gives confidence that our findings have broad applicability.

Table 1: Comparison of HESA-DLHE-DLHE-L sample and all graduates from 2012/13

	Sample	HESA		Sample	HESA
Demographics			*Region of Domicile*		
Male	39.95	44.34	EU	3.98	4.81
Female	60.04	55.65	East Midlands	5.64	5.66
Other	0.01	0.01	East of England	9.10	7.71
			London	20.96	13.16
White	76.72	66.97	North East England	3.65	3.25
Black	5.26	4.77	North West England	9.49	9.44
Asian	9.26	7.72	Northern Ireland	3.34	2.88
Others	3.90	0.82	Other UK region	0.24	0.03
Unknown	4.85	17.17	Scotland	5.85	6.87
			South East England	13.07	11.69
Age	24.54	21.68	South West England	7.93	6.65
			Wales	3.58	3.97
Background			West Midlands	6.57	7.20
Graduate parent(s) = Yes	40.47	38.47	Yorkshire and the Humber	6.60	5.91
Graduate parent(s) = No	35.10	31.19			
Parental education unknown	24.43	30.34	*School Characteristics*		
			State school	59.94	68.51
Higher managerial\professional	16.08	14.01	Independent	6.33	7.14
Lower managerial\professional	20.58	18.14	Any non-UK school	0.68	-
Intermediate occupations	9.68	8.36	School (Unknown)	33.05	24.34
Small employers\own account workers	5.07	4.60			
Lower supervisory\technical occupations	3.47	2.99	No A-levels	8.04	7.50
Semi-routine occupations	8.97	8.34	At least one A-level	63.60	52.81
Routine occupations	3.97	3.64	A-levels (Unknown)	28.36	39.69
Never worked\long-term unemployed	0.19	0.31			
Not classified	21.63	26.34	*Higher education*		
Unknown	10.36	13.26	Russell Group	21.27	19.75
			Pre-1992 universities	17.29	16.56
Quantile 1 (POLAR)	3.54	8.82	Post-1992 universities	36.24	34.99
Quantile 2 (POLAR)	17.41	12.75	Other universities	25.21	28.70
Quantile 3 (POLAR)	26.53	15.98			
Quantile 4 (POLAR)	29.96	19.76	First class honours	21.09	16.73
Quantile 5 (POLAR)	14.81	26.98	Upper second class honours	48.88	44.17
Quantile Unknown (POLAR)	7.75	15.72	Lower second class honours	19.61	23.64
			Third class honours/Pass	3.31	5.85
			Unclassified	7.10	9.61

Definitions of underemployment

Feldman (1996) proposed five dimensions that are used to judge whether an individual is underemployed: (1) they possess more formal education than their current job requires; (2) they are involuntarily employed in a different field from that in which they received their formal education; (3) they possess higher-level

skills than the job requires; (4) they are involuntarily engaged in part-time, temporary or intermittent employment; (5) they are earning 20 per cent less than the average earnings of their graduating cohort in the same major or occupation track. To align with the majority of the existing literature, we focus on definitions 1 and 3, defining underemployment as a mismatch between jobs and human capital as measured by educational qualifications and skills.

Within the literature there are two main explanations offered for the existence of underemployment (Scurry and Blenkinsopp, 2011). Firstly, that underemployment as a "stepping-stone" – a temporary transitional period for acquiring additional skills and experience, or a "stop-gap" before career decisions are made. Secondly, that underemployment is a means to avoid unemployment, that it is seen to be the lesser of two evils. In addition to these explanations, there are some small-scale studies highlighting that certain graduates enter non-graduate occupations as part of a lifestyle choice (Elias and Purcell, 2004) and that voluntary/involuntary underemployment distinction has a strong gender and class dimension (Steffy, 2017). In line with our focus on job/occupation and education/skills mismatch in our definition of underemployment, we implicitly make the assumption that graduates wish to have a graduate job and therefore aim to avoid underemployment i.e. that it is involuntary. To support this, we carry out some supplementary analysis in which we look at career satisfaction at 42-months and find that, after controlling for labour market state at 42-months, compared to being in a graduate job at six-months post-graduation, being underemployed at six-months decreases the probability of a graduate being satisfied with their career by a statistically significant 5 percentage points. While only suggestive evidence, this does imply that the early underemployment is involuntary (see appendix Table A2).

Measurement of underemployment

When it comes to measuring underemployment – as conceptualised in terms of mismatch between the level of education or skills individuals possess and the level required for their job – there are a variety of ways to measure the adequacy of education-occupation match: (1) job analysis (objective) – based on a dictionary of occupation requirements or standard occupational classification; (2) distributional analysis of actual work situation (objective/subjective) e.g. calculating the mean or modal educational attainment of workers in a particular occupation; and (3) worker self-assessment (subjective) – the perceived over-education/over-qualification based on self-reporting of the educational level and field required for job. Options (2) and (3) are problematic, potentially underestimating the extent of underemployment in the context of fluctuations in the labour market and the expansion of HE. Within option (1), some literature attempts to describe occupational categories in terms of skill requirements and distinguish between graduate/non-graduate jobs

on this basis (Elias and Purcell, 2004; Elias et al., 1999, Green and Henseke, 2016). Using our DLHE-L data we compared underemployment definitions derived from classifying jobs as graduate or not based on Standard Occupational Classification (SOC) codes and an alternative definition from Green and Henseke's (2016) skills-based approach to defining jobs as graduate jobs or not. The comparison shows very little difference in how jobs are classified between these two approaches: in our data less that 2% of graduates would change category between graduate and non-graduate jobs if we swtich definition. In light of this, we follow the majority of the literature in classifying occupations in SOC categories[2] 1–3 as graduate jobs (i.e. Managers, Professional and Associate Professional occupations) and anything below this as non-graduate jobs. In the main specification, we necessarily restrict the sample to those who are employed at 42-months post-graduation and for whom we know the SOC code of their job. This excludes the 739 people who are employed but for whom their underemployment status cannot be determined. In later analysis we test the sensitivity of the results to the sample selection of only employed individuals.

3.1 Data descriptives

We now show some data descriptives for our sample of graduates who graduated from an undergraduate degree in 2013. Table 2 shows the breakdown of employment status for our sample at the two time points: six-months post-graduation and 42-months post-graduation, revealing the extent of graduate underemployment.

Table 2: Employment status of graduates at 6-months and 42-months post-graduation

	6 months post-graduation		42-months post-graduation	
Graduate job	33,346	49.5%	45,275	67.2%
Underemployed	**14,906**	**22.1%**	**9,575**	**14.2%**
Employed (unknown level)	656	1.0%	739	1.1%
Unemployed	5,226	7.8%	1,654	2.5%
Further study	10,873	16.1%	8,122	12.1%
Inactive (travel, care responsibilities)	2,374	3.5%	2,016	3.0%
Total	67,381	100.0%	67,381	100.0%

Source: authors' calculations using linked HESA DLHE-Longitudinal, DLHE and student record data.

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[2]SOC 2010 codes used: (1) Managers, directors and senior officials; (2) Professional occupations; (3) Associate professional and technical occupations; (4) Administrative and secretarial occupations; (5) Skilled trades and occupations; (6) Caring, leisure and other service occupations; (7) Sales and customer service occupations; (8) Process, plant and machine operatives; (9) Elementary occupations.

Around 50% of the graduates are employed in a graduate job six-months after graduation, with less than 10% unemployed. The proportion underemployed is however slightly more than 20%, so just over 1-in-5 graduates are underemployed at this time point. Three years later, many more graduates are in graduate jobs, with more than two-thirds now in this category. Unemployment at this point is very low: only 2.5% are in the category of being without a job but would like to have one. There remain however around 1-in-7 graduates underemployed, so by the time graduates have been out of university for 42-months there is still a substantial proportion who are not in a graduate job.

Although we assume that graduate underemployment is for the most part involuntary, it may be that some of the underemployment represents temporary labour market frictions and/or voluntary underemployment as a stop-gap or strategic choice to get a entry into a particular industry. It is instructive therefore to look at the persistence of graduate underemployment in the raw data, which is what we can see in Table 3.

Table 3: Transitions from 6-month status to 42-month status

6 months after graduation		42-months after graduation						
		Grad. job	Underemp.	Emp. (unknown)	Unemp.	Further study	Inactive	**Total**
Graduate job	33,346	**79.7%**	7.1%	0.9%	1.3%	8.7%	2.3%	100%
Underemployed	14,906	52.1%	**30.3%**	0.9%	2.3%	11.8%	2.7%	100%
Employed (uk'n)	656	66.2%	13.6%	**1.4%**	4.2%	13.3%	1.5%	100%
Unemployed	5,226	47.3%	26.4%	2.0%	**9.4%**	10.8%	4.2%	100%
Further study	10,873	63.8%	8.1%	1.0%	2.4%	**23.0%**	1.7%	100%
Inactive	2,374	46.2%	13.9%	3.5%	4.8%	12.6%	**19.0%**	100%
Total	67,381	67.2%	14.2%	1.1%	2.5%	12.1%	3.0%	**100%**

Source: authors' calculations using linked HESA DLHE-Longitudinal, DLHE and student record data.

Amongst those who are underemployed six-months post-graduation, around half have moved into a graduate job three years later. However, just under one-third of the initially underemployed are also underemployed 42-months after graduation. It is noticeable that this degree of persistence is much higher than is seen for the unemployed at six-months — less then 10% of those unemployed at six-months are also unemployed three years later.

This persistence of underemployment in the raw figures of Table 3 does not necessarily mean that early underemployment creates a scarring effect increasing the probability of later underemployment. These raw associations between status at the two time-points may be driven by selection into underemployment based on the characteristics (observable and unobservable) of the graduates, creating the impression of a causal effect from one point to the other when in fact the persistence owes to the persistence of characteristics

that cause underemployment rather than a scarring effect of the early underemployment.

To explore this descriptively, Table 4 displays the characteristics of graduates according to their employment status six-months post-graduation, illustrating how those who are selected into underemployment at this point compare to those in graduate jobs and those unemployed, in terms of on their observable characteristics.

