Access all areas? The impact of fees and background on student demand for postgraduate higher education in the UK

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Abstract

This paper analyses participation in postgraduate higher education in the UK at the micro-level makes several contributions to the literature. Firstly, it describes trends in postgraduate participation in the UK. Secondly, it introduces a hitherto unavailable dataset of postgraduate tuition fees by institution and subject: the first of its kind. Thirdly, it attempts to control for several potential forms of endogeneity to assess the extent to which tuition fees affect demand. It adopts an instrumental variables approach to partially control for the potential endogeneity of tuition fees and includes a broad array of fixed effects to mitigate the impact of sorting into universities and endogenous residential selection. The results suggest that (1) there is substantial variation in tuition fees across and within institutions and that (2) tuition fees reduce demand for postgraduate places. In our preferred specification a 10% increase in tuition fees reduces the probability of progression by 1.7%.

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Philip Wales, July 2011

London School of Economics

Address for correspondence: p.d.wales@lse.ac.uk

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Postgraduate education is a large and growing part of the higher education system in the UK. In 1995/96 there were 132,333 full-time postgraduates at universities in Great Britain. By 2008/09 the number of full-time students had grown to 263,255, taking the total number of postgraduates in higher education to more than 500,000 (HESA 2010). Around 10% of graduating first-degree students progressed directly into study for a higher qualification between 2004/05 and 2008/09[1].

Recent reforms have focussed academic and policy-maker attention on first-degree students (Johnstone 2004, Chowdry et al. 2010, Barr 2010a, 2010b). Despite the large size of the postgraduate sector and the relevance of issues such as access and the impact of tuition fees, few papers have engaged with these questions beyond undergraduate level, with notable exceptions (Machin & Murphy 2010). Highlighting this research deficit, the Browne review of higher education funding concludes that trends in postgraduate study should '*be monitored carefully, including after the introduction of changes to funding and student finance*' (Browne 2010). Although the primary focus of the Review was the financing of undergraduate teaching, Browne (2010) also considered the funding arrangements for taught postgraduate courses, concluding: '*we have seen no evidence that the absence of student support in the taught postgraduate market has had a detrimental impact on access to postgraduate higher education.*'[2]

This paper seeks to address this research deficit through an examination of participation in postgraduate higher education. Using a large micro-level dataset it explores why some undergraduates choose to remain in higher education after completing their first degree and why others do not, and makes several contributions to the literature. Firstly, this paper provides a summary of previously neglected trends in postgraduate participation in the UK. Secondly, it introduces and utilises a substantial and hitherto unavailable dataset of postgraduate tuition fees by institution and subject, generated through a large number of requests made under the Freedom of Information Act. Thirdly, it uses a micro-level model

[1] Based on Destinations of Leavers from Higher Education survey from the Higher Education Statistics Agency and authors own calculations. See Section 4.
[2] Browne (2010): Section 7.4: p. 55

and seeks to control for several potential forms of endogeneity to assess the extent to which tuition fees affect demand for postgraduate education in the UK.

The paper makes a number of findings. Firstly, postgraduate fees increased faster than inflation and undergraduate tuition fees between 2003/04 and 2008/09. Secondly, there are significant differences in tuition fees within and between institutions. Thirdly, our results suggest that fees reduce student demand for postgraduate places. In our preferred specification, a 10% increase in tuition fees is associated with a 1.7% reduction in the probability of progressing to a postgraduate degree. Our results raise questions about relative lack of public funding to support research students above undergraduate level.

The remainder of this paper is structured as follows. Section Two provides a brief examination of higher education funding in the UK. Section Three surveys existing academic work. Section Four examines trends in postgraduate participation, while Section Five introduces the empirical model. Section Six summarises our data, Section Seven documents our results and Section Eight offers some discussion, conclusions and areas for future research.

2. Higher Education Funding Policy

The funding of teaching in UK higher education has been the subject of repeated policy revisions in recent years (Chowdry et al. 2010, Crawford & Dearden 2010, Barr 2009, 2010a, 2010b, Adnett & Tlupova 2007). Starting in 1998/99, a series of reforms[3] have aimed to (1) shift a greater proportion of the cost of undergraduate teaching from tax-payers to graduates, (2) to increase competitive pressure in the higher education sector to raise standards and efficiency, and (3) to ensure that the system remains accessible to all qualified students regardless of ability to pay.

To these ends, institutions derive income for teaching from both the publicly-funded Higher Education Funding Councils (HEFCs) and tuition fees paid by graduates. The balance between these two sources of income varies between subjects and across different

[3] These reforms broadly parallel international changes to higher education finance (Marcucci & Johnstone 2007, Johnstone 2004, Chapman 1997)

qualifications (Table One). At undergraduate level, students pay a common, centrally set tuition fee regardless of the subject they study or the institution they attend.[4] The larger proportion of teaching funding comes through formula-based grants from the HEFCs. These aim to equalise the amount of funding available per equivalent full-time student after controlling for subject specialism (HEFCE 2010). The HEFCs make up the difference between the estimated costs of teaching (A) and the expected average contribution of the student (B), as shown in Table One, row (C). Confronted with different costs of educating students in different subjects and a single-rate tuition fee, the HEFCs offer a smaller public subsidy for students of 'cheaper' degrees (such as Arts and Humanities) than to students of more expensive degrees (such as Clinical Medicine and Dentistry degrees). As the 'standard resource' of even the cheaper degrees exceeds the expected fee income from each student, every undergraduate receives a subsidy.

At the postgraduate level, public funding is more limited and the balance between HEFC funding and tuition fees is shifted towards the student. Once again, the HEFCs aim to equalise teaching funds on a per equivalent full-time student basis, and make up the difference between the cost of teaching and the expected student contribution. As can be seen in Table One, the public subsidy for postgraduate students is substantial – particularly for students in the more expensive, band A subjects – but is smaller than the undergraduate subsidy across the range of subjects and zero for the 'base' subjects. Based on Table One, postgraduate students in all but the most expensive subject areas bear the greater share of their costs of teaching.

The second difference between undergraduate and postgraduate funding concerns how fees are set. While undergraduate fees have effectively been centrally set, taught postgraduate fees are largely unregulated, may vary across subjects and are set independently by the institutions themselves. As a consequence there is greater intra- and inter-institution variation in fee levels which is not captured by the HEFCs workings as set out in Table One. Rather than basing 'expected' postgraduate fee income on survey data, the HEFCs set the student contribution equal to the standard resource for type 'D' degrees. Section Six sets out our findings with regard to tuition fees, but it is clear that (1) this assumption does not hold

[4] The Higher Education Act 2004 introduced a number of changes which are outside the purview of this paper and are detailed elsewhere (Barr 2010). Undergraduate institutions have had the theoretical ability to vary fees by subject since 2006/07, up to a centrally set cap. In practice the vast majority of institutions priced their courses at this maximum fee.

for many courses, (2) that postgraduate fees make up a much larger proportion of HEFCs standard resource than their grant would suggest and (3) that in some cases the level of fees is several times the level of the standard resource.

A further difference between undergraduate and postgraduate financing in the UK is the extent of public funding to help students pay tuition fees. While undergraduate students may use state-financed income-contingent loans to pay their fees, postgraduates are required to meet fees largely from their own resources, either before their course begins or in instalments during their studies. Financial support is provided through publicly funded Research Councils which specialise along academic lines and offer a limited number of scholarships for postgraduate study. These allow students domiciled in the UK and intending to study for a Masters and continue to a PhD to compete for public support to cover both living and tuition costs. Below state-level, some institutions offer financial assistance or early payment discounts, although this is not nationally mandated. In some cases undergraduates seeking to remain at their institution for postgraduate study attract a discount on their tuition fees, although the size of this discount varies.

3. Previous Work

A rigorous analysis of the determinants of participation must confront a series of empirical challenges. Selection into universities and courses based on unobservable characteristics and a shortage of suitable instruments make dependable analytical work difficult. This section surveys a number of papers which offer insightful descriptive work or analysis of participation at undergraduate level to inform our approach.

3.1 Undergraduate participation

Two recent papers examine post-secondary progression rates in the context of family income and socio-economic group. Galindo-Rueda, Gutierrez & Vignoles (2004) use data from the Youth Cohort Survey (YCS), the Higher Education Statistics Agency (HESA) and the CACI Paycheck dataset to examine how individuals from households with different levels of income have varied in their participation likelihood over time. Using individual- and postcode-level analyses, their results suggest that richer postcodes experienced a more rapid

increase in the number of students choosing to participate in higher education at age 18 between 1996 and 2000. The authors highlight the difficulty of separating the effects of economic background and educational performance before university, as students from disadvantaged backgrounds have lower average school-level attainment than wealthier students. They conclude that in 1996 (before the introduction of undergraduate tuition fees) there was a significant class divide in participation which largely reflected pre-existing patterns of educational attainment and economic background. By 2000 however, they find that economic class has a direct impact on participation probabilities, even after controlling for prior academic achievement.

Chowdry et al. (2010) use a student-level dataset to explore patterns of participation among people from different socio-economic backgrounds in the UK. They use a micro-level linear probability model with school fixed effects to try to control for selection and to explore patterns of participation in higher education. Introducing the variables in a stepwise fashion, their initial estimates suggest that male (female) students from the poorest socio-economic quintile are 40.7% (44.6%) less likely to participate in higher education than students from the top quintile. Introducing student and school characteristics alongside academic attainment at 11, 14, 16 and then 18, they find that this gap falls to 4.1% for males and 5.3% for females. Chowdry et al (2010) conclude that poorer students are less likely to attend university, but that the majority of this gap is attributable to well-documented differences in educational attainment earlier in life, rather than specific access constraints at entry to higher education.

