This is a repository copy of *Changing the subject : a further examination of the returns to postgraduate education*.

White Rose Research Online URL for this paper:
http://eprints.whiterose.ac.uk/148191/

Version: Published Version

Monograph:
Lenton, P orcid.org/0000-0002-8449-7207 (2019) Changing the subject : a further examination of the returns to postgraduate education. Working Paper. Sheffield Economic Research Paper Series, 2019015 (2019015). Department of Economics, University of Sheffield ISSN 1749-8368

© 2019 The Author(s). For reuse permissions, please contact the Author(s).

Reuse
Items deposited in White Rose Research Online are protected by copyright, with all rights reserved unless indicated otherwise. They may be downloaded and/or printed for private study, or other acts as permitted by national copyright laws. The publisher or other rights holders may allow further reproduction and re-use of the full text version. This is indicated by the licence information on the White Rose Research Online record for the item.

Takedown
If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing eprints@whiterose.ac.uk including the URL of the record and the reason for the withdrawal request.

eprints@whiterose.ac.uk
https://eprints.whiterose.ac.uk/

The University Of Sheffield.

Department Of Economics.

Sheffield Economic Research Paper Series.

Changing the subject: a further examination of the returns to postgraduate education

Authors: Pamela Lenton

ISSN 1749-8368

SERPS no. 2019015

July 2019

Changing the subject: a further examination of the returns to postgraduate education

Pamela Lenton*

Abstract

An investigation is made of the wage return to postgraduate degrees in the UK, crucially differentiating between subject of study for both undergraduate and postgraduate degree over the period 2014-2017. Positive rewards to postgraduate qualifications are found regardless of classification of undergraduate degree. Social Sciences undergraduates are most likely to change subject at postgraduate and see wage gains, implying that they gain transferable skills from their undergraduate degree to allow them to pursue a different career path should they wish. Business and Finance is a popular choice for postgraduates, which often provides significant wage gains for individuals, regardless of their undergraduate subject.

JEL classifications: I26; J24.

KEYWORDS: Human Capital; Postgraduate Education; Wage returns.

* Department of Economics, University of Sheffield, South Yorkshire S1 4DT, UK.
Email: p.lenton@sheffield.ac.uk . (Tel: +4411 222 3418)

1. Introduction

The increase in UK postgraduate student numbers over recent years, following the expansion of higher education, is well documented (Barber et al 2004; Lenton 2016; Lindley and Machin 2016). With the expansion of higher education and the ever-increasing flow of graduates into the labour market each summer, graduates are increasingly wondering whether or not to undertake a postgraduate qualification in an attempt to place themselves in a favourable position in the jobs queue. There are several types of postgraduate courses available in the UK: traditional master's degree programmes, more vocational programmes such as the Postgraduate Certificate in Education (PGCE) for those wishing to enter the teaching profession, and PhDs. It was reported that in 2003 nearly half of all postgraduates were enrolled on a taught master's programme (Aston, 2004) and this proportion remained constant through to 2008, although the proportion of graduates enrolling on any postgraduate programme has increased (HEPI 2010)[1]. The expansion of higher education in the UK, it has been argued, will continue into the foreseeable future (Bekhradnia and Beech, 2018); consequently it is probable that the number of applications for postgraduate courses will also increase, especially given the increasing availability of postgraduate conversion courses (see Prospects.ac.uk 2018), for which applicants do not necessarily need a high classification of first degree. The expectation of increased productivity and as a result a wage premium in the labour market, as posited by Becker's (1964) theory of human capital and Romer's (1994) theory of endogenous growth, may be one explanation for continuing studies after graduation. Additionally, following the Spence (1974) model of signalling, graduates may believe that the gaining of postgraduate credentials will positively distinguish them on their job application forms, especially for those

[1] Enrolments are classed as those enrolling within 6 months of graduation.

graduates who are unhappy with their degree classification and who believe that the gaining of a postgraduate qualification will somehow mask previous disappointing performance[2], leading to improved job prospects. Indeed, there is some support for the weak screening hypothesis in the UK (Brown and Sessions 1998; 2006) whereby the role of signalling and screening theories is presented as complementary to the approach of Becker's (1964) human capital model.

Certainly, employment prospects for postgraduate taught individuals are known to be better than for undergraduates, with generally higher rates of employment at six months after qualification (Universities UK, 2014). A large literature, discussed below and summarised in Appendix 1, has indicated that there is a significant premium attached to the possession of a postgraduate degree. However, as lamented by several authors including (Walker and Zhu, 2011; Lindley and McIntosh 2015), nothing is known about how the returns to postgraduate education vary by subject. It has been suggested by the economic growth literature that a workforce, a high proportion of whom have a good knowledge of mathematics and the sciences will significantly increase economic growth (Hanushek and Kimko, 2000); however, it is not known at present how this translates into variations in the postgraduate wage premium between maths, science, and other disciplines, because the required decompositions of the data by discipline separately for undergraduate and postgraduate levels, were not previously available.

Having access to the Quarterly Labour Force Survey for 2014-2017, which from 2014 onward distinguishes between subjects taken at undergraduate and postgraduate level, this paper examines, for the first time, the wage premium to postgraduate

[2] This assumes that graduates with lower degree classification are accepted on postgraduate courses. Evidence is provided to support this assumption.

education and how it varies across disciplines, specifically taking into account both the subject taken at first degree and for postgraduate degree level. Three questions are specifically addressed in this paper, namely: (1) What proportion of postgraduates change their subject from that which they studied for their undergraduate degree? (2) Are high-ability graduates more likely to change subject than the less able? (3) Are there significant wage premia to postgraduate qualifications for specific subject pairings from undergraduate to postgraduate? The paper is organised as follows. In the following section, there is a discussion of the existing evidence on the returns to higher education. In section 3, the data set is presented and the econometric methodology discussed. In section 4 the results are discussed and section 5 provides conclusions and a discussion.

2. Returns to higher education

Attention is focused on the literature that examines returns to higher education qualifications and in particular, where possible the literature that incorporates the subject of study in the analysis. An overview of some of the relevant literature on the returns to higher education is presented in Table A1 in the appendix, where it is obvious that there are a good number of authors to date that have focused their attention on the subject studied for an undergraduate degree. However, to date there is a gap in the literature on the return to postgraduate qualifications that specifically focuses on subject area studied at this higher level. This gap is largely because of a lack of data, until recently, which distinguishes between the subject studied at undergraduate level and the subject studied at postgraduate level, which may not be the same. As Table A1 shows, the literature specifically focussed on subject of study at undergraduate degree level spans over thirty years in the UK and many different methods have been used to

calculate returns, the results of which are not always directly comparable across studies for a number of reasons, such as different subject groupings, different comparison categories are utilised or analyses are made at different times in the earnings life cycle.

Over the thirty years presented in Table A1 the UK has witnessed a significant expansion in higher education. The UK labour market has adjusted its demand for highly qualified labour accordingly, with some authors finding that the wage return to degrees have increased over time (Naylor et al, 2007) or that wage returns have showed no significant change (Walker and Zhu, 2008). However, in much of the literature a consistent pattern emerges at the undergraduate level of significant returns to subjects such as medicine, engineering, law, economics and mathematics, which have appeared to have stood the test of time. More recently, evidence has been found of higher proportions of undergraduates in non-graduate jobs, especially Arts and Humanities undergraduates (O'Leary and Sloane, 2016). Differences in the wage return across subjects for females appear to have gone from being small and insignificant (Dolton and Makepeace, 1990) to being substantial and significant (Blackaby et al, 1999; Naylor et al, 2007) and significant differences in wage returns are found between the genders (Naylor et al, 2007; Chevalier, 2011). It is the intention of this paper to examine if there are gender-specific effects for each subject at the postgraduate level. The most recent literature on returns to education has taken into consideration non-economic factors that may explain differences in wage returns such as the graduate's socio-economic background and ability along with the higher education institution attended (Britton et al, 2016; Belfield et al, 2018). After taking all these controls into account the ranking of subjects that produce the greatest and lowest returns appears to have remained remarkably similar over time when compared to previous evidence.

As can be seen from the postgraduate section of Table A1, the economic literature that includes the wage return to postgraduate study has not always agreed on whether or not postgraduate education increases wage returns when compared to an undergraduate degree. More recently, the return to postgraduate education in the UK and the USA has been examined by the level of postgraduate degree held (Lindley and Machin 2013, 2016). These studies find that there has been a significant increase in the wage return to postgraduate qualifications over time and this has been due in large part to an increase in the demand for their superior skills set. However, as the authors acknowledge, the subject area of both undergraduate and postgraduate study of individuals were not available in their data in the time periods studied.

This paper adds to the existing literature on the returns to postgraduate education in that the Mincerian earnings functions which are estimated control, as noted above, not only for gender, first-degree classification and for type of postgraduate programme but crucially also by taking account of both the subject area at first degree level and that taken for postgraduate degree.

3. Data and methodology

3.1 Data

The estimations use data from the Quarterly Labour Force Survey (LFS) which is conducted by the Office for National Statistics (ONS) and pooled over the period 2014 through 2017[3]. Data from individuals whose first response was in the first or fifth quarter is selected to ensure that each observation is unique and that individuals are not

[3] The Quarterly Labour Force Surveys consist of a rotating panel, whereby the maximum any individual appears is for 5 quarters and then they are replaced. Twenty-percent of the panel are replaced each quarter and wage data is only available for waves 1 and 5 within each quarter. For these reasons a panel of the 5 quarters does not provide sufficient wage data within each subject for a panel estimation approach.

recorded multiple times in the estimations to follow. In the final quarter of 2014, for the first time, the questionnaires contain questions that allow separate answers, for the reporting of the subject of first degree and the subject of higher degree. This separate reporting of subjects thereby allows a more detailed analysis of postgraduate education and means that it is possible to control for any change in subject area across first degree and subsequent degrees. The data set is rich in educational information at the individual level, such as the qualification gained, the subject, the classification of first degree and in particular for the requirements of this investigation, the type of postgraduate qualification gained. In addition, the data set also contains information on labour market status, earnings and employment characteristics along with the usual demographic characteristics of individuals. To answer the research questions outlined at the end of the introduction, specifically the wage gain in taking a postgraduate qualification compared to an undergraduate qualification only, the sample consists of all individuals who have any form of higher education qualification.[4] Postgraduate qualifications considered here are the traditional Master's degree (MA or MSc); 'other postgraduate' degrees, which include professional postgraduate qualifications (which may have been undertaken whilst in employment) and also includes teaching qualifications such as the Post Graduate Certificate of Education (PGCE); and finally a doctorate (PhD)[5]. The subject of study is recorded of first degree and of higher degree separately; from these responses it is possible to ascertain whether a postgraduate qualification holder took the same subject or whether they changed the subject studied. Seventeen subject areas are identified for both undergraduate and postgraduate study. The descriptive statistics for

[4] The comparison is made between postgraduate and undergraduate here, not A-level. As pointed out by Walker and Zhu (2011), there is no variable in the LFS, such as parental education, that may be used as an instrument for selection into higher education.

[5] There is no information in the LFS on whether qualifications were gained by full-time or part-time study.

the higher education samples for males and females are provided in Tables 1 and 2 respectively.

The class of degree is taken into account as it is possible that the most able students select themselves into postgraduate education or that they are those most likely to be accepted onto postgraduate programmes. Indeed, Table 3, which presents cross-tabulations of undergraduate degree class and postgraduate qualification in the sample, shows that a higher proportion of those with a first class than an upper second class undertake postgraduate education (columns 2 and 5 for males and females, respectively). There are a greater number of individuals who hold an upper second class than a first class and so when taken together postgraduates are more likely to have gained an upper second class than a first class of degree in their undergraduate degree (columns 1 and 3 for males and females, respectively). It is interesting to note that approximately one fifth of males and one quarter of females in the sample who hold a lower second class undergraduate degree went on to postgraduate study (columns 2 and 4 of Table 3). Therefore, it appears that a low classification of undergraduate degree is not an impediment to securing a place on a postgraduate course, especially as conversion courses are readily available as discussed in the introduction.

Perhaps, following the Spence (1974) model of signalling and Arrow's (1973) model of employer screening, graduates with a lower second class may believe that gaining a postgraduate qualification will improve their curriculum vitae so much that their class of undergraduate degree will no longer be relevant as the postgraduate qualification signals a high quality of job applicant. It may be argued that more able graduates are most likely to switch courses or to be accepted into a different subject area for their postgraduate study. However, the raw data in Table 4 reveals that those individuals with a lower classification of undergraduate degree were more likely to

switch subject than those with a first class, who were more likely to remain within the same subject. This suggests that those individuals with a lower class of undergraduate degree who wish to undertake a higher degree are more likely to undertake a postgraduate conversion course and change subject.