Table 4 shows that those who are underemployed at six-months post-graduation are from non-traditional HE backgrounds, attend lower status universities and have lower attainment at both school and university than those who are in graduate jobs. They are less likely to be from a white ethnic group, more likely to be female, more likely to have attended a state school, have a lower UCAS tariff points score[3] prior to higher education and are less likely to have at least one A-level. In terms of background, they are less likely to have at least one graduate parent, less likely to have a parent who had a graduate job and they are more likely to have come from an area with lower levels of participation in higher education (i.e. lower POLAR[4] quintile). As we might expect given their school prior attainment, compared to those in graduate jobs, the underemployed are much less likely to have gone to a Russell Group university and are more likely to have been to a post-1992 institution or 'Other' type of HEI. They are less likely to have studied STEM subjects but are more likely to have a degree in Arts, Humanities or Social Sciences. Their HE attainment is also lower than the average graduate in a graduate job, with only 66% of the underemployed gaining a 2:1 or above, compared to 70% of those in graduate jobs, and 32% of the underemployed attaining a 2:2 or Third, compared to just 20% for those in graduate jobs.

From the descriptive comparison it is also clear that in many regards the underemployed at six-months look more like the unemployed than they do those in graduate jobs. This is particularly the case in terms of parental background and prior school attainment, plus their outcomes at university as measured by degree class attained. Interestingly though, there is a notable difference when it comes to type of HEI and to a lesser extent subject — here the unemployed and those in graduate jobs look similar to each other. As we might expect, more of those in graduate jobs have been to Russell Group HEIs and fewer to post-1992 than amongst the unemployed but in the other categories (pre-1992 and 'Other') the proportions are very similar. It is the underemployed who have notably lower proportion coming from Russell Group

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[3]The Universities and Colleges Application Service (UCAS) has a tariff point system that translates qualifications and grades into a numerical value to allow comparison of attainment across types of qualification and grading systems. The measure is used by universities to indicate to prospective students the attainment level required for entry to a course, and to rank students applying to a course.

[4]POLAR is the Participation of Local Areas index that classifies the area an individual comes from into quintiles based on the proportion of 18/19 year olds from that area who go on to higher education.

Table 4: Characteristics of graduates in graduate jobs, underemployed or unemployed 6-months post-graduation

Status at 6-months...	...Graduate job	...Underemployed	...Unemployed
	Mean	Mean	Mean
Female	0.59	0.66	0.48
White	0.79	0.77	0.67
Age	25.3	23.3	24.1
Has at least one A-level*	0.89	0.87	0.85
State school	0.58	0.66	0.62
UCAS Tariff	158.0	146.7	145.9
Has at least one graduate parent	0.40	0.38	0.37
Parent graduate job	0.37	0.35	0.32
POLAR quintile 1	0.04	0.04	0.04
POLAR quintile 2	0.17	0.20	0.18
POLAR quintile 3	0.27	0.28	0.26
POLAR quintile 4	0.30	0.30	0.29
POLAR quintile 5	0.15	0.13	0.15
POLAR unknown	0.07	0.06	0.08
Russell Group	0.21	0.14	0.17
Pre-1992 universities	0.16	0.15	0.18
Post-1992 universities	0.37	0.41	0.42
Other universities	0.25	0.30	0.23
STEM	0.26	0.22	0.30
Medicine	0.04	0.00	0.00
Subjects allied to medicine	0.13	0.03	0.05
Humanities	0.11	0.18	0.17
Law, Econ, Management	0.16	0.18	0.18
Social Sciences	0.21	0.24	0.18
Arts	0.09	0.14	0.12
First class honours	0.23	0.14	0.14
Upper second class honours	0.47	0.52	0.46
Lower second class honours	0.17	0.27	0.30
Third class honours/Pass	0.03	0.05	0.07
Unclassified	0.11	0.03	0.03
N	33,346	14,906	5,226

Source: authors' calculations using linked HESA DLHE-Longitudinal, DLHE and student record data.

*This is the proportion with at least one A-level amongst those for whom A-level status is known, since this variable is missing for 52% of the graduates in this table.

universities and more in 'Other' HEIs than all other graduates. Similarly for subjects, those underemployed have markedly less weight in STEM subjects and more in Arts, Humanities, and Social Sciences than those in graduate jobs or those unemployed six-months post-graduation. Taken all together, this descriptive evidence suggests that while in some regards the underemployed and unemployed graduates share common characteristics, the underemployed are different along a number of dimensions to other groups of graduates. They are from similar backgrounds to the unemployed but far fewer have done STEM subjects, more have done degrees in Social Sciences, Arts and Humanities, and more have their degrees from 'Other' types of HEI.

Before moving to the main modelling, Table 5 presents one further piece of descriptive analysis, high-lighting the characteristics of graduates of different employment statuses 42-months post-graduation, only considering the group who were underemployed at six-months post-graduation.

We see from Table 5 table that amongst the group of graduates who were underemployed at six-months post-graduation, those who remain underemployed at the second time-point, are more likely to be female, more likely to be from a non-white ethnic group, have lower prior attainment at school, and are less likely to have a graduate parent or parents in graduate jobs, than those who go on to attain a graduate job by the time of the second observation. As with Table 4, we can see that those who are twice observed underemployed are much more likely to have attended a post-1992 or 'Other' HEI and are less likely to have gone to a Russell Group or older university than those who move into graduate jobs. They are less likely to have studied STEM or subjects allied to medicine and more likely to have read for a degree in Arts or Social Sciences. Those underemployed at both time points are also more likely to have got a 2:2 or Third (40%) than those who moved into a graduate job (28%) and are much less likely to have gained a first or 2:1 (56% versus 70%).

As with Table 4, this descriptive evidence highlights the need to account for observable characteristics in the analysis of underemployment persistence given the strong relationships between attainment, background and underemployment. Even amongst the group who are underemployed at six-months post-graduation, those who are again observed to be underemployed three years later have different characteristics to those who move into graduate jobs. This descriptive picture foreshadows the later heterogeneity analysis that examines how different characteristics interact with early underemployment to exacerbate or mitigate the effect of that early underemployment for later outcomes.

We now to turn to the formal modelling approach to capturing the relationship between early and later

Table 5: Characteristics of graduates in graduate jobs, underemployed or unemployed 42-months post-graduation amongst group who were underemployed at 6-months post-graduation

Underemployed at 6-months and then at 42-months post-graduation...	...Graduate job	...Underemployed	...Unemployed
	Mean	Mean	Mean
Female	0.62	0.69	0.60
White	0.79	0.76	0.58
Age	22.6	24.3	24.3
Has at least one A-level*	0.88	0.83	0.88
State school	0.67	0.65	0.63
UCAS Tariff	151.0	136.6	138.8
Has at least one graduate parent	0.40	0.33	0.38
Parent graduate job	0.38	0.29	0.34
POLAR quintile 1	0.04	0.04	0.06
POLAR quintile 2	0.19	0.21	0.14
POLAR quintile 3	0.28	0.29	0.29
POLAR quintile 4	0.30	0.29	0.33
POLAR quintile 5	0.14	0.11	0.12
POLAR unknown	0.06	0.05	0.06
Russell Group	0.16	0.08	0.13
Pre-1992 universities	0.16	0.13	0.16
Post-1992 universities	0.40	0.44	0.48
Other universities	0.28	0.35	0.23
STEM	0.23	0.19	0.23
Medicine	0.00	0.00	0.00
Subjects allied to medicine	0.04	0.02	0.04
Humanities	0.18	0.19	0.18
Law, Econ, Management	0.19	0.19	0.18
Social Sciences	0.23	0.26	0.23
Arts	0.13	0.16	0.14
First class honours	0.15	0.10	0.08
Upper second class honours	0.55	0.46	0.45
Lower second class honours	0.24	0.33	0.38
Third class honours/Pass	0.04	0.07	0.07
Unclassified	0.03	0.04	0.02
N	7,763	4,518	346

Source: authors' calculations using linked HESA DLHE-Longitudinal, DLHE and student record data.
*This is the proportion with at least one A-level amongst those for whom A-level status is known, since this variable is missing for 23% of the graduates in this table.

experience of graduate underemployment.

4   Empirical Approach

We estimate the relationship between early (six-months post-graduation) and later (42-months post-graduation) underemployment using a series of linear probability models of the form:

$$Y_i = \alpha + Und6_i\beta + U6_i\lambda + Eukn6_i\varphi + IA6_i\theta + FS6_i\rho + \mathbf{HEI'_i}\xi + \mathbf{DSub'_i}\gamma + \mathbf{DClass'_i}\zeta + \mathbf{Prior'_i}\pi + \mathbf{X'_i}\phi + \epsilon_i$$

in which Y_i is a dummy variable for underemployment at 42-months post-graduation, $Und6_i$, $U6_i$, $Eukn6_i$, $IA6_i$, and $FS6_i$ are a series of dummies for employment status six-months post-graduation: underemployed; unemployed; employed in a job of unknown level; inactive; and further study respectively. $\mathbf{HEI_i}$ is a vector of dummy variables for different types of higher education institution: Russell Group HEIs (the elite group of research intensive universities); post-1992 HEIs (former polytechnic colleges that gained university status in 1992); and 'Other' HEIs (the post-1992 institutions that do not have polytechnic or central institution roots). $\mathbf{DSub_i}$ is a vector of dummies for broad degree subject area: medicine; subjects allied to medicine; humanities; law, economics and management; social sciences; arts. $\mathbf{DClass_i}$ is a vector of dummies for degree class attained: upper second class; lower second class; third class; unclassified. The vector $\mathbf{Prior_i}$ contains information on attainment prior to university: UCAS tariff points on entry to university; and dummies for at least one A-level; attended an independent school; attended a non-UK institution. Finally, $\mathbf{X_i}$ is a vector of background controls: age; dummies for female; black; Indian; Pakistani; Bangladeshi; Chinese; other Asian background; other ethnicity; unknown ethnicity; parent(s) not having higher education; parents' education unknown; parental occupational background: lower managerial; intermediate occupations; small employers and own account workers; lower supervisory and technical; semi-routine occupations; routine occupations; never worked and long-term unemployed; not classified; unknown; POLAR quintile 2; POLAR quintile 3; POLAR quintile 4; POLAR quintile 5; domiciled in Scotland; Wales; Northern Ireland; dummies for English regions; other UK territory; EU.