The results of these papers confirm the findings of several others. Gayle, Berridge & Davies (2002) also use YCS data, and conclude that parental education, socio-economic class and state-school attendance all affect participation probabilities. Blanden & Machin (2004) use data from three panel surveys and similarly conclude that the recent expansion of higher education in the UK has disproportionately benefited students from wealthier backgrounds. Their detailed results suggest that after controlling for individual characteristics and prior academic achievement, family income increased in importance as a determinant of participation between 1981 and 1993.

However, while the finding of substantial inequality in undergraduate education is common, several papers challenge the notion that social class and family income are of increasing importance. Using data from the Scottish Higher Education Funding Council, Paterson (1997) concludes that while participation rates are highest among those from the top

social class, the extent of differences between individuals from different classes fell between the early 1980s and the mid-1990s. Gallacher (2006) also finds that students from the wealthiest groups are most likely to continue to higher education, but that students from the most deprived families increased their participation slightly at all types of institution in Scotland between 2001 and 2003. O'Connell, McCoy & Clancy (2006) use data from the Irish Republic and find that while patterns of social inequality in undergraduate education remain in Ireland, there has also been a gradual reduction in the extent of this gap.

3.2 Tuition fees

The introduction of undergraduate tuition fees in the UK created the potential for new papers examining student responses. Crawford & Dearden (2010) use data on four cohorts of British students to examine whether the introduction of 'top-up fees' in 2006/07 had a significant impact on participation in undergraduate higher education. Their formal analysis used a difference-in-difference approach based on limited geographical variation in the introduction of top up fees. Their results suggest that the reforms had a small, negative but insignificant impact on participation. However, they caution that because of underlying differences in the control and treatment groups their results may not be reliable. Soo & Elliot (2010) examine UK data from the University and College Admission Service (UCAS) for evidence that higher tuition fees have discouraged international undergraduate applicants to a selection of British universities. They find that demand for places is largely driven by university quality and environmental factors and that tuition fees are of second order importance.

International evidence on the impact of fees on demand for higher education is more plentiful. Flannery & O'Donoghue (2009) focus primarily on the impact of expected earnings on the probability of attending university in Ireland, but also include average tuition fees in their analysis. They find no evidence that tuition fees either reduce demand for undergraduate places or impede access to higher education for particular groups. Chapman & Ryan (2005) examine the impact of the Australian Higher Education Contribution Scheme on access, while Christofides, Hoy & Yang (2010) examine higher education participation in Canada. Chapman & Ryan (2005) find no impact of tuition fees on student demand and argue that there is no evidence to suggest that fees have deterred individuals from poor backgrounds from attending university in Australia. Christofides, Hoy & Yang (2010) find that tuition fees

do have a small, negative impact on student demand and that they affect females slightly more than males.

In contrast to these results, a large literature in the United States has reported strong evidence that students respond to price signals from higher education institutions, both in terms of the level of tuition fees and the amount of financial assistance available (Leslie & Brinkman 1987, Heller 1997). Carneiro & Heckman (2002) offer evidence on the nature and extent of credit constraints affecting higher education participation in the United States. They argue that two forms of credit constraint are relevant: (1) the short-term credit constraint which prevents some students meeting the financial cost of university, and (2) the long-term credit constraint which prevents students from buying greater ability through higher family income. They estimate that the second of these constraints is far more important in the US case, mirroring findings in the UK (Crawford & Dearden 2010).

More recent work has sought to exploit quasi-experimental methods around policy shifts to identify the impact of tuition fees and financial aid on university enrolment. Dynarski (2003, 2005) and Kane (2003, 2004) offer four such analyses. Dynarksi (2003) conducts a difference-in-difference analysis around the withdrawal of a source of financial aid for university study in 1981. After controlling for individual, parental and family characteristics as well as prior academic attainment, she finds a significant reduction in participation probabilities among eligible students following the withdrawal of the benefit scheme. Dynarksi (2005) similarly finds that the introduction of financial aid schemes in Arkansas and Georgia in 1991 and 1993 had an impact on participation, increasing university enrolment rates by around 3%.

Kane (2003) uses a similar, quasi-experimental approach to estimate the impact of the introduction of the Cal Grant program in California. Using data on 150,000 applicants to the scheme between 1998/99 and 1999/2000, he identifies the impact of eligibility for the scheme using variation in the income and Grade Point Average (GPA) scores required each year. His results suggest that eligibility for the Cal Grant scheme raised the probability of participation by between 3 and 4%. Kane (2004) exploits the introduction of a new financial aid package designed to improve the mobility of students from Washington D.C. to examine how students respond to price changes. He finds that students from the District of Colombia were more likely to attend university, and more likely to go out of state for their higher education, after the introduction of the programme.

In the UK, the literature on the impact of financial aid is more limited. Adnett (2006) summarises concerns about the decentralised nature of financial support in the UK, but Callender (2010) provides the first evidence on the nature of the bursary system established in response to recent reforms. Although it remains too early to assess their effectiveness, the data suggest that around 60% of established bursaries were designed to improve access for individuals from poor backgrounds. A further 25% were merit based and targeted individuals who achieved particular grades at school level, or excellence in a particular subject. Callender (2010) presents evidence that many of these schemes were designed to alter the composition of student bodies, to attract 'star' students and to raise a university's academic standing. Callender (2010) also raises questions about the equity of the decentralised financial aid system. In particular, she demonstrates that some poorer students at the best universities received as much as three times as much aid as equivalent students in other institutions.

3.3 Postgraduate participation

The small size of the literature on postgraduate participation represents a significant research deficit. The author is aware of only one paper which examines trends in progression to further study in the UK.

Machin & Murphy (2010) use individual level data from HESA on students in full-time undergraduate and postgraduate study in 2004/05, 2006/07 and 2008/09 to examine trends in participation in the UK. They find that the social composition of the population of postgraduates in the UK broadly reflects the social composition of the undergraduate population – suggesting that the jump from undergraduate to postgraduate study presents few additional barriers to students from poorer backgrounds. Machin & Murphy (2010) estimate that achieving a 'good' degree[5] increases the probability of progression to a postgraduate course by 12%, while attending an independent school raises the probability of progression by a further 1.2%.

Machin & Murphy (2010) also highlight the increasingly 'gateway' nature of postgraduate qualifications for careers in Law, Journalism and Economics. However, they lack data on postgraduate fees and therefore cannot provide an assessment of how these have shaped student demand in recent years. The extent to which they have controlled for selection

[5] Machin & Murphy (2010) define a 'good degree' as either First or Upper Second class honours.

based on unobservable characteristics is also unclear, but the paper provides a useful yardstick against which to judge the results of our analysis.

4. Trends in Postgraduate Participation

A range of different measures have been used to estimate participation in post-compulsory education. As students may take breaks from their studies before returning to pursue higher qualifications, aggregate birth-cohort measures of participation derived from longitudinal data or multiple cross-section surveys have advantages (Card & Lemeiux 2000), but the definition used in this paper is dictated by our dataset. Participation is here defined as the proportion of students domiciled in the UK who are enrolled in a full-time course of higher education nine- to twelve-months after graduating with a first undergraduate degree. Our results consequently capture 'direct entry' graduates and cannot take into account students who choose to pause between their undergraduate and postgraduate degrees. This is discussed further in section 8 and is a key limitation of this paper, but is similar to other work in the field (Kane 2004).

Figures One to Three show descriptive statistics for our measure of participation. Figure One shows the proportion of students who progress to a postgraduate degree. Average participation rates grew slowly until the final year of our data, from 9.6% in 2004/05 to 12.8% in 2008/9. Male enrolment exceeded female enrolment in every year, although participation rates for both genders increased sharply in 2008/09. Figure One also demonstrates that the population progressing to postgraduate study is heavily weighted in favour of students from higher occupational groups. Students from Managerial & Professional backgrounds account for 60% or more of those continuing each year between 2004/05 and 2008/09. The two lowest socio-economic groups– Routine occupations and Never Worked & Long-term Unemployed – need to be aggregated to form a group large enough for reliable inference, and account for no more than 4% of progressing students during this period.

Figure Two suggests that there are unconditional differences in enrolment rates across socio-economic groups. Students from amongst the wealthiest families enjoy a 4-6%

probability premium in their likelihood of remaining in higher education after graduating relative to students from the poorest backgrounds. However, these differences cannot account for the large inequalities demonstrated in Figure One, which implies that barriers to progression for poorer students earlier in education must play an important role (Galindo-Rueda, Gutierrez & Vignoles, 2004). If participation rates for the lowest socio-economic groups were equal to that of the highest, the number of students from the poorest backgrounds would still be less than one-fifth of the number of progressing students from wealthy families.

Academic criteria appear to be more important. Figure Three shows progression rates among all undergraduates by the class of their degree between 2004/05 and 2008/09. Around one-in-five First-class degree students choose to continue to a postgraduate degree, and 10-13% of Upper-Second class degree holders continue, compared to just 3-4% of Third-class students.

5. Empirical Model

The empirical model is built around the reduced form human capital investment model set out in Rice (1999) and developed in Card & Lemieux (2000). An individual's demand for a postgraduate place to read a particular subject-institution combination, n, in year t, is given by:

$$x^*_{i,n,t} = A_0 + A_1 D_i + A_2 B_{n,t} + A_3 C_{n,t} \quad [1]$$

Where D_i are characteristics of individual i, $B_{n,t}$ is the present discounted value of the expected benefits of a further course of study and $C_{n,t}$ captures the present value of the expected costs of a course of further study including tuition fees. As $x^*_{i,n,t}$ is unobserved, we specify a variable, x, which takes a value one where the student chooses to participate (and therefore the net present value of a further qualification is positive) and zero otherwise.

$$\Pr(x_i = 1) = \begin{cases} 0 & \text{iff } x^*_{i,n,t} < 0 \\ 1 & \text{iff } x^*_{i,n,t} > 0 \end{cases} \quad [2]$$

This specification presents several empirical challenges. First, measures of the discounted future benefits and costs of a higher degree are likely to be measured with

significant error and subject to uncertainty, both by the researcher and by the potential student. Second, unobserved characteristics are likely to influence students' choices about whether to pursue a particular degree. Individual level characteristics, such as a taste for research, or institution level characteristics, such as the extent of research training during their undergraduate degree, are both unobserved and may play significant roles.