This paper is novel in that the analysis of postgraduate qualifications controls for the subject of study both at undergraduate and postgraduate levels. One of the questions to be addressed in this paper, outlined at the end of section 1, was 'what proportion of postgraduate students' change their subject from that studied at undergraduate level?' The percentages of undergraduates who proceeded to postgraduate study in the sample, who are identified by their subjects studied at each level, are presented in Tables 5 and 6 for males and females, respectively. Seventeen subject areas for undergraduate and postgraduate qualifications are identified. The lead diagonals in Tables 5 and 6 reveal the percentage of individuals for each undergraduate subject area who studied the same subject at postgraduate level.

Tables 5 and 6 show that whilst many postgraduates remain within their subject studied at undergraduate level, this varies significantly by subject. For example, a very high percentage of both males and females who studied either education or medicine at undergraduate level also took the same subject at postgraduate level, whilst technology undergraduates were much more likely to change their subject area at postgraduate level. These percentages indicate that it is important to include subject area at both undergraduate and postgraduate level for accurate estimates of returns to study. These tables also highlight that it is possible for an individual to be accepted by an institution for postgraduate study in a different subject area, or discipline, than that of their first degree. Therefore, this implies that the gaining of any first degree must provide the

holder with some generic skills, ability and confidence necessary to complete a postgraduate programme within another discipline.

3.2 Methodology

Estimation is carried out using a standard Mincerian wage equation. Given the fact that individuals are typically in their mid-twenties before they can realistically obtain a PhD qualification, the sample includes only those respondents between the ages of 24 and 65. The dependent variable, logged wages, is deflated, to the base year of 2014, with the basic estimating equation as follows:

$$\ln W_{it} = \alpha + \boldsymbol{\beta}'\boldsymbol{X}_{it} + \sum_{j=2}^{17} \phi_j \, UGsubject_{jit} + \sum_{j=1}^{17} \psi_j \, PGsubject_{kit} + \sum_{j=2}^{17}\sum_{k=1}^{17} \pi_{jk}\left(UGsubject_{jit} \times PGsubject_{kit}\right) + \epsilon_{it} \quad (1)$$

Included in the vector of explanatory variables is age and age squared (to capture non-linearity), marital status, industry, region, class of first degree and also an interaction term between postgraduate qualification and class of degree to ascertain whether the degree class of the first degree still holds influence once a postgraduate qualification has been obtained.

There are 17 subject categories for both undergraduate and postgraduate qualifications and a further category in the postgraduate dummy variables that captures those who did not obtain a postgraduate qualification. The chosen base category for the undergraduate subject is Social Sciences as these students can be observed in every subject of postgraduate study. It is therefore, possible to include all subject dummies at postgraduate level, using individuals who do not hold a postgraduate qualification as

the base category. The regression above, equation (1), is estimated for males whilst for females a Heckman (1979) selection model is estimated, using whether there are children present in the household as an instrument for labour market participation[6].

An alternative estimation method which allows the examination of the total effect of each postgraduate qualification for all subject pairings is given as:

$$\ln W_{it} = \alpha + \boldsymbol{\beta}'\boldsymbol{X}_{it} + \sum_{j=2}^{17} \phi_j \, UGsubject_{jit} + \sum_{j=1}^{17}\sum_{k=1}^{17} \pi_{jk}\left(UGsubject_{jit} \times PGsubject_{kit}\right) + \epsilon_{it} \quad (2)$$

This model, does not contain separate postgraduate subject dummy variables but does incorporate the interaction terms between the undergraduate and postgraduate terms. As stated earlier this model produces equivalent estimates to equation (1). A major advantage of this method is that it provides clear estimates of the wage premium to each postgraduate subject for each of the undergraduate level subjects, along with their respective standard errors, including estimates for Social Sciences. The estimates allow a direct comparison of returns to each postgraduate subject.

The total wage return to holding both undergraduate and postgraduate qualifications is estimated by the use of a model that contains interaction terms only:

$$\ln W_{it} = \alpha + \boldsymbol{\beta}'\boldsymbol{X}_{it} + \sum_{j=1}^{17}\sum_{k=0}^{17} \pi_{jk}\left(UGsubject_{jit} \times PGsubject_{kit}\right) + \epsilon_{it} \quad (3)$$

It will be demonstrated that these models produce equivalent results.

[6] The coefficient on children is significant in the selection equation as is discussed in the results section and is not significant in the wage equation.

4. Results

4.1 Males

The results of the estimations of equations (1), (2) and (3) are presented in Tables 7a-d and 8a-d, for males and females, respectively. The discussion begins with the results for males. Table 7a presents the estimates of the return to each undergraduate and postgraduate subject and Table 7b shows the interaction estimates, from the estimations of equation (1). There are several points of note. Firstly, regardless of subject, the class of first degree is important for wage returns. In agreement with Naylor et al. (2016), a first class undergraduate degree has a slightly larger reward compared to an upper second class, although not statistically different and an upper second class produces a greater reward than a lower second class or below.[7] Secondly, to investigate whether 'better' or 'more able' graduates are driving the wage returns to postgraduate qualifications, the degree class of each individuals' undergraduate degree was interacted with an indicator of whether the individual held a postgraduate qualification. The resulting estimates showed only one coefficient of statistical significance, at the 10 percent level where there is a wage penalty for postgraduates with an upper second class undergraduate degree, suggesting that holders of an upper second class undergraduate degree perform well in the labour market. However, for those postgraduates with a first class or lower second class there is no difference in the return to a postgraduate degree by classification of undergraduate degree. Therefore the gaining of a postgraduate qualification may be a rational choice for an individual who possesses a lower degree classification as they are not penalised for their low undergraduate degree classification

[7] A test of equality between a first class and upper second gave a p value of 0.267 indicating that they are not significantly different. A test of equality between an upper second and lower second class shows that they are significantly different at the 1% level.

once the higher degree is obtained; evidence that supports signalling theory (Spence 1973).

Turning to the subjects of undergraduate degree, compared to an undergraduate degree in the Social Sciences only three undergraduate subjects provide significantly greater wage returns, Medicine, Mathematics or Computer Sciences and Engineering; an ordering which agrees with the existing literature on the wage returns to undergraduate degrees. The postgraduate subject coefficients, presented in Table 7a, show the return to a postgraduate in each subject for the base individual who has a first degree in Social Sciences but has no postgraduate qualification. There are significant rewards to gaining a postgraduate qualification for this individual in nine of the subjects, notably Mathematics or Computer Sciences, Business and Finance and remaining within Social Sciences show the largest returns. It is likely that some individuals switch their subject at postgraduate level because they consider it to be associated with a higher wage return in the labour market than that expected from their undergraduate subject. This idea was posited by Hamermesh and Donald (2008), who noted that advanced degrees in the U.S. are more prevalent among those graduates who majored at undergraduate level in subjects that eventually generate lower earnings. From the cross tabulations of the raw data in Table 5 evidence of the popularity of Business and Finance (column (12)), as a postgraduate major is clear, a subject area that has been found to be popular at undergraduate level (Machin and Puhani, 2003), and that is associated with a high wage return (Naylor, 2007; Chevalier, 2011). A further point of interest is the reduction in the wage return for the Social Sciences graduate when they select Education for their postgraduate qualification. This option is a popular subject choice for nearly eighteen percent of the Social Sciences graduates who progressed to postgraduate study. This result may reflect, the typical high wage return to holding an undergraduate degree in

the Social Sciences or a typically low rate of return in the field of education, where teaching is typically considered as a vocation. Table 7b shows the subject interactions estimated in equation (1). For each undergraduate subject, the additional effect above that of the postgraduate subject coefficients for each undergraduate and postgraduate subject pairing is shown.

There are some blank cells in Table 7b due to there being no observations of subject switching, as shown previously in Table 5. The lead diagonal coefficients are in bold and demonstrate where individuals have taken the same subject for both qualifications. There are significant wage gains in addition to the return on the postgraduate subject for students who take both qualifications in Physical Sciences, Information and Education. There are additional significant returns, both positive and negative, where individuals have changed their subject.

The wage return to each postgraduate subject for each undergraduate subject taken is shown in Table 7c. These estimates are obtained from equation (2), which by the omission of the postgraduate dummy variables allows the direct estimation of the interaction terms between undergraduate and postgraduate subjects, including that for individuals who took Social Sciences as their undergraduate subject. These results are also obtained from equation (1) by summing the postgraduate coefficient and the interaction term i.e. for Biological Sciences the postgraduate coefficient of 0.361 is added to the interaction term -0.056 to produce 0.305, which is identical to the coefficient from equation (2).

Several interesting results are noted here. Firstly, for many of the subjects there are positive and highly significant wage returns to taking a postgraduate qualification in the same subject as that taken for undergraduate. Secondly, there are many positive and significant wage returns to switching subject, for example, medical related

graduates obtain a larger wage return from switching into medicine or into biological sciences than staying in medical related. It is suggested that this finding is due to specialisation in a particular field of medicine or biological sciences, which commands a premium in the labour market and where a good all-round knowledge within related fields is prized. However, there are also sometimes positive and significant wage returns to switching into a subject in another area, for example Medicine undergraduates have a large and statistically significant wage return to a postgraduate qualification in the Social Sciences which is of the same magnitude as that for remaining in Medicine. Thirdly, four undergraduate subjects in particular have significant wage returns to changing subject although these are not always of the same magnitude as the return to the same subject. These undergraduate subjects are Physical Sciences, Engineering, Social Sciences and Humanities. For example, switching to Business and Finance from Humanities leads to a return that is around three-and a-half times greater than the return to staying in the Humanities, which itself provides a wage premium of around 35%. Fourthly and by no means least, for twelve subjects there is an obviously large wage premium to switching into Business and Finance which is highly statistically significant (column 12 of Table 7c). Once again this finding supports the assertion by Hamermesh and Donald (2008) that graduates switch into subjects that are known to provide high wage returns. It is suggested that nearing the completion of their first degree, graduates become aware of the wage returns to degree subjects in the labour market and so switch into Business and Finance. Finally, there are positive returns to switching into Education only for Information, Humanities and Art undergraduates, which suggests that males have better labour market options outside of Education.

To further enhance the interpretation of the results, Table 7d shows the estimates of the total wage return to taking both a postgraduate qualification and an undergraduate

degree, accounting for the subjects taken. The estimates reported are from equation (3), which by the inclusion of the interactions between subjects at undergraduate and postgraduate on their own, also allows the direct estimation of the total return for individuals who took Social Sciences as their undergraduate subject. The results are equivalent to those obtained from equation (1) by summing the undergraduate and postgraduate coefficients to the respective interaction term, i.e. for Biological Sciences the undergraduate coefficient of -0.039 is added to the postgraduate coefficient of 0.361 and the interaction term -0.056 to produce 0.266. Additionally, the coefficients on the interaction terms where no postgraduate qualification was taken are identical to the coefficients on the undergraduate subjects from the estimation of equation (1). The results of joint significance tests of the three sets of coefficients, undergraduate, postgraduate and interaction term, from equation (1) for cases where the same subject choice was made are reported in Table A2 in the appendix.

The total returns here are compared to that of an individual who has an undergraduate degree in the Social Sciences and no postgraduate qualification. For twelve of the seventeen subject areas where the undergraduate and postgraduate subject are the same (the bold lead diagonal coefficients in Table 7d), there are many positive wage returns which are highly significant. This makes sense and conforms to the view that a postgraduate qualification provides the holder with additional skills that are highly prized in the labour market (Lindley and Machin 2016). The greatest wage return, unsurprisingly, is to Medicine, with particularly large returns also to Physical Sciences; Mathematics and Computer Sciences; Engineering; Social Sciences and Business and Finance. Despite the majority of Arts undergraduates taking a postgraduate in either the Arts or Education, the statistical insignificance of the coefficients suggest that these individuals do not fare any better in the labour market

than individuals who have an undergraduate degree in the Social Sciences. It is striking that having an undergraduate degree in the Social Sciences appears to provide a good basis for a postgraduate qualification in many of the other subjects, with positive and statistically significant wage returns to eight of the other subjects. In particular, a postgraduate in Mathematics and Computing or Business and Finance provides a greater wage return than remaining in Social Sciences. It is speculated that the skills and competencies gained in a Social Sciences undergraduate degree are highly transferable to other subjects and thus providing the holder with the flexibility to pursue a different career path should they wish. Engineering, similarly, is another undergraduate subject area where it is possible to change subject area at postgraduate level for a higher wage premium than that to remaining in Engineering. In particular, the largest return is where these individuals changed subject to the Social Sciences. Finally, not all changes of subject bring rewards as Table 7d shows. For example, there are wage penalties for Humanities undergraduates who took a postgraduate in Agricultural or Physical Sciences, or Arts. It is possible that some undergraduate subjects, such as Humanities, Arts and Education do not provide the key skills and competencies required to perform well in a different subject at postgraduate level. It is suggested that the area of subject change across degrees and the relationship with labour market and occupational outcomes is an area for further research.