The omitted categories for the various dummy variables are: graduate job at six-months post-graduation, pre-1992 non-Russell Group HEI, STEM degree, first class honours, no A-levels, attended a state school, male, white ethnicity, parent(s) with higher education, parent(s) from higher managerial and professional occupation; lowest POLAR quintile; domiciled in London.

The first specification of the model includes only the dummy variables for employment status at six-months post-graduation. This shows how being underemployed, unemployed, inactive or undertaking further study, affects the probability of being underemployed 42-months post-graduation, relative to being in a graduate job at the first time point. The subsequent specifications successively add sets of controls for university experience (HEI type, degree subject and degree class); attainment prior to university; and finally, background controls.

5 Results

5.1 Main specifications

Full estimation results for each specification are displayed in Table A1, here in Table 6 we focus on the key coefficients of the model.

Table 6: Estimates of the effect of labour market state at 6-months post-graduation on underemployment probability at 42-months post-graduation

Dependent variable: underemployed at 42-months post-graduation				
	(1)	(2)	(3)	(4)
Underemployed at 6 months	0.29***	0.25***	0.25***	0.24***
Employed (unknown) at 6 months	0.09***	0.08***	0.08***	0.08***
Unemployed at 6 months	0.28***	0.25***	0.24***	0.24***
Further study at 6 months	0.03***	0.03***	0.03***	0.03***
Inactive at 6 months	0.15***	0.14***	0.14***	0.13***
N	54,850	54,850	54,850	54,850
HE related controls	X	✓	✓	✓
Prior attainment controls	X	X	✓	✓
Background controls	X	X	X	✓

*** $p<0.01$.

The initial estimate is that, compared to being in a graduate job six-months post-graduation, being underemployed increases the probability of underemployment at 42-months post-graduation by 0.29 and this is an effect that is statistically significant at conventional levels. This is marginally stronger than the effect of being unemployed at six-months post-graduation (0.28) on the probability of being underemployed three years later. As we might expect, all other employment statuses compared to already being in a graduate job at six-months post-graduation, do increase the likelihood of underemployment three years later. For

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inactivity the increase (0.15) is much less than being underemployed or unemployed, and for further study it is only a 0.03 increase.

In column 2 we see that taking account of the fact that higher education institution attended, subject and attainment all impact on the probability of underemployment at each time point, reduces the underemployed at six-months effect to 0.25. Interestingly then adding school attainment (column 3) does not affect the relationship – suggesting that any effect of school prior attainment on underemployment probability at six-months works through the effect on higher education subject, institution and attainment. Adding background characteristics (column 4) reduces the impact slightly but still, after taking account of a wide array of individual characteristics, being underemployed six-months after graduating is associated with a 0.24 higher probability of being underemployed 42-months after graduating than is the case for someone in a graduate job at the first time point.

Looking at the effects of other covariates (appendix Table A1) reveals some interesting patterns, though in all cases it needs to be borne in mind that we cannot interpret these effects as causal for two reasons. Firstly, because in many cases these variables themselves will be endogenous (i.e. related to the unobservable factors that also affect underemployment at 42-months post-graduation); and secondly, because they affect the probability of underemployment at six-months post-graduation and this will introduce bias into their coefficients since employment status at six-months is also included in the model (i.e. with respect to these variables, six-month employment status dummies are 'bad controls' (Angrist and Pischke, 2008)). Nevertheless it is still interesting to look at these associations albeit with the caveat in mind. It is perhaps unsurprising that compared to graduates from STEM subjects, those who studied humanities (+0.07), social sciences (+0.04) or arts (+0.09) degrees have higher probability of underemployment 42-months post-graduation, however it is also the case that graduates of law, economics and management (+0.04) are also more likely to be underemployed. Only subjects allied to medicine (-0.08) have a lower probability of underemployment than STEM graduates, which is perhaps to be expected given both STEM and subjects allied to medicine often have very clear graduate career pathways closely related to the degree, which is not the case for less vocationally aligned subjects in humanities, arts and the social sciences.

Unsurprisingly, graduates from Russell Group universities (-0.03) have lower probability of underemployment than those from other pre-1992 universities, but interestingly the graduates from post-1992 universities do not have a higher probability than those from non-Russell Group pre-1992 universities. The graduates of 'Other' institutions have the highest probability of underemployment, though only 0.01 higher than those from non-Russell Group pre-1992 HEIs.

There is the expected gradient relating to degree class, with each class lower than a first having a higher probability of underemployment. Interestingly an upper second-class degree adds 0.03, so equivalent to the difference between a Russell Group and a non-Russell Group HEI amongst the older institutions. For the other degree classes the impacts are notably much larger: a lower second-class degree increasing the probability by 0.09 relative to a first-class degree and for a third-class degree it is 0.15 higher probability of underemployment at 42-months than for graduates with a first.

In terms of background, all else equal, attending an independent school reduces the chance of underemployment by 0.03, perhaps hinting at the value of additional social and network capital of independent school attendees. Having no parent with higher education is associated with a 0.01 higher probability of underemployment, and having parents from routine or semi-routine occupations relative to higher managerial occupations increases the probability by 0.04, with all occupations from intermediate downwards associated with an increased probability of underemployment. There is also a gradient in line with what we might expect with regard to the POLAR area measure of HE participation: compared to graduates from the lowest participation areas, graduates who came from areas with higher participation in HE have a lower probability of underemployment 42-months post-graduation, though only significantly so for the highest quintile (-0.03).

Looking at the effect of geography, it is clear that conditional on all the background and attainment characteristics included in the model, underemployment is not uniform across the UK. Compared to graduates domiciled in London, those coming from the North East (+0.02), the North West (+0.02), Yorkshire and the Humber (+0.02) and the South West (+0.01) have a significantly higher probability of being underemployed 42-months after graduation. All else equal, graduates from Wales have the highest probability of underemployment, 0.03 higher than comparable graduates from London.

Finally with respect to demographics, all else equal, female graduates have a 0.04 higher probability of underemployment than similar males, and those of black (+0.05), Pakistani (+0.05) and 'other Asian' (+0.05) ethnicity have higher probabilities than similar white ethnicity counterparts.

Even though we are able to compare graduates that are the same with respect to a rich set of relevant characteristics and attainments, those who are underemployed at six-months may be different in ways we cannot observe in the data. They may differ in terms of their drive, motivation, confidence and communication skills, indeed all of the 'soft skills' that we know are important for success in the labour market (see Cabus et al., 2021, Noray, 2020, for reviews of this large literature), and it may be these things

that affect underemployment at each time point, with no effect from early to late underemployment. As such, we cannot be certain that this persistence of underemployment represents a scarring effect, however, given the range of factors that we are able to take account of, it is very unlikely that the persistence is entirely explained by unobservable characteristics.

5.2 Bounds analysis

To further explore the potential for the relationship to be driven by unobservable characteristics and not reflect a dependence between early and later underemployment, we conduct a bounding exercise following Oster (2013; 2016; 2019) building on the theoretical framework by Altonji et al. (2005). The aim of the bounding procedure is to allow us to estimate the causal effect of early graduate underemployment on later underemployment in the presence of unobserved variables that would otherwise confound the relationship between underemployment at the two time points. We are able to construct an upper and lower bound for the causal effect of early underemployment on later underemployment, under different assumptions regarding the roles of observable and unobservable characteristics in determining which graduates find themselves underemployed six-months post-graduation.

We bound the estimate β to be resilient to a prescribed range of selection on observables and unobservables, conditional on different plausible values of R^2 we posit would be achieved should relevant unobservable characteristics be included in the model. Following the recommendation in Oster (2019) we construct the lower bound of the estimate for the case where the degree of selection on unobservables is equal to and in the same direction as the selection on observables. This seems a reasonable, indeed conservative, assumption given that the observables we are able to include in the model would be the most important drivers of selection into underemployment that we would want to include i.e. degree class attainment, HEI, subject, prior attainment, gender, ethnicity, parental education and social class, POLAR and geographical region. There are likely to be some unobservables that are important at the margin – non-cognitive skills and personality traits such as ability to get on with people, conscientiousness, communication skills etc. – however the relative importance of selection on unobservables versus observables relates to the unconditional correlation between unobservables and underemployment and between observables and underemployment. While, for example, inability to get on with people may tip the balance between two candidates with the same degree class attainment and HEI, it is much less likely to drive selection into underemployment unconditionally. This is even more so the case given that Oster (2019, p.196) suggests that conceptually we can think of the unobserved variables as residualised such that they are orthogonal to the observed variables

and so their unconditional correlation with the treatment will not be capturing the effect on treatment of the observed factors with which they are correlated. Therefore, the unconditional correlation between, for example, degree class attainment and underemployment is likely to be much stronger than between ability to get on with people and underemployment, hence assuming that the unconditional correlation between unobservables and underemployment is the same as the unconditional correlation between observables and underemployment is conservative. The upper bound in this bounding procedure is the estimate from the conditional model. Thereby, the bounded interval contains the true causal estimate, conditional on a given (true) R^2 value.

The estimated bound value $\beta*$ is calculated as follows:

$$\beta* = \tilde{\beta} - \delta(\dot{\beta} - \tilde{\beta})\frac{R_{max} - \tilde{R}}{\tilde{R} - \dot{R}}$$

in which δ is the degree of proportionality that represents the ratio of selection on unobservables to selection on observables. As noted, we set $\delta = 1$ i.e. assuming that selection on unobservables is as important as selection on observables and in the same direction. $\dot{\beta}$ represents the estimate of interest (the coefficient on underemployed at six-months in our context) in the baseline (also referred as uncontrolled or restricted) model:

$$Y_i = \dot{\alpha} + Und6_i\dot{\beta} + U6_i\dot{\lambda} + Eukn6_i\dot{\varphi} + IA6_i\dot{\theta} + FS6_i\dot{\rho} + \dot{\epsilon}_i$$

while $\tilde{\beta}$ represents estimate of interest in the controlled or unrestricted (main specification) model:

$$Y_i = \alpha + Und6_i\tilde{\beta} + U6_i\lambda + Eukn6_i\varphi + IA6_i\theta + FS6_i\rho + \mathbf{HEI'_i}\xi + \mathbf{DSub'_i}\gamma + \mathbf{DClass'_i}\zeta + \mathbf{Prior'_i}\pi + \mathbf{X'_i}\phi + \epsilon_\mathbf{i}$$

$\dot{R}$ and $\tilde{R}$ are the respective R^2 values of the baseline and main specification models. We produce the bounded estimates for a range of plausible values of R_{max} using the stata command psacalc (Oster 2016). The range of R_{max} values are chosen based on the empirical criterion posited by Oster (2013; 2019) in the context of non-randomized data.[5] Following the nascent literature using Oster bounds, we highlight the bounded estimates for $R^2 = \min(1.3 \text{ x } \tilde{R}, 1)$ as the bias-adjusted treatment effect (Oster 2019). Table 7 contains the estimates of the relevant β coefficients from Table 6 columns 1 and 4 and Table 8 contains a range of estimates for the bounds when we allow the R_{max} to vary within plausible values.