Finally, the postgraduate fees component of $C_{n,t}$ poses two problems. Firstly, we only observe fee levels for students who choose to progress, leaving a censored distribution. Secondly, the fee levels themselves are likely to be endogenous in the level of demand. Prestigious research institutions will have higher applicant to place ratios, giving them a degree of market power which allows them to charge a higher price for their services. Failing to account for the simultaneity of prices and quantity would attribute selection into universities based on unobserved characteristics to higher fee levels and suggest a spurious, positive relation between fees and student demand.

To help to mitigate these problems, the basic specification in [1] and [2] is modified and developed. Two stages of estimation are adopted. First, we run a simple linear probability model of the form:

$$P(x_{i,n,t} = 1) = \alpha_0 + \alpha_1 D_i + \alpha_2 NB_{n,t} + \alpha_3 \bar{P}^H_{n,t} + f_n + y_t + \varepsilon_i \qquad [3]$$

On the left-hand-side is the probability that a student enrolled in an undergraduate program defined by a particular subject-institution combination, n, at time t, chooses to progress to a higher degree. On the right-hand-side are the student's characteristics, D_i, and the estimated net benefit of a further course of study, excluding the costs of tuition fees, NB, as well as year fixed effects, y_t, and fixed effects for each undergraduate subject-institution combination observed, f_n.

The tuition fee variable, $\bar{P}^H_{n,t}$, reflects the average cost of a postgraduate degree at the student's undergraduate institution in their undergraduate subject area. This fits with an intention-to-treat approach in which α_3 reflects the cost the student expects to have to bear if they pursue further study and allows us to assign an 'expected fee' to all students regardless of whether they choose to pursue further study. Our underlying assumption is that students build their expectations about the cost of further study on the tuition fee of a course of further study at their undergraduate institution in their undergraduate subject. This assumption is relaxed and modified as a robustness test.

Incorporating the arrays of fixed effects also has several important consequences. First, the fixed effects for each subject-institution combination control for the common, time invariant unobserved characteristics of both undergraduate students and the department at which they are studying. These changes amount to two additional assumptions: (1) that students reveal their preferences for research prestige when they select into their undergraduate courses, and (2) that the unobserved characteristics of the courses and the students on them are time-invariant. Inference is therefore based variation in expected fees and participation choices over time.

While these changes help to mitigate several of the empirical challenges outlined above, a second approach is required to deal with the endogeneity of postgraduate fee levels. This involves an instrumental variables (IV) strategy designed to capture variation in fees which is not attributable to changes in home student demand. Two variables are used to this end. First, following a shift-share approach, the proportion of students on each subject-institution combination who are from overseas in the two years preceding our analysis is interacted with the trade-weighted movement in the Sterling exchange rate. Higher purchasing power for Sterling raises the cost of migrating to the UK for study and reduces the demand for places from overseas. This in turn reduces pressure on the number of places available for students from the UK, reducing home fee levels. The second instrument is the level of HEFC teaching grant received by each institution divided by the number of full-time academic staff. This variable is used in log form, and is interacted in a shift-share manner with the proportion of all academic staff in each department. This generates a proxy variable for the level of academic salaries in each subject area at each university. All else equal, departments with growing staff costs will need to charge higher fee levels to break even.

6. Data

The student level data used in this paper are drawn from the Destination of Leavers from Higher Education (DLHE) dataset provided by HESA which has been analysed extensively elsewhere (Faggian & McCann 2006, 2009, Faggian, McCann & Sheppard, 2006, 2007a, 2007b, Naylor & Smith 2004, Smith & Naylor 2005, Wales 2010). The DLHE is a large survey of graduates from universities in the UK nine-twelve months after they complete

their degrees. It includes a wealth of information about what qualification the student studied for and their degree classification, as well as a range of individual characteristics and the student's pre-university postcode sector of domicile. The DLHE also provides our variable of interest, as it records what the student is doing at the time of survey. Participation is defined as those who report that they are in 'full-time study' for a 'higher degree', nine-twelve months after completing their first undergraduate degree.

Starting with all full-time, non-medical undergraduate students domiciled in Great Britain who take between three and five years to complete their degree between 2004/05 and 2008/09, who respond to the DLHE yields a sample of 786,749 students. After eliminating non-typical students who commenced their degree aged 22 or above and all those for whom there is no information about school level performance, we have a sample of 563,742. Some further attrition occurs as our data on fees, university staff records and HEFC funding is incomplete, leaving a sample of student which slightly over-represents younger students from well-off backgrounds, although these differences are relatively slight[6]. Summary statistics on included students are shown in Appendix Table B1.

6.2 Fees Data

The tuition fee dataset used in this paper represents a significant contribution to the literature. Unlike undergraduate tuition fees which have effectively been centrally set and regulated, postgraduate fees are largely unregulated and are set by individual institutions. Few attempts have been made to monitor how tuition costs at the postgraduate level have changed over time. One notable exception, the 'Public Goods' website (Reddin, 2004, 2005, 2006, 2007, 2008, 2009), contains data on 'standard' Masters course fees by institution, but contains relatively little information about different fees for different subjects at the same university.

To develop a dataset of postgraduate fees by subject and university, I contacted 159 of the 173 postgraduate degree-granting institutions in the UK and requested information about the level of postgraduate fees for each Masters course, both taught and research, offered between 2003/4 and 2009/10. Using the surveyed Masters students in the DLHE, I first constructed a matrix detailing all of the Masters courses taken at the two-digit Joint

[6] The non-response rate to the DLHE survey varies between 23.8% and 27.4% in the period under consideration. These fluctuations are assumed to be random as they do not appear to differ systematically across sub-populations.

Academic Classification of Subjects (JACS) level (Appendix A). This yielded a set of 7,917 courses, distinguished by the type of qualification (taught or research), the institution attended and the subject(s) studied. The detail of the JACS classification allows distinctions to be drawn between courses composed of different elements and different quantities of the 165 academic fields included in the taxonomy.

Using this matrix as the starting point, I manually linked each course included in the DLHE to the tuition fee information provided by institutions and specifically to the home/EU full-time price[7]. In the majority of cases a single definitive fee could be identified. In cases of small ambiguity an average of the possible courses was taken. In the minority where there was no identifiable fee, none was recorded. As not all institutions were able to provide a full time series for their courses, the final dataset includes price information for 47,380 course-institution-year combinations, of a total of 55,412, or 85.5%. A small number of institutions were excluded as their postgraduate degrees took a modular form for which it was impossible to establish a 'standard' subject fee. A small number of institutions also excluded themselves on the grounds of lost records or on the basis of the cost of gathering information[8]. Finally, to reduce the potential for bias introduced through human error, the dataset was aggregated to the JACS 1 level of detail.

The result of this data gathering process is the first dataset of postgraduate tuition fees by subject and institution in the UK. Average tuition fees at current prices increased 31.2% between 2003/04 and 2009/10, from £3293 to just over £4321, faster than inflation and higher than the rate of increase at undergraduate level (Table Two). However, this average masks significant differences in across subjects. Business Studies (comprising Business studies, Management, Marketing, Finance, Accounting and Human Resource Management) were the most expensive for most of the period, ranging from £4883 in 2003/04 to a little over £6,800 in 2009/10. Least expensive were Education courses, which varied from an average of £2,977 in 2003/04 to £3,710 in 2009/10. Among the fastest climbing courses (Figure Four) were Law degrees (rising almost 40% during the period) and Business Studies (39%), while the lowest relative increases came in Biological Science (22%) and Architecture (25%). The Russell

[7] For clarity of exposition, I shall refer to 'Home/EU full-time tuition fees' simply as 'tuition fees' from this point forward.

[8] These were Aston University, Thames Valley University, UHI Millennium Institute, St Mary's University College Twickenham

Group of research institutions has charged the highest average fees throughout the period, rising from £3294 in 2003/04 to £4411 by 2009/10.

The extent of variation in tuition fees has also risen significantly in recent years. Although universities have had the capability to vary fees by subject for several years, there has only been a gradual move away from charging the 'standard HEFC' assumed fee (Tables One and B2). In 2003/04, 74.3% of the courses for which data was gathered charged the HEFC fee, a proportion which falls gradually to 31.1% in 2009/10 and to just 23.5% among postgraduate taught courses. The deregulated nature of postgraduate tuition fees allows us to side-step the empirical difficulties that a single, universal policy shift presents for estimating changes in student demand (Crawford & Dearden, 2010).

6.3 Local Economic Data:

The empirical specification set out in [3] also demands measures of the net benefits of a higher degree relative to an undergraduate degree. Following other work in the field (Rice 1999, 2000) measures of unemployment and hourly wages are included to capture (1) the likelihood of finding employment if the student chooses not to progress and, (2) forgone earnings during further study. These data are drawn from the quarterly Labour Force Survey (LFS) records held by the Office for National Statistics (ONS). Using the micro-level record, measures of unemployment and average hourly earnings were calculated for each of the 297 travel-to-work areas in the UK based on the 1998 definitions[9]. These definitions (see Panel A of Figure Six) were aggregated to 219 entities to avoid non-disclosive sample sizes (see Panel B). Local unemployment is broadly defined as the proportion of the population aged 16 to retirement who are not working or in full-time training/study. Local wages are defined as the natural logarithm of average reported gross hourly earnings in each geographical area. Summary statistics are presented in Appendix B3.

[9] The boundaries of the 1998 travel to work areas were based on an analysis of commuting flows from the 1991 census and are deemed to more closely represent 'local economies' than administrative geographies such as local authorities or counties.