4.2 Females

Turning our focus to females, Table 8a presents the estimates of the return to each undergraduate and postgraduate subject and Table 8b shows the interaction estimates, from the estimations of equation (1), where a Heckman selection model is estimated that takes account of labour market participation. The value of rho is negative and highly significant and the likelihood ratio test justifies the use of the selection model

over the OLS regression model. Examining the degree classification estimates it is apparent that having a first class has a slightly larger reward than an upper second class, in agreement with Naylor et al. (2016), but there is no statistically significant wage premium to a lower second[8]. Thus, it appears that a good class of degree is more important for females than males. In line with the findings for males, the coefficients on the interactions between postgraduate study and class of degree show no statistical significance.

Examining the coefficients on the subjects it is noted that compared to an undergraduate degree in the Social Sciences, eight subjects at undergraduate level provide significantly larger wage returns. This is in contrast to the finding for males where only three subjects gave significantly higher returns. The ordering of the returns shows a pattern that concurs with the existing literature, with Medicine providing the largest return. There are significant rewards to gaining a postgraduate qualification in nine of the subjects, notably Medicine, Business and Finance and Information and Communication compared to the base of a Social Sciences undergraduate. The cross-tabulations presented in Table 6 show that whilst a good proportion in each subject stay in the same subject for their postgraduate qualification it varies by subject. There is evidence of changing into a subject that is associated with a good return in the labour market, as noted in the U.S. by Hamermesh and Donald (2008). Interestingly, there is a positive wage return for the Social Sciences graduate where they select Education for their postgraduate qualification, whereas this was negative for males. This option is a popular subject choice for thirty-one percent of the female Social Sciences graduates who progressed to postgraduate study. Table 8b shows the subject interactions

[8] A test of equality between a first class and upper second gave a p-value of 0.05 indicating that statistically, they are significantly different at the 5% level.

estimated in equation (1), which provides, for each undergraduate subject, the added effect on the postgraduate subject coefficients for each postgraduate subject taken. The blank cells here are where there are no observations of switching subject, as shown previously in Table 6. The lead diagonal coefficients are in bold and demonstrate where individuals have taken the same subject for both qualifications. In six undergraduate subject areas there are wage gains in addition to the return on the postgraduate subject dummy for students who take the same subject for both undergraduate and postgraduate qualifications. There are additional significant interaction effects, both positive and negative, where individuals have changed their subject.

The wage return to each postgraduate subject for each undergraduate subject taken is shown in Table 8c. These estimates are obtained from equation (2), which by the omission of the postgraduate dummy variables allows the direct estimation of the return to each postgraduate subject for each undergraduate subject, including individuals who took Social Sciences as their undergraduate subject.[9]

There are several interesting results of note. Firstly, for all of the subjects, except for Information and Communication and languages, there are positive and highly significant wage returns to taking a postgraduate qualification in the same subject as that taken at undergraduate. Thus it appears that females nearly always see a gain from remaining in the same subject for their postgraduate qualification. Secondly, for eleven undergraduate subjects there are positive wage returns to switching into Education; results which are highly significant for seven of these switches. This is contrary to the finding for males where there were mainly statistically significant wage reductions. This may be indicative of females faring better than males in the labour market for

[9] As before, these results can be obtained from equation (1) by summing the postgraduate coefficient and the interaction term i.e. for Biological Sciences the postgraduate coefficient of 0.982 is added to the interaction term -0.242 to produce 0.740.

educators or that males who have an undergraduate degree fare relatively better than females with an undergraduate degree.

A similar picture of returns to changing subject into a related field as that found for males is evident. For example, Medicine undergraduates obtain a larger wage return from switching into a Medical related subject or into Biological Sciences rather than staying in Medicine. This suggests that specialisation in a particular field related to Medicine or Biological Sciences commands a premium because a good all-round knowledge within related fields is highly valued. There are also positive and significant wage returns to switching into some subjects within another area, for example Medicine undergraduates have a large and statistically significant wage return to a postgraduate qualification in the Social Sciences and Business and Finance which are larger than that from remaining in Medicine. The wage return for changing to Business and Finance is positive and highly significant for most of the undergraduate subjects, which conforms to the results found for males and indicative of these individuals switching into a subject known to provide a high wage return. Finally, Social Sciences undergraduates fare well from switching subject in many, but not all cases, a similar result to that for males.[10] Interestingly, females who take Languages at undergraduate level fare better by switching into one of eight unrelated subjects than staying in the same subject. It is speculated that the ability to speak a second language along with their other postgraduate qualification is an advantage, or that a postgraduate qualification in another subject is more valuable than a languages postgraduate qualification.

Again, to ease interpretation Table 8d shows the estimates of the total wage return to taking a postgraduate qualification accounting for undergraduate subject taken

[10] Economics is consistently shown to be in the top five of the list of subjects that produce good returns for undergraduate degrees (see Table A1 in the appendix), and this suggests that economics may play a large part in the reported high return for social sciences as a whole.

for females. The estimates reported are from equation (3), which by the inclusion of interactions between subjects at undergraduate and postgraduate on their own, allows the direct estimation of the total return to each postgraduate subject for individuals who took each subject as their undergraduate subject.[11] The results of joint significance tests of the three sets of coefficients, undergraduate, postgraduate and interaction term, from equation (1) for cases where the same subject choice was made are reported in Table A2 in the appendix.

The total returns in Table 8d are compared to that of an individual who has an undergraduate degree in the Social Sciences and no postgraduate qualification. For all, except one, of the seventeen subject areas where the undergraduate and postgraduate subject are the same (the bold diagonal coefficients in Table 8d), there are positive and statistically significant wage returns. This suggests that for females, taking a postgraduate qualification in the same subject is a sensible strategy. However, rather surprisingly the greatest return is not found where medicine is taken for both degrees but where the subject is changed to a related subject i.e. medicine to medical related, medical related to medicine, or Biological Sciences to Medicine. This finding may be due to specialisation, where there is a wage premium to extra knowledge. As found for males, it is evident that having an undergraduate degree in the Social Sciences provides a good basis for a postgraduate qualification in many of the other subjects, with positive and statistically significant wage returns to nine of the other subjects. One noticeable difference in the wage returns across the genders is in an Education postgraduate qualification where the coefficients are positive and significant for most undergraduate subjects whereas for males this was negative. This is indicative of either a greater return

[11] As discussed in the results for males, equivalent results are obtained from equation (1) by summing the undergraduate and postgraduate coefficients to the respective interaction term i.e. for Biological Sciences the undergraduate coefficient of -0.005 is added to the postgraduate coefficient of 0.982 and the interaction term -0.242 to produce 0.735, the coefficient from equation (3).

to females than males for taking a postgraduate qualification in Education or that males have more opportunities in the labour market outside of Education.

5. Conclusions

This paper has investigated, for the first time it is believed, the wage premium to postgraduate degrees in the UK, crucially differentiating between subject of qualification for both undergraduate and postgraduate degrees. Using the Quarterly Labour Force Survey from 2014-2017 and including the classification of undergraduate degree several insights emerge from this analysis. Firstly, the initial question asked in the introduction of what proportion of postgraduate students' change their subject of study, is found here to be around 13% of males and 16% of females, but this varies greatly by undergraduate subject of study: for example around 70% of social sciences graduates who took a postgraduate qualification changed their subject. Secondly, postgraduate education is not just the preserve of the most able graduates: of graduates who achieved a lower second class degree, one-fifth of males and one-quarter of females in the sample went on to study at postgraduate level. In addition, the provision of postgraduate conversion courses means that students are able to study in a field that is different to that of their undergraduate degree. Evidence in support of signalling theory (Spence 1973) is found as there is no difference in the return to postgraduate qualifications associated with the classification of undergraduate degree. Therefore, it appears to make sense for a rational student who is disappointed with their undergraduate degree classification to undertake a postgraduate course. The most prestigious universities may reserve their postgraduate places for those individuals who have obtained a minimum upper second class bachelor's degree; however, postgraduate

courses are available to all students at some higher education institutions and shown, by means of postgraduate conversion courses.

Thirdly, interesting patterns of wage returns for given subject pairings are found. For both genders and for most subjects, there are positive wage returns to holding a postgraduate qualification in the same subject. This finding makes sense given the investment in the subject at the undergraduate level. However, there are a number of instances where there is a larger wage return to changing subject. For both genders, the popularity of changing subject to Business and Finance is evident and the estimates reveal a significantly large reward of doing so. Therefore, individuals may perceive that they may improve their wage return by switching to a subject with a higher known wage return as found by Hamermesh and Donald (2008) for the US. There is clear evidence that there are positive wage returns to changing subject from Social Sciences, some which are larger and some smaller than that to staying in Social Sciences. These results which are statistically significant for both genders imply that an undergraduate degree in the Social Sciences provides a good set of transferable skills that enable the holder of this qualification to enter another subject at postgraduate level should they wish to change their career path.

Finally, there is an obvious difference between the genders for those individuals who hold a postgraduate qualification in Education. For females, the returns are mostly positive whichever undergraduate subject was taken but for males the returns show a wage penalty; it is hardly surprising then, given this finding, that there is a shortage of male teachers in the UK.

The average return to a postgraduate qualification compared to an undergraduate has been calculated at around fourteen percent (Lindley and Machin 2013). This paper has demonstrated that wage returns to postgraduate qualifications

vary significantly by subject of study and furthermore, the mix of subjects both at undergraduate and postgraduate levels plays an important part in future wage returns. This is clearly an area for further research.

References

Arrow, K. J. (1973). Higher education as a filter, Journal of Public Economics 2, 193-216.

Aston, Libby. (2004). Higher Education Supply and Demand to 2010 – an update. Report of the Higher Education Policy Institute, April 2004.

Barber, L., Pollard, E., Millmore, B., and Gerova, V. (2004). Higher Degrees of Freedom: The Value of Postgraduate Study, Institute for Employment Studies Report 410.

Becker, G. S. (1964). Human Capital: A theoretical and empirical analysis, with special reference to education, Columbia University Press, New York.

Bekhradnia, B., and Beech, D. (2018). Demand for Higher Education to 2030. Higher Education Policy Institute, Report No 105.

Belfield, C., Britton, J., Buscha, F., Dearden, L., Dickson, M., van der Erve, L., Sibieta, L., Vignoles, A., Walker, I., Zhu, Y. (2018). The relative labour market returns to different degrees. Institute for Fiscal Studies Research Report, June 2018.

Blackaby, D.H., Murphy, P.D. and O'Leary, N. (1999). Graduate earnings in Great Britain: a matter of degree? Applied Economics Letters, 6, 311-315.

Blundell, R., Dearden, L., Goodman, A. and Reed, H. (2000). The returns to higher education in Britain: Evidence from a British cohort, Economic Journal, 110 F82-F89.

Brown, S., and Sessions, J. G. (1998). Education employment status and earnings: A comparative test of the strong screening Hypothesis, Scottish Journal of the Political Economy, 45 (5) 586-591.

Brown, S., and Sessions, J. G. (2006). Evidence on the relationship between firm-based screening and the returns to education, Economics of Education Review, 25, 498-509.

Bratti, M., Naylor, J. and Smith, J. (2006). Different returns to different degrees: Evidence from the British Cohort Study 1970, mimeo, University of Warwick.

Bratti, M. and Mancini, L. (2003). 'Differences in Early Occupational Earnings of UK Male Graduates by Degree Subject: Evidence from the USR, 1980-1993', IZA Discussion Paper No. 890, IZA, Bonn.

Britton, J., Dearden, L., Shepherd, N. and Vignoles, A. (2016). How English domiciled graduate earnings vary with gender, institution attended, subject and socio-economic background. Institute for Fiscal Studies WP16/06.

Chevalier, A. (2011). Subject choice and earnings of UK graduates. Economics of Education Review, 30, 1187-1201.

Department for Business Innovation and Skills. (2011). The Returns to Higher Education Qualifications, Research Paper 45.

Dolton, P. and Makepeace, G.H. (1990). Graduate earnings after six years: Who are the winners? Studies in Higher Education, 15(1), 31-55.

HEPI, (2010). Postgraduate Education in the United Kingdom. Report for the Higher Education Policy Institute and The British Library. Available at:

http://www.hepi.ac.uk/2010/01/21/postgraduate-education-in-the-uk/

Hamermesh, D. S, and Donald, S. G. (2008). The effect of college curriculum on earnings: An affinity identifier for non-ignorable non-response bias. Journal of Econometrics, 144, 479-491.

Hanushek, E.A and Kimko, D.D. (2000). Schooling, Labour-Force Quality, and the growth of Nations. The American Economic Review, 90(5), 1184-1208.

Heckman, J. (1979). Sample Selection Bias as a Specification Error. Econometrica, 47(1), 153-161.

Kelly, E., O'Connell, P. J., and Smyth, E. (2010). The economic returns to field of study and competencies among higher education graduates in Ireland, Economics of Education Review, 29, 650-657.

Lenton, P. (2016). Staying-on after twenty-one: the returns to postgraduate education. Sheffield Economics Research Paper No 2016004.

Lindley, J., and Machin, S. (2013). The Postgraduate Premium: Revisiting Trends in Social Mobility and Educational Inequalities in Britain and America. Report for the Sutton Trust. February 2013.