None of the bounded intervals of estimates for different plausible R^2 values include zero. This gives us

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[5]We do not use R_{max}=1 or $R_{max} = \min(2.2 \text{ x } \tilde{R}, 1)$ as it is argued to be an unrealistic threshold and could lead to over-adjustment (Oster 2019).

Table 7: Baseline and Main specification coefficients on underemployed at 6-months

	Baseline Effect		Controlled Effect	
	$\hat{\beta}$		$\tilde{\beta}$	
	(std. error)	$\dot{R}$	(std. error)	$\tilde{R}$
Underemployed at 6 months after graduation	0.28565	0.11	0.24134	0.146
	(0.005)		(0.005)	

Table 8: Oster bounds estimates for different values of R_{max} with $\delta = 1$

	R_{max}	Bound $\beta*$ for $\delta = 1$	$\beta*$ bounded interval	Sensitivity Parameter (δ) for $\beta = 0$
$R_{max} = \min(2.00 \times \tilde{R}, 1)$	0.292	0.031	(0.031, 0.241)	1.097
$R_{max} = \min(1.50 \times \tilde{R}, 1)$	0.219	0.141	(0.141, 0.241)	1.708
$R_{max} = \min(1.30 \times \tilde{R}, 1)$	**0.190**	**0.183**	**(0.183, 0.241)**	**2.197**
$R_{max} = \min(1.25 \times \tilde{R}, 1)$	0.183	0.193	(0.193, 0.241)	2.366
$R_{max} = \min(1.15 \times \tilde{R}, 1)$	0.168	0.212	(0.212, 0.241)	2.797

a higher degree of confidence to argue for a causal effect of being underemployed at six-months after graduation. Under the assumption that unobservable characteristics are as important as the rich set of observable characteristics that we include in the model, and taking the case of $R^2 = \min(1.3 \text{ x } \tilde{R}, 1)$ as the bias-adjusted treatment effect, we can conclude that after adjusting for the selection bias, the true causal estimate is estimated to be contained in the interval 0.183 to 0.241. Looking at the final column of Table 8, the sensitivity parameter δ shows that the selection on unobservables would have to be 2.197 times the selection on observables for the causal impact to be zero. As discussed above, since we control for many of the most relevant observables in our model, it is highly unlikely that the unobservables driving selection are that much more important that the observables, such that the causal estimate is close to zero.

We can be confident therefore that the causal effect of underemployment at six-months post-graduation on underemployment probability three years later is an increase of at least 0.18. This suggests that there is a scarring effect of early underemployment on later graduate employment outcomes, the relationship between the status at each time point is not all driven by unobservable differences between those who are and are not underemployed at six-months post-graduation. This has implications for policy which we will return to in the later sections below but it is worth noting at this point the magnitude of the effect. At +0.18 the scarring effect is much stronger than the effect of being first-in-family to go to higher education

(+0.01) or having parents who worked in routine occupations compared to being professionals (+0.04), and even exceeds the effect of gaining the lowest classified degree class (third) (+0.15) compared to attaining a first class degree.

5.3 'Mal-employment'

One potential concern with our analysis thus far is the potential for non-random selection of individuals into the labour market at 42-months post-graduation. This would introduce a sample selection bias into our estimates, though *a priori* it is not clear whether the selection would be on characteristics that have a positive or negative impact on underemployment. In order to test the robustness of the relationship between early graduate underemployment and later graduate outcomes, we now consider an alternative model that includes all graduates in the sample, and categorises labour market states into two groups captured in a 'mal-employment' dummy taking the value of 1 for those who are unemployed, underemployed, employed in a job of unknown category, or inactive, and zero for all other states (graduate job, further study). In this case there is no issue of selection into the labour market, and we can examine the impact of early mal-employment on later mal-employment.

Table 9: Estimates of the effect of mal-employment at 6-months post-graduation on mal-employment probability at 42-months post-graduation

Dependent variable: mal-employed at 42-months post-graduation				
	(1)	(2)	(3)	(4)
Mal-employed at 6 months	0.26***	0.22***	0.22***	0.21***
N	67,381	67,381	67,381	67,381
HE related controls	X	✓	✓	✓
Prior attainment controls	X	X	✓	✓
Background controls	X	X	X	✓
*** p<0.01.				

The results in Table 9 suggest that compared to being in a graduate job or undertaking further study, being mal-employed at six-months post-graduation increases the chance of being mal-employed three years later by 0.21 when we include the full set of controls. Without controls the impact is 0.26 and the pattern of reduction in the coefficient as more controls are added in Table 9 is very similar to that seen for underemployment in Table 6, with the mal-employment coefficient slightly smaller in magnitude in each case. As is the case with the main specification results, we can compute Oster bounds for the mal-

employment effect; results are shown in Tables 10 and 11. Again, setting $\delta = 1$, none of the estimates ranges for the causal effect β include zero, and for the recommended value of the R_{max} parameter of $1.3 \times \tilde{R}$, the lower bound is 0.174. This gives a range of (0.17, 0.21) for the causal effect of early mal-employment on later mal-employment – very similar to the range of (0.18, 0.24) for the causal effect of early underemployment on later underemployment. This strong congruence of findings provides supportive evidence for the conclusion that there is a causal effect of early underemployment on later underemployment and that this is not being driven by selection into employment at the 42-month time-point.

Table 10: Baseline and Main specification coefficients on mal-employed at 6-months

	Baseline Effect		Controlled Effect	
	$\dot{\beta}$		$\tilde{\beta}$	
	(std. error)	$\dot{R}$	(std. error)	$\tilde{R}$
Underemployed at 6 months after graduation	0.25552	0.09	0.21378	0.134
	(0.004)		(0.004)	

Table 11: Oster bounds estimates for different values of R_{max} with $\delta = 1$

	R_{max}	Bound $\beta*$ for $\delta = 1$	$\beta*$ bounded interval	Sensitivity Parameter (δ) for $\beta = 0$
$R_{max} = \min(2.00 \times \tilde{R}, 1)$	0.268	0.071	(0.071, 0.214)	1.311
$R_{max} = \min(1.50 \times \tilde{R}, 1)$	0.201	0.145	(0.145, 0.214)	2.018
$\mathbf{R_{max} = \min(1.30 \times \tilde{R}, 1)}$	**0.174**	**0.174**	**(0.174, 0.214)**	**2.578**
$R_{max} = \min(1.25 \times \tilde{R}, 1)$	0.168	0.180	(0.180, 0.214)	2.747
$R_{max} = \min(1.15 \times \tilde{R}, 1)$	0.154	0.194	(0.194, 0.214)	3.245

5.4   Multinomial analysis

In order to further test the sensitivity of results to sample selection based on being employed at the 42-month time point, we now examine the impact of underemployment at six-months not just on the probability of underemployment at 42-months post-graduation but how it affects the probability of being in each of the six possible labour market states at the second time point. We estimate this using a multinomial logit model, including all of the variables in the full specification of the earlier model (i.e. the final column of Table 6).

The rows shows the possible labour market states at six-months post-graduation, with graduate job being

the reference category. The columns then show the possible labour market state at 42-months years post-graduation, with the cell entries the marginal effects from the model capturing how the state at six-months post-graduation affects the probability of each status three years later relative to being in a graduate job at the first time point.

Table 12: Multinomial logit model of labour market status at 42-months post-graduation for all individuals

6 months post-graduation	42-months post-graduation					
	Graduate job	Underemp.	Unemp.	Further study	Inactive	Emp (unk'n)
Graduate job (ref)	—	—	—	—	—	—
Underemployed	-0.22***	0.15***	0.01***	0.06***	0.01***	-0.002*
	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)
Unemployed	-0.25***	0.14***	0.04***	0.04***	0.02***	0.01***
	(0.006)	(0.004)	(0.002)	(0.005)	(0.002)	(0.001)
Emp. unknown	-0.13***	0.06***	0.02***	0.04***	-0.01	0.003
	(0.017)	(0.013)	(0.005)	(0.012)	(0.009)	(0.004)
Further study	-0.13***	0.02***	0.02***	0.10***	-0.001	0.001
	(0.005)	(0.005)	(0.002)	(0.003)	(0.002)	(0.001)
Inactive	-0.23***	0.08***	0.03***	0.06***	0.05***	0.01***
	(0.009)	(0.007)	(0.003)	(0.007)	(0.002)	(0.001)

Notes: N=67,381. Full sets of HE related controls, prior attainment controls and background controls included, as per Table 6 column 4.

We see that, controlling for all of the socio-demographic, prior attainment and higher education related variables in the model, not only does being underemployed at six-months post-graduation significantly increase the probability of later underemployment (+0.15), it increases the probability of unemployment (+0.01), inactivity (+0.01) and further study (+0.06). There is a commensurate decrease in the probability of being in a graduate job (-0.22) which is very similar to the impact on graduate level employment in the main specification. In that specification there are only two outcomes: graduate job or underemployed at 42-months post-graduation. Therefore the increase in the probability of being underemployed at 42-months if underemployed at the first time point is equivalent to the reduction in the chance of being in a graduate job at 42-months if underemployed at the first time point. In the main specification this reduction is 0.24 and it is notable that here the reduction in the probability of being in a graduate job if underemployed at the first time point is 0.22, so very similar.