7. Results

To examine the impact of expected postgraduate tuition fees on student demand, two analyses were carried out. The first set of results is derived from a series of ordinary least squares regressions (OLS) in the likelihood of progression, conditional on a range of student characteristics and expected tuition fees. The second set of results includes the same variables, but instruments for postgraduate fees using changes in the trade-weighted exchange rate of Sterling and the level of HEFC funding per full-time academic employee. The main results are summarized in Tables Three, Four and Five. The full results are available in the Appendix.

7.1 Expected Tuition fees

Table Three summarises the findings with respect to expected postgraduate tuition fees. The dependent variable is a binary variable which takes a value one if the student is in full-time study for a higher degree nine-twelve months after graduating with their first undergraduate degree, and zero otherwise. A step-wise approach is taken to the inclusion of explanatory variables in both the OLS (Specifications 1-6) and IV (7-12) estimations.

Across the range of specifications, the coefficients estimated by OLS are smaller than those produced by the IV procedure. Specifications (1-6) suggest that expected tuition fees have a small, negative but insignificant impact on participation probabilities. This confirms the findings of other recent studies of student demand in the UK (Soo & Elliot 2010, Crawford & Dearden 2010).

Specifications (7-12) instrument for postgraduate tuition fees to partially account for their endogeneity and suggest a larger and more important role for expected tuition costs. After controlling for year effects (four) and institution-by-subject fixed effects (1,381) in specification (7), the estimated coefficient suggests that a 1% increase in expected tuition fees is associated with a 0.14% reduction in the probability of participation. This effect is significant at the 1% level, despite a substantial increase in the standard error over the OLS measure. Introducing individual level characteristics in (8) reduces the magnitude of this coefficient slightly to -0.13, but it remains significant at conventional levels.

Specification (9) incorporates controls for the student's socio-economic group and academic characteristics, including their secondary school type, performance and their

undergraduate degree class. These variables serve to increase the magnitude and standard error of the coefficient on expected tuition fees. Incorporating unemployment rates and average earnings in the student's domicile travel-to-work-area in (10) suggests that a 1% increase in expected tuition costs reduces the probability of participation by 0.17%.

To more accurately focus on the effective demand for postgraduate places, (11) and (12) limit their sample to students who obtain at least Lower Second Class honours in their undergraduate degree studies. (12) also attempts to mitigate against endogenous patterns of residential selection through an array of domicile travel-to-work-area fixed effects (219 effects). Neither of these specifications significantly alters the results of (10). (12), which reflects our preferred specification, suggests that a 1% increase in expected tuition costs is associated with a 0.17% reduction in the probability of progression.

The disparity between the OLS and IV results is significant and suggests the IV results partially resolve several empirical problems likely to hamper the least squares procedure. Firstly, the OLS results are likely to be attenuated by measurement error, both in the recording of fee levels and in the assignment of expected fees to students who change subjects or universities. Secondly, the smaller OLS results are also consistent with a mechanism for setting fees which is sensitive to patterns of demand. Stronger (weaker) demand for a particular institution-subject combination will lead to higher (lower) fee levels. Failing to control for this endogeneity in the OLS regressions therefore understates the impact of expected tuition fees on students, as it spuriously assigns higher (lower) participation probabilities to higher (lower) fees, which in turn were caused by higher (lower) demand. Failing to control for this endogeneity is a serious problem in the OLS regressions.

The IV estimates are also dependent upon our identifying assumptions. These are that (a) a stronger Sterling Exchange rate deters foreign students from coming to the UK for postgraduate study, reducing pressure on the supply of places for home students, and (b) that changes to academic salaries raise university costs but leave student demand for places unchanged. The results of our first stage regressions are shown in full in the Appendix and summarised in Table Four, which reports the estimated coefficients on the instruments, the controls included and the results of tests for the joint significance of the instruments.

These results bear out expectations. The teaching salary instrument is positively and significantly correlated with postgraduate tuition fees in each specification, which is consistent with higher input costs pushing up the price of the final good. The trade weighted

Sterling index, by contrast, is negatively and significantly correlated with postgraduate tuition fees, suggesting that a stronger Pound reduces the attractiveness of the UK as a destination for Higher Education migration, reducing pressure on postgraduate places for home students. Both variables are individually significant at conventional levels, and are jointly significant with an F-stat comfortably above the Angrist-Pishke recommended level of 10.

7.2 Socio-economic group

Table Five summarises the findings with respect to socio-economic group[10] reporting the estimated coefficients on group dummies from specifications (3-6) and (9-12). In each case the base category are students from Higher managerial and professional occupations. In contrast to the results on expected tuition fees, the estimated coefficients on socio-economic group are remarkably stable across specifications.

Compared to students from Higher managerial and professional occupations, students from lower socio-economic groups appear less likely to progress to postgraduate study. The magnitude of this effect varies, from -0.4% for students from Lower managerial and professional occupations, to -1.8% for students from the two poorest socio-economic groups, Routine occupations and Never worked & long term unemployed. Students from Lower supervisory & technical occupations and Small employers & own account worker backgrounds are 1.4% and 1.5% less likely to progress to postgraduate study respectively. Although on first glance the magnitude of these effects is relatively small, it is robust to the inclusion of a large number of individual, academic and local economic factors and a substantial set of fixed effects.

7.3 Robustness

To check that these results are not the product of our assumptions, a number of robustness checks were carried out.[11] Firstly, to test whether our assumptions about expected fees were valid, we replaced our preferred measure – the fee the student would expect to pay to study a postgraduate qualification at their undergraduate institution in their undergraduate subject – with the average fee at their undergraduate institution (controlling for the possibility that students might change subjects). In this analysis the coefficient on expected fees became

[10] Socio-economic group is here defined as the 2001-National Statistics Socio-Economic Classification (NS-SEC) which is based on the Standard Occupational Classification 2000. See Table Five for categories.

[11] The results of these robustness tests are available on request from the author.

more negative (-0.28% vs. -0.17%) and remained significant. We also estimated the correlation between our preferred fees measure and the fees paid by students who move universities for postgraduate study. The resulting strong, positive correlation suggests our assumption holds for both remaining and migrating students.

Secondly, a further set of regression results were carried out using more detailed measures of the return to a further degree. These analyses were motivated by the desire to control for changing financial rewards accruing to different higher degrees which are imperfectly captured by our proxies. Using micro-data from the Labour Force Survey (LFS), a series of regressions were run and the estimated coefficients used to impute (1) expected earnings and (2) unemployment risk for each student in our dataset. Including these characteristics in the participation regressions had no effect on the significance of expected fees, but reduced the coefficient slightly, from -0.17% to -0.15%.

To test our identifying assumptions we also ran our instrumental variables regressions using each instrument separately. In both these regressions, as in our preferred specification, the coefficient on the instrument is of the expected sign and is significant at the 5% level. The second-stage coefficient on expected fees in both cases is negative (-0.34% and -0.14% for the teaching costs and exchange rate instruments respectively). Using the teaching cost instrument generates a second stage coefficient on fees which is significant at the 5% level, while the exchange rate instrument produces a second stage coefficient which is significant at the 10% level. We also ran the regressions separately for male and female students, but as the parameters of interest were similar for each group, our preferred specification pools observations from both groups. Finally, a set of regressions were run to examine whether the fee response varied depending on the student's socio-economic group. The results of these regressions suggest that students from different backgrounds respond similarly to expected fees.

8. Discussion and Conclusions

This paper examines the impact of tuition fees on student demand for postgraduate higher education in the UK and explores patterns of participation among students from

different economic backgrounds. Using a large, micro-level dataset of students in higher education between 2004/05 and 2008/09, it makes several contributions to the literature. Firstly, it provides a summary of previously neglected trends in participation above undergraduate level. Secondly, it uses a large and hitherto unavailable dataset of postgraduate tuition fees by institution and subject. Thirdly, it uses a micro-level, two-stage model to reduce the impact of multiple forms of endogeneity to assess the extent to which postgraduate tuition fees impact on demand for postgraduate higher education in the UK.

The results suggest that students do respond to price signals in higher education and that the marginal impact of postgraduate fees may be quite large. Our preferred specification, which attempts to control for unobserved individual and departmental characteristics and which attempts to deal with the endogeneity of postgraduate fees, suggests that a 10% increase in expected tuition fees is associated with a 1.7% reduction in the probability of progressing to a postgraduate degree. The results also suggest that there are significant differences in the progression rates of students from different economic backgrounds. Students from the poorest families are 1.8% less likely to progress to a postgraduate degree than students from the wealthiest backgrounds, even after controlling for their individual characteristics and prior academic attainment. Set in the context of an average propensity to progress directly to postgraduate study of 10.7%, both these variables have the potential to have significant effects.

Two areas present scope for future work. First, the definition of participation used here only captures 'direct entry' postgraduate students. As a consequence, it fails to capture those who return to study for a higher degree after a spell of other activity. Longitudinal datasets offer scope to improve the robustness of these analyses. Further investigation to examine which sub-groups of students choose to defer further study may also shed light on access concerns. Second, this paper can say nothing about the impact of changes to undergraduate tuition fees on access to postgraduate higher education, as all the students included in our dataset took their undergraduate degrees under the same tuition fee regime. Given the price sensitivity these results suggest, further research is urgently needed to examine the effect of student debt on willingness to pursue higher degrees in the UK.

Two implications of our results for policy are especially clear. Firstly, a systematic effort is needed to monitor all postgraduate tuition fees in the UK. The absence of a database of fees by subject, institution and qualification level has presented a significant barrier for

research and is an essential pre-requisite for efforts to effectively monitor access above undergraduate level, as demanded by the Browne Review (Browne 2010). Recent policy reforms to encourage institutions to charge different rates for undergraduate courses must also be accompanied with effective monitoring.

Secondly, there is a need to re-examine how public support for postgraduate study is allocated. The 'assumed fee' used by the Higher Education Funding Councils understates the true student contribution in many cases and therefore fails to equalise per equivalent student funding. Our results suggest that students from poorer backgrounds (1) are under-represented in postgraduate study and (2) that the jump from undergraduate to postgraduate study presents an additional barrier, through both level effects and the deterrent effect of tuition fees. Policy makers should consider the funding arrangements for postgraduate study and in particular the extent of public support for students from low income backgrounds who aspire to study beyond undergraduate level.