Lindley, J., and Machin, S. (2016). The Rising Postgraduate Wage Premium. Economica, 83, 281-306.

Lindley, J., and McIntosh, S. (2015). Growth in Within Graduate Wage Inequality: The Role of Subjects, Cognitive Skill Dispersion and Occupational Concentration. Labour Economics, 37, 101-111.

Machin, S., and Puhani, P.A. (2003). Subject of degree and the gender wage differential: evidence from the UK and Germany. Economics Letters, 79, 393-400.

Naylor, R., Smith, J., and McKnight, A. (2007). Sheer Class? Returns to educational performance: evidence from UK graduates' first destination labour market outcomes. Warwick Economic Research Paper No 786, University of Warwick.

Naylor, R., Smith, J., and Telhaj, S. (2016). Graduate Returns, Degree Class Premia and Higher Education Expansion in the UK. Oxford Economic Papers, 68(2), 525-545.

O'Leary, N.C, and Sloane, P.J. (2005). The return to a university education in Great Britain. National Institute Economic Review 193 (1), 75-89.

O'Leary, N.C, and Sloane, P.J. (2016). Too many graduates? An application of the Gottschalk-Hansen model to young British graduates between 2001-2010. Oxford Economic Papers, 68(4), 945-967.

Prospects.ac.uk (2018). Available at https://www.prospects.ac.uk/postgraduate-study/conversion-courses

Romer, P. (1994). The Origins of Economic Growth. Journal of Economic Perspectives, 8(1), 3-22.

Spence, M. (1973), Job Market Signalling, The Quarterly Journal of Economics, 87 (3), 355-374.

Universities UK. (2014). Masters with a purpose. Report for UUK available at www.universitiesuk.ac.uk/highereducation

Walker, I. and Zhu, Y. (2008). The College Wage Premium and the Expansion of Higher Education in the UK. Scandinavian Journal of Economics, 110(4), 695-709.

Walker, I. and Zhu, Y. (2011). Differences by degree: Evidence of the net financial rates of return to undergraduate study for England and Wales, Economics of Education Review, 30, 1177-86.

Table 1: Descriptive statistics: males holding at least a first degree.

Males N= 11,986					
Variable	mean	std dev	Variable	Mean	std dev
Ln deflated weekly wage	6.543	0.594	Industry		
Age	41.460	10.714	Agriculture/fishery	0.004	0.064
Married	0.611	0.488	Mining/quarrying	0.008	0.090
PhD same subject	0.034	0.182	Manufacturing	0.114	0.317
PhD changed subject	0.014	0.115	Utilities	0.014	0.117
Masters same subject	0.068	0.251	Construction	0.041	0.197
Masters changed subject	0.068	0.253	Wholesale/retail	0.065	0.247
Other PG same subject	0.024	0.152	Hotels/hospitality	0.012	0.110
Other PG changed subject not education	0.018	0.132	Transport	0.052	0.223
Other PG changed subject to education	0.034	0.182	Financial services	0.070	0.254
First degree only	0.741	0.438	Real estate	0.231	0.421
First class	0.129	0.336	Public administration	0.104	0.305
Upper second class	0.455	0.498	Education	0.152	0.359
Lower second class	0.303	0.460	Health services	0.134	0.341
Third class or Pass degree	0.112	0.315	Other services	0.000	0.018
Subject of first degree			Year		
Medicine	0.014	0.118	Year 2014	0.075	0.263
Medicine related	0.029	0.168	Year 2015	0.301	0.459
Biological sciences	0.079	0.269	Year 2016	0.310	0.462
Agricultural sciences	0.011	0.105	Year 2017	0.315	0.464
Physical sciences	0.095	0.293			
Maths/Computer science	0.116	0.320			
Engineering	0.135	0.341			
Technology	0.013	0.114			
Architecture	0.037	0.189			
Social sciences	0.100	0.300			
Law	0.031	0.174			
Business and Finance	0.126	0.332			
Information & Communication	0.021	0.143			
Languages	0.038	0.191			
Humanities	0.070	0.255			
Arts	0.061	0.239			
Education	0.022	0.146			
Region					
North	0.145	0.352			
Yorkshire & Humber	0.087	0.281			
East Midlands	0.057	0.232			
West Midlands	0.074	0.262			
East Anglia	0.083	0.276			
South East	0.143	0.350			
South West	0.100	0.300			
Greater London	0.176	0.381			
Wales	0.038	0.192			
Scotland	0.073	0.260			
N. Ireland	0.024	0.152			

Table 2: Descriptive statistics: females holding at least a first degree.

Females N= 14, 499					
Variable	mean	std dev	Variable	Mean	std dev
Ln deflated weekly wage	6.151	0.621	Industry		
Age	40.234	10.284	Agriculture/fishery	0.003	0.055
Married	0.557	0.497	Mining/quarrying	0.002	0.041
Children	0.442	0.497	Manufacturing	0.045	0.208
PhD same subject	0.020	0.140	Utilities	0.005	0.073
PhD changed subject	0.009	0.095	Construction	0.013	0.113
Masters same subject	0.054	0.227	Wholesale/retail	0.052	0.222
Masters changed subject	0.065	0.247	Hotels/hospitality	0.013	0.115
Other PG same subject	0.045	0.206	Transport	0.024	0.154
Other PG changed subject not education	0.027	0.162	Financial services	0.037	0.190
Other PG changed subject to education	0.063	0.242	Real estate	0.119	0.323
First degree only	0.717	0.451	Public administration	0.099	0.299
First class	0.123	0.328	Education	0.293	0.455
Upper second class	0.528	0.499	Health services	0.293	0.455
Lower second class	0.262	0.440	Other services	0.001	0.029
Third class or Pass degree	0.087	0.281	Year		
Subject of first degree			Year 2014	0.069	0.254
Medicine	0.019	0.136	Year 2015	0.290	0.454
Medicine related	0.129	0.335	Year 2016	0.317	0.465
Biological sciences	0.106	0.307	Year 2017	0.324	0.468
Agricultural sciences	0.012	0.109			
Physical sciences	0.045	0.208			
Maths/Computer science	0.037	0.190			
Engineering	0.011	0.103			
Technology	0.005	0.067			
Architecture	0.011	0.105			
Social sciences	0.125	0.331			
Law	0.043	0.203			
Business and Finance	0.112	0.315			
Information & Communication	0.018	0.134			
Languages	0.089	0.285			
Humanities	0.064	0.244			
Arts	0.083	0.276			
Education	0.086	0.280			
Region					
North	0.151	0.359			
Yorkshire & Humber	0.099	0.299			
East Midlands	0.062	0.242			
West Midlands	0.071	0.256			
East Anglia	0.081	0.274			
South East	0.139	0.346			
South West	0.096	0.295			
Greater London	0.143	0.350			
Wales	0.047	0.211			
Scotland	0.081	0.273			
N.Ireland	0.029	0.167			

Table 3: Proportions of degree class and postgraduate qualifications.

	Males			Females		
	of all PGs	has PG	N	of all PGs	has PG	N
First	18.6	37.6	578	14.5	33.5	597
Upper second	49.9	28.5	1551	55.1	29.6	2265
Lower second	23.4	19.9	727	23.9	25.8	981
Third/Pass	8.2	18.3	254	6.4	21.0	264
	100			100		

Columns 1 and 4 read down as the percentage of postgraduates with corresponding class of degree. Columns 2 and 5 read across as the percentage of that degree class holding a PG qualification, with columns 3 and 6 the corresponding number of students.

Table 4: Proportions of degree class and whether changed subject for postgraduates.

MALES			
Classification of First degree	Changed Subject	Same Subject	N
First class	39.45	60.55	578
Upper second	51.71	48.29	1551
Lower second	59.01	40.99	727
Third/Pass	57.48	42.52	254
FEMALES			
First class	45.39	54.61	597
Upper second	56.82	43.18	2265
Lower second	67.48	32.52	981
Third/Pass	60.61	39.39	264

Table 5: Cross-tabulations of subject of study from undergraduate to postgraduate study: Males.

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Social Sciences	**26.02**	0.58	0.58	3.51	1.17	3.22	7.60	0.58	0.88	6.73	4.98	16.96	3.80	0.88	4.68	0.29	17.54
(2) Medicine	2.56	**62.83**	19.24	7.69	0.00	2.56	0.00	1.28	0.00	0.00	0.00	0.00	0.00	0.00	2.56	0.00	1.28
(3) Medical related	5.68	11.36	**42.05**	7.95	0.00	6.82	5.68	0.00	0.00	0.00	1.14	9.09	0.00	0.00	0.00	1.14	9.09
(4) Biological sciences	2.42	2.12	4.55	**48.79**	2.42	7.27	4.24	0.00	0.00	0.00	0.61	7.58	2.12	0.61	0.91	1.21	15.15
(5) Agricultural sciences	0.00	0.00	3.57	25.00	**28.58**	3.57	0.00	10.71	0.00	3.57	0.00	14.29	0.00	0.00	0.00	0.00	10.71
(6) Physical sciences	2.31	0.23	1.15	4.16	0.46	**53.35**	5.54	7.39	1.39	2.54	0.92	8.56	0.69	0.00	0.69	0.00	10.62
(7) Math/computing	1.14	0.00	0.76	1.89	0.00	3.03	**60.23**	3.79	0.00	0.00	0.00	8.32	0.38	0.00	1.14	0.76	18.56
(8) Engineering	0.28	0.00	0.00	0.83	0.55	5.23	8.26	**57.30**	1.10	1.10	0.55	15.43	0.55	0.28	0.83	0.55	7.16
(9) Technology	0.00	0.00	4.55	0.00	0.00	18.18	13.63	9.09	**18.18**	0.00	0.00	22.72	4.55	0.00	0.00	4.55	4.55
(10) Architecture	0.00	0.00	0.00	0.00	0.90	0.90	0.90	3.60	1.80	**72.07**	1.80	13.53	0.00	0.00	0.00	1.80	2.70
(11) Law	7.32	0.00	0.00	0.00	0.00	0.00	3.66	0.00	0.00	1.22	**69.50**	12.20	0.00	1.22	0.00	0.00	4.88
(12) Business & finance	6.99	0.00	0.00	1.61	2.15	0.00	4.84	1.08	1.08	2.15	1.08	**56.97**	1.08	0.54	2.15	0.54	17.74
(13) Information	10.34	0.00	0.00	0.00	0.00	0.00	6.90	3.45	0.00	0.00	0.00	0.00	**17.24**	0.00	0.00	17.24	44.83
(14) Languages	10.00	0.00	1.76	0.59	0.00	0.00	2.35	0.00	0.00	0.59	0.59	4.71	6.47	**38.82**	4.71	5.88	23.53
(15) Humanities	7.56	0.34	0.00	1.38	1.03	1.38	5.84	1.03	0.00	1.03	4.12	7.22	2.75	3.44	**41.58**	1.03	20.27
(16) Art	1.36	0.00	0.00	0.00	0.00	0.00	3.40	0.00	2.04	0.00	0.00	3.40	3.40	2.04	3.40	**41.50**	39.46
(17) Education	3.62	0.00	3.62	1.20	0.00	1.20	1.20	0.00	0.00	0.00	0.00	4.82	0.00	2.41	3.62	0.00	**78.31**

Table 6: Cross-tabulations of subject of study from undergraduate to postgraduate study: Females.