As with the main model, the impact of being unemployed at six-months post-graduation on underemployment 42-months post-graduation is almost identical to the effect of early underemployment. However, we can see here that the early unemployed are even less likely to be in a graduate job than the underemployed

and that early unemployment has a stronger effect than underemployment on later unemployment (+0.04) and later inactivity (+0.02), suggesting that despite having a similar effect to early underemployment on later underemployment, being unemployed at the first time point has a wider range of negative effects on subsequent labour market experience. As with the 'mal-employment' analysis, the congruence between the impact of early graduate underemployment on later graduate underemployment here and in the main specification suggests that the main results are not being driven by sample selection.[6]

The mal-employment and multinomial analyses each take a different approach to dealing with the impact of sample selection bias, and it is notable that both support the conclusions of the main model. This gives confidence that the findings are robust and identify a causal effect of early gradaute underemployment on later graduate underemployment i.e. a scarring effect.

5.5 Heterogeneity analysis

Having established that our findings are very likely to reflect a scarring effect of early underemployment, we now explore the extent to which the effect is mitigated or exacerbated by particular characteristics of the graduates themselves. Appendix Table A3 shows the results of the heterogeneity analysis. In each regression all of the controls included in the final column of Table 6 are included, and in each column we allow the underemployed at six-months dummy variable to be interacted with different characteristics in turn. Below we display the results graphically.

Figure 1 shows that when we allow the effect of underemployment six-months post-graduation to differ for females, the underemployment effect for males reduces to a 0.21 increase and the interaction with female is significant and positive, suggesting the effect of underemployment six-months post-graduation for females is a 0.26 increase in likelihood of underemployment three years after this. Figure 1 also examines heterogeneity with regard to geography. It allows the impact of underemployment at six-months to vary according to the quintile of the POLAR index for the area in which the graduate grew up. The POLAR index captures the degree of participation in higher education for different geographical areas, with quintile one having the lowest participation, quintile five the highest. We can see that the impact of

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[6]This multinomial analysis does explicitly show that early underemployment reduces the chances of an individual being in the employed sample at 42-months post-graduation. Therefore there is some endogenous sample selection in our data and there may be a worry that our findings are driven by the selection into continued employment amongst the early underemployed. The worry would be that if there is a negative selection of the early underemployed into continued employment, the findings may be reflecting unobserved heterogeneity rather than a scarring effect from early underemployment to later underemployment. In light of this, to further test the robustness of our findings, in Appendix B we employ a Heckman selection correction model to account for differential selection into employment. Findings there suggest that there is selection into the labour market on unobserved characteristics but this does not affect the estimated scarring effect of early graduate underemployment.

Figure 1: Heterogeneity: gender, POLAR and parents attending HE
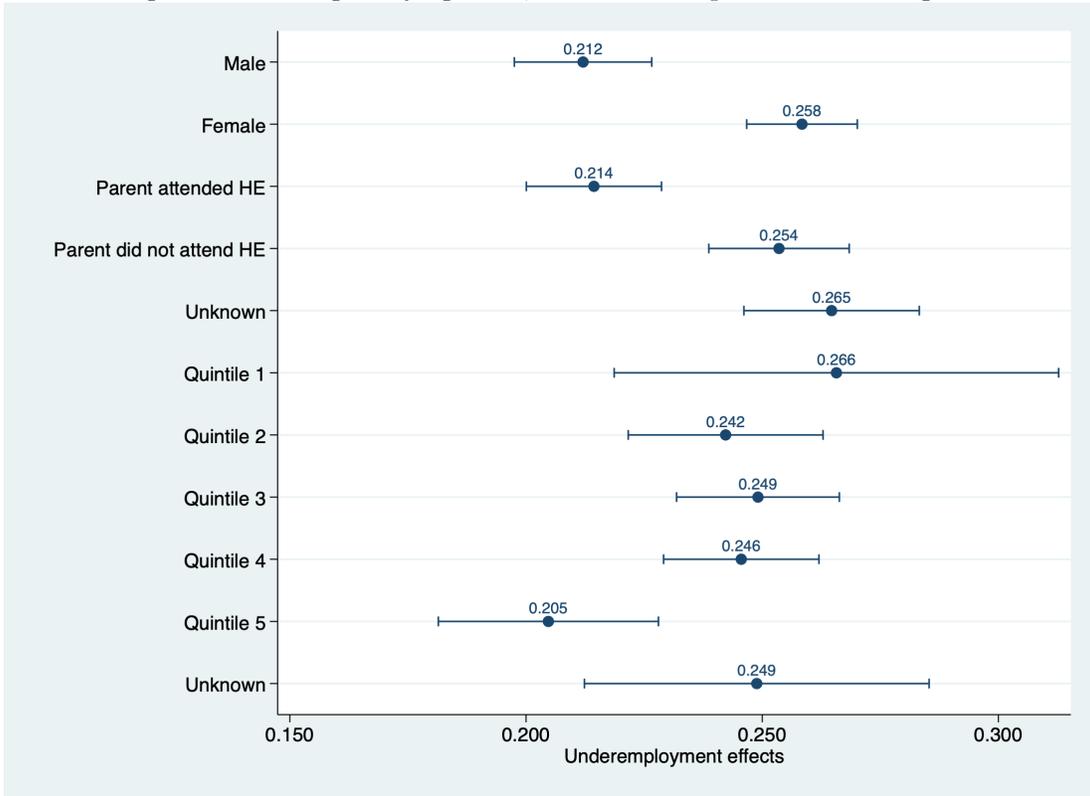
early graduate underemployment for graduates from the lowest participation quintile is an increase of 0.27 in the probability of being underemployed three-years later. There is no statistically significant difference in the effect as we move up the POLAR quintiles until we reach the top quintile where the penalty is a statistically significant 0.06 lower. The finding that for graduates from areas where there are more people with higher education, the impact of early underemployment is less than for graduates from the lowest participation areas, suggests that there are factors associated with better off areas that cushion the impact of early graduate underemployment. Similarly, we observe underemployment effects to be significantly stronger for individuals whose parent(s) have not been to higher education compared to others for whom at least one of the parents has attended a higher education institution (0.25 versus 0.21).

The interactions in Figure 2 show that there is no additional penalty for underemployment for most ethnic groups compared to graduates of white ethnicity, apart from for black and Indian graduates. For black graduates, being underemployed at six-months carries an additional penalty in increasing the likelihood of underemployment three years later by 0.05 compared to white graduates, giving a total effect of +0.29. For Indian graduates by contrast, there is a 0.04 lower penalty for early underemployment compared to otherwise similar white graduates.

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Figure 2: Heterogeneity: ethnicity
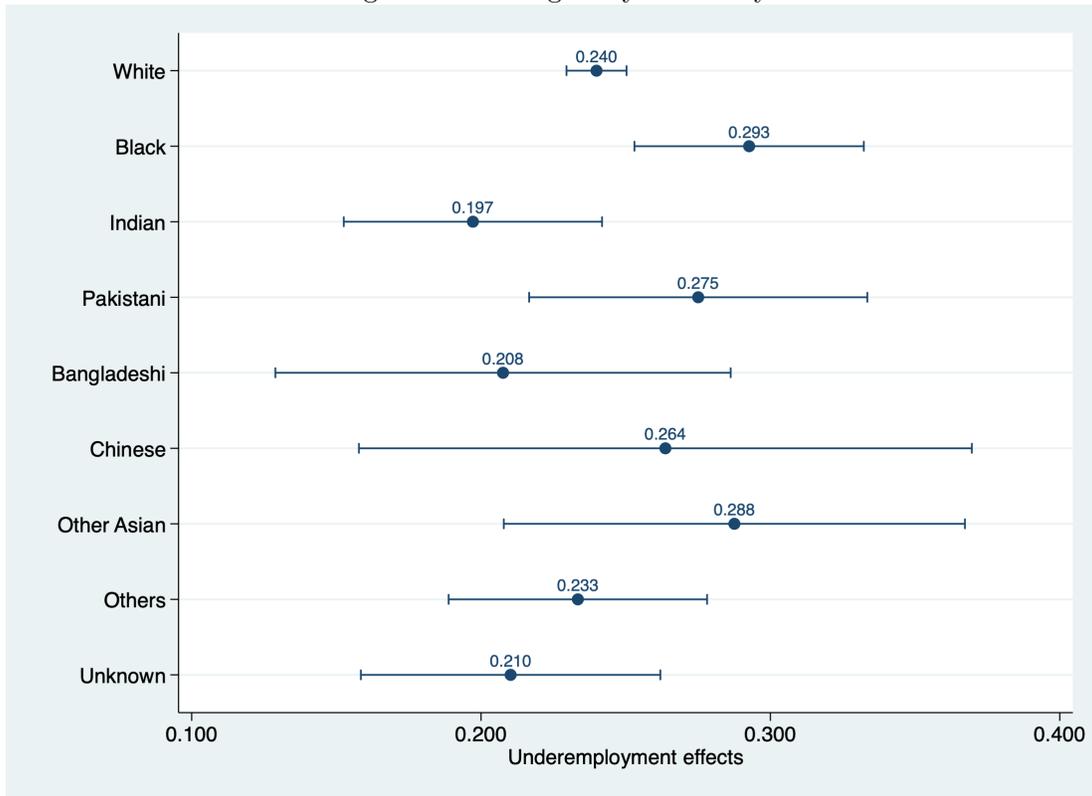
Figure 3 looks at how the impact of early underemployment varies by region of the UK. We see that for graduates from London the effect is an increase of 0.23 in the probability of later underemployment, relative to being in a graduate job at six-months post-graduation. Though estimates for almost all other regions of the UK are higher than this, the effect is only statistically significantly higher for North West of England (0.27) and for Wales (0.31). This suggests that there may be differences in access to graduate labour markets for graduates from these regions, which make early underemployment more of a trap than is the case for graduates from other regions.

Again considering factors relating to background, Figure 4 shows how the impact of early underemployment varies according to school type. For those attending state schools, the impact of early underemployment on later underemployment is to increase the probability by 0.23 compared to those in a graduate job six-months post-graduation. Graduates from independent schools however have a penalty 0.09 lower than this, again reflecting that those who come from better-off backgrounds are in general less likely to be underemployed six-months post-graduation and if they are, the penalty for this for future graduate employment is not as severe as it is for those from less well-off backgrounds. We also find a significant disparity in penalties between students who opt to take A-levels (0.06 lower) compared to those who do not.