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Table One: Public & private per-student funding (£) for undergraduate & postgraduate studies in the UK: 2010-11[1]

	Undergraduate				Postgraduate			
Subject Group[2]:	D	C	B	A	D	C	B	A
(A) Standard Resource	3,951	5,136	6,717	15,804	3,951	5,136	6,717	15,804
(B) Expected Fees[3]	1,310 (33.2%)	1,310 (22.5%)	1,310 (19.5%)	1,310 (8.3%)	3,951 (100%)	3,951 (76.9%)	3,951 (58.8%)	3,951 (25.0%)
(C) HEFCE Grant	2,641 (66.8%)	3,826 (74.5%)	5,407 (80.5%)	14,494 (91.7%)	0 (0%)	1,185 (23.1%)	2,766 (41.2%)	11,853 (75.0%)

Notes: (1) Based on HEFCE (2010). (2) Subject groups are defined by HEFCE. Group A includes clinical stages of medicine and dentistry courses and veterinary science. Group B includes laboratory based subjects, including pre-clinical stages of medicine & dentistry, engineering and technology. Group C includes subjects with a studio, laboratory or fieldwork element. Group D includes all other subjects. (3) Expected Fees reflect HEFCE assumptions, set by statutory instrument. These have continued to reflect tuition fees in the pre-Higher Education Act 2004 era as a result of a consultation carried out by HEFCE in 2005. See HEFCE (2006) for more detail.

Table Two: UK Tuition Fees 2003/04-2009/10

	£, current			£, current by institutional group			
	UG[1]	Public Goods[2]	FOI Dataset[3]	Russell Group[5]	1994 Group[6]	Million+[7]	University Alliance[8]
2003/04	1125	3048	3293	3294	3233	3206	3216
2004/05	1150	3031	3498	3572	3369	3319	3392
2005/06	1175	3441	3678	3790	3572	3496	3522
2006/07	3000[4]	3730	3855	3964	3686	3730	3723
2007/08	3070	3970	4037	4160	3822	3943	3938
2008/09	3145	3989	4167	4320	3962	3960	4074
2009/10	3225	4191	4321	4411	4169	4250	4251

Notes: (1) Regulated undergraduate annual fee levels for students starting in that academic year. (2) Average postgraduate fee as reported by Reddin (2004-2009). (3) Average postgraduate fee based on freedom of information requests carried out for this paper. (4) Undergraduate fees increased due to a policy shift between 2005/06 and 2006/07. (5) Russell Group of research institutions is a group twenty research institutions in the United Kingdom. (6) 1994 Group is a group of nineteen 'smaller research-intensive' institutions. (7) Million+ is a group of 27 universities including many former poly-techniques. (8) University Alliance is a group of 23 universities which focus on business courses.

Table Three: Expected postgraduate tuition fees & participation probabilities[1,9]

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
ln(Expected Fees)[2]	-0.007 (0.007)	-0.006 (0.007)	-0.005 (0.007)	-0.006 (0.007)	-0.007 (0.008)	-0.006 (0.008)	**-0.140**** (0.034)	**-0.130**** (0.034)	**-0.167*** (0.070)	**-0.172*** (0.072)	**-0.167*** (0.071)	**-0.171*** (0.073)
Controls												
Subject*Institution FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Personal Characteristics[3]		Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
School Type[4]			Y	Y	Y	Y			Y	Y	Y	Y
School Performance[5]			Y	Y	Y	Y			Y	Y	Y	Y
Socio-economic group			Y	Y	Y	Y			Y	Y	Y	Y
UG Degree Class			Y	Y	Y	Y			Y	Y	Y	Y
Labour Market Effects[6]				Y	Y	Y				Y	Y	Y
Domicile TTWA FE[7]						Y						Y
Sample[8]	ALL	ALL	ALL	ALL	Selection	Selection	ALL	ALL	ALL	ALL	Selection	Selection
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV	IV
Diagnostics												
Observations	658,618	658,618	528,430	524,941	495,996	495,996	612,531	612,531	493,664	490,358	463,197	463,197
Main Equation F-stat	**126.52****	**73.33****	**72.51****	**68.64****	**69.88****	**14.16****	**103.19****	**70.58****	**68.53****	**64.75****	**66.09****	**13.96****
Angrist-Pishke							**54.95****	**54.96****	**29.09****	**28.83****	**28.71****	**28.74****

Notes: (1) Dependent variable is a binary indicator of whether the student progressed to postgraduate higher education. Estimated coefficients are shown with standard errors in brackets. Standard errors are clustered at the Institution-by-subject level. (2) ln(Expected Fees) is the natural logarithm of the average cost of a course of higher study at the student's undergraduate institution in their undergraduate subject, see Section Five. (3) Personal characteristics include dummy variables for age, gender, ethnicity and disability status. (4) School type is defined as State, Private or Unknown. (5) School Performance includes dummies for the quartile position of students in the A-level point score distribution in their year of undergraduate commencement. (6) Labour market effects consist of average hourly earnings and the rate of unemployment in the student's domicile travel-to-work-area. (7) 219 domicile travel to work areas are included, see Section Five. (8) Specifications (5)-(6) and (11)-(12) include only students obtaining Lower Second Class UG degree classification or above. (9) * and ** reflect significance at the 5% and 1% levels respectively.

Table Four: First stage IV results for Expected postgraduate fees[1,6]

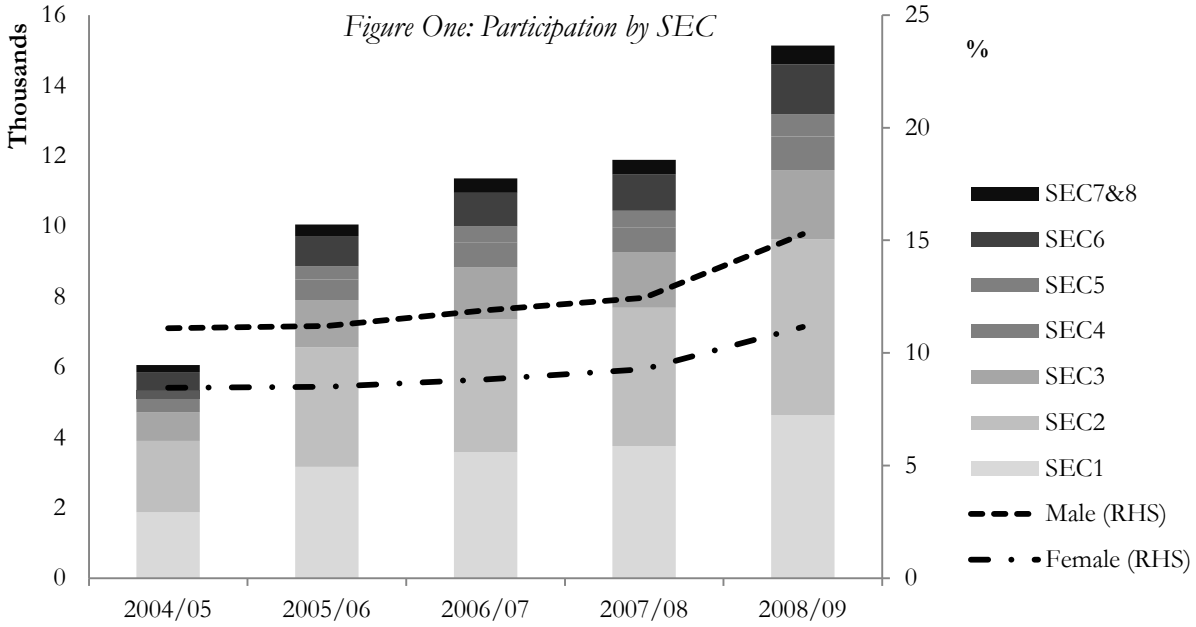
	(7)	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Instruments						
Subject-weighted teaching grant per academic staff FPE[2]	**0.049**** (0.012)	**0.049**** (0.012)	**0.040**** (0.010)	**0.040**** (0.009)	**0.040**** (0.009)	**0.040**** (0.009)
Overseas share * Trade weighted Sterling[3]	**-0.042*** (0.017)	**-0.042*** (0.017)	**-0.033*** (0.015)	**-0.033*** (0.015)	**-0.033*** (0.015)	**-0.033*** (0.015)
Controls (see Table Three)[4]	Y	Y	Y	Y	Y	Y
Sample[5]	All	All	All	All	Selection	Selection
Diagnostics						
Observations	612,531	612,531	493,664	490,358	463,197	463,197
Main Equation F-stat	**103.19****	**70.58****	**68.53****	**64.75****	**66.09****	**13.96****
Angrist-Pishke	**54.95****	**54.96****	**29.09****	**28.83****	**28.71****	**28.74****

Notes: (1) Dependent variable is the natural logarithm of the average cost of a course of higher study by subject and institution, see Section Five. Estimated coefficients are shown with standard errors in brackets. Standard errors are clustered at the Institution-by-subject level. (2) The HEFC teaching grant awarded to each institution divided by the number of full-time equivalent academic staff, which is logged and interacted with the proportion of academic staff in each subject in 2003/4. (3) The share of overseas students taking each subject at each institution in 2002/03 and 2003/04 is interacted with the trade weighted Sterling exchange rate. (4) Controls included are shown in Table Three and vary across the reported specifications. (5) Specifications (5)-(6) and (11)-(12) include only students obtaining Lower Second Class UG degree classification or above. (6) * and ** reflect significance at the 5% and 1% levels respectively.