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Social Sciences	**29.87**	0.64	3.60	4.66	0.42	2.75	2.12	1.06	0.21	2.97	4.45	10.59	1.69	0.85	2.12	0.85	31.15
(2) Medicine	3.57	**54.46**	16.07	8.93	1.79	1.79	0.00	0.00	0.00	0.00	1.79	4.46	0.00	0.89	0.89	0.00	5.36
(3) Medical related	8.21	4.56	**55.02**	4.86	1.52	5.47	2.13	0.30	0.61	0.31	0.91	4.56	0.00	0.30	0.91	0.00	10.33
(4) Biological sciences	5.14	1.25	10.28	**42.68**	1.87	3.58	1.71	0.62	0.47	0.47	0.47	4.36	0.78	0.62	0.47	0.31	24.92
(5) Agricultural sciences	5.00	2.50	15.00	7.50	**10.00**	10.00	0.00	0.00	0.00	2.50	5.00	10.00	0.00	0.00	2.50	2.50	27.50
(6) Physical sciences	1.78	0.36	5.69	5.34	2.49	**44.13**	3.56	5.34	0.71	1.78	1.07	3.56	1.41	0.00	0.36	0.00	22.42
(7) Math/computing	3.07	1.23	0.61	2.46	0.00	1.23	**43.56**	0.61	0.00	0.61	0.00	7.36	1.23	0.00	1.84	0.61	35.58
(8) Engineering	1.56	0.00	1.56	1.56	0.00	0.00	12.50	**53.14**	0.00	1.56	3.13	9.36	0.00	0.00	3.13	0.00	12.50
(9) Technology	9.09	0.00	0.00	0.00	0.00	9.09	0.00	0.00	**9.09**	0.00	0.00	0.09	0.00	0.00	0.00	0.00	63.64
(10) Architecture	0.00	0.00	0.00	0.00	0.00	0.00	1.75	0.00	0.00	**68.42**	3.51	5.26	0.00	0.00	0.00	1.75	19.31
(11) Law	4.93	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.70	**61.27**	11.98	3.52	0.00	2.82	0.70	13.38
(12) Business & finance	6.64	0.95	0.00	1.47	1.47	1.47	7.96	0.00	0.00	1.47	0.96	**44.94**	0.49	0.95	0.95	0.00	30.28
(13) Information	3.33	0.00	0.00	3.33	0.00	0.00	6.67	0.00	0.00	3.33	0.00	16.67	**16.67**	0.00	6.67	3.33	40.00
(14) Languages	5.36	0.19	1.34	0.77	0.96	0.00	1.92	0.00	0.19	0.19	1.34	6.13	6.13	**27.59**	3.07	2.87	41.95
(15) Humanities	6.71	0.29	1.17	1.46	1.17	1.17	2.92	0.00	0.00	0.29	3.21	7.58	9.04	2.60	**28.28**	1.46	32.65
(16) Art	3.51	0.00	4.91	0.00	0.35	0.00	1.40	0.00	2.46	1.05	1.05	3.16	3.51	2.11	1.76	**37.19**	37.54
(17) Education	2.52	0.00	1.58	0.95	0.00	0.00	1.58	0.63	0.00	0.00	0.00	2.52	0.00	1.89	1.58	1.26	**85.49**

Table 7a: Wage Return to Postgraduate Subject - Males.

Dependent variable = ln weekly wage N= 11,986	Coefficient	Standard error
Age	0.101***	0.004
Age Square	-0.001***	0.000
Married	0.148***	0.011
First class	0.184***	0.023
Upper second class	0.164***	0.016
Lower second class	0.082***	0.018
Postgraduate *Undergraduate class interactions		
Postgraduate*First class	-0.040	0.048
Postgraduate*Upper second class	-0.071*	0.043
Postgraduate*Lower second class	-0.048	0.045
Undergraduate subject		
Medicine	0.440***	0.057
Medicine related	-0.019	0.036
Biological sciences	-0.039	0.027
Agricultural sciences	0.025	0.053
Physical sciences	0.016	0.026
Maths/Computer science	0.057**	0.023
Engineering	0.108***	0.023
Technology	-0.054	0.047
Architecture	0.010	0.034
Law	0.048	0.034
Business and Finance	0.021	0.022
Information & Communication	-0.185***	0.038
Languages	-0.073**	0.035
Humanities	-0.091***	0.028
Arts	-0.189***	0.027
Education	-0.008	0.041
Postgraduate subject		
Social sciences	1.065***	0.069
Medicine	0.886**	0.361
Medicine related	-0.064	0.360
Biological sciences	0.361***	0.152
Agricultural sciences	0.055	0.257
Physical sciences	0.210	0.159
Maths/Computer science	1.183***	0.108
Engineering	0.527	0.361
Technology	0.221	0.296
Architecture	0.212*	0.115
Law	0.353***	0.131
Business and Finance	1.331***	0.080
Information & Communication	-0.194	0.147
Languages	0.497*	0.296
Humanities	0.332**	0.134
Arts	0.423	0.508
Education	-0.135*	0.078
Year		
Year 2015	0.031*	0.019
Year 2016	0.062***	0.019
Year 2017	0.077***	0.019
Constant	4.127***	0.110
Adjusted R-squared	0.4521	

Variables included in the modelling but not reported here for brevity are region and industry. Interaction of undergraduate and postgraduate subjects reported in table 7b. Full results available from the author on request. ***;** and * denote significance at the 1%, 5% and 10% levels, respectively. Wage is deflated to 2014. Base category is undergraduate in social sciences no postgraduate.

Table 7b: Interaction effects of subjects studied across undergraduate and postgraduate programmes: Males.

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(2) Medicine	0.253	**0.430**	-0.026	-0.096	-	-0.036	-	-0.814	-	-	-	-	-	-	0.295	-	0.129
	[0.367]	**[0.370]**	[0.386]	[0.261]		[0.395]		[0.623]							[0.386]		[0.515]
(3) Medical related	-0.808*	0.776	**0.546**	0.347	-	0.092	-1.025*	-	-	-	1.074	0.112	-	-	-	-0.623	0.124
	[0.236]	[0.394]	**[0.370]**	[0.244]		[0.260]	[0.250]				[0.523]	[0.195]				[0.717]	[0.194]
(4) Biological sciences	-0.939*	0.511	0.301	**-0.056**	0.149	-0.070	-0.786*	-	-	-	-0.004	-0.167	0.165	-0.905	-0.335	-0.109	0.259
	[0.189]	[0.407]	[0.383]	**[0.154]**	[0.312]	[0.187]	[0.170]				[0.380]	[0.124]	[0.239]	[0.464]	[0.320]	[0.568]	[0.101]
(5) Agricultural sciences	-	-	0.267	-0.702*	**0.082**	-0.418	-	-0.831	-	-1.846*	-	-1.078*	-	-	-	-	0.499
			[0.624]	[0.247]	**[0.315]**	[0.532]		[0.466]		[0.520]		[0.268]					[0.305]
(6) Physical sciences	-1.002*	-0.785	0.535	-0.687*	-0.024	**1.019***	0.186	0.448	0.078	-0.363	-0.689	-0.191	-0.183	-	-0.213	-	0.235
	[0.171]	[0.621]	[0.424]	[0.191]	[0.441]	**[0.159]**	[0.146]	[0.370]	[0.359]	[0.188]	[0.283]	[0.109]	[0.326]		[0.320]		[0.103]
(7) Math/computing	-0.912*	-	0.080	-0.488	-	0.248	**-0.182**	-0.404	-	-	-	-0.056	0.975	-	-0.453	-0.704	0.208
	[0.298]		[0.508]	[0.271]		[0.237]	**[0.110]**	[0.393]				[0.127]	[0.526]		[0.320]	[0.621]	[0.101]
(8) Engineering	0.177	-	-	-0.202	-0.103	0.01	-1.112*	**0.468**	0.502	-0.380	0.138	-0.859*	1.224*	-0.438	-0.241	-0.421	0.071
	[0.510]			[0.328]	[0.440]	[0.194]	[0.138]	**[0.361]**	[0.389]	[0.276]	[0.380]	[0.098]	[0.386]	[0.587]	[0.320]	[0.621]	[0.121]
(9) Technology	-	-	0.521	-	-	0.114	-1.555*	-0.421	**-0.101**	-	-	-0.122	0.865	-	-	-0.465	-0.902
			[0.623]			[0.300]	[0.313]	[0.509]	**[0.390]**			[0.241]	[0.529]			[0.720]	[0.513]
(10) Architecture	-	-	-	-	0.318	0.007	-1.171	-0.105	-0.053	**-0.177**	0.104	-0.227	-	-	-	-0.077	0.052
					[0.568]	[0.530]	[0.518]	[0.440]	[0.464]	**[0.124]**	[0.381]	[0.144]				[0.622]	[0.302]
(11) Law	-1.213*	-	-	-	-	-	-0.904*	-	-	-0.210	**0.450***	-0.252	-	0.557	-	-	0.181
	[0.202]						[0.311]			[0.520]	**[0.144]**	[0.177]		[0.587]			[0.264]
(12) Business & finance	-0.888*	-	-	-0.026	0.174	-	-0.913*	-0.517	-0.165	-0.027	0.078	**-0.297***	0.435	-0.024	-0.555	-0.799	0.17
	[0.148]			[0.328]	[0.360]		[0.197]	[0.507]	[0.463]	[0.275]	[0.380]	**[0.086]**	[0.386]	[0.586]	[0.286]	[0.717]	[0.112]
(13) Information	-0.556	-	-	-	-	-	-0.707	-0.233	-	-	-	-	**0.496**	-	-	-0.194	0.404
	[0.300]						[0.374]	[0.623]					**[0.270]**			[0.556]	[0.160]
(14) Languages	-1.029*	-	0.493	0.045	-	-	-0.865*	-	-	-0.16	0.537	-0.743*	0.257	**0.185**	-0.483	-0.343	0.242
	[0.139]		[0.464]	[0.529]			[0.276]			[0.519]	[0.524]	[0.194]	[0.211]	**[0.301]**	[0.222]	[0.533]	[0.109]
(15) Humanities	-0.961*	-0.442	-	-0.058	-0.672	-0.854	-0.916*	-0.094	-	-0.020	0.224	-0.118	0.445	-0.553	**0.020**	-0.957	0.275
	[0.124]	[0.621]		[0.294]	[0.389]	[0.298]	[0.161]	[0.463]		[0.312]	[0.193]	[0.132]	[0.229]	[0.335]	**[0.138]**	[0.585]	[0.097]
(16) Art	-0.673	-	-	-	-	-	-0.619	-	-0.211	-	-	-0.626*	0.601	-0.119	-0.156	**-0.184**	0.310*
	[0.363]						[0.249]		[0.415]			[0.238]	[0.268]	[0.415]	[0.262]	**[0.511]**	[0.097]
(17) Education	-0.641	-	-0.121	-0.794	-	0.074	-1.869*	-	-	-	-	-1.115*	-	-0.550	-0.758	-	**0.302***
	[0.301]		[0.465]	[0.530]		[0.531]	[0.518]					[0.265]		[0.464]	[0.322]		**[0.099]**

The base category consists of Social Sciences undergraduates who have no postgraduate qualification. Standard errors given in brackets. Shading denotes significance up to the 10% level; * denotes significance at the 1% level.

Table 7c Return to postgraduate subject above that of undergraduate subject.

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Social Sciences	**1.065***	0.886	-0.064	0.361	0.055	0.210	1.183*	0.527	0.221	0.212	0.353*	1.331*	-0.194	0.497	0.332	0.423	-0.135
	[0.069]	[0.361]	[0.360]	[0.152]	[0.257]	[0.159]	[0.108]	[0.361]	[0.296]	[0.155]	[0.131]	[0.080]	[0.148]	[0.296]	[0.134]	[0.509]	[0.078]
(2) Medicine	1.318*	**1.317***	-0.090	0.265	-	0.174	-	-0.287	-	-	-	-	-	-	0.627	-	-0.006
	[0.363]	**[0.090]**	[0.142]	[0.214]		[0.362]		[0.511]							[0.363]		[0.509]
(3) Medical related	0.257	1.662*	**0.482***	0.708*	-	0.302	0.158	-	-	-	1.427*	1.443*	-	-	-	-0.199	-0.011
	[0.232]	[0.168]	**[0.097]**	[0.197]		[0.213]	[0.233]				[0.510]	[0.185]				[0.509]	[0.186]
(4) Biological sciences	0.126	1.397*	0.237	**0.305***	0.205	0.140	0.397*	-	-	-	0.349	1.164*	-0.029	-0.408	-0.003	0.314	0.125
	[0.184]	[0.197]	[0.138]	**[0.060]**	[0.184]	[0.113]	[0.142]				[0.360]	[0.109]	[0.197]	[0.362]	[0.296]	[0.258]	[0.085]
(5) Agricultural sciences	-	-	0.203	-0.340	**0.137**	-0.207	-	-0.304	-	-1.634*	-	0.252	-	-	-	-	0.364
			[0.512]	[0.202]	**[0.188]**	[0.511]		[0.300]		[0.511]		[0.260]					[0.299]
(6) Physical sciences	0.063	0.101	0.471	-0.326	0.031	**1.230***	1.369*	0.975*	0.299	-0.151	-0.336	1.139*	-0.377	-	0.119	-	0.100
	[0.166]	[0.509]	[0.229]	[0.128]	[0.362]	**[0.054]**	[0.111]	[0.100]	[0.211]	[0.159]	[0.257]	[0.090]	[0.296]		[0.296]		[0.084]
(7) Math/computing	0.154	-	0.016	-0.126	-	0.458*	**1.002***	0.123	-	-	-	1.275*	0.781	-	-0.121	-0.281	0.073
	[0.296]		[0.361]	[0.231]		[0.185]	**[0.057]**	[0.166]				[0.114]	[0.508]		[0.296]	[0.361]	[0.081]
(8) Engineering	1.243	-	-	0.159	-0.048	0.221	0.071	**0.995***	0.723*	-0.169	0.491	0.472*	1.030*	0.059	0.091	0.002	-0.064
	[0.508]			[0.294]	[0.361]	[0.123]	[0.100]	**[0.054]**	[0.259]	[0.257]	[0.361]	[0.077]	[0.359]	[0.510]	[0.296]	[0.361]	[0.108]
(9) Technology	-	-	0.457	-	-	0.324	-0.372	0.106	**0.121**	-	-	1.208*	0.671	-	-	-0.042	-1.037
			[0.510]			[0.260]	[0.297]	[0.364]	**[0.260]**			[0.234]	[0.512]			[0.512]	[0.510]
(10) Architecture	-	-	-	-	0.373	0.217	0.012	0.422	0.168	**0.035**	0.457	1.103*	-	-	-	0.346	-0.082
					[0.510]	[0.509]	[0.510]	[0.257]	[0.362]	**[0.074]**	[0.360]	[0.133]				[0.362]	[0.297]
(11) Law	-0.147	-	-	-	-	-	0.280	-	-	0.002	**0.803***	1.079*	-	1.054	-	-	0.047
	[0.198]						[0.297]			[0.508]	**[0.083]**	[0.167]		[0.510]			[0.259]
(12) Business & finance	0.177	-	-	0.336	0.229	-	0.270	0.010	0.056	0.185	0.431	**1.033***	0.241	0.473	-0.223	-0.376	0.035
	[0.142]			[0.296]	[0.255]		[0.174]	[0.361]	[0.361]	[0.257]	[0.361]	**[0.064]**	[0.361]	[0.509]	[0.259]	[0.509]	[0.098]
(13) Information	0.510	-	-	-	-	-	0.477	0.294	-	-	-	-	**0.302**	-	-	0.229	0.269
	[0.298]						[0.363]	[0.511]					**[0.233]**			[0.233]	[0.150]
(14) Languages	0.037	-	0.429	0.407	-	-	0.319	-	-	0.052	0.889	0.588*	0.063	**0.682***	-0.151	0.081	0.107
	[0.133]		[0.297]	[0.510]			[0.260]			[0.510]	[0.511]	[0.185]	[0.161]	**[0.080]**	[0.186]	[0.168]	[0.095]
(15) Humanities	0.104	0.444	-	0.303	-0.617	-0.644	0.268	0.433	-	0.192	0.576*	1.212*	0.251	-0.056	**0.352***	-0.534	0.140
	[0.118]	[0.509]		[0.258]	[0.298]	[0.258]	[0.132]	[0.296]		[0.296]	[0.154]	[0.120]	[[0.185]	[0.167]	**[0.065]**	[0.296]	[0.081]
(16) Art	0.392	-	-	-	-	-	0.565	-	0.010	-	-	0.704*	0.407	0.378	0.176	**0.239***	0.175
	[0.361]						[0.231]		[0.296]			[0.231]	[0.231]	[0.295]	[0.232]	**[0.079]**	[0.080]
(17) Education	0.424	-	-0.185	-0.432	-	0.284	-0.686	-	-	-	-	0.216	-	-0.053	-0.426	-	**0.167**
	[0.295]		[0.298]	[0.510]		[0.509]	[0.510]					[0.258]		[0.362]	[0.295]		**[0.082]**