Figure 3: Heterogeneity: region
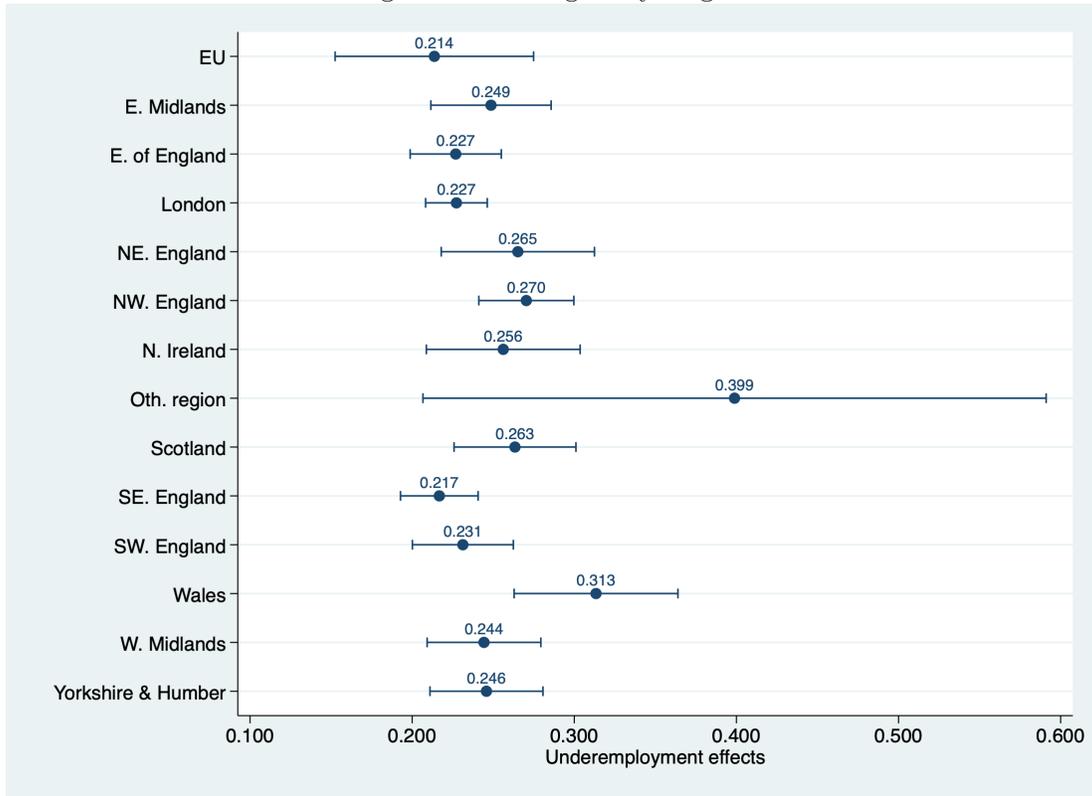
The final Figure examines how the impact of underemployment varies depending on the graduates' HE choices and attainment. For graduates of pre-92 but not Russell Group universities, early underemployment is associated with just under 20pp higher probability of later underemployment, compared to graduates already in a graduate job at six-months post-graduation. For Russell Group graduates the penalty is a statistically significant 0.04 lower, whereas for post-1992 universities (+0.07) and 'Other' HEIs (+0.09) the impact of early underemployment is much higher and in both cases a statistically significant difference. This again reflects the uneven distribution of the effect of early underemployment experience – even after taking account of background characteristics and prior attainment and all of the other factors in the model, those attending the more prestigious HEIs are more insulated against the labour market consequences of underemployment than those who go to post-1992 or 'Other' universities. Interestingly, in addition to being more likely to be underemployed at 42-months post-graduation than STEM graduates, those who studied Social Science subjects also suffer an additional penalty for early underemployment adding 0.04 to the 0.23 impact of early underemployment for STEM graduates. This is the only subject where the early underemployment penalty is more than trivially different to the penalty for STEM graduates, and it is a statistically significant difference.

Figure 4: Heterogeneity: school type and A-levels
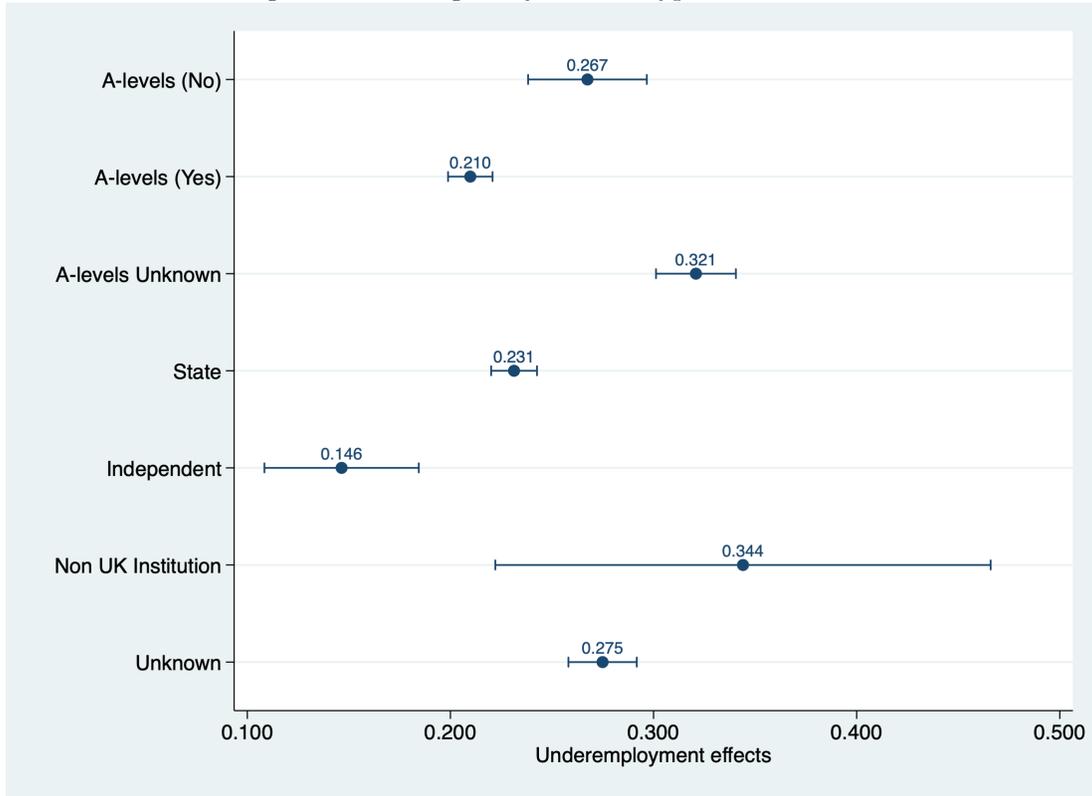
Finally Figure 5 also shows how the early underemployment penalty increases as we move down the degree classification system with the impact increasing from 0.20 for those with a first class degree up to 0.35 for those with an unclassified degree. Interestingly the effect is not statistically significantly different for those who gain an upper second-class degree compared to a first, but for all other classifications the penalty is higher and the differences are significant.

In summary, this heterogeneity analysis suggests that compared to graduates who have already secured a graduate job six-months after graduation, the impact of early underemployment on the probability of underemployment at 42-months post-graduation is significantly higher for women, people of black ethnicity, those from low HE participation areas, first-in-family graduates, those domiciled in the north-west of England, or Wales, those who attended a state school, a post-1992 HEI, who studied Social Sciences and got a lower-second class degree or lower. As Appendix Table A1 shows, many of these characteristics also have a level effect to increase the probability of underemployment at 42-months post-graduation regardless of labour market status six-months post-graduation, and the heterogeneity analysis shows that in addition they magnify the harmful impact of early underemployment on later underemployment.

Figure 5: Heterogeneity: degree outcome, HEI type and subject
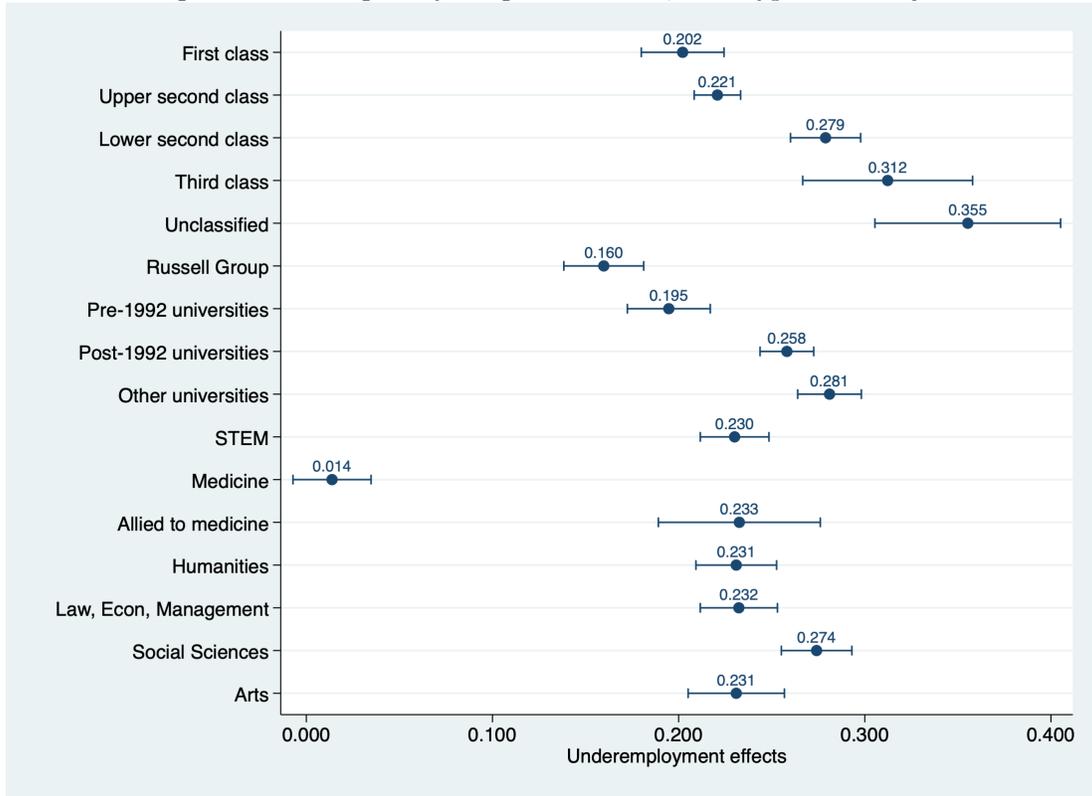
6   Discussion and conclusions

While there is a large literature on the scarring effects of unemployment, to date much less is known about the extent to which early experience of *underemployment* has a causal effect on future labour market outcomes. We examine this for a recent cohort of higher education graduates from the UK.