Table Five: Socio-economic group & participation probabilities[1,4]

	(3)	*(4)*	*(5)*	*(6)*	*(9)*	*(10)*	*(11)*	*(12)*
Socio-economic group								
Lower managerial and professional occupations	**-0.004**** (0.001)	**-0.005**** (0.001)	**-0.005**** (0.001)	**-0.005**** (0.001)	**-0.005**** (0.001)	**-0.005**** (0.001)	**-0.005**** (0.001)	**-0.005**** (0.001)
Intermediate occupations	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)
Small employers and own account workers	**-0.015**** (0.002)	**-0.015**** (0.002)	**-0.016**** (0.002)	**-0.015**** (0.002)	**-0.015**** (0.002)	**-0.016**** (0.002)	**-0.016**** (0.002)	**-0.016**** (0.002)
Lower supervisory and technical occupations	**-0.014**** (0.002)	**-0.015**** (0.002)	**-0.014**** (0.002)	**-0.015**** (0.002)	**-0.014**** (0.002)	**-0.015**** (0.002)	**-0.015**** (0.002)	**-0.015**** (0.002)
Semi-routine occupations	**-0.011**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.012**** (0.002)	**-0.013**** (0.002)	**-0.013**** (0.002)	**-0.013**** (0.002)
Routine occupations & Never worked and long-term unemployed	**-0.017**** (0.002)	**-0.018**** (0.002)	**-0.018**** (0.002)	**-0.018**** (0.002)	**-0.017**** (0.002)	**-0.018**** (0.002)	**-0.018**** (0.002)	**-0.018**** (0.002)
Not classified	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)	-0.002 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Controls (see Table Three)[2]	Y	Y	Y	Y	Y	Y	Y	Y
Sample[3]	All	All	Selection	Selection	All	All	Selection	Selection
Estimation Method	OLS	OLS	OLS	OLS	IV	IV	IV	IV

Notes: (1) Dependent variable is a binary indicator of whether the student progressed to postgraduate higher education. Estimated coefficients are shown with standard errors in brackets. Standard errors are clustered at the Institution-by-subject level. (2) Controls included are shown in Table Three and vary across the reported specifications. (3) Specifications (5)-(6) and (11)-(12) include only students obtaining Lower Second Class UG degree classification or above. (4) * and ** reflect significance at the 5% and 1% levels respectively.

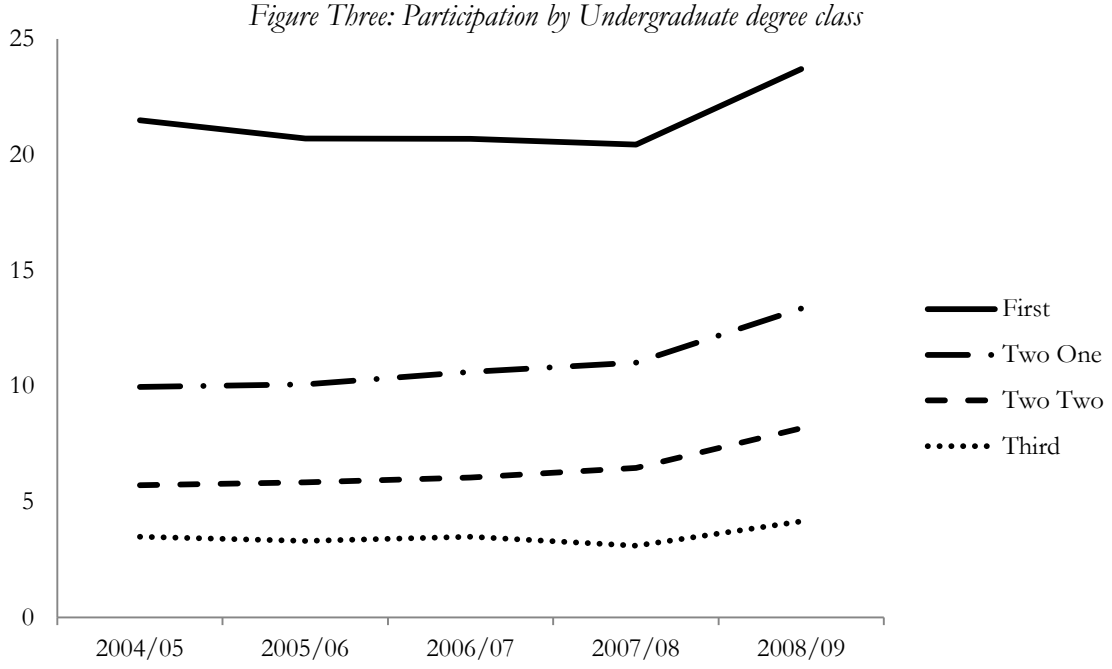


Notes: (1) Based on HESA DLHE data and author's own calculations.

Figure Two: Cohort Participation Rates by SEC

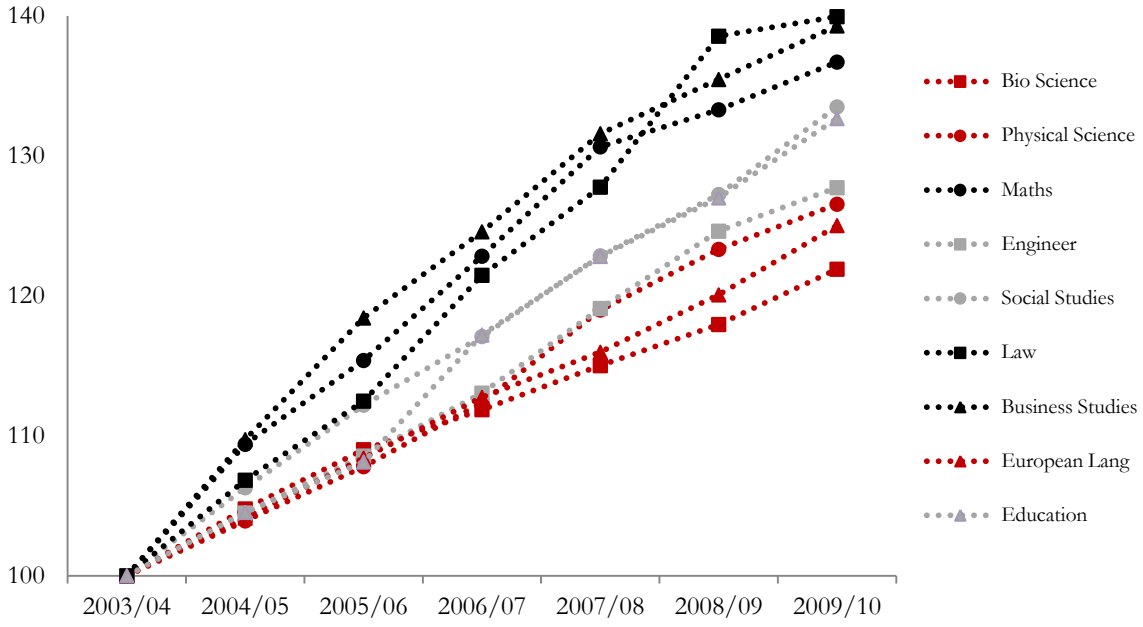
Notes: (1) Based on HESA DLHE data and author's own calculations

Figure Three: Participation by Undergraduate degree class



Notes: (1) Based on HESA DLHE data and author's own calculations

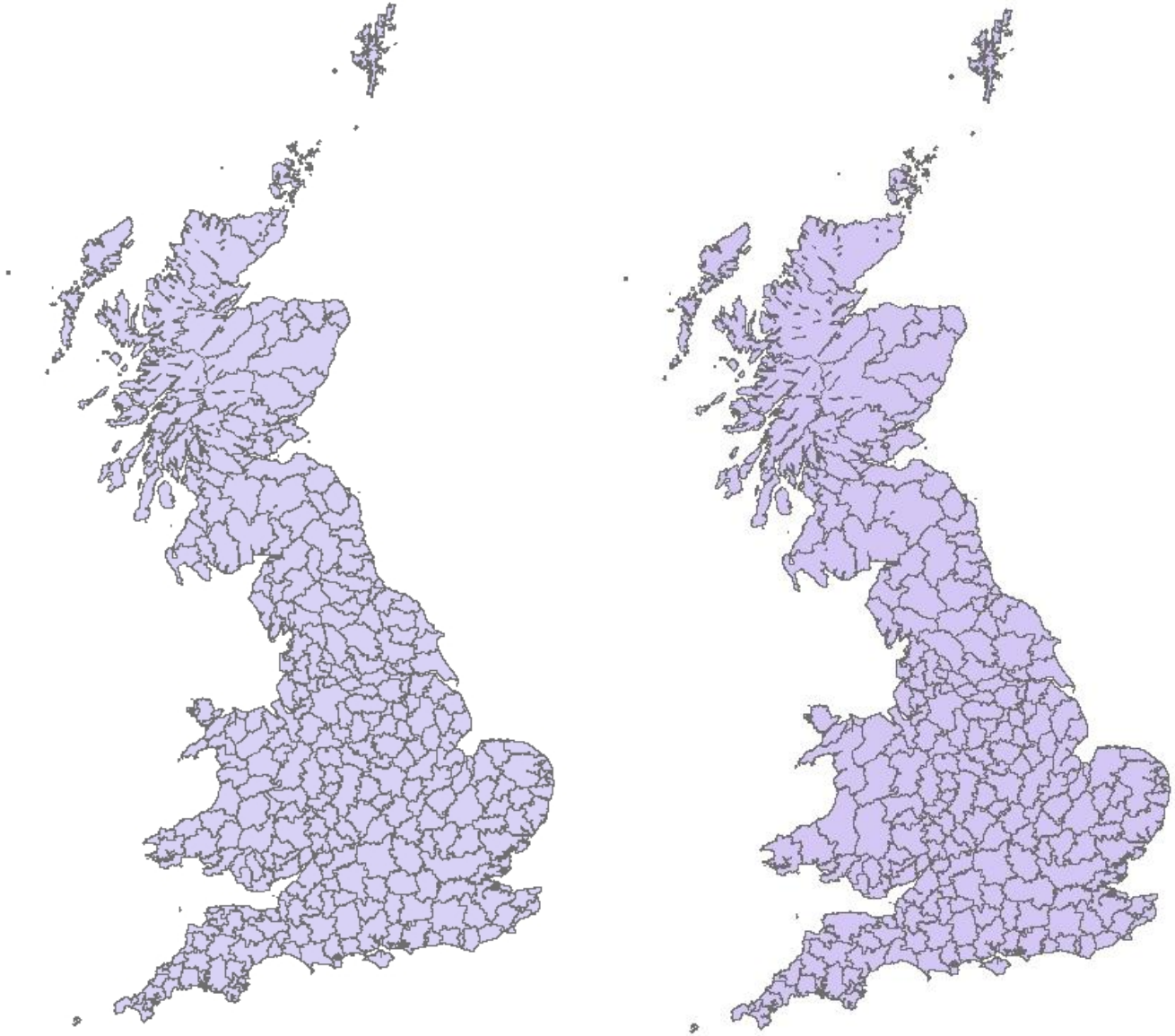
Figure Four: Postgraduate Tuition Fees by Academic Field