Coefficients presented are the full interactions from equation (2) which are equal to the summed postgraduate dummies and interaction terms in equation (1). Shaded cells indicate significance up to the10% level; * denotes significance at the 1% level.

Table 7d Total return to postgraduate subject.

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Social Sciences	**1.065***	0.886	-0.064	0.361	0.055	0.210	1.183*	0.527	0.221	0.212	0.353*	1.331*	-0.194	0.497	0.332	0.423	-0.135
	[0.069]	[0.361]	[0.360]	[0.152]	[0.257]	[0.159]	[0.108]	[0.361]	[0.296]	[0.115]	[0.131]	[0.080]	[0.148]	[0.296]	[0.134]	[0.509]	[0.078]
(2) Medicine	1.758*	**1.757***	0.350*	0.705*		0.614		0.153							1.067*		0.434
	[0.359]	**[0.077]**	[0.134]	[0.208]	-	[0.359]	-	[0.509]	-	-	-	-	-	-	[0.360]	-	[0.507]
(3) Medical related	0.239	1.643*	**0.463***	0.690*		0.284	0.139				1.408*	1.424*				-0.218	-0.029
	[0.231]	[0.166]	**[0.093]**	[0.196]	-	[0.212]	[0.231]	-	-	-	[0.509]	[0.184]	-	-	-	[0.509]	[0.184]
(4) Biological sciences	0.087	1.358*	0.198	**0.266***	0.165	0.101	0.358				0.309	1.125*	-0.068	-0.447	-0.042	0.275	0.085
	[0.184]	[0.197]	[0.138]	**[0.059]**	[0.184]	[0.112]	[0.142]	-	-	-	[0.360]	[0.109]	[0.197]	[0.362]	[0.296]	[0.258]	[0.085]
(5) Agricultural sciences	-		0.228	-0.315	**0.162**	-0.183		-0.280		-1.609*		0.277					0.389
		-	[0.509]	[0.197]	**[0.183]**	[0.509]	-	[0.296]	-	[0.509]	-	[0.256]	-	-	-	-	[0.295]
(6) Physical sciences	0.079	0.117	0.487	-0.310	0.047	**1.245***	1.385*	0.991*	0.315	-0.135	-0.320	1.155*	-0.361		0.135		0.115
	[0.166]	[0.509]	[0.229]	[0.128]	[0.362]	**[0.054]**	[0.111]	[0.100]	[0.211]	[0.159]	[0.257]	[0.090]	[0.296]	-	[0.296]	-	[0.084]
(7) Math/computing	0.211		0.073	-0.069		0.515*	**1.059***	0.180				1.332*	0.838		-0.064	-0.224	0.130
	[0.296]	-	[0.361]	[0.231]	-	[0.185]	**[0.058]**	[0.166]	-	-	-	[0.114]	[0.509]	-	[0.296]	[0.361]	[0.081]
(8) Engineering	1.350*			0.267	0.060	0.328*	0.179	**1.103***	0.831*	-0.061	0.598	0.580*	1.137*	0.166	0.199	0.110	0.044
	[0.509]	-	-	[0.295]	[0.361]	[0.123]	[0.101]	**[0.055]**	[0.259]	[0.258]	[0.361]	[0.078]	[0.359]	[0.510]	[0.296]	[0.361]	[0.108]
(9) Technology	-		0.403			0.271	-0.426	0.052	**0.067**			1.155*	0.618			-0.096	-1.091
		-	[0.509]	-	-	[0.257]	[0.295]	[0.362]	**[0.257]**	-	-	[0.231]	[0.510]	-	-	[0.511]	[0.509]
(10) Architecture	-				0.382	0.227	0.022	0.431	0.178	**0.045**	0.467	1.113*				0.356	-0.073
		-	-	-	[0.509]	[0.509]	[0.509]	[0.256]	[0.362]	**[0.071]**	[0.360]	[0.131]	-	-	-	[0.361]	[0.296]
(11) Law	-0.099						0.327			0.050	**0.851***	1.126*		1.102			0.094
	[0.197]	-	-	-	-	-	[0.296]	-	-	[0.507]	**[0.079]**	[0.165]	-	[0.510]	-	-	[0.257]
(12) Business & finance	0.198			0.357	0.250		0.291	0.031	0.077	0.206	0.452	**1.054***	0.262	0.494	-0.202	-0.355	0.056
	[0.142]	-	-	[0.296]	[0.255]	-	[0.175]	[0.361]	[0.361]	[0.257]	[0.361]	**[0.065]**	[0.361]	[0.509]	[0.259]	[0.509]	[0.099]
(13) Information	0.325						0.292	0.109					**0.117**			0.044	0.084
	[0.297]	-	-	-	-	-	[0.361]	[0.510]	-	-	-	-	**[0.231]**	-	-	[0.231]	[0.147]
(14) Languages	-0.036		0.356	0.334			0.246			-0.021	0.817	0.515*	-0.010	**0.609***	-0.223	0.008	0.035
	[0.131]	-	[0.296]	[0.509]	-	-	[0.259]	-	-	[0.509]	[0.510]	[0.184]	[0.159]	**[0.076]**	[0.185]	[0.166]	[0.092]
(15) Humanities	0.012	0.352		0.211	-0.709	-0.736*	0.176	0.342		0.100	0.485*	1.121*	0.159	-0.148	**0.260***	-0.626	0.048
	[0.117]	[0.508]	-	[0.257]	[0.298]	[0.257]	[0.131]	[0.296]	-	[0.296]	[0.153]	[0.119]	[0.185]	[0.167]	**[0.064]**	[0.296]	[0.080]
(16) Art	0.203						0.376		-0.179			0.516	0.218	0.189	-0.013	**0.050**	-0.014
	[0.361]	-	-	-	-	-	[0.231]	-	[0.296]	-	-	[0.231]	[0.231]	[0.295]	[0.231]	**[0.078]**	[0.079]
(17) Education	0.416		-0.193	-0.441		0.276	-0.694					0.208		-0.062	-0.434		**0.159**
	[0.294]	-	[0.296]	[0.509]	-	[0.509]	[0.509]	-	-	-	-	[0.256]	-	[0.361]	[0.294]	-	**[0.077]**

The base group consists of Social sciences at undergraduate level but no postgraduate qualification. Coefficients presented are the full interactions from equation (2) which are equal to the summed postgraduate dummies and interaction terms in equation (1). Shaded cells indicate significance up to the10% level; * denotes significance at the 1% level.

Table 8a: Wage Return to Postgraduate Subject – Females.

Dependent variable = logged weekly wage N= 30,201 Selected=14,499	Coefficient	Standard error
Age	0.074***	0.004
Age Square	-0.001***	0.000
Married	-0.029***	0.009
First class	0.118***	0.022
Upper second class	0.086***	0.018
Lower second class	0.001	0.019
Postgraduate *Undergraduate class interactions		
Postgraduate*First class	-0.049	0.044
Postgraduate*Upper second class	0.030	0.038
Postgraduate*Lower second class	0.054	0.041
Undergraduate subject		
Medicine	0.353***	0.042
Medicine related	0.015	0.019
Biological sciences	-0.005	0.022
Agricultural sciences	0.113**	0.045
Physical sciences	0.050**	0.030
Maths/Computer science	0.105***	0.029
Engineering	0.212***	0.054
Technology	-0.129*	0.068
Architecture	0.045	0.051
Law	0.122***	0.027
Business and Finance	0.032*	0.019
Information & Communication	-0.056	0.036
Languages	0.000	0.023
Humanities	-0.034	0.025
Art	-0.149***	0.022
Education	0.059***	0.022
Postgraduate subject		
Social sciences	0.308***	0.056
Medicine	2.549***	0.280
Medicine related	0.061	0.122
Biological sciences	0.982***	0.117
Agricultural sciences	-0.258	0.314
Physical sciences	0.355	0.143
Maths/Computer science	0.297*	0.154
Engineering	0.025	0.219
Technology	0.252	0.469
Architecture	0.315**	0.136
Law	0.231**	0.113
Business and Finance	1.043***	0.079
Information & Communication	1.160***	0.217
Languages	0.239	0.238
Humanities	0.222	0.160
Arts	0.338	0.237
Education	0.212***	0.056
Year		
Year 2015	0.023	0.018
Year 2016	0.035**	0.017
Year 2017	0.079***	0.017
Constant	4.661***	0.109
Rho	-0.940***	0.002
Log Likelihood -32081.72		

Female estimates are obtained by a Heckman selection model for participation in the labour market, which is identified by having children. See notes to Table 7a. Interaction of undergraduate and postgraduate subjects are reported in Table 8b.