Our findings strongly suggest that a large part of the persistence in underemployment status from six-months to 42-months post-graduation is the result of a scarring effect of the early underemployment. This conclusion is supported both by Oster bounds analysis and a range of specification checks which show that the main conclusion is not being driven by selection into employment.

The finding of a substantial scarring effect of early graduate underemployment has significant policy implications. This is especially true given that for graduates initially entering the labour market, underemployment is three-times as likely as unemployment and yet has similar implications for future chances of securing a gradaute level job. Moreover, even the (Oster) lower bound of the estimated impact of early underemployment (+0.18) is larger than the effect of any other graduate characteristic on the probability of

underemployment 42-months post-graduation. To the extent that persistence in underemployment status results from a scarring effect, assisting graduates into graduate jobs in the early months post-graduation will deal with the problem and ensure that graduates are much more likely to remain on a trajectory that will see them have higher earnings and better employment throughout their careers. From a policy perspective, it is worth noting that even if the persistence was down to unobserved differences between graduates, it is still the case that helping the graduates who are at risk of underemployment into graduate jobs will enhance their attachment to the graduate labour market, and provide experience that will mitigate the negative characteristics that would otherwise lead to persistent underemployment.

The issue of graduate underemployment cannot be discussed without reference to the wider context of increased higher education participation in the UK over recent decades which has seen the proportion of school leavers attending higher education increase from 40% at the start of this millennium to more than 50% in the most recent data. As higher education participation has continued to increase, the funding of the sector has become a huge policy issue, and this is the case even more so today with stagnant economic performance focusing minds on the skills needed to lead the economy back to consistently strong growth, how to ensure those skills are available, and how it is all funded. Our findings suggest that if policy action can help to connect graduates with graduate employers and reduce the incidence of early underemployment this will in turn reduce the probability of graduates not being in graduate level employment later in their careers. Graduates obtaining graduate level and remunerated employment should ensure that the productivity enhancing effects of higher education are realised, that graduates earn more (and pay more tax) and that the taxpayer subsidy to higher education is reduced. At present this subsidy is estimated to be 30%[7] – this is the proportion of the total value of income contingent student loans that will remain unpaid after 40 years and will subsequently be written off by the Government. Hence improving pathways into the graduate labour market will pay long-term dividends to the public finances. Moreover, greater attachment to the graduate labour market should bring benefits to the graduates themselves in terms of continued employment at a level commensurate with their skills, higher lifetime earnings, greater job satisfaction, and the faster repayment of student loans. For HEIs, in an increasingly competitive higher education sector, strong graduate employment statistics contribute to higher placing in the various university league tables, increasing institutional reputation and likely increasing demand for places.

A more efficient mechanism to link graduates with the graduate labour market is particularly important

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[7]This applies to student loans issued from 2023/24 under the new repayment system implemented this academic year. Prior to this new system, the subsidy was estimated to be 53%. Latest estimates are available here: https://explore-education-statistics.service.gov.uk/find-statistics/student-loan-forecasts-for-england#.

for young people from lower socio-economic status backgrounds and other groups – relating to ethnicity, gender, geographic region – who are at greater risk of early underemployment *and* who suffer a more severe detrimental effect on their future labour market outcomes as a result of it. These inequalities in graduate job attainment immediately post-graduation have longer lasting impacts on socio-economic inequality because of the particularly high penalty for early underemployment that graduates from these groups face. Therefore, there are both equity and efficiency arguments for partnerships between HEIs, the Government and employers to improve the connection between graduates and the graduate labour market. This can help to ensure that the increasing aspiration of young people to attend HE can be met in a manner that delivers the benefits of HE for graduates and their local economies, whilst reducing the risk of underemployment, poor earnings outcomes and the attendant negative consequences for graduates, productivity and the public finances.

Finally, this issue is far from unique to the UK. Almost all EU countries have seen sizeable increases in their higher education participation rate in recent years and there is evidence that in many countries in southern Europe and Scandinavia, graduate underemployment has been rising (Green and Henseke, 2017). Therefore, the conclusion that early graduate underemployment has a significant scarring effect on later employment prospects is likely to also be relevant for policymakers in numerous countries beyond the UK.

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Appendix A

Table A1: Determinants of underemployment at 42-months
post-graduation

Dependent var: underemployed at 42-months post-graduation	(1)	(2)	(3)	(4)
Ref: Graduate job at 6 months				
Underemployed at 6 months	0.29***	0.25***	0.25***	0.24***
	(0.005)	(0.005)	(0.005)	(0.005)
Unemployed at 6 months	0.28***	0.25***	0.24***	0.24***
	(0.008)	(0.008)	(0.008)	(0.008)
Further study at 6 months	0.03***	0.03***	0.03***	0.03***
	(0.004)	(0.004)	(0.004)	(0.004)
Inactive at 6 months	0.15***	0.14***	0.14***	0.13***
	(0.011)	(0.011)	(0.011)	(0.011)
Ref: Pre-1992 universities				
Russell Group		-0.04***	-0.03***	-0.03***
		(0.005)	(0.005)	(0.005)
Post-1992 universities		0.02***	0.01**	0.01
		(0.004)	(0.005)	(0.005)
Other universities		0.03***	0.02***	0.01***
		(0.005)	(0.005)	(0.005)
Ref: subject = STEM				
Medicine		-0.00	0.01	-0.00
		(0.006)	(0.006)	(0.006)
Subjects allied to medicine		-0.05***	-0.05***	-0.08***
		(0.004)	(0.004)	(0.005)
Humanities		0.08***	0.08***	0.07***
		(0.005)	(0.005)	(0.005)
Law, Econ, Management		0.04***	0.04***	0.04***
		(0.005)	(0.005)	(0.005)
Social Sciences		0.06***	0.06***	0.04***
		(0.005)	(0.005)	(0.005)
Arts		0.09***	0.09***	0.09***
		(0.006)	(0.006)	(0.006)
Ref = First class honours				
Upper second class honours		0.03***	0.03***	0.03***
		(0.004)	(0.004)	(0.004)
Lower second class honours		0.10***	0.10***	0.09***
		(0.005)	(0.005)	(0.005)
Third class honours/Pass		0.17***	0.16***	0.15***
		(0.011)	(0.011)	(0.011)
Unclassified		0.02***	0.02**	0.01*
		(0.006)	(0.006)	(0.007)
At least one A-level			-0.02***	-0.02***

	(0.007)	(0.007)
Unknown	-0.01*	-0.02**
	(0.007)	(0.008)
Ref = State school		
Independent	-0.05***	-0.03***
	(0.005)	(0.006)
Any Non-Uk Institution	-0.02	-0.01
	(0.019)	(0.020)
Unknown	-0.01**	-0.01
	(0.004)	(0.004)
UCAS Tariff	-0.00***	-0.00***
	(0.000)	(0.000)
Female		0.04***
		(0.003)
Ref = White		
Black		0.05***
		(0.008)
Indian		-0.01
		(0.008)
Pakistani		0.05***
		(0.012)
Bangladeshi		0.03*
		(0.017)
Chinese		0.01
		(0.017)
Other Asian background		0.05***
		(0.015)
Other ethnicity		0.03***
		(0.009)
Unknown		-0.04**
		(0.015)
REF =Parental education (HE)= YES		
Parental education (HE)= NO		0.01***
		(0.004)
Parental education (HE)= Unknown		0.01***
		(0.004)
Age		0.00***
		(0.000)
Ref = Higher managerial & professional occupation		
Lower managerial & professional occupation		0.00
		(0.005)
Intermediate occupations		0.02***
		(0.006)
Small employers & own account workers		0.02**
		(0.008)
Lower supervisory & technical occupation		0.03***

	(0.009)
Semi-routine occupations	0.04***
	(0.007)
Routine occupations	0.04***
	(0.009)
Never worked & long-term unemployed	0.04
	(0.047)
Not classified	0.02***
	(0.005)
Unknown	0.01
	(0.007)
Ref= Quantile 1	
Quintile 2	-0.00
	(0.009)
Quintile 3	-0.01
	(0.009)
Quintile 4	-0.01
	(0.009)
Quintile 5	-0.03***
	(0.010)
Unknown	-0.02
	(0.033)
Ref = London	
South East England	-0.00
	(0.005)
South West England	0.01**
	(0.007)
West Midlands	0.00
	(0.007)
East Midlands	0.01
	(0.007)
East of England	-0.01
	(0.006)
North West England	0.02***
	(0.006)
Yorkshire and the Humber	0.02**
	(0.007)
North East England	0.02**
	(0.009)
Scotland	0.01
	(0.008)
Wales	0.03***
	(0.009)
Northern Ireland	0.01
	(0.033)
EU	0.02
	(0.036)

Other UK region				-0.01
				(0.042)
Constant	0.08***	0.01**	0.06***	0.00
	(0.002)	(0.005)	(0.008)	(0.015)
N	54850	54850	54850	54850