Notes: Based on FOI data requested for this paper and authors own calculations

Figure Five: 1998 Travel to work areas: Original & Modified

Panel A: Original	*Panel B: Modified*



Appendix

Appendix A: Joint Academic Classification of Subjects[1]

JACS2 Subject	*JACS3 Codes*
Degrees related to Medicine	B0-B9
Biological Science	C0-C9
Veterinary Science	D0-D9
Physical Science	F0-F9
Mathematics	G0-G92
Engineering	H0-H9
Mineral Technology	J1-J9
Architecture	K0-K9
Social Sciences	L0-L9
Law	M0-M9
Business Studies	N0-N9
Communications	P0-P9
Lang, Ling and Classics	Q0-Q9
European Languages	R1-R9
Other Languages	T1-T9
History	V0-V9
Art and Music	W0-W9
Education	X0-X9
Combined degrees	Y0

Notes: (1) Listings available at www.hesa.ac.uk

Appendix B:

Table B1: Summary Statistics for Individual Level HESA Data

	Males		*Females*	
	Frequency	*%*	*Frequency*	*%*
Total	289,800	*44.0*	368,830	*56.0*
Ethnicity				
White	242,920	*83.8*	311,850	*84.6*
Black	5,470	*1.9*	9,450	*2.6*
Asian	27,870	*9.6*	31,900	*8.6*
Other	7,790	*2.7*	10,300	*2.8*
Unknown	5,750	*2.0*	5,330	*1.4*
Year				
2004/05	55,260	*19.1*	69,670	*18.9*
2005/06	56,200	*19.4*	71,460	*19.4*
2006/07	57,250	*19.8*	72,930	*19.8*
2007/08	58,880	*20.3*	75,920	*20.6*
2008/09	62,210	*21.5*	78,840	*21.4*
School				
State	218,920	*75.5*	289,800	*78.6*
Private	40390	*13.9*	40300	*10.9*
Unknown	30490	*10.5*	38730	*10.5*
Undergraduate degree class				
First	41,550	*14.3*	46,150	*12.5*
Upper Second	139,250	*48.0*	206,020	*55.9*
Lower Second	86,140	*29.7*	97,030	*26.3*
Third	16,120	*5.6*	11,380	*3.1*
Unclassified	6,750	*2.3*	8,240	*2.2*
Progression Rates				
Further Study	36,070	*12.4*	34,230	*9.3*
Other	253,730	*87.6*	334,600	*90.7*
Socio-economic group				
SEC1	59,680	*20.6*	71,830	*19.5*
SEC2	69,620	*24.0*	91,850	*24.9*
SEC3	30,260	*10.4*	40,140	*10.9*
SEC4	14,880	*5.1*	20,720	*5.6*
SEC5	10,500	*3.6*	14,410	*3.9*
SEC6	20,930	*7.2*	29,480	*8.0*
SEC7 & 8	9,440	*3.3*	13,530	*3.7*
Unknown	74,490	*25.7*	86,870	*23.6*

Notes: (1) Figures are for all academic years combined, percentages based on proportion of gender group. (2) Figures may not sum to totals due to rounding. (3) Progression rates based on direct entry graduates, see Sections Four and Eight.

Table B2: Variation in Postgraduate Tuition Fees: 2003/04-2008/09

	% Courses within +/- £10 of HEFC Fee	Standard Deviation	Observations
2003/04	74.3	1608	6265
2004/05	63.9	1833	6376
2005/06	55.2	1972	6503
2006/07	48.6	2051	6699
2007/08	44.0	2172	6756
2008/09	33.5	2266	7225
2009/10	31.1	2303	7556

Notes: Based on data gathered by FOI requests and authors own calculations.

Table B3: Average Gross Hourly Wages and Average Unemployment Rates: 2004-2008[1]

	Hourly Earnings (Current £)		*Unemployment Rates (%)*	
	Average	Standard Deviation	Average	Standard Deviation
2004	9.65	1.41	22.64	5.19
2005	9.94	1.42	17.58	4.16
2006	10.52	1.50	18.18	3.85
2007	10.90	1.46	18.19	3.99
2008	11.57	1.53	18.38	3.39

Notes: (1) Annual gross hourly wages across 219 amalgamated TTWAs at current prices based on pooled four-quarter averages from LFS. (2) Unemployment rate – including all economically active who are out of work – averaged across 219 amalgamated TTWAs.

Appendix C.1: Detailed Results: Main Equation[1]

	(1)		(2)		(3)		(4)		(5)		(6)	
	β	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*
ln(Fee)[2]	-0.007	0.007	-0.006	0.007	-0.005	0.007	-0.006	0.007	-0.007	0.008	**-0.006****	0.008
Year 2005	**-0.005****	0.001	**-0.004****	0.001	**-0.006****	0.002	**-0.007****	0.002	**-0.007****	0.002	**-0.007****	0.002
Year 2007	**0.006****	0.001	**0.005****	0.001	**0.004****	0.001	**0.006****	0.001	**0.005****	0.002	**0.005****	0.002
Year 2008	**0.011****	0.001	**0.012****	0.001	**0.008****	0.002	**0.010****	0.002	**0.010****	0.002	**0.009****	0.002
Year 2009	**0.036****	0.002	**0.036****	0.002	**0.033****	0.002	**0.035****	0.002	**0.036****	0.002	**0.036****	0.002
Female			**-0.022****	0.001	**-0.029****	0.001	**-0.029****	0.001	**-0.031****	0.001	**-0.031****	0.001
Age 20			0.002	0.003	**0.010****	0.003	**0.010****	0.003	**0.010****	0.003	**0.010****	0.003
Age 21			-0.002	0.002	**0.005****	0.002	**0.004****	0.002	**0.004****	0.002	**0.004***	0.002
Age 23			**-0.006****	0.001	**-0.007****	0.002	**-0.007****	0.002	**-0.007****	0.002	**-0.006****	0.002
Age 24			-0.003	0.002	**-0.007***	0.003	**-0.007***	0.003	-0.006	0.003	-0.006	0.003
Age 25			**0.008****	0.003	0.005	0.004	0.004	0.004	0.004	0.005	0.004	0.005
Age 26			-0.004	0.005	-0.014	0.009	-0.014	0.009	-0.018	0.009	-0.018	0.009
Age 27			-0.010	0.014	**-0.055****	0.020	**-0.054****	0.020	**-0.089****	0.023	**-0.089****	0.024
Disability Status			**0.024****	0.002	**0.030****	0.002	**0.030****	0.002	**0.031****	0.002	**0.031****	0.002
Ethnicity Black			**0.038****	0.004	**0.054****	0.004	**0.057****	0.004	**0.056****	0.004	**0.058****	0.004
Ethnicity Asian			**0.033****	0.002	**0.050****	0.003	**0.051****	0.003	**0.052****	0.003	**0.052****	0.003
Ethnicity Other			**0.033****	0.003	**0.035****	0.003	**0.037****	0.003	**0.037****	0.003	**0.037****	0.003
Ethnicity Unknown			**0.021****	0.004	**0.027****	0.005	**0.027****	0.005	**0.028****	0.005	**0.027****	0.005
School Private					**0.008****	0.002	**0.009****	0.002	**0.009****	0.002	**0.010****	0.002
School Unknown					0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
SEC2					**-0.004****	0.001	**-0.005****	0.001	**-0.005****	0.001	**-0.005****	0.001
SEC3					**-0.012****	0.002	**-0.012****	0.002	**-0.012****	0.002	**-0.012****	0.002
SEC4					**-0.015****	0.002	**-0.015****	0.002	**-0.016****	0.002	**-0.015****	0.002
SEC5					**-0.014****	0.002	**-0.015****	0.002	**-0.014****	0.002	**-0.015****	0.002
SEC6					**-0.011****	0.002	**-0.012****	0.002	**-0.012****	0.002	**-0.012****	0.002
SEC7&8					**-0.017****	0.002	**-0.018****	0.002	**-0.018****	0.002	**-0.018****	0.002
SEC Unknown					-0.001	0.002	-0.001	0.002	-0.001	0.002	-0.001	0.002
UG Class First					**0.177****	0.006	**0.177****	0.006	**0.134****	0.004	**0.134****	0.004
UG Class Upper Second					**0.084****	0.003	**0.084****	0.003	**0.041****	0.002	**0.041****	0.002
UG Class Lower Second					**0.043****	0.002	**0.043****	0.002				
UG Class Unknown					0.008	0.007	0.008	0.007				
School Results 2nd Quartile					**-0.009****	0.001	**-0.009****	0.001	**-0.009****	0.001	**-0.009****	0.001
School Results 3rd Quartile					**-0.013****	0.002	**-0.013****	0.002	**-0.013****	0.002	**-0.013****	0.002
School Results 4th Quartile					0.000	0.002	-0.001	0.002	-0.002	0.002	-0.002	0.002
Domicile Unemployment[2]							0.015	0.013	0.018	0.013	**-0.050***	0.024
Domicile Hourly Earnings[2]							**-0.028****	0.003	**-0.030****	0.004	-0.011	0.008
Observations	658,618		658,618		528,430		524,941		495,996		495,996	
F-stat	**126.52****		**73.33****		**72.51****		**68.64****		**69.88****		**14.16****	

Notes: (1) Dependent variable is a binary indicator of whether the student progressed to postgraduate higher education. Standard errors are clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. * and ** reflect significance at the 5% and 1% levels respectively. Excluded dummy variable categories: Year: 2005/6, Age at graduation: 22, Ethnicity: White, School Type: State, SEC: Group 1, UG Class: Third, School Results: 1st quartile (highest performers), UG Subject: Social Sciences. (2) These variables are continuous.