Table 8b: Interaction effects of subjects studied across undergraduate and postgraduate programmes: Females

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(2) Medicine	0.252	**-2.092***	2.274*	0.234	0.197	-0.144					0.159	-0.017		-0.362	-3.204*		0.052
	[0.272]	**[0.287]**	[0.169]	[0.196]	[0.455]	[0.363]	-	-	-	-	[0.353]	[0.238]	-	[0.537]	[0.523]	-	[0.214]
(3) Medical related	0.082	0.181	**1.289***	0.022	0.749	-0.185	-0.196	0.276	-0.423	0.054	0.163	-0.336		0.088	0.146		-0.010
	[0.104]	[0.309]	**[0.122]**	[0.161]	[0.383]	[0.179]	[0.241]	[0.506]	[0.574]	[0.516]	[0.300]	[0.163]	-	[0.560]	[0.325]	-	[0.092]
(4) Biological sciences	0.036	-0.239	0.743*	**-0.242**	0.512	-0.222	0.054	0.320	-0.327	-0.315	-0.080	-0.026	-1.289*	0.501	-0.127	-0.045	-0.039
	[0.096]	[0.326]	[0.132]	**[0.112]**	[0.346]	[0.172]	[0.211]	[0.323]	[0.546]	[0.290]	[0.304]	[0.117]	[0.313]	[0.354]	[0.326]	[0.407]	[0.060]
(5) Agricultural sciences	-0.310	-2.205	0.150	-0.915	**1.505***	-0.029				0.606	-0.065	-0.527			-0.137	-0.834	-0.294
	[0.342]	[0.550]	[0.247]	[0.303]	**[0.393]**	[0.283]	-	-	-	[0.485]	[0.347]	[0.253]	-	-	[0.525]	[0.528]	[0.157]
(6) Physical sciences	0.029	-2.544*	0.265	-0.776*	0.467	**0.186**	-0.091	0.235	-0.358	-0.091	-0.043	0.147	-1.004*		0.229		-0.068
	[0.225]	[0.565]	[0.171]	[0.165]	[0.362]	**[0.146]**	[0.219]	[0.251]	[0.584]	[0.252]	[0.322]	[0.179]	[0.319]	-	[0.493]	-	[0.077]
(7) Math/computing	-0.128	-2.535*	0.159	-0.773*		-0.508	**0.856***	0.790		-0.560		-0.139	-1.201*		-0.346	-0.480	-0.087
	[0.221]	[0.430]	[0.513]	[0.248]	-	[0.364]	**[0.163]**	[0.546]	-	[0.497]	-	[0.158]	[0.418]	-	[0.325]	[0.558]	[0.080]
(8) Engineering	-0.772		-0.239	-0.812			-0.433	**0.391**		-0.265	-0.072	-0.850*			0.112		-0.284
	[0.495]	-	[0.480]	[0.478]	-	-	[0.238]	**[0.238]**	-	[0.526]	[0.356]	[0.220]	-	-	[0.391]	-	[0.181]
(9) Technology	-0.982					-0.076			**0.590**			-0.196					0.536*
	[0.461]	-	-	-	-	[0.481]	-	-	**[0.549]**	-	-	[0.505]	-	-	-	-	[0.202]
(10)Architecture	-						-1.180			**0.573***	0.162	-1.011*				-1.389*	-0.147
		-	-	-	-	-	[0.482]	-	-	**[0.160]**	[0.348]	[0.291]	-	-	-	[0.539]	[0.159]
(11) Law	-0.211							-0.084		-1.475*	**0.076**	-0.649*	-1.351*		-0.377	-1.329	0.494*
	[0.191]	-	-	-	-	-	-	[0.546]	-	[0.470]	**[0.121]**	[0.148]	[0.303]	-	[0.283]	[0.536]	[0.119]
(12) Business & finance	0.435*	-1.380*		-0.792	0.035	0.506	0.535*			0.148	0.550	**0.076**	-0.709	0.040	0.078		-0.132
	[0.171]	[0.440]	-	[0.312]	[0.418]	[0.317]	[0.195]	-	-	[0.323]	[0.350]	**[0.087]**	[0.513]	[0.414]	[0.364]	-	[0.075]
(13)Information	0.612			-0.358			0.168			0.181		-0.213	**-0.956***		-0.115	-0.185	0.131
	[0.506]	-	-	[0.462]	-	-	[0.379]	-	-	[0.507]	-	[0.231]	**[0.309]**	-	[0.374]	[0.545]	[0.154]
(14) Languages	0.586*	-2.102*	0.422	-0.680	0.657		0.132		-1.050	-0.293	0.015	0.138	-0.979*	**-0.104**	0.242	-0.268	0.321*
	[0.105]	[0.530]	[0.221]	[0.274]	[0.379]	-	[0.215]	-	[0.661]	[0.495]	[0.206]	[0.112]	[0.233]	**[0.239]**	[0.199]	[0.267]	[0.057]
(15) Humanities	-0.134	-0.679	0.099	-0.961*	0.649	-0.376	-0.070			-1.451*	-0.013	-0.149	-1.166*	-0.243	**0.020**	0.151	0.607*
	[0.112]	[0.524]	[0.265]	[0.263]	[0.403]	[0.285]	[0.217]	-	-	[0.495]	[0.179]	[0.124]	[0.233]	[0.284]	**[0.164]**	[0.321]	[0.066]
(16) Art	-0.023		0.395		0.542		0.055		-0.428	-0.135	0.384	-0.479*	-0.864*	0.046	-0.196	**-0.015**	0.123
	[0.157]	-	[0.176]	-	[0.600]	-	[0.283]	-	[0.501]	[0.323]	[0.313]	[0.173]	[0.267]	[0.305]	[0.265]	**[0.239]**	[0.066]
(17) Education	-0.318		0.716*	-0.731			-0.317	0.224				0.059		-0.13	-0.526	-0.691	**0.583***
	[0.164]	-	[0.255]	[0.294]	-	-	[0.267]	[0.391]	-	-	-	[0.176]	-	[0.308]	[0.258]	[0.334]	**[0.054]**

The base category consists of Social Sciences undergraduates who have no postgraduate qualification. Standard errors given in brackets. Shaded cells denote significance up to the 10% level. * denotes significance at the 1% level.

Table 8c Return to postgraduate subject above that of undergraduate subject: Females

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Social Sciences	**0.308***	2.549*	0.061	0.983*	-0.258	0.355	0.297	0.025	0.252	0.315	0.231	1.043*	1.160*	0.239	0.222	0.338	0.212*
	[0.056]	[0.280]	[0.122]	[0.112]	[0.314]	[0.143]	[0.154]	[0.219]	[0.469]	[0.136]	[0.113]	[0.079]	[0.218]	[0.238]	[0.160]	[0.237]	[0.056]
(2) Medicine	0.560	**0.457***	2.335*	1.217*	-0.061	0.212					0.391	1.026*		-0.123	-2.982*		0.264
	[0.266]	**[0.076]**	[0.121]	[0.163]	[0.331]	[0.338]	-	-	-	-	[0.335]	[0.229]	-	[0.484]	[0.500]	-	[0.209]
(3) Medical related	0.390*	2.730*	**1.351***	1.005*	0.491	0.171	0.100	0.301	-0.171	0.369	0.394	0.707*		0.326	0.367		0.201
	[0.098]	[0.138]	**[0.050]**	[0.126]	[0.224]	[0.119]	[0.191]	[0.459]	[0.335]	[0.501]	[0.283]	[0.149]	-	[0.509]	[0.287]	-	[0.089]
(4) Biological sciences	0.344*	2.309*	0.804*	**0.740***	0.235	0.134	0.351	0.344	-0.075	0.001	0.151	1.017*	-0.129	0.739*	0.094	0.293	0.173*
	[0.093]	[0.175]	[0.073]	**[0.050]**	[0.155]	[0.109]	[0.153]	[0.244]	[0.284]	[0.262]	[0.287]	[0.101]	[0.231]	[0.267]	[0.289]	[0.336]	[0.056]
(5) Agricultural sciences	-0.002	0.343	0.211	0.068	**1.247***	0.327				0.922	0.166	0.516			0.084	-0.496	-0.082
	[0.341]	[0.477]	[0.221]	[0.285]	**[0.242]**	[0.251]	-	-	-	[0.469]	[0.333]	[0.245]	-	-	[0.503]	[0.475]	[0.155]
(6) Physical sciences	0.337	0.004	0.326	0.207	0.209	**0.541***	0.205	0.260	-0.106	0.224	0.189	1.190*	0.156		0.450		0.144
	[0.223]	[0.493]	[0.131]	[0.131]	[0.188]	**[0.061]**	[0.162]	[0.133]	[0.352]	[0.219]	[0.306]	[0.168]	[0.239]	-	[0.470]	-	[0.074]
(7) Math/computing	0.180	0.014	0.220	0.210		-0.153	**1.152***	0.814		-0.244		0.904*	-0.041		-0.125	-0.142	0.125
	[0.220]	[0.330]	[0.501]	[0.226]	-	[0.339]	**[0.070]**	[0.503]	-	[0.481]	-	[0.145]	[0.361]	-	[0.288]	[0.508]	[0.074]
(8) Engineering	-0.464		-0.178	0.170			-0.137	**0.416***		0.051	0.160	0.193			0.333		-0.073
	[0.494]	-	[0.468]	[0.467]	-	-	[0.187]	**[0.106]**	-	[0.511]	[0.342]	[0.211]	-	-	[0.361]	-	[0.180]
(9) Technology	-0.674					0.280			**0.842***			0.847					0.748*
	[0.460]	-	-	-	-	[0.463]	-	-	**[0.291]]**	-	-	[0.501]	-	-	-	-	[0.201]
(10) Architecture							-0.833			**0.899***	0.393	0.032				-1.050	0.065
	-	-	-	-	-	-	[0.459]	-	-	**[0.098]**	[0.333]	[0.285]	-	-	-	[0.487]	[0.158]
(11) Law	0.097							-0.059		-1.159	**0.307***	0.394*	-0.191		-0.156	-0.991	0.706*
	[0.190]	-	-	-	-	-	-	[0.503]	-	[0.453]	**[0.068]**	[0.134]	[0.216]	-	[0.238]	[0.484]	[0.117]
(12) Business & finance	0.743*	1.169*		0.191	-0.224	0.861*	0.832*			0.463	0.781	**1.119***	0.451	0.279	0.299		0.079
	[0.169]	[0.343]	-	[0.296]	[0.280]	[0.288]	[0.129]	-	-	[0.297]	[0.336]	**[0.061]**	[0.467]	[0.343]	[0.331]	-	[0.070]
(13) Information	0.920			0.625			0.464			0.496		0.830*	**0.204**		0.106	0.153	0.343
	[0.506]	-	-	[0.452]	-	-	[0.350]	-	-	[0.492]	-	[0.223]	**[0.225]**	-	[0.343]	[0.494]	[0.153]
(14) Languages	0.894*	0.446	0.483	0.302	0.399		0.429*		-0.798	0.022	0.246	1.181*	0.181	**0.135**	0.463*	0.071	0.532*
	[0.102]	[0.453]	[0.192]	[0.255]	[0.218]	-	[0.158]	-	[0.469]	[0.479]	[0.180]	[0.093]	[0.097]	**[0.057]**	[0.129]	[0.135]	[0.053]
(15) Humanities	0.174	1.869*	0.160	0.022	0.391	-0.020	0.227			-1.135	0.219	0.894*	-0.006	-0.005	**0.241***	0.489	0.819*
	[0.110]	[0.447]	[0.241]	[0.240]	[0.258]	[0.253]	[0.160]	-	-	[0.480]	[0.149]	[0.109]	[0.097]	[0.164]	**[0.064]**	[0.224]	[0.062]
(16) Art	0.285		0.457*		0.284		0.351		-0.177	0.181	0.615	0.564*	0.296	0.285	0.025	**0.324***	0.334*
	[0.155]	-	[0.137]	-	[0.514]	-	[0.242]	-	[0.182]	[0.297]	[0.296]	[0.162]	[0.163]	[0.198]	[0.217]	**[0.060]**	[0.062]
(17) Education	-0.010		0.777*	0.252			-0.020	0.249				1.102*		0.109	-0.304	-0.353	**0.795***
	[0.162]	-	[0.229]	[0.275]	-	-	[0.222]	[0.329]	-	-	-	[0.166]	-	[0.202]	[0.208]	[0.239]	**[0.048]**

Coefficients presented are the summed postgraduate dummies and interaction terms. Standard errors given in brackets. Shaded cells indicate significance up to the 10% level; * denotes significance at the 1% level.

Table 8d Total return to postgraduate subject.