Notes: Standard errors in parentheses.
*p<0.10 ** p<0.05 *** p<0.01

Table A2: Satisfaction with career 42-months post-graduation

Dependent variable: satisfaction with career at 42-months post-graduation

	(1)	(2)	(3)	(4)
Graduate job at 42-months (Reference Category)				
Underemployed at 42-months	-0.21**	-0.20**	-0.20**	-0.20**
Not known (jobs) at 42-months	-0.18**	-0.17**	-0.17**	-0.16**
Unemployed at 42-months	-0.51**	-0.50**	-0.50**	-0.50**
Further study at 42-months	-0.07**	-0.08**	-0.08**	-0.07**
Inactive at 42-months	-0.27**	-0.26**	-0.26**	-0.26**
Graduate job at 6 months (Reference Category)				
Underemployed at 6 months	-0.06**	-0.05**	-0.05**	-0.05**
Not known (jobs) at 6 months	-0.06**	-0.06**	-0.06**	-0.06**
Unemployed at 6 months	-0.15**	-0.14**	-0.14**	-0.14**
Further study at 6 months	-0.02**	-0.03**	-0.03**	-0.03**
Inactive at 6 months	-0.09**	-0.09**	-0.09**	-0.09**
N	67381	67381	67381	67381
HE controls	X	✓	✓	✓
Prior attainment controls	X	X	✓	✓
Background controls	X	X	X	✓

Table A3: Heterogeneity in the impact of underemployment at 6-months post-graduation on underemployment at 42-months post-graduation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Underemployed at 6 months	0.212***	0.240***	0.266***	0.227***	0.214***	0.195***	0.230***	0.202***	0.231***	0.267***	0.118***
	(0.007)	(0.005)	(0.024)	(0.010)	(0.007)	(0.011)	(0.009)	(0.011)	(0.006)	(0.015)	(0.037)
Underemployed x Male											
Underemployed x Female	0.046***										0.047***
	(0.009)										(0.010)
Underemployed x Other	-0.280***										-0.257***
	(0.029)										(0.028)
Underemployed x White											
Underemployed x Black		0.053**									0.036
		(0.021)									(0.022)
Underemployed x Indian		-0.043*									-0.022
		(0.023)									(0.024)
Underemployed x Pakistani		0.035									0.031
		(0.030)									(0.030)
Underemployed x Bangladeshi		-0.032									-0.023
		(0.040)									(0.041)
Underemployed x Chinese		0.024									0.05
		(0.054)									(0.054)
Underemployed x Other Asian		0.048									0.063
		(0.041)									(0.041)
Underemployed x Other ethnicity		-0.006									0.002
		(0.023)									(0.023)
Underemployed x Unknown		-0.03									-0.045
		(0.027)									(0.049)
Underemployed x Quantile 1 (POLAR)											
Underemployed x Quantile 2			-0.023								-0.013
			(0.026)								(0.026)
Underemployed x Quantile 3			-0.017								0.002
			(0.025)								(0.026)
Underemployed x Quantile 4			-0.02								0.009
			(0.025)								(0.026)
Underemployed x Quantile 5			-0.061**								-0.017
			(0.027)								(0.027)
Underemployed x Quantile Unknown			-0.017								0.139
			(0.030)								(0.121)
Underemployed x London											
Underemployed x EU				-0.014							-0.146
				(0.033)							(0.133)
Underemployed x East Midlands				0.021							0.022
				(0.021)							(0.022)
Underemployed x East of England				0							0.01
				(0.017)							(0.018)
Underemployed x North East England				0.038							0.037
				(0.026)							(0.027)
Underemployed x North West England				0.043**							0.047**
				(0.018)							(0.019)
Underemployed x Northern Ireland				0.029							-0.112
				(0.026)							(0.122)

Underemployed x Other UK region	-0.01 (0.151)	0.172* (0.099)
Underemployed x Scotland	0.027 (0.024)	0.036* (0.021)
Underemployed x South East England	0.001 (0.016)	-0.011 (0.015)
Underemployed x South West England	0.008 (0.020)	0.004 (0.018)
Underemployed x Wales	0.085*** (0.028)	0.086*** (0.027)
Underemployed x West Midlands	0.018 (0.021)	0.017 (0.020)
Underemployed x Yorkshire and the Humber	0.028 (0.021)	0.019 (0.020)
Underemployed x Parental HE = Yes		
Underemployed x Parental HE = No	0.020* (0.011)	0.039*** (0.010)
Underemployed x Parental HE = Don't know	0.02 (0.012)	0.050*** (0.012)
Underemployed x Pre-1992 universities		
Underemployed x Russell Group	-0.023 (0.016)	-0.035** (0.016)
Underemployed x Post-1992 universities	0.049*** (0.014)	0.063*** (0.013)
Underemployed x Other universities	0.054*** (0.015)	0.086*** (0.014)
Underemployed x STEM		
Underemployed x Medicine	-0.217*** (0.038)	-0.216*** (0.014)
Underemployed x Subjects allied to medicine	-0.025 (0.024)	0.003 (0.024)
Underemployed x Humanities	0.02 (0.015)	0.001 (0.014)
Underemployed x Law, Econ, Management	-0.006 (0.014)	0.002 (0.014)
Underemployed x Social Sciences	0.015 (0.014)	0.044*** (0.013)
Underemployed x Arts	-0.016 (0.017)	0.001 (0.016)
Underemployed x First class honours		
Underemployed x Upper second class honours	0.023* (0.013)	0.019 (0.013)
Underemployed x Lower second class honours	0.066*** (0.015)	0.077*** (0.015)
Underemployed x Third class honours/Pass	0.089*** (0.026)	0.110*** (0.026)
Underemployed x Unclassified	0.093*** (0.029)	0.153*** (0.028)
Underemployed x State school		
Underemployed x Independent school	-0.037* (0.021)	-0.085*** (0.020)
Underemployed x Any non-UK school	0.043 (0.063)	0.113* (0.062)

Underemployed x School (Unknown)									0.044***		0.016
									(0.010)		(0.011)
Underemployed x No A-levels											
Underemployed x At least one A-level										-0.058***	-0.030*
										(0.016)	(0.017)
Underemployed x A-levels (Unknown)										0.053***	0.042**
										(0.018)	(0.019)
All Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.146	0.146	0.146	0.146	0.148	0.146	0.146	0.147	0.147	0.148	0.152
N	54,850	54,850	54,850	54,850	54,850	54,850	54,850	54,850	54,850	54,850	54,850

Appendix B

To address the potential impact of early underemployment on later selection into employment, we implement the Heckman two-step estimator. The first step models selection into employment at 42-months post-graduation based on all the covariates in our main model, including employment status at six-months post-graduation. In addition, we include whether or not the individual is recorded as having a disability. We argue that this provides an exclusion restriction on the basis that having a disability may affect selection into employment, however conditional on employment should not affect the likelihood of being underemployed. Legally, equality legislation in the UK (Equality Act 2010) enshrines that individuals with disabilities should not be discriminated against in the labour market and as such, *ceteris paribus* disabled graduates should be no more likely than non-disabled to fail to obtain a graduate job. It might be argued that those with a disability may be more likely to choose underemployment voluntarily, however this seems no more likely for disabled than non-disabled graduates, given that these are all individuals who have graduated from university despite the additional challenges that their disability presents. Therefore, we use this exclusion restriction to identify the selection equation and include the inverse mills ratio in the main equation to control for selection.

We estimate the following two equations:

Selection equation:

$$Pr(Emp42_i) = \Phi(\alpha_1 + D_i\psi + Und6_i\beta_1 + U6_i\lambda_1 + Eukn6_i\varphi1 + IA6_i\theta_1 + FS6_i\rho_1 + \mathbf{HEI}'_i\xi_1 + \mathbf{DSub}'_i\gamma_1 +$$
$$\mathbf{DClass}'_i\zeta_1 + \mathbf{Prior}'_i\pi_1 + \mathbf{X}'_i\phi_1 + \epsilon_{1i})$$

in which $Emp42_i$ is a [0,1] indicator for being employed at 42-months post-graduation, D_i is a [0,1] indictor for having a disability, and all other variables and vectors are as defined in section 4. The selection equation is estimated as a probit i.e. Φ is the cumulative standard normal distribution.

Main (regression) equation:

$$Y_i = \alpha_2 + Und6_i\beta_2 + U6_i\lambda_2 + Eukn6_i\varphi_2 + IA6_i\theta_2 + FS6_i\rho_2 + \mathbf{HEI}'_i\xi_2 + \mathbf{DSub}'_i\gamma_2 +$$
$$\mathbf{DClass}'_i\zeta_2 + \mathbf{Prior}'_i\pi_2 + \mathbf{X}'_i\phi_2 + \mu\mathrm{IMR}_i + \epsilon_{2i}$$

Here IMR_i is the inverse Mills ratio recovered from the selection equation for all observations in the sample

Table A4: Selection correction model of scarring effects of underemployment

Dependent variable: Selection eq.: in employment at 42-months post-graduation
Dependent variable: Main eq.: underemployed at 42-months post-graduation

	Selection Eqn.	Main Eqn.
Disability	-0.17***	—
Underemployed at 6 months	-0.27***	0.22***
Unemployed at 6 months	-0.50***	0.19***
Employed (unknown) at 6 months	-0.28***	0.05***
Further study at 6 months	-0.52***	-0.02
Inactive at 6 months	-0.77***	0.05**
Inverse Mills Ratio	—	0.25***
N	66,642	66,642
HE related controls	✓	✓
Prior attainment controls	✓	✓
Background controls	✓	✓

*** $p<0.01$, ** $p<0.05$, * $p<0.10$.

observed 42-months post-graduation. We can see from Table A4 that having a disability does indeed reduce the probability of being employed at 42-months post-graduation by around 0.17 which is perhaps what we might expect – *ceteris paribus* having a disability reduces the chance of being in employment. Turning to the main equation results, the inverse mills ratio is positive and statistically significant with a coefficient of 0.25. This captures the correlation between unobservables that influence the probability of selecting into employment and the unobservables that affect the probability of being underemployed 42-months post-graduation. The positive correlation suggests that those who select into employment are a negative selection, such that they are unobservably more likely to become underemployed. This is in line with the finding from Table 12 that being underemployed at six-months post-graduation increases the chances of being in further study at 42-months post-graduation – suggesting that there is positive selection into further study amongst the underemployed at six-months, while those for whom further study is not an option remain in the labour market. Once this negative selection into employment is accounted for, we see that the impact of early underemployment (+0.22) on later underemployment is less than in Table 6, but only by 0.02. Once we control for the negative selection of the early underemployed into continued employment, we still find a substantial and statistically significant impact of underemployment at six-months post-graduation on the probability of underemployment 42-months post-graduation. This again supports the conclusion that for the graduates in our data, the scarring effect of early underemployment

on later underemployment is not being driven by sample selection.