Appendix C.2: Detailed Results: Main Equation[1]

	(7)		(8)		(9)		(10)		(11)		(12)	
	β	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*
ln(Fee)[2]	**-0.140****	0.034	**-0.130****	0.034	**-0.167***	0.070	**-0.172***	0.072	**-0.167***	0.071	**-0.171***	0.073
Year 2005	**-0.011****	0.002	**-0.010****	0.002	**-0.012****	0.003	**-0.013****	0.003	**-0.013****	0.003	**-0.013****	0.003
Year 2007	**0.012****	0.002	**0.011****	0.002	**0.012****	0.004	**0.013****	0.004	**0.012****	0.004	**0.012****	0.004
Year 2008	**0.022****	0.003	**0.022****	0.003	**0.021****	0.006	**0.023****	0.006	**0.023****	0.006	**0.023****	0.006
Year 2009	**0.052****	0.005	**0.051****	0.005	**0.052****	0.008	**0.055****	0.009	**0.055****	0.009	**0.056****	0.009
Female			**-0.022****	0.001	**-0.029****	0.001	**-0.029****	0.001	**-0.031****	0.001	**-0.031****	0.001
Age 20			0.001	0.003	**0.009****	0.003	**0.009****	0.003	**0.010****	0.003	**0.009****	0.003
Age 21			-0.001	0.002	**0.005****	0.002	**0.004****	0.002	**0.004****	0.002	**0.004***	0.002
Age 23			**-0.006****	0.001	**-0.007****	0.002	**-0.007****	0.002	**-0.007****	0.002	**-0.007****	0.002
Age 24			-0.003	0.002	**-0.007***	0.003	**-0.008***	0.003	**-0.007***	0.003	**-0.007***	0.003
Age 25			**0.008****	0.003	0.005	0.005	0.005	0.005	0.005	0.005	0.004	0.005
Age 26			-0.004	0.005	-0.010	0.009	-0.010	0.009	-0.014	0.010	-0.014	0.010
Age 27			-0.006	0.015	**-0.059****	0.019	**-0.059****	0.019	**-0.104****	0.014	**-0.105****	0.015
Disability Status			**0.024****	0.002	**0.031****	0.002	**0.030****	0.002	**0.032****	0.002	**0.032****	0.002
Ethnicity Black			**0.038****	0.004	**0.055****	0.004	**0.058****	0.004	**0.057****	0.004	**0.058****	0.004
Ethnicity Asian			**0.033****	0.002	**0.050****	0.003	**0.051****	0.003	**0.052****	0.003	**0.052****	0.003
Ethnicity Other			**0.034****	0.003	**0.036****	0.003	**0.038****	0.003	**0.038****	0.003	**0.038****	0.003
Ethnicity Unknown			**0.022****	0.004	**0.028****	0.005	**0.028****	0.005	**0.029****	0.005	**0.029****	0.005
School Private					**0.008****	0.002	**0.009****	0.002	**0.009****	0.002	**0.009****	0.002
School Unknown					0.003	0.002	0.002	0.002	0.003	0.002	0.002	0.002
SEC2					**-0.005****	0.001	**-0.005****	0.001	**-0.005****	0.001	**-0.005****	0.001
SEC3					**-0.012****	0.002	**-0.012****	0.002	**-0.012****	0.002	**-0.012****	0.002
SEC4					**-0.015****	0.002	**-0.016****	0.002	**-0.016****	0.002	**-0.016****	0.002
SEC5					**-0.014****	0.002	**-0.015****	0.002	**-0.015****	0.002	**-0.015****	0.002
SEC6					**-0.012****	0.002	**-0.013****	0.002	**-0.013****	0.002	**-0.013****	0.002
SEC7&8					**-0.017****	0.002	**-0.018****	0.002	**-0.018****	0.002	**-0.018****	0.002
SEC Unknown					-0.001	0.002	-0.002	0.002	-0.001	0.002	-0.001	0.002
UG Class First					**0.177****	0.008	**0.177****	0.008	**0.134****	0.005	**0.134****	0.005
UG Class Upper Second					**0.084****	0.007	**0.084****	0.007	**0.041****	0.002	**0.041****	0.002
UG Class Lower Second					**0.043****	0.007	**0.043****	0.007				
UG Class Unknown					0.008	0.007	0.008	0.007				
School Results 2nd Quartile					**-0.010****	0.001	**-0.010****	0.001	**-0.010****	0.002	**-0.010****	0.002
School Results 3rd Quartile					**-0.013****	0.002	**-0.013****	0.002	**-0.014****	0.002	**-0.013****	0.002
School Results 4th Quartile					-0.001	0.003	-0.002	0.003	-0.002	0.003	-0.002	0.003
Domicile Unemployment[2]							0.020	0.013	0.023	0.013	**-0.053***	0.025
Domicile Hourly Earnings[2]							**-0.028****	0.004	**-0.030****	0.004	-0.012	0.008
Observations	612,531		612,531		493,664		490,358		463,197		463,197	
F-stat	**103.19****		**70.58****		**68.53****		**64.75****		**66.09****		**13.96****	

Notes: (1) Dependent variable is a binary indicator of whether the student progressed to postgraduate higher education. Standard errors are clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. * and ** reflect significance at the 5% and 1% levels respectively. Excluded dummy variable categories: Year: 2005/6, Age at graduation: 22, Ethnicity: White, School Type: State, SEC: Group 1, UG Class: Third, School Results: 1st quartile (highest performers), UG Subject: Social Sciences. (2) These variables are continuous.

Appendix C.3: Detailed Results: First Stage Equation[1]

	(7)		*(8)*		*(9)*		*(10)*		*(11)*		*(12)*	
	β	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*	*β*	*s.e*
Teaching Cost[2]	**0.049****	0.012	**0.049****	0.012	**0.040****	0.01	**0.040****	0.009	**0.040****	0.009	**0.040****	0.009
Trade Weighted GBP[2]	**-0.042***	0.017	**-0.042***	0.017	**-0.033***	0.015	**-0.033***	0.015	**-0.033***	0.015	**-0.033***	0.015
Year 2005	**-0.042****	0.003	**-0.042****	0.003	**-0.036****	0.004	**-0.036****	0.004	**-0.036****	0.004	**-0.036****	0.004
Year 2007	**0.046****	0.004	**0.046****	0.004	**0.046****	0.004	**0.046****	0.004	**0.046****	0.004	**0.046****	0.004
Year 2008	**0.075****	0.005	**0.074****	0.005	**0.076****	0.005	**0.076****	0.005	**0.076****	0.005	**0.076****	0.005
Year 2009	**0.104****	0.006	**0.104****	0.006	**0.105****	0.006	**0.105****	0.006	**0.106****	0.006	**0.107****	0.006
Female			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Age 20			**0.001****	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Age 21			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Age 23			0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
Age 24			**-0.002***	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001
Age 25			-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001
Age 26			**-0.003***	0.001	0.002	0.002	0.001	0.002	0.000	0.002	0.000	0.002
Age 27			0.001	0.003	0.014	0.009	0.014	0.009	0.007	0.008	0.007	0.008
Disability Status			-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001
Ethnicity Black			0.000	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001	-0.001	0.001
Ethnicity Asian			0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001
Ethnicity Other			0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
Ethnicity Unknown			-0.001	0.002	-0.002	0.003	-0.002	0.003	-0.002	0.003	-0.002	0.003
School Private					-0.001	0.000	-0.001	0.000	0.000	0.000	-0.001	0.000
School Unknown					0.000	0.002	0.000	0.002	-0.001	0.002	-0.001	0.002
SEC2					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SEC3					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SEC4					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SEC5					0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
SEC6					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SEC7&8					0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
SEC Unknown					-0.001	0.002	-0.001	0.002	-0.002	0.002	-0.002	0.002
UG Class First					0.004	0.004	0.003	0.004	0.000	0.001	0.000	0.001
UG Class Upper Second					0.003	0.004	0.003	0.003	0.000	0.000	0.000	0.000
UG Class Lower Second					0.003	0.004	0.003	0.003				
UG Class Unknown					0.003	0.004	0.003	0.004				
School Results 2nd Quartile					0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
School Results 3rd Quartile					0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
School Results 4th Quartile					0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001
Domicile Unemployment[2]							0.005	0.004	0.004	0.004	0.002	0.013
Domicile Hourly Earnings[2]							-0.001	0.001	-0.001	0.001	**-0.006***	0.003
Observations	612,531		612,531		493,664		490,358		463,197		463,197	
F-stat	**162.39****		**66.33****		**43.67****		**40.96****		**40.98****		**16.60****	

Notes: (1) Dependent variable is natural logarithm of the average cost of a course of higher study by subject and institution, see Section Five. Standard errors are clustered at the Institution-by-subject level. All specifications include Institution-by-subject fixed effects. * and ** reflect significance at the 5% and 1% levels respectively. Excluded dummy variable categories: Year: 2005/6, Age at graduation: 22, Ethnicity: White, School Type: State, SEC: Group 1, UG Class: Third, School Results: 1st quartile (highest performers), UG Subject: Social Sciences. (2) These variables are continuous.