	Postgraduate subject of study																
Undergraduate subject	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Social Sciences	**0.308***	2.549*	0.061	0.983*	-0.258	0.355	0.297	0.025	0.252	0.315	0.231	1.043*	1.160*	0.239	0.222	0.338	0.212*
	[0.056]	[0.280]	[0.122]	[0.112]	[0.314]	[0.143]	[0.154]	[0.219]	[0.469]	[0.136]	[0.113]	[0.079]	[0.218]	[0.238]	[0.160]	[0.237]	[0.056]
(2) Medicine	0.913*	**0.809***	2.688*	1.570*	0.291	0.565	-	-	-	-	0.743	1.379*	-	0.230	-2.630*	-	0.617*
	[0.264]	**[0.069]**	[0.117]	[0.160]	[0.329]	[0.336]					[0.333]	[0.226]		[0.483]	[0.499]		[0.206]
(3) Medical related	0.405*	2.744*	**1.365***	1.020*	0.506	0.185	0.115	0.315	-0.157	0.384	0.409	0.721*	-	0.341	0.382	-	0.216
	[0.098]	[0.138]	**[0.051]**	[0.126]	[0.225]	[0.119]	[0.191]	[0.459]	[0.335]	[0.501]	[0.283]	[0.149]		[0.509]	[0.287]		[0.089]
(4) Biological sciences	0.338*	2.304*	0.799*	**0.735***	0.248	0.128	0.346	0.339	-0.081	-0.005	0.146	1.011*	-0.134	0.734*	0.089	0.288	0.167*
	[0.092]	[0.175]	[0.072]	**[0.049]**	[0.155]	[0.109]	[0.152]	[0.243]	[0.284]	[0.262]	[0.287]	[0.100]	[0.230]	[0.267]	[0.289]	[0.335]	[0.055]
(5) Agricultural sciences	0.111	0.457	0.324	0.182	**1.361***	0.440	-	-	-	1.035	0.279	0.630*	-	-	0.198	-0.382	0.031
	[0.339]	[0.475]	[0.217]	[0.283]	**[0.239]**	[0.248]				[0.467]	[0.330]	[0.242]			[0.501]	[0.473]	[0.150]
(6) Physical sciences	0.387	0.055	0.377*	0.257	0.259	**0.592***	0.256	0.311	-0.056	0.274	0.239	1.240*	0.206	-	0.501	-	0.194*
	[0.222]	[0.492]	[0.129]	[0.129]	[0.187]	**[0.057]**	[0.161]	[0.131]	[0.352]	[0.218]	[0.305]	[0.167]	[0.238]		[0.469]		[0.071]
(7) Math/computing	0.285	0.119	0.325	0.315	-	-0.048	**1.257***	0.919	-	-0.139	-	1.009*	0.064	-	-0.020	-0.037	0.230*
	[0.219]	[0.329]	[0.501]	[0.225]		[0.339]	**[0.067]**	[0.502]		[0.480]		[0.144]	[0.360]		[0.287]	[0.508]	[0.071]
(8) Engineering	-0.252	-	0.034	0.382	-	-	0.075	**0.628***	-	0.263	0.371	0.405	-	-	0.545	-	0.139
	[0.491]		[0.465]	[0.464]			[0.181]	**[0.094]**		[0.509]	[0.338]	[0.206]			[0.358]		[0.172]
(9) Technology	-0.803	-	-	-	-	0.151	-	-	**0.713**	-	-	0.719	-	-	-	-	0.619*
	[0.456]					[0.458]			**[0.284]**			[0.497]					[0.190]
(10) Architecture	-	-	-	-	-	-	-0.838	-	-	**0.934***	0.439	0.078	-	-	-	-1.005	0.110
							[0.457]			**[0.087]**	[0.331]	[0.281]				[0.485]	[0.151]
(11) Law	0.219	-	-	-	-	-	-	0.063	-	-1.037	**0.429***	0.516*	-0.069	-	-0.034	-0.869	0.828*
	[0.189]							[0.503]		[0.453]	**[0.065]**	[0.133]	[0.215]		[0.237]	[0.484]	[0.116]
(12) Business & finance	0.776*	1.201*	-	0.223	-0.191	0.894*	0.864*	-	-	0.495	0.814	**1.152***	0.483	0.311	0.332	-	0.112
	[0.169]	[0.343]		[0.296]	[0.280]	[0.288]	[0.129]			[0.297]	[0.335]	**[0.061]**	[0.467]	[0.343]	[0.331]		[0.070]
(13) Information	0.864	-	-	0.570	-	-	0.409	-	-	0.441	-	0.774*	**0.148**	-	0.051	0.098	0.287
	[0.505]			[0.451]			[0.349]			[0.491]		[0.221]	**[0.223]**		[0.341]	[0.493]	[0.150]
(14) Languages	0.894*	0.446	0.484	0.303	0.399	-	0.429*	-	-0.798	0.022	0.246	1.181*	0.181	**0.135**	0.463*	0.071	0.532*
	[0.101]	[0.453]	[0.191]	[0.255]	[0.218]		[0.157]		[0.469]	[0.479]	[0.180]	[0.093]	[0.096]	**[0.055]**	[0.128]	[0.135]	[0.052]
(15) Humanities	0.140	1.835*	0.126	-0.012	0.356	-0.054	0.193	-	-	-1.170	0.184	0.860*	-0.041	-0.039	**0.207***	0.455	0.784*
	[0.109]	[0.446]	[0.240]	[0.240]	[0.257]	[0.252]	[0.160]			[0.480]	[0.148]	[0.108]	[0.095]	[0.163]	**[0.062]**	[0.223]	[0.060]
(16) Art	0.137	-	0.308	-	0.135	-	0.203	-	-0.325	0.032	0.466	0.415*	0.148	0.136	-0.123	**0.175***	0.186*
	[0.155]		[0.136]		[0.514]		[0.242]		[0.182]	[0.297]	[0.296]	[0.162]	[0.162]	[0.198]	[0.217]	**[0.060]**	[0.061]
(17) Education	0.050	-	0.837	0.311*	-	-	0.039	0.308	-	-	-	1.162*	-	0.168	-0.245	-0.293	**0.854***
	[0.162]		[0.229]	[0.275]			[0.222]	[0.329]				[0.166]		[0.202]	[0.208]	[0.240]	**[0.048]**

The base group consists of Social sciences undergraduates with no postgraduate qualification. Coefficients presented are the full interactions from equation (2) which are equal to the summed postgraduate dummies and interaction terms in equation (1). Shaded cells indicate significance up to the 10% level; * denotes significance at the 1% level.

Table A1: Overview of the literature on undergraduate and postgraduate wage returns.

Undergraduate			
Authors	**Methods and data**	**UG subjects included**	**Findings**
Dolton & Makepeace (1990)	1980 Graduates and Diplomates survey – 6 years after graduation. OLS. Logged annual earnings. UK.	No But include faculty dummy variables – base category 'other subjects'.	Male return: Engineering 4.6% Social studies 5.7% Female returns: all insignificant
Blackaby et al (1999)	Quarterly Labour Force Surveys, pooled 1993-1995. OLS. Ln weekly earnings. UK.	YES Broad subject areas Base category is highest qualification of A'levels.	Highest return males: Medical subjects 67% Maths subjects 34% Economic subjects 41% Highest return females: Medical subjects 74% Engineering 53% Maths subjects 49%
Blundell et al. (2000)	National Child Development Study 1991. Participants aged 33. Log wage. OLS taking ability into account.	YES 9 subject categories considered	Males: Economics/accountancy/law Maths/Physics Other Sciences Females: Economics/accountancy/law Engineering Maths/Physics
Bratti & Mancini (2003)	Universities Statistical Records/New Earnings Survey 1980- 1993. OLS, Propensity Score Matching and Simultaneous Equations. Ln gross weekly occupational earnings. UK.	YES But 5 broad subject areas included.	OLS and PSM methods: Economics and Business category had highest earnings 1980-93. Simultaneous equations: No stable ranking of subjects over time.
O'Leary & Sloane (2005)	UK Quarterly Labour Force Survey 1994-2002. OLS and Blinder-Oaxaca decomposition. Log earnings.	YES 9 Broad categories and 24 narrower subject categories. Base Category is Arts.	Maths and Computing 31.97% Medicine and Related 29.23% Engineering & technology 27.04%
Naylor et al. (2007)	University Statistical records/Higher Education Statistical Agency & New Earnings Survey 1985-1993. OLS. Log occupational weekly earnings. UK	YES 20 subjects included. Languages is the base category.	Highest returns males: Law 35% Business 6.3% Economics 3.8% Highest returns females: Law 24% Computing 17.9% Education 16.2%
Kelly et al (2010)	Irish Higher Education Institution leavers 2001 follow-up Survey. OLS. Log hourly earnings. Quantile regression.	YES 9 Broad subject areas included. Base category is Arts and Humanities.	Top 3 highest returns: Medicine and Veterinary sciences Education Engineering & architecture
Walker and Zhu (2011)	UK Labour Force Surveys 1994-2009 (degree class 2005-	YES 12 subject areas put into 4 broad	Both male and female returns in group consisting of:

	2009). Log wages. OLS	subject areas as include degree class. Base category Lower 2nd class and below.	Law, Economics and Management
Chevalier (2011)	LDHLE Survey UK graduates 2002/3 surveyed six months and then three years after graduation. Log annual earnings. Quantile regression.	YES 22 single subject areas. Base category is Physical science.	Highest returns: Medicine Medicine related Architecture Differences found in subject returns across genders.
Britton et al. (2016)	UK Matched Administrative tax data and Student Loan Company records. Higher Education Statistical Agency data. Longitudinal data, cohorts up to 10 Years after graduation. Quantile regression.	YES 22 subject areas. Base is creative arts.	Highest returns: Medicine Economics Marginal reduction in students taking Economics, Law, Mathematics and IT.
Belfield et al. (2018)	UK Longitudinal Educational Outcomes data, HMRC tax data and National Pupil database. Log real earnings. OLS and inverse probability weighted regression adjustment for average treatment effects.	YES 30 subject areas. All relative to the average graduate.	Medicine, Mathematics and Economics graduates earn at least 30% more than the average graduate.
Postgraduate			
Authors	**Methods and data**	**PG specific subjects included**	
Dolton & Makepeace (1990)	1980 Graduates and Diplomates survey – 6 years after graduation. OLS. Logged annual earnings. Dummy variables for PG qualification.	NO Broad faculty dummies at UG level only	Male returns: MSc 4.6% PGCE -8.3% Females: All insignificant
Blackaby et al. (1999)	Quarterly Labour Force Surveys, pooled 1993-1995. OLS. Dummy variable for PG qualification.	NO UG subjects only	Return to PG: Males 69.6% Females 84% Compared to holding no qualification.
Blundell et al. (2000)	National Child Development Study 1991. Participants aged 33. Log wage. OLS taking ability into account.	NO PG dummy variable included	Male returns: Undergraduate 12.2% PG 8.4% Female returns: Undergraduate 37% PG 37% Compared to holding at least 1 A'level.
O'Leary & Sloane (2005)	UK Quarterly Labour Force Survey 1994-2002. OLS and Blinder-Oaxaca decomposition.	NO	Male returns: Masters 29.15% PhD 31.4% Female returns: Masters 54.0%

	Log earnings.		PhD 60.02% Compared to highest qualification A'level.
Bratti et al. (2006)	UK British Cohort 30 year follow-up. OLS. Log wage	NO PG dummy variable	Males: PG 5% insignificant Females: PG 10% significant Compared to holding 2 A'levels.
Kelly et al. (2010)	Irish Higher Education Institution leavers 2001 follow-up Survey. OLS. Log hourly earnings. Dummy variables for PG diploma and degree.	NO	Returns: PG Diploma 7.5% PG Degree 14% Compared to first degree in the arts or humanities.
Walker and Zhu (2011)	UK Labour Force Surveys 1994-2009 (degree class 2005-2009). Log wages. OLS. Dummy for PG qualification.	NO 4 broad subject areas as UG analysis. Base category Lower 2nd class and below.	Return to PG: Males: Combined subjects Females: Law, Economics and Management group.
Lindley & Machin (2013)	UK - National Child Development Study; Youth Cohort Study; Labour Force survey. 1981-2011 US - Current Population Survey; National Longitudinal Survey of Youth. 1981-2011 OLS Wages	NO	In the UK in 2011 a postgraduate worker on average earns 14% more than an undergraduate. Amounts to £5,500 a year more. In the US the postgraduate premium is 29% compared to an undergraduate.
Lindley & Machin (2016)	US - Current Population Surveys 1979-2012	NO	There is a significant increase in the postgraduate wage premium over the time period, This stems from an increased demand for their superior skills.

Table A2: Tests of joint significance of coefficients.

Undergraduate	Postgraduate	F test statistic	P value
Males			
Medicine	Medicine	F = 516.93	P > F = 0.000
Medical related	Medical related	F = 24.62	P > F = 0.000
Biological sciences	Biological sciences	F = 20.18	P > F = 0.000
Agricultural sciences	Agricultural sciences	F = 0.78	P > F = 0.378
Physical sciences	Physical sciences	F = 534.26	P > F = 0.000
Math/computing	Math/computing	F = 331.26	P > F = 0.000
Engineering	Engineering	F = 401.93	P > F = 0.000
Technology	Technology	F = 0.07	P > F = 0.794
Architecture	Architecture	F = 0.40	P > F = 0.528
Law	Law	F = 114.91	P > F = 0.000
Business & finance	Business & finance	F = 262.11	P > F = 0.000
Information	Information	F = 0.26	P > F = 0.613
Languages	Languages	F = 63.84	P > F = 0.000
Humanities	Humanities	F = 16.59	P > F = 0.000
Arts	Arts	F = 0.42	P > F = 0.519
Education	Education	F = 4.19	P > F = 0.041
Females			
Medicine	Medicine	F = 138.37	P > F = 0.000
Medical related	Medical related	F = 719.17	P > F = 0.000
Biological sciences	Biological sciences	F = 228.81	P > F = 0.000
Agricultural sciences	Agricultural sciences	F = 32.33	P > F = 0.000
Physical sciences	Physical sciences	F = 107.16	P > F = 0.000
Math/computing	Math/computing	F = 351.95	P > F = 0.000
Engineering	Engineering	F = 44.62	P > F = 0.000
Technology	Technology	F = 6.33	P > F = 0.012
Architecture	Architecture	F = 115.67	P > F = 0.000
Law	Law	F = 43.57	P > F = 0.000
Business & finance	Business & finance	F = 357.41	P > F = 0.000
Information	Information	F = 0.44	P > F = 0.507
Languages	Languages	F = 5.95	P > F = 0.015
Humanities	Humanities	F = 11.02	P > F = 0.001
Arts	Arts	F = 8.62	P > F = 0.003
Education	Education	F = 310.63	P > F = 0.000

F tests of joint significance from equation (1): undergraduate subject + postgraduate subject + interaction=0.